RECORD OF BOREHOLE DRLE-G005

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Microsoft campus

DRILLING START: August 31, 2017 23:06
DRILLING END: September 1, 2017 03:44
COORDINATES: N: 340,131 E: 1,419,318

SHEET: 2 of 2
GS ELEV.: 360.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Hollow Stem Auger	40.0	(SM), SILTY SAND, fine to medium sand, little nonplastic fines, little fine to coarse subrounded to subangular trace gravel, gray-brown; very dense, moist *(continued)*	320.9	SM		SS S-12	28-50/5" **(50/5")**	12/11	>>		
45							SS S-13	33-50/5" **(50/5")**	11/11	>>		
		47.5	(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, light brown-gray; very dense, moist to wet	313.4								
50							SS S-14	9-22-31 **(53)**	18/18	>>		
55							SS S-15	24-26-43 **(69)**	18/18	>>		
60					SP							
											∇ 63.8 ft, ATD	
65							SS S-16	18-31-37 **(68)**	18/18	>>		
70												
75							SS S-17	21-44-50/3" **(94/9")**	15/15	>>		
		76.3	Bottom of borehole at 76.3 ft. Backfilled with bentonite grout.	284.6								
80												

DRILLING CO.: Holt Services Inc
DRILLER: John Bennet
DRILL RIG: CME-85, Truck Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G006

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: NE 51st St

DRILLING START: October 26, 2017 11:16
DRILLING END: October 27, 2017 10:59
COORDINATES: N: 340,684 E: 1,419,215

SHEET: 1 of 2
GS ELEV.: 340.7 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0	Hollow Stem Auger	0.0	(SP-SM), FILL: POORLY GRADED SAND WITH SILT AND GRAVEL, fine to coarse sand, little fine to coarse subrounded to subangular gravel, few nonplastic fines, light brown; moist, asphalt fragments	340.7	SP-SM						0 - 6.9: Air knife and vac truck used to clear utilities; soil description based on cuttings.	
		3.0	(SM), FILL: SILTY SAND, fine to medium sand, some nonplastic fines, few fine to coarse subrounded to subangular gravel, gray and brown, mottled; loose to medium dense, moist, few wood fragments and roots; alternating Silty Sand and Sandy Silt fill material	337.7	SM		SS S-1	3-2-3 **(5)**	18/18	5	7.5: S-1: % Fines = 35	
5												
10							SS S-2	2-7-8 **(15)**	18/18	15		
							SS S-3	3-5-32 **(37)**	18/18	37		
		13.5	(SP), POORLY GRADED SAND, medium to coarse sand, few fine to coarse rounded to subrounded gravel, light brown; very dense, moist	327.2	SP							
15							SS S-4	42-50/5" **(50/5")**	11/11	>>		
		17.5	(SP), POORLY GRADED SAND, medium to coarse sand, light brown and tan; very dense, moist to wet	323.2								
20							SS S-5	20-28-28 **(56)**	18/18	>>		
25							SS S-6	19-31-50/5" **(81/11")**	17/17	>>		
					SP							
30							SS S-7	29-33-43 **(76)**	18/18	>>		
35							SS S-8	18-21-35 **(56)**	18/18	>>		
40												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G006

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: NE 51st St

DRILLING START: October 26, 2017 11:16
DRILLING END: October 27, 2017 10:59
COORDINATES: N: 340,684 E: 1,419,215

SHEET: 2 of 2
GS ELEV.: 340.7 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Hollow Stem Auger	40.0	(SP), POORLY GRADED SAND, medium to coarse sand, light brown and tan; very dense, moist to wet *(continued)*	300.7	SP		SS S-9	21-24-34 **(58)**	18/18	>>		
45							SS S-10	15-25-27 **(52)**	18/18	>>	▼ 43.3 ft, 06/02/2018 VWP reading; 43.4 ft, ATD; 43.8 ft, 03/04/2018 VWP reading; 44.1 ft, 11/16/2017 VWP reading	
50							SS S-11	11-20-48 **(68)**	18/18	>>		
55											55: VWP installed	
60		59.0		281.7								
		60.5	(ML), SILT, nonplastic fines, trace fine to medium sand, dark brown; hard, moist to wet	280.2	ML		SS S-12	12-17-33 **(50)**	18/18	50		
		61.5	(CL), LEAN CLAY, low plasticity fines, light gray with green; hard, moist	279.2	CL							
65			Bottom of borehole at 61.5 ft. Installed vibrating wire piezometer.									
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G007

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION:

DRILLING START: October 30, 2017 09:35
DRILLING END: October 30, 2017 09:35
COORDINATES: N: 341,331 E: 1,419,279

SHEET: 1 of 2
GS ELEV.: 327.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0		0.0	(SM), FILL: SILTY SAND, fine sand, some low plasticity fines, brown mottled gray; medium dense to dense, moist, trace wood fragments	327.0	SM	SS S-1	5-14-17 **(31)**	12/18	31		
5						SS S-2	5-5-7 **(12)**	9/18	12	5: S-2: % Fines = 29	
						SS S-3	2-7-15 **(22)**	12/18	22		
10		9.5	(ML), SANDY SILT WITH GRAVEL, low plasticity fines, some fine to medium sand, little fine to coarse subrounded to subangular gravel, brown with gray; stiff to very stiff, moist, trace wood fragments and roots; thin seams of coarse sand less than 1/4 thick	317.5	ML	SS S-4	2-5-5 **(10)**	15/18	10		
						SS S-5	3-5-10 **(15)**	12/18	15		
15						SS S-6	5-7-5 **(12)**	18/18	12		
20		17.5	(SM), SILTY SAND, fine sand, some nonplastic fines, trace fine to coarse rounded to subrounded gravel, light brown; very dense, moist	309.5	SM	SS S-7	16-24-50/5" **(74/11")**	17/17	>>		
		22.5	(SP), POORLY GRADED SAND, medium sand, brown; dense to very dense, wet	304.5	SP					∇ 22.3 ft, ATD	
25						SS S-8	16-17-22 **(39)**	18/18	39		
30						SS S-9	18-26-50 **(76)**	18/18	>>		
35		35.5	(ML), SILT, nonplastic fines, trace fine sand, gray; hard, wet	291.5	ML	SS S-10	10-16-28 **(44)**	18/18	44		
40											

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G007

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION:

DRILLING START: October 30, 2017 09:35
DRILLING END: October 30, 2017 09:35
COORDINATES: N: 341,331 E: 1,419,279

SHEET: 2 of 2
GS ELEV.: 327.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		287.0								
		40.5	(SP), POORLY GRADED SAND, medium to coarse sand, gray; dense, wet	286.5	SP		SS S-11	7-12-20 **(32)**	18/18	32		
		42.5	(ML), SILT, nonplastic fines, gray with brown; hard, wet	284.5								
45			Dark brown organic layer from 45.5 to 45.6 ft.		ML		SS S-12	11-12-37 **(49)**	18/18	49		
			Color change to green-gray									
50		51.5		275.5			SS S-13	17-28-40 **(68)**	18/18	>>		
			Bottom of borehole at 51.5 ft. Backfilled with bentonite grout.									
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

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RECORD OF BOREHOLE DRLE-G008

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION:

DRILLING START: October 31, 2017 10:47
DRILLING END: October 31, 2017 12:12
COORDINATES: N: 341,739 E: 1,419,202

SHEET: 1 of 1
GS ELEV.: 282.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Hollow Stem Auger

Depth (ft)	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Notes
0.0	(SP-SM), POORLY GRADED SAND WITH SILT, fine to medium sand, few nonplastic fines, trace fine to coarse rounded to subrounded gravel, gray; very dense, moist	282.3	SP-SM	SS S-1	50/5" **(50/5")**	5/5	0 - 3.5: Air knife and vac truck used to clear utilities; soil description based on cuttings.
				SS S-2	24-39-50/5" **(89/11")**	17/17	
10	Color change to gray			SS S-3	33-50/5" **(50/5")**	11/11	
				SS S-4	36-50/5" **(50/5")**	11/11	
14.5		267.8					
15	(SP), POORLY GRADED SAND, fine sand, trace fine to coarse rounded to subrounded gravel, trace nonplastic fines, gray; very dense, moist		SP	SS S-5	33-50/5" **(50/5")**	11/11	
20				SS S-6	50/5" **(50/5")**	5/5	
22.5		259.8					
	(ML), SILT, nonplastic fines, trace fine sand, gray; hard, moist		ML				
25				SS S-7	17-32-50 **(82)**	18/18	
26.5		255.8					
30	Bottom of borehole at 26.5 ft. Backfilled with bentonite chips. Groundwater not observed during drilling						
35							
40							

PENETRATION RESISTANCE BLOWS / ft (10, 20, 30, 40)
WATER CONTENT (%) (W_p, W, W_l) (20, 40, 60, 80)

ADDITIONAL LAB TESTING

DRILLING CO.: Holt Services Inc
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G010

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: 154th NE and NE 59th

DRILLING START: September 8, 2017 07:51
DRILLING END: September 8, 2017 11:19
COORDINATES: N: 342,505 E: 1,419,307

SHEET: 1 of 2
GS ELEV.: 254.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Hollow Stem Auger

Depth (ft)	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Notes
0.0		254.4					
0.4	ASPHALT	254.0					
	(SM), FILL: SILTY SAND, fine sand, some low plasticity fines, few fine to coarse subrounded to subangular gravel, brown-gray; very dense, moist		SM	GB GS-1			
5				SS S-1	6-50/5" (50/5")	9/11	
				SS S-2	35-50/4" (50/4")	10/10	
10				SS S-3	48-50/3" (50/3")	9/9	
12.0		242.4					
	(ML), SILT WITH SAND, low plasticity fines, few fine sand, few fine subrounded gravel, dark gray; hard, moist		ML	SS S-4	50/5" (50/5")	0/5	
15				SS S-5	50/5" (50/5")	5/5	15 - 25: Difficult drilling
20				SS S-6	45-50/3" (50/3")	9/9	20: Water added to ease drilling
25				SS S-7	29-50/5" (50/5")	11/11	
30				SS S-8	21-22-32 (54)	18/18	
32.5		221.9					
	(SM), SILTY SAND, fine sand, some low plasticity fines, few fine to coarse rounded to subrounded gravel, dark gray; very dense, moist		SM	SS S-9	50/5" (50/5")	5/5	35: Drilling chatter
40							

PENETRATION RESISTANCE BLOWS / ft: 10 20 30 40
WATER CONTENT (%): W_p — W — W_l; 20 40 60 80

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Kevin Bacon
DRILL RIG: CME-85

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G010

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: 154th NE and NE 59th

DRILLING START: September 8, 2017 07:51
DRILLING END: September 8, 2017 11:19
COORDINATES: N: 342,505 E: 1,419,307

SHEET: 2 of 2
GS ELEV.: 254.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
40		40.0		214.4								
		41.0	Increased silt and gravel content	213.4	SM		SS 10	26-50/5" (50/5")	11/11	>>		
			Bottom of borehole at 41.0 ft. Backfilled with bentonite chips. Groundwater not observed during drilling									
45												
50												
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Kevin Bacon
DRILL RIG: CME-85

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G011

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION:

DRILLING START: November 1, 2017 10:46
DRILLING END: November 1, 2017 12:27
COORDINATES: N: 343,344 E: 1,419,663

SHEET: 1 of 2
GS ELEV.: 236.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Hollow Stem Auger

Depth (ft)	Elev	USCS	Description	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes
0.0	236.8		RIPRAP (cobbles and boulders)					0 - 7.5: Air knife and vac truck used to clear utilities; soil description based on cuttings.
5.0	231.8	SP-SM	(SP-SM), FILL: POORLY GRADED SAND WITH SILT AND GRAVEL, fine to medium sand, few fine to coarse rounded to subrounded gravel, few nonplastic fines, brown; medium dense, moist	SS S-1	8-11-19 **(30)**	18/18	30	
9.5	227.3	ML	(ML), SANDY SILT, nonplastic fines, some fine sand, gray; very stiff to hard, moist	SS S-2	5-10-15 **(25)**	18/18	25	
				SS S-3	9-12-19 **(31)**	3/18	31	
14.5	222.3	SM	(SM), SILTY SAND, fine to medium sand, some nonplastic fines, gray; dense, moist	SS S-4	6-16-24 **(40)**	18/18	40	
17.5	219.3	SP-SM	(SP-SM), POORLY GRADED SAND WITH SILT, fine to medium sand, few nonplastic fines, trace fine rounded to subrounded gravel, gray; very dense, moist	SS S-5	14-22-33 **(55)**	18/18	>>	
				SS S-6	19-36-42 **(78)**	18/18	>>	
27.5	209.3	SP	(SP), POORLY GRADED SAND, fine sand, trace fine to coarse rounded to subrounded gravel, trace nonplastic fines, gray; very dense, moist, trace wood fragments	SS S-7	25-49-50/5" **(99/11")**	17/17	>>	
32.5	204.3	SP-SM	(SP-SM), POORLY GRADED SAND WITH SILT, fine sand, few nonplastic fines, trace fine rounded to subrounded gravel, gray; very dense, moist	SS S-8	24-40-50/5" **(90/11")**	17/17	>>	

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G011

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION:

DRILLING START: November 1, 2017 10:46
DRILLING END: November 1, 2017 12:27
COORDINATES: N: 343,344 E: 1,419,663

SHEET: 2 of 2
GS ELEV.: 236.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
40		40.0		196.8								
		41.5		195.3	SP-SM							
			Bottom of borehole at 41.5 ft. Backfilled with bentonite chips. Groundwater not observed during drilling									
45												
50												
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G012

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: NB SR520 Shoulder

DRILLING START: November 2, 2017 09:43
DRILLING END: November 2, 2017 12:14
COORDINATES: N: 343,826 E: 1,419,759

SHEET: 1 of 2
GS ELEV.: 223.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Hollow Stem Auger

Depth (ft)	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes Water Levels
0.0	(PT), SANDY PEAT, some fine sand, very dark brown-brown; moist	223.2	PT					
1.8	(SM), SILTY SAND, fine to coarse sand, some nonplastic fines, trace fine to coarse subangular gravel, pale gray-blue; medium dense to very dense, moist, iron staining	221.4	SM	SS S-1	15-14-18 **(32)**	13/18	32	
				SS S-2	3-5-12 **(17)**	12/18	17	5: S-2: % Fines = 37
	Color change to pale tan gray			SS S-3	44-14-27 **(41)**	11/18	41	
				SS S-4	11-30-50/4" **(80/10")**	12/16	>>	
	Trace wood fragments			SS S-5	6-16-16 **(32)**	13/18	32	
	Color change to pale brown			SS S-6	27-30-26 **(56)**	14/18	>>	
				SS S-7	50/4" **(50/4")**	2/4	>>	
24.0	(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, little fine to coarse subrounded gravel, trace nonplastic fines, pale gray to dark gray; very dense, moist	199.2	SP	SS S-8	26-50/5" **(50/5")**	11/11	>>	
30.5	(SP-SM), POORLY GRADED SAND WITH SILT, fine sand, few nonplastic fines, pale tan-brown; very dense, moist to wet	192.7		SS S-9	13-25-35 **(60)**	18/18	>>	∇ 32.7 ft, ADT
	6-inch thick lense of Sandy Silt		SP-SM	SS S-10	26-28-27 **(55)**	18/18	>>	

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B58

LOGGED: Daniel Bida
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G012

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: NB SR520 Shoulder

DRILLING START: November 2, 2017 09:43
DRILLING END: November 2, 2017 12:14
COORDINATES: N: 343,826 E: 1,419,759

SHEET: 2 of 2
GS ELEV.: 223.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		183.2								
	Hollow Stem Auger		(SP-SM), POORLY GRADED SAND WITH SILT, fine sand, few nonplastic fines, pale tan-brown; very dense, moist to wet *(continued)*		SP-SM		SS S-11	12-18-50/5" **(68/11")**	17/17	>>		
		44.0		179.2								
45			(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, little fine to coarse subrounded to subangular gravel, pale brown-tan; very dense, wet		SP		SS S-12	50/5" **(50/5")**	5/5	>>		
50		50.4		172.8			SS S-13	50/5" **(50/5")**	5/5	>>		
			Bottom of borehole at 50.4 ft. Backfilled with bentonite chips.									
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B58

LOGGED: Daniel Bida
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:40
C:\USERS\CSCHAEFFER\DESKTOP\DRLE LOGS.GPJ

RECORD OF BOREHOLE DRLE-G013

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: EB SR520 Shoulder

DRILLING START: November 3, 2017 09:45
DRILLING END: November 3, 2017 12:14
COORDINATES: N: 344,114 E: 1,419,863

SHEET: 1 of 2
GS ELEV.: 205.6 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Hollow Stem Auger

Depth (ft)	Elev	USCS	Description	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes / Water Levels
0.0	205.6	ML	(ML), SANDY SILT, nonplastic fines, some fine to medium sand, very dark brown; moist					
2.5	203.1	SM	(SM), SILTY SAND WITH GRAVEL, fine to coarse sand, some nonplastic fines, little fine to coarse subrounded to subangular gravel, pale gray; medium dense, moist, trace wood fragments	SS S-1	5-12-18 **(30)**	18/18	30	
				SS S-2	4-5-6 **(11)**	2/18	11	5: S-2: % Fines = 28
7.5	198.1	SP	(SP), POORLY GRADED SAND WITH GRAVEL, fine to medium sand, few fine to coarse subrounded to subangular gravel, trace nonplastic fines, light tan-brown; medium dense to very dense, moist to wet	SS S-3	5-7-12 **(19)**	0/18	19	
				SS S-4	18-16-18 **(34)**	18/18	34	
				SS S-5	15-20-16 **(36)**	11/18	36	
			Brown, Lean Clay (CL) observed in tip of sampler shoe (S-5)					
				SS S-6	16-21-30 **(51)**	12/18	>>	15.4 ft, 03/04/2018 VWP reading; 15.5 ft, 06/02/2018 VWP reading
17.5	188.1	SP	(SP), POORLY GRADED SAND, fine to coarse sand, trace nonplastic fines, pale tan-gray; dense to very dense, wet					
				SS S-7	8-12-19 **(31)**	18/18	31	
								24.7 ft, ADT
			6 inch thick lense of Sandy Silt; color change to pale tan	SS S-8	22-34-40 **(74)**	18/18	>>	
			Increased coarse sand content	SS S-9	20-50/5" **(50/5")**	11/11	>>	30: 6 inches of heave in S-9
			Color change to pale gray brown	SS S-10	19-28-50/4" **(78/10")**	16/16	>>	35: 6 inches of heave in S-10

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Daniel Bida
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G013

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: EB SR520 Shoulder

DRILLING START: November 3, 2017 09:45
DRILLING END: November 3, 2017 12:14
COORDINATES: N: 344,114 E: 1,419,863

SHEET: 2 of 2
GS ELEV.: 205.6 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Hollow Stem Auger	40.0	(SP), POORLY GRADED SAND, fine to coarse sand, trace nonplastic fines, pale tan-gray; dense to very dense, wet *(continued)*	165.6	SP		SS S-11	5-18-50 **(68)**	18/18	>>		
45			Color change to dark gray				SS S-12	10-50/5" **(50/5")**	11/11	>>	45: VWP installed	
50		51.5	Color change to pale gray	154.1			SS S-13	10-20-50 **(70)**	18/18	>>		
55			Bottom of borehole at 51.5 ft. Installed vibrating wire piezometer									
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Daniel Bida
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G014

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: EB SR520 shoulder

DRILLING START: November 6, 2017 09:30
DRILLING END: November 6, 2017 12:12
COORDINATES: N: 344,452 E: 1,419,988

SHEET: 1 of 2
GS ELEV.: 179.6 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Hollow Stem Auger

Depth (ft)	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes / Water Levels
0	(ML), SILT, nonplastic fines, trace fine sand, trace coarse rounded gravel, pale gray; hard, moist to wet	179.6	ML					0 - 28: Difficult drilling
				SS S-1	9-18-30 **(48)**	18/18	48	
5				SS S-2	6-18-29 **(47)**	18/18	47	
				SS S-3	16-30-50 **(80)**	18/18	>>	
10				SS S-4	20-40-50/5" **(90/11")**	17/17	>>	
				SS S-5	18-30-39 **(69)**	18/18	>>	
15				SS S-6	22-30-50 **(80)**	18/18	>>	
20				SS S-7	10-30-50 **(80)**	18/18	>>	
25				SS S-8	22-36-50 **(86)**	18/18	>>	24.2 ft, ADT
28.0	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, pale gray; dense to very dense, wet	151.6	SP					
30				SS S-9	8-8-26 **(34)**	18/18	34	30: S-9: % Fines = 4
35				SS S-10	22-28-34 **(62)**	18/18	>>	
39.0		140.6	SM					
40								40: S-11: % Fines = 16

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Daniel Bida
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G014

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: EB SR520 shoulder

DRILLING START: November 6, 2017 09:30
DRILLING END: November 6, 2017 12:12
COORDINATES: N: 344,452 E: 1,419,988

SHEET: 2 of 2
GS ELEV.: 179.6 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		139.6								
	Hollow Stem Auger		(SM), SILTY SAND, fine sand, little nonplastic fines, pale gray; dense to very dense, wet *(continued)*		SM		SS S-11	6-10-22 **(32)**	18/18	32		
45							SS S-12	22-34-50/5" **(84/11")**	17/17	>>		
50		51.3		128.3			SS S-13	28-40-50/4" **(90/10")**	16/16	>>		
			Bottom of borehole at 51.3 ft. Backfilled with bentonite chips.									
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Daniel Bida
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G015

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: EB SR520 shoulder

DRILLING START: November 7, 2017 10:10
DRILLING END: November 8, 2017 13:36
COORDINATES: N: 344,876 E: 1,420,171

SHEET: 1 of 3
GS ELEV.: 110.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
0	Mud rotary	0.0	(SM), FILL: SILTY SAND WITH GRAVEL, fine to coarse sand, some fine to coarse subangular to angular gravel, little nonplastic fines, pale gray-brown; medium dense to very dense, moist, trace wood fragments, glass, and plastic	110.0	SM		SS S-1	50/4" **(50/4")**	4/4	>>	2.5: Possible cobbles	
5							SS S-2	40-46-50/4" **(96/10")**	12/16	>>		
							SS S-3	12-50/5" **(50/5")**	8/11	>>		
10							SS S-4	12-40-22 **(62)**	7/18	>>		
							SS S-5	23-22-27 **(49)**	14/18	49		
15							SS S-6	22-26-30 **(56)**	9/18	>>		
20							SS S-7	11-12-14 **(26)**	12/18	26	20: S-7: % Fines = 28 22: Drilling chatter	
25							SS S-8	7-5-6 **(11)**	13/18	11	25: S-8: % Fines = 23	
30							SS S-9	4-30-50/5" **(80/11")**	13/17	>>	32: Drilling chatter	
35							SS S-10	7-7-7 **(14)**	14/18	14	35: S-10: % Fines = 24	
40												

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Daniel Bida
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G015

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: EB SR520 shoulder

DRILLING START: November 7, 2017 10:10
DRILLING END: November 8, 2017 13:36
COORDINATES: N: 344,876 E: 1,420,171

SHEET: 2 of 3
GS ELEV.: 110.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
40	Mud rotary	40.0		70.0	SM		SS S-11	7-18-30 **(48)**	10/18	48		
		42.5	(CH), FAT CLAY WITH SAND, high plasticity fines, trace fine to coarse sand, trace fine to coarse subrounded to rounded gravel, pale gray; hard, moist	67.5	CH							
45			Thin seams < 1/4 inch thick of preserved wood fibers observed throughout				SS S-12	9-20-30 **(50)**	18/18	50		
50							SS S-13	19-30-50/5" **(80/11")**	17/17	>>	50: S-13: PI = 37	
55							SS S-14	12-23-50 **(73)**	18/18	>>	55: S-14: % Fines = 91	
60							SS S15	16-21-30 **(51)**	18/18	>>		
65							SS S-16	17-28-37 **(65)**	18/18	>>		
70							SS S-17	21-17-28 **(45)**	18/18	45	70: S-17: PI = 46	
		74.0	(CH), SANDY FAT CLAY, high plasticity fines, some fine to coarse sand, trace fine to coarse subrounded to rounded gravel, pale gray; hard, moist	36.0	CH							
75							SS S-18	19-28-36 **(64)**	18/18	>>	75: S-18: % Fines = 55	
80												

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Daniel Bida
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G015

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: EB SR520 shoulder

DRILLING START: November 7, 2017 10:10
DRILLING END: November 8, 2017 13:36
COORDINATES: N: 344,876 E: 1,420,171

SHEET: 3 of 3
GS ELEV.: 110.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
80		80.0		30.0								
	Mud rotary		(CH), SANDY FAT CLAY, high plasticity fines, some fine to coarse sand, trace fine to coarse subrounded to rounded gravel, pale gray; hard, moist *(continued)*		CH		SS S-19	36-50/5" **(50/5")**	11/11	>>		
85							SS S-20	50/5" **(50/5")**	5/5	>>		
90							SS S-21	40-50/5" **(50/5")**	11/11	>>		
95							SS S-22	30-29-26 **(55)**	18/18	>>		
100		101.0		9.0			SS S-23	40-50/5" **(50/5")**	11/11	>>		
			Bottom of borehole at 101.0 ft. Backfilled with bentonite grout. Groundwater not observed during drilling									
105												
110												
115												
120												

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Daniel Bida
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:40
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RECORD OF BOREHOLE DRLE-G016

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lk Sam 520 E onramp

DRILLING START: October 31, 2017 09:38
DRILLING END: October 31, 2017 00:00
COORDINATES: N: 345,657 E: 1,421,021

SHEET: 1 of 3
GS ELEV.: 82.7 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40)	WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0		0.0	(SC), FILL: CLAYEY SAND, fine to medium sand, some nonplastic to low plasticity fines, trace to little fine subrounded to subangular gravel, light brown mottled dark brown; medium dense to very dense, moist to wet	82.7									
	Hollow Stem Auger						SS S-1	18-19-24 **(43)**	15/18	43		4: Drilling chatter	
5							SS S-2	7-8-13 **(21)**	15/18	21			
							SS S-3	7-8-11 **(19)**	9/18	19		7.5: S-3: PI = 8	
10							SS S-4	3-10-11 **(21)**	2/18	21			
							SS S-5	5-9-10 **(19)**	15/18	19		12.5: S-5: % Fines = 25	
15							SS S-6	5-8-12 **(20)**	16/18	20		15: S-6: PI = 8	
20					SC		SS S-7	18-29-24 **(53)**	10/18	>>			
25							SS S-8	10-15-30 **(45)**	0/18	45			
30	Mud Rotary						SS S-9	8-10-12 **(22)**	12/18	22		30: S-9: PI = 11	
35							SS S-10	6-10-14 **(24)**	12/18	24			
40												▼ 38.7 ft, 03/04/2018 VWP reading 40: S-11: PI = NP	

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G016

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lk Sam 520 E onramp

DRILLING START: October 31, 2017 09:38
DRILLING END: October 31, 2017 00:00
COORDINATES: N: 345,657 E: 1,421,021

SHEET: 2 of 3
GS ELEV.: 82.7 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud Rotary	40.0	(SC), FILL: CLAYEY SAND, fine to medium sand, some nonplastic to low plasticity fines, trace to little fine subrounded to subangular gravel, light brown mottled dark brown; medium dense to very dense, moist to wet *(continued)* Decreased plasticity, decreased fines content	42.7	SC		SS S-11	5-5-5 **(10)**	12/18	10	41.1 ft, 11/16/2017 VWP reading 41.4 ft, 06/02/2018 VWP reading	
45							SS S-12	15-12-9 **(21)**	0/18	21	46: Drilling chatter	
		47.5	(CL), LEAN CLAY WITH SAND, low to medium plasticity fines, little medium sand, trace fine to coarse subrounded to subangular gravel, very dark gray; medium stiff, moist	35.2	CL							
50		50.5	(PT), SANDY PEAT, low plasticity fines, little fine sand, dark brown; medium stiff, moist	32.2	PT		SS S-13	5-3-5 **(8)**	18/18	8	50: S-13: PI = 15	
		52.5	(GP-GM), POORLY GRADED GRAVEL WITH SILT AND SAND, fine to coarse subrounded gravel, little fine to medium sand, few nonplastic fines; very dense, wet	30.2	GP-GM							
55							SS S-14	31-36-29 **(65)**	0/18	>>	55: VWP installed	
		57.5	(SC), CLAYEY SAND, fine sand, some low plasticity fines, trace fine subrounded gravel, light gray; very dense, wet	25.2	SC							
60							SS S-15	14-27-29 **(56)**	18/18	>>	60: S-15: % Fines = 25	
		64.0	(CL), SANDY LEAN CLAY, low plasticity fines, some fine sand, trace fine subrounded gravel, light gray; hard, moist	18.7	CL							
65							SS S-16	22-25-50 **(75)**	18/18	>>	65: S-16: PI = 16	
70							SS S-17	26-50/5" **(50/5")**	11/11	>>	70: S-17: % Fines = 75	
75							SS S-18	35-50/5" **(50/5")**	10/11	>>		
80											80: S-19: PI = 9	

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:40
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RECORD OF BOREHOLE DRLE-G016

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lk Sam 520 E onramp

DRILLING START: October 31, 2017 09:38
DRILLING END: October 31, 2017 00:00
COORDINATES: N: 345,657 E: 1,421,021

SHEET: 3 of 3
GS ELEV.: 82.7 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud Rotary	80.0	(CL), SANDY LEAN CLAY, low plasticity fines, some fine sand, trace fine subrounded gravel, light gray; hard, moist *(continued)*	2.7	CL		SS S-19	27-35-45 **(80)**	18/18	>>		
85							SS S-20	21-31-43 **(74)**	18/18	>>		
90							SS S-21	50/5" **(50/5")**	5/5	>>		
95							SS S-22	25-33-50/4" **(83/10")**	16/16	>>	95: S-22: % Fines = 54	
100		101.5		-18.8			SS S-23	19-25-35 **(60)**	18/18	>>		
105			Bottom of borehole at 101.5 ft. Installed vibrating wire piezometer									
110												
115												
120												

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:40
C:\USERS\CSCHAEFFER\DESKTOP\DRLE LOGS.GPJ

RECORD OF BOREHOLE DRLE-G017

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lk Sammamish 520 E onramp

DRILLING START: November 1, 2017 13:21
DRILLING END: November 3, 2017 11:10
COORDINATES: N: 345,796 E: 1,421,475

SHEET: 1 of 2
GS ELEV.: 40.7 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0	Mud Rotary	0.0	QUARRY SPALLS	40.7							0 - 55: Casing advanced to prevent caving	
		3.0	(CL), FILL: SANDY LEAN CLAY, low plasticity fines, some fine to medium sand, light gray mottled brown; medium stiff to stiff, moist	37.7	CL		SS S-1	4-4-5 **(9)**	12/18	9		
5							SS S-2	2-3-4 **(7)**	14/18	7	7.5: S-2: PI = 13	
		9.0	(SM), SILTY SAND, fine to coarse sand, some nonplastic fines, dark gray with dark brown; loose to medium dense, moist to wet, thin peat seams < 1/8 inch thick and trace wood fragments present	31.7	SM		SS S-3	3-3-3 **(6)**	12/18	6	10: S-3: % Fines = 38	
10							SS S-4	3-3-3 **(6)**	12/18	6	12.5: S-4: % Fines = 35	
15							SS S-5	3-4-4 **(8)**	0/18	8		
20							SS S-6	10-8-6 **(14)**	6/18	14	∇ 20.0 ft, ATD (estimated based on soil conditions)	
		22.5	(GP), POORLY GRADED GRAVEL WITH SAND, coarse subangular to angular gravel, little sand, dark gray; dense to very dense, wet	18.2								
25							SS S-7	15-29-26 **(55)**	0/18	>>	25 - 60: Drilling mud loss; 27 - 60: Drilling chatter; possible cobbles	
30					GP		SS S-8	18-19-21 **(40)**	4/18	40	30: S-8: % Fines < 1	
35							SS S-9	28-19-50 **(69)**	4/18	>>		
40												

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:40
C:\USERS\CSCHAEFFER\DESKTOP\DRLE LOGS.GPJ

RECORD OF BOREHOLE DRLE-G017

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lk Sammamish 520 E onramp

DRILLING START: November 1, 2017 13:21
DRILLING END: November 3, 2017 11:10
COORDINATES: N: 345,796 E: 1,421,475

SHEET: 2 of 2
GS ELEV.: 40.7 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0	(GP), POORLY GRADED GRAVEL WITH SAND, coarse subangular to angular gravel, little sand, dark gray; dense to very dense, wet *(continued)*	0.7								
	Mud Rotary				GP		SS S-10	45-26-19 **(45)**	3/18			
45							SS S-11	29-30-28 **(58)**	2/18			
50							SS S-12	50/5" **(50/5")**	1/5			
55							SS S-13	29-30-37 **(67)**	4/18		55: Hole cased to 55'	
60		60.0		-19.3								
			Bottom of borehole at 60.0 ft. Backfilled with bentonite grout. Terminated borehole due to practical refusal.									
65												
70												
75												
80												

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G017A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lake Sammamish Parkway

DRILLING START: December 4, 2017 10:00
DRILLING END: December 11, 2017 13:37
COORDINATES: N: 345,809 E: 1,421,706

SHEET: 1 of 7
GS ELEV.: 45.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

Depth (ft)	Boring Method	Soil Profile Depth	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes Water Levels	Additional Lab Testing
0	Mud Rotary	0.0		45.2							
		0.3	ASPHALT	44.9						0 - 80: Casing advanced to prevent caving	
			(GM), FILL (BASE COURSE): SILTY GRAVEL, fine to coarse subrounded to subangular gravel, little fine to medium sand, little low plasticity fines, dark brown to black; very dense, moist, (base course)		GM	SS S-1	30-50/3" **(50/3")**	6/9	>>		
		4.0		41.2							
5			(SM), FILL: SILTY SAND WITH GRAVEL, fine to medium sand, little low plasticity fines, little fine to coarse subrounded to subangular gravel, brown to tan; dense, moist		SM	SS S-2	10-18-24 **(42)**	9/18	42		
		7.0		38.2							
			(SP-SM), FILL: POORLY GRADED SAND WITH SILT, fine to medium sand, few low plasticity fines, trace fine to coarse subrounded to subangular gravel, brown mottled gray; loose, moist, thin peat seams < 1/4 inch thick		SP-SM	SS S-3	3-4-5 **(9)**	10/18	9	7.5: S-3: % Fines = 12	
10						SS S-4	4-4-3 **(7)**	9/18	7		
		12.0		33.2							
			(SM), SILTY SAND, fine sand, some low plasticity fines, gray; soft to medium stiff, moist to wet, trace wood fragments		SM	SS S-5	1-3-2 **(5)**	12/18	5	12.5: S-5: % Fines = 26	
15						SS S-6	1-1-3 **(4)**	14/18	4	∇ 15.0 ft, ATD (estimated based on soil conditions) 15: S-6: PI = NP	
20						SS S-7	4-1-2 **(3)**	1/18	3		
		22.0		23.2							
			(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, some fine to coarse sand, trace nonplastic fines, gray; medium dense to very dense, wet		GP					22 - 65: Drilling chatter; possible cobbles	
25						SS S-8	19-17-23 **(40)**	7/18	40		
30						SS S-9	23-40-27 **(67)**	1/18	>>		
35						SS S-10	40-17-11 **(28)**	5/18	28	35: S-10: % Fines = 3	
40											

Penetration Resistance Blows / ft: 10, 20, 30, 40
Water Content (%): W_p — W — W_l; 20, 40, 60, 80

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: B58 Truck

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G017A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lake Sammamish Parkway
DRILLING START: December 4, 2017 10:00
DRILLING END: December 11, 2017 13:37
COORDINATES: N: 345,809 E: 1,421,706
SHEET: 2 of 7
GS ELEV.: 45.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		5.2								
	Mud Rotary		(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, some fine to coarse sand, trace nonplastic fines, gray; medium dense to very dense, wet *(continued)*		GP		SS S-11	12-15-16 **(31)**	3/18	31		
45							SS S-12	11-16-17 **(33)**	2/18	33		
50							SS S-13	12-12-12 **(24)**	5/18	24	50: S-13: % Fines = 3	
55							SS S-14	22-27-30 **(57)**	6/18	>>		
60							SS S-15	13-11-12 **(23)**	8/18	23		
		62.5		-17.3								
			(SP-SM), POORLY GRADED SAND WITH SILT, fine to medium sand, few nonplastic fines, dark gray red; dense, wet									
65							SS S-16	14-15-18 **(33)**	9/18	33		
70					SP-SM		SS S-17	15-18-16 **(34)**	12/18	34		
75							SS S-18	14-17-14 **(31)**	10/18	31	75: S-18: % Fines = 7	
80		80.0		-34.8								

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: B58 Truck
LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G017A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lake Sammamish Parkway
DRILLING START: December 4, 2017 10:00
DRILLING END: December 11, 2017 13:37
COORDINATES: N: 345,809 E: 1,421,706
SHEET: 3 of 7
GS ELEV.: 45.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80		80.0		-34.8								
	Mud Rotary		(CL), LEAN CLAY WITH SAND, low plasticity fines, few fine sand, trace subrounded to subangular gravel, gray; stiff to hard, moist to wet		CL		SS S-19	14-19-21 **(40)**	0/18	40		
85							SS S-20	11-6-7 **(13)**	11/18	13	85: S-20: PI = 24	
90							SS S-21	6-11-13 **(24)**	18/18	24		
95							SS S-22	10-12-16 **(28)**	18/18	28	95: S-22: PI = 21	
100							SS S-23	13-18-19 **(37)**	9/18	37		
105							SS S-24	20-28-32 **(60)**	9/18	>>		
110							SS S-25	11-16-20 **(36)**	18/18	36	110: S-25: PI = 20	
115							SS S-26	11-19-31 **(50)**	18/18	50	115: Drilling chatter	
120												

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: B58 Truck
LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G017A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lake Sammamish Parkway
DRILLING START: December 4, 2017 10:00
DRILLING END: December 11, 2017 13:37
COORDINATES: N: 345,809 E: 1,421,706
SHEET: 4 of 7
GS ELEV.: 45.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
120		120.0		-74.8								
	Mud Rotary		(CL), LEAN CLAY WITH SAND, low plasticity fines, few fine sand, trace subrounded to subangular gravel, gray; stiff to hard, moist to wet *(continued)*		CL		SS S-27	22-23-22 **(45)**	18/18	45		
125							SS S-28	29-38-50 **(88)**	18/18	>>		
130							SS S-29	18-23-26 **(49)**	8/18	49		
135							SS S-30	11-19-21 **(40)**	18/18	40		
140							SS S-31	10-14-20 **(34)**	18/18	34	140: S-31: PI = 25	
145							SS S-32	9-17-20 **(37)**	18/18	37		
150							SS S-33	13-25-30 **(55)**	18/18	>>		
155							SS S-34	13-22-27 **(49)**	18/18	49		
160												

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: B58 Truck
LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G017A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lake Sammamish Parkway

DRILLING START: December 4, 2017 10:00
DRILLING END: December 11, 2017 13:37
COORDINATES: N: 345,809 E: 1,421,706

SHEET: 5 of 7
GS ELEV.: 45.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160	Mud Rotary	160.0	(CL), LEAN CLAY WITH SAND, low plasticity fines, few fine sand, trace subrounded to subangular gravel, gray; stiff to hard, moist to wet *(continued)*	-114.8	CL		SS S-35	17-27-33 **(60)**	18/18	>>		
165							SS S-36	13-16-19 **(35)**	18/18	35		
		167.5	(CH), FAT CLAY WITH SAND, high plasticity fines, few fine sand, dark gray; hard, moist to wet	-122.3	CH							
170							SS S-37	11-17-20 **(37)**	18/18	37	170: S-37: PI = 43	
							ST ST-1		0/30		172: Shelby tube sample attempted; 1500 psi pushing pressure; tube buckled	
175		175.0	(CL), LEAN CLAY WITH SAND, low plasticity fines, few fine sand, trace subrounded to subangular gravel, gray; stiff to hard, moist to wet	-129.8								
180							SS S-38	10-17-22 **(39)**	18/18	39		
185					CL							
190							SS S-39	10-17-22 **(39)**	18/18	39		
195												
200		200.0		-154.8							200: S-40: PI = 65	

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: B58 Truck

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G017A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lake Sammamish Parkway

DRILLING START: December 4, 2017 10:00
DRILLING END: December 11, 2017 13:37
COORDINATES: N: 345,809 E: 1,421,706

SHEET: 6 of 7
GS ELEV.: 45.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40)	WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
200		200.0		-154.8									
	Mud Rotary		(CH), FAT CLAY, high plasticity fines, trace fine sand, trace subrounded to subangular gravel, gray; very stiff to hard, moist		CH		SS S-40	10-15-19 **(34)**	18/18		34		
205													
210							SS S-41	13-17-21 **(38)**	18/18		38		
215													
		219.0		-173.8									
220			(SM), SILTY SAND, fine to medium sand, some fines, few fine to coarse subrounded to subangular gravel, gray; very dense, wet				SS S-42	28-31-50 **(81)**	18/18		>>	220 - 240: Drilling chatter	
225													
230					SM		SS S-43	38-50/5" **(50/5")**	5/11		>>	230: S-43: % Fines = 36; Difficult drilling	
235													
240		240.0		-194.8									

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: B58 Truck

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G017A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: W Lake Sammamish Parkway

DRILLING START: December 4, 2017 10:00
DRILLING END: December 11, 2017 13:37
COORDINATES: N: 345,809 E: 1,421,706

SHEET: 7 of 7
GS ELEV.: 45.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
240		240.0		-194.8								
			Bottom of borehole at 240.1 ft. Backfilled with bentonite chips.				SS S-44	50/1" **(50/1")**	1/1			
245												
250												
255												
260												
265												
270												
275												
280												

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: B58 Truck

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G018

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 23, 2017 08:22
DRILLING END: October 30, 2017 00:00
COORDINATES: N: 345,744 E: 1,421,719

SHEET: 1 of 6
GS ELEV.: 38.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft / WATER CONTENT (%)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0		0.0		38.4							
	Hollow Stem Auger	0.5	(CL), SANDY LEAN CLAY, low plasticity fines, some fine sand, light gray-brown to brown; moist	37.9	CL						
			(ML), SILT, nonplastic fines, trace fine sand, trace subrounded to subangular fine gravel, white mottled light gray-blue; very stiff, moist to wet, trace rootlets present		ML	SS S-1	4-6-10 **(16)**	16/18	16		
5						SS S-2	4-8-11 **(19)**	16/18	19	5: S-2: PI = NP	
		7.0		31.4							
			(SM), SILTY SAND, fine to coarse sand, some nonplastic fines, trace subrounded to subangular fine gravel, brown to dark gray; loose to medium dense, wet, some rootlets present		SM	SS S-3	8-10-8 **(18)**	12/18	18	8 - 15: Samples screened by archaeologist	
10						SS S-4	2-2-3 **(5)**	18/18	5	9: S-4: % Fines = 40	
						SS S-5	4-4-8 **(12)**	12/18	12	12: S-6: % Fines = 25	
						SS S-6	2-3-3 **(6)**	18/18	6		
15		15.0		23.4							
	Mud Rotary		(GP), POORLY GRADED GRAVEL, fine to coarse subrounded to subangular gravel, trace fines, dark gray; loose to very dense, wet		GP					15 - 20: Unsuccessful pressuremeter test attempt; drilling mud loss 16.8 ft, ATD	
20										20: S-7: % Fines < 1	
						SS S-7	1-2-3 **(5)**	1/18	5		
25						SS S-8	24-36-34 **(70)**	1/18	>>		
						SS S-9	18-23-19 **(42)**	1/18	42		
30										30 - 35: Unsuccessful pressuremeter test attempt	
35		36.0		2.4							
			(SP-SM), POORLY GRADED SAND WITH SILT, medium sand, few nonplastic fines, dark gray; medium dense to dense, wet		SP-SM	SS S-10	14-15-18 **(33)**	12/18	33		
40										40: S-11: % Fines = 7	

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G018

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 23, 2017 08:22
DRILLING END: October 30, 2017 00:00
COORDINATES: N: 345,744 E: 1,421,719

SHEET: 2 of 6
GS ELEV.: 38.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud Rotary	40.0	(SP-SM), POORLY GRADED SAND WITH SILT, medium sand, few nonplastic fines, dark gray; medium dense to dense, wet *(continued)*	-1.6	SP-SM		SS S-11	12-12-15 **(27)**	12/18	27		
							SS S-12	14-15-16 **(31)**	12/18	31		
45												
50		50.0	(SM), SILTY SAND, fine to medium sand, little nonplastic fines, dark gray; medium dense to very dense, wet, thin seams of clean sand (SP) < 1/4 inch thick	-11.6	SM						53.5: Successful pressuremeter test	
55											55: Successful pressuremeter test	
							SS S-13	9-10-12 **(22)**	4/18	22		
60							SS S-14	8-10-12 **(22)**	15/18	22	60: S-14: % Fines = 25	
65							SS S-15	22-25-23 **(48)**	18/18	48		
							SS S-16	8-14-19 **(33)**	18/18	33		
70												
75											73: Successful pressuremeter test 74.5: Successful pressuremeter test	
							SS S-17	11-12-14 **(26)**	16/18	26	77.5: S-17: % Fines = 23; Drilling chatter from 77 to 82 ft, Possible gravel and cobbles present	
80												

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:40
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RECORD OF BOREHOLE DRLE-G018

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 23, 2017 08:22
DRILLING END: October 30, 2017 00:00
COORDINATES: N: 345,744 E: 1,421,719

SHEET: 3 of 6
GS ELEV.: 38.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud Rotary	80.0	(SM), SILTY SAND, fine to medium sand, little nonplastic fines, dark gray; medium dense to very dense, wet, thin seams of clean sand (SP) < 1/4 inch thick	-41.6	SM	SS S-18	25-30-34 **(64)**	14/18	>>		
		82.5	*(continued)*	-44.1							
			(CL-ML), SILTY CLAY WITH SAND, low plasticity fines, little fine to medium sand, dark gray; very stiff, moist, sand seams up to 3 inches thick								
85						SS S-19	7-6-9 **(15)**	18/18	15	85.8 ft, 03/04/2018 VWP reading; 86.6 ft, 11/17/2017 VWP reading	
90					CL-ML	SS S-20	11-7-10 **(17)**	18/18	17	89.1 ft, 06/02/2018 VWP reading; 90: S-20: PI = 6	
95						SS S-21	6-7-9 **(16)**	18/18	16		
		97.0	(ML), SILT, nonplastic fines, trace fine sand, trace fine subrounded to subangular gravel, dark gray; very stiff to hard, wet	-58.6							
100						SS S-22	11-11-12 **(23)**	18/18	23	100: S-22: PI = NP	
105					ML	SS S-23	5-9-14 **(23)**	18/18	23		
110						SS S-24	9-18-19 **(37)**	18/18	37		
		112.5	(CH), FAT CLAY, high plasticity fines, few fine sand, dark gray; soft, moist, thin sand seams <1/4 thick	-74.1							
115					CH	SS S-25	1-2-4 **(6)**	18/18	6		
						ST ST-1		30/30			
120		120.0		-81.6						120: S-26: PI = 13	

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G018

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 23, 2017 08:22
DRILLING END: October 30, 2017 00:00
COORDINATES: N: 345,744 E: 1,421,719

SHEET: 4 of 6
GS ELEV.: 38.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Mud Rotary

Depth (ft)	Depth	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance (Blows / ft)	Notes Water Levels
120	120.0	(CL), LEAN CLAY, medium plasticity fines, few fine sand, dark gray; very soft to stiff, moist	-81.6	CL	SS S-26	0-0-0 **(0)**	16/18	0	
	122.0	(CL-ML), SILTY CLAY, low plasticity fines, few fine sand, dark gray; soft, moist	-83.6	CL-ML	ST ST-2		30/30		
125					SS S-27	1-2-3 **(5)**	1/18	5	
	127.5	(CL), LEAN CLAY, medium plasticity fines, few fine sand, dark gray; very soft to stiff, moist	-89.1	CL					
130					SS S-28	4-6-8 **(14)**	18/18	14	130: S-28: PI = 18
135					ST ST-3		30/30		
140					SS S-29	4-6-4 **(10)**	1/18	10	
	142.5	(SM), SILTY SAND, medium sand, little nonplastic fines, trace subrounded to subangular gravel, dark gray; dense to very dense, wet	-104.1	SM					
145					SS S-30	23-26-25 **(51)**	12/18	>>	
150					SS S-31	15-20-20 **(40)**	9/18	40	150: S-31: % Fines = 18; VWP installed
155					SS S-32	26-32-32 **(64)**	10/18	>>	
	157.5	(CL), LEAN CLAY, low plasticity fines, some fine to medium sand, dark gray; stiff, moist	-119.1	CL					
160									160: S-33: PI = 18

Log continued on next page

Penetration Resistance: ■ Blows / ft (10, 20, 30, 40)
Water Content (%): W_p — W — W_l (20, 40, 60, 80)

ADDITIONAL LAB TESTING

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

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RECORD OF BOREHOLE DRLE-G018

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 23, 2017 08:22
DRILLING END: October 30, 2017 00:00
COORDINATES: N: 345,744 E: 1,421,719

SHEET: 5 of 6
GS ELEV.: 38.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft	WATER CONTENT (%)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160	Mud Rotary	160.0	(CL), LEAN CLAY, low plasticity fines, some fine to medium sand, dark gray; stiff, moist *(continued)*	-121.6	CL		SS S-33	20-11-8 **(19)**	18/18	19			
		162.5	(CH), SANDY FAT CLAY, high plasticity fines, some fine to medium sand, dark gray, laminated; very stiff to hard, moist	-124.1	CH								
165							ST ST-4		30/30				
170							SS S-34	16-16-18 **(34)**	14/18	34		170: S-34: % Fines = 53	
175							SS S-35	10-13-24 **(37)**	18/18	37		175: S-35: PI = 52	
180							SS S-36	10-14-19 **(33)**	18/18	33			
185							SS S-37	14-15-27 **(42)**	16/18	42		185: S-37: % Fines = 61	
190							SS S-38	15-21-24 **(45)**	0/18	45		190: S-38: PI = 52	
195		197.5	(SM), SILTY SAND, fine sand, some nonplastic fines, trace fine subrounded gravel, dark gray; very dense, wet	-159.1	SM								
200													

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G018

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 23, 2017 08:22
DRILLING END: October 30, 2017 00:00
COORDINATES: N: 345,744 E: 1,421,719

SHEET: 6 of 6
GS ELEV.: 38.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft / WATER CONTENT (%)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
200	Mud Rotary	200.0	(SM), SILTY SAND, fine sand, some nonplastic fines, trace fine subrounded gravel, dark gray; very dense, wet *(continued)*	-161.6	SM		SS S-39	50/2" **(50/2")**	2/2	>>	200.1 - 220: S-39: % Fines = 31; Drilling chatter	
205							SS S-40	50/1" **(50/1")**	1/1	>>		
210												
215												
220		220.0	Bottom of borehole at 220.0 ft. Installed seismic casing and vibrating wire piezometer	-181.6								
225												
230												
235												
240												

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G019

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: North of Marymoor Park, South of 520

DRILLING START: July 21, 2017 09:02
DRILLING END: July 25, 2017 17:00
COORDINATES: N: 345,899 E: 1,422,090

SHEET: 1 of 5
GS ELEV.: 32.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0	Mud Rotary	0.0	(ML), SILT, low plasticity fines, brown and white; stiff, moist to wet, few roots and wood fragments observed	32.4	ML		SS S-1	2-5-7 **(12)**	9/18	12		
		2.0	(CL), LEAN CLAY, low plasticity fines, few fine sand, gray; soft, moist, few roots	30.4	CL		SS S-2	2-1-1 **(2)**	6/18	2		
5		4.5	(PT), PEAT, dark brown; very soft, wet	27.9	PT		SS S-3	0-3-10 **(13)**	8/18	13	4.5: Drilling mud loss >> 6: Drilling chatter	
		5.8	(GP), POORLY GRADED GRAVEL, fine to coarse subrounded to subangular gravel, trace medium to coarse sand, trace nonplastic fines, dark gray; medium dense to dense, wet	26.7	GP		SS S-4	30-21-19 **(40)**	8/18	40	∇ 7.5 ft, ATD	
10							SS S-5	24-21-18 **(39)**	2/18	39		
							SS S-6	21-17-16 **(33)**	10/18	33		
15							SS S-7	8-10-17 **(27)**	0/18	27	15: S-7: % Fines < 1 16: Drilling chatter	
20							SS S-8	19-19-19 **(38)**	8/18	38		
25							SS S-9	11-14-14 **(28)**	0/18	28		
		27.5	(SP), POORLY GRADED SAND, fine to medium sand, trace subrounded gravel, trace nonplastic fines, dark gray; medium dense to dense, wet	4.9	SP							
30							SS S-10	19-18-14 **(32)**	9/18	32		
35							SS S-11	15-14-16 **(30)**	14/18	30		
		37.5	(SM), SILTY SAND, fine to medium sand, little nonplastic fines, dark gray; medium dense to dense, wet	-5.1	SM							
40											40: S-12: % Fines = 30	

Log continued on next page

WATER CONTENT (%): W_p 20 — W 40 — W_l 60 80

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G019

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: North of Marymoor Park, South of 520

DRILLING START: July 21, 2017 09:02
DRILLING END: July 25, 2017 17:00
COORDINATES: N: 345,899 E: 1,422,090

SHEET: 2 of 5
GS ELEV.: 32.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud Rotary	40.0	(SM), SILTY SAND, fine to medium sand, little nonplastic fines, dark gray; medium dense to dense, wet *(continued)*	-7.6	SM		SS S-12	8-9-11 **(20)**	16/18	20		
45							SS S-13	8-9-10 **(19)**	16/18	19		
50							SS S-14	3-6-22 **(28)**	18/18	28		
55							SS S-15	8-9-13 **(22)**	16/18	22		
60							SS S-16	10-11-10 **(21)**	16/18	21	60: S-16: % Fines = 16	
65							SS S-17	15-16-19 **(35)**	16/18	35		
70							SS S-18	8-10-18 **(28)**	15/18	28		
		72.5	(ML), SANDY SILT, nonplastic fines, some fine sand, dark gray; stiff to hard, wet	-40.1	ML							
75							SS S-19	1-3-5 **(8)**	18/18	8	75: S-19: PI = NP	
80												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G019

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: North of Marymoor Park, South of 520

DRILLING START: July 21, 2017 09:02
DRILLING END: July 25, 2017 17:00
COORDINATES: N: 345,899 E: 1,422,090

SHEET: 3 of 5
GS ELEV.: 32.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (■) / WATER CONTENT (%) (○)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud Rotary	80.0	(ML), SANDY SILT, nonplastic fines, some fine sand, dark gray; stiff to hard, wet *(continued)*	-47.6	ML		SS S-20	5-14-17 **(31)**	14/18	31		
		84.0	(CL), SANDY LEAN CLAY, low plasticity fines, some fine sand, dark gray; medium stiff to very stiff, moist	-51.6	CL		SS S-21	5-1-6 **(7)**	18/18	7	85: S-21: PI = 9	
90							SS S-22	7-4-11 **(15)**	18/18	15		
95							SS S-23	0-1-5 **(6)**	18/18	6	95: S-23: PI = 15	
100							SS S-24	2-0-6 **(6)**	18/18	6		
105							SS S-25	3-1-4 **(5)**	18/18	5	105: S-25: PI = 13	
110							SS S-26	4-0-2 **(2)**	18/18	2		
		113.0	(ML), SANDY SILT, nonplastic fines, some fine sand, dark gray; very soft to medium stiff, wet	-80.6	ML							
115							SS S-27	0-2-5 **(7)**	18/18	7	115: S-27: PI = NP	
120												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G019

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: North of Marymoor Park, South of 520

DRILLING START: July 21, 2017 09:02
DRILLING END: July 25, 2017 17:00
COORDINATES: N: 345,899 E: 1,422,090

SHEET: 4 of 5
GS ELEV.: 32.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
120	Mud Rotary	120.0	(ML), SANDY SILT, nonplastic fines, some fine sand, dark gray; very soft to medium stiff, wet *(continued)*	-87.6	ML	SS S-28	0-0-1 **(1)**	18/18	1		
		122.0	(CL), SANDY LEAN CLAY, low plasticity fines, some fine sand, dark gray; medium stiff to hard, moist Decreased sand content	-89.6	CL	ST ST-1		24/24		121.5: ST-1 Advanced at 400 psi. Dent in shelby tube 1 foot from bottom of tube.	
125						SS S-29	0-3-4 **(7)**	18/18	7	125: S-29: PI = 15	
						ST ST-2		24/24		126.5: ST-2 Advanced at 300 psi; ST-2: PI = 21	
130						SS S-30	12-13-17 **(30)**	18/18	30		
		132.5	(SC), CLAYEY SAND, fine sand, some medium plasticity fines, gray; medium dense, moist	-100.1	SC						
135						SS S-31	4-4-13 **(17)**	18/18	17	135: S-31: % Fines = 35	
		137.5	(SP-SC), POORLY GRADED SAND WITH CLAY, fine to coarse sand, few medium plasticity fines, gray; dense to very dense, moist	-105.1	SP-SC						
140						SS S-32	11-18-28 **(46)**	12/18	46		
			Decreased sand content								
145						SS S-33	20-28-40 **(68)**	12/18	>>		
		147.5	(CL), LEAN CLAY, low plasticity fines, gray; stiff, moist	-115.1	CL						
150						SS S-34	3-2-8 **(10)**	18/18	10		
		154.0	(SM), SILTY SAND, fine to coarse sand, little nonplastic fines, trace gravel, light gray; very dense, moist	-121.6	SM						
155						SS S-35	32-38-38 **(76)**	12/18	>>		
160											

Log continued on next page

PENETRATION RESISTANCE BLOWS / ft: 10 20 30 40
WATER CONTENT (%): W_p W W_l 20 40 60 80

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G019

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: North of Marymoor Park, South of 520

DRILLING START: July 21, 2017 09:02
DRILLING END: July 25, 2017 17:00
COORDINATES: N: 345,899 E: 1,422,090

SHEET: 5 of 5
GS ELEV.: 32.4 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160		160.0		-127.6								
		160.3	Bottom of borehole at 160.3 ft. Backfilled with bentonite grout.	-127.9			SS S-36	100/4" **(100/4")**	2/4			
165												
170												
175												
180												
185												
190												
195												
200												

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G020

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 27, 2017 15:35
DRILLING END: August 3, 2017 10:25
COORDINATES: N: 345,927 E: 1,422,451

SHEET: 1 of 6
GS ELEV.: 34.6 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft	WATER CONTENT (%)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0	Mud Rotary	0.0	(ML), SILT WITH SAND, nonplastic fines, little fine sand, light brown, roots; stiff, moist	34.6	ML		SS S-1	3-4-5 **(9)**	4/18	9			
		2.0	(GW-GM), WELL GRADED GRAVEL WITH SILT AND SAND, fine to coarse subrounded to subangular gravel, some fine to coarse sand, little low plastic fines, gray and brown; medium dense to very dense, moist to wet	32.6								2: Drilling chatter	
							SS S-2	7-9-12 **(21)**	7/18	21			
5							SS S-3	19-20-21 **(41)**	10/18	41			
							SS S-4	18-21-18 **(39)**	6/18	39		6.9 ft, 03/04/2018 VWP reading; 7.2 ft, ATD; 7.7 ft, 06/02/2018 VWP reading	
10							SS S-5	12-7-6 **(13)**	7/18	13		9.2 ft, 11/17/2017 VWP reading; 9.7 ft, 09/28/2017 VWP reading; 10: S-5: % Fines = 5; 11.7 ft, 11/04/2017 VWP reading	
							SS S-6	20-16-13 **(29)**	8/18	29			
15					GW-GM		SS S-7	14-19-21 **(40)**	8/18	40			
20			Color change to gray				SS S-8	18-44-50 **(94)**	7/18	>>			
25							SS S-9	17-19-34 **(53)**	7/18	>>		25: Drilling chatter	
30		30.0	(SM), SILTY SAND, fine to medium sand, little nonplastic fines, few coarse subrounded to subangular gravel, dark gray; medium dense, wet	4.6			SS S-10	10-12-11 **(23)**	0/18	23			
35					SM		SS S-11	13-10-13 **(23)**	12/18	23		35: S-11: % Fines = 20	
40		40.0		-5.4									

Log continued on next page

DRILLING CO.: Holt Services
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G020

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 27, 2017 15:35
DRILLING END: August 3, 2017 10:25
COORDINATES: N: 345,927 E: 1,422,451

SHEET: 2 of 6
GS ELEV.: 34.6 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0	(SP-SM), POORLY GRADED SAND WITH SILT, fine to medium sand, few nonplastic fines, dark gray; medium dense to very, wet	-5.4								
	Mud Rotary				SP-SM		SS S-12	9-14-20 **(34)**	0/18	34		
45							SS S-13	9-10-12 **(22)**	14/18	22	45: S-13: % Fines = 12	
50							SS S-14	10-13-11 **(24)**	12/18	24	50: S-14: % Fines = 14	
55							SS S-15	9-15-24 **(39)**	15/18	39		
60							SS S-16	9-11-13 **(24)**	0/18	24		
65							SS S-17	16-25-28 **(53)**	0/18	>>		
70							SS S-18	16-20-21 **(41)**	18/18	41		
75							SS S-19	8-12-15 **(27)**	14/18	27		
		77.5	(ML), SANDY SILT, nonplastic fines, some fine to medium sand, dark gray; very stiff to hard, wet	-42.9	ML						78: VWP Installed	
80												

Log continued on next page

DRILLING CO.: Holt Services
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G020

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 27, 2017 15:35
DRILLING END: August 3, 2017 10:25
COORDINATES: N: 345,927 E: 1,422,451

SHEET: 3 of 6
GS ELEV.: 34.6 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud Rotary	80.0	(ML), SANDY SILT, nonplastic fines, some fine to medium sand, dark gray; very stiff to hard, wet *(continued)*	-45.4	ML		SS S-20	2-8-12 **(20)**	15/18	20	80: S-20: PI = NP; % Fines = 60	
85							SS S-21	13-22-28 **(50)**	13/18	50		
		87.0	(CL), SANDY LEAN CLAY, low plasticity fines, some fine to medium sand, dark gray; stiff, moist	-52.4	CL							
90							SS S-22	5-6-6 **(12)**	18/18	12	90: S-22: PI = 8	
		93.0	(ML), SANDY SILT, nonplastic fines, some fine to medium sand, dark gray; very stiff, wet	-58.4	ML							
95							SS S-23	12-13-14 **(27)**	15/18	27		
100							SS S-24	1-8-16 **(24)**	18/18	24	100: S-24: PI = NP; % Fines = 55	
		103.0	(CL), SANDY LEAN CLAY, low plasticity fines, some fine to medium sand, dark gray; stiff, moist	-68.4	CL							
105							SS S-25	12-6-7 **(13)**	18/18	13	105: S-25: PI = 8; % Fines = 69	
		108.0	(ML), SANDY SILT, low plasticity fines, some fine to medium sand, dark gray; medium stiff, wet	-73.4	ML							
110							SS S-26	2-1-6 **(7)**	18/18	7	110: S-26: PI = 4; % Fines = 85	
		112.5	(CL), LEAN CLAY, low plasticity fines, few fine sand, dark gray; medium stiff to hard, moist, thin sand seams < 1/4 inch thick	-77.9	CL							
115							ST ST-1		24/24			
							SS S-27	0-2-5 **(7)**	18/18	7		
120											120: S-28: PI = 17	

Log continued on next page

DRILLING CO.: Holt Services
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

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RECORD OF BOREHOLE DRLE-G020

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 27, 2017 15:35
DRILLING END: August 3, 2017 10:25
COORDINATES: N: 345,927 E: 1,422,451

SHEET: 4 of 6
GS ELEV.: 34.6 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40)	WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
120	Mud Rotary	120.0	(CL), LEAN CLAY, low plasticity fines, few fine sand, dark gray; medium stiff to hard, moist, thin sand seams < 1/4 inch thick *(continued)*	-85.4	CL		SS S-28	0-1-5 **(6)**	18/18	6			
125							SS S-29	2-2-5 **(7)**	18/18	7			
130							SS S-30	11-27-21 **(48)**	3/18		48		
135							SS S-31	0-0-5 **(5)**	18/18	5		135: S-31: PI = 12	
140			Color change to gray				SS S-32	0-3-8 **(11)**	18/18	11			
145							SS S-33	0-0-5 **(5)**	18/18	5		145: S-33: PI = 14	
		147.5	(SM), SILTY SAND, fine to medium sand, some nonplastic fines, dark gray; medium dense, wet	-112.9									
150					SM		SS S-34	1-3-7 **(10)**	18/18	10		150: S-34: % Fines = 38	
155							SS S-35	8-8-11 **(19)**	18/18		19	155: S-35: % Fines = 23	
		157.5	(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, gray; very dense, wet	-122.9	SP								
160													

Log continued on next page

DRILLING CO.: Holt Services
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G020

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 27, 2017 15:35
DRILLING END: August 3, 2017 10:25
COORDINATES: N: 345,927 E: 1,422,451

SHEET: 5 of 6
GS ELEV.: 34.6 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160	Mud Rotary	160.0	(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, gray; very dense, wet *(continued)*	-125.4	SP		SS S-36	29-32-27 **(59)**	15/18	>>		
		162.5	(CL), LEAN CLAY, medium plasticity fines, trace fine sand, gray; stiff to hard, moist	-127.9								
165							SS S-37	0-3-9 **(12)**	18/18	12	165: S-37: PI = 19	
170							SS S-38	34-50/3" **(50/3")**	8/9	>>		
175					CL		SS S-39	10-14-18 **(32)**	4/18	32		
180							SS S-40	0-2-11 **(13)**	18/18	13	180: S-40: PI = 14	
185							SS S-41	4-3-5 **(8)**	18/18	8		
		187.5		-152.9			ST ST-2		12/12		186.5 - 188.5: Shelby Tube ST-2 Advanced with 600 psi of pressure.	
			(SM), SILTY SAND, fine to coarse sand, some nonplastic fines, few gravel, dark gray; very dense, wet									
190							SS S-42	30-48-38 **(86)**	12/18	>>	190: S-40: % Fines = 32	
					SM							
195							SS S-43	100/2" **(100/2")**	2/2		195 - 200: Drilling chatter	
200												

Log continued on next page

DRILLING CO.: Holt Services
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

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RECORD OF BOREHOLE DRLE-G020

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 27, 2017 15:35
DRILLING END: August 3, 2017 10:25
COORDINATES: N: 345,927 E: 1,422,451

SHEET: 6 of 6
GS ELEV.: 34.6 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
200		200.0		-165.4								
		201.0		-166.4	SM		SS S-44	85/5" **(85/5")**	1/5		201: Drilling chatter, possible cobbles/boulders.	
			Bottom of borehole at 201.0 ft. Installed vibrating wire piezometer									

205
210
215
220
225
230
235
240

DRILLING CO.: Holt Services
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

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RECORD OF BOREHOLE DRLE-G021

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 20, 2017 10:13
DRILLING END: July 20, 2017 16:26
COORDINATES: N: 345,946 E: 1,422,844

SHEET: 1 of 2
GS ELEV.: 35.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Mud Rotary

Depth (ft)	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes Water Levels
0.0	(ML), SILT WITH SAND, nonplastic fines, brown and white; medium stiff, wet	35.2	ML	SS S-1	1-3-2 **(5)**	9/18	5	
2.0	(ML), SILT, low plasticity fines, trace fine to medium sand, light gray; soft, wet, trace roots	33.2	ML	SS S-2	1-2-2 **(4)**	9/18	4	2.5: S-2: PI = 8
3.5	(SP-SM), POORLY GRADED SAND WITH SILT, fine to medium sand, few nonplastic fines, dark gray; loose, wet, trace roots	31.7	SP-SM					
4.5	(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, dark brown; medium dense, wet, trace roots	30.7	SP	SS S-3	0-6-13 **(19)**	4/18	19	∇ 5.0 ft, ATD (estimated based on soil conditions)
6.0	(PT), SANDY PEAT WITH GRAVEL, nonplastic fines, some fine to medium sand, little coarse subangular gravel, dark brown; stiff, wet	29.2	PT	SS S-4	12-16-15 **(31)**	8/18	31	
6.5	(SM), SILTY SAND WITH GRAVEL, fine to medium sand, some fine to coarse subrounded to subangular gravel, little nonplastic fines, gray-brown; dense, wet	28.7	SM	SS S-5	7-21-22 **(43)**	4/18	43	
9.5	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, medium sand, some fine to coarse subrounded to subangular gravel, few nonplastic fines, dark gray; dense to very dense, wet Increased sand content (S-6)	25.7	SP-SM	SS S-6	14-11-12 **(23)**	8/18	23	12.5: S-6: % Fines = 7
				SS S-7	13-21-19 **(40)**	6/18	40	
				SS S-8	23-34-35 **(69)**	4/18	>>	
				SS S-9	15-20-29 **(49)**	8/18	49	
27.5	(GM), SILTY GRAVEL, fine to coarse subrounded to subangular gravel, some fine to medium sand, little nonplastic fines, dark gray; dense to very dense, wet	7.7	GM	SS S-10	15-17-23 **(40)**	12/18	40	
				SS S-11	18-21-22 **(43)**	8/18	43	40: Difficult drilling

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G021

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 20, 2017 10:13
DRILLING END: July 20, 2017 16:26
COORDINATES: N: 345,946 E: 1,422,844

SHEET: 2 of 2
GS ELEV.: 35.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud Rotary	40.0	(GM), SILTY GRAVEL, fine to coarse subrounded to subangular gravel, some fine to medium sand, little nonplastic fines, dark gray; dense to very dense, wet *(continued)*	-4.8	GM		SS S-12	17-33-48 **(81)**	10/18	>>		
		44.0	(SP), POORLY GRADED SAND, fine sand, trace low plasticity fines, dark gray; very dense, wet	-8.8	SP		SS S-13	17-30-33 **(63)**	7/18	>>		
45												
50		51.5		-16.3			SS S-14	20-27-37 **(64)**	10/18	>>		
			Bottom of borehole at 51.5 ft. Backfilled with bentonite grout.									
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G022

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 26, 2017 11:04
DRILLING END: July 27, 2017 10:00
COORDINATES: N: 345,946 E: 1,423,213

SHEET: 1 of 2
GS ELEV.: 36.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0	Mud Rotary	0.0	(ML), SANDY SILT, nonplastic fines, some fine to medium sand, white and light brown, roots; stiff to hard, moist	36.3	ML		SS S-1	2-4-6 **(10)**	7/18	10		
		3.0	(PT), PEAT, low plasticity fines, very dark brown, roots; hard, moist	33.3	PT		ST ST-1		24/24			
5		6.0	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, few fine to coarse sand, trace nonplastic fines, gray; dense, moist to wet	30.3	GP		SS S-2	9-22-34 **(56)**	18/18	>>	6.5 - 12: Drilling chatter	
							SS S-3	19-21-20 **(41)**	9/18	41	8.4 ft, 03/04/2018 VWP reading	
10							SS S-4	10-18-13 **(31)**	2/18	31	8.6 ft, 06/02/2018 VWP reading; 9.3 ft, ATD; 9.7 ft, 09/28/2017 VWP reading; 10: S-4: % Fines = 3	
							SS S-5	22-18-21 **(39)**	4/18	39	11.1 ft, 11/17/2017 VWP reading; 11.7 ft, 11/04/2017 VWP reading	
15							SS S-6	13-16-17 **(33)**	8/18	33		
20							SS S-7	11-18-18 **(36)**	0/18	36		
25							SS S-8	15-16-18 **(34)**	9/18	34		
30		31.5	(SP-SM), POORLY GRADED SAND WITH SILT, fine to medium sand, few nonplastic fines, dark gray; medium dense, wet	4.8			SS S-9	10-16-18 **(34)**	3/18	34		
35					SP-SM		SS S-10	12-8-15 **(23)**	14/18	23	35: S-10: % Fines = 6	
40												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G022

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 26, 2017 11:04
DRILLING END: July 27, 2017 10:00
COORDINATES: N: 345,946 E: 1,423,213

SHEET: 2 of 2
GS ELEV.: 36.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		-3.7								
	Mud Rotary		(SP-SM), POORLY GRADED SAND WITH SILT, fine to medium sand, few nonplastic fines, dark gray; medium dense, wet *(continued)*		SP-SM		SS S-11	9-11-8 **(19)**	13/18	19		
		44.0		-7.7								
45			(SM), SILTY SAND WITH GRAVEL, fine to medium sand, little fine to coarse subrounded gravel, little nonplastic fines, dark gray; medium dense, wet		SM		SS S-12	8-11-10 **(21)**	14/18	21	45: S-12: % Fines = 14 47: VWP Installed	
50		51.5		-15.2			SS S-13	9-10-10 **(20)**	14/18	20		
55			Bottom of borehole at 51.5 ft. Installed vibrating wire piezometer									
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G023

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 19, 2017 10:45
DRILLING END: July 19, 2017 16:59
COORDINATES: N: 345,936 E: 1,423,624

SHEET: 1 of 2
GS ELEV.: 37.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft	WATER CONTENT (%)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0	Mud Rotary	0.0	(ML), FILL: SANDY SILT, nonplastic fines, some fine to medium sand, brown to dark brown; very soft to soft, moist to wet	37.0	ML	SS S-1b	3-2-1 **(3)**	14/18	3		2.5: S-1: PI = NP	
5		4.5	(PT), FILL: PEAT, low plasticity fines, very dark brown, roots; very soft, moist	32.5	PT	SS S-2	0-0-0 **(0)**	18/18	0	>>	5: S-2: PI = NP	
		7.5	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, fine to medium sand, some fine subrounded to subangular gravel, few nonplastic fines, brown; medium dense, wet	29.5	SP-SM	SS S-3	10-17-12 **(29)**	11/18	29		∇ 7.0 ft, ATD (estimated based on soil conditions) 7.5 - 40: Difficult drilling	
10		9.0	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, some fine to coarse sand, trace nonplastic fines, gray; medium dense to very dense, wet	28.0	GP	SS S-4	13-11-21 **(32)**	4/18	32			
						SS S-5	18-16-13 **(29)**	6/18	29			
15						SS S-6	8-17-15 **(32)**	7/18	32			
20						SS S-7	50-47-35 **(82)**	8/18			20 - 40: Caving gravels	
25						SS S-8	30-30-29 **(59)**	0/18		>>		
		27.5	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, fine to coarse sand, few fine to coarse subrounded gravel, few nonplastic fines, gray; medium dense, wet	9.5	SP-SM							
30						SS S-9	9-11-13 **(24)**	9/18	24		30: S-9: % Fines = 5	
		32.5	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, little fine to coarse sand, trace nonplastic fines, gray; very dense, wet	4.5	GP							
35						SS S-10	19-26-47 **(73)**	4/18		>>		
40												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G023

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 19, 2017 10:45
DRILLING END: July 19, 2017 16:59
COORDINATES: N: 345,936 E: 1,423,624

SHEET: 2 of 2
GS ELEV.: 37.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		-3.0								
	Mud Rotary				GP		SS S-11	5-25-39 **(64)**	0/18	>>		
		42.5		-5.5								
45			(SP), POORLY GRADED SAND WITH GRAVEL, fine to medium sand, little fine to coarse subrounded to subangular gravel, gray; dense to very dense, wet									
							SS S-12	17-16-17 **(33)**	9/18	33		
					SP							
50												
							SS S-13	17-26-33 **(59)**	2/18	>>		
		51.5		-14.5								
			Bottom of borehole at 51.5 ft. Backfilled with bentonite grout.									
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:41
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RECORD OF BOREHOLE DRLE-G023B

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: July 27, 2017 00:00
DRILLING END: July 27, 2017 00:00
COORDINATES: N: 345,927 E: 1,424,002

SHEET: 1 of 1
GS ELEV.: 36.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
0	Mud Rotary	0.0	(ML), SANDY SILT, nonplastic fines, some fine to medium sand, brown to dark brown; very soft to soft, wet	36.9	ML							
							ST ST-1		24/24		1.5: ST-1: PI = 80	
											3.5: Sand at bottom of ST sample	
5											4: ST-2: PI = 73	
							ST ST-2		18/24		6: Peat at bottom of ST sample	
		6.5	Bottom of borehole at 6.5 ft. Backfilled with bentonite grout.	30.4								
10												
15												
20												
25												
30												
35												
40												

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselmore
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G024

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: August 10, 2017 08:02
DRILLING END: August 11, 2017 11:16
COORDINATES: N: 345,927 E: 1,423,995

SHEET: 1 of 2
GS ELEV.: 40.7 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

Depth (ft)	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes Water Levels
0.0	(SP-SM), POORLY GRADED SAND WITH SILT, fine to medium sand, few nonplastic fines, brown; medium dense, moist, few roots	39.2	SP-SM	SS S-1	5-9-7 **(16)**	18/18	16	
1.5	(ML), SILT WITH SAND, nonplastic fines, little medium sand, brown mottled gray; medium stiff to medium stiff, moist to wet		ML	SS S-2	6-7-6 **(13)**	8/18	13	2.5: S-2: PI = NP
				SS S-3	3-5-9 **(14)**	12/18	14	>>
				SS S-4	2-2-4 **(6)**	10/18	6	7.5: S-4: PI = NP
9.5	(OL), ORGANIC SILT, low plasticity fines, gray; very soft, wet	31.2	OL	SS S-5	0-0-0 **(0)**	18/18	0	>> 10: S-5A (10-10.75): PI = 16; 10.75: S-5B (10.75-11.5): PI = NP
10.8	(PT), PEAT, nonplastic fines, dark brown; wet	29.9	PT					
12.0	(OH), ORGANIC SILT, high plasticity fines, gray; very soft, wet	28.7	OH	ST ST-1		24/36		12.5: S-6: PI = 53
15.0	(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, dark gray; very loose, wet, trace wood fragments	25.7	SP	SS S-6	0-0-3 **(3)**	12/18	3	15.0 ft, 03/04/2018 VWP reading; 15.2 ft, 06/02/2018 VWP reading; 17.7 ft, 10/03/2017 VWP reading; 18.1 ft, 11/17/2017 VWP reading; 18.7 ft, 11/04/2017 VWP reading
19.0	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, some fine to coarse sand, trace nonplastic fines, dark gray; medium dense to very dense, wet	21.7	GP	SS S-7	10-11-16 **(27)**	9/18	27	
				SS S-8	28-30-24 **(54)**	0/18		>>
				SS S-9	16-19-19 **(38)**	11/18	38	
				SS S-10	13-15-16 **(31)**	9/18	31	
40.0		0.7						

Boring Method: Mud Rotary

Log continued on next page

Additional Lab Testing

DRILLING CO.: Holt Services Inc
DRILLER: Abe Causland
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G024

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: August 10, 2017 08:02
DRILLING END: August 11, 2017 11:16
COORDINATES: N: 345,927 E: 1,423,995

SHEET: 2 of 2
GS ELEV.: 40.7 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		0.7								
	Mud Rotary		(SP), POORLY GRADED SAND, medium sand, trace nonplastic fines, dark gray; dense to very dense, wet		SP		SS S-11	11-20-31 **(51)**	0/18	>>		
45							SS S-12	17-20-21 **(41)**	13/18	41	47: VWP Installed	
50							SS S-13	11-18-23 **(41)**	13/18	41		
		51.5		-10.8								
			Bottom of borehole at 51.5 ft. Installed vibrating wire piezometer									
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Abe Causland
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G025

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: August 8, 2017 08:42
DRILLING END: August 9, 2017 12:46
COORDINATES: N: 345,868 E: 1,424,704

SHEET: 1 of 2
GS ELEV.: 41.5 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0	Mud Rotary	0.0	(ML), FILL: SILT WITH SAND, mostly nonplastic fines, little fine to medium sand, brown; moist	41.5	ML		GS GS-1				0 - 5: Hand augered	
5		4.5	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, dark gray; loose to medium dense, moist to wet	37.0	SP		SS S-1	5-7-9 **(16)**	14/18	16	7.0 ft, ATD (estimated based on soil conditions)	
		8.5	(OH), ORGANIC SILT, high plasticity fines, gray; soft, moist to wet, seams of wood/roots < 1/2 inch thick	33.0	OH		SS S-2	4-2-0 **(2)**	6/18	2		
10							SS S-3	1-1-2 **(3)**	18/18	3		
							ST ST-1		24/24		12.5: ST-1 @ 12.5': PI = 113 13: ST-1 @ 13.0': PI = 101 13.5: ST-1 @ 13.5': PI = 159	
15		14.0	(PT), PEAT, nonplastic fines, dark brown; very soft, wet	27.5	PT							
		15.8	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, some medium sand, dark gray; dense to very dense, wet	25.7	GP		SS S-4	0-3-14 **(17)**	14/18	17	>> 15: S-4: PI = NP 17: Drilling chatter	
20							SS S-5	12-26-31 **(57)**	6/18	>>		
25							SS S-6	18-25-22 **(47)**	9/18	47	25: Drilling chatter	
30							SS S-7	15-20-30 **(50)**	9/18	50	30: Drilling chatter	
35		35.5	(SP), POORLY GRADED SAND, medium sand, trace nonplastic fines, dark gray; dense, wet	6.0	SP		SS S-8	15-15-20 **(35)**	14/18	35		
40												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Abe Causland
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G025

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: August 8, 2017 08:42
DRILLING END: August 9, 2017 12:46
COORDINATES: N: 345,868 E: 1,424,704

SHEET: 2 of 2
GS ELEV.: 41.5 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		1.5								
	Mud Rotary		(SP), POORLY GRADED SAND, medium sand, trace nonplastic fines, dark gray; dense, wet *(continued)*		SP		SS S-9	11-17-17 **(34)**	12/18	34		
45							SS S-10	10-18-16 **(34)**	13/18	34		
50		51.5		-10.0			SS S-11	14-18-18 **(36)**	13/18	36		
			Bottom of borehole at 51.5 ft. Backfilled with bentonite grout.									
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Abe Causland
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G027

PROJECT: ST Redmond Link
PROJECT NO.: 1657705
LOCATION: Redmond

DRILLING START: September 5, 2017 08:26
DRILLING END: September 5, 2017 14:37
COORDINATES: N: 345,844 E: 1,425,112

SHEET: 1 of 2
GS ELEV.: 43.3 feet
TOC ELEV.: na
DATUM: Project Datum

Depth (ft)	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes / Water Levels
0.0		43.3						
0.3	ASPHALT	43.0						
	(SP), POORLY GRADED SAND, fine to coarse sand, trace fine subangular to angular gravel, trace nonplastic fines, brown; medium dense, moist		SP	SS S-1	9-7-6 **(13)**	6/18	13	
				SS S-2	5-6-7 **(13)**	12/18	13	
				SS S-3	6-6-8 **(14)**	14/18	14	
				SS S-4	4-5-7 **(12)**	18/18	12	10: S-4: % Fines = 1
				SS S-5	6-8-11 **(19)**	8/18	19	12.1 ft, 03/04/2018, VWP reading
14.0		29.3						
	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, medium to coarse sand, little fine to coarse subangular to angular gravel, few nonplastic fines, brown and gray; medium dense, moist to wet		SP-SM	SS S-6	8-10-8 **(18)**	7/18	18	14.2 ft, ATD; 14.9 ft, 09/28/2017, VWP reading; 15.6 ft, 11/17/2017, VWP reading
				SS S-7	5-8-9 **(17)**	4/18	17	20: S-7: % Fines = 6
22.5		20.8						
	(SP), POORLY GRADED SAND, medium to coarse sand, trace nonplastic fines, dark gray to dark brown; very dense, wet		SP	SS S-8	32-19-50/5" **(69/11")**	18/17	>>	
30.5		12.8						
	(SP), POORLY GRADED SAND, fine to coarse sand, trace fine to coarse subrounded to subangular gravel, gray; medium dense to very dense, wet		SP	SS S-9	5-11-15 **(26)**	12/18	26	
				SS S-10	10-19-29 **(48)**	18/18	48	

Boring method: Mud Rotary

Log continued on next page

Well Installation: Solid 2" PVC 0-15'; Slotted 2" PVC 15-25'; capped at 25'; Annular Space: Bentonite 0-13' &Filter Sand 13-25

DRILLING CO.: Holt Services Inc
DRILLER: John Bennet
DRILL RIG: CME-85, Truck Mount

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G027

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: NE 70th St cul de sac

DRILLING START: September 5, 2017 08:26
DRILLING END: September 5, 2017 14:37
COORDINATES: N: 345,844 E: 1,425,112

SHEET: 2 of 2
GS ELEV.: 43.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		3.3								
	Mud Rotary		(SP), POORLY GRADED SAND, fine to coarse sand, trace fine to coarse subrounded to subangular gravel, gray; medium dense to very dense, moist to wet *(continued)*		SP		SS S-11	12-16-39 **(55)**	18/18	>>		
45							SS S-12	10-32-50/3" **(82/9")**	18/15	>>	48: VWP Installed	
50							SS S-13	3-5-15 **(20)**	6/18	20	50: 5 feet of heave observed in auger	
		51.5		-8.2								
			Bottom of borehole at 51.5 ft. Installed monitoring well and vibrating wire piezometer.									
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: John Bennet
DRILL RIG: CME-85, Truck Mount

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G028

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: NE 70th St

DRILLING START: September 7, 2017 07:31
DRILLING END: September 7, 2017 11:39
COORDINATES: N: 346,002 E: 1,425,966

SHEET: 1 of 2
GS ELEV.: 41.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0	Mud Rotary	0.0	ASPHALT	41.9							0 - 6: Air knife and vac truck used to clear utilities; soil description based on cuttings.	
		1.0	(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, little fine to coarse subrounded to subangular gravel, trace nonplastic fines, light brown and gray; medium dense, moist	40.9	SP							
5							SS S-1	10-6-6 **(12)**	12/18	12	7.5: S-1: % Fines = 4	
10							SS S-2	4-6-9 **(15)**	14/18	15		
		11.0	(GW), WELL GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, some medium to coarse sand, trace nonplastic fines, brown and gray; medium dense to very dense, moist to wet	30.9	GW		SS S-3	12-15-13 **(28)**	4/18	28	∇ 13.0 ft, ATD	
15							SS S-4	9-15-20 **(35)**	18/18	35		
20							SS S-5	5-6-12 **(18)**	12/18	18	20: S-5: % Fines = 1	
25							SS S-6	6-9-11 **(20)**	12/18	20	25: S-6: % Fines = 4	
30							SS S-7	19-28-30 **(58)**	9/18	>>	30: 1.5 feet of heave, added drilling mud	
		32.5	(SP), POORLY GRADED SAND, fine to coarse sand, trace gravel, trace nonplastic fines, gray; medium dense to very dense, wet	9.4	SP							
35							SS S-8	12-12-18 **(30)**	18/18	30		
40												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Kevin Bacon
DRILL RIG: Mobile B59

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G028

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: NE 70th St

DRILLING START: September 7, 2017 07:31
DRILLING END: September 7, 2017 11:39
COORDINATES: N: 346,002 E: 1,425,966

SHEET: 2 of 2
GS ELEV.: 41.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		1.9								
	Mud Rotary		(SP), POORLY GRADED SAND, fine to coarse sand, trace gravel, trace nonplastic fines, gray; medium dense to very dense, wet *(continued)*		SP		SS S-9	16-24-33 **(57)**	18/18	>> ■		
45							SS S-10	16-26-50/5" **(76/11")**	18/17	>> ■		
50		51.5		-9.6			SS S-11	12-17-28 **(45)**	12/18	45 ■		
			Bottom of borehole at 51.5 ft. Backfilled with bentonite chips.									
55												
60												
65												
70												
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Kevin Bacon
DRILL RIG: Mobile B59

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G029

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: East Shoulder of 520-E Offramp at Redmond Way
DRILLING START: January 7, 2018 20:00
DRILLING END: January 9, 2018 22:00
COORDINATES: N: 346,124 E: 1,426,321
SHEET: 1 of 3
GS ELEV.: 48.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0		0.0		48.0								
	Air Knife/Vac Truck	0.5	TOPSOIL	47.5							0 - 5: Air knife and vac truck used to clear utilities; soil description based on cuttings.	
			(GP), FILL: POORLY GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, some fine to coarse sand, trace nonplastic fines, olive-gray with orange-gray; medium dense, moist, trace cobbles; minor pockets of dark brown silty sand		GP		SS S-1	6-6-12 **(18)**	12/18	18		
							SS S-2	7-9-10 **(19)**	0/18	19		
		12.0		36.0								
			(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, some fine to coarse subrounded to subangular gravel, trace nonplastic fines, olive-gray; medium dense, moist to wet		SP		SS S-3	6-10-12 **(22)**	4/18	22	12.5: S-3: % Fines 1	
							SS S-4	7-13-18 **(31)**	0/18	31	14.5 - 18: Drilling chatter; possible cobbles 14.6 ft, 03/04/2018 VWP reading 1 5.0 ft, ATD (estimated based on soil conditions) 15: of S-4; Cal Mod sampler advanced to obtain material. 16.2 ft, 06/02/2018 VWP reading 17.5 - 44: Drilling chatter	
		18.0		30.0								
	Mud rotary		(GP), POORLY GRADED GRAVEL, fine to coarse subrounded to subangular gravel, few medium to coarse sand, gray to dark gray; loose to medium dense, wet		GP		SS S-5	6-9-9 **(18)**	5/18	18		
							SS S-6	11-11-12 **(23)**	5/18	23	25: Cal Mod sampler advanced to obtain additional samples; Possible cobbles.	
							SS S-7	8-13-11 **(24)**	2/18	24		
							SS S-8	5-4-4 **(8)**	2/18	8	35: S-8: % Fines 1	

Log continued on next page

DRILLING CO.: Holocene Drilling Inc
DRILLER: Matt Graham
DRILL RIG: Mobile B-58 Truck
LOGGED: John Hennessy
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G029

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: East Shoulder of 520-E Offramp at Redmond Way
DRILLING START: January 7, 2018 20:00
DRILLING END: January 9, 2018 22:00
COORDINATES: N: 346,124 E: 1,426,321
SHEET: 2 of 3
GS ELEV.: 48.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Mud rotary

SOIL PROFILE

Depth	Elev	USCS	DESCRIPTION
40.0	8.0	GP	(GP), POORLY GRADED GRAVEL, fine to coarse subrounded to subangular gravel, few medium to coarse sand, gray to dark gray; loose to medium dense, wet *(continued)*
44.0	4.0	SP-SM	(SP-SM), POORLY GRADED SAND WITH SILT, fine to medium sand, trace fine subrounded to subangular gravel, few nonplastic fines, olive-gray; medium dense, wet
58.0	-10.0	SM	(SM), SILTY SAND, fine to medium sand, some nonplastic fines, trace fine subrounded to subangular gravel, olive-gray; medium dense, wet

SAMPLES

Sample Type & Number	Blows per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes Water Levels
SS S-9	12-11-11 **(22)**	0/18	22	
SS S-10	20-15-7 **(22)**	6/18	22	
SS S-11	5-8-6 **(14)**	12/18	14	50: S-11: % Fines 5
SS S-12	7-8-9 **(17)**	12/18	17	
SS S-13	5-8-8 **(16)**	12/18	16	60: S-13: % Fines 24
SS S-14	6-7-7 **(14)**	10/18	14	
SS S-15	8-8-8 **(16)**	12/18	16	70: S-15: % Fines 25
SS S-16	9-11-12 **(23)**	13/18	23	

Penetration Resistance Blows / ft: 10, 20, 30, 40
Water Content (%): W_p, W, W_l; 20, 40, 60, 80

Depth (ft): 40, 45, 50, 55, 60, 65, 70, 75, 80

80: VWP installed

ADDITIONAL LAB TESTING

Log continued on next page

DRILLING CO.: Holocene Drilling Inc
DRILLER: Matt Graham
DRILL RIG: Mobile B-58 Truck
LOGGED: John Hennessy
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G029

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: East Shoulder of 520-E Offramp at Redmond Way
DRILLING START: January 7, 2018 20:00
DRILLING END: January 9, 2018 22:00
COORDINATES: N: 346,124 E: 1,426,321
SHEET: 3 of 3
GS ELEV.: 48.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud rotary	80.0	(SM), SILTY SAND, fine to medium sand, some nonplastic fines, trace fine subrounded to subangular gravel, olive-gray; medium dense, wet *(continued)*	-32.0	SM		SS S17	9-12-15 **(27)**	13/18	27		
		83.0	(ML), SANDY SILT, mostly nonplastic fines, some fine sand, dark olive-gray; medium stiff to very stiff, wet	-35.0								
85							SS S-18	6-4-10 **(14)**	12/18	14	85: S-18: % Fines 50	
90					ML		SS S-19	5-3-3 **(6)**	18/18	6		
95							SS S-20	6-7-9 **(16)**	0/18	16	95: Cal Mod sampler advanced to obtain additional material.	
		98.0	(SM), SILTY SAND, fine sand, little nonplastic fines, dark olive-gray; medium dense, moist to wet	-50.0								
100					SM		SS S-21	11-12-14 **(26)**	12/18	26	100: S-21: % Fines 17	
		101.5	Bottom of borehole at 101.5 ft. Installed vibrating wire piezometer.	-53.5								
105												
110												
115												
120												

DRILLING CO.: Holocene Drilling Inc
DRILLER: Matt Graham
DRILL RIG: Mobile B-58 Truck
LOGGED: John Hennessy
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G031

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: End of a dirt road off of the 520 W onramp from Redmond Way
DRILLING START: September 18, 2017 07:00
DRILLING END: September 24, 2017 03:15
COORDINATES: N: 346,473 E: 1,426,562
SHEET: 1 of 5
GS ELEV.: 44.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0	Mud Rotary	0.0	(ML), SANDY SILT, nonplastic fines, some fine to coarse sand, few fine to coarse subangular to angular gravel, dark brown and dark gray; stiff, moist to wet	44.0	ML		SS S-1	8-4-6 **(10)**	4/18	10	2.5: S-1: PI = NP	
5							SS S-2	5-5-8 **(13)**	0/18	13	5.0 ft, ATD	
		7.0	(SP-SM), POORLY GRADED SAND WITH SILT, fine to medium sand, few nonplastic fines, light gray; medium dense, wet	37.0	SP-SM		SS S-4	15-12-11 **(23)**	9/18	23		
10		10.0	(SP-SM), POORLY GRADED SAND WITH SILT, fine to coarse sand, few fine to coarse rounded to subrounded gravel, few nonplastic fines, gray; medium dense to very dense, wet	34.0							10 - 17: Drilling chatter	
15											12 - 17: Attempted PMT from 12 ft to 17 ft. Slough in pilot hole resulted in only one successful PMT at a depth of 16 ft. 13.2 ft, 03/04/2018 VWP reading 14.4 ft, 06/02/2018 VWP reading 15.4 ft, 09/28/2017 VWP reading 16.8 ft, 11/16/2017 VWP reading	
20							SS S-5	30-21-16 **(37)**	6/18	37	19 - 26: Drilling chatter 20 - 26: Attempted PMT from 20 ft to 26 ft. Slough in the pilot hole resulted in only one PMT at 24.5 ft.	
			Increased gravel content									
25					SP-SM		SS S-6	17-23-30 **(53)**	6/18	>>		
							SS S-7	23-27-26 **(53)**	9/18	>>		
30											30 - 35: Drilling chatter 30.01 - 36: Attempted PMT from 30 ft to 36 ft; no PMT performed due to the caving of pilot hole 33 - 35: Drilling mud loss 33 ft and 35 ft.	
35							SS S-8	12-19-18 **(37)**	9/18	37		
40							SS S-9	18-24-28 **(52)**	9/18	>>	40 - 46: Attempted	

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G031

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: End of a dirt road off of the 520 W onramp from Redmond Way
DRILLING START: September 18, 2017 07:00
DRILLING END: September 24, 2017 03:15
COORDINATES: N: 346,473 E: 1,426,562
SHEET: 2 of 5
GS ELEV.: 44.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	Depth	DESCRIPTION	Elev	USCS	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40)	WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud Rotary	40.0	(SP-SM), POORLY GRADED SAND WITH SILT, fine to coarse sand, few fine to coarse rounded to subrounded gravel, few nonplastic fines, gray; medium dense to very dense, wet *(continued)*	4.0	SP-SM						PMT from 40 ft to 46 ft; no PMT performed due to the caving of pilot hole.	
45		45.0	(SP), POORLY GRADED SAND, fine to coarse sand, trace fine to coarse rounded to subrounded gravel, gray and brown; dense, wet	-1.0	SP	SS S-10	21-22-20 **(42)**	18/18	42		48 - 52: Drilling chatter	
50						SS S-11	21-19-21 **(40)**	12/18	40			
		52.0	(SM), SILTY SAND, fine sand, little nonplastic fines, trace fine subangular gravel, gray; dense, wet	-8.0	SM						52.01 - 58: PMT preformed at 58 ft and 56.5 ft.	
55												
60						SS S-12	10-18-19 **(37)**	12/18	37			
						SS S-13	18-19-16 **(35)**	18/18	35			
65						SS S-14	13-13-18 **(31)**	15/18	31		65: S-14: % Fines = 17	
			Increased silt content									
70						SS S-15	10-13-18 **(31)**	15/18	31		70: S-15: % Fines = 32	
		72.0	(ML), SILT WITH SAND, nonplastic fines, some fine sand, gray; hard, wet	-28.0	ML							
75						SS S-16	13-24-32 **(56)**	5/18	>>			
		77.5	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, gray; dense to very dense, wet	-33.5	SP							
80											80: VWP Installed	

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G031

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: End of a dirt road off of the 520 W onramp from Redmond Way
DRILLING START: September 18, 2017 07:00
DRILLING END: September 24, 2017 03:15
COORDINATES: N: 346,473 E: 1,426,562
SHEET: 3 of 5
GS ELEV.: 44.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud Rotary	80.0	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, gray; dense to very dense, wet *(continued)*	-36.0	SP		SS S-17	18-18-28 **(46)**	18/18	46		
85							SS S-18	24-26-36 **(62)**	15/18	>>		
		87.5	(ML), SILT, nonplastic fines, trace fine sand, gray; dense, wet	-43.5	ML							
90							SS S-19	18-21-23 **(44)**	18/18	44		
		94.0	(CL), LEAN CLAY, medium plasticity fines, gray; medium stiff, moist	-50.0	CL		SS S-20	1-1-5 **(6)**	18/18	6	95: S-20: PI = 19	
95		97.5	(CL), SANDY LEAN CLAY, low plasticity fines, some fine sand, gray; very stiff, moist, thin seams of silts and sands < 1/8 inch thick	-53.5	CL						97 - 99: Drilling chatter	
100							SS S-21	14-11-11 **(22)**	18/18	22	100: S-21: PI = 12	
		102.5	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, gray; very dense, wet	-58.5	SP							
105							SS S-22	21-25-29 **(54)**	18/18	>>		
		107.5	(CL), SANDY LEAN CLAY, low plasticity fines, some fine sand, gray; hard to dense, moist	-63.5	CL							
110							SS S-23	11-16-16 **(32)**	18/18	32		
115							SS S-24	14-11-10 **(21)**	18/18	21	115: S-24: PI = 9	
		117.5	(ML), SILT WITH SAND, nonplastic fines, some fine sand, gray; stiff, wet	-73.5	ML							
120												

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G031

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: End of a dirt road off of the 520 W onramp from Redmond Way
DRILLING START: September 18, 2017 07:00
DRILLING END: September 24, 2017 03:15
COORDINATES: N: 346,473 E: 1,426,562
SHEET: 4 of 5
GS ELEV.: 44.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
120	Mud Rotary	120.0	(ML), SILT WITH SAND, nonplastic fines, some fine sand, gray; stiff, wet *(continued)*	-76.0	ML		SS S-25	3-3-8 **(11)**	18/18	11	120.1: S-25: PI = NP	
		122.5	(CL), LEAN CLAY, low to medium plasticity fines, gray; medium stiff, moist	-78.5								
125					CL		SS S-26	6-3-1 **(4)**	18/18	4	125: S-26: PI = 16	
							ST ST-1		6/24			
		129.5	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, gray; dense, wet	-85.5								
130					SP		SS S-27	25-23-25 **(48)**	12/18	48		
		132.5	(SM), SILTY SAND, fine sand, little nonplastic fines, gray; dense, wet	-88.5								
135					SM		SS S-28	10-19-20 **(39)**	15/18	39		
		137.5	(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, gray; dense, wet	-93.5								
140					SP		SS S-29	19-16-23 **(39)**	18/18	39		
		142.5	(ML), SILT, nonplastic fines, gray; stiff, wet	-98.5								
145					ML		SS S-30	0-2-8 **(10)**	18/18	10	145: S-30: PI = NP	
		147.5	(ML), SANDY SILT, nonplastic fines, some fine sand, gray; very stiff, wet	-103.5			ST ST-2		9/24			
150					ML		SS S-31	6-7-11 **(18)**	18/18	18	150: S-31: PI = NP	
		152.5	(CL), LEAN CLAY, low plasticity fines, few fine to medium sand, gray; very stiff, moist	-108.5								
155					CL		SS S-32	6-9-10 **(19)**	18/18	19	155: S-32: PI = 13	
160		160.0		-116.0								

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G031

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: End of a dirt road off of the 520 W onramp from Redmond Way
DRILLING START: September 18, 2017 07:00
DRILLING END: September 24, 2017 03:15
COORDINATES: N: 346,473 E: 1,426,562
SHEET: 5 of 5
GS ELEV.: 44.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160	Mud Rotary	160.0	(SP), POORLY GRADED SAND, fine to coarse sand, trace fine subangular gravel, trace nonplastic fines, gray; very dense, wet	-116.0	SP		SS S-33	30-36-44 **(80)**	6/18	>>		
165							SS S-34	8-6-10 **(16)**	0/18	16		
		166.5	(GP), POORLY GRADED GRAVEL, fine to coarse subrounded to subangular gravel, few fine to coarse sand, trace nonplastic fines, gray; very dense, wet	-122.5	GP							
170							SS S-35	50/5" **(50/5")**	3/5	>>		
175							SS S-36	47-50/5" **(50/5")**	6/11	>>		
180							SS S-37	50/0" **(50/0")**	0/0	>>	180: S-37 did not advance. Sampler appeared to be bouncing on a rock.	
		183.0	(ML), SILT, low plasticity fines, trace fine sand, gray; stiff to hard, wet	-139.0	ML							
185							SS S-38	0-2-7 **(9)**	0/18	9		
											188.5 - 189: Drilling chatter	
190							SS S-39	36-31-50 **(81)**	0/18	>>		
		193.5	(SM), SILTY SAND WITH GRAVEL, fine to coarse sand, fine to coarse rounded to subrounded gravel, little nonplastic fines, gray; very dense, wet	-149.5	SM							
195							SS S-40	43-41-49 **(90)**	12/18	>>	195: S-40: % Fines = 20	
		196.5	Bottom of borehole at 196.5 ft. Installed seismic casing and vibrating wire piezometer.	-152.5								
200												

DRILLING CO.: Holt Services Inc.
DRILLER: Todd Knipscheld
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

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RECORD OF BOREHOLE DRLE-G032

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 9, 2017 00:00
DRILLING END: October 13, 2017 00:00
COORDINATES: N: 346,834 E: 1,425,997

SHEET: 1 of 6
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40)	WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0		0.0		43.8									
	Hollow Stem Auger	0.3	ASPHALT	43.5									
			(SM), SILTY SAND, fine to medium sand, little nonplastic fines, brown-olive; loose to medium dense, moist		SM		SS S-1	5-6-9 **(15)**	2/18	15			
5							SS S-2	5-6-6 **(12)**	14/18	12		5: S-2: % Fines = 13	
							SS S-3	1-2-4 **(6)**	12/18	6			
		9.5		34.3									
10			(ML), SILT, nonplastic fines, few fine to medium sand, brown to olive-brown; soft to very stiff, moist to wet, wood fragment approx. 0.2' thick		ML		SS S-4	1-0-2 **(2)**	18/18	2		10: S-4: PI = NP	
			Color change to gray				SS S-5	1-3-11 **(14)**	12/18	14		∇ 12.7 ft, ATD	
15	Mud Rotary						SS S-6	5-6-5 **(11)**	18/18	11		15: S-6: PI = NP	
20							SS S-7	9-5-14 **(19)**	18/18	19			
		22.0		21.8									
			(GW), WELL-GRADED GRAVEL WITH SAND, fine to coarse well graded subrounded gravel, some fine to coarse sand, trace nonplastic fines, olive-brown to gray; dense to very dense, wet		GW								
25							SS S-8	28-28-27 **(55)**	2/18		>>		
30							SS S-9	20-26-23 **(49)**	4/18		49		
35							SS S-10	30-18-22 **(40)**	7/18		40		
		37.5		6.3									
			(SW), WELL-GRADED SAND, medium to coarse sand, few fine to coarse subrounded gravel, trace nonplastic fines, brown-olive to gray; very dense, wet		SW								
40													

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: John Bennet
DRILL RIG: CME-85, Truck Mount

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G032

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 9, 2017 00:00
DRILLING END: October 13, 2017 00:00
COORDINATES: N: 346,834 E: 1,425,997

SHEET: 2 of 6
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud Rotary	40.0	(SW), WELL-GRADED SAND, medium to coarse sand, few fine to coarse subrounded gravel, trace nonplastic fines, brown-olive to gray; very dense, wet *(continued)*	3.8	SW		SS S-11	35-30-32 **(62)**	12/18	>>		
45							SS S-12	47-50/5" **(50/5")**	6/11	>>		
50							SS S-13	50/4" **(50/4")**	0/4	>>		
		53.0	(SM), SILTY SAND, fine to medium sand, few to little nonplastic fines, brown-olive; dense, wet	-9.2								
55							SS S-14	15-18-22 **(40)**	18/18	40		
60			Increased sand content from ~62 to 67 ft (SP-SM)		SM		SS S-15	11-20-24 **(44)**	18/18	44		
65							SS S-16	14-18-18 **(36)**	18/18	36	65: S-16: % Fines = 9	
70							SS S-17	14-15-18 **(33)**	18	33	70: S-17: % Fines = 20	
75		75.0	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, gray; dense to very dense, wet	-31.2	SP		SS S-18	19-21-24 **(45)**	18	45		
80												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: John Bennet
DRILL RIG: CME-85, Truck Mount

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G032

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 9, 2017 00:00
DRILLING END: October 13, 2017 00:00
COORDINATES: N: 346,834 E: 1,425,997

SHEET: 3 of 6
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud Rotary	80.0	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, gray; dense to very dense, wet *(continued)*	-36.2	SP		SS S-19	17-19-23 **(42)**	18/18	42		
85							SS S-20	27-24-21 **(45)**	18/18	45		
90							SS S-21	25-27-32 **(59)**	18/18	>>		
		93.0	(CL), LEAN CLAY, low plasticity fines, few fine sand, gray; hard to soft, wet	-49.2	CL							
95							SS S-22	20-20-22 **(42)**	18/18	42		
100							SS S-23	2-4-12 **(16)**	18/18	16	100: S-23: PI = 12	
105							SS S-24	3-2-2 **(4)**	18/18	4	105: S-24: PI = 15	
		109.0	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, gray; dense, wet	-65.2	SP							
110							SS S-25	15-17-21 **(38)**	18/18	38		
		114.0	(CL-ML), SILTY CLAY, low plasticity fines, gray; stiff, moist	-70.2	CL-ML						113 - 114: Drilling chatter	
115							SS S-26	4-4-10 **(14)**	18/18	14	115: S-26: PI = 6	
		117.5	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, gray; dense, wet	-73.7	SP							
120												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: John Bennet
DRILL RIG: CME-85, Truck Mount

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:41
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RECORD OF BOREHOLE DRLE-G032

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 9, 2017 00:00
DRILLING END: October 13, 2017 00:00
COORDINATES: N: 346,834 E: 1,425,997

SHEET: 4 of 6
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
120	Mud Rotary	120.0	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, gray; dense, wet *(continued)*	-76.2	SP		SS S-27	21-24-24 **(48)**	16/18	48		
		123.0	(CL), LEAN CLAY, low plasticity fines, trace fine sand, gray; stiff, moist	-79.2	CL		SS S-28	6-6-8 **(14)**	16/18	14	125: S-28: PI = 13	
		127.5	(SM), SILTY SAND, fine sand, some nonplastic fines, gray; medium dense to dense, wet	-83.7	SM		SS S-29	8-15-12 **(27)**	18/18	27	130: S-29: % Fines = 38	
							SS S-30	12-16-22 **(38)**	18/18	38		
		137.5	(CL), LEAN CLAY, low to medium plasticity fines, trace fine sand, gray; stiff to very stiff, moist	-93.7	CL		SS S-31	8-10-13 **(23)**	18/18	23	140: S-31: PI = 13	
							SS S-32	0-3-11 **(14)**	18/18	14		
							SS S-33	0-6-7 **(13)**	18/18	13		
							SS S-34	3-5-9 **(14)**	18/18	14	155: S-34: PI = 17	
		158.0	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, gray; medium dense to dense, wet	-114.2	SP							

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: John Bennet
DRILL RIG: CME-85, Truck Mount

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:41
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RECORD OF BOREHOLE DRLE-G032

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 9, 2017 00:00
DRILLING END: October 13, 2017 00:00
COORDINATES: N: 346,834 E: 1,425,997

SHEET: 5 of 6
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160		160.0		-116.2								
		161.5	(CH), FAT CLAY, high plasticity fines, few fine to coarse sand, gray; stiff to very stiff, moist	-117.7	SP		ST S-35		0/24			
					CH		SS S-36	6-6-8 **(14)**	18/18	14		
165							ST S-37		24/24		165: S-37: PI = 32	
		167.0	(CL), LEAN CLAY, low plasticity fines, few fine to coarse sand, gray; stiff to very stiff, moist	-123.2			SS S-38	6-7-9 **(16)**	18/18	16	167.5: S-38: PI = 13	
170					CL		SS S-39	4-8-11 **(19)**	18/18	19		
		173.0	(GC), CLAYEY GRAVEL, fine to coarse gravel, little low plasticity fines, trace fine to coarse sand, gray; very dense, wet	-129.2								
175							SS S-40	24-25-26 **(51)**	8/18	>>		
					GC							
180	Mud Rotary						SS S-41	18-24-38 **(62)**	0/18	>>		
		182.5	(CL), LEAN CLAY WITH GRAVEL, low to medium plasticity fines, few fine subrounded gravel, trace fine sand, gray; very stiff to hard, moist	-138.7								
185							SS S-42	8-11-13 **(24)**	0/18	24		
							SS S-43	8-7-10 **(17)**	0/18	17		
190											190: S-44: PI = 20	
					CL		SS S-44	36-40-15 **(55)**	18/18	>>		
195							SS S-45	31-50/5" **(50/5")**	6/11	>>		
200												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: John Bennet
DRILL RIG: CME-85, Truck Mount

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G032

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 9, 2017 00:00
DRILLING END: October 13, 2017 00:00
COORDINATES: N: 346,834 E: 1,425,997

SHEET: 6 of 6
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
200	Mud Rotary	200.0	(CL), LEAN CLAY WITH GRAVEL, low to medium plasticity fines, few fine subrounded gravel, trace fine sand, gray; very stiff to hard, moist *(continued)*	-156.2	CL		SS S-46	26-50/5" **(50/5")**	6/11	>>		
		203.0	(SM), SILTY SAND, fine to coarse sand, little nonplastic fines, trace fine to coarse subrounded to subangular gravel, dark gray; very dense, wet	-159.2	SM							
205							SS S-47	50/1" **(50/1")**	1/1	>>		
210							SS S-48	50/4" **(50/4")**	4/4	>>	210: S-48: % Fines = 19	
215							SS S-49	50/4" **(50/4")**	4/4	>>		
220												
225							SS S-50	50/1" **(50/1")**	1/1	>>		
230												
235		234.0	(ML), SILT WITH GRAVEL, low plasticity fines, little fine subrounded gravel, trace fine to medium sand, gray; very dense, wet	-190.2	ML		SS S-51	36-48-50/4" **(98/10")**	8/16	>>		
		236.3	Bottom of borehole at 236.5 ft. Backfilled with bentonite grout.	-192.5								
240												

DRILLING CO.: Holt Services Inc
DRILLER: John Bennet
DRILL RIG: CME-85, Truck Mount

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G033

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: November 13, 2017 14:00
DRILLING END: November 16, 2017 14:02
COORDINATES: N: 346,976 E: 1,425,591

SHEET: 1 of 6
GS ELEV.: 43.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
0	Mud rotary	0.0	ASPHALT	43.9							0 - 70: Casing advanced to prevent caving	
		0.4	(ML), SANDY SILT, low plasticity fines, some fine to medium sand, trace gravel, brown to brown-gray; soft to stiff, wet, trace wood fragments	43.5	ML		SS S-1	1-2-2 **(4)**	14/18	4		
5							SS S-2	1-4-3 **(7)**	14/18	7		
							SS S-3	2-4-5 **(9)**	13/18	9	7.5: S-3: % Fines = 65	
10							SS S-4	3-2-1 **(3)**	14/18	3		
							SS S-5	1-2-1 **(3)**	18/18	3		
15							SS S-6	1-1-7 **(8)**	14/18	8	15: S-6: % Fines = 69	
		18.0	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, little medium to coarse sand, dark gray; medium dense to dense, wet	25.9	GP						18 - 33: Drilling chatter	
20							SS S-7	19-29-15 **(44)**	11/18	44		
25							SS S-8	8-8-10 **(18)**	8/18	18		
30							SS S-9	9-16-15 **(31)**	6/18	31		
		32.5	(SM), SILTY SAND, fine to coarse sand, little nonplastic fines, trace subrounded gravel, brown-gray; medium dense to very dense, wet	11.4	SM							
35							SS S-10	11-14-15 **(29)**	14/18	29		
40												

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G033

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: November 13, 2017 14:00
DRILLING END: November 16, 2017 14:02
COORDINATES: N: 346,976 E: 1,425,591

SHEET: 2 of 6
GS ELEV.: 43.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES	ADDITIONAL LAB TESTING
40		40.0	(SM), SILTY SAND, fine to coarse sand, little nonplastic fines, trace subrounded gravel, brown-gray; medium dense to very dense, wet *(continued)*	3.9			SS S-11	12-18-19 **(37)**	12/18	37		
45							SS S-12	11-14-14 **(28)**	12/18	28	45: S-12: % Fines = 17	
50							SS S-13	20-32-24 **(56)**	10/18	>>		
55							SS S-14	14-14-16 **(30)**	13/18	30		
60	Mud rotary				SM		SS S-15	13-13-12 **(25)**	10/18	25	60: S-15: % Fines = 27	
65							SS S-16	9-10-12 **(22)**	13/18	22		
70			'Decreased fines content 70 to 80 feet				SS S-17	10-12-12 **(24)**	14/18	24	70: S-17: % Fines = 6	
75							SS S-18	10-10-14 **(24)**	12/18	24		
80											80: S-19: % Fines = 16	

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G033

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: November 13, 2017 14:00
DRILLING END: November 16, 2017 14:02
COORDINATES: N: 346,976 E: 1,425,591

SHEET: 3 of 6
GS ELEV.: 43.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES	ADDITIONAL LAB TESTING
80		80.0	(SM), SILTY SAND, fine to coarse sand, little nonplastic fines, trace subrounded gravel, brown-gray; medium dense to very dense, wet *(continued)*	-36.1	SM		SS S-19	7-9-9 **(18)**	13/18	18		
85							SS S-20	12-11-15 **(26)**	15/18	26		
90							SS S-21	15-19-20 **(39)**	13/18	39		
95							SS S-22	8-10-14 **(24)**	14/18	24	95: S-22: % Fines = 31	
		97.5	(CL), LEAN CLAY WITH SAND, low plasticity fines, little fine to coarse sand, trace fine to coarse subrounded to subangular gravel, gray; medium stiff to hard, moist	-53.6	CL							
100	Mud rotary						SS S-23	6-6-7 **(13)**	18/18	13	100: S-23: PI = 12	
105							SS S-24	3-5-6 **(11)**	18/18	11		
							ST S-25		25/25			
110							SS S-26	17-23-32 **(55)**	18/18	>>		
115							SS S-27	0-0-7 **(7)**	18/18	7		
							ST S-28		24/24			
120		120.0		-76.1							120: S-29: PI = 5	

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G033

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: November 13, 2017 14:00
DRILLING END: November 16, 2017 14:02
COORDINATES: N: 346,976 E: 1,425,591

SHEET: 4 of 6
GS ELEV.: 43.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (■)	WATER CONTENT (%) (○)	NOTES	ADDITIONAL LAB TESTING
120	Mud rotary	120.0	(CL-ML), SILTY CLAY WITH SAND, low plasticity fines, little fine to coarse sand, trace fine to coarse subrounded to subangular gravel, gray; stiff, moist	-76.1	CL-ML		SS S-29	3-5-6 **(11)**	18/18	11			
		124.0	(CL), LEAN CLAY WITH SAND, medium plasticity fines, little fine to coarse sand, trace fine to coarse subrounded to subangular gravel, gray; soft to hard, moist	-80.1									
125							SS S-30	11-8-7 **(15)**	18/18	15			
130							SS S-31	1-2-5 **(7)**	0/18	7			
135							SS S-32	0-0-4 **(4)**	18/18	4		135: S-32: PI = 23	
140					CL		SS S-33	2-4-6 **(10)**	18/18	10		140: S-33: PI = 22	
145							SS S-34	1-2-4 **(6)**	18/18	6			
150							SS S-35	9-7-8 **(15)**	18/18	15		150: S-35: PI = 25	
155							SS S-36	5-6-6 **(12)**	2/18	12			
							ST S-37		24				
160												160: S-38: PI = 21	

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G033

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: November 13, 2017 14:00
DRILLING END: November 16, 2017 14:02
COORDINATES: N: 346,976 E: 1,425,591

SHEET: 5 of 6
GS ELEV.: 43.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
160	Mud rotary	160.0	(CL), LEAN CLAY WITH SAND, medium plasticity fines, little fine to coarse sand, trace fine to coarse subrounded to subangular gravel, gray; soft to hard, moist *(continued)*	-116.1	CL		SS S-38	1-4-8 **(12)**	18/18	12		
165							SS S-39	4-7-8 **(15)**	10/18	15		
170							SS S-40	7-10-13 **(23)**	18/18	23		
175							SS S-41	13-12-23 **(35)**	14/18	35		
180							SS S-42	7-9-11 **(20)**	18/18	20	180: S-42: PI = 21	
		184.0	(ML), SANDY SILT, low plasticity fines, little fine to coarse sand, few fine to coarse gravel, gray; hard, wet	-140.1	ML							
185							SS S-43	44-50/5" **(50/5")**	10/11	>>		
190							SS S-44	20-50/5" **(50/5")**	3/11	>>		
195							SS S-45	50/5" **(50/5")**	2/5	>>		
200												

Log continued on next page

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G033

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: November 13, 2017 14:00
DRILLING END: November 16, 2017 14:02
COORDINATES: N: 346,976 E: 1,425,591

SHEET: 6 of 6
GS ELEV.: 43.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
200		200.0	(ML), SANDY SILT, low plasticity fines, little fine to coarse sand, few fine to coarse gravel, gray; hard, wet *(continued)*	-156.1								
205	Mud rotary						SS S-46	50/5" **(50/5")**	5/5	>>		
210												
215					ML		SS S-47	24-50/5" **(50/5")**	11/11	>>		
220												
225							SS S-48	50/4" **(50/4")**	4/4	>>		
230		231.5		-187.6			SS S-49	17-28-31 **(59)**	18/18	>>		
235			Bottom of borehole at 231.5 ft. Installed seismic casing.									
240												

DRILLING CO.: Holt Services Inc.
DRILLER: Todd
DRILL RIG: Mobile B58 Truck

LOGGED: Ted Sager
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G034

PROJECT: ST Redmond Link
PROJECT NO.: 1657705
LOCATION: South of McDonald's

DRILLING START: August 16, 2017 09:32
DRILLING END: August 22, 2017 07:27
COORDINATES: N: 347,128 E: 1,425,193

SHEET: 1 of 3
GS ELEV.: 44.1 feet
TOC ELEV.: na
DATUM: Project Datum

Depth (ft)	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes / Water Levels
0.0	(SM), FILL: SILTY SAND WITH GRAVEL, fine to coarse sand, little fine to coarse subangular to angular gravel, little nonplastic fines, brown; medium dense to very dense, dry to moist, few creosote wood fragments	44.1	SM	SS S-1	10-17-38 **(55)**	12/18	>>	
				SS S-2	4-5-9 **(14)**	0/18	14	
4.5	(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, some fine rounded to subrounded gravel, trace nonplastic fines, gray and brown; loose, moist	39.6	SP	SS S-3	10-5-4 **(9)**	9/18	9	4.5 - 6: Drilling chatter
6.0	(ML), SANDY SILT, nonplastic fines, some fine to medium sand, few fine angular gravel, gray and brown; soft, moist to wet	38.1	ML	SS S-4	0-1-3 **(4)**	18/18	4	7.5: S-4: PI = NP
10.5	(GP-GM), POORLY GRADED GRAVEL WITH SILT AND SAND, fine subrounded to subangular gravel, little fine to coarse sand, little nonplastic fines, gray with tan; medium dense to dense, wet	33.6	GP-GM	SS S-5	2-5-5 **(10)**	12/18	10	
				SS S-6	10-13-13 **(26)**	4/18	26	
				SS S-7	19-21-18 **(39)**	4/18	39	15: S-7: % Fines = 8
				SS S-8	22-20-16 **(36)**	6/18	36	17.0 ft, 03/04/2018, VWP reading 17.2 ft, 09/28/2017, VWP reading 20.6 ft, 11/16/2017, VWP reading
				SS S-9	14-18-15 **(33)**	10/18	33	
27.5	(SP), POORLY GRADED SAND, medium sand, trace nonplastic fines, brown gray; dense, wet	16.6	SP	SS S-10	15-17-18 **(35)**	9/18	35	
32.5	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, medium to coarse sand, some fine to coarse subrounded to subangular gravel, few nonplastic fines, brown gray; dense, wet	11.6	SP-SM	SS S-11	14-15-17 **(32)**	3/18	32	35: S-11: % Fines = 8

Boring method: Mud Rotary

Penetration resistance scale: 10, 20, 30, 40 blows / ft

Water content (%): W_p 20, 40, 60, 80 W_l

Log continued on next page

WELL INSTALLATION

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselman
DRILL RIG: Mobile B-54

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/20/18 13:06
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RECORD OF BOREHOLE DRLE-G034

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: South of McDonald's

DRILLING START: August 16, 2017 09:32
DRILLING END: August 22, 2017 07:27
COORDINATES: N: 347,128 E: 1,425,193

SHEET: 2 of 3
GS ELEV.: 44.1 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p — W — W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud Rotary	40.0		4.1	SP-SM	SS S-12	15-15-17 **(32)**	9/18	32		
		42.5	(GW-GM), WELL-GRADED GRAVEL WITH SILT AND SAND, fine to coarse subrounded to subangular gravel, some medium to coarse sand, few nonplastic fines, gray and brown; medium dense to dense, wet	1.6	GW-GM						
45						SS S-13	13-19-16 **(35)**	3/18	35		
50						SS S-14	18-14-12 **(26)**	6/18	26	50: S-14: % Fines = 7	
		52.5	(GW), WELL-GRADED GRAVEL, fine to coarse subrounded gravel, little medium to coarse sand, trace nonplastic fines, gray and brown; medium dense to dense, wet	-8.4	GW						
55						SS S-15	21-12-13 **(25)**	5/18	25	55: S-15: % Fines = 2	
60						SS S-16	15-25-24 **(49)**	6/18	49		
65						SS S-17	17-17-18 **(35)**	4/18	35		
		67.5	(SP), POORLY GRADED SAND WITH GRAVEL, medium to coarse sand, some fine to coarse subrounded to subangular gravel, trace nonplastic fines, brown and gray; dense, wet	-23.4	SP						
70						SS S-18	26-18-18 **(36)**	6/18	36		
		72.5	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, little medium to coarse sand, trace nonplastic fines, gray and brown; medium dense to dense, wet	-28.4	GP						
75						SS S-19	21-15-13 **(28)**	4/18	28	75: S-19: % Fines = 3	
										77: Drilling mud loss	
80										80: VWP Installed	

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselman
DRILL RIG: Mobile B-54

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G034

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: South of McDonald's

DRILLING START: August 16, 2017 09:32
DRILLING END: August 22, 2017 07:27
COORDINATES: N: 347,128 E: 1,425,193

SHEET: 3 of 3
GS ELEV.: 44.1 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40)	WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80		80.0		-35.9									
	Mud Rotary				GP		SS S-20	13-17-24 **(41)**	6/18	41			
		82.5		-38.4									
			(SP), POORLY GRADED SAND WITH GRAVEL, medium to coarse sand, some fine to coarse rounded to subrounded gravel, brown and gray; very dense, wet										
85					SP		SS S-21	25-41-42 **(83)**	9/18	>>			
		87.5		-43.4									
			(SM), SILTY SAND WITH GRAVEL, medium to coarse sand, some fine to coarse rounded to subrounded gravel, little nonplastic fines, brown and gray; dense to very dense, wet										
90							SS S-22	21-25-21 **(46)**	9/18	46			
95							SS S-23	28-30-23 **(53)**	12/18	>>		95: S-23: % Fines = 13	
					SM								
100							SS S-24	18-21-29 **(50)**	9/18	50			
105							SS S-25	21-24-33 **(57)**	6/18	>>			
		107.5		-63.4									
			(SW-SM), WELL GRADED SAND WITH SILT AND GRAVEL, fine to coarse sand, little fine to coarse subrounded to subangular gravel, few nonplastic fines, gray and brown; very dense, wet		SW-SM								
110							SS S-26	18-31-50 **(81)**	9/18	>>		110: S-26: % Fines = 10	
		111.5		-67.4									
			Bottom of borehole at 111.5 ft. Installed monitoring well and vibrating wire piezometer.										
115													
120													

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselman
DRILL RIG: Mobile B-54

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G034A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC; east of DRLE-G034
DRILLING START: February 5, 2018 09:00
DRILLING END: February 8, 2018 15:00
COORDINATES: N: 347,290 E: 1,424,842
SHEET: 1 of 4
GS ELEV.: 44.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	SAMPLES: REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10, 20, 30, 40) / WATER CONTENT (%) (W_p, W, W_l) (20, 40, 60, 80)	NOTES	ADDITIONAL LAB TESTING
0		0.0	SEE G034 FOR 0 TO 110 FEET								
5											
10											
15											
20											
25											
30											
35											
40											

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Colin Bloom
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G034A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC; east of DRLE-G034
DRILLING START: February 5, 2018 09:00
DRILLING END: February 8, 2018 15:00
COORDINATES: N: 347,290 E: 1,424,842
SHEET: 2 of 4
GS ELEV.: 44.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	SAMPLES: REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10, 20, 30, 40) / WATER CONTENT (%) (W_p, W, W_l) (20, 40, 60, 80)	NOTES	ADDITIONAL LAB TESTING
40		40.0	SEE G034 FOR 0 TO 110 FEET *(continued)*								
45											
50											
55											
60											
65											
70											
75											
80											

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Colin Bloom
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G034A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC; east of DRLE-G034
DRILLING START: February 5, 2018 09:00
DRILLING END: February 8, 2018 15:00
COORDINATES: N: 347,290 E: 1,424,842
SHEET: 3 of 4
GS ELEV.: 44.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
80		80.0	SEE G034 FOR 0 TO 110 FEET *(continued)*								
85											
90											
95											
100											
105											
110		110.0	(GW-GM), WELL GRADED GRAVEL WITH SILT AND SAND, fine to coarse subrounded to subangular gravel, some fine to coarse sand, few low plasticity fines, gray-brown; very dense, wet	GW-GM		SS S-1	20-30-33 **(63)**	2/18		>>	
115						SS S-2	21-22-28 **(50)**	6/18		50	
120											

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Colin Bloom
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G034A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC; east of DRLE-G034
DRILLING START: February 5, 2018 09:00
DRILLING END: February 8, 2018 15:00
COORDINATES: N: 347,290 E: 1,424,842
SHEET: 4 of 4
GS ELEV.: 44.2 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES	ADDITIONAL LAB TESTING
120		120.0	(GW-GM), WELL GRADED GRAVEL WITH SILT AND SAND, fine to coarse subrounded to subangular gravel, some fine to coarse sand, few low plasticity fines, gray-brown; very dense, wet *(continued)*	GW-GM		SS S-3	50/5" **(50/5")**	0/5	>>		
125						SS S-4	26-42-39 **(81)**	5/18	>>	125: S-4: % Fines = 6	
130						SS S-5	16-28-30 **(58)**	7/18	>>		
135						SS S-6	23-29-43 **(72)**	5/18	>>		
140											
145		145.0	Bottom of borehole at 145.0 ft. Backfilled with bentonite grout.								
150											
155											
160											

DRILLING CO.: Holocene
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Colin Bloom
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G035

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 2, 2017 08:11
DRILLING END: October 9, 2017 13:49
COORDINATES: N: 347,288 E: 1,424,809

SHEET: 1 of 6
GS ELEV.: 42.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Mud Rotary

Depth (ft)	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Water Content (%)	Notes Water Levels
0.0	(SP), POORLY GRADED SAND, fine to medium sand, trace fine to coarse subrounded to subangular gravel, trace nonplastic fines, dark brown; medium dense, moist	42.9	SP	SS S-1	2-4-9 **(13)**	12/18	13		
5.0	(GP-GM), POORLY GRADED GRAVEL WITH SILT AND SAND, fine to coarse rounded to subrounded gravel, little fine to coarse sand, few nonplastic fines, brown; medium dense to dense, moist	37.9	GP-GM	SS S-2	19-17-20 **(37)**	6/18	37		5 - 15: Drilling chatter
				SS S-3	2-5-11 **(16)**	1/18	16		
				SS S-4	14-15-16 **(31)**	6/18	31		10: S-4: % Fines = 9
12.0	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, some fine to coarse sand, trace nonplastic fines, brown; dense, moist to wet	30.9	GP	SS S-5	21-22-26 **(48)**	9/18	48		
				SS S-6	11-17-14 **(31)**	9/18	31		∇ 16.2 ft, ATD
17.5	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, fine to medium sand, little fine to coarse rounded to subrounded gravel, few nonplastic fines, gray; medium dense to dense, wet	25.4	SP-SM	SS S-7	8-19-14 **(33)**	4/18	33		
				SS S-8	8-10-12 **(22)**	6/18	22		
				SS S-9	10-10-7 **(17)**	9/18	17		30: S-9: % Fines = 8
32.5	(GP), POORLY GRADED GRAVEL WITH SAND, fine rounded to subrounded gravel, some fine to coarse sand, trace nonplastic fines, brown and gray; medium dense to dense, wet	10.4	GP	SS S-10	18-24-19 **(43)**	3/18	43		
37.5		5.4	GP						

Log continued on next page

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G035

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 2, 2017 08:11
DRILLING END: October 9, 2017 13:49
COORDINATES: N: 347,288 E: 1,424,809

SHEET: 2 of 6
GS ELEV.: 42.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud Rotary	40.0	(GP), POORLY GRADED GRAVEL, fine to coarse rounded to subrounded gravel, trace medium to coarse sand, trace nonplastic fines, gray and brown; medium dense to dense, wet *(continued)*	2.9	GP		SS S-11	10-10-9 **(19)**	3/18	19		
45							SS S-12	11-13-9 **(22)**	3/18	22	45: S-12: % Fines = 1	
		47.5	(SP-SC), POORLY GRADED SAND WITH CLAY AND GRAVEL, medium to coarse sand, some fine to coarse rounded to subrounded gravel, few low to medium plasticity fines, gray and brown; medium dense to dense, wet	-4.6	SP-SC							
50							SS S-13	11-15-22 **(37)**	6/18	37		
55							SS S-14	10-17-12 **(29)**	7/18	29		
60							SS S-15	22-16-19 **(35)**	0/18	35		
65							SS S-16	15-11-13 **(24)**	6/18	24	65: S-16: % Fines = 5	
		67.5	(SW-SM), WELL-GRADED SAND WITH SILT, fine to medium sand, few nonplastic fines, brown; medium dense to very dense, wet	-24.6	SW-SM							
70							SS S-17	20-22-30 **(52)**	9/18	>>		
75							SS S-18	14-13-12 **(25)**	18/18	25	75: S-18: % Fines = 8	
80												

Log continued on next page

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G035

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 2, 2017 08:11
DRILLING END: October 9, 2017 13:49
COORDINATES: N: 347,288 E: 1,424,809

SHEET: 3 of 6
GS ELEV.: 42.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80		80.0		-37.1								
	Mud Rotary				SW-SM		SS S-19	11-9-9 **(18)**	12/18	18		
		82.0	(SW-SM), WELL-GRADED SAND WITH SILT AND GRAVEL, fine to coarse sand, fine to coarse rounded to subrounded gravel, few nonplastic fines, gray and brown; dense to very dense, wet	-39.1							82 - 85: Drilling chatter	
85							SS S-20	16-22-17 **(39)**	6/18	39		
90							SS S-21	19-19-19 **(38)**	9/18	38	90 - 150: Drilling chatter	
95							SS S-22	24-34-50 **(84)**	6/18	>>		
100					SW-SM		SS S-23	23-30-24 **(54)**	9/18	>>		
105							SS S-24	24-33-37 **(70)**	6/18	>>		
110							SS S-25	28-18-29 **(47)**	6/18	47		
115							SS S-26	33-35-27 **(62)**	12/18	>>	113.5 - 114.5: Possible boulder; casing advanced to 115 ft so boulder doesn't shift into the hole. 115: S-26: % Fines = 11	
120												

Log continued on next page

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G035

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 2, 2017 08:11
DRILLING END: October 9, 2017 13:49
COORDINATES: N: 347,288 E: 1,424,809

SHEET: 4 of 6
GS ELEV.: 42.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
120	Mud Rotary	120.0	(SW-SM), WELL-GRADED SAND WITH SILT AND GRAVEL, fine to coarse sand, fine to coarse rounded to subrounded gravel, few nonplastic fines, gray and brown; dense to very dense, wet *(continued)*	-77.1	SW-SM		SS S-27	29-29-26 **(55)**	0/18	>>		
125							SS S-28	50/5" **(50/5")**	0/5	>>		
		127.5	(SP), POORLY GRADED SAND WITH GRAVEL, medium to coarse sand, some fine to coarse rounded to subrounded gravel, trace nonplastic fines, brown; very dense, wet	-84.6	SP		SS S-29	38-28-27 **(55)**	12/18	>>		
130							SS S-30	27-33-25 **(58)**	6/18	>>		
		132.5	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, some fine to coarse sand, brown; dense to very dense, wet	-89.6	GP		SS S-31	23-21-20 **(41)**	9/18	41		
140							SS S-32	16-27-24 **(51)**	6/18	>>		
		142.5	(GW-GM), WELL GRADED GRAVEL WITH SILT AND SAND, fine to coarse rounded to subrounded gravel, little fine to coarse sand, few nonplastic fines, brown; very dense, wet	-99.6	GW-GM		SS S-33	39-38-24 **(62)**	3/18	>>		
150							SS S-34	49-50/4" **(50/4")**	0/10	>>	150: Cal Mod sampler advanced to obtain additional material.	
155							SS S-35	32-39-36 **(75)**	12/18	>>	155: S-35: % Fines = 8	
160											158 - 180: Drilling chatter	

Log continued on next page

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
C:\USERS\CSCHAEFFER\DESKTOP\DRLE LOGS.GPJ

RECORD OF BOREHOLE DRLE-G035

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 2, 2017 08:11
DRILLING END: October 9, 2017 13:49
COORDINATES: N: 347,288 E: 1,424,809

SHEET: 5 of 6
GS ELEV.: 42.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160	Mud Rotary	160.0	(GW-GM), WELL GRADED GRAVEL WITH SILT AND SAND, fine to coarse rounded to subrounded gravel, little fine to coarse sand, few nonplastic fines, brown; very dense, wet *(continued)*	-117.1	GW-GM		SS S-36	25-39-35 **(74)**	12/18	>>		
165							SS S-37	27-26-34 **(60)**	9/18	>>		
		167.5	(SP), POORLY GRADED SAND WITH GRAVEL, medium to coarse sand, some fine to coarse rounded to subrounded gravel, trace nonplastic fines, gray; very dense, wet	-124.6	SP							
170							SS S-38	24-50/5" **(50/5")**	6/11	>>		
175							SS S-39	45-48-50/5" **(98/11")**	6/17	>>		
180		180.5	(SP), POORLY GRADED SAND, fine to coarse sand, trace nonplastic fines, gray; very dense, wet	-137.6	SP		SS S-40	20-31-30 **(61)**	12/18	>>		
		182.5	(CH), FAT CLAY, high plasticity fines, gray; very stiff, moist	-139.6	CH							
185							SS S-41	5-6-11 **(17)**	18/18	17		
		187.5	(CL), LEAN CLAY, medium plasticity fines, gray; very stiff, moist	-144.6	CL							
190							SS S-42	6-7-12 **(19)**	18/18	19	190: S-42: PI = 18	
							ST ST-1		8/24		192: Shelby tube ST-1 was damaged with 1/3 of sample material recovered; collected bulk sample in plastic bag.	
195		195.0	(GM), SILTY GRAVEL, fine to coarse rounded to subrounded gravel, little nonplastic fines, few medium to coarse sand, gray; very dense, wet	-152.1	GM		SS S-43	16-27-36 **(63)**	4/18	>>		
200											200: S-44: % Fines =	

Log continued on next page

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
C:\USERS\CSCHAEFFER\DESKTOP\DRLE LOGS.GPJ

RECORD OF BOREHOLE DRLE-G035

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: RCC

DRILLING START: October 2, 2017 08:11
DRILLING END: October 9, 2017 13:49
COORDINATES: N: 347,288 E: 1,424,809

SHEET: 6 of 6
GS ELEV.: 42.9 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
200		200.0		-157.1								
	Mud Rotary		(GM), SILTY GRAVEL, fine to coarse rounded to subrounded gravel, little nonplastic fines, few medium to coarse sand, gray; very dense, wet *(continued)*		GM		SS S-44	21-23-27 **(50)**	12/18	○ 50 ■	21	
205		205.0		-162.1								
			Bottom of borehole at 205.0 ft. Backfilled with bentonite grout. Terminated due to caving.									
210												
215												
220												
225												
230												
235												
240												

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G036

PROJECT: ST Redmond Link
PROJECT NO.: 1657705
LOCATION: 76th and 166th

DRILLING START: August 22, 2017 11:37
DRILLING END: August 24, 2017 15:40
COORDINATES: N: 347,450 E: 1,424,316

SHEET: 1 of 2
GS ELEV.: 42.1 feet
TOC ELEV.: na
DATUM: Project Datum

Depth (ft)	Boring Method	Depth	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes / Water Levels
0	Mud Rotary	0.0	(SM), FILL: SILTY SAND, fine sand, some nonplastic fines, trace fine to coarse subrounded gravel, brown; medium dense to very dense, moist	42.1	SM	SS S-1	10-22-39 **(61)**	9/18	>>	
						SS S-2	4-7-8 **(15)**	7/18	15	2.5: S-2: % Fines = 33
5		5.0	(GM), POORLY GRADED GRAVEL WITH SILT AND SAND, fine to coarse subrounded to subangular gravel, some medium to coarse sand, few nonplastic fines, tan-brown with gray; medium dense to very dense, moist	37.1	GM	SS S-3	7-10-12 **(22)**	0/18	22	5 - 25: Drilling chatter
						SS S-4	16-21-19 **(40)**	10/18	40	7.5: Sample S-3 appears to be washed out
10						SS S-5	12-36-29 **(65)**	8/18	>>	
		12.0	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, medium to coarse sand, little fine to coarse subrounded gravel, few nonplastic fines, tan and gray; dense to very dense, moist	30.1	SP-SM	SS S-6	23-24-22 **(46)**	13/18	46	
15						SS S-7	23-31-34 **(65)**	12/18	>>	
		17.5	(GW-GM), WELL GRADED GRAVEL WITH SILT AND SAND, fine to coarse subrounded gravel, some medium to coarse sand, few nonplastic fines, gray with tan; medium dense to dense, wet	24.6	GW-GM					17.0 ft, 03/04/2018, VWP reading 18.4 ft, 09/28/2017, VWP reading
20						SS S-8	17-14-16 **(30)**	3/18	30	20: S-8: % Fines = 6 21.5 ft, 11/16/2017, VWP reading
25						SS S-9	14-13-16 **(29)**	6/18	29	
30						SS S-10	17-20-19 **(39)**	12/18	39	
35						SS S-11	15-10-8 **(18)**	6/18	18	35: S-11: % Fines = 7
40										

Penetration Resistance: Blows / ft (10, 20, 30, 40); Water Content (%): W_p, W, W_l (20, 40, 60, 80)

Well Installation: Solid 2" PVC 0-10'; Slotted 2" PVC 10-15'; capped at 15'; Annular Space: Bentonite 0-8' & Filter Sand 8-15'

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselman
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G036

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: 76th and 166th

DRILLING START: August 22, 2017 11:37
DRILLING END: August 24, 2017 15:40
COORDINATES: N: 347,450 E: 1,424,316

SHEET: 2 of 2
GS ELEV.: 42.1 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0	(GW-GM), WELL GRADED GRAVEL WITH SILT AND SAND, fine to coarse subrounded gravel, some medium to coarse sand, few nonplastic fines, gray with tan; medium dense to dense, wet *(continued)*	2.1								
	Mud Rotary				GW-GM		SS S-12	13-12-10 **(22)**	4/18	22	42.5 - 70: Drilling chatter	
45							SS S-13	12-12-13 **(25)**	7/18	25	45: S-13: % Fines = 6	
50		50.0		-7.9								
			(GW), WELL GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, little medium to coarse sand, trace nonplastic fines, brown and gray; medium dense to dense, wet				SS S-14	15-20-17 **(37)**	1/18	37		
55							SS S-15	18-11-10 **(21)**	0/18	21	55: S-15: % Fines = 1	
					GW							
60							SS S-16	15-16-14 **(30)**	5/18	30	60 - 67: Drilling mud loss	
65							SS S-17	16-13-11 **(24)**	5/18	24	65: S-17: % Fines = 5 66: VWP Installed 67: Unable to establish circulation, abandoned borehole at 68 feet.	
		68.0		-25.9								
70			Bottom of borehole at 68.0 ft. Installed monitoring well, seismic casing, and vibrating wire piezometer.									
75												
80												

DRILLING CO.: Holt Services Inc
DRILLER: Larry Inselman
DRILL RIG: Mobile B-54

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G036A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: 76th and 166th; 30 ft NE of DRLE-G036
DRILLING START: October 10, 2017 10:35
DRILLING END: October 17, 2017 08:44
COORDINATES: N: 347,667 E: 1,423,823
SHEET: 1 of 7
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0	Mud Rotary	0.0	SEE G036 FOR 0 TO 50 FEET	43.8								
5												
10												
15												
20												
25												
30											∇ 31.7 ft, ATD	
35												
40			Log continued on next page									

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G036A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: 76th and 166th; 30 ft NE of DRLE-G036
DRILLING START: October 10, 2017 10:35
DRILLING END: October 17, 2017 08:44
COORDINATES: N: 347,667 E: 1,423,823
SHEET: 2 of 7
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0	SEE G036 FOR 0 TO 50 FEET *(continued)*	3.8								
45												
50		50.0	(GW), WELL GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, little medium to coarse sand, trace nonplastic fines, brown and gray; medium dense, wet	-6.2	GW		SS S-1	9-8-9 **(17)**	9/18	17	50 - 70: Drilling chatter	
55	Mud Rotary						SS S-2	10-15-14 **(29)**	6/18	29		
60							SS S-3	11-11-10 **(21)**	6/18	21		
65		62.5	(GW), WELL GRADED GRAVEL, fine to coarse subrounded to subangular gravel, trace coarse sand, gray; medium dense, wet	-18.7	GW		SS S-4	7-9-9 **(18)**	3/18	18	65: S-4: % Fines < 1	
70							SS S-5	15-9-7 **(16)**	6/18	16	70: Drilling mud loss	
75		75.0	(SP-SM), POORLY GRADED SAND WITH SILT, fine to coarse sand, few nonplastic fines, brown; medium dense to dense, wet	-31.2	SP-SM		SS S-6	32-23-22 **(45)**	0/18	45		
80			Increased fine sand content with depth									

Log continued on next page

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

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RECORD OF BOREHOLE DRLE-G036A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: 76th and 166th; 30 ft NE of DRLE-G036
DRILLING START: October 10, 2017 10:35
DRILLING END: October 17, 2017 08:44
COORDINATES: N: 347,667 E: 1,423,823
SHEET: 3 of 7
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud Rotary	80.0	(SP-SM), POORLY GRADED SAND WITH SILT, fine to coarse sand, few nonplastic fines, brown; medium dense to dense, wet *(continued)*	-36.2	SP-SM		SS S-7	14-10-12 **(22)**	12/18	22		
85							SS S-8	10-10-11 **(21)**	15/18	21	85: S-8: % Fines = 6	
90							SS S-9	11-17-15 **(32)**	18/18	32		
		92.5	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, some fine to coarse sand, trace nonplastic fines, brown; dense, wet	-48.7	GP						93 - 109: Drilling chatter	
95							SS S-10	19-21-18 **(39)**	6/18	39		
100							SS S-11	19-25-24 **(49)**	2/18	49		
105							SS S-12	16-24-25 **(49)**	6/18	49		
		109.0	(SP), POORLY GRADED SAND, fine to coarse sand, trace nonplastic fines, brown; dense, wet	-65.2	SP		SS S-13	16-14-20 **(34)**	15/18	34		
		112.5	(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, some fine to coarse rounded to subrounded gravel, trace nonplastic fines, brown and gray; dense to very dense, wet	-68.7	SP						112.5 - 121: Drilling chatter	
115							SS S-14	25-23-26 **(49)**	9/18	49		
120												

Log continued on next page

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

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RECORD OF BOREHOLE DRLE-G036A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: 76th and 166th; 30 ft NE of DRLE-G036
DRILLING START: October 10, 2017 10:35
DRILLING END: October 17, 2017 08:44
COORDINATES: N: 347,667 E: 1,423,823
SHEET: 4 of 7
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
120		120.0		-76.2								
	Mud Rotary				SP		SS S-15	23-49-27 **(76)**	9/18	>>		
		122.5		-78.7								
			(SP), POORLY GRADED SAND, fine to coarse sand, brown; dense, wet									
125					SP		SS S-16	20-21-26 **(47)**	12/18	47		
		127.5		-83.7								
			(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, some fine to coarse sand, trace nonplastic fines, gray and brown; very dense, wet								128 - 188.5: Drilling chatter	
130							SS S-17	26-31-29 **(60)**	9/18	>>		
135							SS S-18	22-39-29 **(68)**	9/18	>>		
140					GP		SS S-19	40-34-23 **(57)**	12/18	>>		
145							SS S-20	22-25-26 **(51)**	9/18	>>		
150							SS S-21	20-28-31 **(59)**	3/18	>>		
		152.5		-108.7								
			(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, some fine to coarse rounded to subangular gravel, trace nonplastic fines, brown and gray; dense to very dense, wet									
155					SP		SS S-22	32-31-26 **(57)**	9/18	>>		
160												

Log continued on next page

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

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RECORD OF BOREHOLE DRLE-G036A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: 76th and 166th; 30 ft NE of DRLE-G036
DRILLING START: October 10, 2017 10:35
DRILLING END: October 17, 2017 08:44
COORDINATES: N: 347,667 E: 1,423,823
SHEET: 5 of 7
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160	Mud Rotary	160.0	(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, some fine to coarse rounded to subangular gravel, trace nonplastic fines, brown and gray; dense to very dense, wet *(continued)*	-116.2	SP		SS S-23	25-31-33 **(64)**	9/18	>>		
165							SS S-24	23-26-22 **(48)**	6/18	48		
		167.5	(GP), POORLY GRADED GRAVEL, fine to coarse rounded to subrounded gravel, few some fine to coarse sand, gray; very dense, wet	-123.7	GP							
170							SS S-25	27-50/5" **(50/5")**	9/11	>>		
175		175.5	(GM), SILTY GRAVEL, fine to coarse rounded to subrounded gravel, some fine to coarse sand, nonplastic fines, gray-olive; very dense, wet	-131.7	GM		SS S-26	32-50/5" **(50/5")**	10/11	>>		
		177.5	(SP), POORLY GRADED SAND, medium to coarse sand, trace fine rounded gravel, gray; very dense, wet	-133.7	SP							
180							SS S-27	24-32-50 **(82)**	12/18	>>		
		182.5	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, some fine to coarse sand, trace nonplastic fines, gray; dense, wet	-138.7	GP							
185							SS S-28	30-26-22 **(48)**	6/18	48		
		188.5	(SM), SILTY SAND, fine sand, little nonplastic fines, gray; very dense, wet	-144.7	SM							
190		191.0	(SP), POORLY GRADED SAND, medium to coarse sand, gray; very dense, wet	-147.2	SP		SS S-29	25-28-40 **(68)**	18/18	>>		
		192.5	(SP-SM), POORLY GRADED SAND WITH SILT, fine sand, few nonplastic fines, gray; very dense, wet	-148.7	SP-SM							
195							SS S-30	22-30-36 **(66)**	18/18	>>		
		197.5	(ML), SANDY SILT, low plasticity fines, some fine to medium sand, gray; hard, wet	-153.7	ML							
200												

Log continued on next page

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G036A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: 76th and 166th; 30 ft NE of DRLE-G036
DRILLING START: October 10, 2017 10:35
DRILLING END: October 17, 2017 08:44
COORDINATES: N: 347,667 E: 1,423,823
SHEET: 6 of 7
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
200	Mud Rotary	200.0	(ML), SANDY SILT, low plasticity fines, some fine to medium sand, gray; hard, wet *(continued)*	-156.2	ML		SS S-31	25-39-33 **(72)**	18/18	>>		
205		208.0	(CL), LEAN CLAY, low to medium plasticity fines, gray; very stiff, moist	-164.2								
210					CL		SS S-32	7-10-15 **(25)**	18/18	25	210: S-32: PI = 26	
							ST ST-1		0/24		212: in ST-1. Shelby tube was crushed.	
215							SS S-33	8-13-16 **(29)**	12/18	29	215: S-33: PI = 22	
220		218.0	(SP), POORLY GRADED SAND, medium to coarse sand, trace fine rounded to subrounded gravel, trace nonplastic fines, gray; very dense, wet	-174.2	SP		SS S-34	50/5" **(50/5")**	5/5	>>		
225		225.0	(SP-SM), POORLY GRADED SAND WITH SILT, medium to coarse sand, few nonplastic fines, trace fine to coarse rounded to subrounded gravel, gray; very dense, wet	-181.2			SS S-35	50/3" **(50/3")**	0/3	>>		
230					SP-SM		SS S-36	50/3" **(50/3")**	0/3	>>	230: Cal Mod sampler advanced to obtain additional material.	
235												
240												

Log continued on next page

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G036A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: 76th and 166th; 30 ft NE of DRLE-G036
DRILLING START: October 10, 2017 10:35
DRILLING END: October 17, 2017 08:44
COORDINATES: N: 347,667 E: 1,423,823
SHEET: 7 of 7
GS ELEV.: 43.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
240		240.0		-196.2								
		240.5		-196.7			SS S-37	100 (100/6")	6/6			
			Bottom of borehole at 240.5 ft. Backfilled with bentonite grout.									
245												
250												
255												
260												
265												
270												
275												
280												

DRILLING CO.: Holocene Drilling
DRILLER: Matt Graham
DRILL RIG: Mobile B-58
LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
C:\USERS\CSCHAEFFER\DESKTOP\DRLE LOGS.GPJ

RECORD OF BOREHOLE DRLE-G037

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Cleveland and 164th

DRILLING START: September 12, 2017 13:01
DRILLING END: September 22, 2017 08:03
COORDINATES: N: 347,668 E: 1,423,851

SHEET: 1 of 7
GS ELEV.: 43.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

Depth (ft)	Boring Method	Soil Profile Depth	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes / Water Levels
0		0.0		43.3						
	Air Knife & Vac Truck	0.3	(SP), FILL: POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, some fine to coarse subrounded to subangular gravel, trace nonplastic fines, gray-brown; medium dense, moist	43.0	SP	SS S-1	2-4-26 **(30)**	18/18	30	0 - 5: Air knife and vac truck used to clear utilities. After vaccing hole was backfilled with bentonite chips and sand then advanced using sonic.
5										
10						SS S-2	13-12-10 **(22)**	4/18	22	
		12.0	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, some fine to coarse sand, trace nonplastic fines, gray-brown; medium dense, moist	31.3	GP	SS S-3	10-13-16 **(29)**	11/18	29	
15		15.0	(SP), POORLY GRADED SAND, fine to coarse sand, trace fine to coarse subrounded to subangular gravel, trace nonplastic fines, dark gray; dense, moist	28.3	SP	SS S-4	42-27-18 **(45)**	6/18	45	
		18.0	(SM), SILTY SAND, fine to coarse sand, some nonplastic fines, few fine to coarse subrounded to subangular gravel, dark gray; very loose, wet	25.3	SM					∇ 18.7 ft, ATD
20						SS S-5	0-0-2 **(2)**	3/18	2	
		21.8	(SP-SM), POORLY GRADED SAND WITH SILT, fine to coarse sand, few nonplastic fines, trace fine to coarse subrounded to subangular gravel, dark gray; very loose, wet	21.6	SP-SM	SS S-6	1-1-1 **(2)**	6/18	2	
		24.3	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, some fine to coarse sand, trace nonplastic fines, dark gray to gray; medium dense to very dense, wet	19.1	GP	SS S-7	3-5-5 **(10)**	12/18	10	
25										
30						SS S-8	19-49-35 **(84)**	18/18	>>	
		32.0	(SP), POORLY GRADED SAND, medium to coarse sand, few fine to coarse rounded to subrounded gravel, trace nonplastic fines, dark gray; medium dense, wet	11.3	SP					
35						SS S-9	5-7-11 **(18)**	18/18	18	35: S-9: % Fines = 3
			12 inch thick layer of Silty Sand with Gravel (SM)							
40										

Log continued on next page

Sonic Drilling

DRILLING CO.: Holt Services Inc
DRILLER: Josh Marsh
DRILL RIG: Terra Sonic TSi 150

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G037

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Cleveland and 164th

DRILLING START: September 12, 2017 13:01
DRILLING END: September 22, 2017 08:03
COORDINATES: N: 347,668 E: 1,423,851

SHEET: 2 of 7
GS ELEV.: 43.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Sonic Drilling

Depth (ft)	Depth	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes Water Levels
40	40.0	(SP), POORLY GRADED SAND, medium to coarse sand, few fine to coarse rounded to subrounded gravel, trace nonplastic fines, dark gray; medium dense, wet *(continued)*	3.3	SP	SS S-10	14-17-10 **(27)**	6/18	27	
45	45.8	(SP), POORLY GRADED SAND WITH GRAVEL, medium to coarse sand, little fine to coarse rounded gravel, trace nonplastic fines, gray; medium dense, wet	-2.4	SP	SS S-11	5-5-8 **(13)**	9/18	13	45: 0.5 ft to 1 ft of heave encountered; performed clean out pass
50	52.5		-9.2	SP	SS S-12	5-13-6 **(19)**	12/18	19	50: S-12: % Fines = <1
55	55.0	(GP-GM), POORLY GRADED GRAVEL WITH SILT, fine to coarse rounded to subrounded gravel, few nonplastic fines, trace sand, gray; medium dense, wet	-11.7	GP-GM					
	57.0	(SP), POORLY GRADED SAND WITH GRAVEL, medium to coarse sand, little fine to coarse rounded to subrounded gravel, dark gray; loose, wet	-13.7	SP	SS S-13	2-2-7 **(9)**	9/18	9	55: Approximately 2 ft of heave encountered. Clean out pass completed. S-13 blow counts may have been impacted by heaving soil.
60	63.0	(GP), POORLY GRADED GRAVEL, fine to coarse rounded to subrounded gravel, trace fine to coarse sand, trace nonplastic fines, gray; dense, wet	-19.7	GP	SS S-14	16-21-26 **(47)**	6/18	47	
65	72.5	(SP), POORLY GRADED SAND, fine to coarse sand, trace fine subrounded to subangular gravel, trace nonplastic fines, dark gray; medium dense, wet, thin silt interbeds < 1/4 inch thick	-29.2	SP	SS S-15	6-5-6 **(11)**	18/18	11	65: Approximately 2 ft of slough and minor heave observed. Casing flushed with water and a clean out pass completed.
70					SS S-16	11-11-10 **(21)**	12/18	21	70: S-16: % Fines = 6; Approximately 7 feet of heave and sluff observed
75	76.0	(SP), POORLY GRADED SAND WITH GRAVEL, medium to coarse sand, little fine to coarse rounded to subrounded gravel, trace nonplastic fines, gray; medium dense, wet	-32.7	SP					75: Approximately 4 ft of heave observed. No sample taken at 75 ft due to excessive heave.
80		(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, gray; medium dense, wet		SP					80: Approximately 5 ft

Log continued on next page

Penetration Resistance Blows / ft: 10, 20, 30, 40
Water Content (%): W_p 20, W 40, 60, W_l 80

DRILLING CO.: Holt Services Inc
DRILLER: Josh Marsh
DRILL RIG: Terra Sonic TSi 150

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G037

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Cleveland and 164th

DRILLING START: September 12, 2017 13:01
DRILLING END: September 22, 2017 08:03
COORDINATES: N: 347,668 E: 1,423,851

SHEET: 3 of 7
GS ELEV.: 43.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Sonic Drilling	80.0	(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, gray; medium dense, wet *(continued)*	-36.7	SP						of heave observed. No sample taken at 80 ft due to excessive heave. 80.1: Approximately 5 ft of heave observed. No sample taken at 80 ft due to excessive heave. 85: Approximately 4 ft of heave observed. No sample taken at 85 ft due to excessive heave.	
85		86.0	(CL), LEAN CLAY, low plasticity fines, trace to few fine sand, olive-gray to gray; medium stiff to stiff, moist to wet	-42.7	CL							
90							SS S-17	3-3-3 (6)	18/18	6	90: S-17: PI = 14	
95							ST ST-1		24/24		94 - 96: No pressure for ST-1 recorded because pressure too low for sonic rig gauges to register.	
							SS S-18	1-2-4 (6)	18/18	6	97.5: S-18: PI = 11	
							SS S-18	1-2-4 (6)	18/18			
100							SS S-19	3-4-5 (9)	18/18	9		
105							SS S-20	3-2-3 (5)	18/18	5	105: S-20: PI = 12	
110		110.0	(CH), FAT CLAY, high plasticity fines, trace fine sand, gray; medium stiff, moist to wet	-66.7	CH		ST ST-2		24/24		112 - 114: No pressure for ST-2 recorded because pressure too low for sonic rig gauges to register.	
115		115.0	(CL), LEAN CLAY, low plasticity fines, trace to few fine sand, olive-gray to gray; medium stiff to stiff, moist to wet	-71.7	CL		SS S-21	1-2-5 (7)	18/18	7	115: S-21: PI = 12	
120												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Josh Marsh
DRILL RIG: Terra Sonic TSi 150

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G037

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Cleveland and 164th

DRILLING START: September 12, 2017 13:01
DRILLING END: September 22, 2017 08:03
COORDINATES: N: 347,668 E: 1,423,851

SHEET: 4 of 7
GS ELEV.: 43.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
120	Sonic Drilling	120.0	(CL), LEAN CLAY, low plasticity fines, trace to few fine sand, olive-gray to gray; medium stiff to stiff, moist to wet *(continued)*	-76.7	CL		SS S-22	1-3-4 **(7)**	18/18	7		
125		126.5		-83.2			SS S-23	3-4-6 **(10)**	18/18	10	125: S-23: PI = 12	
			(SM), SILTY SAND, fine to medium sand, little to some nonplastic fines, dark olive-gray; loose to medium dense, wet		SM							
130							SS S-24	3-4-6 **(10)**	18/18	10		
135							SS S-25	4-6-6 **(12)**	18/18	12	135: S-25: % Fines = 25	
		139.0		-95.7								
140			(CL), LEAN CLAY, low plasticity fines, trace fine sand, dark olive-gray; very stiff, moist		CL		SS S-26	9-11-17 **(28)**	18/18	28		
145							SS S-27	12-13-11 **(24)**	18/18	24	145: S-27: PI = 14	
150							SS S-28	8-7-12 **(19)**	18/18	19		
155							SS S-29	10-8-9 **(17)**	18/18	17	155: S-29: PI = 11	
160												

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Josh Marsh
DRILL RIG: Terra Sonic TSi 150

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G037

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Cleveland and 164th

DRILLING START: September 12, 2017 13:01
DRILLING END: September 22, 2017 08:03
COORDINATES: N: 347,668 E: 1,423,851

SHEET: 5 of 7
GS ELEV.: 43.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160	Sonic Drilling	160.0	(CL), LEAN CLAY, low plasticity fines, trace fine sand, dark olive-gray; very stiff, moist *(continued)*	-116.7	CL		ST ST-3		24/24			
		162.5	(SC), CLAYEY SAND, fine to medium sand, little low plasticity fines, dark olive-gray; very stiff, wet	-119.2	SC		SS S-30	8-6-10 **(16)**	18/18	16		
165		167.5	(CL), LEAN CLAY, low plasticity fines, trace fine to medium sand, dark olive-gray; very stiff, moist	-124.2	CL		SS S-31	10-6-9 **(15)**	18/18	15	170: S-31: PI = 7	
170							SS S-32	7-8-10 **(18)**	18/18	18		
175		177.5	(SM), SILTY SAND, medium sand, little nonplastic fines, trace fine subrounded gravel, dark olive-gray; loose to medium dense, wet	-134.2	SM		SS S-33	9-13-9 **(22)**	18/18	22	180: S-33: % Fines = 15	
180							SS S-34	14-13-10 **(23)**	18/18	23		
185		191.5	(CL), LEAN CLAY, low plasticity fines, few fine to medium sand, dark olive-gray; very stiff to hard, moist, thin interbeds of Clayey Sand (SC) < 1/4 inch thick	-148.2	CL		SS S-35	3-3-4 **(7)**	18/18	7		
190							SS S-36	15-21-33 **(54)**	18/18	>>		
195												
200											200: S-37: PI = 11	

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Josh Marsh
DRILL RIG: Terra Sonic TSi 150

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

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RECORD OF BOREHOLE DRLE-G037

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Cleveland and 164th

DRILLING START: September 12, 2017 13:01
DRILLING END: September 22, 2017 08:03
COORDINATES: N: 347,668 E: 1,423,851

SHEET: 6 of 7
GS ELEV.: 43.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
200	Sonic Drilling	200.0	(CL), LEAN CLAY, low plasticity fines, few fine to medium sand, dark olive-gray; very stiff to hard, moist, thin interbeds of Clayey Sand (SC) < 1/4 inch thick *(continued)*	-156.7	CL		SS S-37	13-15-12 **(27)**	18/18	27		
205												
210							SS S-38	12-13-15 **(28)**	18/18	28		
215												
220		220.0	(GP-GM), POORLY GRADED GRAVEL WITH SILT AND SAND, fine to coarse subrounded to subangular gravel, some fine to medium sand, few nonplastic fines, olive-gray; medium dense to very dense, moist to wet	-176.7	GP-GM		SS S-39	40-31-29 **(60)**	12/18	>>	220 - 246: S-39: % Fines = 5; Difficult drilling	
225												
230							SS S-40	50/1" **(50/1")**	0/1	>>		
235							SS S-41	13-10-19 **(29)**	0/18	29		
240		238.0		-194.7	SM						240: S-42: % Fines =	

Log continued on next page

DRILLING CO.: Holt Services Inc
DRILLER: Josh Marsh
DRILL RIG: Terra Sonic TSi 150

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G037

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Cleveland and 164th

DRILLING START: September 12, 2017 13:01
DRILLING END: September 22, 2017 08:03
COORDINATES: N: 347,668 E: 1,423,851

SHEET: 7 of 7
GS ELEV.: 43.3 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
240		240.0		-196.7								
	Sonic Drilling		(SM), SILTY SAND, medium sand, little nonplastic fines, few fine to coarse subrounded to subangular gravel, olive-gray; very dense, wet *(continued)*		SM		SS S-42	10-43-50/4" **(93/10")**	10 / 16	>>	21	
245							SS S-43	10-50/5" **(50/5")**	4 / 11	>>		
		246.8	Rock encountered	-203.5								
			Bottom of borehole at 246.8 ft. Installed seismic casing. Terminated borehole due to practical refusal.									
250												
255												
260												
265												
270												
275												
280												

DRILLING CO.: Holt Services Inc
DRILLER: Josh Marsh
DRILL RIG: Terra Sonic TSi 150

LOGGED: Jack Perkins
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G037A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Cleveland and 164th

DRILLING START: February 12, 2018 07:35
DRILLING END: February 13, 2018 16:00
COORDINATES: N: 347,865 E: 1,423,332

SHEET: 1 of 3
GS ELEV.: 43.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
0		0.0		43.0								
	Vac Truck	0.3	ASPHALT	42.7							0 - 6: Air Knife/Vac Truck to clear utilities; soil description based on cuttings.	
5			(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, some fine to coarse subangular gravel, trace nonplastic fines, brown to gray; moist		SP							
	Mud Rotary	7.5		35.5								
10			(GP), POORLY GRADED GRAVEL WITH SAND, subrounded to subangular gravel, some fine to coarse sand, trace nonplastic fines, gray to brown; medium dense to very dense, moist		GP		SS S-1	8-13-8 **(21)**	4/18	21		
							SS S-2	9-11-12 **(23)**	0/18	23		
							SS S-3	31-46-31 **(77)**	10/18	>>		
15							SS S-4	12-14-14 **(28)**	7/18	28	15 - 65: Casing advanced due to caving soil conditions.	
		18.0		25.0								
20			(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, some fine subangular to angular gravel, trace nonplastic fines, gray; medium dense, moist to wet		SP		SS S-5	7-6-8 **(14)**	7/18	14		
25							SS S-6	9-13-14 **(27)**	0/18	27		
		27.0		16.0								
30			(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subangular to angular gravel, some fine to coarse sand, trace nonplastic fines, gray; medium dense, wet		GP						28: Difficult drilling	
		31.0		12.0			SS S-7	14-12-8 **(20)**	8/18	20		
35			(SP), POORLY GRADED SAND WITH SILT AND GRAVEL, fine to coarse sand, some fine to coarse subrounded to subangular gravel, trace nonplastic fines, gray; medium dense to dense, wet		SP		SS S-8	6-11-10 **(21)**	10/18	21	32: Drilling becomes smoother after about 32 ft depth 35: S-8: % Fines = 4	
40												

Log continued on next page

DRILLING CO.: Holocene Drilling, Inc
DRILLER: Matt Graham
DRILL RIG: B-58 Truck Rig

LOGGED: McMillin, A.
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G037A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Cleveland and 164th

DRILLING START: February 12, 2018 07:35
DRILLING END: February 13, 2018 16:00
COORDINATES: N: 347,865 E: 1,423,332

SHEET: 2 of 3
GS ELEV.: 43.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud Rotary	40.0	(SP), POORLY GRADED SAND WITH SILT AND GRAVEL, fine to coarse sand, some fine to coarse subrounded to subangular gravel, trace nonplastic fines, gray; medium dense to dense, wet *(continued)*	3.0	SP		SS S-9	15-16-21 **(37)**	13/18	37		
		43.0	(GP), POORLY GRADED GRAVEL WITH SAND, fine to coarse subrounded to subangular gravel, some fine to coarse sand, trace nonplastic fines, gray; medium dense to dense, wet	0.0	GP							
45							SS S-10	12-10-11 **(21)**	5/18	21		
50							SS S-11	14-11-9 **(20)**	5/18	20	50: S-11: % Fines = 2	
55							SS S-12	12-18-14 **(32)**	11/18	32		
60							SS S-13	8-9-14 **(23)**	4/18	23		
		63.0	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, fine to coarse sand, some fine subrounded to subangular gravel, few nonplastic fines, gray; medium dense to dense, wet	-20.0	SP-SM							
65							SS S-14	10-10-14 **(24)**	10/18	24	65: S-14: % Fines = 5; Drilled without casing below 65 feet	
70							SS S-15	11-12-12 **(24)**	12/18	24		
75							SS S-16	8-9-9 **(18)**	13/18	18	75.0 ft, ATD (estimated based on soil conditions) 75: S-16: % Fines = 6	
80												

Log continued on next page

DRILLING CO.: Holocene Drilling, Inc
DRILLER: Matt Graham
DRILL RIG: B-58 Truck Rig

LOGGED: McMillin, A.
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G037A

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Cleveland and 164th

DRILLING START: February 12, 2018 07:35
DRILLING END: February 13, 2018 16:00
COORDINATES: N: 347,865 E: 1,423,332

SHEET: 3 of 3
GS ELEV.: 43.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud Rotary	80.0	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, fine to coarse sand, some fine subrounded to subangular gravel, few nonplastic fines, gray; medium dense to dense, wet *(continued)*	-37.0	SP-SM		SS S-17	13-13-15 **(28)**	8/18	28		
85							SS S-18	16-15-14 **(29)**	13/18	29		
90			Trace organics				SS S-19	17-17-14 **(31)**	12/18	31		
95		96.0		-53.0			SS S-20	13-10-7 **(17)**	18/18	17		
			(CL), LEAN CLAY, low plasticity fines, few fine sand, gray; medium stiff to stiff, moist, thin interbeds of fine sand < 1/8 inch thick		CL		ST S-21		30/30			
100							SS S-22	5-6-7 **(13)**	2/18	13	100: S-22: PI = 16	
105							SS S-23	1-2-5 **(7)**	1/18	7		
		107.0		-64.0							107 - 109.5: Attempted Shelby tube sample from 107 to 109 ft; 107.5: S-24: PI = NP	
			(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, gray; medium dense, wet		SP		SS S-24	7-8-3 **(11)**	11/18	11		
110		110.5		-67.5							110: 2.5 sch. 40 PVC pipe installed, filled with water	
			Bottom of borehole at 110.5 ft. Installed seismic casing.									
115												
120												

DRILLING CO.: Holocene Drilling, Inc
DRILLER: Matt Graham
DRILL RIG: B-58 Truck Rig

LOGGED: McMillin, A.
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:42
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RECORD OF BOREHOLE DRLE-G038

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Eastbound Redmond Way, Turn Lane to 520-W Onramp
DRILLING START: January 9, 2018 23:45
DRILLING END: January 11, 2018 02:15
COORDINATES: N: 347,859 E: 1,423,350
SHEET: 1 of 3
GS ELEV.: 49.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

Depth (ft)	Boring Method	Depth	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Notes Water Levels
0	Air Knife/Vac Truck	0.0	ASPHALT	49.0						0 - 5: Air Knife/Vac Truck to clear utilities
		1.2	(GP), FILL: POORLY GRADED GRAVEL WITH SAND, fine to coarse rounded to subrounded gravel, some fine to medium sand, trace nonplastic fines, brown; medium dense, moist	47.8	GP	SS S-1	4-9-12 **(21)**	12/18	21	5: Possible cobbles
		8.5		40.5		SS S-2	2-3-12 **(15)**	5/18	15	
10		9.5	(OL), SANDY ORGANIC SILT WITH GRAVEL, nonplastic fines, little fine to medium sand, little fine to coarse rounded gravel, very dark brown; medium stiff, wet, trace wood fragments	39.5	OL					
			(MH), ELASTIC SILT, high plasticity fines, few fine sand, olive-gray; medium stiff, wet, trace wood fragments		MH	SS S-3	6-4-4 **(8)**	0/18	8	10.0 ft, ATD (estimated based on soil conditions)
						SS S-4	0-2-4 **(6)**	14/18	6	12.5: S-4: PI = 10
15		14.5	(CL), LEAN CLAY WITH SAND, low to medium plasticity fines, little fine to medium sand, olive-gray; medium stiff to loose, moist, trace wood fragments	34.5	CL	SS S-5	2-2-2 **(4)**	14/18	4	15: S-5: PI = 16
20	Mud rotary	18.0	(SP-SM), POORLY GRADED SAND WITH SILT, fine to coarse sand, few nonplastic fines, trace fine subrounded gravel, olive-gray; medium dense, wet	31.0	SP-SM	SS S-6	5-7-8 **(15)**	12/18	15	20: S-6: % Fines = 10
25		23.0	(GP-GM), POORLY GRADED GRAVEL WITH SILT AND SAND, fine to coarse rounded to subrounded gravel, some medium to coarse sand, few nonplastic fines, olive-gray; dense to very dense, wet	26.0	GP-GM	SS S-7	11-15-16 **(31)**	0/18	31	23 - 73: Drilling chatter
30						SS S-8	18-18-13 **(31)**	6/18	31	30 - 60: Steel casing broke off downhole while attempting to remove it upon hole termination
35						SS S-9	18-22-28 **(50)**	6/18	50	
			Color change to light brown							
40										

Log continued on next page

DRILLING CO.: Holocene Drilling Inc
DRILLER: Matt Graham
DRILL RIG: Mobile B-58 Truck
LOGGED: John Hennessy
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G038

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Eastbound Redmond Way, Turn Lane to 520-W Onramp
DRILLING START: January 9, 2018 23:45
DRILLING END: January 11, 2018 02:15
COORDINATES: N: 347,859 E: 1,423,350
SHEET: 2 of 3
GS ELEV.: 49.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud rotary	40.0	(GP-GM), POORLY GRADED GRAVEL WITH SILT AND SAND, fine to coarse rounded to subrounded gravel, some medium to coarse sand, few nonplastic fines, olive-gray; dense to very dense, wet *(continued)*	9.0	GP-GM	SS S-10	19-19-18 **(37)**	12/18	37		
45						SS S-11	12-17-10 **(27)**	6/18	27	45: S-11: % Fines = 6	
50						SS S-12	15-46-26 **(72)**	6/18	>>		
		53.0	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, medium to coarse sand, some fine to coarse rounded to subrounded gravel, few nonplastic fines, light brown; medium dense, wet	-4.0	SP-SM						
55						SS S-13	9-12-15 **(27)**	7/18	27	55: S-13: % Fines = 7	
		58.0	(GP-GM), POORLY GRADED GRAVEL WITH SILT AND SAND, fine to coarse rounded to subrounded gravel, some medium to coarse sand, few nonplastic fines, light brown; dense, wet	-9.0	GP-GM						
60						SS S-14	14-18-20 **(38)**	7/18	38		
		63.0	(GP-GM), POORLY GRADED GRAVEL WITH SILT AND SAND, fine to coarse rounded to subrounded gravel, some medium to coarse sand, few nonplastic fines, light orange-brown, iron oxide staining; dense to very dense, wet	-14.0	GP-GM						
65						SS S-15	23-14-21 **(35)**	7/18	35		
			Color change to olive gray								
70						SS S-16	19-25-33 **(58)**	5/18	>>		
		73.0	(SM), SILTY SAND, fine sand, some nonplastic fines, olive-gray; dense, wet	-24.0	SM						
75						SS S-17	18-19-16 **(35)**	12/18	35		
80											

Log continued on next page

DRILLING CO.: Holocene Drilling Inc
DRILLER: Matt Graham
DRILL RIG: Mobile B-58 Truck
LOGGED: John Hennessy
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G038

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Eastbound Redmond Way, Turn Lane to 520-W Onramp
DRILLING START: January 9, 2018 23:45
DRILLING END: January 11, 2018 02:15
COORDINATES: N: 347,859 E: 1,423,350
SHEET: 3 of 3
GS ELEV.: 49.0 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic hammer 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft / WATER CONTENT (%)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud rotary	80.0	(SM), SILTY SAND, fine sand, some nonplastic fines, olive-gray; dense, wet *(continued)*	-31.0	SM		SS S-18	10-18-19 **(37)**	6/18	37		
		83.0	(SP), POORLY GRADED SAND, fine sand, trace nonplastic fines, olive-gray; dense, wet	-34.0	SP							
85							SS S-19	16-18-17 **(35)**	13/18	35		
90							SS S-20	21-23-21 **(44)**	6/18	44		
		93.0	(SP-SM), POORLY GRADED SAND WITH SILT, fine sand, few nonplastic fines, olive-gray; dense, wet	-44.0	SP-SM							
95		96.0		-47.0			SS S-21	16-15-12 **(27)**	12/18	27	95: S-21: % Fines = 34	
			(CL), LEAN CLAY, medium plasticity fines, trace fine sand, olive-gray; very stiff, moist		CL							
100							SS S-22	8-7-8 **(15)**	18/18	15	100: S-22: PI = 16	
		103.0	(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, olive-gray; dense, wet	-54.0	SP							
105		106.5		-57.5			SS S-23	16-16-15 **(31)**	12/18	31		
110			Bottom of borehole at 106.5 ft. Backfilled with bentonite grout.									
115												
120												

DRILLING CO.: Holocene Drilling Inc
DRILLER: Matt Graham
DRILL RIG: Mobile B-58 Truck
LOGGED: John Hennessy
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G044

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 9, 2017 07:16
DRILLING END: October 11, 2017 09:54
COORDINATES: N: 347,106 E: 1,426,096

SHEET: 1 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Hollow Stem Auger

Depth (ft)	Depth	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Water Content (%)	Notes Water Levels
0	0.0	(SM), SILTY SAND WITH GRAVEL, fine to medium sand, some nonplastic fines, fine to coarse subrounded to subangular gravel, brown; loose to dense, moist, few roots	32.8	SM	SS S-1	12-28-18 **(46)**	18/18	46		
					SS S-2	9-10-11 **(21)**	6/18	21		
					SS S-3	4-4-4 **(8)**	3/18	8		
5	5.0	(SW-SM), WELL GRADED SAND WITH SILT, fine to coarse sand, trace to fine subrounded gravel, trace to few nonplastic fines, gray and brown; medium dense to dense, moist to wet	27.8	SW-SM	SS S-4	11-11-10 **(21)**	3/18	21		
					SS S-5	8-6-5 **(11)**	4/18	11		7.5: S-5: % Fines = 11
					SS S-6	6-9-8 **(17)**	18/18	17		9: S-6: % Fines = 5
10					SS S-7	6-7-8 **(15)**	15/18	15		10.5: S-7: % Fines = 9
					SS S-8	18-18-20 **(38)**	12/18	38		∇ 11.0 ft, 10/11/2017, ATD
15	15.0	(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, little fine to coarse subrounded to subangular gravel, trace nonplastic fines, dark gray; medium dense to very dense, wet	17.8	SP	SS S-9	18-15-20 **(35)**	6/18	35		
20					SS S-10	19-24-30 **(54)**	4/18	>>		
25					SS S-11	16-10-19 **(29)**	18/18	29		25: S-11: % Fines = 1; Drilling mud introduced into hole to reduce potential for heave.
	27.5	(SP-SM), POORLY GRADED SAND WITH SILT, medium sand, few nonplastic fines, dark gray; medium dense to very dense, wet	5.3	SP-SM						
30					SS S-12	13-9-15 **(24)**	12/18	24		30: S-6: % Fines = 7
35					SS S-13	13-13-13 **(26)**	12/18	26		35: S-7: % Fines = 11
40										

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G044

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park
DRILLING START: October 9, 2017 07:16
DRILLING END: October 11, 2017 09:54
COORDINATES: N: 347,106 E: 1,426,096
SHEET: 2 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40		40.0		-7.2							
	Hollow Stem Auger		(SP-SM), POORLY GRADED SAND WITH SILT, medium sand, few nonplastic fines, dark gray; medium dense to very dense, wet *(continued)*			SS S-14	9-15-26 **(41)**	12/18	41		
45											
					SP-SM	SS S-15	11-19-44 **(63)**	18/18	>>		
50										50: Drilling chatter	
						SS S-16	6-14-20 **(34)**	0/18	34		
		52.5		-19.7							
			(SM), SILTY SAND, fine sand, some nonplastic fines, few coarse gravel, gray; very dense, wet								
55					SM					55: S-17: % Fines = 42	
						SS S-17	10-21-30 **(51)**	9/18	>>		
		57.5		-24.7							
			(SP-SM), POORLY GRADED SAND WITH SILT, fine sand, trace to few nonplastic fines, brown gray; medium dense to very dense, wet								
60										60: S-18: % Fines = 8	
	Mud Rotary					SS S-18	11-12-13 **(25)**	14/18	25		
65											
						SS S-19	13-19-24 **(43)**	15/18	43		
					SP-SM						
70											
						SS S-20	25-24-28 **(52)**	13/18	>>		
75											
						SS S-21	24-26-28 **(54)**	13/18	>>		
		77.5		-44.7							
			(ML), SANDY SILT, low plasticity fines, some fine sand, dark gray; very stiff to hard, wet, thin interbeds of clean sand < 1/4 inch thick		ML						
80										80: S-22: PI = NP	

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount
LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G044

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 9, 2017 07:16
DRILLING END: October 11, 2017 09:54
COORDINATES: N: 347,106 E: 1,426,096

SHEET: 3 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud Rotary	80.0	(ML), SANDY SILT, low plasticity fines, some fine sand, dark gray; very stiff to hard, wet, thin interbeds of clean sand < 1/4 inch thick *(continued)*	-47.2	ML		SS S-22	7-9-15 **(24)**	18/18	24		
85							SS S-23	6-11-15 **(26)**	18/18	26	85: S-23: PI = NP	
90							SS S-24	6-18-26 **(44)**	18/18	44		
95							SS S-25	14-14-10 **(24)**	18/18	24	95: S-25: PI = NP	
100							SS S-26	13-14-10 **(24)**	18/18	24		
		102.5	(CL), LEAN CLAY, low plasticity fines, some fine sand, dark gray; very stiff, wet	-69.7	CL		ST ST-1		27/30			
105		107.5	(ML), SANDY SILT, low plasticity fines, some fine sand, dark gray; very stiff, wet, thin interbeds of clean sand < 1/4 inch thick	-74.7	ML							
110		111.0	(CL-ML), SILTY CLAY, low plasticity fines, few fine sand, dark gray; stiff to very stiff, moist	-78.2	CL-ML		SS S-27	13-9-9 **(18)**	12/18	18	110: S-27: PI = 7	
115		115.5	(CL), LEAN CLAY WITH SAND, low plasticity fines, little fine sand, dark gray; stiff to very stiff, moist, thin interbeds of sand < 1/4 inch thick	-82.7	CL		SS S-28	7-6-6 **(12)**	18/18	12		
120											120: S-29: PI = 14	

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G044

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 9, 2017 07:16
DRILLING END: October 11, 2017 09:54
COORDINATES: N: 347,106 E: 1,426,096

SHEET: 4 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
120	Mud Rotary	120.0	(CL), LEAN CLAY WITH SAND, low plasticity fines, little fine sand, dark gray; stiff to very stiff, moist, thin interbeds of sand < 1/4 inch thick *(continued)*	-87.2	CL		SS S-29	3-5-6 **(11)**	18/18	11		
125							SS S-30	5-7-13 **(20)**	18/18	20		
130							SS S-31	7-7-7 **(14)**	18/18	14	130: S-31: PI = 10	
							ST ST-2		30/30			
135							SS S-32	5-8-10 **(18)**	18/18	18		
		137.5	(SM), SILTY SAND, fine to medium sand, little nonplastic fines, dark gray; dense to very dense, wet	-104.7	SM							
140							SS S-33	14-19-19 **(38)**	14/18	38	140: S-33: % Fines = 19	
145							SS S-34	17-19-33 **(52)**	12/18	>>		
150							SS S-35	19-22-29 **(51)**	12/18	>>		
155							SS S-36	38-50/5" **(50/5")**	5/11	>>		
		157.5	(CL), LEAN CLAY, low to medium plasticity fines, trace fine sand, gray; very stiff, moist	-124.7	CL							
160											160: S-37: PI = 13	

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G044

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 9, 2017 07:16
DRILLING END: October 11, 2017 09:54
COORDINATES: N: 347,106 E: 1,426,096

SHEET: 5 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160	Mud Rotary	160.0	(CL), LEAN CLAY, low to medium plasticity fines, trace fine sand, gray; very stiff, moist *(continued)*	-127.2	CL		SS S-37	3-6-10 **(16)**	18/18	16		
		162.0	(CH), FAT CLAY, high plasticity fines, trace fine sand, gray; very stiff to hard, moist	-129.2	CH		ST ST-3		30/30			
165							SS S-38	6-9-14 **(23)**	18/18	23	165: S-38: PI = 49	
170							SS S-39	19-23-28 **(51)**	6/18	>>		
175							SS S-40	18-24-26 **(50)**	18/18	50		
180							SS S-41	13-18-22 **(40)**	15/18	40		
185		186.0		-153.2			SS S-42	15-25-50/3" **(75/9")**	15/15	>>		
			(SM), SILTY SAND, fine sand, some nonplastic fines, few fine to coarse subrounded to subangular gravel, dark gray; very dense, wet		SM						187.5: Drilling chatter	
190							SS S-43	50/1" **(50/1")**	1/1	>>		
195							SS S-44	50/1" **(50/1")**	1/1	>>		
200												

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G044

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 9, 2017 07:16
DRILLING END: October 11, 2017 09:54
COORDINATES: N: 347,106 E: 1,426,096

SHEET: 6 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft / WATER CONTENT (%)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
200	Mud Rotary	200.0	(SM), SILTY SAND, fine sand, some nonplastic fines, few fine to coarse subrounded to subangular gravel, dark gray; very dense, wet *(continued)*	-167.2	SM		SS S-45	50/1" **(50/1")**	1/1	>>		
205							SS S-46	50/1" **(50/1")**	1/1	>>	205 - 225: Drilling chatter	
210												
215							SS S-47	50/1" **(50/1")**	1/1	>>		
220												
225		225.1	Bottom of borehole at 225.1 ft. Backfilled with bentonite grout.	-192.3			SS S-48	50/1" **(50/1")**	1/1	>>		
230												
235												
240												

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G045

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 2, 2017 08:13
DRILLING END: October 5, 2017 12:26
COORDINATES: N: 345,921 E: 1,422,639

SHEET: 1 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

BORING METHOD: Mud Rotary

Depth (ft)	Description	Elev	USCS	Sample Type & Number	Blows per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	Penetration Resistance Blows / ft	Water Content (%)	Notes Water Levels
0.0	(OL), ORGANIC SILT, nonplastic fines, little fine to medium sand, dark brown; soft, wet	32.8	OL	SS S-1	2-2-1 **(3)**	6/18	3		0 - 30: Cased hole to prevent caving; 2.5: S-1: PI = NP
4.5	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, medium sand, some fine to coarse subrounded to subangular gravel, few nonplastic fines, gray and tan, iron oxide staining; medium dense to dense, moist	28.3	SP-SM	SS S-2	7-13-16 **(29)**	10/18	29		5: S-2: % Fines = 8; 5.5 - 25: Drilling chatter
	Dense, trace black wood fragments observed			SS S-3	7-15-16 **(31)**	9/18	31		
9.0	(GW-GM), WELL GRADED GRAVEL WITH SILT AND SAND, fine to coarse well graded subrounded to subangular gravel, some medium to coarse sand, few nonplastic fines, light gray; medium dense to very dense, moist to wet	23.8	GW-GM	SS S-4	13-15-10 **(25)**	6/18	25		∇ 10.0 ft, 10/03/2017 07:10, ATD
				SS S-5	12-16-18 **(34)**	6/18	34		
				SS S-6	15-11-13 **(24)**	5/18	24		15: S-6: % Fines = 6
				SS S-7	10-22-21 **(43)**	3/18	43		
				SS S-8	29-27-24 **(51)**	0/18	>>		
27.0	(ML), SANDY SILT, nonplastic fines, some fine sand, dark gray; stiff to very stiff, wet	5.8	ML	SS S-9	13-12-12 **(24)**	0/18	24		
				SS S-10	7-6-8 **(14)**	18/18	14		35: S-10: % Fines = 54
40.0		-7.2							40: S-11: % Fines = 27

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:43
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RECORD OF BOREHOLE DRLE-G045

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 2, 2017 08:13
DRILLING END: October 5, 2017 12:26
COORDINATES: N: 345,921 E: 1,422,639

SHEET: 2 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
40	Mud Rotary	40.0	(SM), SILTY SAND, fine sand, some nonplastic fines, dark gray; medium dense, wet, 6 inch thick interbeds of sand	-7.2	SM		SS S-11	5-5-6 **(11)**	12/18	11		
45		45.0	(SP-SM), POORLY GRADED SAND WITH SILT, medium sand, few nonplastic fines, dark gray; medium dense to dense, wet	-12.2	SP-SM		SS S-12	9-8-13 **(21)**	11/18	21	45: S-12: % Fines = 12	
50							SS S-13	4-10-22 **(32)**	18/18	32	50 - 55: Drilling mud loss	
55							SS S-14	9-11-14 **(25)**	10/18	25		
60							SS S-15	10-10-13 **(23)**	10/18	23	60: S-15: % Fines = 7	
65							SS S-16	16-19-24 **(43)**	16/18	43		
70			Thin organic seams in sample < 1/4 inch thick				SS S-17	16-17-17 **(34)**	9/18	34		
75		72.5	(SC), CLAYEY SAND, fine to medium sand, some nonplastic to low plasticity fines, gray; medium dense, wet, 6 inch interbeds of sand	-39.7	SC		SS S-18	8-6-9 **(15)**	0/18	15	75: S-18: % Fines = 47; Cal Mod sampler advanced to obtain material.	
							SS S-19	7-10-15 **(25)**	18/18	25	77.5: S-19: PI = NP	
80												

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G045

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 2, 2017 08:13
DRILLING END: October 5, 2017 12:26
COORDINATES: N: 345,921 E: 1,422,639

SHEET: 3 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (WATER CONTENT (%))	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
80	Mud Rotary	80.0	(SC), CLAYEY SAND, fine to medium sand, some nonplastic to low plasticity fines, gray; medium dense, wet, 6 inch interbeds of sand *(continued)*	-47.2	SC		SS S-20	4-4-8 **(12)**	18/18	12		
85							SS ST-1	12-7-6 **(13)**	18/18	13	85: S-20: PI = 8	
90							ST S-21		30/30			
95							SS S-22	8-11-13 **(24)**	18/18	24	95: S-21: PI = NP	
			Color change to dark gray									
100							SS S-23	9-9-12 **(21)**	10/18	21	100: S-22: % Fines = 16	
		102.5	(CL), SANDY LEAN CLAY, low plasticity fines, some fine to medium sand, dark gray; stiff, moist, thin interbeds of silt and sand < 1/4 inch thick	-69.7	CL							
105							SS S-24	3-4-7 **(11)**	18/18	11	105: S-23: PI = 13	
110							ST ST-2		30/30			
115							SS S-25	4-5-5 **(10)**	18/18	10		
		117.0	(ML), SANDY SILT, nonplastic fines, some fine sand, dark gray; stiff to very stiff, wet	-84.2	ML							
120											120: S-25: PI = NP	

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G045

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 2, 2017 08:13
DRILLING END: October 5, 2017 12:26
COORDINATES: N: 345,921 E: 1,422,639

SHEET: 4 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
120	Mud Rotary	120.0	(ML), SANDY SILT, nonplastic fines, some fine sand, dark gray; stiff to very stiff, wet *(continued)*	-87.2	ML		SS S-26	5-5-4 **(9)**	3/18	9		
		124.0	(CL), SANDY LEAN CLAY, low plasticity fines, some fine to medium sand, dark gray; stiff to very stiff, moist, thin interbeds of silt and sand < 1/4 inch thick	-91.2	CL		SS S-27	5-8-12 **(20)**	18/18	20		
125												
130							SS S-28	3-4-5 **(9)**	18/18	9		
135							SS S-29	3-3-6 **(9)**	18/18	9	135: S-28: PI = 16	
140							ST ST-3		20/30			
		142.5	(SM), SILTY SAND, medium sand, little nonplastic fines, very dark gray; dense, wet	-109.7	SM							
145							SS S-30	10-12-19 **(31)**	18/18	31	145: S-30: % Fines = 16	
		147.5	(CL), LEAN CLAY, low plasticity fines, few fine to medium sand, dark gray; stiff, moist	-114.7	CL							
150							SS S-31	3-3-6 **(9)**	18/18	9	150: S-31: PI = 14	
155							SS S-32	6-12-38 **(50)**	18/18	50		
		156.0	(ML), SANDY SILT, low plasticity fines, some fine sand, few fine subrounded to subangular gravel, dark gray; hard, wet	-123.2	ML							
160												

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G045

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 2, 2017 08:13
DRILLING END: October 5, 2017 12:26
COORDINATES: N: 345,921 E: 1,422,639

SHEET: 5 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft / WATER CONTENT (%)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
160	Mud Rotary	160.0	(ML), SANDY SILT, low plasticity fines, some fine sand, few fine subrounded to subangular gravel, dark gray; hard, wet *(continued)*	-127.2	ML		SS S-33	50/2" **(50/2")**	1/2	>>		
165							SS S-34	50/3" **(50/3")**	3/3	>>		
170							SS S-35	50/1" **(50/1")**	0/1	>>		
175							SS S-36	50/1" **(50/1")**	1/1	>>		
		177.0	(SP-SC), POORLY GRADED SAND WITH CLAY, fine sand, few low plasticity fines, dark gray; dense to very dense, wet	-144.2	SP-SC							
180							SS S-37	13-16-22 **(38)**	18/18	38	180: S-37: % Fines = 11	
185							SS S-38	15-20-50/4" **(70/10")**	16/16	>>		
		187.5	(ML), SANDY SILT, low plasticity fines, some fine sand, few fine subrounded to subangular gravel, dark gray; hard, wet	-154.7	ML							
190							SS S-39	50/1" **(50/1")**	1/1	>>		
195							SS S-40	50/2" **(50/2")**	2/2	>>		
		199.0		-166.2	GP-GM						199 - 205: Drilling mud loss; material	
200												

Log continued on next page

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

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RECORD OF BOREHOLE DRLE-G045

PROJECT: Downtown Redmond Link Extension
PROJECT NO.: 1657705
LOCATION: Marymoor Park

DRILLING START: October 2, 2017 08:13
DRILLING END: October 5, 2017 12:26
COORDINATES: N: 345,921 E: 1,422,639

SHEET: 6 of 6
GS ELEV.: 32.8 feet
TOC ELEV.: na
DATUM: NAVD88/Project Datum

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	BLOWS per 6 in (Automatic 140 lb Hammer, 30 inch drop)	REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft / WATER CONTENT (%)	NOTES WATER LEVELS	ADDITIONAL LAB TESTING
200	Mud Rotary	200.0	(GP-GM), POORLY GRADED GRAVEL WITH SILT AND SAND, fine to coarse subrounded to subangular gravel, some fine sand, few nonplastic fines; very dense, wet *(continued)*	-167.2	GP-GM		SS S-41	50/1" **(50/1")**	0/1	>>	classified based on cuttings	
205							SS S-42	50/0" **(50/0")**	0/0	>>	205 - 225.08: Drilling chatter	
210							SS S-43	50/1" **(50/1")**	0/1	>>		
		212.5	(SM), SILTY SAND, fine to medium sand, some nonplastic fines, few fine subrounded to subangular gravel, dark gray; very dense, wet	-179.7	SM							
215							SS S-44	50/1" **(50/1")**	1/1	>>		
220							SS S-45	50/1" **(50/1")**	2/1	>>		
		222.5	(SP-SM), POORLY GRADED SAND WITH SILT AND GRAVEL, fine to medium sand, few fine to coarse subrounded to subangular gravel, few nonplastic fines, dark gray; very dense, wet	-189.7	SP-SM							
225		225.1	Bottom of borehole at 225.1 ft. Backfilled with bentonite grout.	-192.3			SS S-46	50/1" **(50/1")**	1/1	>>		
230												
235												
240												

DRILLING CO.: Holocene
DRILLER: Roddy Gilszth
DRILL RIG: CME-850, Track Mount

LOGGED: Carly Schaeffer
CHECKED: Margaret Pryor
REVIEWED: Dave Findley

Golder Associates

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 6/28/18 08:43
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APPENDIX B

RECORD OF TEST PITS

Golder Associates

RECORD OF TEST PIT LOG

TEST PIT NUMBER DRLE-TP1

DATE: 3-20-18
PROJECT: ST Redmond Link
PROJECT No.: 1657705
LOCATION: NE 16th St./166th Ave. NE
Northing: 347,676 **Easting:** 1,423,837
Datum: NAVD88/Project Datum
Elevation ft: 43.8 feet **Length x Width ft:** 4.5 x 3.5
Contractor: Kelly's Excavating (Pat Hill)
Logged By: J. Jamsgard
Equipment: TB138
Water Conditions:
Not observed

Surface Conditions:
Sod

DEPTH (ft)	SOIL PROFILE: Depth	DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	CONSISTENCY[1] OR DENSITY[2]	INSITU, LABORATORY TESTING[1] & NOTES: WATER CONTENT (%)	OTHER TESTS & NOTES
0	0.0							
	0.4	Sod						
	1.0	(SM), FILL: SILTY SAND WITH GRAVEL, fine to coarse sand, little fine to coarse subrounded to subangular gravel, some nonplastic fines, trace organics, dark brown, heterogeneous; loose to medium dense, moist	SM			loose to med. dense	moist	0.5 - 1: Rusty Metal Pipe
	2.0	(SP-SM), FILL: POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, little fine to coarse subrounded to subangular gravel, few nonplastic fines, trace organics, brown-tan, medium dense, moist, charcoal present	SP-SM			medium dense	moist	
	4.5	(SM), FILL: SILTY SAND WITH GRAVEL, fine to coarse sand, little fine to coarse subrounded to subangular gravel, some nonplastic fines, trace organics, dark brown, heterogeneous; loose to medium dense, moist	SM			loose to medium dense	moist	3 - 3.5: Auto Parts
5		(GW), WELL GRADED GRAVEL WITH SAND, fine to coarse, subrounded to subangular gravel, some fine to coarse sand, trace nonplastic fines, brown-tan, stratified; few rounded cobbles and boulders observed up to 12 inches in diameter, loose, moist; caving observed throughout soil layer.	GW		GB S-1	loose	moist	S-1: % Fines = 1
10	10.0				GB S-2			6 - 7: Highly Oxidized
		Bottom of test pit at 10.0 ft. Backfilled with cuttings and tamped with bucket.						
15								

Notes: [1] See Legend Sheet for Definition of Terms, Symbols and Abbreviations
[2] Consistency or Density values are estimated based on excavation resistance and/or visual/manual assessment of samples

Checked: Margaret Pryor
Reviewed: David Findley

03 - GOLDER - TEST PIT LOG WITH PHOTO - TEST V7 2012_01_22B E-M 1A.GPJ - 5/18/18 14:32
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Golder Associates

RECORD OF TEST PIT LOG

TEST PIT NUMBER DRLE-TP2

DATE: 3-22-18
PROJECT: ST Redmond Link
PROJECT No.: 1657705
LOCATION: Marymoor Park Velodrome, North
Northing: 345,908 **Easting:** 1,425,663
Datum: NAVD88/Project Datum
Elevation ft: 42.6 feet **Length x Width ft:** 4.0 x 3.5
Contractor: Kelly's Excavating (Pat Hill)
Logged By: J. Jamsgard
Equipment: TB138
Water Conditions:
Not observed

Surface Conditions:
Sod

DEPTH (ft)	Depth	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	CONSISTENCY[1] OR DENSITY[2]	INSITU, LABORATORY TESTING[1] & NOTES: WATER CONTENT (%)	OTHER TESTS & NOTES
0	0.0							
	0.3	Sod						
5		(SM), SILTY SAND, fine sand, some nonplastic fines, gray-tan to gray, homogeneous, iron oxide staining; loose to medium dense, moist	SM		GB S-1	loose to medium dense	moist	S-1: %Fines = 34
	6.0				GB S-2			
		(SP-SM), POORLY GRADED SAND WITH SILT, fine to coarse sand, little nonplastic fines, trace organics, pale to dark brown, homogeneous; medium dense, moist	SP-SM		GB S-3	medium dense	moist	
	7.0	(SP), POORLY GRADED SAND, fine to coarse sand, few fine to coarse rounded to subrounded gravel, pale brown, homogeneous; medium dense, moist	SP		GB S-4	medium dense	moist	
10	10.0							
		Bottom of test pit at 10.0 ft. Backfilled with cuttings and tamped with bucket.						
15								

Notes: [1] See Legend Sheet for Definition of Terms, Symbols and Abbreviations
[2] Consistency or Density values are estimated based on excavation resistance and/or visual/manual assessment of samples

Checked: Margaret Pryor
Reviewed: David Findley

Golder Associates

RECORD OF TEST PIT LOG

TEST PIT NUMBER DRLE-TP3A

DATE: 3-21-18
PROJECT: ST Redmond Link
PROJECT No.: 1657705
LOCATION: Marymoor Park Velodrome, East
Northing: 345,420 **Easting:** 1,425,641
Datum: NAVD88/Project Datum
Elevation ft: 43.1 feet **Length x Width ft:** 4.0 x 3.5
Contractor: Kelly's Excavating (Pat Hill)
Logged By: J. Jamsgard
Equipment: TB138
Water Conditions:
Not observed

Surface Conditions:
Sod

DEPTH (ft)	SOIL PROFILE: Depth	DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	CONSISTENCY[1] OR DENSITY[2]	INSITU, LABORATORY TESTING[1] & NOTES: WATER CONTENT (%)	OTHER TESTS & NOTES
0	0.0							
	0.3	Sod						
		(SP), POORLY GRADED SAND, fine to medium sand, trace nonplastic fines, trace fine subrounded gravel, tan-gray, stratified, trace subrounded cobbles up to 6 inches in diameter; loose, moist; caving obsreved from about 3 feet below the ground surface.						
					GB S-1			S-1: %Fines = 2
5			SP			loose	moist	5 - 6: Iron Oxide Staining
								7 - 9: Lens of coarse sand and gravel
		Increased coarse sand content.						
					GB S-2			
10	10.0							
		Bottom of test pit at 10.0 ft. Backfilled with cuttings and tamped with bucket.						
15								

Notes: [1] See Legend Sheet for Definition of Terms, Symbols and Abbreviations
[2] Consistency or Density values are estimated based on excavation resistance and/or visual/manual assessment of samples

Checked: Margaret Pryor
Reviewed: David Findley

Golder Associates

RECORD OF TEST PIT LOG

TEST PIT NUMBER DRLE-TP3B

DATE: 3-23-18
PROJECT: ST Redmond Link
PROJECT No.: 1657705
LOCATION: Marymoor Park Velodrome, East
Northing: 345,425 **Easting:** 1,425,643
Datum: NAVD88/Project Datum
Elevation ft: 43.2 feet **Length x Width ft:** 4.5 x 3.5
Contractor: Kelly's Excavating (Pat Hill)
Logged By: C. Bloom
Equipment: TB138
Water Conditions:
Not observed

Surface Conditions:
Sod

DEPTH (ft)	SOIL PROFILE: Depth	DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	CONSISTENCY[1] OR DENSITY[2]	INSITU, LABORATORY TESTING[1] & NOTES: WATER CONTENT (%)	OTHER TESTS & NOTES	WELL INSTALL.
0	0.0	Sod							
	1.0	(SP), POORLY GRADED SAND, fine to coarse sand, trace fine to coarse subrounded gravel, light brown to light tan; non-cohesive, medium dense, moist; sand and gravel content coarsened with depth.	SP			compact	moist	1 - 2: Iron Oxide Staining	Well Installation: Solid 2" PVC 0-4' bgs; Slotted 2" PVC 4-9.5', capped at 9.5'
5									
10	10.5	Bottom of test pit at 10.5 ft. Completed as well. Refer to diagram.							
15									

Notes: [1] See Legend Sheet for Definition of Terms, Symbols and Abbreviations
[2] Consistency or Density values are estimated based on excavation resistance and/or visual/manual assessment of samples

Checked: Margaret Pryor
Reviewed: David Findley

Golder Associates

RECORD OF TEST PIT LOG

TEST PIT NUMBER DRLE-TP4

DATE: 3-23-18

PROJECT: ST Redmond Link

PROJECT No.: 1657705

LOCATION: East Lake Sammamish Trail

Northing: 346,342 **Easting:** 1,426,994

Datum: NAVD88/Project Datum

Elevation ft: 46.8 feet **Length x Width ft:** 3.0 x 4.0

Contractor: Kelly's Excavating (Pat Hill)

Logged By: J. Jamsgard

Equipment: TB138

Water Conditions:
Not observed

Surface Conditions:
Sod

DEPTH (ft)	SOIL PROFILE: Depth	DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE TYPE & NUMBER	CONSISTENCY[1] OR DENSITY[2]	INSITU, LABORATORY TESTING[1] & NOTES: WATER CONTENT (%)	OTHER TESTS & NOTES
0	0.0							
	0.3	Sod						
		(SP), POORLY GRADED SAND, fine to coarse sand, few fine subrounded to subangular gravel, trace , gray, homogeneous; loose to medium dense, moist	SP			loose to medium dense	moist	
	1.5							
	1.8	(SP), POORLY GRADED SAND, fine to coarse organic sand, trace fine subrounded gravel, black, stratified; loose to medium dense, moist, charcoal	SP		GB S-1	loose	moist	1.8 - 2.8: Iron Oxide Staining
		(SP), POORLY GRADED SAND WITH GRAVEL, fine to coarse sand, little fine to coarse subrounded to subangular gravel, trace subgrounded cobbles up to 4 inches in diameter, organics, red-orange to tan, stratified; medium dense, moist, some charcoal and gravel lenses			GB S-2			
					GB S-3			S-3: % Fines = 3
5								
			SP			medium dense	moist	6 - 7: Iron Oxide Staining
					GB S-4			
10	10.5							
		Bottom of test pit at 10.5 ft. Backfilled with cuttings and tamped with bucket.						
15								

Notes: [1] See Legend Sheet for Definition of Terms, Symbols and Abbreviations
[2] Consistency or Density values are estimated based on excavation resistance and/or visual/manual assessment of samples

Checked: Margaret Pryor
Reviewed: David Findley

03 - GOLDER - TEST PIT LOG WITH PHOTO - TEST V7 2012_01_22B E-M 1A.GPJ - 5/18/18 14:32
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APPENDIX C

IN SITU TESTS – PILOT INFILTRATION TESTING (PIT)

Golder completed the excavation of five test pits at four locations for the purpose of evaluating stormwater infiltration potential. The location of the test pit infiltration sites are shown on Figure 2 and are summarized in Table 2-1. The logs of the test pits are contained in Appendix B. Laboratory tests on test pit samples included grain size analyses, the results of which are contained in Appendix G.

The infiltration tests were completed under the general guidance provided by the Washington State Department of Ecology (WSDOE) guidelines provided in Volume III – Hydrologic Analysis and Flow Control BMPs; Stormwater Management in Western Washington (August 2012)[1]. The method utilized was the Small-Scale Pilot Infiltration Test (PIT). The test pits excavated for the PIT were typically 3 feet wide, 4 feet long, and 3 to 4 feet below the existing ground surface. The recommended 6-hour presoak period was abbreviated on three of the four test pits (DRLE-TP1, DRLE-TP3a, and DRLE-TP4) because of very high inflow of water and difficulty in maintaining the 12 inches of presoak head. Typically, inflows for the presoak were on the order of 1,000 gallons in less than an hour. As such, the recommended 6-hour presoak period was terminated early. The actual infiltration testing consisted of a constant head test followed by a falling head test until the test pit was drained. After completion of each infiltration test, the test pit was deepened full depth (10 feet below existing ground) to evaluate the presence or absence of any lower permeable layer that could affect infiltration. The field data analysis results in an uncorrected infiltration rate in inches/hour, summarized in Table C1.

Table C1. Infiltration Rate Correction

	TP-1	TP-2	TP-3A	TP-4
K_{field} (inches/hr)	49	2	74	71

The field data for each PIT is presented below.

[1] Washington State Department of Ecology. 2012. Stormwater Management Manual for Western Washington. Publication Number: 12-10-030. August.

18300 NE Union Hill Road, Suite 200, Redmond, Washington, USA 98052
T: +1 425 883-0777 F: +1 425 882-5498

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Table C2. DRLE-TP1 Constant Head Test

Elapsed Time (min)	Gallons of water added	Rate (gpm)
15	449	29.9
30	288	19.2
45	192	12.8
60	204	13.6
75	193	12.9
90	195	13.0

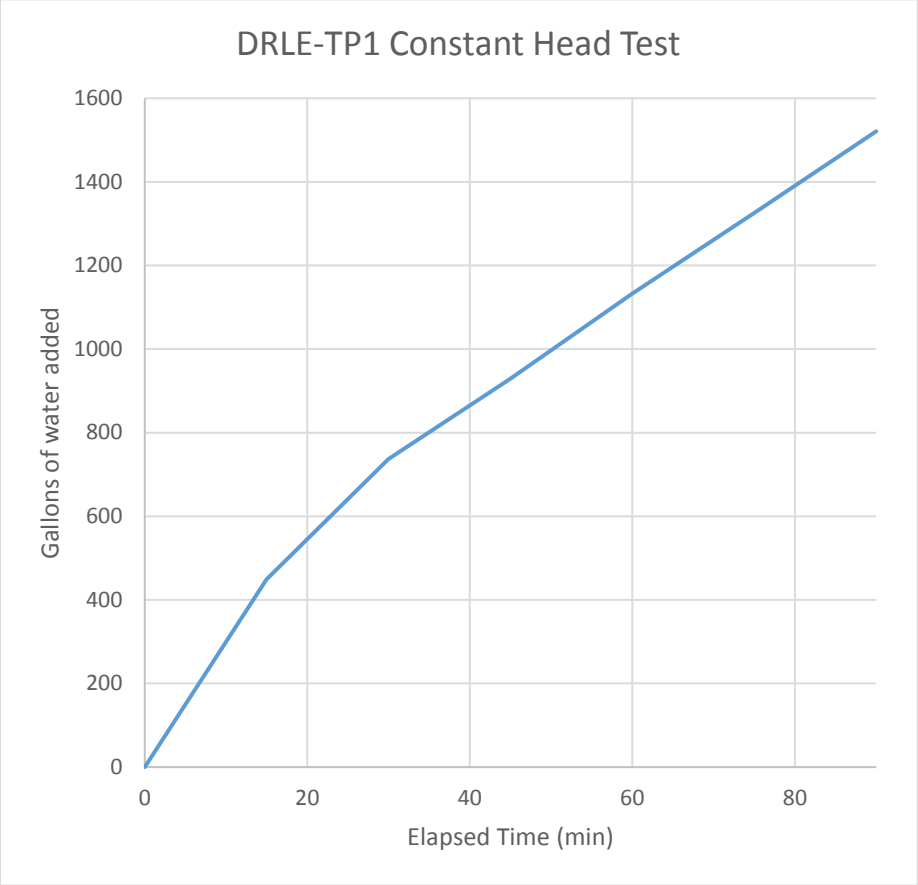


Table C3. DRLE-TP1 Falling Head Test 1

Elapsed Time (hr)	Head (in)	Rate (in/hr)
0	12	-
0.03	10	77.9
0.06	8	64.7
0.09	6	53.7
0.14	4	47.9
0.19	2	35.7
0.25	0	37.9

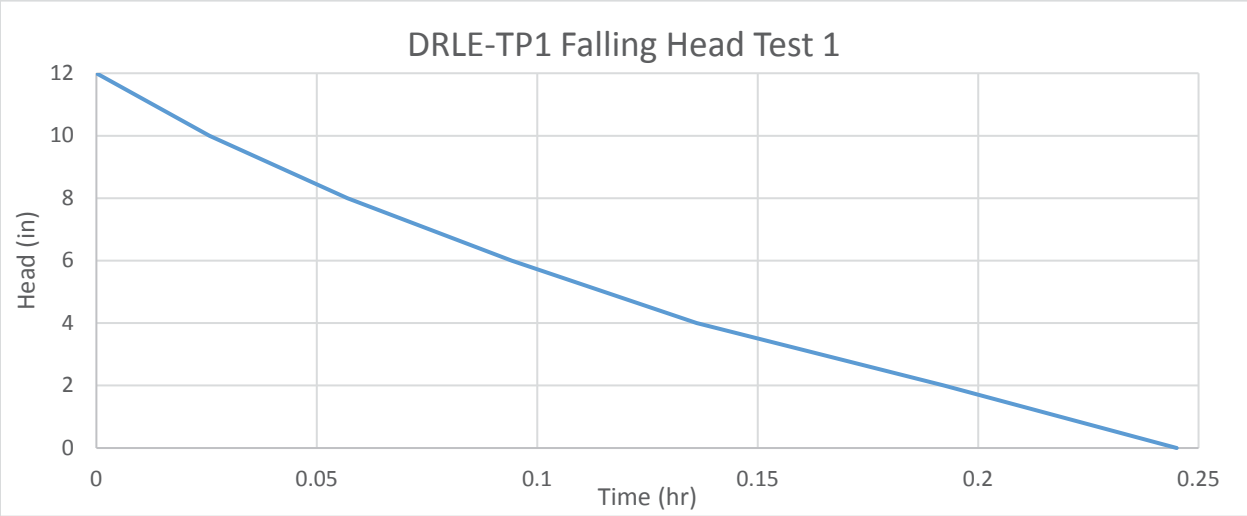


Table C4. DRLE-TP1 Falling Head Test 2

Elapsed Time (hr)	Head (in)	Rate (in/hr)
0	12	-
0.05	10	41.1
0.11	8	35.3
0.16	6	34.6
0.23	4	27.8
0.32	2	23.4
0.41	0	22.8

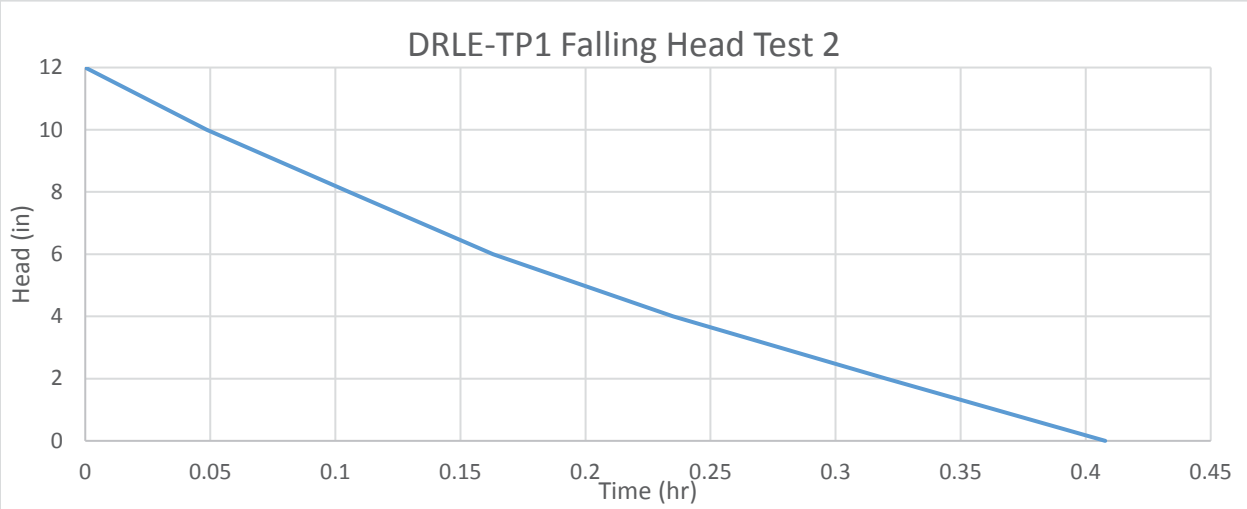


Table C5. DRLE-TP1 Falling Head Test 3

Elapsed Time (hr)	Head (in)	Rate (in/hr)
0	12	-
0.06	10	31.1
0.13	8	29.8
0.21	6	29.3
0.30	4	21.1
0.41	2	18.4
0.53	0	17.6

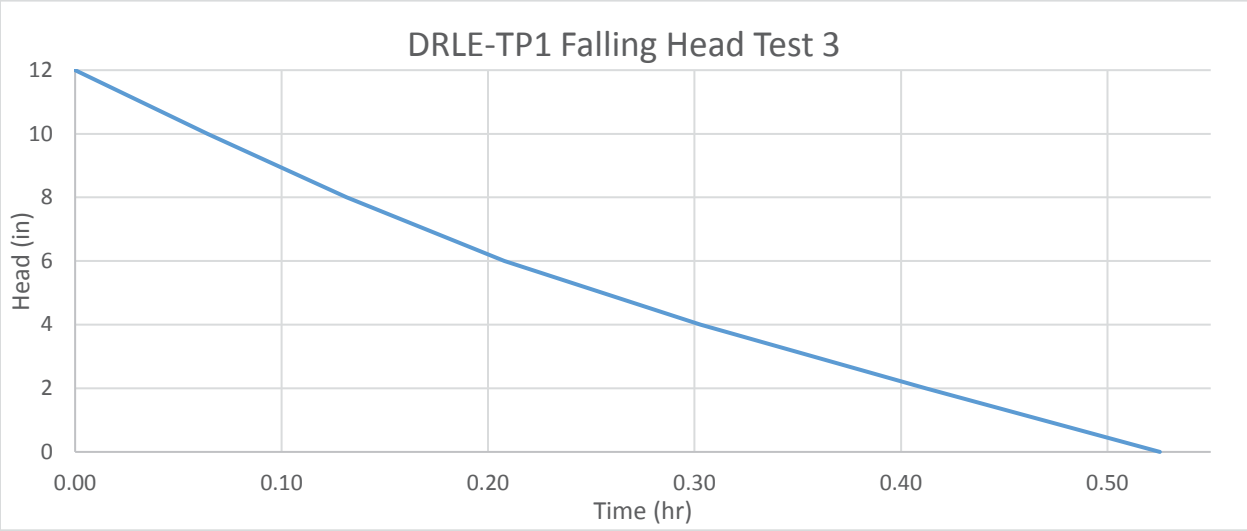


Table C6. DRLE-TP2 Constant Head Test

Elapsed Time (min)	Gallons of water added	Rate (gpm)
15	0	0
30	0	0
45	0	0
60	0	0
75	0	0
90	15	1
105	5	0.33
120	5	0.33
135	5	0.33
150	5	0.33
165	10	0.67
180	5	0.33
195	5	0.33
210	5	0.33
225	5	0.33
240	10	0.67
255	5	0.33
270	5	0.33
285	5	0.33
300	5	0.33
315	5	0.33
330	5	0.33
345	5	0.33
360	5	0.33
375	5	0.33
390	5	0.33
405	5	0.33
420	8	0.53

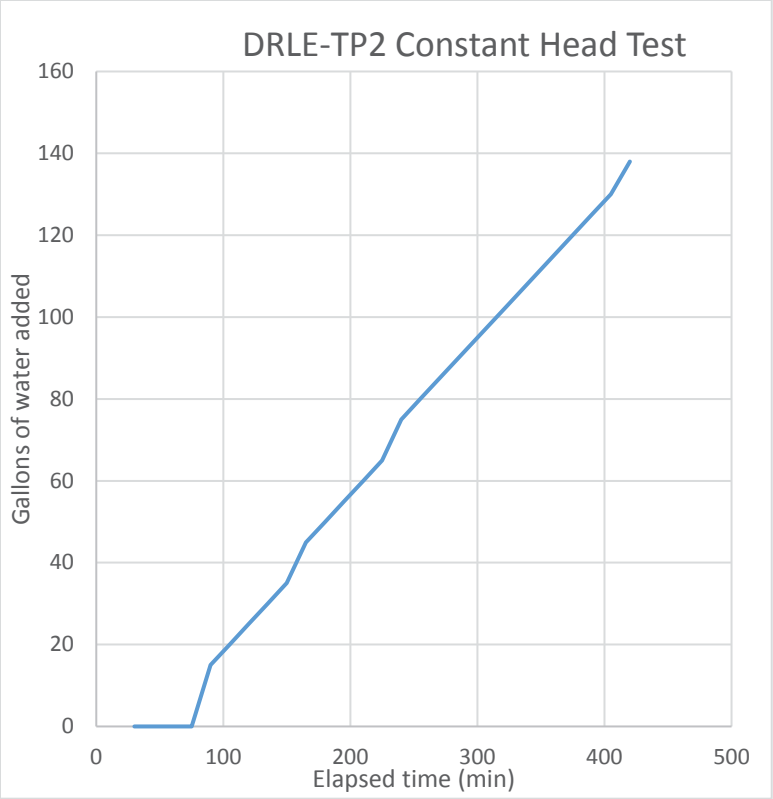

DRLE-TP2 Constant Head Test
Gallons of water added
160
140
120
100
80
60
40
20
0
0
100
200
300
400
500
Elapsed time (min)

Table C7. DRLE-TP2 Falling Head Test 1

Elapsed time (hr)	Head (in)	Rate (in/hr)
0	12	-
1	9.75	2.25
2	7.75	2
2.92	6	1.91

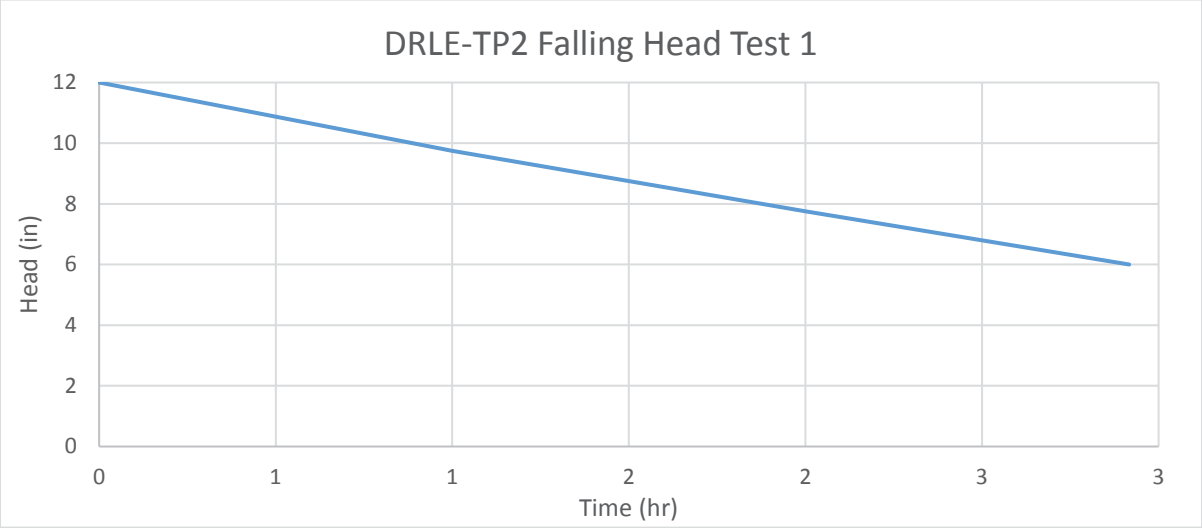


Table C8. DRLE-TP3A Constant Head Test

Elapsed Time (min)	Gallons of water added	Rate (gpm)
15	406	27.1
30	265	17.7
45	217	14.5
60	294	19.6
75	291	19.4
90	242	16.1

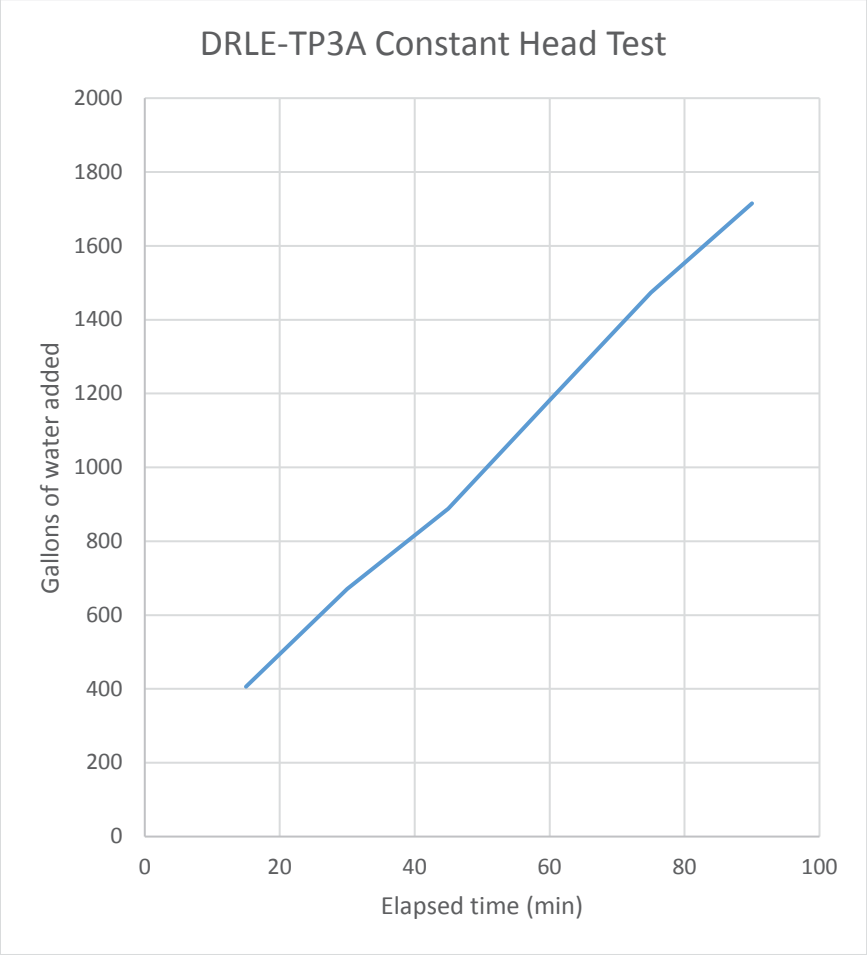


Table C9. DRLE-TP3A Falling Head Test 1

Elapsed Time (hr)	Head (in)	Rate (in/hr)
0	12	-
0.03	10	67.0
0.06	8	67.1
0.09	6	58.3
0.12	4	67.7
0.15	2	67.4

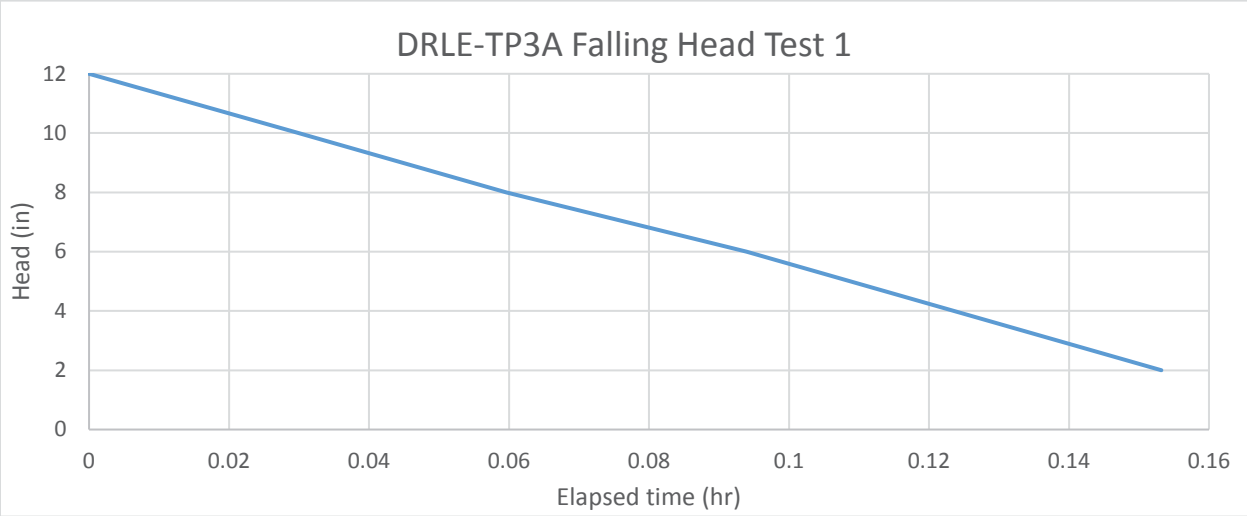


Table C10. DRLE-TP3A Falling Head Test 2

Elapsed Time (hr)	Head (in)	Rate (in/hr)
0	12	-
0.03	10	77.7
0.06	8	67.9
0.08	6	72.5
0.11	4	69.0
0.14	2	85.9

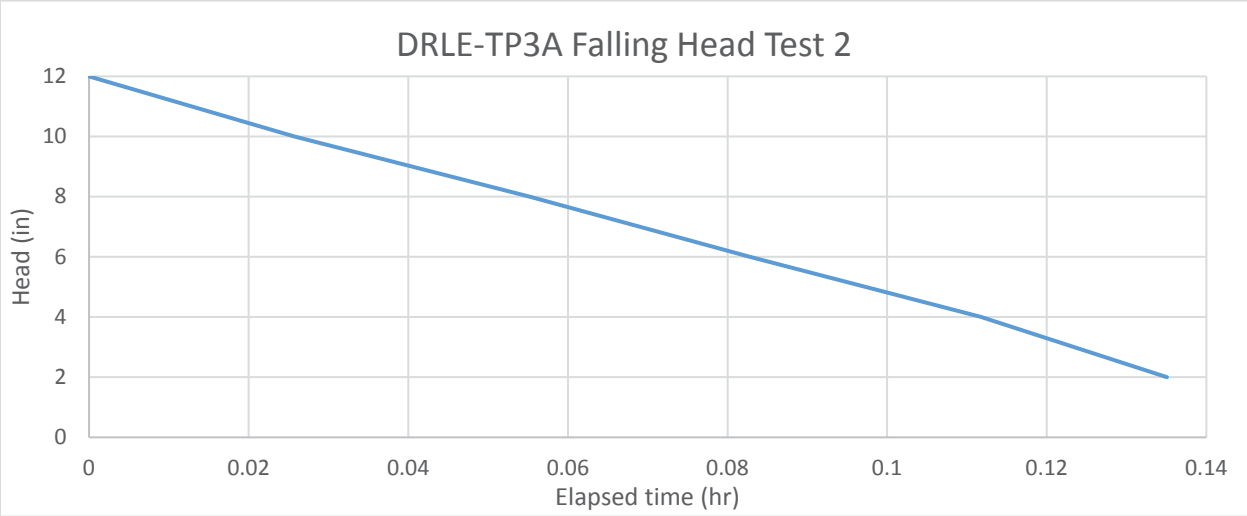


Table C11. DRLE-TP3A Falling Head Test 3

Elapsed Time (hr)	Head (in)	Rate (in/hr)
0	5	-
0.03	3	74.0
0.05	1	75.4

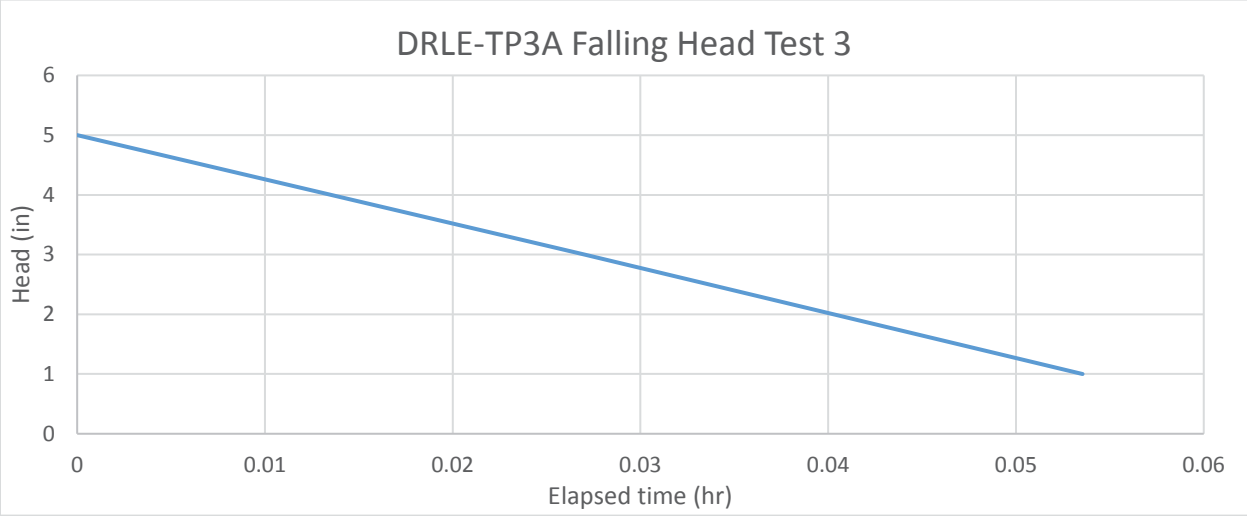


Table C12. DRLE-TP4 Constant Head Test

Elapsed Time (min)	Gallons of water added	Rate (gpm)
15	411	27.4
30	306	20.4
45	845	56.3
60	446	29.7

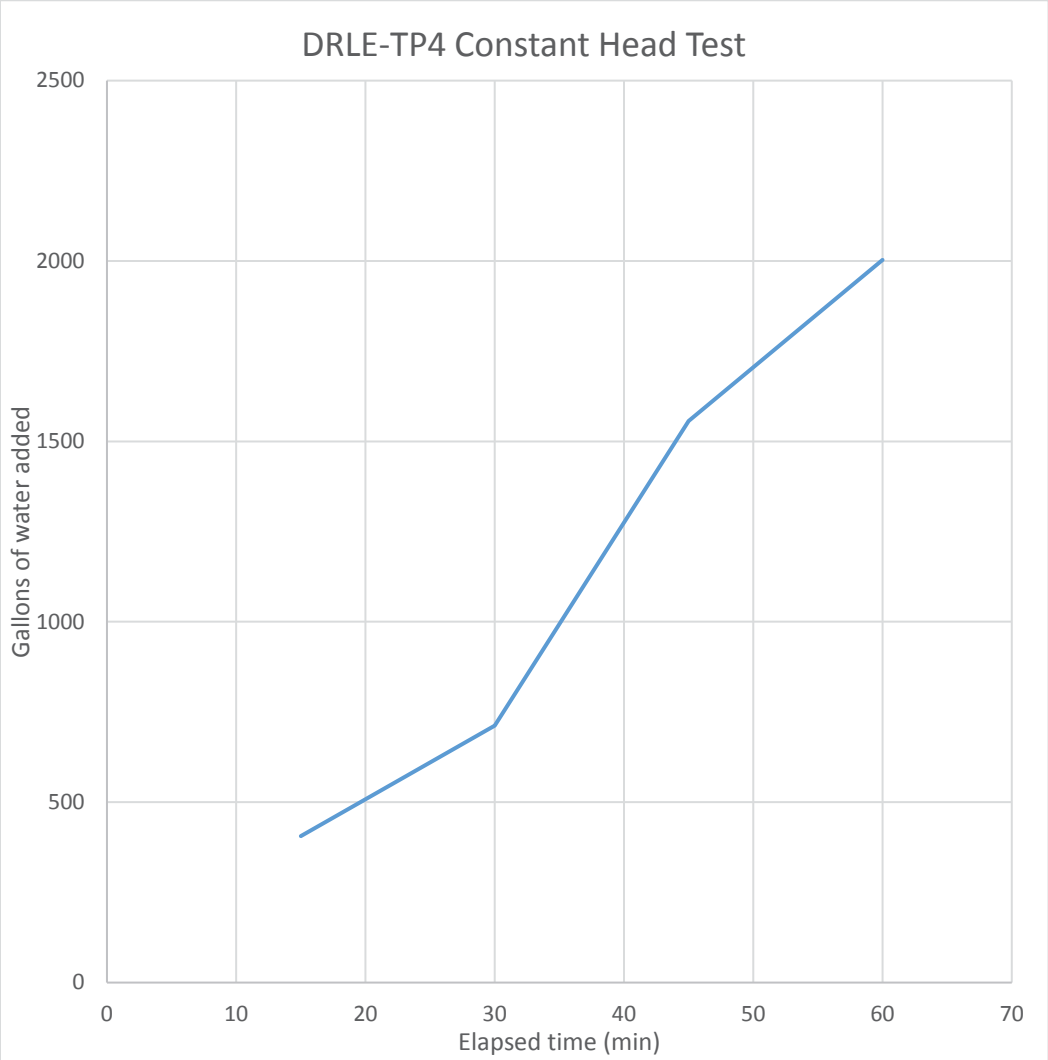


Table C13. DRLE-TP4 Falling Head Test 1

Elapsed time (hr)	Head (in)	Rate (in/hr)
0	10	-
0.01	9	92.8
0.02	8	101.0
0.03	7	108.8
0.04	6	81.9
0.06	5	66.3
0.07	4	73.6
0.08	3	71.1
0.10	2	52.4
0.13	1	44.0

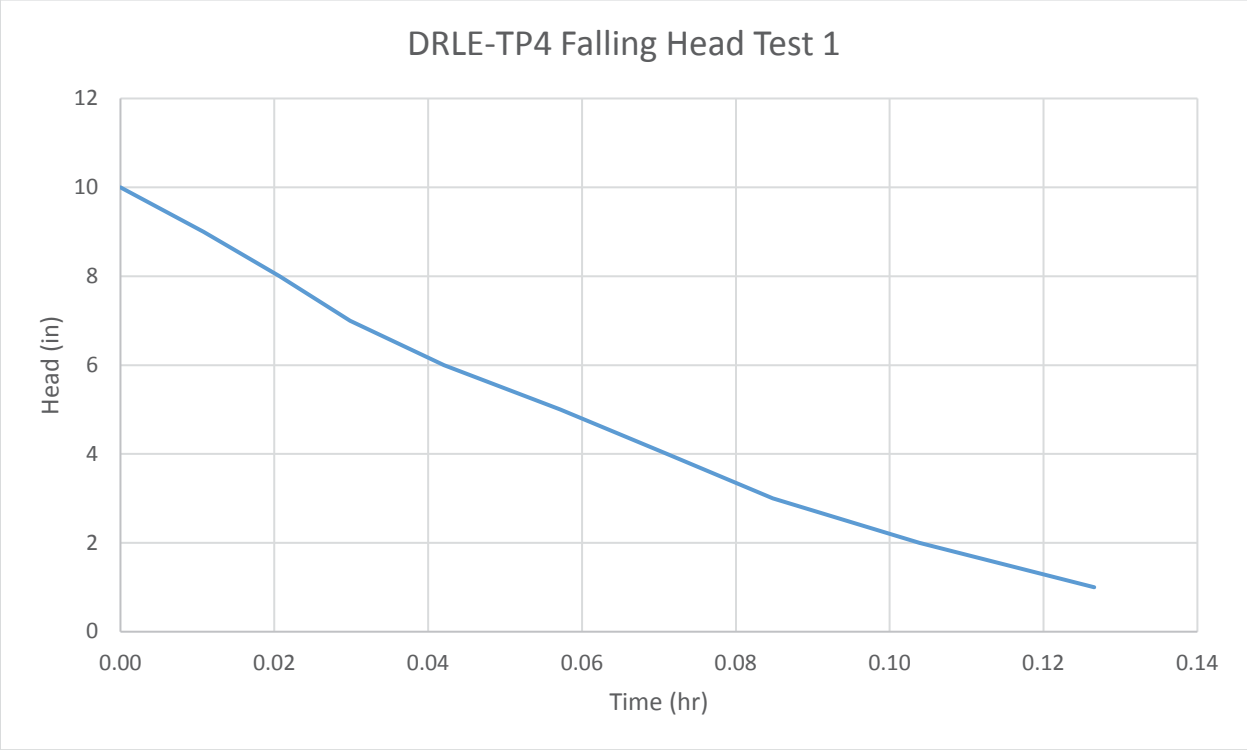


Table C14. DRLE-TP4 Falling Head Test 2

Elapsed time (hr)	Head (in)	Rate (in/hr)
0	12	-
0.01	11	92.7
0.02	10	74.5
0.04	9	60.4
0.06	8	57.7
0.08	7	54.8
0.10	6	48.1
0.12	5	45.3
0.15	4	42.2
0.17	3	46.0
0.19	2	40.9
0.22	1	38.6

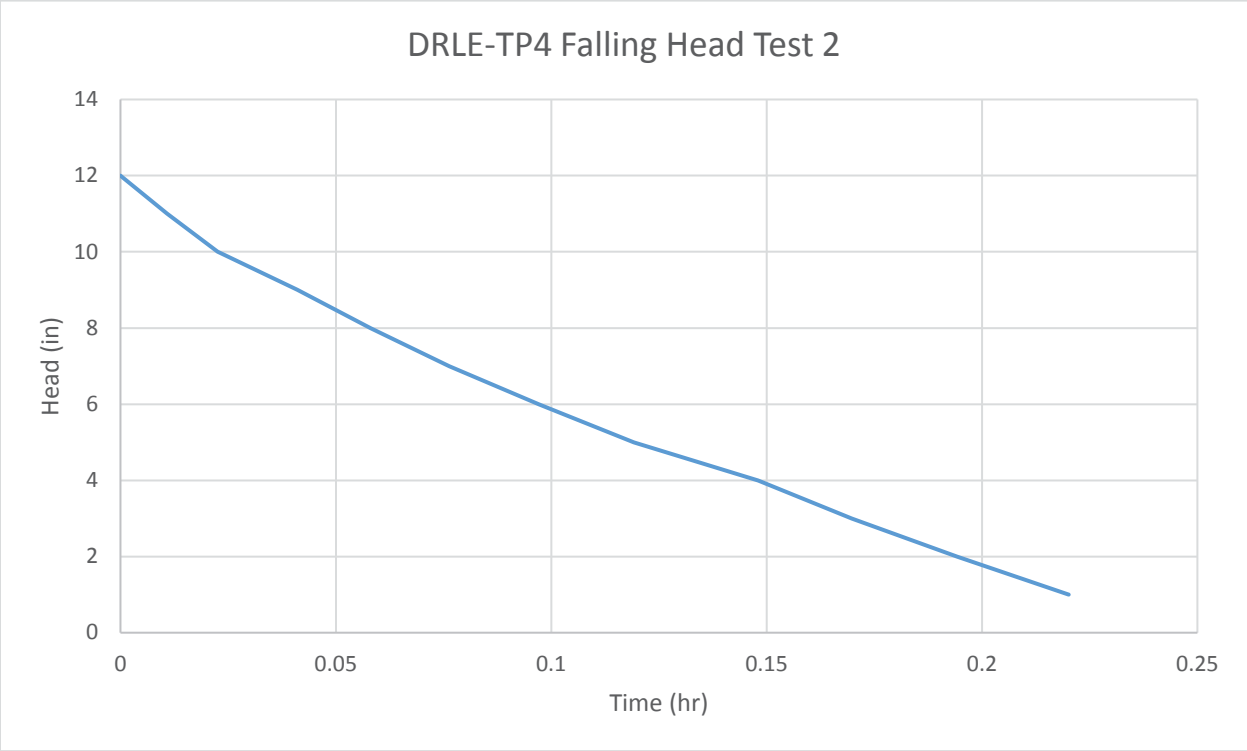
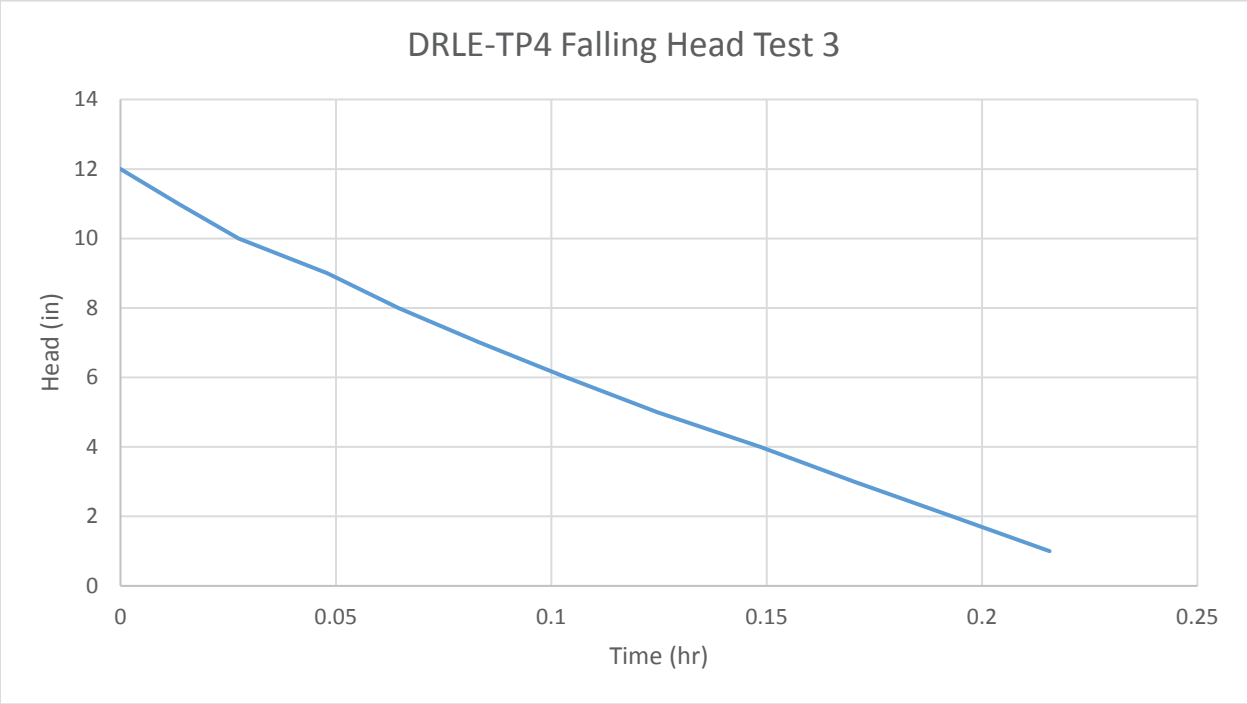


Table C15. DRLE-TP4 Falling Head Test 3

Elapsed Time (hr)	Head (in)	Rate (in/hr)
0	12	-
0.01	11	74.6
0.03	10	71.0
0.05	9	48.9
0.06	8	60.4
0.08	7	52.8
0.10	6	49.7
0.12	5	47.3
0.15	4	41.9
0.17	3	45.9
0.19	2	44.1
0.22	1	44.2



APPENDIX D

IN SITU TESTS – SUSPENSION LOGGING DATA

Global Geophysics

P. O. Box 2229
Redmond, WA, 98073-2229
Tel: 425-890-4321
Fax: 360-805-0259

March 7, 2018 Our Ref.: 107-0816.000

Golder Associates, Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052

Attention: Mr. Birkan Bayrak

RE: REPORT ON THE SUSPENSION LOGGING FOR SOUND TRANSIT DOWNTOWN REDMOND LINK EXTENSION PROJECT, REDMOND, WA

Dear Mr. Bayrak:

Global Geophysics conducted a suspension logging in boreholes G018, G031, G033, G036, G037 and G37A along Sound Transit -Downtown Redmond Link Extension Project in October and December, 2017, and March 2018. The proposed objective of the geophysical investigation was to determine the s-wave velocity of the soil column below the ground surface.

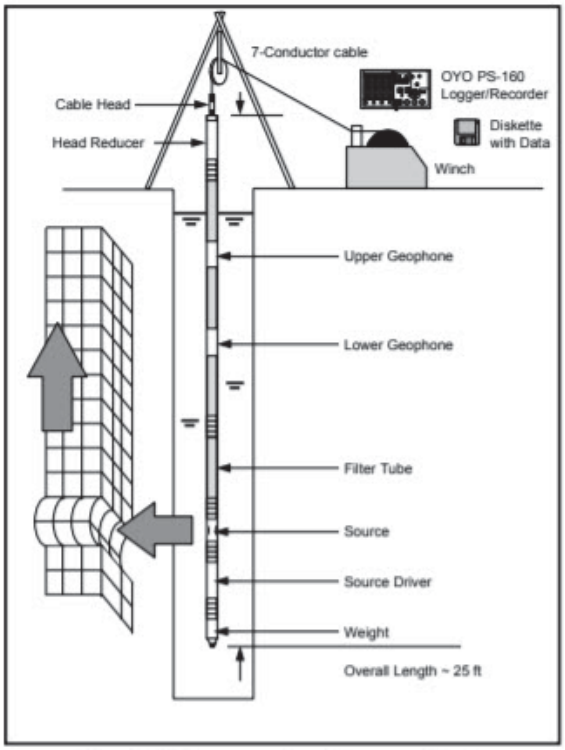
METHODOLOGY AND INSTRUMENTATION

Suspension logging

Soil velocity measurements were obtained using a suspension PS logging system, manufactured by OYO Corporation, and their subsidiary, Robertson Geologging. Data obtained with this system was used to calculate the average velocity of the soil column surrounding the boring by measuring the elapsed time of a wave propagating upward through the soil column from the transmitter to the receivers over a distance of 3.3 feet. The receivers that detect the wave, and the source that generates the wave, are moved as a unit down the boring at fixed intervals producing relatively constant amplitude signals at each depth where measurements are obtained.

The suspension system probe consists of a combined reversible polarity solenoid horizontal shear wave source (SH) and compressional-wave source (P), joined to two biaxial receivers by a flexible isolation cylinder. The separation of the two receivers is 3.28 feet, allowing average wave velocity in the region between the receivers to be determined by inversion of the wave travel time between the two receivers. The total length of the probe as used in these surveys is 21 feet. The probe receives control signals from, and sends the receiver signals to, instrumentation on the surface via an armored 4-conductor cable. The cable is wound onto

the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a 1.3-foot circumference sheave fitted with a digital rotary encoder.



Oyo PS Suspension Logger Setup

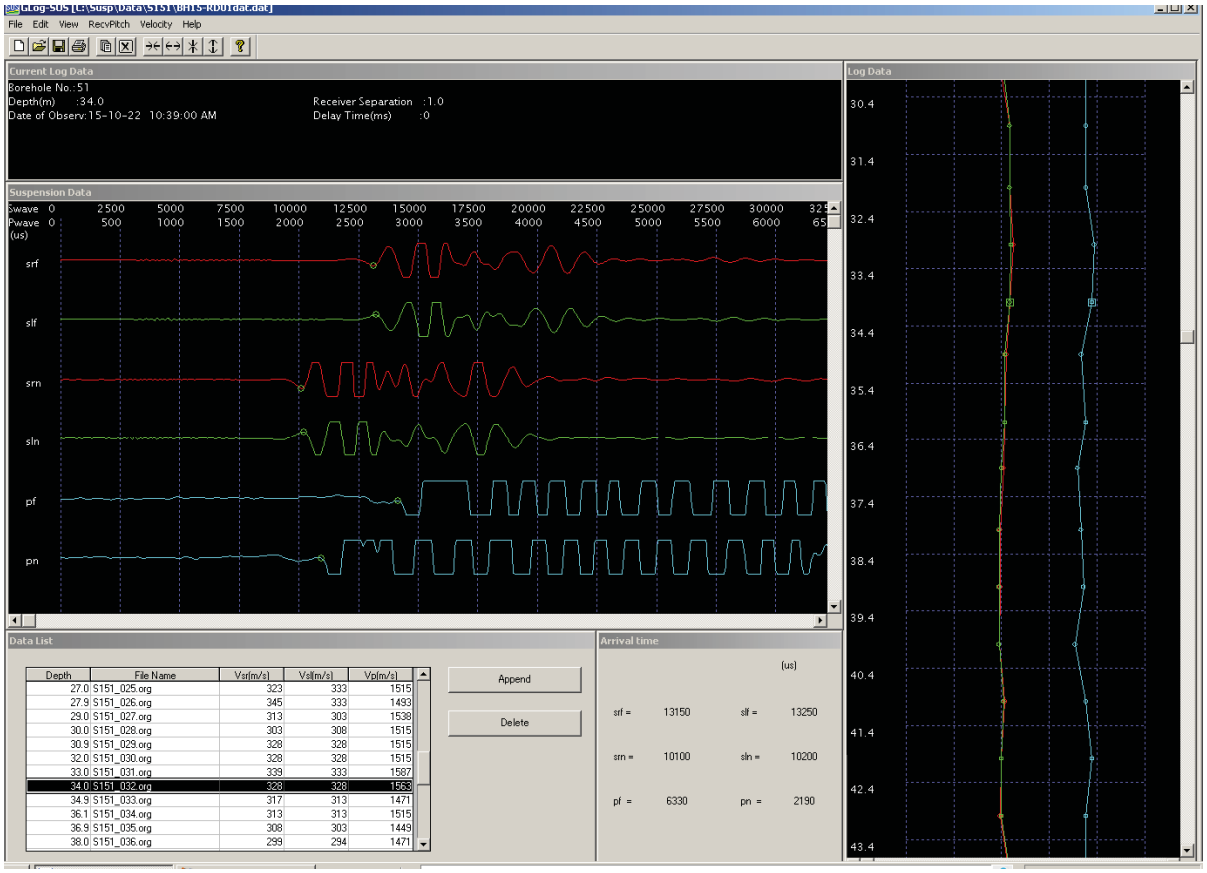
The entire probe is suspended in the boring by the cable, therefore, source motion is not coupled directly to the boring walls; rather, the source motion creates a horizontally propagating impulsive pressure wave in the fluid filling the boring and surrounding the source. This pressure wave is converted to P and SH-waves in the surrounding soil and rock as it passes through the casing and grout annulus and impinges upon the wall of the boring. These waves propagate through the soil and rock surrounding the boring, in turn causing a pressure wave to be generated in the fluid surrounding the receivers as the soil waves pass their location.

In operation, a distinct, repeatable pattern of impulses is generated at each depth as follows:

1. The source is fired in one direction producing dominantly horizontal shear with some vertical compression, and the signals from the horizontal receivers situated parallel to the axis of motion of the source are recorded.
2. The source is fired again in the opposite direction and the horizontal receiver signals are recorded.
3. The source is fired again and the vertical receiver signals are recorded. The repeated source pattern facilitates the picking of the P and SH-wave arrivals; reversal of the source changes the polarity of the SH-wave pattern but not the P-wave pattern.

QUALITY ASSESMENT ON SITE

The data quality was carefully monitored during acquisition. Polarity reversal for shear wave and strong s-wave data must be observed and confirmed. An example data is shown below.



Refraction Micro-tremor (ReMi)

The ReMi method determines variations in surface wave velocities with increasing distances and wavelengths. The data from these measurements are used to model the shear wave velocities of the subsurface. This information can then be used to infer rock/soil types, stratigraphy and soil conditions.

The ReMi survey requires a seismic source, to generate surface-waves, and at least 24 geophones, to measure the ground response at increasing distances from the source. Surface waves are a special type of seismic wave whose propagation is confined to the near surface medium. The depth of subsurface penetration of a surface-wave is directly proportional to its wavelength. In a non-homogeneous medium, surface-waves are dispersive, i.e. each wavelength has a characteristic velocity stemming from subsurface heterogeneities. The relationship between surface-wave velocity and wavelength is used to calculate the shear-wave velocity of the medium with increasing depth.

The seismic source can be either active or passive, depending on the application and location of the survey. Examples of active sources include explosives, weight-drops, and vibrating pads. Examples of passive sources are drill rigs, road traffic, micro-tremors, and water-wave action (in near-shore environments). Geophone measures the arrival time of the various components of the surface wave-train traveling from the seismic source.

The surface-wave velocity with respect to frequency (called the ‘dispersion curve’) is determined by measuring the delay time in wave propagation between the geophones. The dispersion curve is then matched to a theoretical dispersion curve using an iterative forward-modeling procedure. The result is a profile of shear-wave velocity versus depth. This shear wave profile can be with used other parameters such as density, to estimate the dynamic shear modulus of the medium as a function of depth.

The ReMi survey was conducted using a Geometrics Geode 24-channel digital seismograph with acquisition software. The sensors were Mark Products 4.5-Hz vertical geophones placed at 5 and 10 ft spacing and the seismic energy source was from traffic.

RESULTS

The s-wave velocities from suspension logging are direct measurement of s-wave speed between the two geophones. ReMi data were collected at G018 and G033 due to possible poor grouting upper part of the boreholes.

Table 1: S-wave velocity from Borehole G018

Depth (ft)	S-wave velocity (ft/s)	Note
0.0	608	Modeled velocity from ReMi
3.6	606	
7.6	591	
12.4	636	
17.5	650	
23.3	711	
29.6	739	
36.1	548	S-wave velocity from suspension logging
39.4	677	
42.6	979	
45.9	556	
49.2	613	
52.5	508	
55.8	587	
59.0	631	
62.3	1312	
65.6	1312	
69.2	671	
72.2	722	
75.4	800	
78.7	528	
82.0	745	
85.3	899	
88.6	656	
91.8	912	
95.1	912	
98.4	830	
101.7	764	
105.0	782	
108.2	874	

Depth (ft)	S-wave velocity (ft/s)	Note
111.5	663	
114.8	876	
118.1	874	
121.4	1132	
125.0	830	
127.9	900	
131.2	938	
134.5	1027	
137.8	1824	
141.4	1683	
144.3	508	
147.9	754	
150.9	1112	
154.2	597	
157.4	631	
160.7	982	
164.0	1027	
167.0	874	
170.6	863	
173.8	676	
177.1	1010	
180.4	945	
183.7	987	
187.0	1084	
190.2	1050	
193.8	1084	
196.8	1397	
200.1	2624	
202.0	2982	

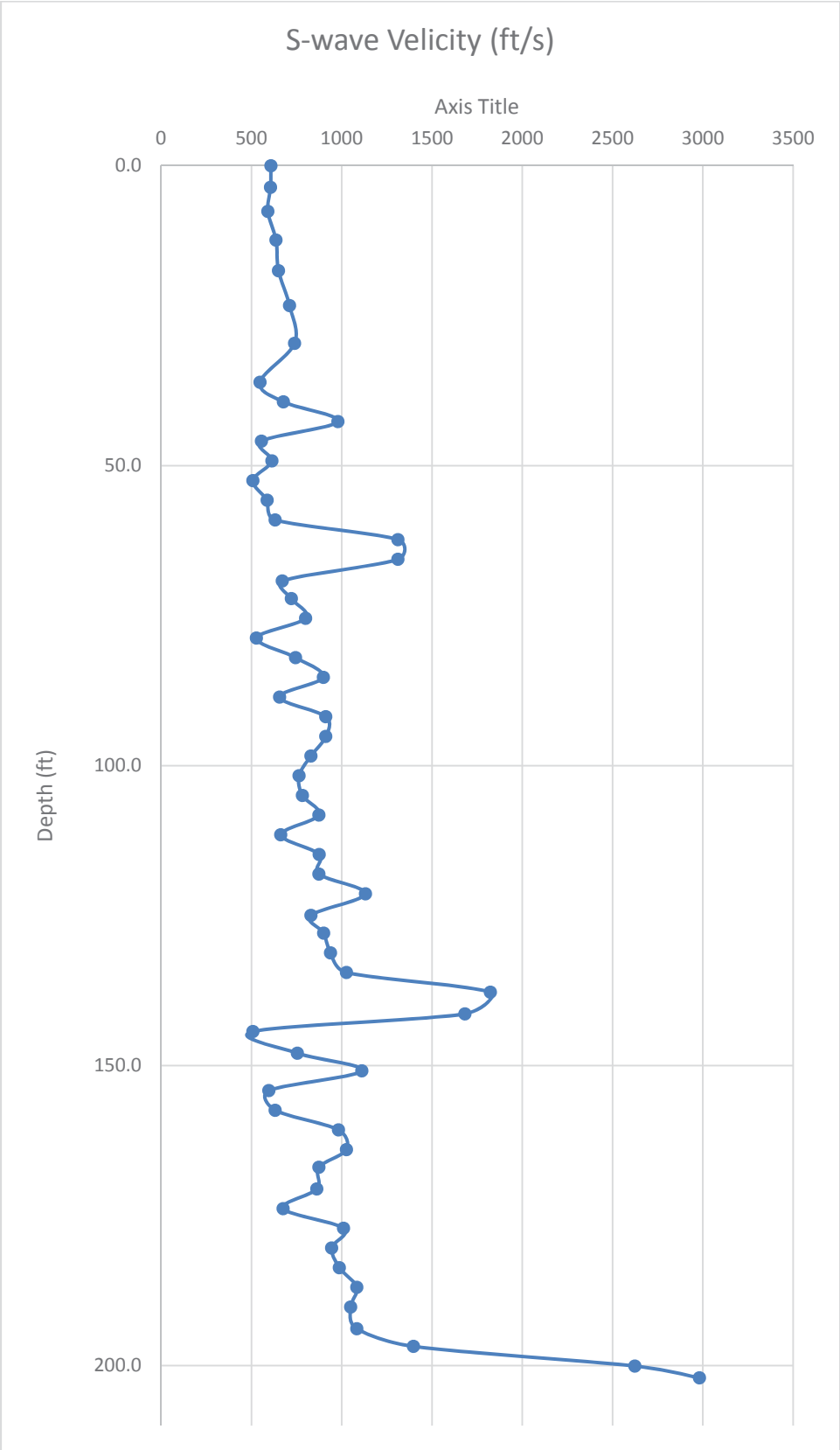

S-wave Velicity (ft/s)
Axis Title
0
500
1000
1500
2000
2500
3000
3500
0.0
50.0
100.0
150.0
200.0
Depth (ft)

Table 2: S-wave velocity from Borehole G031

Depth (ft)	S-wave velocity (ft/s)	Note
7.9	331	
9.8	336	
13.1	421	
16.4	695	
19.7	827	
23.3	979	
26.2	973	
29.5	1182	
32.8	666	
36.1	1010	
39.4	1474	
42.6	1004	
46.2	1301	
49.2	1445	
52.8	973	
56.1	864	
59.0	853	
62.6	841	
65.9	881	
68.9	763	
72.2	790	
75.4	835	Good quality data
78.7	836	

Depth (ft)	S-wave velocity (ft/s)	Note
82.3	858	
85.3	874	
88.6	899	
91.8	841	
95.1	858	
98.4	981	
102.0	1025	
105.0	864	
108.2	864	
111.5	951	
114.8	945	
118.4	835	
121.4	825	
124.3	938	
127.9	815	
131.2	966	
134.5	932	
137.8	918	
141.0	958	
144.3	1161	
147.6	987	
150.6	1004	

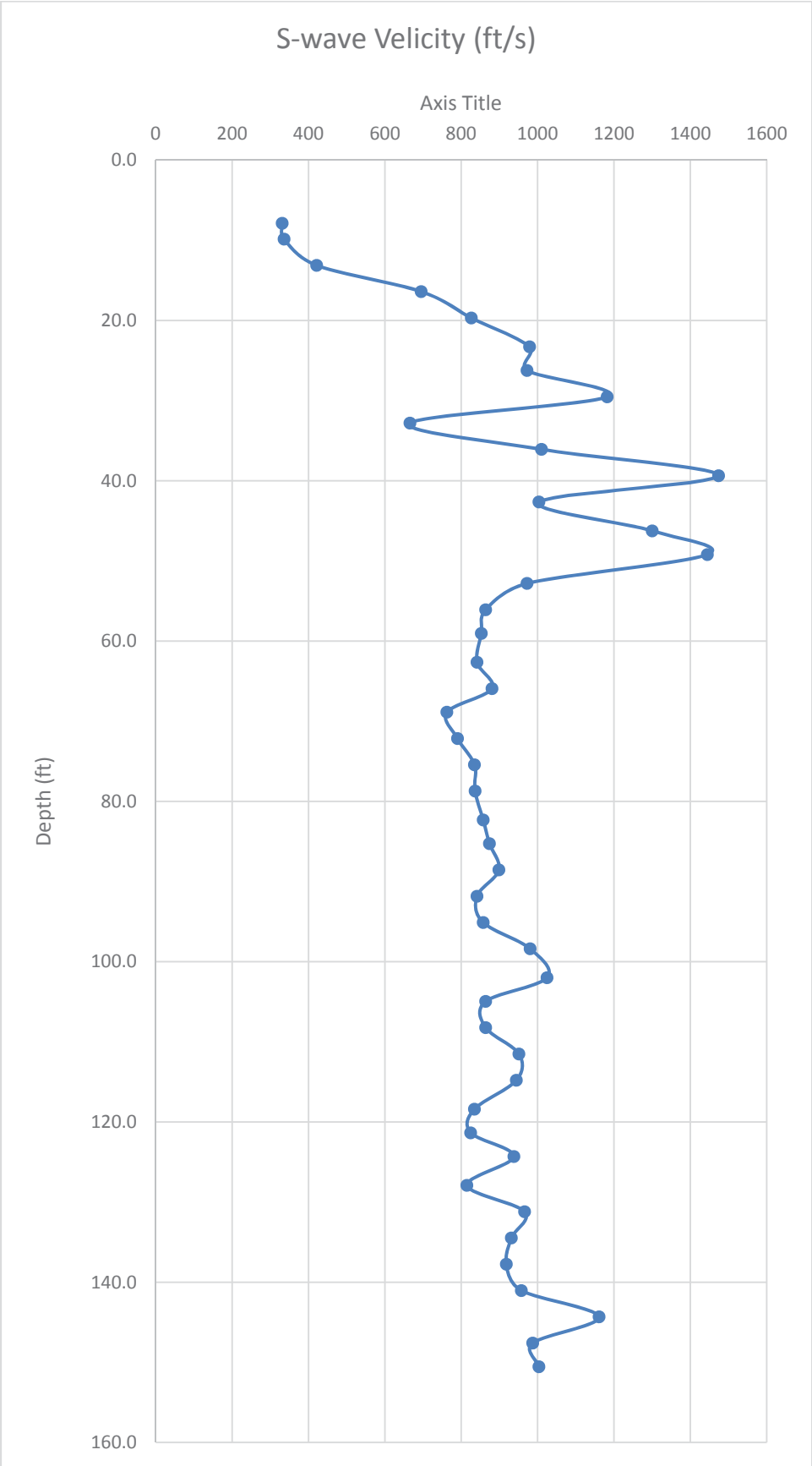

S-wave Velicity (ft/s)
Axis Title
0
200
400
600
800
1000
1200
1400
1600
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
Depth (ft)

Table 3: S-wave velocity from Borehole G033

Depth (ft)	S-wave velocity (ft/s)	Note
0.0	358	Modeled velocity from ReMi
3.5	329	
7.7	428	
12.4	571	
17.6	764	
23.3	921	
29.6	1063	
36.1	1197	S-wave velocity from suspension logging
39.4	781	
43.0	602	
45.9	741	
49.2	886	
52.5	1122	
56.1	1102	
59.0	1010	
62.3	786	
65.6	946	
68.9	1076	
72.2	1010	
75.4	979	
78.7	841	
82.3	853	
85.3	815	
88.9	841	
91.8	874	
95.1	810	
98.4	830	
101.7	981	
104.6	995	
108.2	754	
111.5	853	

Depth (ft)	S-wave velocity (ft/s)	Note
114.5	1043	
118.1	1043	
121.4	805	
124.6	945	
127.9	951	
131.2	1004	
134.5	964	
137.8	1018	
141.0	1004	
144.3	1002	
147.6	1112	
150.9	995	
154.2	1051	
157.4	1092	
160.7	1084	
164.0	1312	
167.3	1383	
170.9	1215	
173.8	1456	
177.1	1261	
180.4	1286	
184.0	1683	
187.0	2083	
190.2	2265	
193.2	2678	
196.8	3201	
200.1	2678	
203.4	2918	
206.6	2624	
209.9	2573	
212.9	2432	

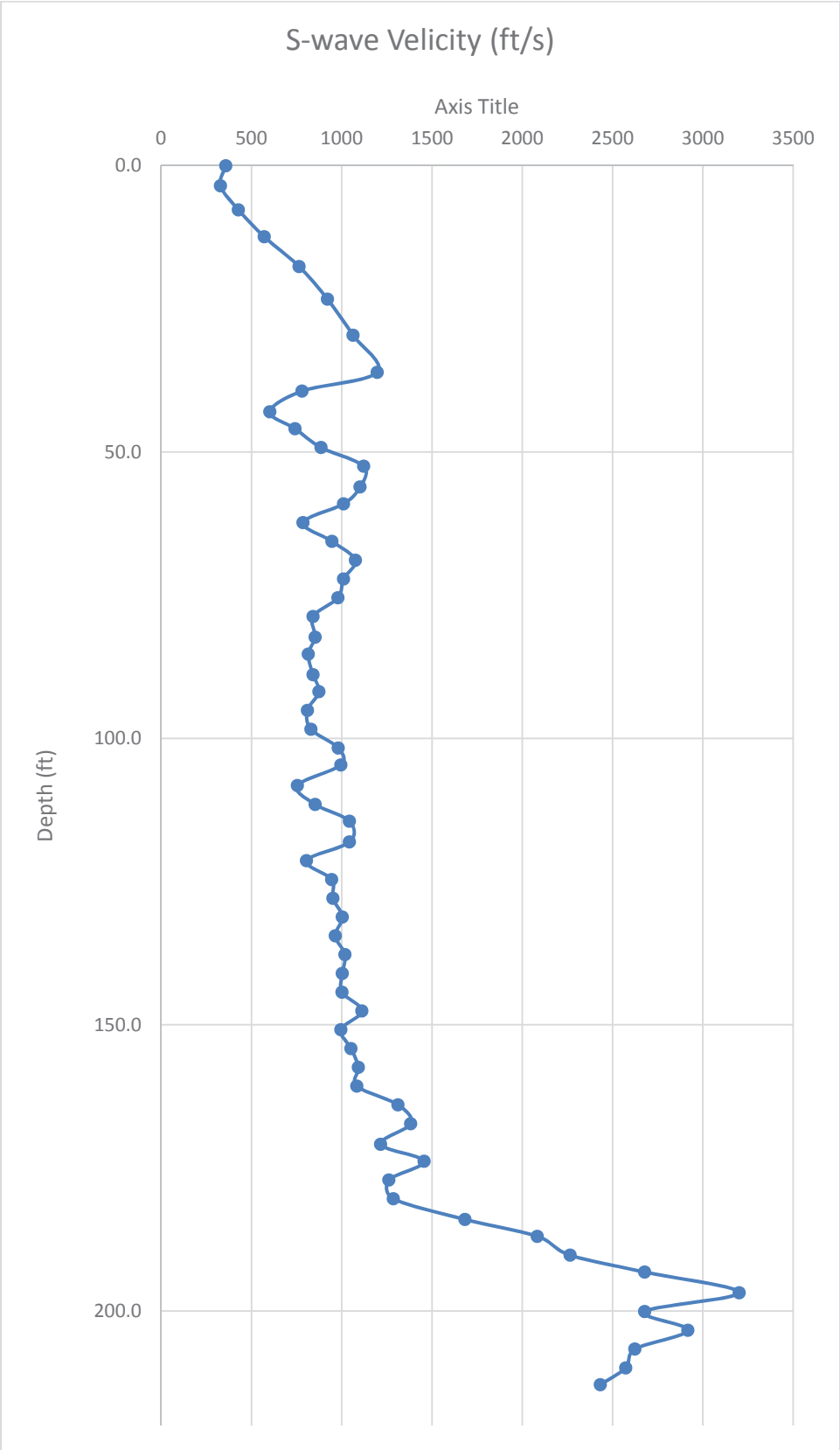

S-wave Velicity (ft/s)
Axis Title
0
500
1000
1500
2000
2500
3000
3500
0.0
50.0
100.0
150.0
200.0
Depth (ft)

Table 4: S-wave velocity from Borehole G036

Depth (ft)	S-wave velocity (ft/s)	Note
7.9	705	
9.8	587	
13.1	513	
16.1	1197	
19.7	1238	
23.0	1112	
25.9	795	
29.2	1099	
32.8	982	
36.1	1015	
39.4	886	
42.6	912	
45.6	469	
48.9	556	
52.8	526	
55.8	722	
59.0	925	
62.0	651	
65.6	736	
68.9	782	
72.5	899	
75.4	1043	
78.7	1043	
82.0	1287	
85.3	887	
88.6	1010	
91.8	1151	
95.1	2050	
98.7	1291	
101.7	863	
105.3	1040	S-wave velocity from suspension logging
108.2	874	
111.5	1066	

Depth (ft)	S-wave velocity (ft/s)	Note
115.1	1460	
118.1	1427	
121.7	1214	
124.6	1325	
127.9	1250	
131.2	1476	
134.5	1474	
141.0	1583	
144.3	1661	
147.6	1642	
150.9	1525	
154.5	1774	
157.4	1848	
161.0	1525	
164.3	1620	
167.3	1601	
170.6	1661	
174.2	1799	
177.1	1750	
180.4	1353	
183.7	1474	
187.3	1460	
190.2	1353	
193.8	1025	
196.8	1182	
200.1	1397	
203.4	1442	
206.6	1274	
209.9	1263	
213.5	1286	
216.5	1383	
219.8	1852	
222.7	1929	

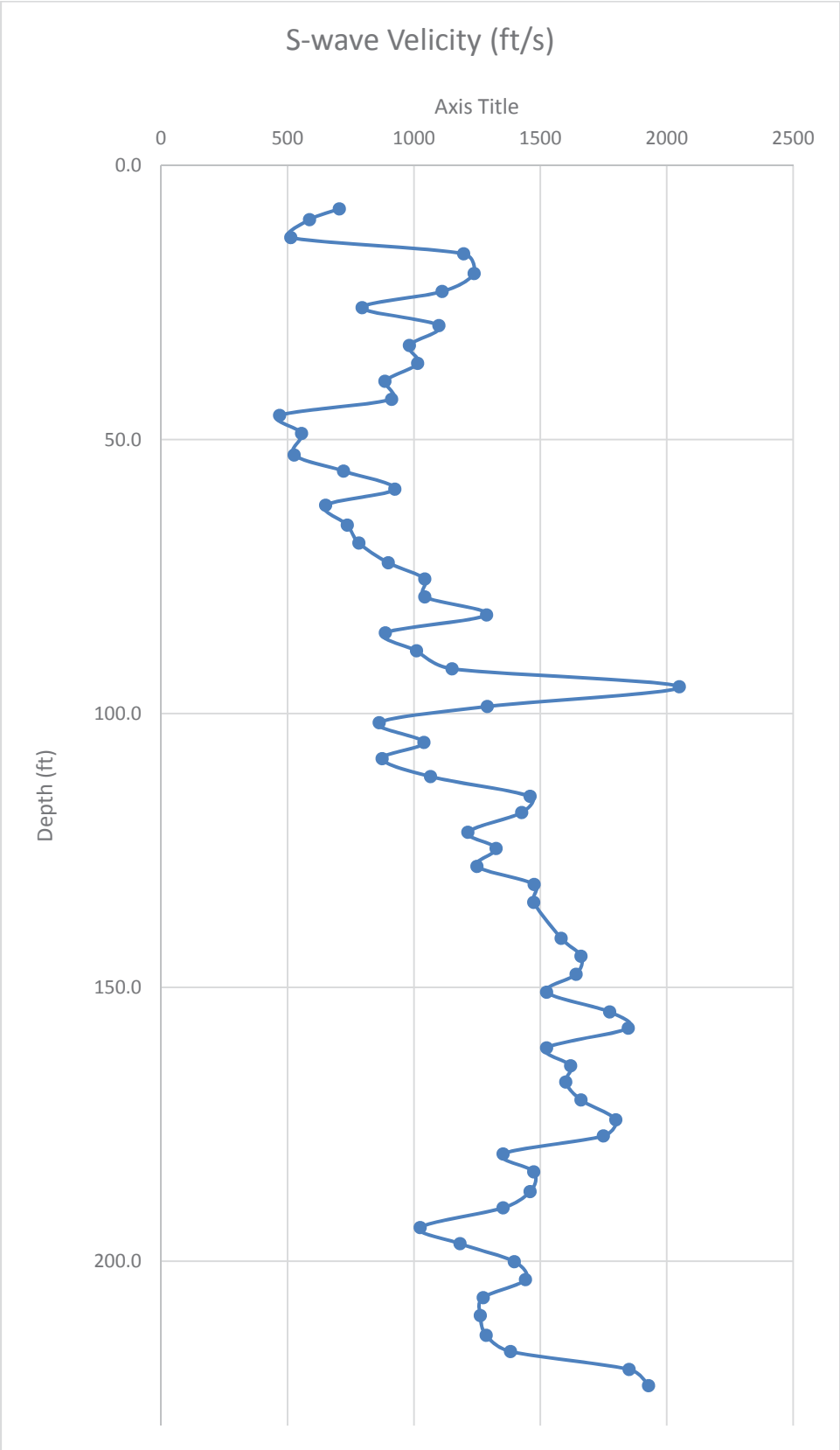

S-wave Velicity (ft/s)
Axis Title
0
500
1000
1500
2000
2500
0.0
50.0
100.0
150.0
200.0
Depth (ft)

Table 5: S-wave velocity from Borehole G037

Depth (ft)	S-wave velocity (ft/s)	Note
7.9	471	
9.5	608	
13.1	510	
16.1	305	
19.4	353	
22.6	433	
26.2	308	
29.8	320	
32.8	313	
36.1	213	
39.4	208	
42.6	412	
45.9	367	
49.5	254	
52.5	499	
56.1	297	
59.0	366	Poor quality data
62.3	251	
65.6	449	
69.2	372	
72.2	466	
75.4	563	
78.7	636	
82.3	590	
85.3	571	
88.6	987	
91.8	846	
95.4	1035	
98.4	874	
101.7	874	
105.3	858	
108.2	846	
111.5	869	
115.1	1084	Good quality data
118.1	951	

Depth (ft)	S-wave velocity (ft/s)	Note
121.4	776	
124.6	1002	
128.2	625	
131.2	720	
134.5	795	
138.1	738	
141.0	1066	
144.6	932	
147.6	1620	
150.9	1368	
154.2	1058	
157.1	597	
161.0	810	
164.3	572	
167.3	792	
170.6	784	
173.8	761	Poor quality data
177.1	851	
180.7	1151	
183.7	1122	
187.0	876	
190.6	684	
193.8	1173	
197.1	1051	
200.1	848	
203.4	1068	
207.0	1238	
209.9	995	
213.5	894	
216.5	1194	
219.4	1397	
223.4	1601	
226.3	2386	Good quality data
228.9	2052	

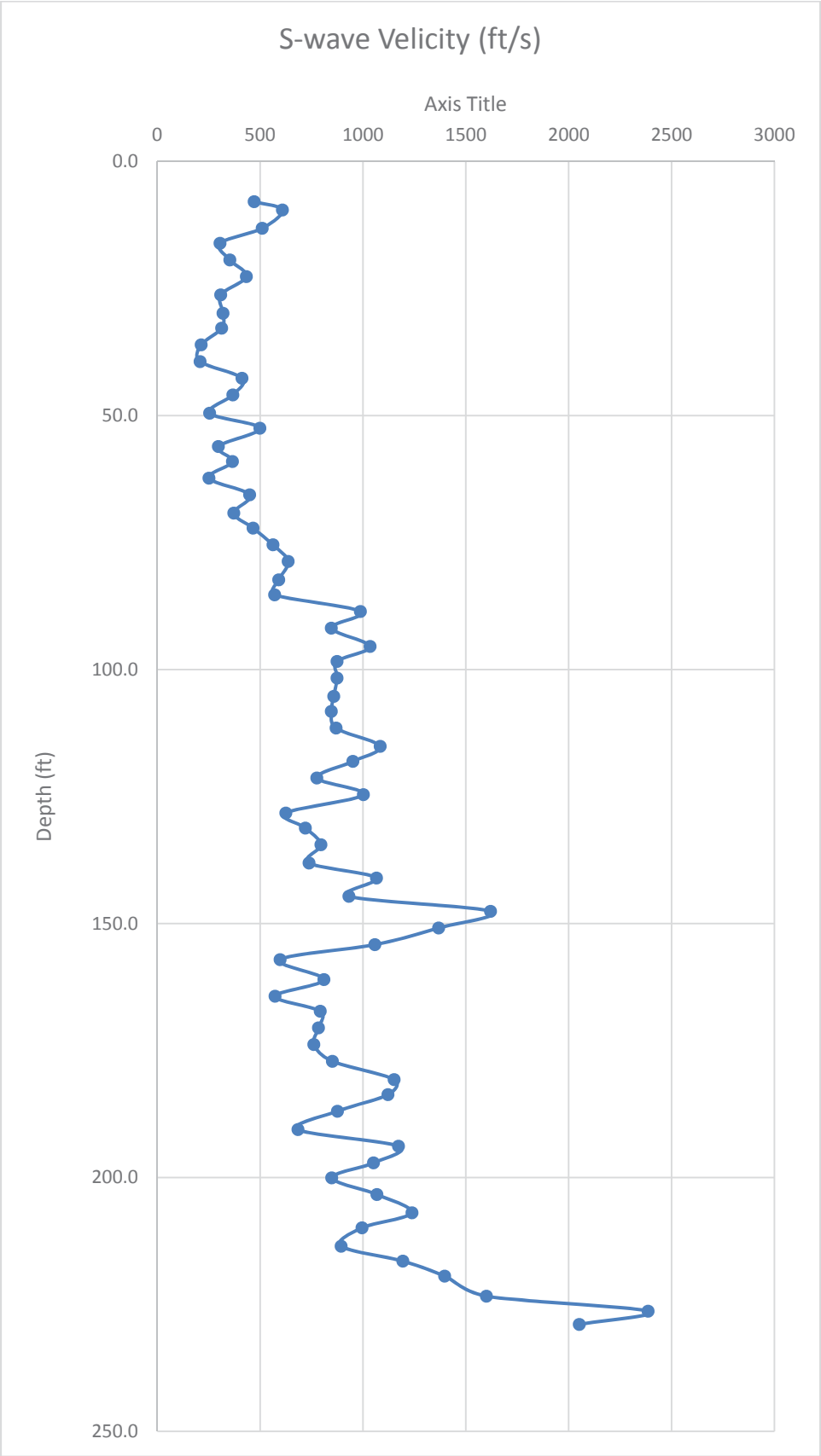
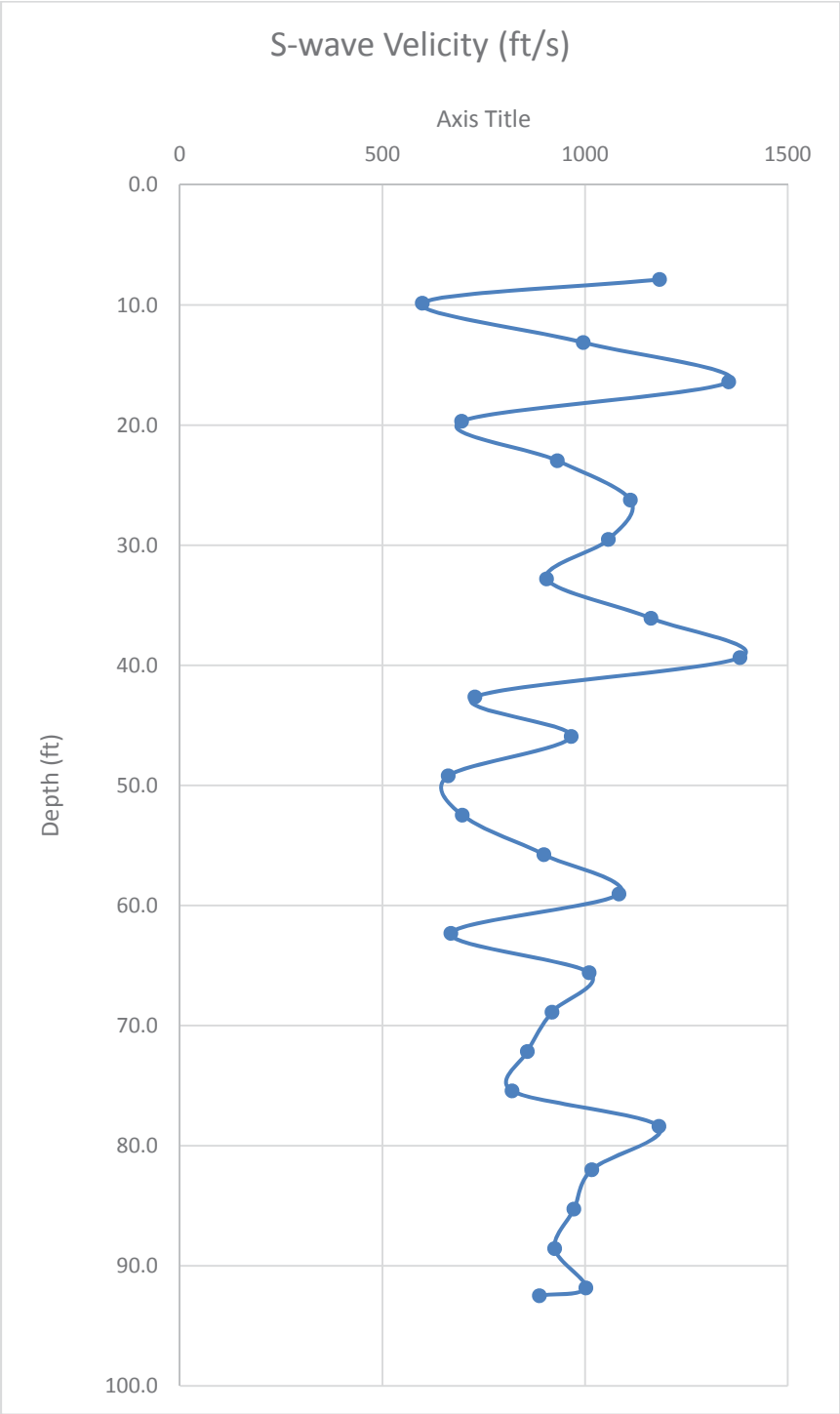

S-wave Velicity (ft/s)
Axis Title
0
500
1000
1500
2000
2500
3000
0.0
50.0
100.0
150.0
200.0
250.0
Depth (ft)

Table 6: S-wave velocity from Borehole G037A

Depth (ft)	S-wave velocity (ft/s)	Note
7.9	1184	
9.8	599	
13.1	995	
16.4	1355	
19.7	695	
23.0	932	
26.2	1112	
29.5	1058	
32.8	905	
36.1	1163	
39.4	1383	
42.6	728	
45.9	966	
49.2	663	
52.5	697	
55.8	899	
59.0	1084	
62.3	669	
65.6	1010	
68.9	918	
72.2	858	
75.4	820	
78.4	1182	
82.0	1017	
85.3	973	
88.6	925	
91.8	1002	Good quality data
92.5	887	


S-wave Velicity (ft/s)
Axis Title
0
500
1000
1500
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Depth (ft)

LIMITATIONS OF THE GEOPHYSICAL METHODS

Global geophysics services are conducted in a manner consistent with the level of care and skill ordinarily exercised by other members of the geophysical community currently practicing under similar conditions subject to the time limits and financial and physical constraints applicable to the services. Suspension logging is a remote sensing geophysical method that may not detect all subsurface conditions due to the limitations of the methods, soil conditions, and size of the features.

Sincerely,

Global Geophysics, LLC.

John Liu, Ph.D., R.G.
Principal Geophysicist

APPENDIX E

IN SITU TESTS - PRESSUREMETER TESTING DATA

Report of Pressuremeter Testing Boreholes DRLE-G031 & DRLE-G018 Redmond Link Downtown Extension Redmond, WA

Submitted to:

Golder Associates Inc.
18300 NE Union Hill Rd, Suite 200
Redmond, WA 98052

Golder Associates Project Number 1657705
In Situ Engineering Project Number 1543
November 1, 2017

Testing conducted and report prepared by:

In Situ Engineering

6232 195th Avenue SE

Snohomish, WA 98290 360-568-2807

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1.0 INTRODUCTION

This report contains the test results and analyses for electronic pressuremeter testing (PMT) performed in Redmond, Washington for the Sound Transit Redmond Link Downtown Extension project. In Situ Engineering was under contract to Golder Associates, Redmond, Washington.

The test was performed in two boreholes, DRLE-G031 and DRLE-G018.

Borehole DRLE-G031 had drilling performed by Holt Drilling using a truck mounted B-58 at depths up to 58 feet. Four tests were performed in a single mobilization from September 19-20, 2017 at depths of 16 and 58 feet below ground surface.

Borehole DRLE-G018 had drilling performed by Holocene Drilling using a CME 850 Drill rig at depths up to 75 feet. Six tests were performed in a single mobilization from October 23-24, 2017.

Borehole names, test depths and preliminary material descriptions are presented in Appendix I, Table 1.

An estimated average unit weight of 130 pounds per cubic foot and a water table depth of 15 feet was used for analyses of DRLE-G031; and 125 pounds per cubic foot of weight and a water table depth of 10 feet was used for analyses of DRLE-G018. A K_0 value was calculated by the formula 1-sinφ or estimated by In Situ Engineering from geotechnical references.

2.0 PURPOSE

The purpose of the PMT was to determine in situ material properties for the Sound Transit Redmond Link Downtown Extension. In situ material properties analyzed are as follows:

Shear Modulus
Limit Pressure
Shear Strength (Cohesion or Friction)

3.0 PRESSUREMETER TESTING

A total of four pressuremeter tests were performed in G031 borehole. Due to the high percentage of clean gravel encountered in the upper portion of the borehole, only one test was performed in each test interval at 16 feet and 23.5 feet. The proposed test intervals at approximately 30 feet and 40 feet were unattainable, as too much gravel sloughed into the test pocket, making instrument insertion impossible. The final two tests performed at 56.5 feet and 58 feet were successful.

In borehole G018, a total of six pressuremeter tests were performed. Due to the high percentage of clean gravel encountered in the upper portion of the borehole, the upper two test pockets of 15-20 feet and 30-35 feet are over washed. Two test attempts at 19.7 feet and 33.5 feet were unattainable, as the gravel washed out, making bigger boreholes beyond the instrument maximum

radial range. The four tests performed at 55.0 feet, 53.5 feet, 74.5 feet and 73.0 feet were successful.

Two field engineers performed testing in 10-hour shifts. The details of the pressuremeter testing and interpretations of these tests are included in the following sections of this report.

3.1 Instrumentation

The instrument used for this study was a pre-bored mono-cell electronic pressuremeter. The pressuremeter is equipped with a pressure sensor and three electronic displacement sensors spaced 120 degrees apart and located at the center of the instrument. A flexible membrane is placed over the sensors and clamped at each end. The membrane is covered by a protective sheet of stainless steel strips referred to as a shield. The unit is pressurized using compressed air, which expands the membrane to deform the adjacent material. Electronic signals from the displacement and pressure sensors are transmitted via cable to the surface. An electronic circuit board in the instrument converts the analog signal to digital output. The digital output is sent via data control wires, located alongside the high pressure supply hose. During testing, the average expansion versus pressure is displayed on a computer screen. The membrane is expanded and drained by regulating the flow of compressed air to the PMT unit via manual control panel operated by the field engineer. The instrument is placed down a pre-bored hole before expansion commences. A schematic of the instrument is shown as Figure 1.

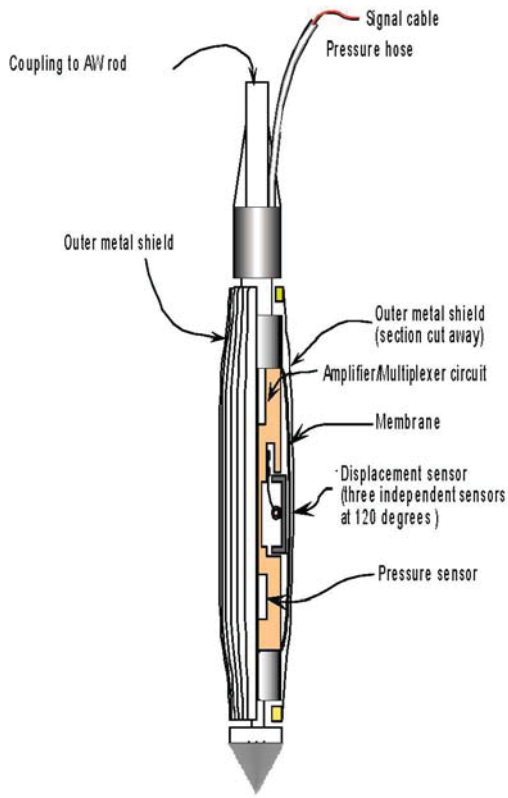

Figure 1 Schematic Details of the Pressuremeter Instrument

Instrument readings also include effects of the response due to the strength and compressibility of the expanding rubber membrane. To correct for these effects, membrane correction tests are performed each time a membrane is replaced on the instrument.

To correct for membrane strength, an air correction test is performed. The instrument is placed in a vertical position with no lateral constraint. The instrument is then inflated several times (normally 0% to 14% strain). Resulting stress strain curves record the amount of resistance to expansion caused by the membrane, or membrane strength.

To correct for membrane compressibility and the effect of pressure on the electronics, a tube test is performed. The instrument is placed within a thick walled steel tube and inflated to 2000 psi (14,000 kPa). The resulting stress strain curve is a record of the membrane's stiffness. All data presented in this report are corrected for membrane effects.

Test depths are recorded using the bottom of the pressuremeter as a reference. The expansion of the pressuremeter occurs approximately between 6.5 inches (0.165 meters) and 24 inches (0.6 meters) above the reference depth. For example, if the test depth was 6.0 feet, the actual test zone would be between 4.0 and 5.55 feet.

3.2 Hole Formation

The borehole and test pockets were formed using mud rotary techniques. The boring was advanced with a 5 $^{7}/_{8}$" tricone. Test intervals were drilled with a 2 $^{15}/_{16}$" tricone. No casing was installed in borehole DRLE-G031. Casing was installed over the bigger hole of borehole DRLE-G018 about 10-feet above the bottom of the hole. The instrument was then lowered down to the bottom of the test pocket with NWJ and 6 feet of AWJ on the end just above the instrument.

3.3 Test Procedure

After placing the instrument into the test pocket, the membrane was inflated by controlling the flow of compressed air into the pressuremeter, increasing the pressure until the membrane started to expand against the borehole wall. After the instrument began to deform the material, the first of a series of unload-reload cycles (loop) was performed. The point of initiation of the unload-reload loop is a judgment call of the field engineer, but usually results in a series of loops that are spaced more or less evenly through the pressure-expansion curve. Unload-reload loops are formed by reducing the applied pressure by no more than 40% of the initiation point of the loop, then increasing again.

Resultant unload-reload loop can be used to evaluate the material's elastic behavior. In materials which behave in a plastic manner, the loops will exhibit a hysteretic behavior. That is, the unloading path will follow the "mirror" image of the reloading path. In materials such as sand the

loops will be very tight, exhibiting little hysteretic behavior; in materials such as clay, the loops will exhibit large hysteretic behavior.

Pressure is then added until a sufficient increase in stress or strain has occurred before completing a second unload-reload loop. This process is then repeated a third or fourth time as the test progresses. If the disturbance from drilling is small and the material behavior is consistent with increased strain, the slope of the loops will tend to be parallel.

After the strain reaches the maximum range (12% to 18%) or the stress reaches the maximum range (2000 psi or 14MPa), pressure is reduced to zero. The exact maximum stress or strain at which pressure is reduced to zero is a decision made by the operator based on the behavior of the three arms, instrument response and other limiting conditions. Tests may be terminated before material failure if one of the following occurs: the limit of any one strain arm is reached, the maximum pressure of the pressure bottle is reached, electronic failure occurs, the membrane ruptures, or the instrument response is such that membrane rupture may be imminent. For all the tests in this scope of work, the limiting factor was the maximum strain of the instrument.

An example of a pressuremeter test (PMT) curve is shown below in Figure 2. Four unload-reload loops were performed. This test also illustrates a very slightly oversize hole resulting in minor disturbance. The sidewall is appears intact at about 5% strain and the test exhibits undisturbed response past this point.

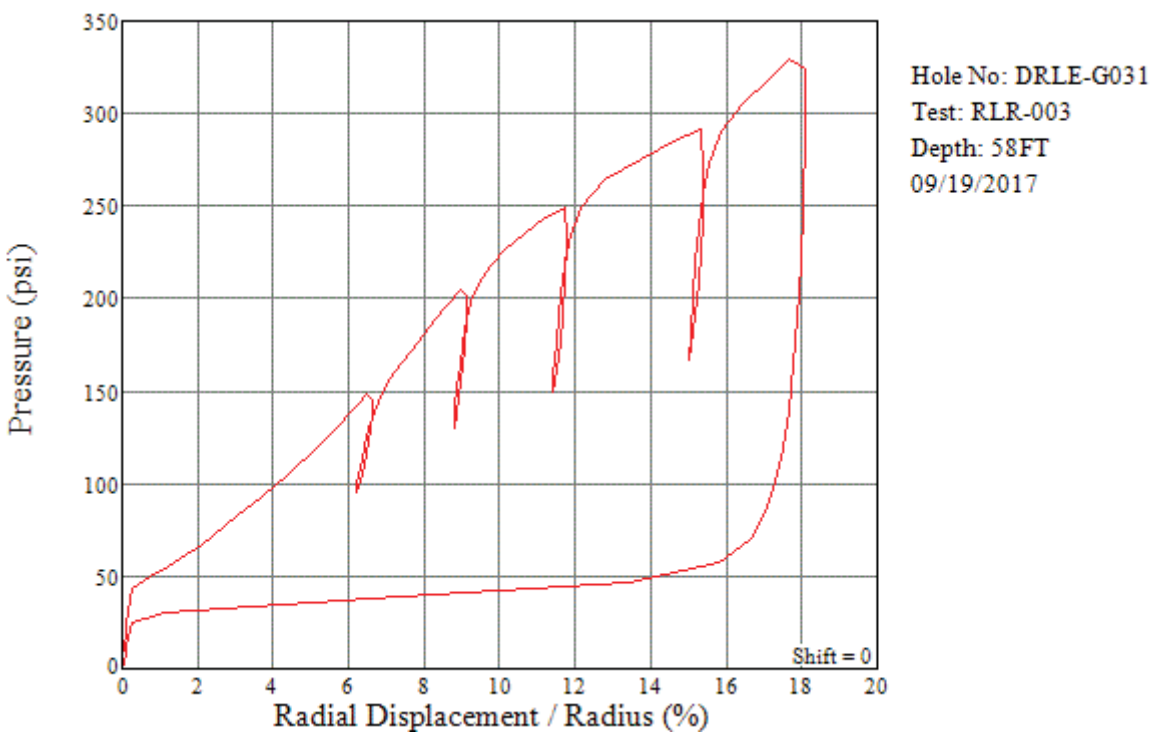

Figure 2 Example PMT Curve

3.4 Analysis of the Shear Modulus

If material surrounding the pressuremeter is assumed to extend to infinity, and assumed to behave as an idealized linear elastic, homogeneous material, which does not fail under shear or tension, then the displacement on the boundary of the pressuremeter, u_a, for a given pressure, P, is given by:

$$\mu_a = P(a)\ (1 + \upsilon) / E \qquad 1)$$

where:

"E" is Young's Modulus
"a" is radius of the pressuremeter cavity
"υ" is Poisson's ratio.

As the shear modulus, "G", and the Young's modulus, "E", are related by the following relationship:

$$E = 2\ (G)\ (1 + \upsilon) \qquad 2)$$

Equation 1 reduces to:

$$\mu_a = 0.5\ P(a) / G \qquad 3)$$

Hence, the shear modulus G is given by:

$$G = 0.5\ (\Delta \text{ Pressure} / \Delta \text{ (radial displacement / radius)}) \qquad 4)$$

The shear modulus for the average slope of the initial loading curve of the pressuremeter test data expressed as a Young's modulus (Equation 2) is the same as the "Pressuremeter Modulus" defined in the American Society for Testing and Materials (ASTM) D4719, Section 9.5.

The moduli determined from the unload-reload loops are more accurately defined than the initial modulus and are more representative of the elastic modulus for the *in-situ* material. Figure 3, shown below, is an example of the moduli determined from unload-reload loops.

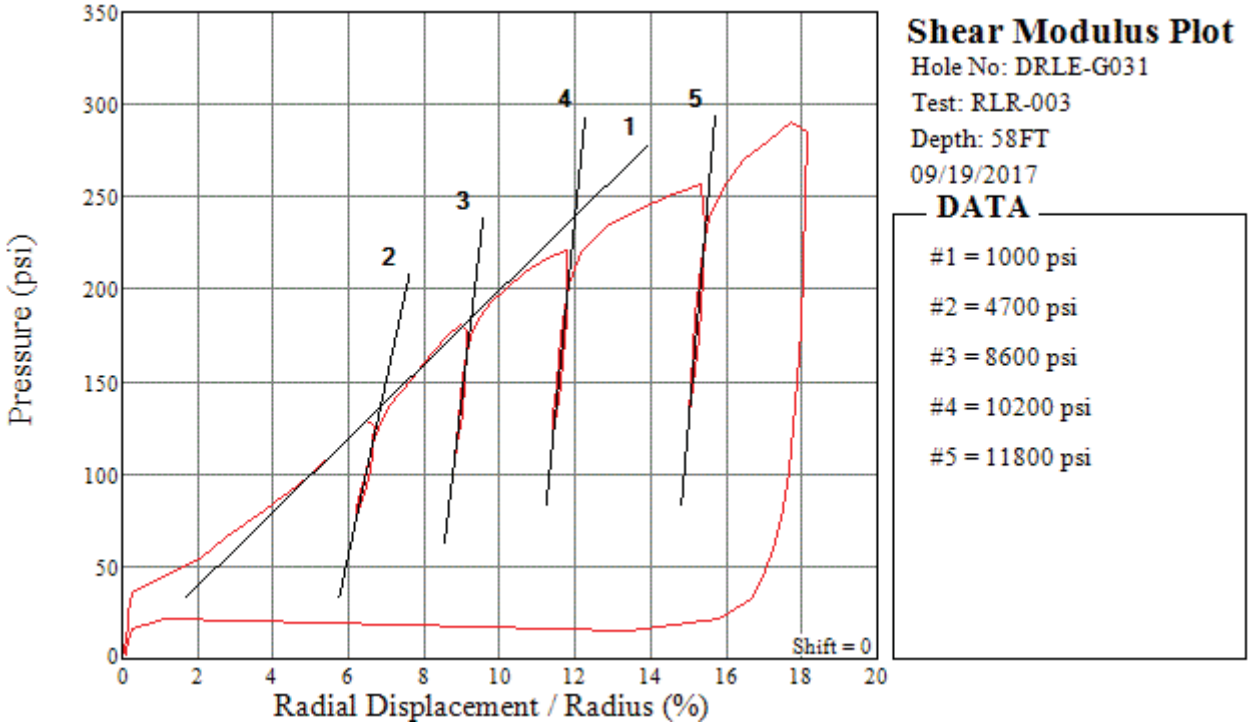

Figure 3 Shear Modulus Analysis

Typically, by performing multiple unload-reload loops during a test, two or more of the loops tend to be parallel, confirming a particular shear modulus value and indicating that the material is not disturbed. However, if the test pocket is highly disturbed, then parallel loops can be difficult to obtain. Also, these unload-reload loops may exhibit anti-parallel behavior (decreasing or increasing shear modulus) due to the nature of the material. In other words, the material behavior may change with strain. In general, frictional material will exhibit strain hardening and cohesive materials strain softening. In the example shown above, it appears that strain hardening takes place. All unload-reload moduli values are summarized in Appendix I, Table 2.

3.5 Limit Pressure and Approximate Shear Strength by Log Method

Visual inspection of the typical PMT curve (Figure 2), demonstrates that as the material is loaded, the stress strain curve is not a straight line, but tends to curve. It can be surmised that if our instruments could supply sufficient pressure, then a maximum value would be reached. This effect is more pronounced in cohesive soils.

Different materials reach their limit pressure at different strains. For consistency, the limit pressure has been defined as the pressure achieved when the volume of the pressuremeter has doubled. Few pressuremeters can actually expand this far before reaching the limit of the strain sensing system. The pressuremeters used in this investigation will only expand to about 20% before the displacement limit is reached. Therefore, to overcome instrument limitations of both pressure and strain, the double volume must be mathematically extrapolated.

If the material being tested is assumed to behave as an elastic cohesive material, then the equation governing the pressure-displacement curve is given by:

$$P = P_L + (c)\log_e (u_a/_a) \qquad 5)$$

$$P_L = P_o + c + (c)\log_e [G/c] \qquad 6)$$

Where:

"P_L" is theoretical limit pressure at infinite expansion
"c" is undrained cohesive strength
"P_O" is total *in-situ* lateral stress
"G" is shear modulus

From Equation 5, a plot of pressure against the log of u_a/a will be a straight line, provided the shear strength remains constant with strain. The slope of this line will provide a measure of the undrained shear strength, c. The Limit Pressure, as defined by the ASTM D4719, Section 10.6, is the pressure at which the cavity has doubled in size. This doubling in size occurs when (u_a/a) is equal to 41%. If any disturbance is present, the above method of determining cohesive strength usually provides an overly optimistic value. Figure 4, shown below, is plotted in the above manner.

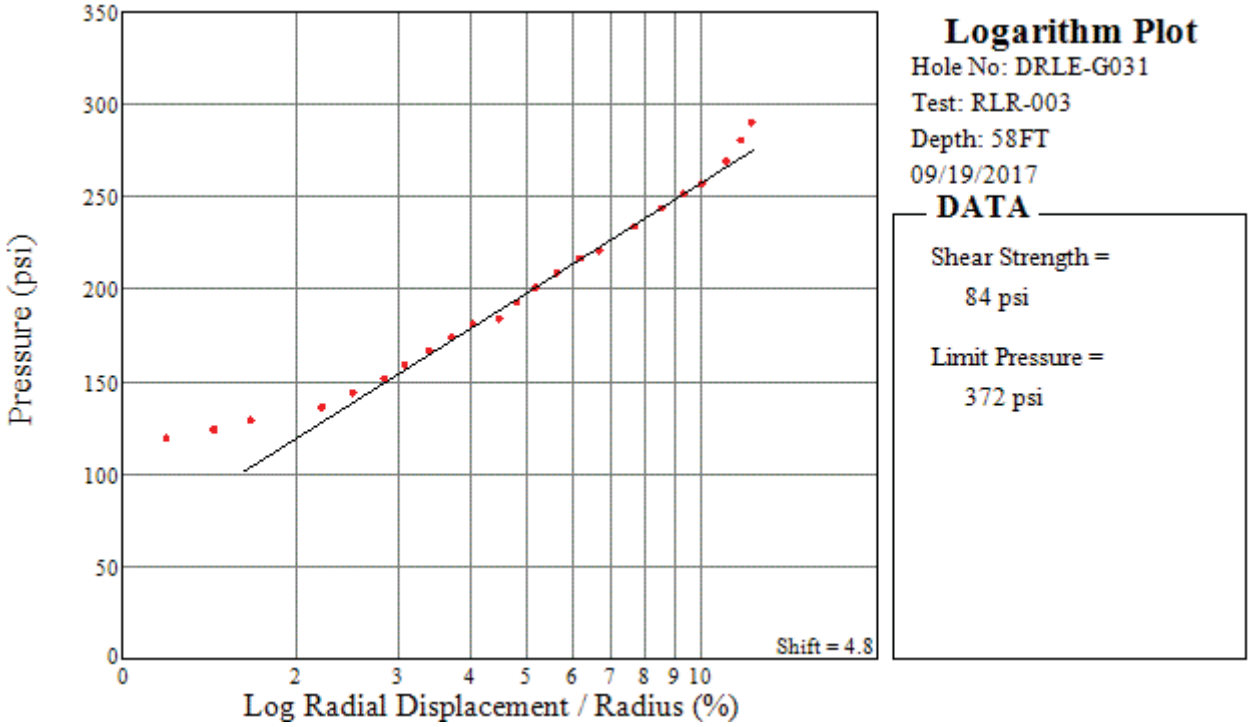

Figure 4 Limit Pressure by Log Method

The above shear strength method applies to cohesive materials and is not appropriate in granular materials or rock. However it can be used in the onsite materials to give an indication of the strength and limit pressure that can be applied to the ground. This helps constrain upper bounds for design purposes. The limit pressure and shear strength derived from the log plot are presented in Appendix I, Table 3. The shear strength by log method are not technically valid for these predominately frictional materials as it is inappropriate, and are shown for qualitative purposes only.

3.6 Material Properties by Model Analyses

The strength of a material being tested can be determined if a failure mechanism or model is assumed. The modeling approach incorporates assumptions about the material properties and mechanism of failure. Each type of model has input variables. The more simple the model, the fewer the number of variables, whereas more complex models have more variables. In modeling, the variables are input and the resultant curve examined against the field curve. The variables are then adjusted until a best fit curve is obtained.

In Situ Engineering uses three primary models in analysis. These are:

Cohesive Model by Gibson.

Variables:
1. Shear strength
2. Total lateral stress
3. Shear modulus

Assumptions:
1. Material deforms as a right circular cylinder
2. Material behaves as a purely cohesive material with no friction
3. Shear strength remains constant during failure
4. No volume change

Friction Model by Hughes

Variables:
1. Friction angle
2. Lateral effective stress
3. Critical friction angle is constant
4. Water pressure
5. Shear modulus

Assumptions:
1. Material deforms as a right circular cylinder
2. Material behaves as a purely frictional material with no cohesion
3. Frictional strength remains constant

Cohesive Model by Palmer with Arnold's Analysis

Variables:
1. Model the curve with three points

Assumptions:
1. Material deforms as a right circular cylinder
2. Material behaves as a purely cohesive material with no friction
3. Shear strength remains constant during failure
4. No volume change

In modeling analysis, it can usually be readily determined by the shape of the field curve if the material is primarily cohesive, primarily frictional or a combination of the two. The soils tested in this study were all frictional and therefore the Hughes friction model was the only model used.

3.7 Frictional Strength Model Analysis

The PMT data in sands can be used directly to determine the *in-situ* material properties such as friction angle. For frictional materials, it is assumed that the material surrounding the pressuremeter deforms as a uniform right cylinder; that is, it deforms in plane strain. Another assumption is that the material has a constant friction angle and no cohesion. The method used for interpretation is based on analysis presented by Hughes *et* al (1977), and can also be found in Mair and Wood, *Pressuremeter Testing*.

The friction angle and lateral stress are adjusted, using engineering judgment, until a best fit is obtained. Figure 5, shown below, is an example of the model analysis.

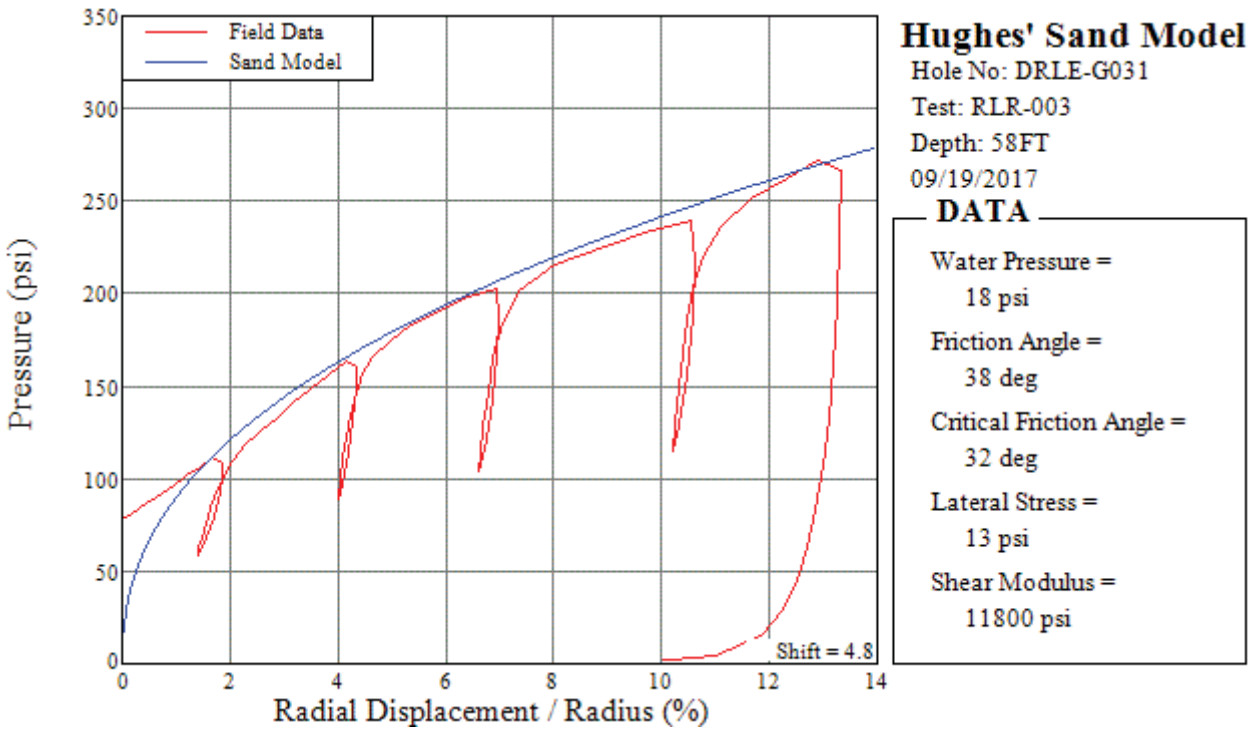

Figure 5 Frictional Model

In examining the results of the friction model on test RLR-03, it can be seen that that the model curve fits the field curve center portion well but does not fit the beginning and the end well. The curve has been shifted 4.8% so that the initial curve portion has been "cut off". This is to help reset the curve strain origin to account for initial oversize hole and relaxation disturbance. The results of this model analysis have been presented in Appendix I, Table 4.

3.8 Lateral Pressure Comments

One of the objectives of pressuremeter testing is to help define the lateral stress of the materials. Depending upon the materials there may be several methods which can be used to obtain lateral

pressure information. These include lift off pressure analysis in undisturbed clay, balance pressure in clay and modeling techniques.

Because of significant disturbance in many of the tests and the frictional behavior of all the materials, analyzing the lift off was not possible. The balance pressure method was also not feasible due to the absence of pure clays.

In analyzing the data with the Hughes friction model, we initially begin with the relationship of $K_0 = 1 - \sin\varphi$ and set an assumed value of 32° friction angle. We then iteratively adjust the friction angle and the lateral stress until a stable solution was formed. This resulted in K_0 values ranging from .28 to .43 which appear to be reasonable values from textbook references for sand and gravel materials. If the above iteration does not fit the field curve, we then use higher values of K_0 with an engineering judgment until a reasonable lateral stress is attained and results a best model to field curve fitting. Higher K_0 values could be an indication of possible glacial consolidation of the in-situ material.

3.9 Pile Displacement Curves (P-Y)

The design of laterally loaded piles can be considered in two ways. Firstly the ground can be considered as a continuum with some ideal material properties. That is each element in the surrounding soil is influenced by neighboring elements in three dimensions. A simple model would include a stiffness strength and lateral stress. Finite element or FLAC models are useful for that approach. Alternatively the soil can be divided up into discrete horizontal layers with each layer acting as a spring against the pile. An example of this is shown in Figure 6. However in this case the layers do not interact with each other. This is a much simpler approach from an analytical point of view. The pile is considered as a continuous elastic member with known properties and the lateral resistance of the soil is considered as a series of independent springs.

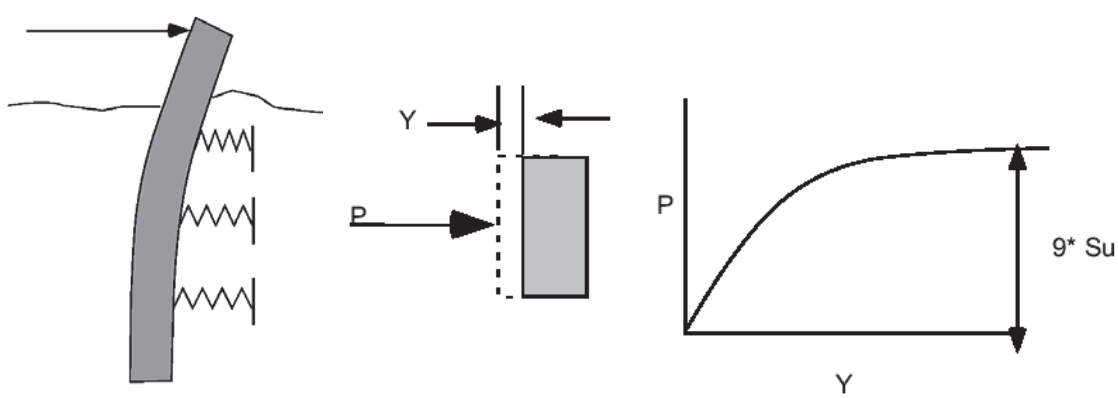

Figure 6 Spring action acting on a length of pile.

From back calculation of lateral loading tests (Briaud 1986) it has been found that in medium clays the spring stiffness of the soil is geometrically similar to the loading stage of a

pressuremeter tests. However some adjustment to the pressuremeter curve is necessary. If a section of pile, some distance below the ground surface (at least 4 diameters) is pushed laterally the ultimate resistance will be approximately 9 * the cohesive strength (shown above Figure 11). In contrast the Limit Pressure from the pressuremeter test is approximately 5 * the cohesive strength + the static lateral pressure, shown below in Figure 7.

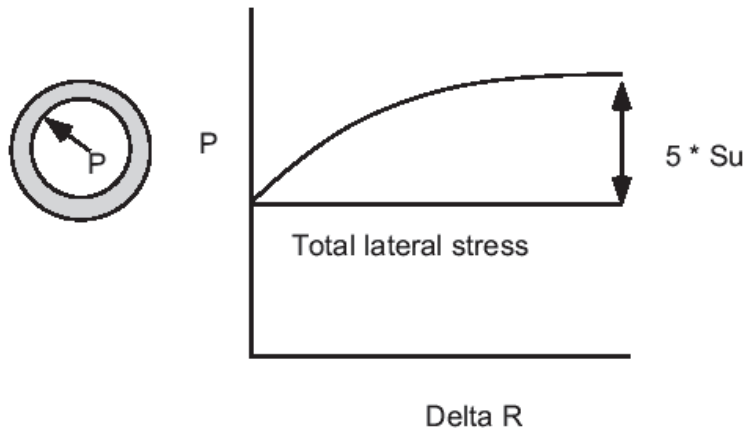

Figure 7 Ideal pressuremeter test

Hence the P/Y curve can be developed from the ideal pressuremeter curve by increasing the pressure (less the lateral pressure) by a factor. For clays this factor is 2 and for sands it is 1.5. An example representative P/Y curve is shown in Figure 8.

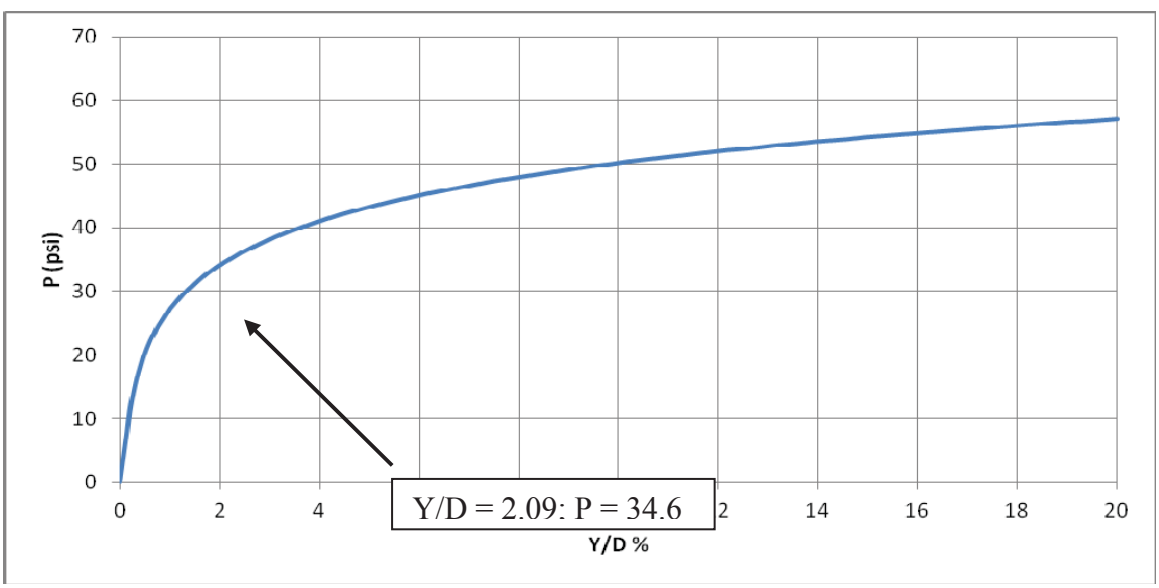

Figure 8 P-Y data developed from a pressuremeter test

The chart shown above displays the P-Y data as a pressure on the vertical axis and displacement divided by pile diameter on the horizontal axis.

For example, using a drilled shaft foundation 36 inches in diameter with the springs at 72 inch centre then the load displacement curve is shown in Figure 9.

.

An example calculation using the point shown in Figure 9:
The projected area of a 36 inch diameter shaft for a 72 inch increment with the applied 34.6 psi load is: 36*72 *34.6= 89,683 lbs.
The corresponding displacement is: Y/D = 2.09%;
therefore Y =(36*2.09)/100= .752 inches

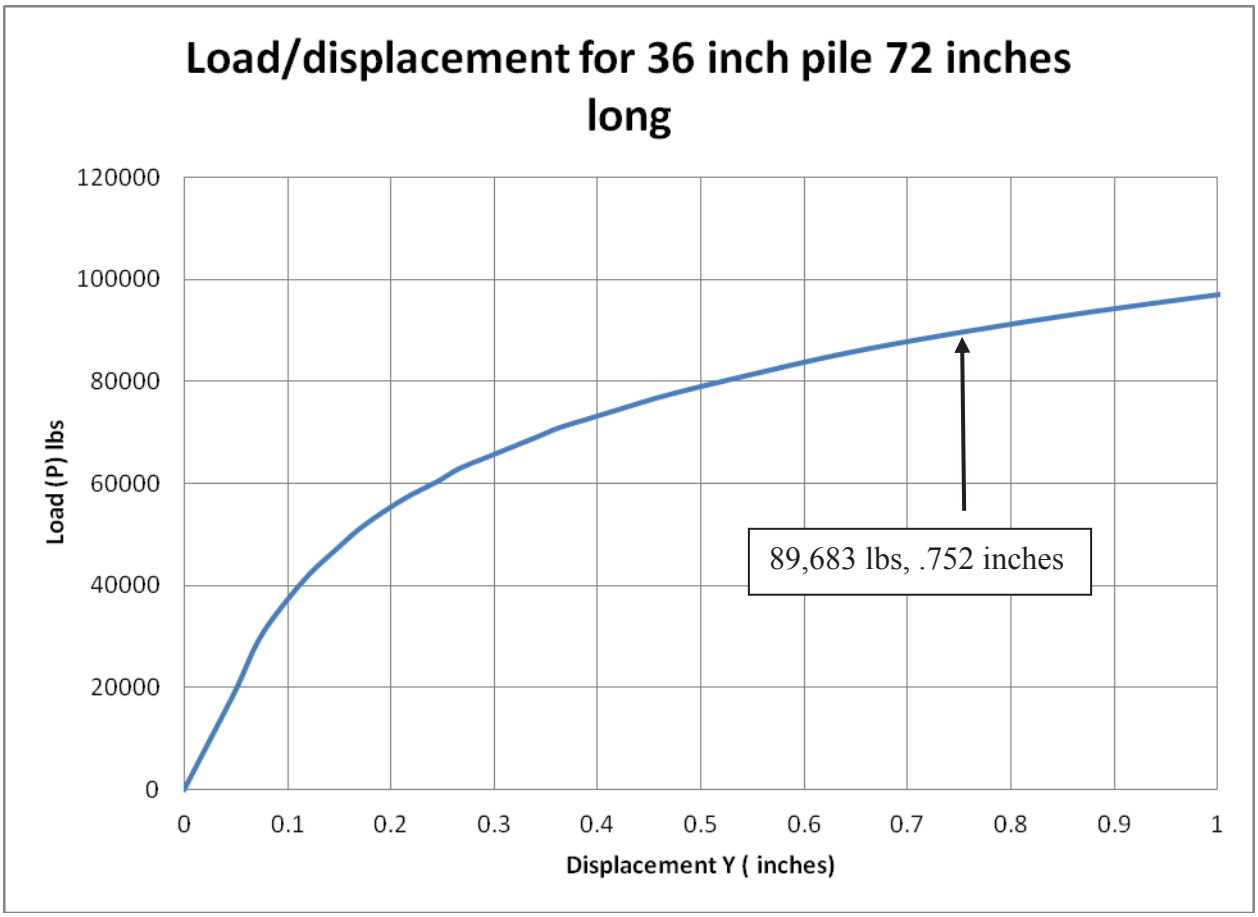

Figure 9 Example Load Displacement Data

P-Y curves for both frictional and cohesive responses are provided in the Appendices.

4.0 CONCLUSIONS

The test program was partially successful in that tests produced good quality useable results in material which had sufficient fines to bind particles and hold the pre-drilled hole open. Clean gravelly zones could not be drilled and held stable even with heavy bentonite mud.

The soil materials tested responded in a frictional manner and we only applied the Hughes friction model for analyzing the soils.

The limit pressure extrapolations should be considered of high quality.

Shear strength derived from the log method should be used only as a guide. The cohesive strength theory used with the log plots is not strictly applicable to materials with any frictional component and the shear strength value is shown only for qualitative purposes.

The shear modulus derived from the unload-reload loops should be considered of high quality. Shear modulus values at higher strains are probably more representative of the intact material as there was relaxation of the soils during the drilling process. The relaxation is more pronounced at low strains.

Both tests RLR-005 at 19.75ft and RLR-006 at 33.2ft in borehole DRLE-G018 were unattainable, as the gravel was washed out, making bigger boreholes beyond the instrument maximum radial range.

Attempting to derive the lateral stress from the PMT could not be done and we used a relationship of $K_0 = 1- \sin\varphi$ in an iterative manner in the Hughes model to derive lateral stress solutions for all tests of borehole DRLE-G031. For borehole DRLE-G018, only K_0 for test RLR-010 was derived in such an iterative manner. For tests RLR-007, RLR-008 and RLR-009 K_0 was adjusted to attain a suitable lateral stress that best fit the model curve to the field curves.

P-Y curves were developed from the Hughes model curve responses.

5.0 REFERENCES

Mair, R.J. and Wood, D.M. 1987. Pressuremeter testing: methods and interpretation. CIRIA Ground Engineering Report. Butterworths, London.

ASTM D4719. 2007. Standard tests method for pressuremeter testing in soils.

Uses of Insitu Tests in Geotechnical Engineering Geotechnical Special Publications No 6, 1986, Briaud, J.L. Pressuremeter and Foundations Design Page 110 Method 8

Appendix I – Data Tables

Table 1 Pressuremeter Test Depths and Material Descriptions

Test	Boring	Date	Test Depth (feet)	Formation
RLR-001	DRLE-G031	09/18/2017	16.0	Gravel
RLR-002	DRLE-G031	09/18/2017	23.5	Gravel
RLR-003	DRLE-G031	09/19/2017	58.0	Sand
RLR-004	DRLE-G031	09/19/2017	56.5	Sand
RLR-005*	DRLE-G018	10/23/17	19.8	Sandy Gravel
RLR-006*	DRLE-G018	10/23/17	33.2	Sandy Gravel
RLR-007	DRLE-G018	10/24/2017	55.00	Sand
RLR-008	DRLE-G018	10/24/2017	53.50	Sand
RLR-009	DRLE-G018	10/24/2017	74.50	Sand
RLR-010	DRLE-G018	10/24/2017	73.00	Sand

- - Denotes caving test pocket and/or oversize hole. No valid test was possible.

Table 2 Shear Modulus Values

Test	Depth (feet)	Initial Shear Modulus (psi)	Unload-Reload Shear Moduli (psi)			
RLR-001	16.0	1060	4810	9170	10200	14640
RLR-002	23.5	1700	3200	4800	9300	17400
RLR-003	58.0	1000	4700	8600	10200	11800
RLR-004	56.5	900	4600	7800	13000	
RLR-007	55.00	19900	15200	18300	22800	27900
RLR-008	53.50	16270	6200	9400	10300	14100
RLR-009	74.50	21800	19900	25500	28000	
RLR-010	73.00	13500	9500	11500		

Table 3 Log Shear Strengths and Limit Pressure

Test	Depth (feet)	Shear Strength (psi)	Limit Pressure (psi)
RLR-001	16.0	78	327
RLR-002	23.5	119	496
RLR-003	58.0	84	372
RLR-004	56.5	91	395
RLR-007	55.00	141	596
RLR-008	53.50	66	331
RLR-009	74.50	140	643
RLR-010	73.00	72	323

Shear strength values are not technically valid for these frictional soils and are shown for qualitative purposes only.

Table 4 Hughes Model Frictional Strengths

Test	Test Depth (ft)	Shear Modulus (psi)	u (psi)	σ'_h (psi)	Φ degrees	K_0
RLR-001	16.0	14640	0	5	42	.33
RLR-002	23.5	17400	4	5	46	.28
RLR-003	58.0	11800	18	13	38	.38
RLR-004	56.5	13000	18	13	38	.38
RLR-007	55.00	27900	19	26	34	.9
RLR-008	53.50	14100	19	21	32	.75
RLR-009	74.50	28000	28	27	35	.65
RLR-010	73.00	9500	27	15	35	.43

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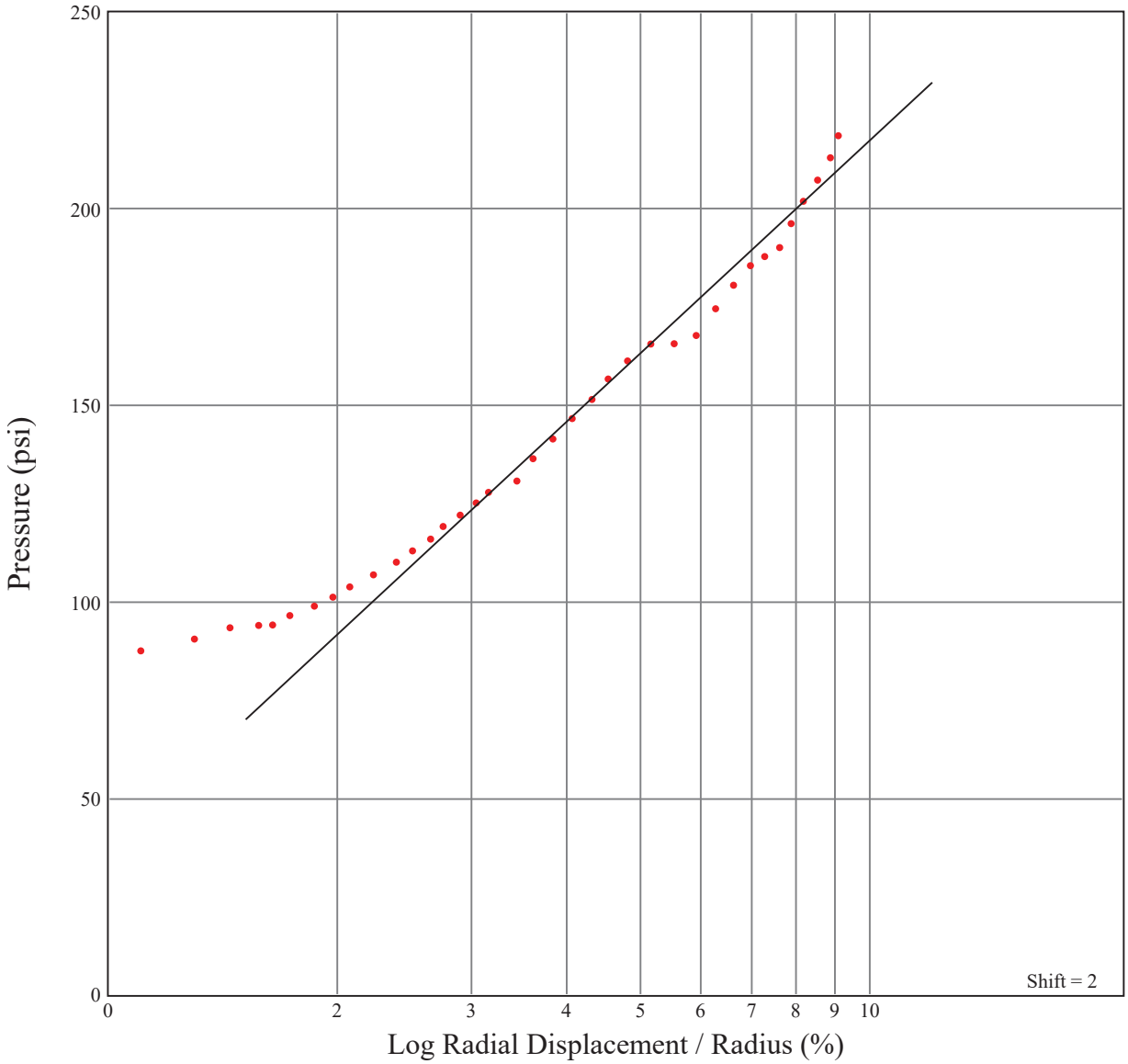
Appendix II – Pressuremeter Data

In Situ Engineering - Logarithm Plot

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-001 Depth: 16FT Date: 09/18/2017
Oper: Mayfield/Okbay Job # 1657705 Time of Test: 10:47 AM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)



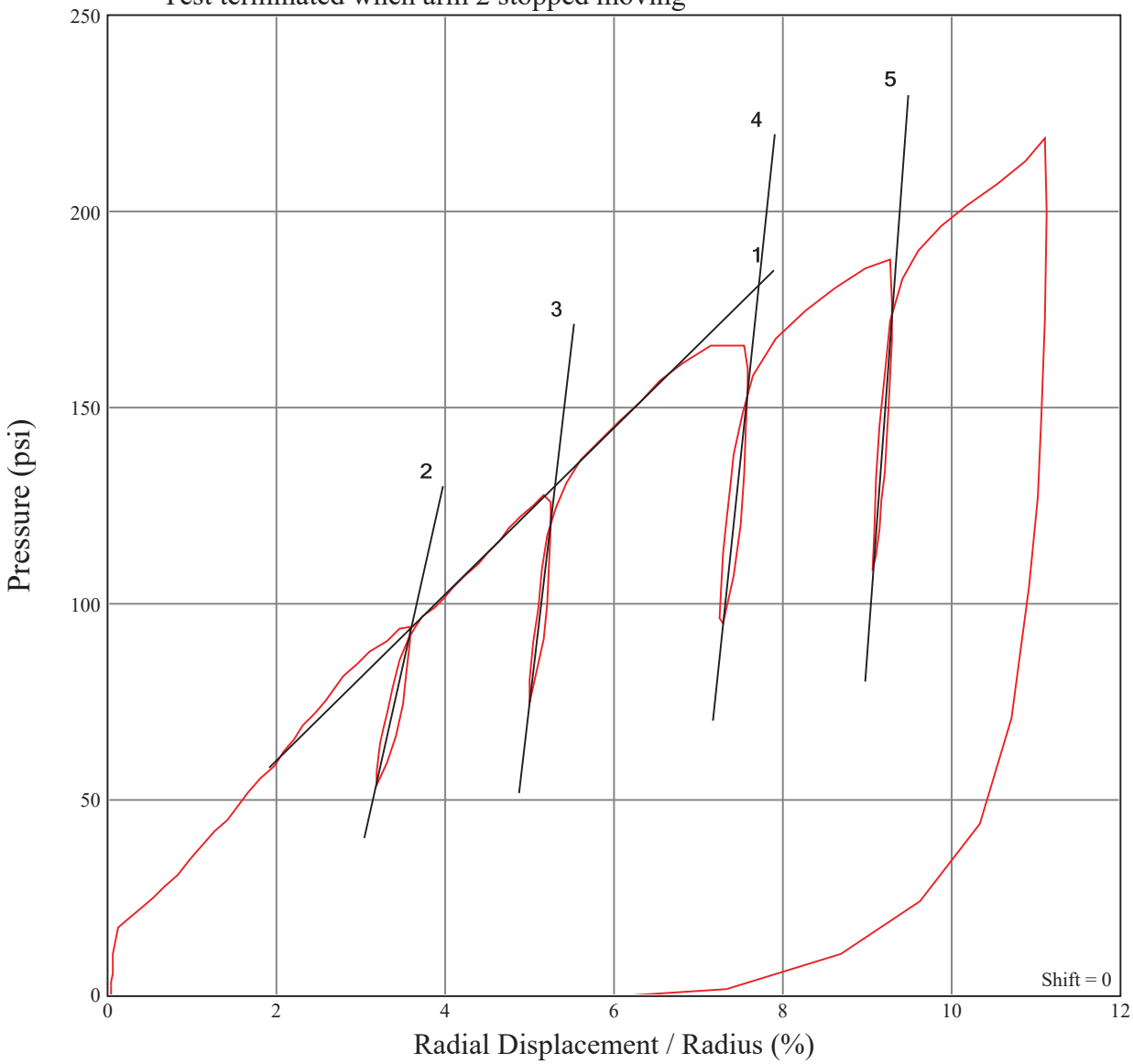
DATA

Shear Strength = 78 psi

Limit Pressure = 327 psi

In Situ Engineering - Shear Modulus Plot

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-001 Depth: 16FT Date: 09/18/2017
Oper: Mayfield/Okbay Job # 1657705 Time of Test: 10:47 AM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)
Test terminated when arm 2 stopped moving

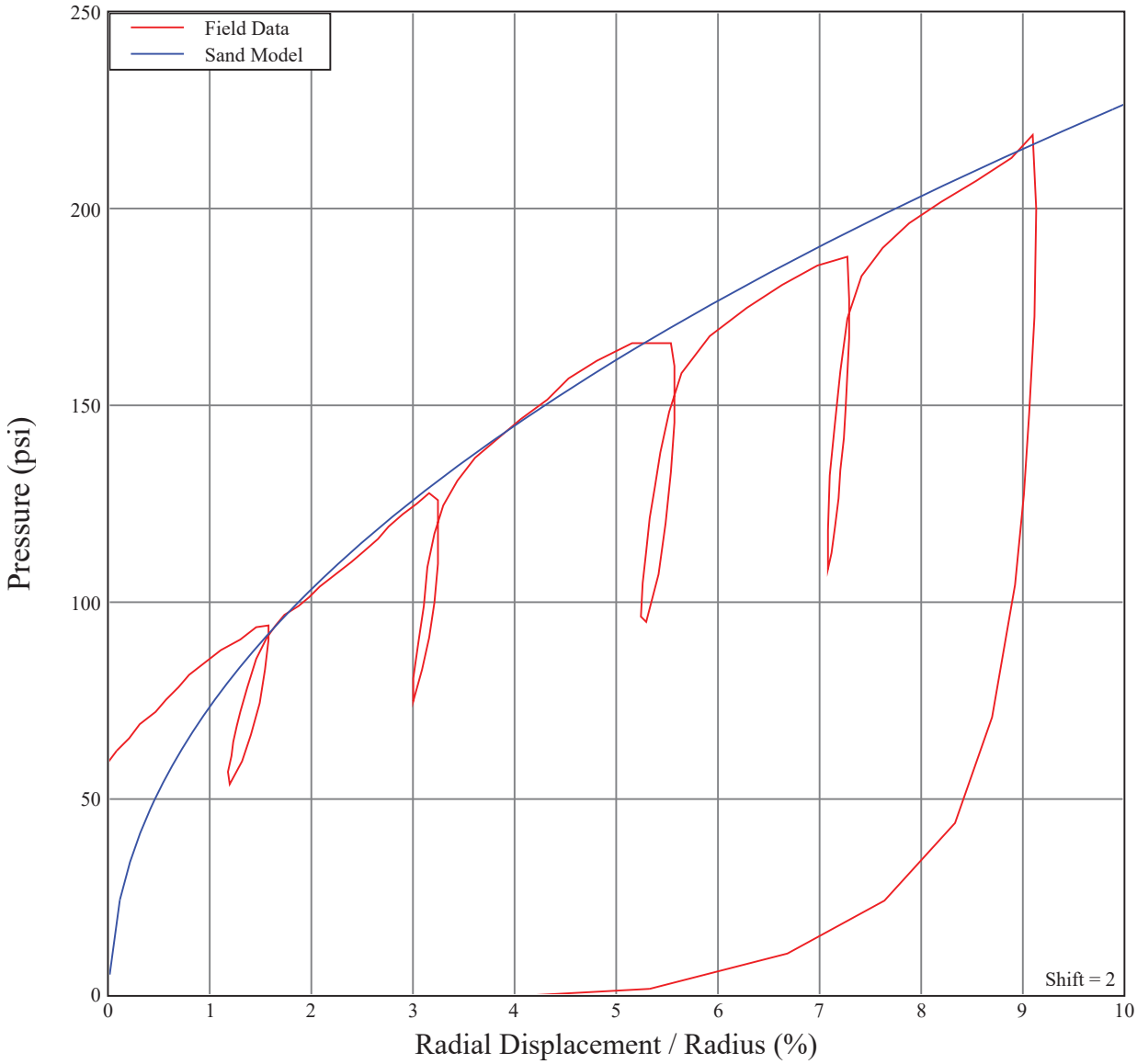


DATA

#1 Shear Modulus = 1060 psi
#2 Shear Modulus = 4810 psi
#3 Shear Modulus = 9170 psi
#4 Shear Modulus = 10200 psi
#5 Shear Modulus = 14640 psi

In Situ Engineering - Hughes' Sand Model

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-001 Depth: 16FT Date: 09/18/2017
Oper: Mayfield/Okbay Job # 1657705 Time of Test: 10:47 AM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)

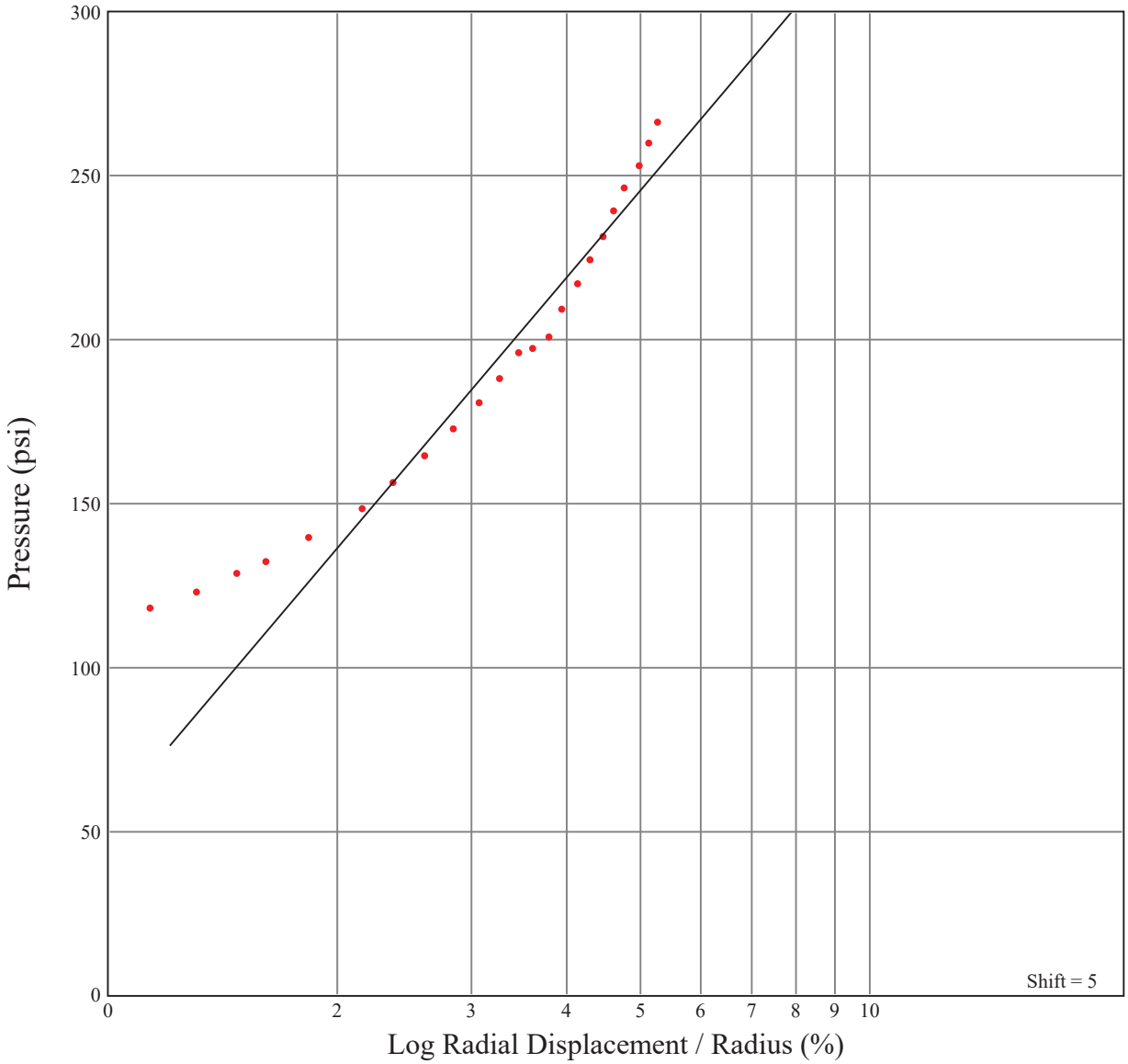


DATA

Water Pressure = 0 psi
Lateral Stress = 5 psi
Friction Angle = 42 deg
Shear Modulus = 14640 psi
Critical Friction Angle = 32 deg

In Situ Engineering - Logarithm Plot

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-002 Depth: 23.5FT Date: 09/18/2017
Oper: Mayfield/Okbay Job # 1657705 Time of Test: 03:30 PM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)



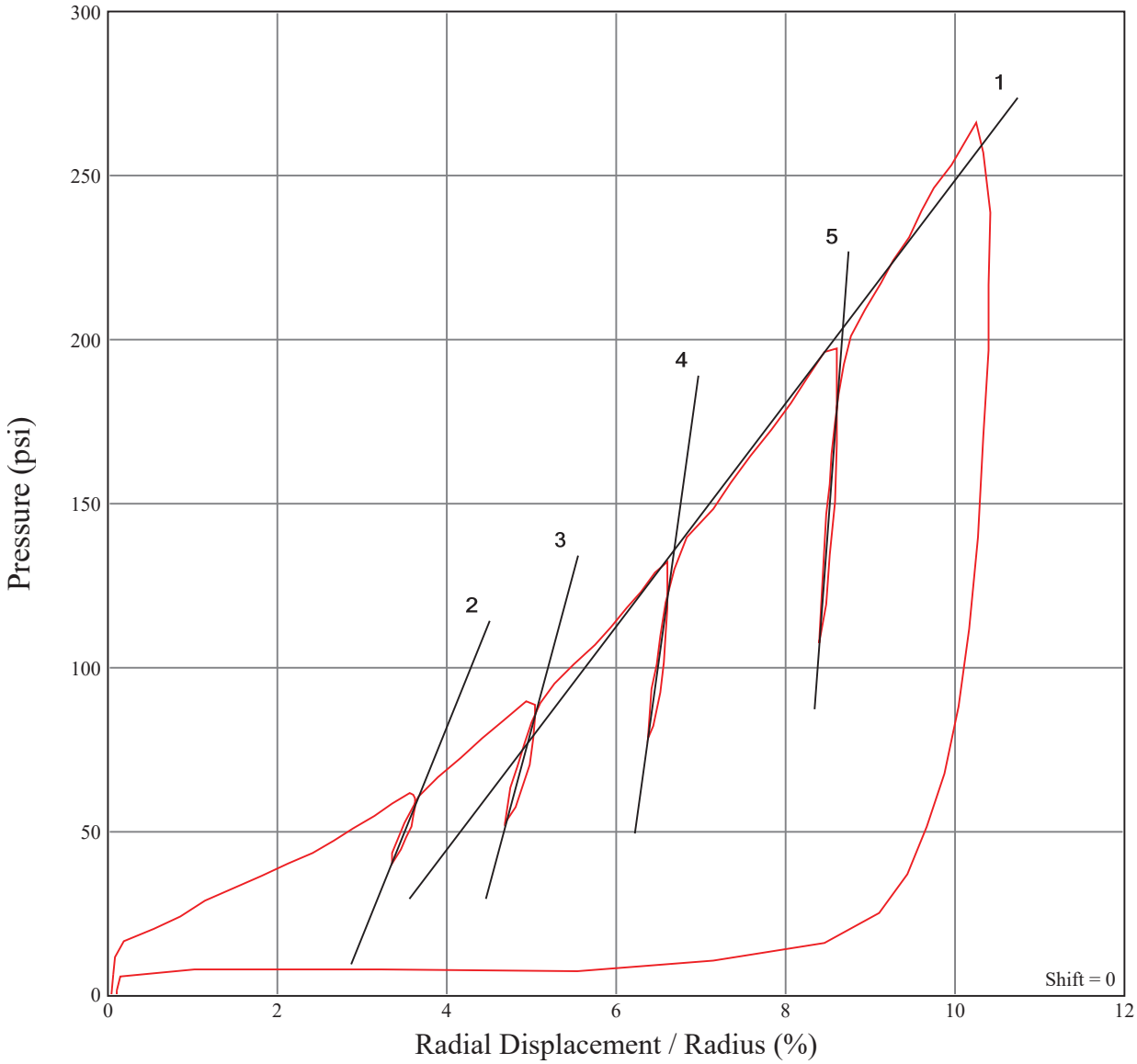
DATA

Shear Strength = 119 psi

Limit Pressure = 496 psi

In Situ Engineering - Shear Modulus Plot

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-002 Depth: 23.5FT Date: 09/18/2017
Oper: Mayfield/Okbay Job # 1657705 Time of Test: 03:30 PM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)

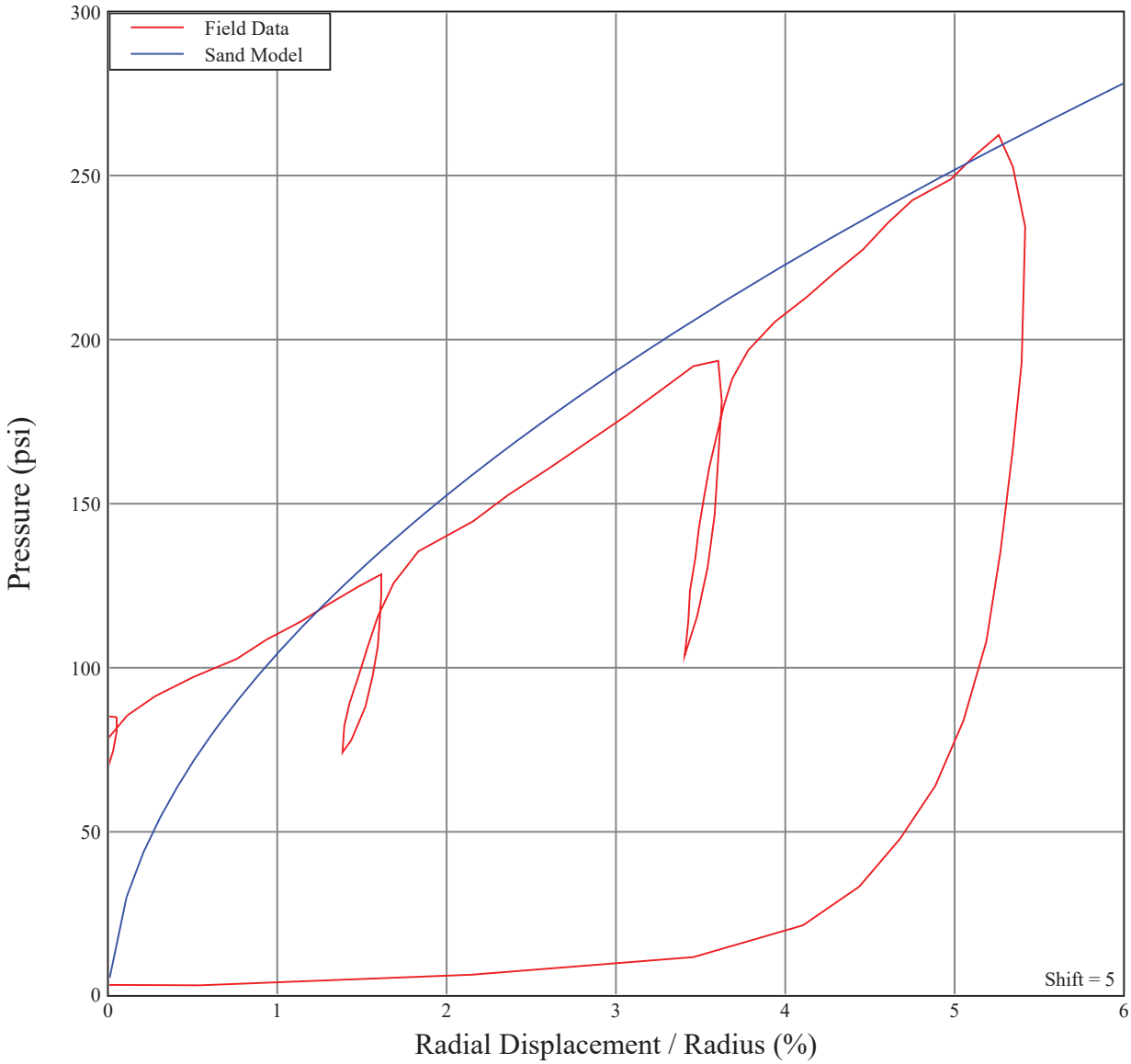


DATA

#1 Shear Modulus = 1700 psi
#2 Shear Modulus = 3200 psi
#3 Shear Modulus = 4800 psi
#4 Shear Modulus = 9300 psi
#5 Shear Modulus = 17400 psi

In Situ Engineering - Hughes' Sand Model

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-002 Depth: 23.5FT Date: 09/18/2017
Oper: Mayfield/Okbay Job # 1657705 Time of Test: 03:30 PM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)

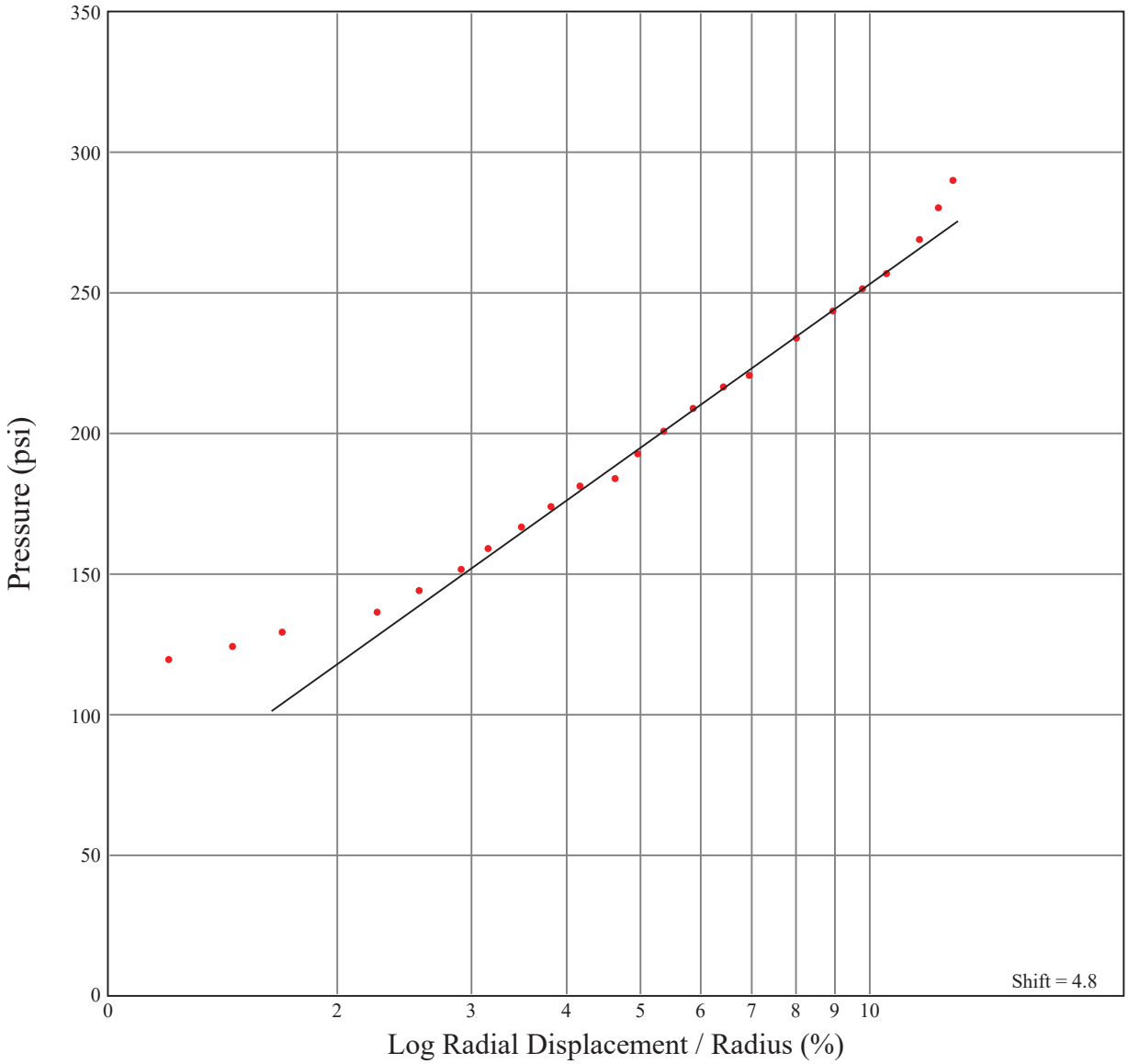


DATA

Water Pressure = 4 psi
Lateral Stress = 5 psi
Friction Angle = 46 deg
Shear Modulus = 17400 psi
Critical Friction Angle = 32 deg

In Situ Engineering - Logarithm Plot

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-003 Depth: 58FT Date: 09/19/2017
Oper: Okbay Job # 1657705 Time of Test: 04:02 PM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)



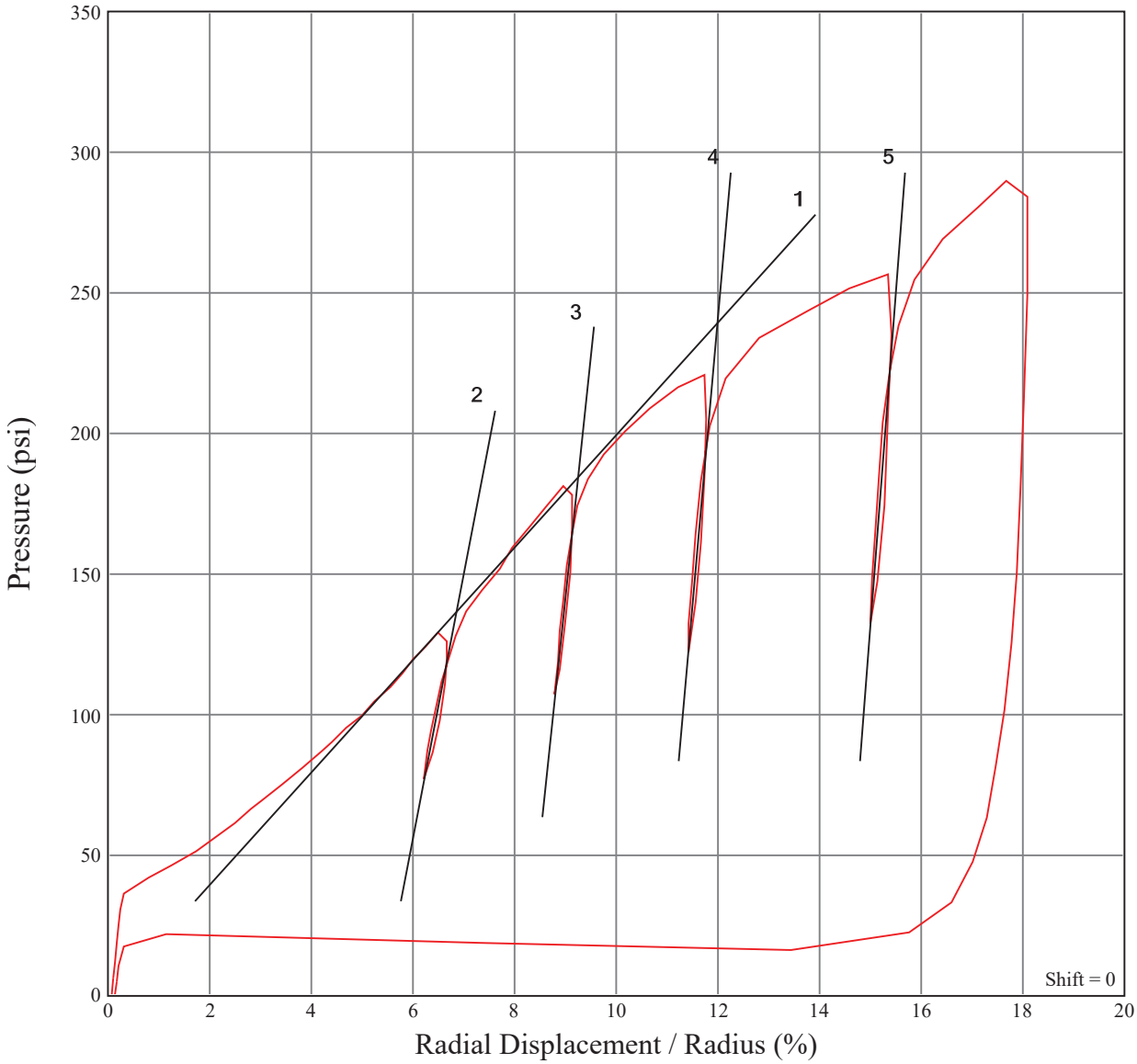
DATA

Shear Strength = 84 psi

Limit Pressure = 372 psi

In Situ Engineering - Shear Modulus Plot

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-003 Depth: 58FT Date: 09/19/2017
Oper: Okbay Job # 1657705 Time of Test: 04:02 PM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)

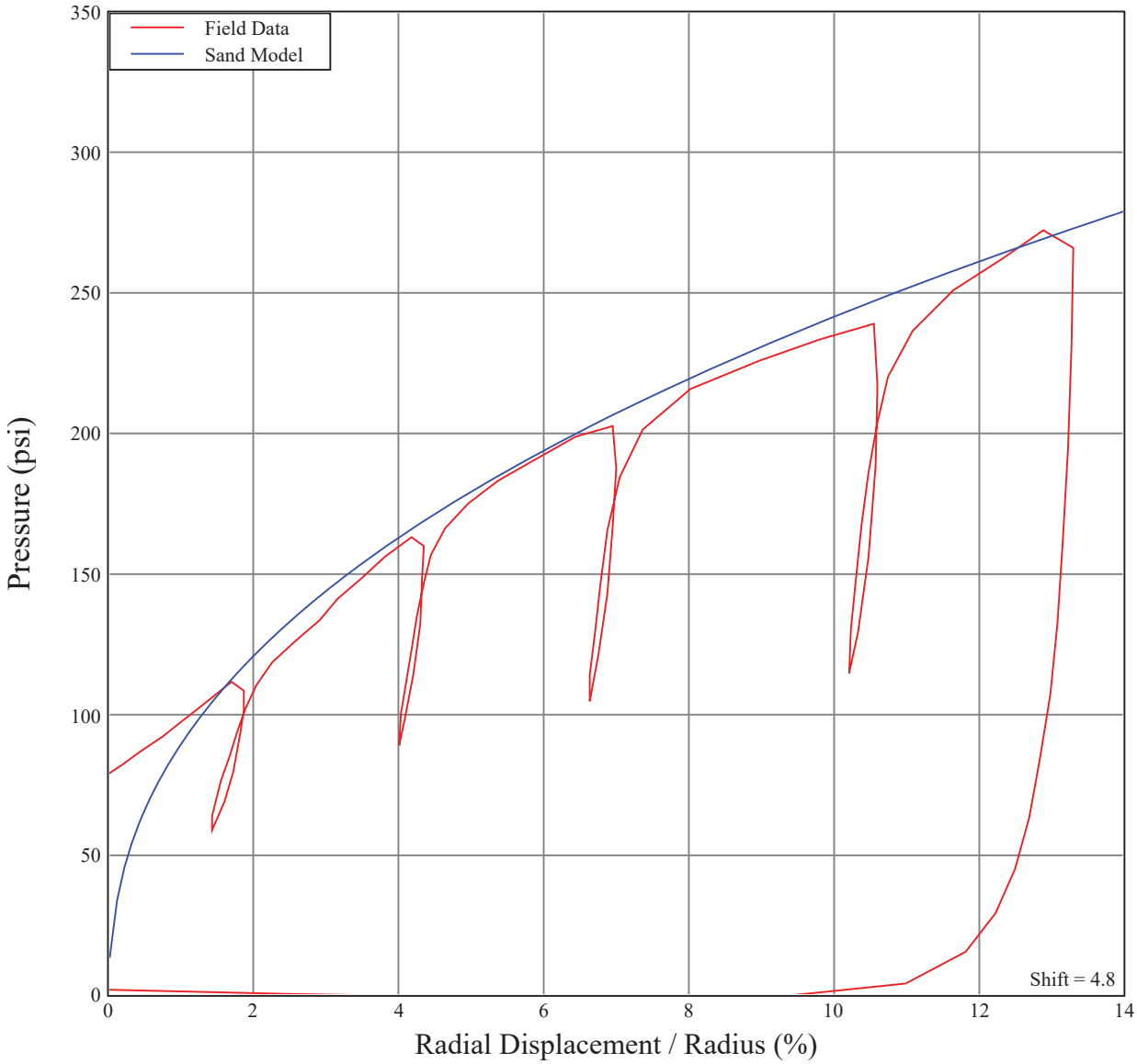


DATA

#1 Shear Modulus = 1000 psi
#2 Shear Modulus = 4700 psi
#3 Shear Modulus = 8600 psi
#4 Shear Modulus = 10200 psi
#5 Shear Modulus = 11800 psi

In Situ Engineering - Hughes' Sand Model

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-003 Depth: 58FT Date: 09/19/2017
Oper: Okbay Job # 1657705 Time of Test: 04:02 PM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)

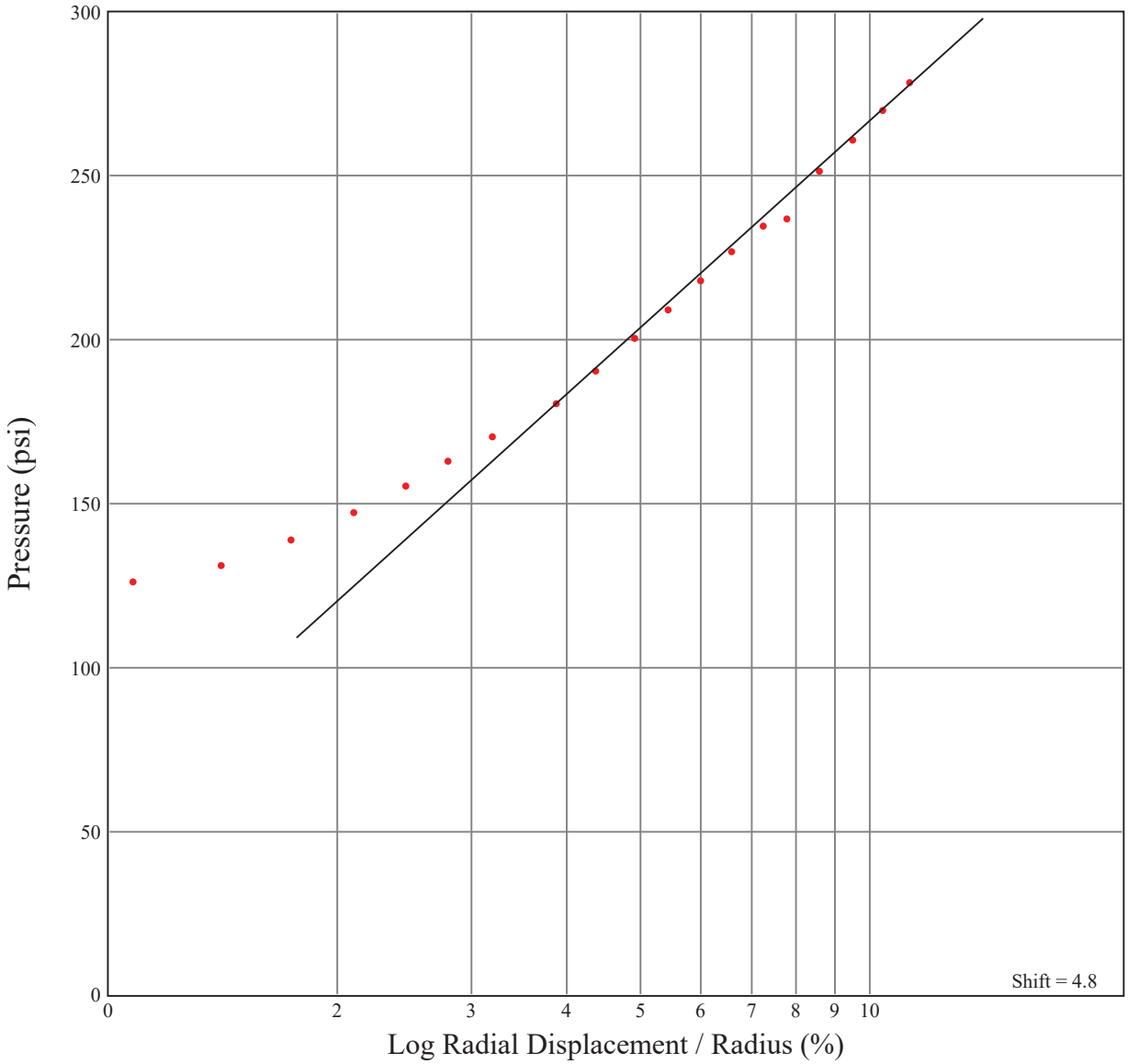


DATA

Water Pressure = 18 psi
Lateral Stress = 13 psi
Friction Angle = 38 deg
Shear Modulus = 11800 psi
Critical Friction Angle = 32 deg

In Situ Engineering - Logarithm Plot

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-004 Depth: 56.5FT Date: 09/19/2017
Oper: Okbay Job # 1657705 Time of Test: 04:18 PM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)



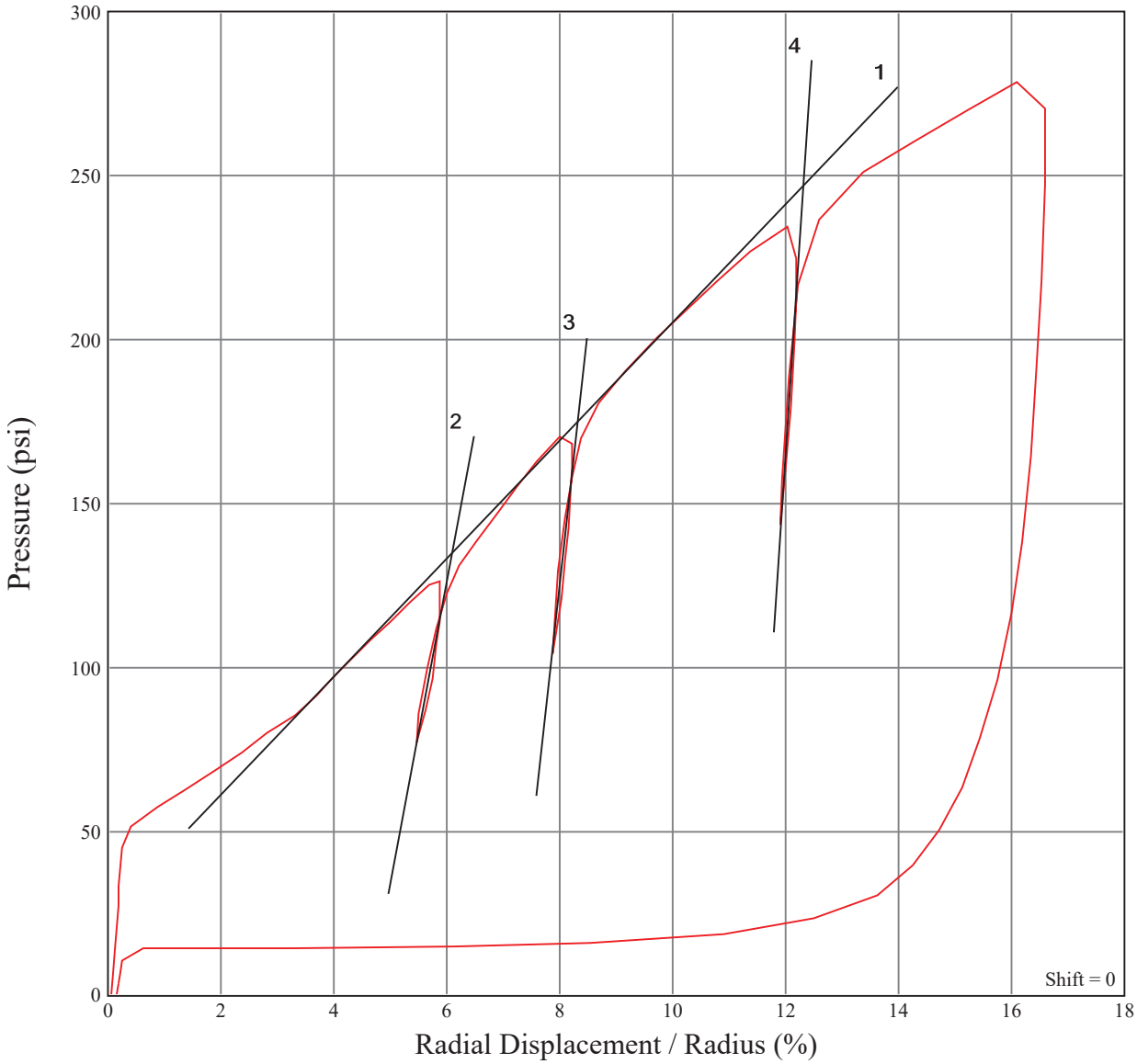
DATA

Shear Strength = 91 psi

Limit Pressure = 395 psi

In Situ Engineering - Shear Modulus Plot

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-004 Depth: 56.5FT Date: 09/19/2017
Oper: Okbay Job # 1657705 Time of Test: 04:18 PM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)



DATA

#1 Shear Modulus = 900 psi

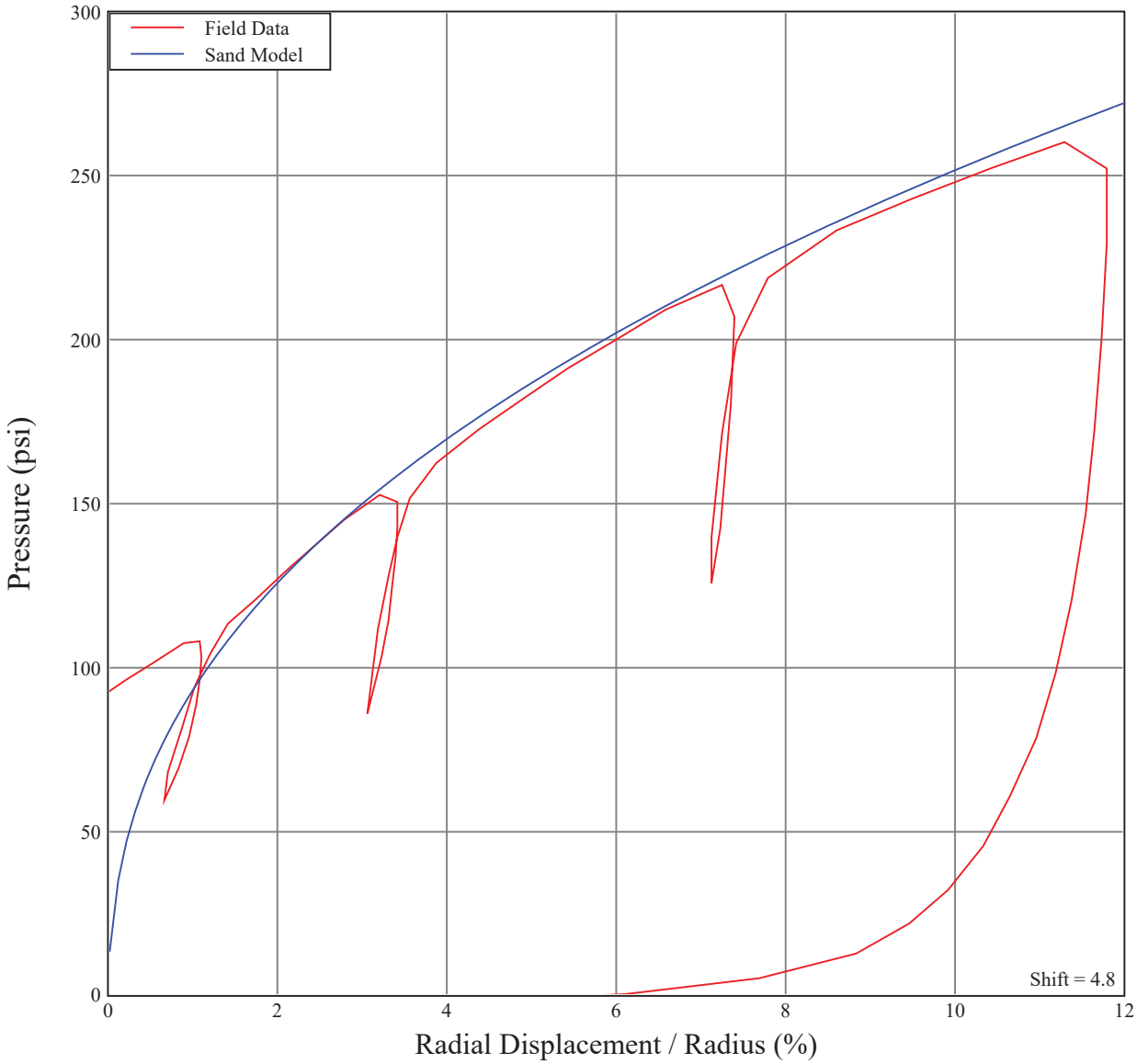
#2 Shear Modulus = 4600 psi

#3 Shear Modulus = 7800 psi

#4 Shear Modulus = 13000 psi

In Situ Engineering - Hughes' Sand Model

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031 Test: RLR-004 Depth: 56.5FT Date: 09/19/2017
Oper: Okbay Job # 1657705 Time of Test: 04:18 PM Inst: 05
Test terminated when arm 2 stopped moving (reached max expansion)

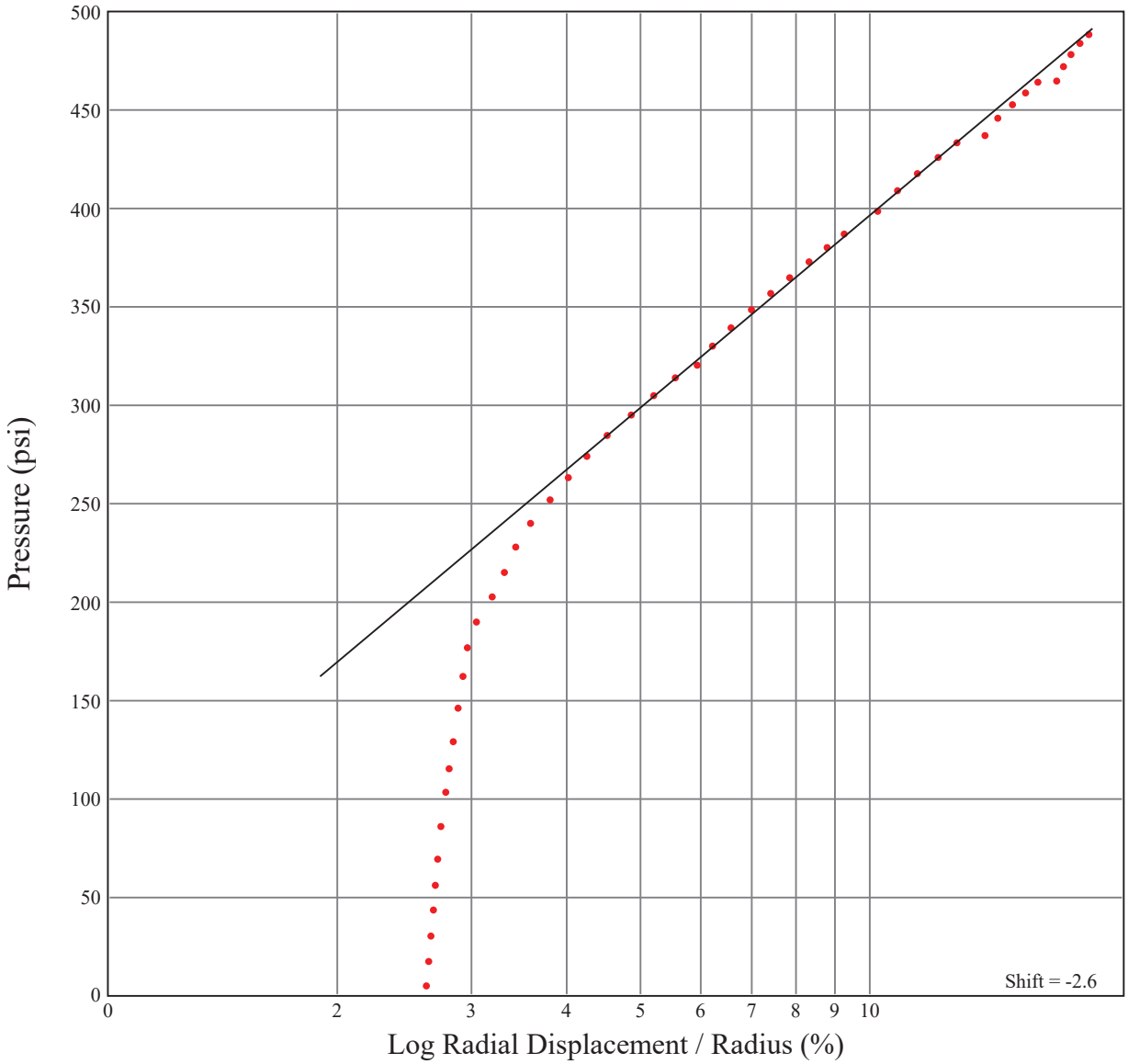


DATA

Water Pressure = 18 psi
Lateral Stress = 13 psi
Friction Angle = 38 deg
Shear Modulus = 13000 psi
Critical Friction Angle = 32 deg

In Situ Engineering - Logarithm Plot

Golder Associate
Sound Transit Downtowen Redmond Link Extension
Boring: DRLE-G018 Test: RLR-007 Depth: 55FT Date: 10/24/2017
Oper: Mayfield Job # 1657705 Time of Test: 08:04 AM Inst: 05



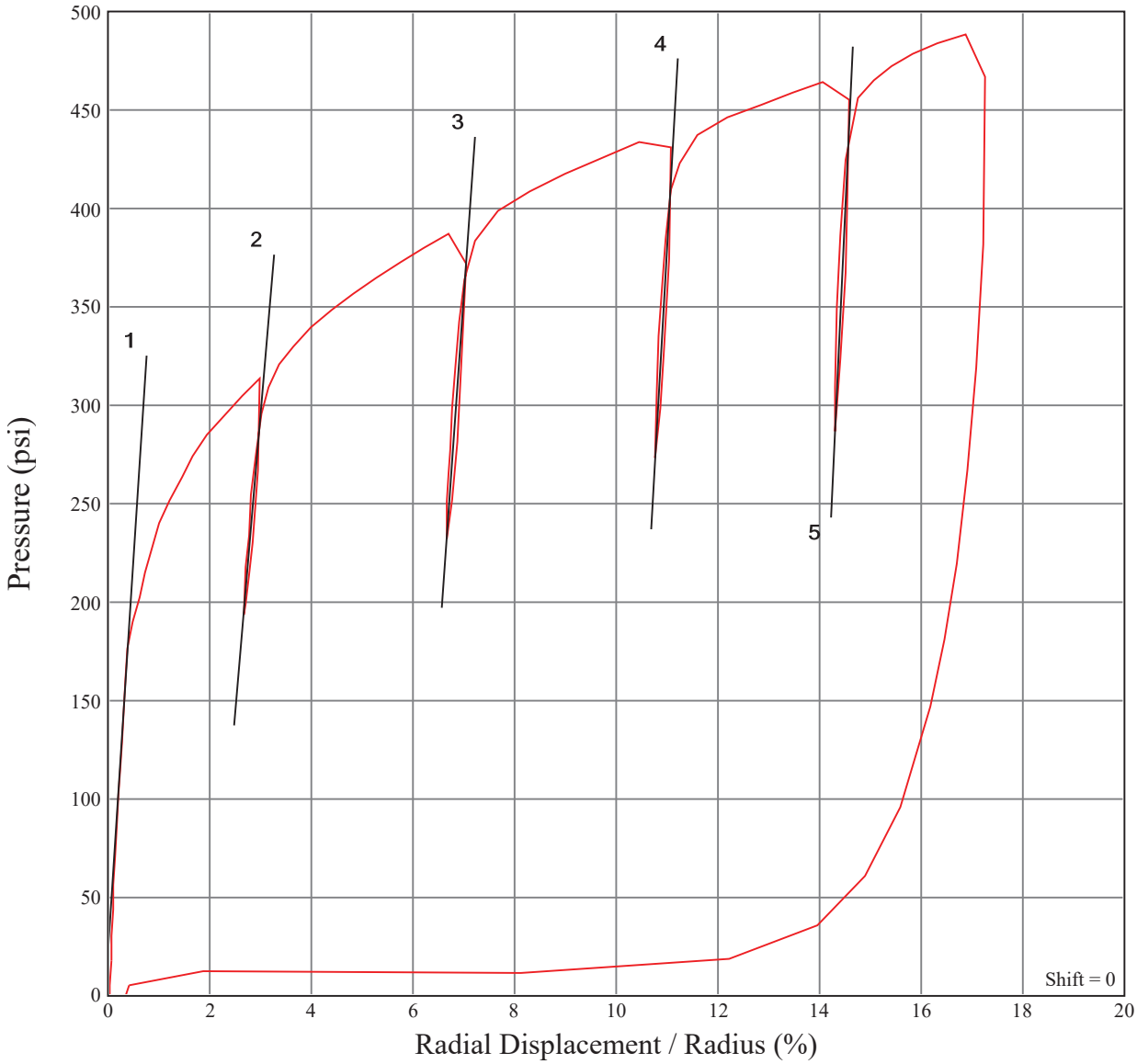
DATA

Shear Strength = 141 psi

Limit Pressure = 596 psi

In Situ Engineering - Shear Modulus Plot

Golder Associate
Sound Transit Downtowen Redmond Link Extension
Boring: DRLE-G018 Test: RLR-007 Depth: 55FT Date: 10/24/2017
Oper: Mayfield Job # 1657705 Time of Test: 08:04 AM Inst: 05



DATA

#1 Shear Modulus = 19900 psi

#2 Shear Modulus = 15200 psi

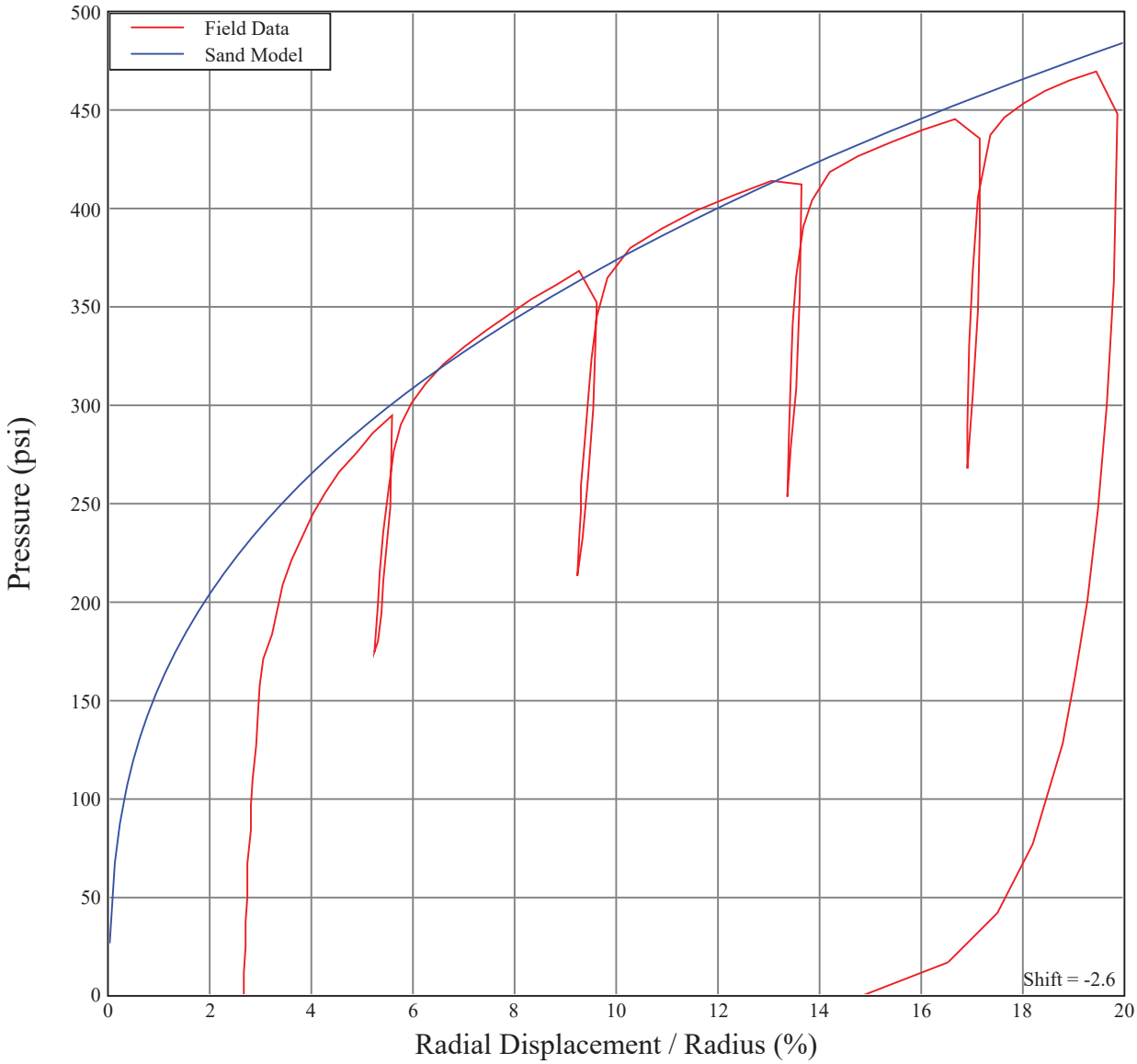
#3 Shear Modulus = 18300 psi

#4 Shear Modulus = 22800 psi

#5 Shear Modulus = 27900 psi

In Situ Engineering - Hughes' Sand Model

Golder Associate
Sound Transit Downtowen Redmond Link Extension
Boring: DRLE-G018 Test: RLR-007 Depth: 55FT Date: 10/24/2017
Oper: Mayfield Job # 1657705 Time of Test: 08:04 AM Inst: 05

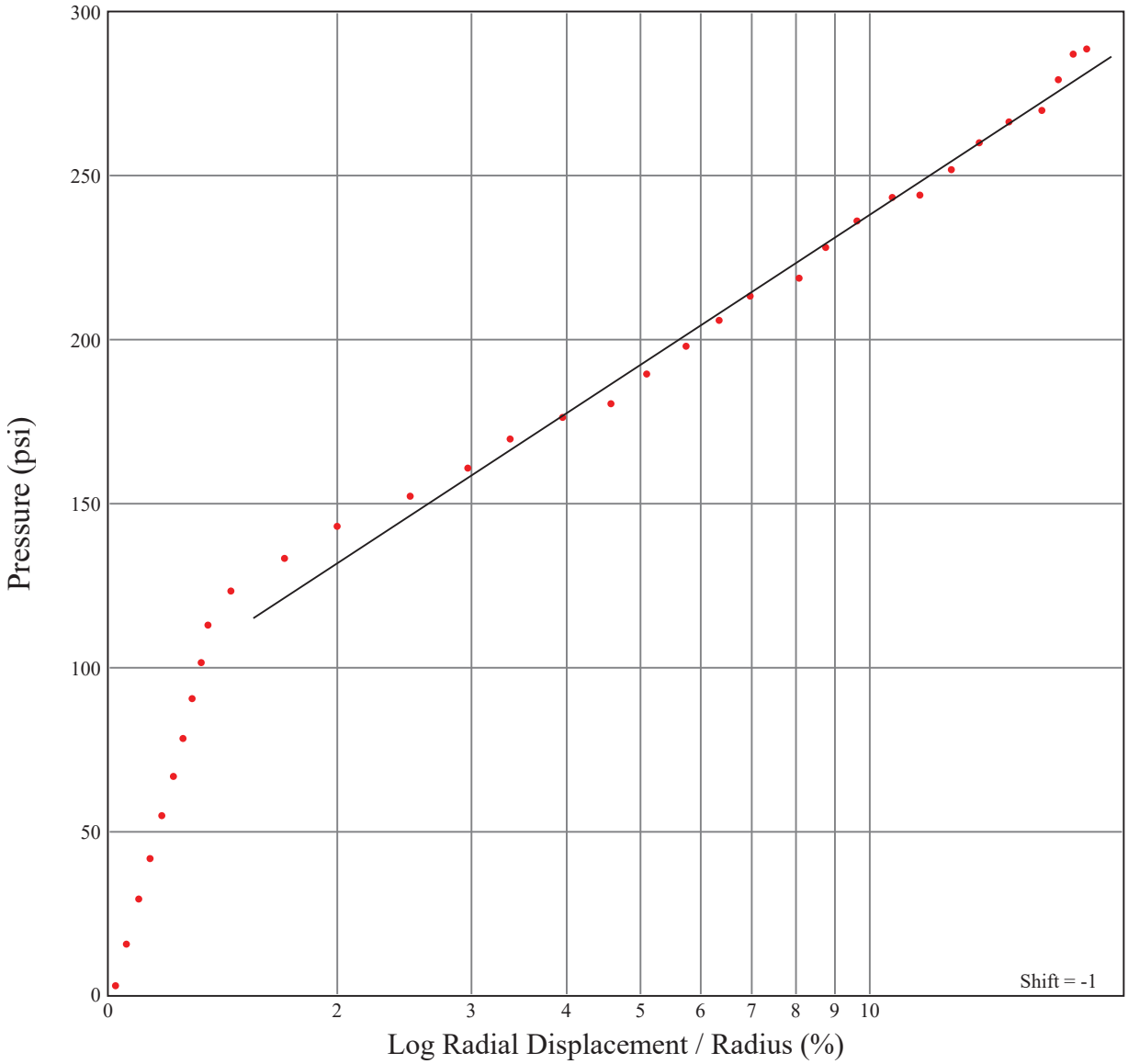


DATA

Water Pressure = 19 psi
Lateral Stress = 26 psi
Friction Angle = 34 deg
Shear Modulus = 27900 psi
Critical Friction Angle = 32 deg

In Situ Engineering - Logarithm Plot

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018 Test: RLR-008 Depth: 53.5FT Date: 10/24/2017
Oper: Mayfield Job # 1657705 Time of Test: 08:15 AM Inst: 05



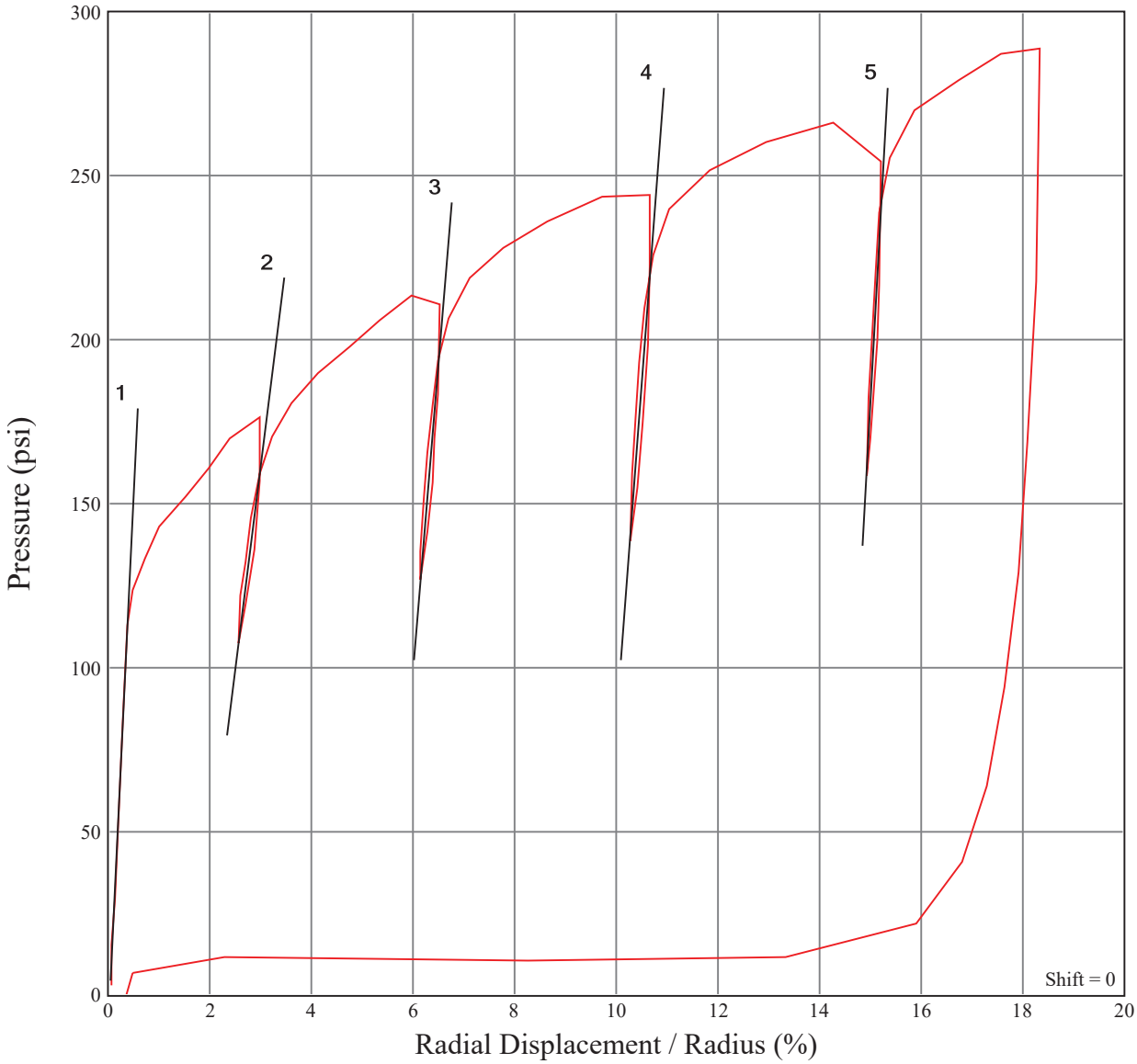
DATA

Shear Strength = 66 psi

Limit Pressure = 331 psi

In Situ Engineering - Shear Modulus Plot

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018 Test: RLR-008 Depth: 53.5FT Date: 10/24/2017
Oper: Mayfield Job # 1657705 Time of Test: 08:15 AM Inst: 05



DATA

#1 Shear Modulus = 16270 psi

#2 Shear Modulus = 6200 psi

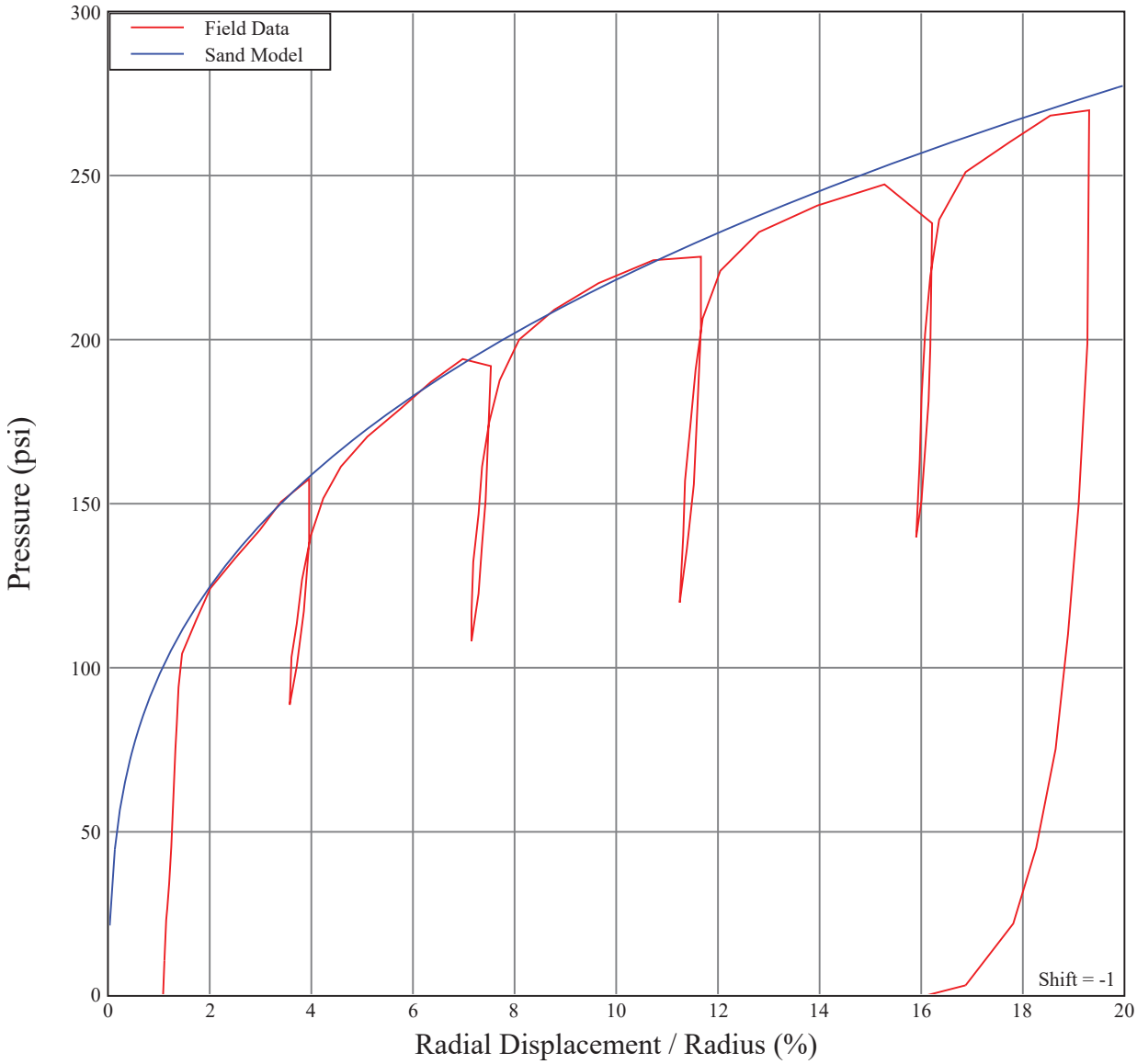
#3 Shear Modulus = 9400 psi

#4 Shear Modulus = 10300 psi

#5 Shear Modulus = 14100 psi

In Situ Engineering - Hughes' Sand Model

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018 Test: RLR-008 Depth: 53.5FT Date: 10/24/2017
Oper: Mayfield Job # 1657705 Time of Test: 08:15 AM Inst: 05

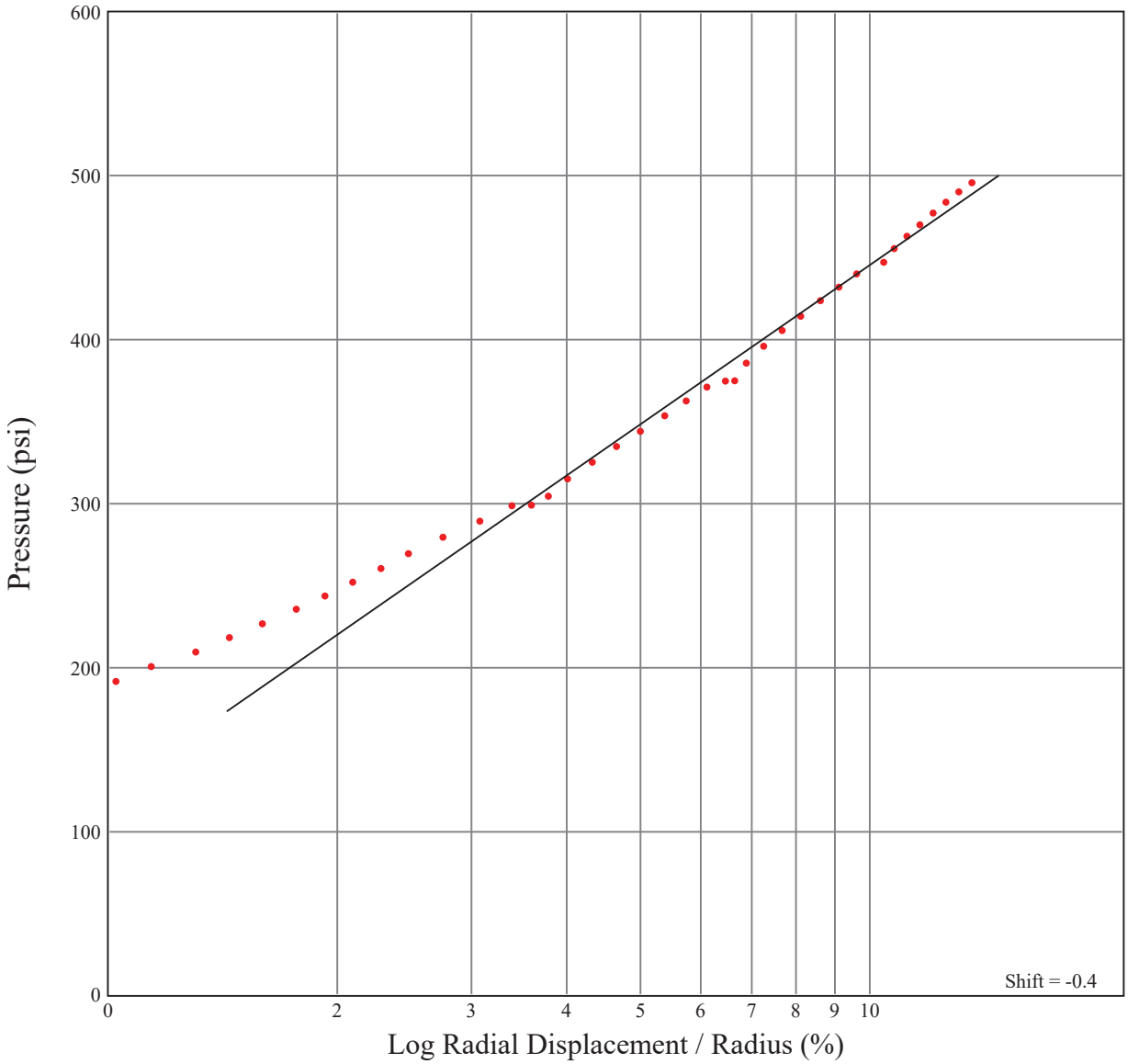


DATA

Water Pressure = 19 psi
Lateral Stress = 21 psi
Friction Angle = 32 deg
Shear Modulus = 14100 psi
Critical Friction Angle = 32 deg

In Situ Engineering - Logarithm Plot

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018 Test: RLR-009 Depth: 74.5FT Date: 10/24/2017
Oper: Okbay Job # 1657705 Time of Test: 09:56 AM Inst: 05



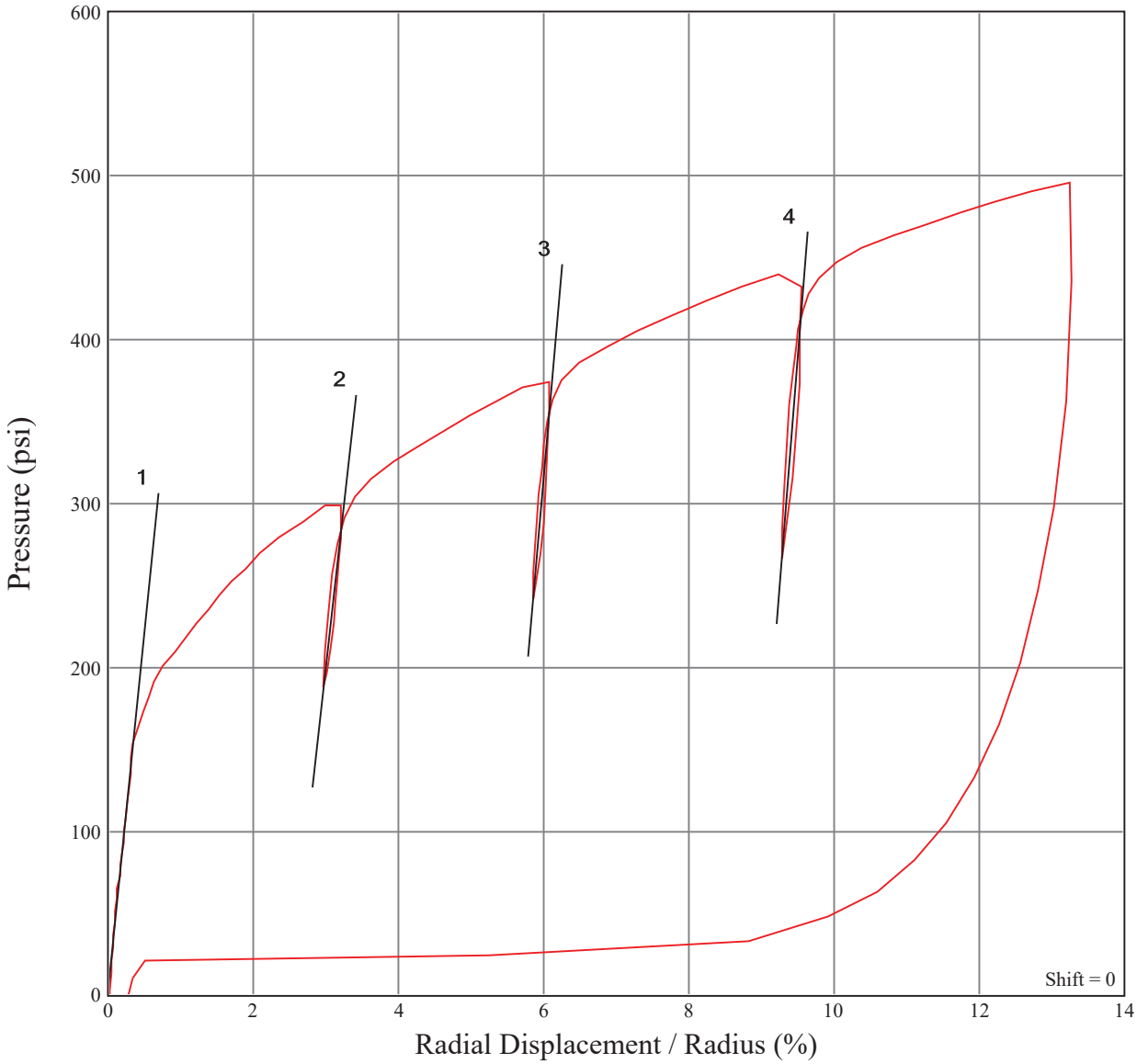
DATA

Shear Strength = 140 psi

Limit Pressure = 643 psi

In Situ Engineering - Shear Modulus Plot

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018 Test: RLR-009 Depth: 74.5FT Date: 10/24/2017
Oper: Okbay Job # 1657705 Time of Test: 09:56 AM Inst: 05



DATA

#1 Shear Modulus = 21800 psi

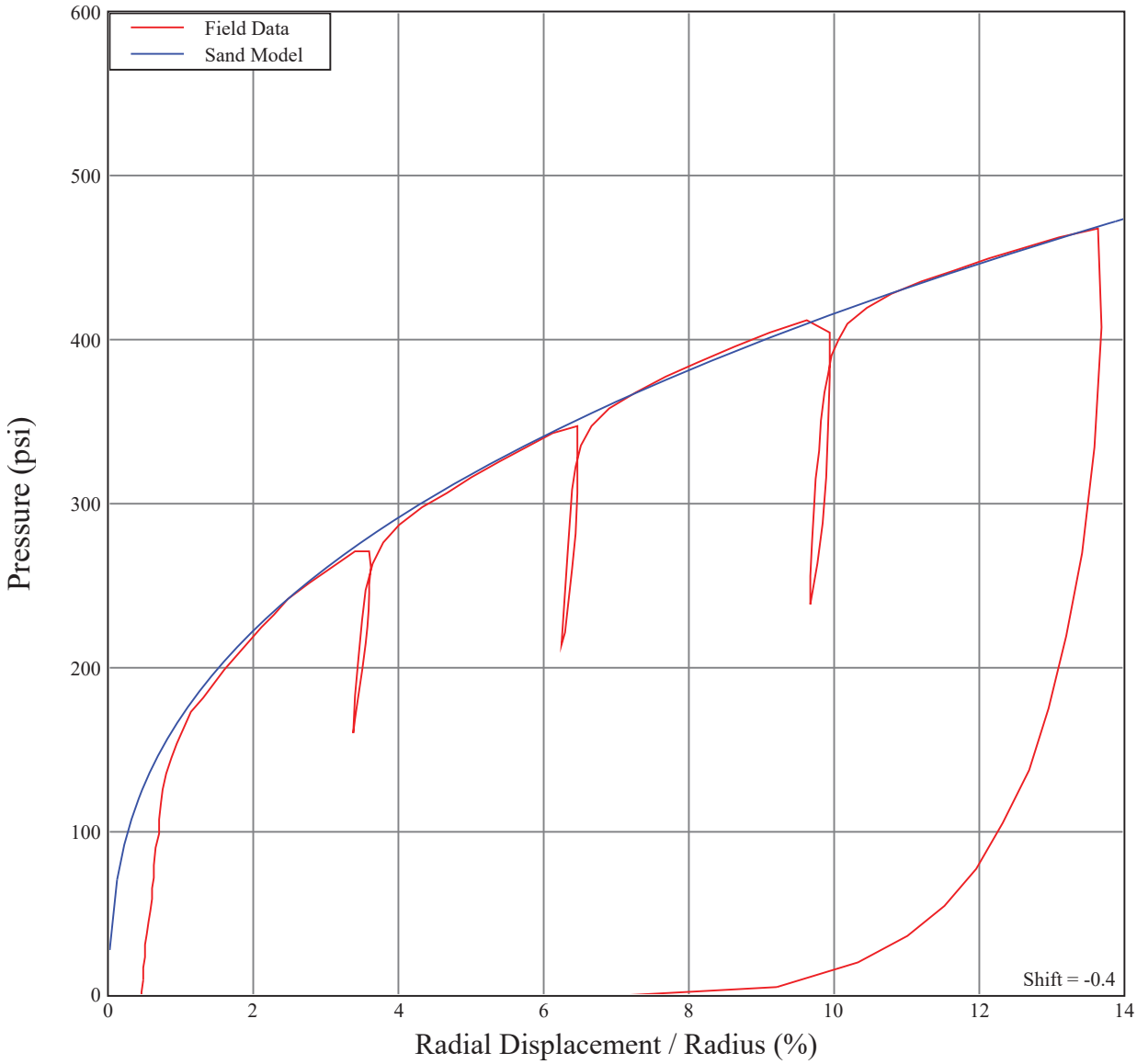
#2 Shear Modulus = 19900 psi

#3 Shear Modulus = 25500 psi

#4 Shear Modulus = 28000 psi

In Situ Engineering - Hughes' Sand Model

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018 Test: RLR-009 Depth: 74.5FT Date: 10/24/2017
Oper: Okbay Job # 1657705 Time of Test: 09:56 AM Inst: 05

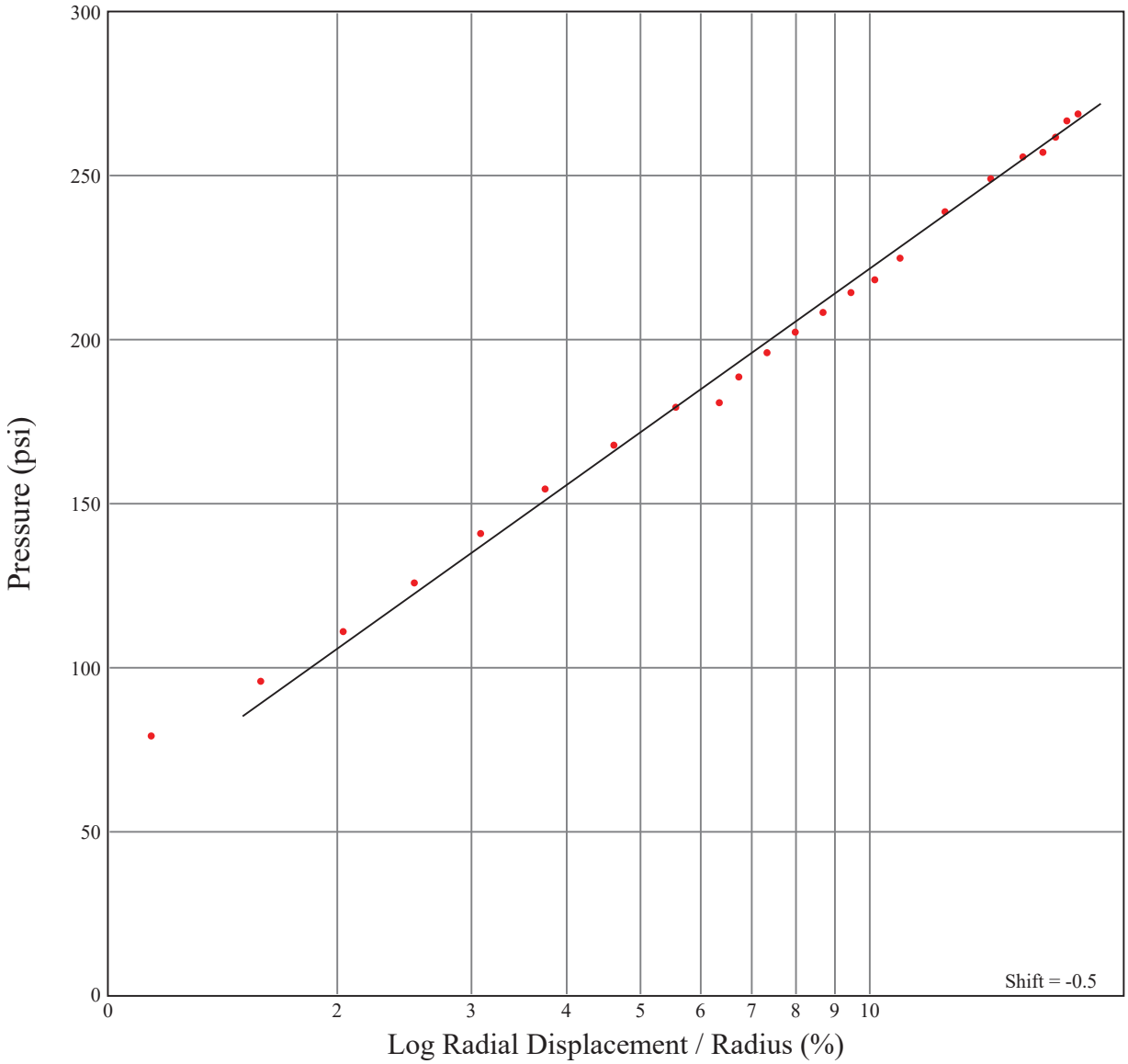


DATA

Water Pressure = 28 psi
Lateral Stress = 27 psi
Friction Angle = 35 deg
Shear Modulus = 28000 psi
Critical Friction Angle = 32 deg

In Situ Engineering - Logarithm Plot

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018 Test: RLR-010 Depth: 73FT Date: 10/24/2017
Oper: Okbay Job # 1657705 Time of Test: 10:09 AM Inst: 05



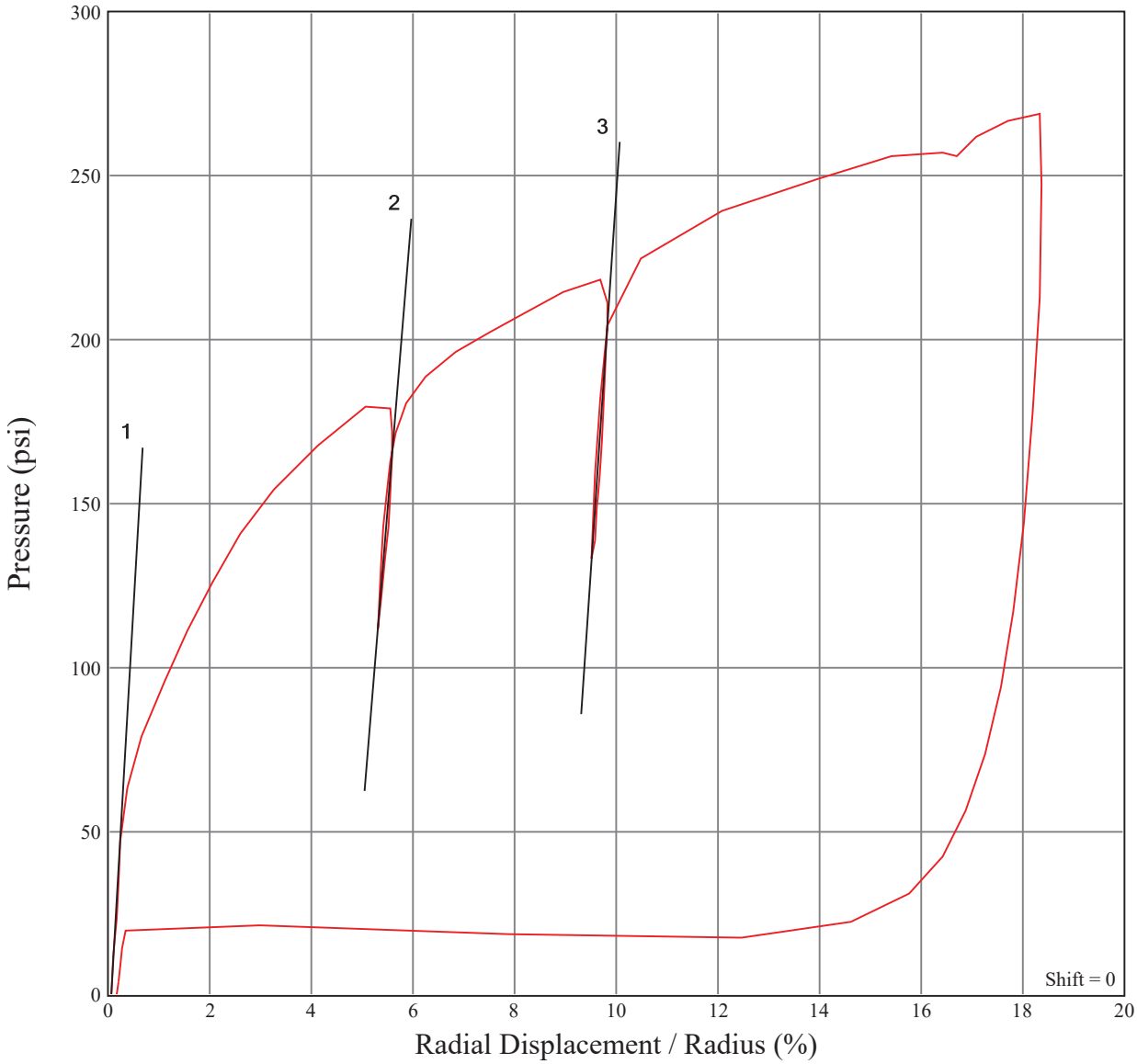
DATA

Shear Strength = 72 psi

Limit Pressure = 323 psi

In Situ Engineering - Shear Modulus Plot

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018 Test: RLR-010 Depth: 73FT Date: 10/24/2017
Oper: Okbay Job # 1657705 Time of Test: 10:09 AM Inst: 05



DATA

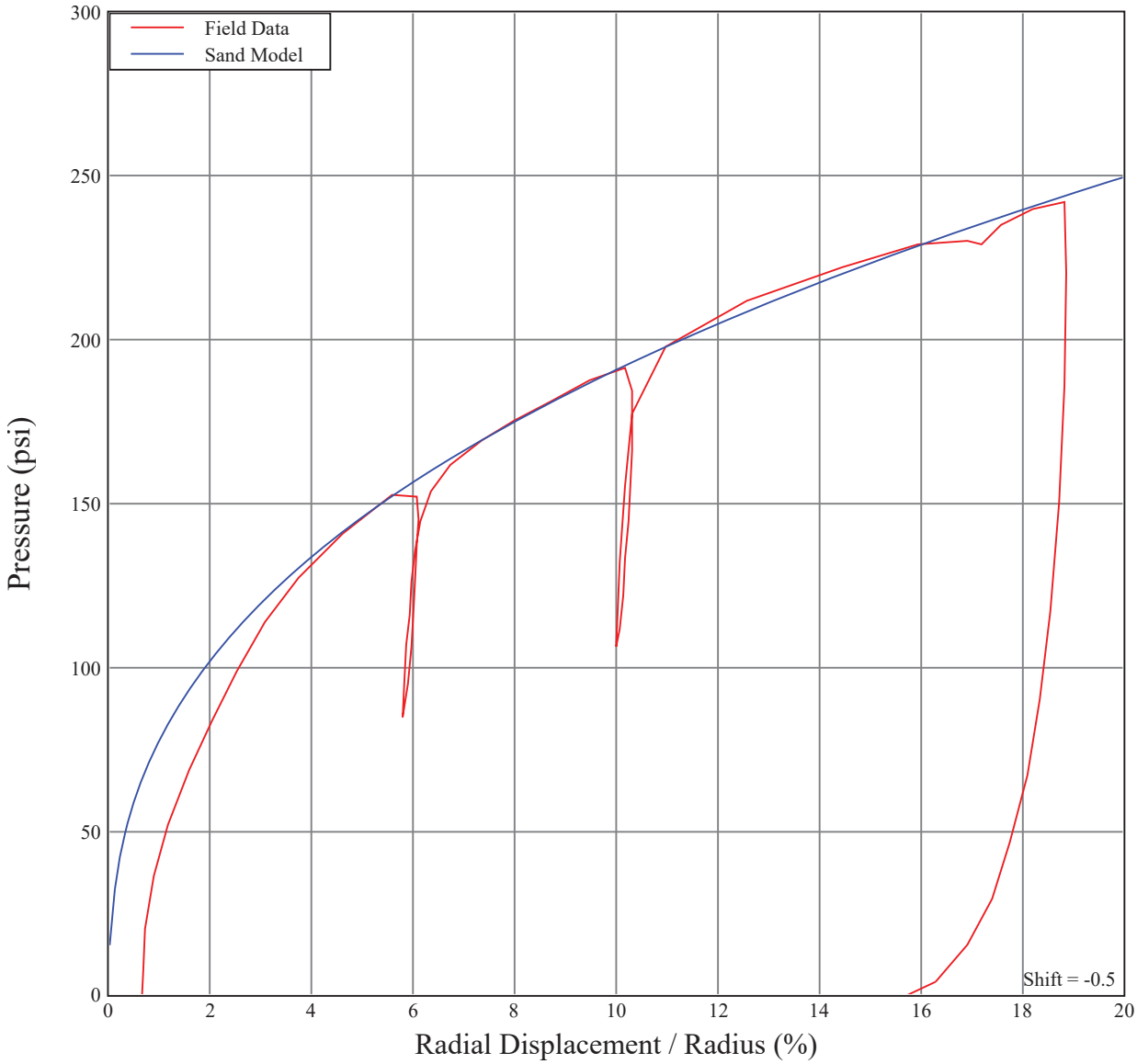
#1 Shear Modulus = 13500 psi

#2 Shear Modulus = 9500 psi

#3 Shear Modulus = 11500 psi

In Situ Engineering - Hughes' Sand Model

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018 Test: RLR-010 Depth: 73FT Date: 10/24/2017
Oper: Okbay Job # 1657705 Time of Test: 10:09 AM Inst: 05

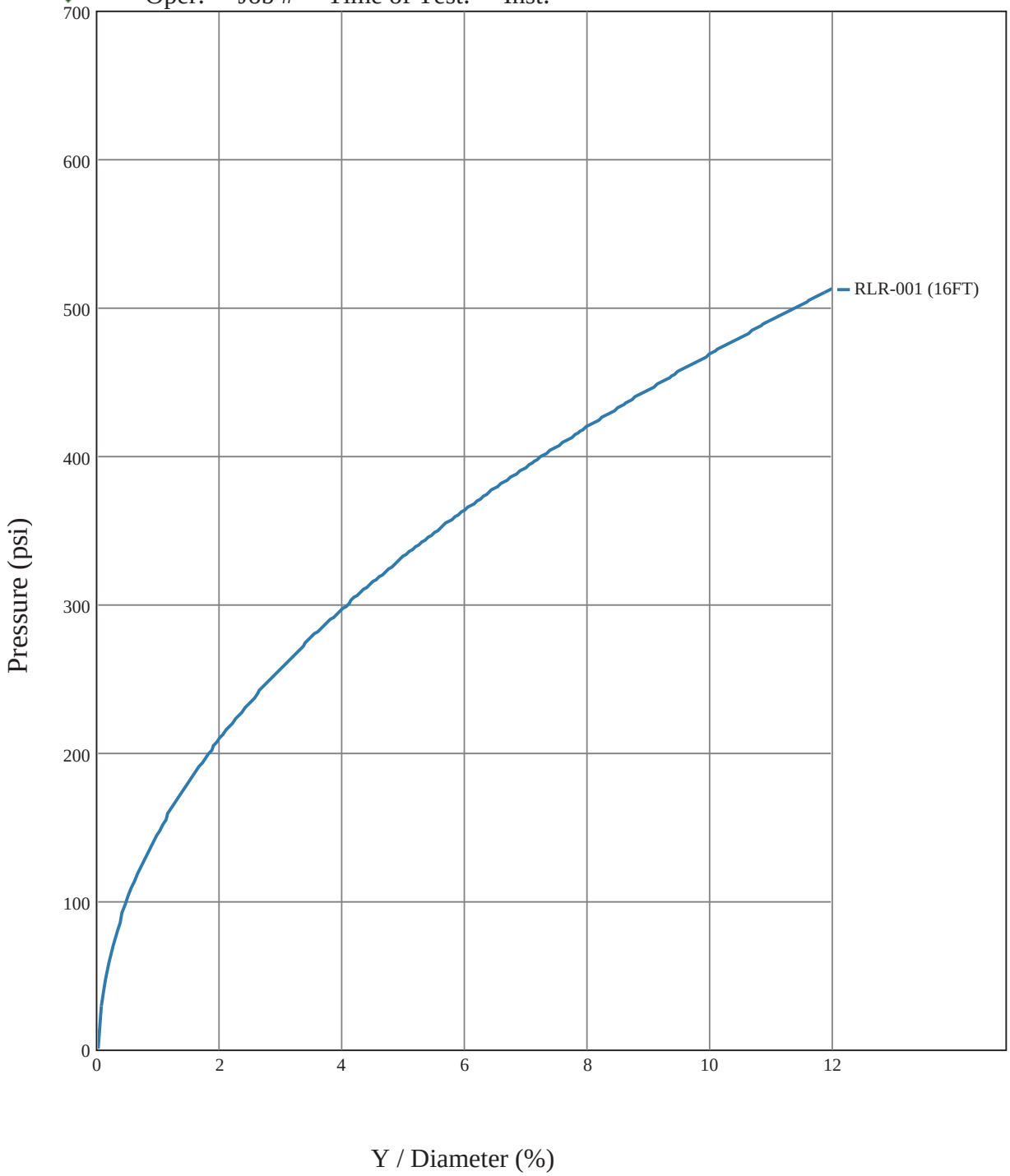


DATA

Water Pressure = 27 psi
Lateral Stress = 15 psi
Friction Angle = 35 deg
Shear Modulus = 9500 psi
Critical Friction Angle = 32 deg

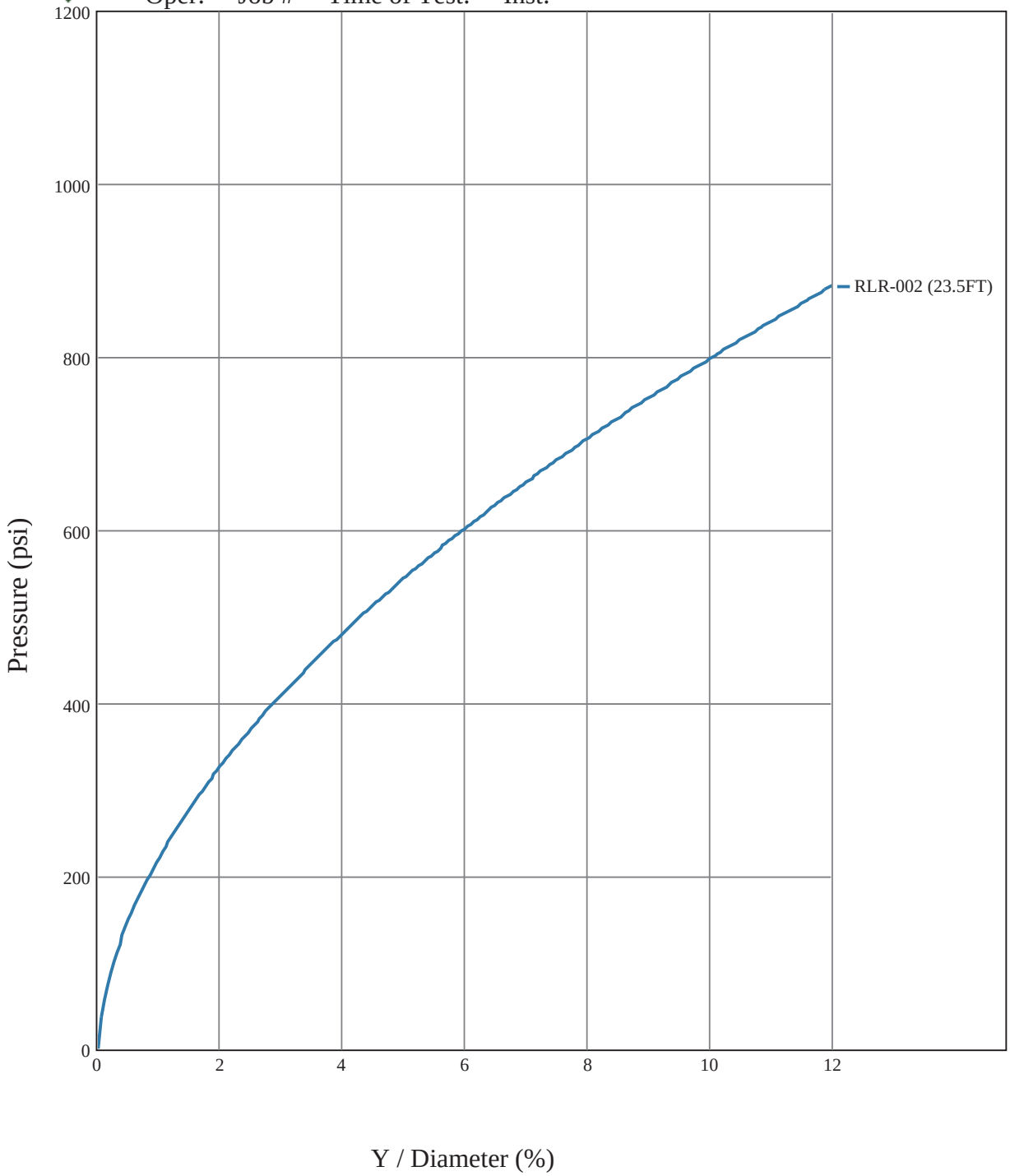
In Situ Engineering - PY Data - Frictional

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031
Oper: Job # Time of Test: Inst:



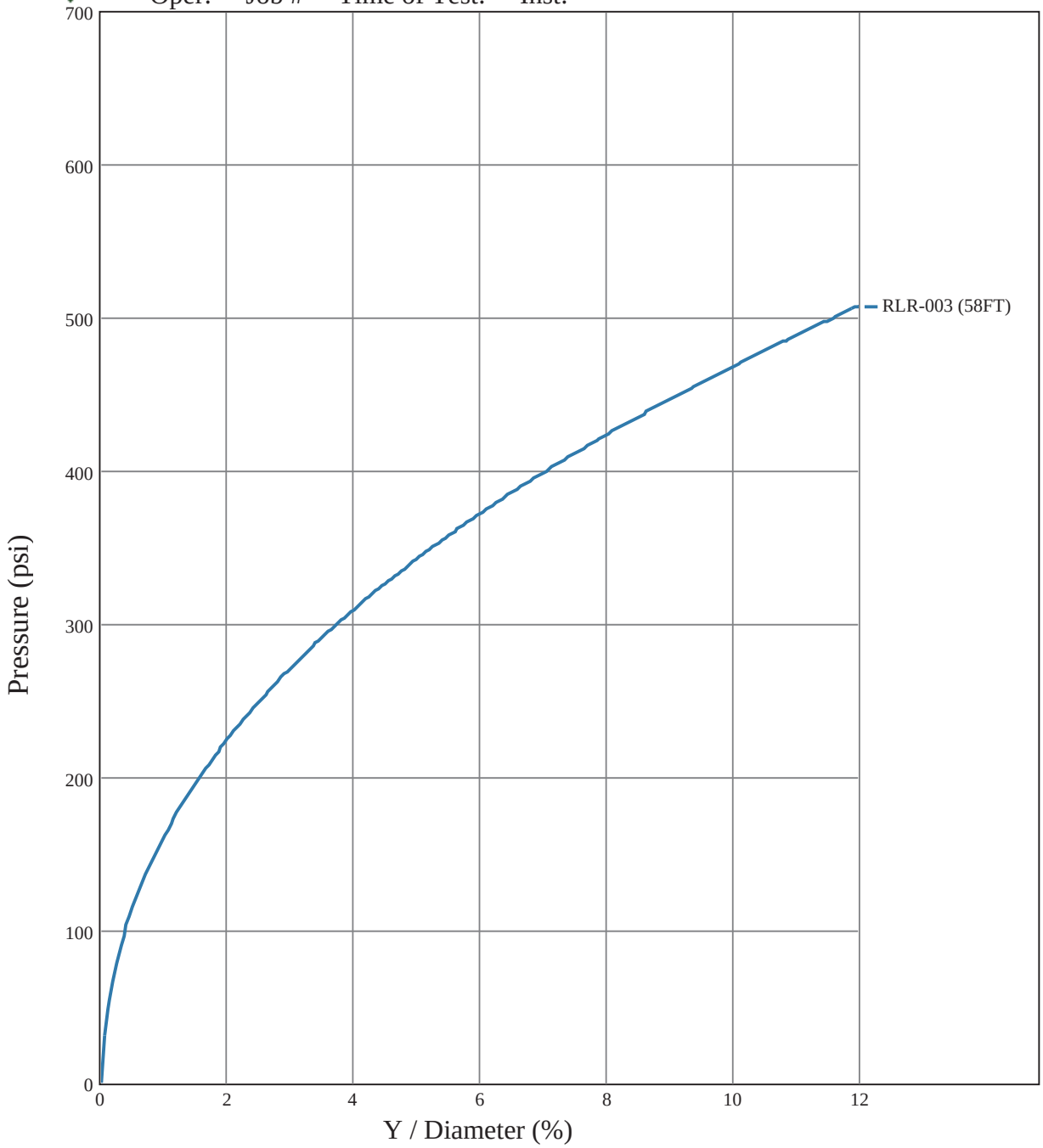
In Situ Engineering - PY Data - Frictional

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031
Oper: Job # Time of Test: Inst:



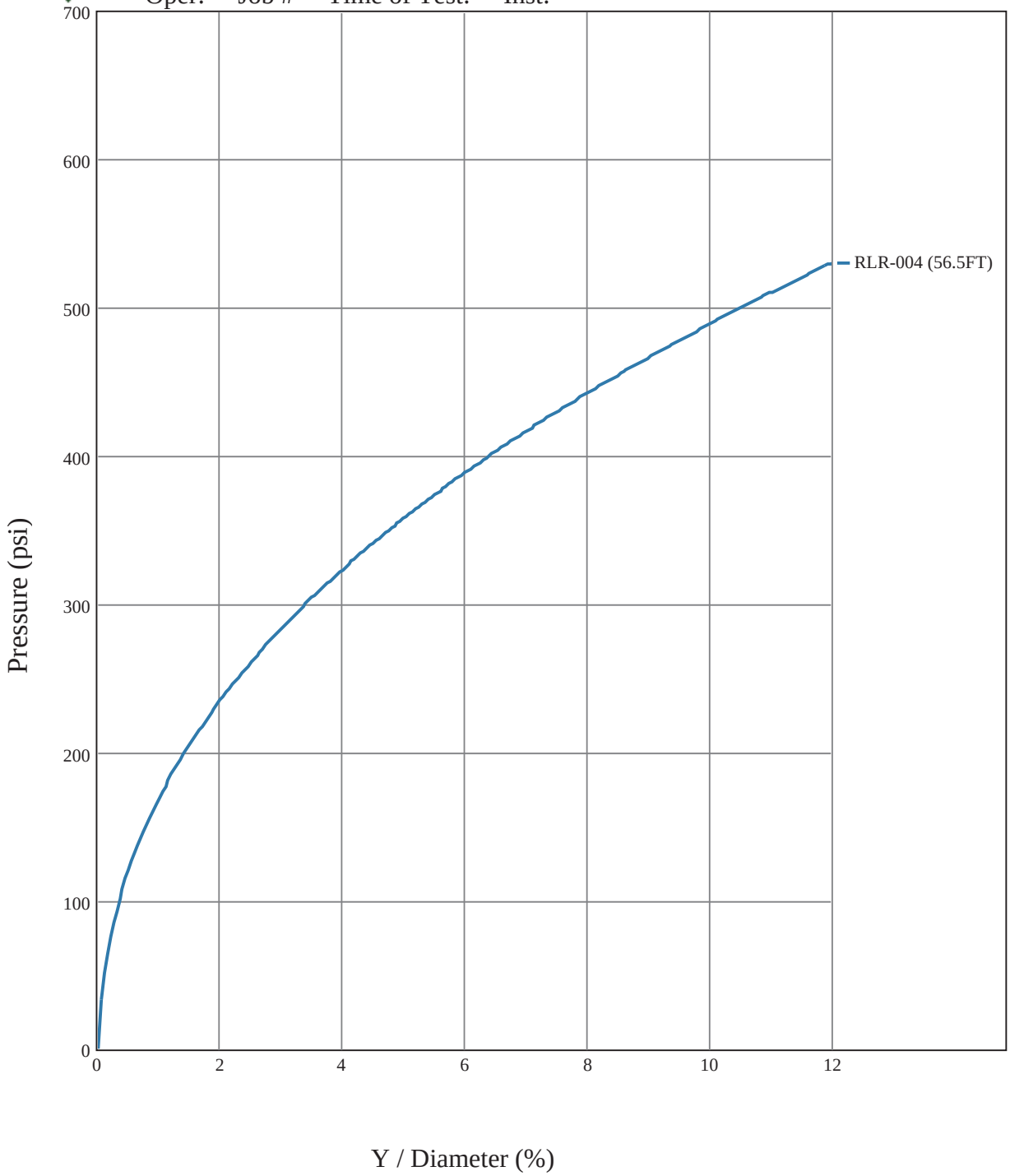
In Situ Engineering - PY Data - Frictional

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031
Oper: Job # Time of Test: Inst:



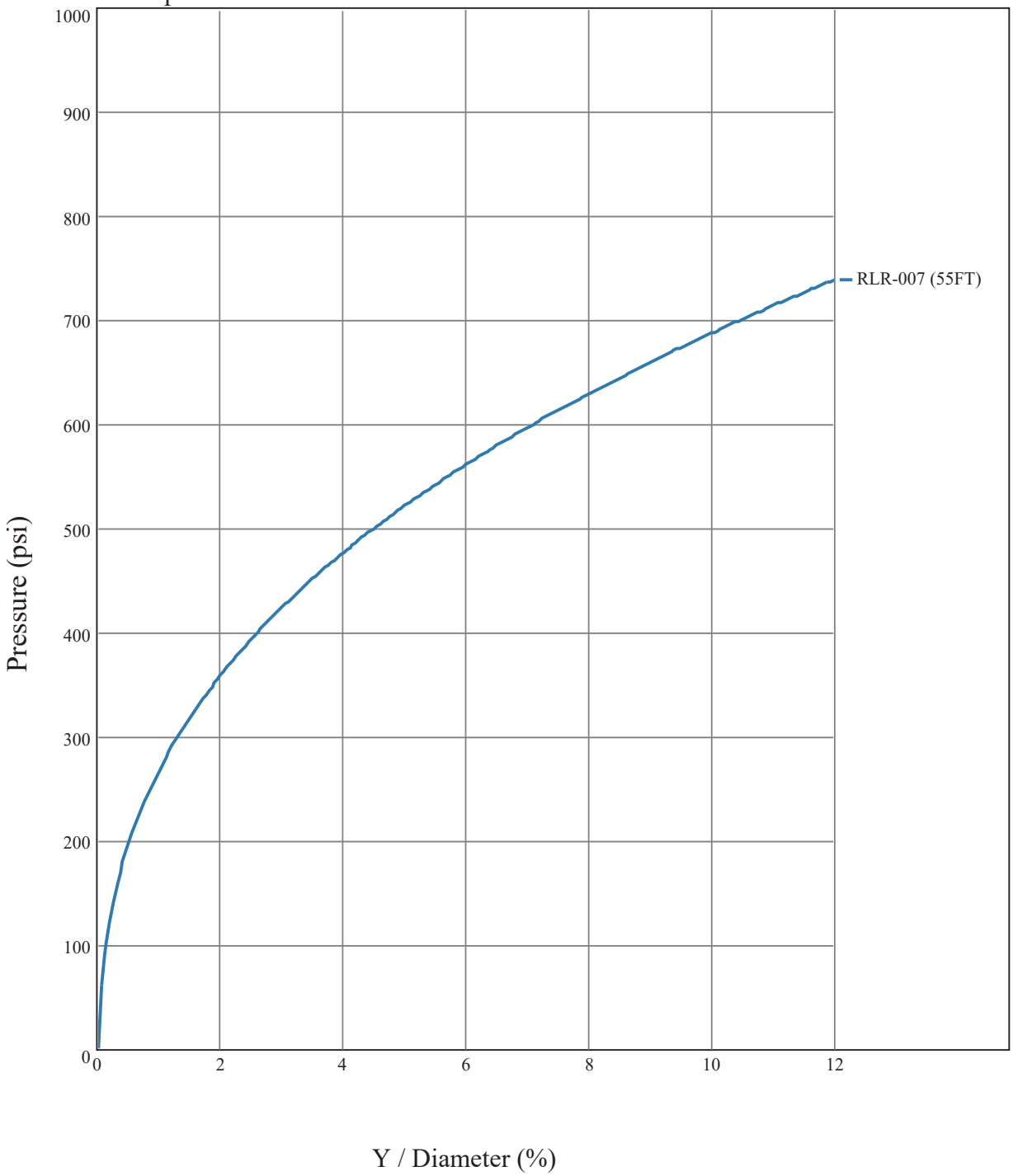
In Situ Engineering - PY Data - Frictional

Golder
Sound Transit Redmond Link Downtown Extension
Boring: DRLE-G031
Oper: Job # Time of Test: Inst:



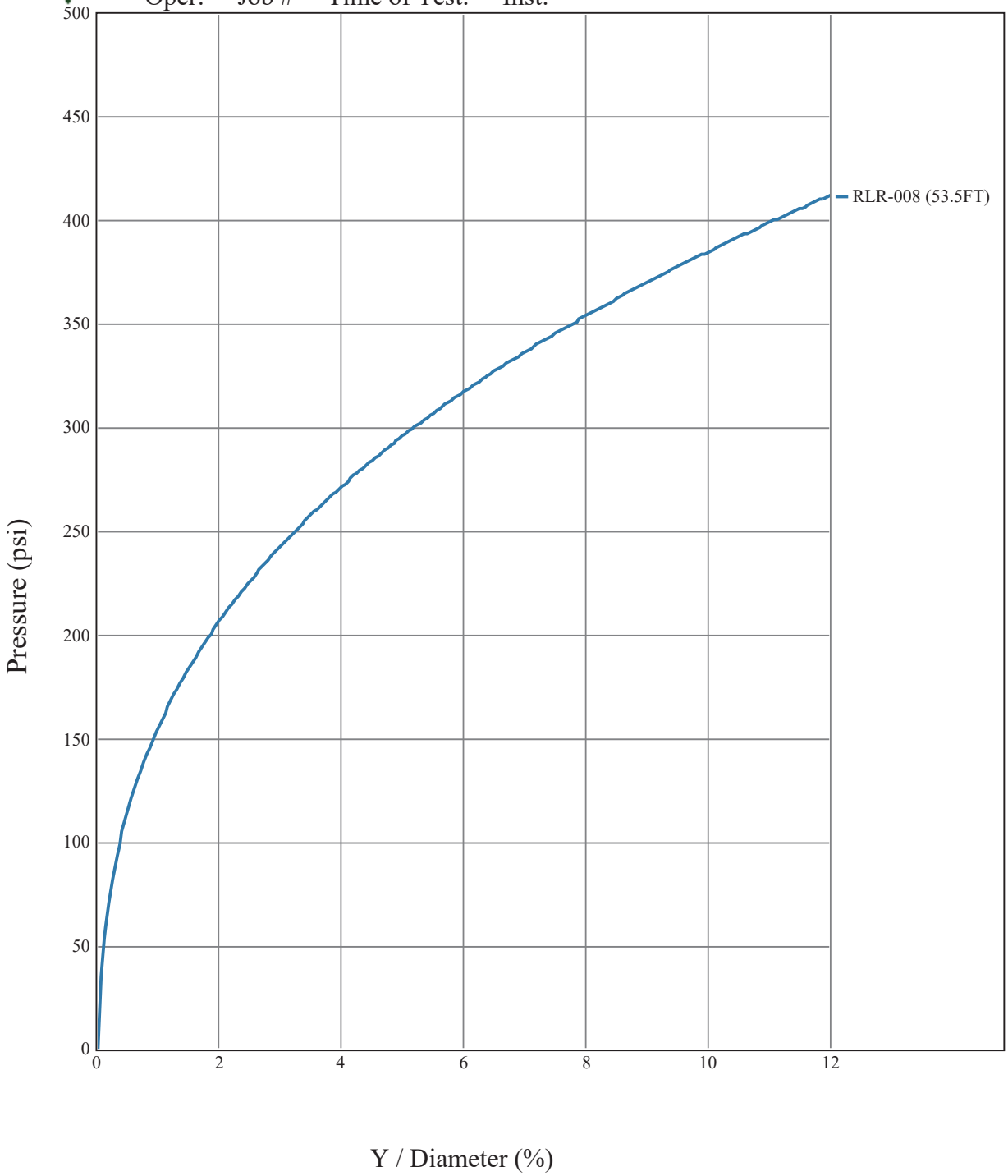
In Situ Engineering - PY Data - Frictional

Golder Associate
Sound Transit Downtowen Redmond Link Extension
Boring: DRLE-G018
Oper: Job # Time of Test: Inst:



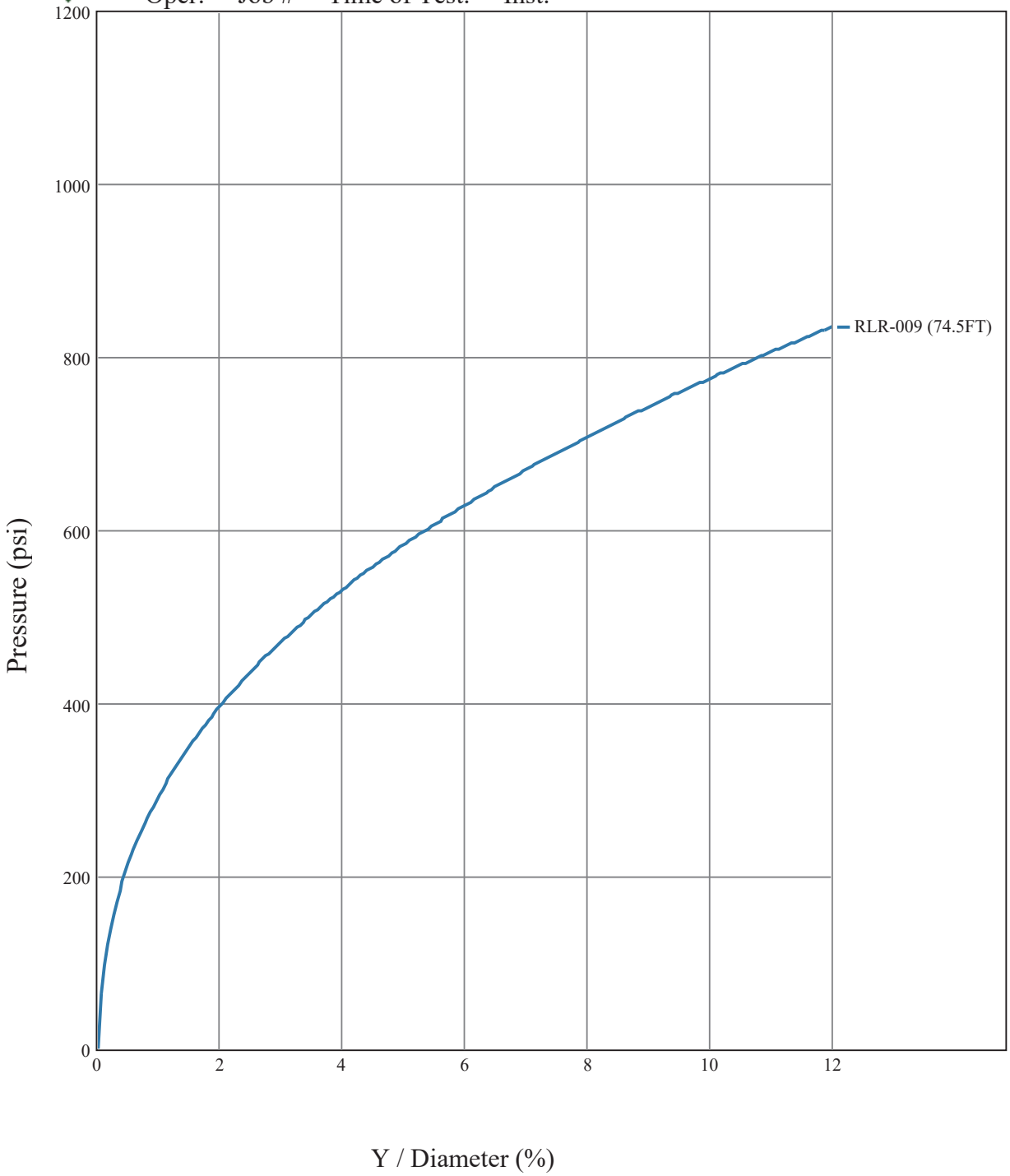
In Situ Engineering - PY Data - Frictional

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018
Oper: Job # Time of Test: Inst:



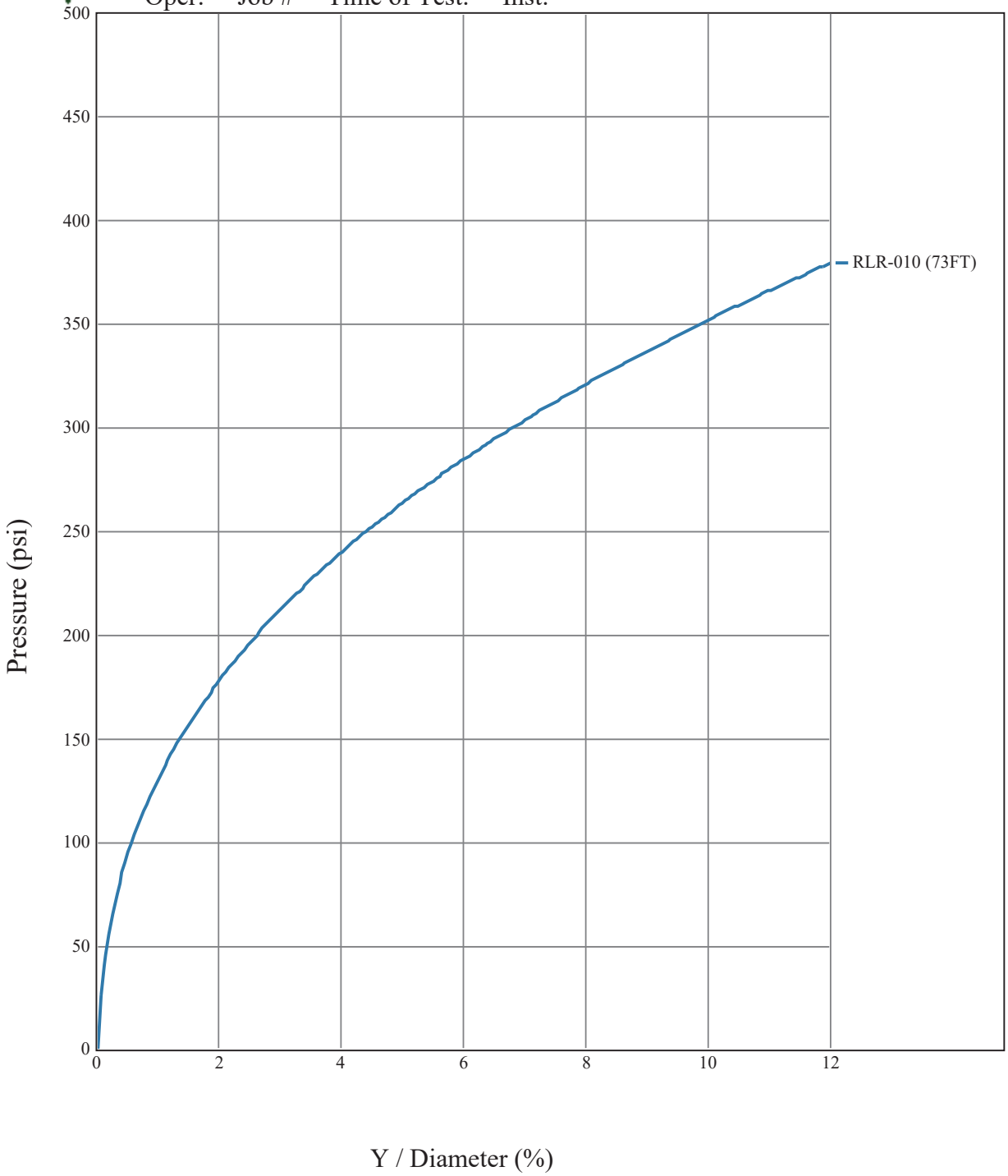
In Situ Engineering - PY Data - Frictional

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018
Oper: Job # Time of Test: Inst:



In Situ Engineering - PY Data - Frictional

Golder Associate
Sound Transit Downtown Redmond Link Extension
Boring: DRLE-G018
Oper: Job # Time of Test: Inst:



In Situ Pressuremeter Data

Golder Associate
Sound Transit Downtowen Redmond Link Extension

PY Data - Frictional
Hole No: DRLE-G018

Y/Diameter (%)	Pressure (psi)	Pressure (psi)	Pressure (psi)	Pressure (psi)
	RLR-007 55FT	RLR-008 53.5FT	RLR-009 74.5FT	RLR-010 73FT
0.00	0.0	0.0	0.0	0.0
0.05	61.5	35.0	64.4	26.4
0.10	91.2	53.1	96.6	42.1
0.15	112.5	65.8	120.0	53.5
0.20	129.7	76.0	138.9	62.6
0.25	144.3	84.6	155.1	70.4
0.30	157.3	92.2	169.4	77.2
0.35	168.9	99.0	182.3	83.4
0.40	179.5	105.2	194.1	89.1
0.45	189.4	110.9	205.1	94.3
0.50	198.5	116.1	215.3	99.2
0.55	207.1	121.1	225.0	103.7
0.60	215.3	125.8	234.1	108.0
0.65	223.0	130.2	242.7	112.1
0.70	230.3	134.4	250.9	116.0
0.75	237.4	138.4	258.8	119.8
0.80	244.1	142.2	266.4	123.4
0.85	250.6	145.9	273.7	126.8
0.90	256.9	149.5	280.7	130.1
0.95	262.9	152.9	287.5	133.3
1.00	268.7	156.2	294.1	136.4
1.05	274.4	159.4	300.5	139.4
1.10	279.9	162.5	306.7	142.4
1.15	285.2	165.5	312.7	145.2
1.20	290.4	168.4	318.6	148.0
1.25	295.5	171.3	324.3	150.6
1.30	300.4	174.1	329.9	153.3
1.35	305.2	176.8	335.4	155.8
1.40	310.0	179.4	340.7	158.3
1.45	314.6	182.0	345.9	160.8
1.50	319.1	184.5	351.0	163.2
1.55	323.5	187.0	356.0	165.5
1.60	327.8	189.4	360.9	167.8
1.65	332.0	191.8	365.8	170.1
1.70	336.2	194.1	370.5	172.3
1.75	340.3	196.4	375.1	174.4
1.80	344.3	198.6	379.7	176.6
1.85	348.2	200.8	384.2	178.7

1.90	352.1	202.9	388.6	180.7
1.95	355.9	205.1	392.9	182.7
2.00	359.7	207.1	397.2	184.7
2.05	363.4	209.2	401.4	186.7
2.10	367.0	211.2	405.5	188.6
2.15	370.6	213.2	409.6	190.5
2.20	374.1	215.2	413.7	192.4
2.25	377.6	217.1	417.6	194.3
2.30	381.1	219.0	421.5	196.1
2.35	384.4	220.9	425.4	197.9
2.40	387.8	222.7	429.2	199.7
2.45	391.1	224.5	433.0	201.4
2.50	394.3	226.3	436.7	203.1
2.55	397.6	228.1	440.4	204.9
2.60	400.7	229.9	444.0	206.5
2.65	403.9	231.6	447.6	208.2
2.70	407.0	233.3	451.2	209.9
2.75	410.1	235.0	454.7	211.5
2.80	413.1	236.6	458.1	213.1
2.85	416.1	238.3	461.6	214.7
2.90	419.0	239.9	464.9	216.3
2.95	422.0	241.5	468.3	217.8
3.00	424.9	243.1	471.6	219.4
3.05	427.8	244.7	474.9	220.9
3.10	430.6	246.3	478.2	222.4
3.15	433.4	247.8	481.4	223.9
3.20	436.2	249.3	484.6	225.4
3.25	439.0	250.9	487.8	226.8
3.30	441.7	252.3	490.9	228.3
3.35	444.4	253.8	494.0	229.7
3.40	447.1	255.3	497.1	231.2
3.45	449.8	256.8	500.1	232.6
3.50	452.4	258.2	503.1	234.0
3.55	455.0	259.6	506.1	235.4
3.60	457.6	261.0	509.1	236.7
3.65	460.1	262.4	512.1	238.1
3.70	462.7	263.8	515.0	239.4
3.75	465.2	265.2	517.9	240.8
3.80	467.7	266.6	520.7	242.1
3.85	470.2	267.9	523.6	243.4
3.90	472.7	269.3	526.4	244.7
3.95	475.1	270.6	529.2	246.0
4.00	477.5	271.9	532.0	247.3
4.05	479.9	273.2	534.8	248.6
4.10	482.3	274.5	537.5	249.9
4.15	484.7	275.8	540.2	251.1
4.20	487.0	277.1	542.9	252.4
4.25	489.3	278.3	545.6	253.6
4.30	491.7	279.6	548.3	254.8
4.35	494.0	280.9	550.9	256.1
4.40	496.2	282.1	553.5	257.3
4.45	498.5	283.3	556.1	258.5
4.50	500.8	284.5	558.7	259.7
4.55	503.0	285.8	561.3	260.8

4.60	505.2	287.0	563.9	262.0
4.65	507.4	288.2	566.4	263.2
4.70	509.6	289.3	568.9	264.4
4.75	511.8	290.5	571.4	265.5
4.80	513.9	291.7	573.9	266.7
4.85	516.1	292.8	576.4	267.8
4.90	518.2	294.0	578.8	268.9
4.95	520.3	295.1	581.3	270.1
5.00	522.4	296.3	583.7	271.2
5.05	524.5	297.4	586.1	272.3
5.10	526.6	298.5	588.5	273.4
5.15	528.7	299.7	590.9	274.5
5.20	530.7	300.8	593.2	275.6
5.25	532.7	301.9	595.6	276.7
5.30	534.8	303.0	597.9	277.7
5.35	536.8	304.1	600.3	278.8
5.40	538.8	305.1	602.6	279.9
5.45	540.8	306.2	604.9	280.9
5.50	542.8	307.3	607.2	282.0
5.55	544.7	308.4	609.4	283.0
5.60	546.7	309.4	611.7	284.1
5.65	548.6	310.5	614.0	285.1
5.70	550.6	311.5	616.2	286.1
5.75	552.5	312.5	618.4	287.1
5.80	554.4	313.6	620.6	288.2
5.85	556.3	314.6	622.8	289.2
5.90	558.2	315.6	625.0	290.2
5.95	560.1	316.6	627.2	291.2
6.00	562.0	317.7	629.4	292.2
6.05	563.9	318.7	631.5	293.2
6.10	565.7	319.7	633.7	294.2
6.15	567.6	320.7	635.8	295.1
6.20	569.4	321.6	637.9	296.1
6.25	571.2	322.6	640.0	297.1
6.30	573.0	323.6	642.2	298.1
6.35	574.9	324.6	644.2	299.0
6.40	576.7	325.5	646.3	300.0
6.45	578.4	326.5	648.4	300.9
6.50	580.2	327.5	650.5	301.9
6.55	582.0	328.4	652.5	302.8
6.60	583.8	329.4	654.6	303.8
6.65	585.5	330.3	656.6	304.7
6.70	587.3	331.3	658.6	305.6
6.75	589.0	332.2	660.6	306.5
6.80	590.8	333.1	662.6	307.5
6.85	592.5	334.1	664.6	308.4
6.90	594.2	335.0	666.6	309.3
6.95	595.9	335.9	668.6	310.2
7.00	597.6	336.8	670.6	311.1
7.05	599.3	337.7	672.6	312.0
7.10	601.0	338.6	674.5	312.9
7.15	602.7	339.5	676.5	313.8
7.20	604.3	340.4	678.4	314.7
7.25	606.0	341.3	680.3	315.6

7.30	607.7	342.2	682.2	316.4
7.35	609.3	343.1	684.2	317.3
7.40	611.0	344.0	686.1	318.2
7.45	612.6	344.8	688.0	319.1
7.50	614.2	345.7	689.8	319.9
7.55	615.9	346.6	691.7	320.8
7.60	617.5	347.4	693.6	321.7
7.65	619.1	348.3	695.5	322.5
7.70	620.7	349.2	697.3	323.4
7.75	622.3	350.0	699.2	324.2
7.80	623.9	350.9	701.0	325.1
7.85	625.5	351.7	702.9	325.9
7.90	627.0	352.6	704.7	326.7
7.95	628.6	353.4	706.5	327.6
8.00	630.2	354.2	708.3	328.4
8.05	631.7	355.1	710.1	329.2
8.10	633.3	355.9	711.9	330.0
8.15	634.8	356.7	713.7	330.9
8.20	636.4	357.6	715.5	331.7
8.25	637.9	358.4	717.3	332.5
8.30	639.4	359.2	719.1	333.3
8.35	641.0	360.0	720.9	334.1
8.40	642.5	360.8	722.6	334.9
8.45	644.0	361.6	724.4	335.7
8.50	645.5	362.4	726.1	336.5
8.55	647.0	363.2	727.9	337.3
8.60	648.5	364.0	729.6	338.1
8.65	650.0	364.8	731.3	338.9
8.70	651.5	365.6	733.1	339.7
8.75	653.0	366.4	734.8	340.5
8.80	654.4	367.2	736.5	341.3
8.85	655.9	368.0	738.2	342.1
8.90	657.4	368.7	739.9	342.8
8.95	658.8	369.5	741.6	343.6
9.00	660.3	370.3	743.3	344.4
9.05	661.7	371.1	745.0	345.2
9.10	663.2	371.8	746.7	345.9
9.15	664.6	372.6	748.3	346.7
9.20	666.0	373.4	750.0	347.4
9.25	667.5	374.1	751.7	348.2
9.30	668.9	374.9	753.3	349.0
9.35	670.3	375.6	755.0	349.7
9.40	671.7	376.4	756.6	350.5
9.45	673.1	377.1	758.2	351.2
9.50	674.5	377.9	759.9	352.0
9.55	675.9	378.6	761.5	352.7
9.60	677.3	379.4	763.1	353.4
9.65	678.7	380.1	764.8	354.2
9.70	680.1	380.9	766.4	354.9
9.75	681.5	381.6	768.0	355.7
9.80	682.9	382.3	769.6	356.4
9.85	684.3	383.1	771.2	357.1
9.90	685.6	383.8	772.8	357.8
9.95	687.0	384.5	774.4	358.6

10.00	688.3	385.2	775.9	359.3
10.05	689.7	386.0	777.5	360.0
10.10	691.1	386.7	779.1	360.7
10.15	692.4	387.4	780.7	361.4
10.20	693.7	388.1	782.2	362.2
10.25	695.1	388.8	783.8	362.9
10.30	696.4	389.5	785.3	363.6
10.35	697.8	390.2	786.9	364.3
10.40	699.1	390.9	788.4	365.0
10.45	700.4	391.6	790.0	365.7
10.50	701.7	392.3	791.5	366.4
10.55	703.0	393.0	793.1	367.1
10.60	704.4	393.7	794.6	367.8
10.65	705.7	394.4	796.1	368.5
10.70	707.0	395.1	797.6	369.2
10.75	708.3	395.8	799.1	369.9
10.80	709.6	396.5	800.7	370.6
10.85	710.9	397.2	802.2	371.2
10.90	712.1	397.9	803.7	371.9
10.95	713.4	398.5	805.2	372.6
11.00	714.7	399.2	806.7	373.3
11.05	716.0	399.9	808.1	374.0
11.10	717.3	400.6	809.6	374.6
11.15	718.5	401.2	811.1	375.3
11.20	719.8	401.9	812.6	376.0
11.25	721.1	402.6	814.1	376.7
11.30	722.3	403.3	815.5	377.3
11.35	723.6	403.9	817.0	378.0
11.40	724.8	404.6	818.5	378.7
11.45	726.1	405.2	819.9	379.3
11.50	727.3	405.9	821.4	380.0
11.55	728.6	406.6	822.8	380.7
11.60	729.8	407.2	824.3	381.3
11.65	731.0	407.9	825.7	382.0
11.70	732.3	408.5	827.1	382.6
11.75	733.5	409.2	828.6	383.3
11.80	734.7	409.8	830.0	383.9
11.85	736.0	410.5	831.4	384.6
11.90	737.2	411.1	832.9	385.2
11.95	738.4	411.8	834.3	385.9
12.00	739.6	412.4	835.7	386.5
12.05	740.8	413.0	837.1	387.2
12.10	742.0	413.7	838.5	387.8
12.15	743.2	414.3	839.9	388.4
12.20	744.4	414.9	841.3	389.1
12.25	745.6	415.6	842.7	389.7
12.30	746.8	416.2	844.1	390.4
12.35	748.0	416.8	845.5	391.0
12.40	749.2	417.5	846.9	391.6
12.45	750.4	418.1	848.3	392.2
12.50	751.6	418.7	849.7	392.9
12.55	752.8	419.3	851.0	393.5
12.60	753.9	420.0	852.4	394.1
12.65	755.1	420.6	853.8	394.7

12.70	756.3	421.2	855.1	395.4
12.75	757.4	421.8	856.5	396.0
12.80	758.6	422.4	857.9	396.6
12.85	759.8	423.0	859.2	397.2
12.90	760.9	423.7	860.6	397.8
12.95	762.1	424.3	861.9	398.5
13.00	763.2	424.9	863.3	399.1
13.05	764.4	425.5	864.6	399.7
13.10	765.5	426.1	866.0	400.3
13.15	766.7	426.7	867.3	400.9
13.20	767.8	427.3	868.6	401.5
13.25	769.0	427.9	870.0	402.1
13.30	770.1	428.5	871.3	402.7
13.35	771.2	429.1	872.6	403.3
13.40	772.4	429.7	874.0	403.9
13.45	773.5	430.3	875.3	404.5
13.50	774.6	430.9	876.6	405.1
13.55	775.8	431.5	877.9	405.7
13.60	776.9	432.1	879.2	406.3
13.65	778.0	432.7	880.5	406.9
13.70	779.1	433.2	881.8	407.5
13.75	780.2	433.8	883.1	408.1
13.80	781.3	434.4	884.4	408.7
13.85	782.4	435.0	885.7	409.3
13.90	783.6	435.6	887.0	409.9
13.95	784.7	436.2	888.3	410.4
14.00	785.8	436.7	889.6	411.0
14.05	786.9	437.3	890.9	411.6
14.10	788.0	437.9	892.2	412.2
14.15	789.1	438.5	893.5	412.8
14.20	790.1	439.1	894.7	413.4
14.25	791.2	439.6	896.0	413.9
14.30	792.3	440.2	897.3	414.5
14.35	793.4	440.8	898.5	415.1
14.40	794.5	441.3	899.8	415.7
14.45	795.6	441.9	901.1	416.2
14.50	796.6	442.5	902.3	416.8
14.55	797.7	443.0	903.6	417.4
14.60	798.8	443.6	904.8	418.0
14.65	799.9	444.2	906.1	418.5
14.70	800.9	444.7	907.4	419.1
14.75	802.0	445.3	908.6	419.7
14.80	803.1	445.8	909.8	420.2
14.85	804.1	446.4	911.1	420.8
14.90	805.2	447.0	912.3	421.3
14.95	806.2	447.5	913.6	421.9
15.00	807.3	448.1	914.8	422.5
15.05	808.3	448.6	916.0	423.0
15.10	809.4	449.2	917.3	423.6
15.15	810.4	449.7	918.5	424.1
15.20	811.5	450.3	919.7	424.7
15.25	812.5	450.8	920.9	425.2
15.30	813.6	451.4	922.2	425.8
15.35	814.6	451.9	923.4	426.4

15.40	815.7	452.5	924.6	426.9
15.45	816.7	453.0	925.8	427.5
15.50	817.7	453.5	927.0	428.0
15.55	818.8	454.1	928.2	428.6
15.60	819.8	454.6	929.4	429.1
15.65	820.8	455.2	930.6	429.6
15.70	821.8	455.7	931.8	430.2
15.75	822.9	456.2	933.0	430.7
15.80	823.9	456.8	934.2	431.3
15.85	824.9	457.3	935.4	431.8
15.90	825.9	457.8	936.6	432.4
15.95	826.9	458.4	937.8	432.9
16.00	827.9	458.9	939.0	433.4
16.05	829.0	459.4	940.2	434.0
16.10	830.0	460.0	941.3	434.5
16.15	831.0	460.5	942.5	435.0
16.20	832.0	461.0	943.7	435.6
16.25	833.0	461.6	944.9	436.1
16.30	834.0	462.1	946.1	436.6
16.35	835.0	462.6	947.2	437.2
16.40	836.0	463.1	948.4	437.7
16.45	837.0	463.6	949.6	438.2
16.50	838.0	464.2	950.7	438.8
16.55	839.0	464.7	951.9	439.3
16.60	840.0	465.2	953.1	439.8
16.65	840.9	465.7	954.2	440.3
16.70	841.9	466.2	955.4	440.9
16.75	842.9	466.8	956.5	441.4
16.80	843.9	467.3	957.7	441.9
16.85	844.9	467.8	958.8	442.4
16.90	845.9	468.3	960.0	442.9
16.95	846.8	468.8	961.1	443.5
17.00	847.8	469.3	962.3	444.0
17.05	848.8	469.8	963.4	444.5
17.10	849.7	470.3	964.5	445.0
17.15	850.7	470.8	965.7	445.5
17.20	851.7	471.4	966.8	446.0
17.25	852.7	471.9	967.9	446.6
17.30	853.6	472.4	969.1	447.1
17.35	854.6	472.9	970.2	447.6
17.40	855.5	473.4	971.3	448.1
17.45	856.5	473.9	972.5	448.6
17.50	857.5	474.4	973.6	449.1
17.55	858.4	474.9	974.7	449.6
17.60	859.4	475.4	975.8	450.1
17.65	860.3	475.9	976.9	450.6
17.70	861.3	476.4	978.1	451.1
17.75	862.2	476.9	979.2	451.6
17.80	863.2	477.4	980.3	452.1
17.85	864.1	477.9	981.4	452.6
17.90	865.1	478.3	982.5	453.1
17.95	866.0	478.8	983.6	453.6
18.00	866.9	479.3	984.7	454.1
18.05	867.9	479.8	985.8	454.6

18.10	868.8	480.3	986.9	455.1
18.15	869.8	480.8	988.0	455.6
18.20	870.7	481.3	989.1	456.1
18.25	871.6	481.8	990.2	456.6
18.30	872.6	482.3	991.3	457.1
18.35	873.5	482.8	992.4	457.6
18.40	874.4	483.2	993.5	458.1
18.45	875.3	483.7	994.6	458.6
18.50	876.3	484.2	995.6	459.1
18.55	877.2	484.7	996.7	459.6
18.60	878.1	485.2	997.8	460.1
18.65	879.0	485.6	998.9	460.6
18.70	879.9	486.1	1000.0	461.1
18.75	880.9	486.6	1001.0	461.5
18.80	881.8	487.1	1002.1	462.0
18.85	882.7	487.6	1003.2	462.5
18.90	883.6	488.0	1004.3	463.0
18.95	884.5	488.5	1005.3	463.5
19.00	885.4	489.0	1006.4	464.0
19.05	886.3	489.5	1007.5	464.4
19.10	887.2	489.9	1008.5	464.9
19.15	888.1	490.4	1009.6	465.4
19.20	889.0	490.9	1010.7	465.9
19.25	890.0	491.4	1011.7	466.4
19.30	890.9	491.8	1012.8	466.8
19.35	891.8	492.3	1013.8	467.3
19.40	892.6	492.8	1014.9	467.8
19.45	893.5	493.2	1015.9	468.3
19.50	894.4	493.7	1017.0	468.7
19.55	895.3	494.2	1018.0	469.2
19.60	896.2	494.6	1019.1	469.7
19.65	897.1	495.1	1020.1	470.2
19.70	898.0	495.6	1021.2	470.6
19.75	898.9	496.0	1022.2	471.1
19.80	899.8	496.5	1023.3	471.6
19.85	900.7	496.9	1024.3	472.1
19.90	901.5	497.4	1025.3	472.5
19.95	902.4	497.9	1026.4	473.0
20.00	903.3	498.3	1027.4	473.5

In Situ Pressuremeter Data

Golder
Sound Transit Redmond Link Downtown Extension

PY Data - Frictional
Hole No: DRLE-G031

Y/Diameter (%)	Pressure (psi)	Pressure (psi)	Pressure (psi)	Pressure (psi)
	RLR-001 16FT	RLR-002 23.5FT	RLR-003 58FT	RLR-004 56.5FT
0.00	0.0	0.0	0.0	0.0
0.05	28.5	37.1	30.6	32.8
0.10	43.0	57.6	48.0	50.9
0.15	54.0	73.7	60.9	64.3
0.20	63.3	87.6	71.4	75.3
0.25	71.4	99.9	80.6	84.8
0.30	78.8	111.1	88.7	93.3
0.35	85.5	121.6	96.1	101.1
0.40	91.8	131.3	103.0	108.2
0.45	97.6	140.6	109.3	114.8
0.50	103.2	149.4	115.3	121.0
0.55	108.4	157.7	120.9	126.9
0.60	113.5	165.8	126.3	132.5
0.65	118.3	173.5	131.4	137.8
0.70	122.9	181.0	136.3	142.9
0.75	127.4	188.3	140.9	147.8
0.80	131.7	195.3	145.4	152.5
0.85	135.8	202.1	149.8	157.0
0.90	139.9	208.8	154.0	161.4
0.95	143.8	215.3	158.1	165.6
1.00	147.6	221.6	162.0	169.8
1.05	151.4	227.8	165.9	173.8
1.10	155.0	233.8	169.6	177.7
1.15	158.6	239.8	173.3	181.5
1.20	162.1	245.6	176.8	185.2
1.25	165.5	251.3	180.3	188.8
1.30	168.8	256.9	183.7	192.3
1.35	172.1	262.4	187.0	195.8
1.40	175.3	267.8	190.3	199.2
1.45	178.4	273.2	193.5	202.5
1.50	181.5	278.4	196.6	205.8
1.55	184.6	283.6	199.6	209.0
1.60	187.6	288.7	202.7	212.1
1.65	190.5	293.7	205.6	215.2
1.70	193.4	298.6	208.5	218.2
1.75	196.3	303.5	211.4	221.2
1.80	199.1	308.4	214.2	224.1
1.85	201.9	313.1	216.9	227.0

1.90	204.6	317.8	219.7	229.8
1.95	207.3	322.5	222.4	232.6
2.00	210.0	327.1	225.0	235.4
2.05	212.6	331.6	227.6	238.1
2.10	215.2	336.1	230.2	240.8
2.15	217.8	340.6	232.7	243.4
2.20	220.3	345.0	235.2	246.0
2.25	222.8	349.3	237.7	248.6
2.30	225.3	353.6	240.1	251.2
2.35	227.8	357.9	242.5	253.7
2.40	230.2	362.1	244.9	256.2
2.45	232.6	366.3	247.3	258.6
2.50	235.0	370.5	249.6	261.0
2.55	237.3	374.6	251.9	263.4
2.60	239.7	378.6	254.2	265.8
2.65	242.0	382.7	256.4	268.1
2.70	244.3	386.7	258.6	270.5
2.75	246.5	390.7	260.8	272.8
2.80	248.8	394.6	263.0	275.0
2.85	251.0	398.5	265.2	277.3
2.90	253.2	402.4	267.3	279.5
2.95	255.4	406.2	269.4	281.7
3.00	257.5	410.1	271.5	283.9
3.05	259.7	413.8	273.6	286.0
3.10	261.8	417.6	275.6	288.2
3.15	263.9	421.3	277.7	290.3
3.20	266.0	425.0	279.7	292.4
3.25	268.1	428.7	281.7	294.5
3.30	270.1	432.4	283.7	296.6
3.35	272.2	436.0	285.6	298.6
3.40	274.2	439.6	287.6	300.6
3.45	276.2	443.2	289.5	302.7
3.50	278.2	446.8	291.4	304.7
3.55	280.2	450.3	293.3	306.6
3.60	282.1	453.8	295.2	308.6
3.65	284.1	457.3	297.1	310.5
3.70	286.0	460.8	299.0	312.5
3.75	288.0	464.2	300.8	314.4
3.80	289.9	467.6	302.6	316.3
3.85	291.8	471.0	304.4	318.2
3.90	293.7	474.4	306.2	320.1
3.95	295.5	477.8	308.0	321.9
4.00	297.4	481.1	309.8	323.8
4.05	299.3	484.5	311.6	325.6
4.10	301.1	487.8	313.3	327.4
4.15	302.9	491.1	315.0	329.3
4.20	304.7	494.3	316.8	331.1
4.25	306.5	497.6	318.5	332.8
4.30	308.3	500.8	320.2	334.6
4.35	310.1	504.1	321.9	336.4
4.40	311.9	507.3	323.6	338.1
4.45	313.7	510.5	325.2	339.9
4.50	315.4	513.6	326.9	341.6
4.55	317.2	516.8	328.5	343.3

4.60	318.9	519.9	330.2	345.0
4.65	320.6	523.0	331.8	346.7
4.70	322.3	526.2	333.4	348.4
4.75	324.0	529.3	335.0	350.1
4.80	325.7	532.3	336.6	351.8
4.85	327.4	535.4	338.2	353.4
4.90	329.1	538.4	339.8	355.1
4.95	330.8	541.5	341.4	356.7
5.00	332.4	544.5	342.9	358.3
5.05	334.1	547.5	344.5	359.9
5.10	335.7	550.5	346.0	361.5
5.15	337.4	553.5	347.6	363.1
5.20	339.0	556.5	349.1	364.7
5.25	340.6	559.4	350.6	366.3
5.30	342.2	562.4	352.1	367.9
5.35	343.8	565.3	353.6	369.5
5.40	345.4	568.2	355.1	371.0
5.45	347.0	571.1	356.6	372.6
5.50	348.6	574.0	358.1	374.1
5.55	350.2	576.9	359.5	375.6
5.60	351.7	579.8	361.0	377.2
5.65	353.3	582.6	362.5	378.7
5.70	354.8	585.5	363.9	380.2
5.75	356.4	588.3	365.4	381.7
5.80	357.9	591.1	366.8	383.2
5.85	359.5	594.0	368.2	384.7
5.90	361.0	596.8	369.6	386.2
5.95	362.5	599.6	371.0	387.6
6.00	364.0	602.3	372.5	389.1
6.05	365.5	605.1	373.9	390.6
6.10	367.0	607.9	375.2	392.0
6.15	368.5	610.6	376.6	393.5
6.20	370.0	613.4	378.0	394.9
6.25	371.5	616.1	379.4	396.3
6.30	373.0	618.8	380.8	397.8
6.35	374.4	621.5	382.1	399.2
6.40	375.9	624.2	383.5	400.6
6.45	377.3	626.9	384.8	402.0
6.50	378.8	629.6	386.2	403.4
6.55	380.2	632.3	387.5	404.8
6.60	381.7	634.9	388.8	406.2
6.65	383.1	637.6	390.2	407.6
6.70	384.5	640.2	391.5	408.9
6.75	386.0	642.9	392.8	410.3
6.80	387.4	645.5	394.1	411.7
6.85	388.8	648.1	395.4	413.0
6.90	390.2	650.7	396.7	414.4
6.95	391.6	653.3	398.0	415.7
7.00	393.0	655.9	399.3	417.1
7.05	394.4	658.5	400.6	418.4
7.10	395.8	661.1	401.8	419.7
7.15	397.2	663.7	403.1	421.1
7.20	398.5	666.2	404.4	422.4
7.25	399.9	668.8	405.6	423.7

7.30	401.3	671.3	406.9	425.0
7.35	402.6	673.9	408.2	426.3
7.40	404.0	676.4	409.4	427.6
7.45	405.4	678.9	410.6	428.9
7.50	406.7	681.4	411.9	430.2
7.55	408.0	683.9	413.1	431.5
7.60	409.4	686.4	414.3	432.8
7.65	410.7	688.9	415.6	434.0
7.70	412.0	691.4	416.8	435.3
7.75	413.4	693.9	418.0	436.6
7.80	414.7	696.3	419.2	437.8
7.85	416.0	698.8	420.4	439.1
7.90	417.3	701.3	421.6	440.4
7.95	418.6	703.7	422.8	441.6
8.00	419.9	706.2	424.0	442.8
8.05	421.2	708.6	425.2	444.1
8.10	422.5	711.0	426.4	445.3
8.15	423.8	713.4	427.6	446.5
8.20	425.1	715.8	428.7	447.8
8.25	426.4	718.3	429.9	449.0
8.30	427.7	720.7	431.1	450.2
8.35	428.9	723.0	432.2	451.4
8.40	430.2	725.4	433.4	452.6
8.45	431.5	727.8	434.6	453.8
8.50	432.8	730.2	435.7	455.0
8.55	434.0	732.6	436.9	456.2
8.60	435.3	734.9	438.0	457.4
8.65	436.5	737.3	439.1	458.6
8.70	437.8	739.6	440.3	459.8
8.75	439.0	742.0	441.4	461.0
8.80	440.3	744.3	442.5	462.2
8.85	441.5	746.6	443.7	463.3
8.90	442.7	749.0	444.8	464.5
8.95	444.0	751.3	445.9	465.7
9.00	445.2	753.6	447.0	466.8
9.05	446.4	755.9	448.1	468.0
9.10	447.6	758.2	449.2	469.2
9.15	448.8	760.5	450.3	470.3
9.20	450.1	762.8	451.4	471.5
9.25	451.3	765.1	452.5	472.6
9.30	452.5	767.4	453.6	473.7
9.35	453.7	769.6	454.7	474.9
9.40	454.9	771.9	455.8	476.0
9.45	456.1	774.2	456.9	477.1
9.50	457.3	776.4	458.0	478.3
9.55	458.5	778.7	459.1	479.4
9.60	459.7	780.9	460.1	480.5
9.65	460.8	783.2	461.2	481.6
9.70	462.0	785.4	462.3	482.7
9.75	463.2	787.6	463.3	483.9
9.80	464.4	789.9	464.4	485.0
9.85	465.5	792.1	465.5	486.1
9.90	466.7	794.3	466.5	487.2
9.95	467.9	796.5	467.6	488.3

10.00	469.0	798.7	468.6	489.4
10.05	470.2	800.9	469.7	490.4
10.10	471.4	803.1	470.7	491.5
10.15	472.5	805.3	471.8	492.6
10.20	473.7	807.5	472.8	493.7
10.25	474.8	809.7	473.8	494.8
10.30	476.0	811.8	474.9	495.9
10.35	477.1	814.0	475.9	496.9
10.40	478.2	816.2	476.9	498.0
10.45	479.4	818.3	477.9	499.1
10.50	480.5	820.5	479.0	500.1
10.55	481.6	822.6	480.0	501.2
10.60	482.8	824.8	481.0	502.3
10.65	483.9	826.9	482.0	503.3
10.70	485.0	829.1	483.0	504.4
10.75	486.1	831.2	484.0	505.4
10.80	487.3	833.3	485.0	506.5
10.85	488.4	835.5	486.0	507.5
10.90	489.5	837.6	487.0	508.5
10.95	490.6	839.7	488.0	509.6
11.00	491.7	841.8	489.0	510.6
11.05	492.8	843.9	490.0	511.7
11.10	493.9	846.0	491.0	512.7
11.15	495.0	848.1	492.0	513.7
11.20	496.1	850.2	493.0	514.7
11.25	497.2	852.3	494.0	515.8
11.30	498.3	854.4	494.9	516.8
11.35	499.4	856.5	495.9	517.8
11.40	500.5	858.5	496.9	518.8
11.45	501.5	860.6	497.9	519.8
11.50	502.6	862.7	498.8	520.8
11.55	503.7	864.8	499.8	521.8
11.60	504.8	866.8	500.8	522.9
11.65	505.9	868.9	501.7	523.9
11.70	506.9	870.9	502.7	524.9
11.75	508.0	873.0	503.6	525.9
11.80	509.1	875.0	504.6	526.9
11.85	510.1	877.1	505.5	527.8
11.90	511.2	879.1	506.5	528.8
11.95	512.3	881.1	507.4	529.8
12.00	513.3	883.2	508.4	530.8
12.05	514.4	885.2	509.3	531.8
12.10	515.4	887.2	510.3	532.8
12.15	516.5	889.2	511.2	533.8
12.20	517.5	891.2	512.1	534.7
12.25	518.6	893.3	513.1	535.7
12.30	519.6	895.3	514.0	536.7
12.35	520.7	897.3	514.9	537.6
12.40	521.7	899.3	515.9	538.6
12.45	522.7	901.3	516.8	539.6
12.50	523.8	903.3	517.7	540.5
12.55	524.8	905.2	518.6	541.5
12.60	525.9	907.2	519.6	542.5
12.65	526.9	909.2	520.5	543.4

12.70	527.9	911.2	521.4	544.4
12.75	528.9	913.2	522.3	545.3
12.80	530.0	915.1	523.2	546.3
12.85	531.0	917.1	524.1	547.2
12.90	532.0	919.1	525.0	548.2
12.95	533.0	921.0	525.9	549.1
13.00	534.0	923.0	526.9	550.1
13.05	535.1	924.9	527.8	551.0
13.10	536.1	926.9	528.7	551.9
13.15	537.1	928.8	529.6	552.9
13.20	538.1	930.8	530.4	553.8
13.25	539.1	932.7	531.3	554.7
13.30	540.1	934.7	532.2	555.7
13.35	541.1	936.6	533.1	556.6
13.40	542.1	938.5	534.0	557.5
13.45	543.1	940.4	534.9	558.4
13.50	544.1	942.4	535.8	559.4
13.55	545.1	944.3	536.7	560.3
13.60	546.1	946.2	537.5	561.2
13.65	547.1	948.1	538.4	562.1
13.70	548.1	950.0	539.3	563.0
13.75	549.0	951.9	540.2	563.9
13.80	550.0	953.8	541.0	564.9
13.85	551.0	955.8	541.9	565.8
13.90	552.0	957.6	542.8	566.7
13.95	553.0	959.5	543.7	567.6
14.00	554.0	961.4	544.5	568.5
14.05	554.9	963.3	545.4	569.4
14.10	555.9	965.2	546.3	570.3
14.15	556.9	967.1	547.1	571.2
14.20	557.8	969.0	548.0	572.1
14.25	558.8	970.9	548.8	573.0
14.30	559.8	972.7	549.7	573.9
14.35	560.8	974.6	550.5	574.8
14.40	561.7	976.5	551.4	575.6
14.45	562.7	978.3	552.2	576.5
14.50	563.6	980.2	553.1	577.4
14.55	564.6	982.1	553.9	578.3
14.60	565.6	983.9	554.8	579.2
14.65	566.5	985.8	555.6	580.1
14.70	567.5	987.6	556.5	580.9
14.75	568.4	989.5	557.3	581.8
14.80	569.4	991.3	558.1	582.7
14.85	570.3	993.2	559.0	583.6
14.90	571.3	995.0	559.8	584.4
14.95	572.2	996.8	560.7	585.3
15.00	573.2	998.7	561.5	586.2
15.05	574.1	1000.5	562.3	587.0
15.10	575.0	1002.3	563.1	587.9
15.15	576.0	1004.2	564.0	588.8
15.20	576.9	1006.0	564.8	589.6
15.25	577.9	1007.8	565.6	590.5
15.30	578.8	1009.6	566.5	591.3
15.35	579.7	1011.4	567.3	592.2

15.40	580.6	1013.2	568.1	593.1
15.45	581.6	1015.0	568.9	593.9
15.50	582.5	1016.9	569.7	594.8
15.55	583.4	1018.7	570.5	595.6
15.60	584.4	1020.5	571.4	596.5
15.65	585.3	1022.3	572.2	597.3
15.70	586.2	1024.1	573.0	598.2
15.75	587.1	1025.9	573.8	599.0
15.80	588.0	1027.6	574.6	599.8
15.85	589.0	1029.4	575.4	600.7
15.90	589.9	1031.2	576.2	601.5
15.95	590.8	1033.0	577.0	602.4
16.00	591.7	1034.8	577.8	603.2
16.05	592.6	1036.6	578.6	604.0
16.10	593.5	1038.3	579.4	604.9
16.15	594.4	1040.1	580.2	605.7
16.20	595.3	1041.9	581.0	606.5
16.25	596.3	1043.7	581.8	607.4
16.30	597.2	1045.4	582.6	608.2
16.35	598.1	1047.2	583.4	609.0
16.40	599.0	1048.9	584.2	609.8
16.45	599.9	1050.7	585.0	610.7
16.50	600.8	1052.5	585.8	611.5
16.55	601.7	1054.2	586.6	612.3
16.60	602.6	1056.0	587.3	613.1
16.65	603.5	1057.7	588.1	613.9
16.70	604.3	1059.5	588.9	614.8
16.75	605.2	1061.2	589.7	615.6
16.80	606.1	1062.9	590.5	616.4
16.85	607.0	1064.7	591.3	617.2
16.90	607.9	1066.4	592.0	618.0
16.95	608.8	1068.2	592.8	618.8
17.00	609.7	1069.9	593.6	619.6
17.05	610.6	1071.6	594.4	620.4
17.10	611.4	1073.3	595.1	621.2
17.15	612.3	1075.1	595.9	622.0
17.20	613.2	1076.8	596.7	622.8
17.25	614.1	1078.5	597.4	623.6
17.30	615.0	1080.2	598.2	624.4
17.35	615.8	1082.0	599.0	625.2
17.40	616.7	1083.7	599.7	626.0
17.45	617.6	1085.4	600.5	626.8
17.50	618.5	1087.1	601.3	627.6
17.55	619.3	1088.8	602.0	628.4
17.60	620.2	1090.5	602.8	629.2
17.65	621.1	1092.2	603.5	630.0
17.70	621.9	1093.9	604.3	630.8
17.75	622.8	1095.6	605.1	631.6
17.80	623.7	1097.3	605.8	632.4
17.85	624.5	1099.0	606.6	633.2
17.90	625.4	1100.7	607.3	633.9
17.95	626.3	1102.4	608.1	634.7
18.00	627.1	1104.1	608.8	635.5
18.05	628.0	1105.8	609.6	636.3

18.10	628.8	1107.4	610.3	637.1
18.15	629.7	1109.1	611.1	637.8
18.20	630.5	1110.8	611.8	638.6
18.25	631.4	1112.5	612.6	639.4
18.30	632.2	1114.2	613.3	640.2
18.35	633.1	1115.8	614.0	641.0
18.40	633.9	1117.5	614.8	641.7
18.45	634.8	1119.2	615.5	642.5
18.50	635.6	1120.8	616.3	643.3
18.55	636.5	1122.5	617.0	644.0
18.60	637.3	1124.2	617.7	644.8
18.65	638.2	1125.8	618.5	645.6
18.70	639.0	1127.5	619.2	646.3
18.75	639.9	1129.1	619.9	647.1
18.80	640.7	1130.8	620.7	647.9
18.85	641.5	1132.5	621.4	648.6
18.90	642.4	1134.1	622.1	649.4
18.95	643.2	1135.8	622.9	650.1
19.00	644.1	1137.4	623.6	650.9
19.05	644.9	1139.0	624.3	651.7
19.10	645.7	1140.7	625.0	652.4
19.15	646.6	1142.3	625.8	653.2
19.20	647.4	1144.0	626.5	653.9
19.25	648.2	1145.6	627.2	654.7
19.30	649.0	1147.2	627.9	655.4
19.35	649.9	1148.9	628.6	656.2
19.40	650.7	1150.5	629.4	656.9
19.45	651.5	1152.1	630.1	657.7
19.50	652.4	1153.8	630.8	658.4
19.55	653.2	1155.4	631.5	659.2
19.60	654.0	1157.0	632.2	659.9
19.65	654.8	1158.6	632.9	660.7
19.70	655.6	1160.3	633.7	661.4
19.75	656.5	1161.9	634.4	662.1
19.80	657.3	1163.5	635.1	662.9
19.85	658.1	1165.1	635.8	663.6
19.90	658.9	1166.7	636.5	664.4
19.95	659.7	1168.3	637.2	665.1
20.00	660.5	1169.9	637.9	665.8

In Situ Pressuremeter Data

Golder
Sound Transit Redmond Link Downtown Extension
Hole No: DRLE-G031
Test: RLR-001
Depth: 16FT
09/18/2017

Oper: Mayfield/Okbay
Job #1657705
Time of Test: 10:47 AM
Inst: 05

Unknown Membrane Corrections
Report was printed from a .P file,
which doesn't save corrections information.

Arm 1 (mm)	Arm 2 (mm)	Arm 3 (mm)	Pressure (psi)	Strain (%)
0.001	-0.001	0.000	-5.8	0.000
0.005	0.008	0.001	-3.2	0.012
0.006	0.012	0.001	-1.5	0.017
0.008	0.016	0.002	2.1	0.023
0.009	0.021	0.000	3.3	0.027
0.012	0.025	0.002	5.3	0.034
0.012	0.026	0.001	6.6	0.035
0.013	0.037	0.001	8.2	0.045
0.015	0.039	0.001	10.2	0.049
0.018	0.048	0.002	12.5	0.060
0.020	0.073	0.002	14.7	0.084
0.024	0.098	0.003	17.3	0.110
0.025	0.258	0.003	19.8	0.252
0.030	0.405	0.003	22.2	0.385
0.033	0.550	0.004	24.9	0.516
0.039	0.694	0.005	27.6	0.649
0.042	0.873	0.006	30.7	0.811
0.045	1.038	0.009	34.6	0.959
0.049	1.190	0.012	38.1	1.100
0.052	1.364	0.016	41.6	1.258
0.055	1.508	0.020	44.6	1.391
0.057	1.648	0.024	48.3	1.520
0.059	1.782	0.028	51.6	1.643
0.061	1.943	0.033	55.2	1.789
0.067	2.125	0.037	58.5	1.959
0.066	2.254	0.043	62.0	2.076
0.067	2.373	0.048	65.0	2.187
0.069	2.499	0.054	68.6	2.303
0.069	2.661	0.059	71.9	2.450
0.071	2.779	0.064	75.0	2.561
0.072	2.913	0.069	78.3	2.684

0.080	3.020	0.074	81.5	2.788
0.163	3.108	0.079	84.7	2.944
0.245	3.199	0.083	87.5	3.099
0.321	3.339	0.088	90.5	3.293
0.392	3.433	0.092	93.4	3.440
0.450	3.521	0.095	94.0	3.571
0.440	3.525	0.093	90.3	3.565
0.416	3.519	0.092	82.8	3.537
0.378	3.500	0.089	74.0	3.484
0.321	3.468	0.085	66.1	3.402
0.251	3.428	0.081	59.5	3.301
0.164	3.378	0.077	53.6	3.177
0.152	3.380	0.077	56.7	3.169
0.165	3.396	0.078	60.6	3.196
0.182	3.410	0.079	64.4	3.225
0.204	3.427	0.081	68.2	3.261
0.228	3.444	0.083	72.1	3.297
0.273	3.472	0.086	78.3	3.364
0.331	3.508	0.089	85.5	3.451
0.389	3.561	0.092	90.9	3.551
0.437	3.611	0.095	94.1	3.639
0.481	3.666	0.097	96.5	3.727
0.548	3.746	0.101	98.9	3.860
0.610	3.804	0.103	101.2	3.968
0.671	3.857	0.107	103.8	4.071
0.748	3.952	0.111	106.9	4.225
0.823	4.055	0.114	110.1	4.385
0.887	4.124	0.118	113.0	4.505
0.961	4.208	0.122	116.0	4.647
0.997	4.283	0.126	119.2	4.749
1.091	4.352	0.130	122.1	4.895
1.173	4.431	0.132	125.2	5.039
1.237	4.495	0.135	127.9	5.154
1.295	4.537	0.136	126.0	5.242
1.295	4.538	0.135	119.4	5.243
1.293	4.531	0.134	109.8	5.233
1.277	4.522	0.132	100.0	5.207
1.252	4.492	0.129	90.9	5.157
1.198	4.464	0.126	82.7	5.083
1.140	4.427	0.123	74.5	4.995
1.141	4.428	0.122	80.5	4.996
1.170	4.446	0.125	90.0	5.041
1.202	4.472	0.127	99.0	5.093
1.229	4.499	0.129	108.6	5.144
1.261	4.534	0.132	117.2	5.205
1.312	4.588	0.135	124.7	5.301
1.392	4.661	0.138	130.8	5.438
1.486	4.758	0.142	136.5	5.610
1.605	4.889	0.148	141.5	5.834
1.730	5.023	0.153	146.7	6.066
1.896	5.138	0.159	151.6	6.317
2.015	5.259	0.165	156.8	6.535
2.163	5.377	0.213	161.4	6.810
2.325	5.535	0.290	165.7	7.159

2.425	5.829	0.332	165.8	7.540
2.427	5.876	0.330	160.1	7.582
2.427	5.880	0.326	154.4	7.581
2.426	5.878	0.319	145.5	7.572
2.417	5.873	0.304	133.0	7.545
2.402	5.857	0.279	120.2	7.496
2.371	5.827	0.245	107.0	7.412
2.312	5.799	0.204	94.8	7.299
2.289	5.781	0.190	96.4	7.250
2.296	5.789	0.196	104.6	7.270
2.308	5.800	0.205	113.0	7.298
2.324	5.813	0.218	121.4	7.335
2.340	5.828	0.234	129.7	7.377
2.363	5.850	0.250	138.2	7.432
2.394	5.892	0.274	148.3	7.516
2.436	5.969	0.306	158.3	7.650
2.540	6.123	0.358	167.9	7.922
2.657	6.342	0.431	174.7	8.282
2.769	6.545	0.517	180.7	8.633
2.894	6.726	0.606	185.7	8.981
2.994	6.890	0.694	188.0	9.290
2.998	6.906	0.691	177.3	9.304
2.995	6.912	0.686	167.4	9.302
2.994	6.904	0.679	158.2	9.287
2.990	6.899	0.669	149.3	9.269
2.985	6.890	0.658	141.5	9.248
2.978	6.880	0.646	133.6	9.221
2.969	6.866	0.631	126.4	9.188
2.959	6.856	0.616	119.0	9.156
2.949	6.840	0.599	112.4	9.119
2.939	6.825	0.584	108.2	9.083
2.938	6.832	0.589	118.3	9.094
2.939	6.843	0.602	132.2	9.116
2.951	6.859	0.620	145.7	9.157
2.968	6.884	0.641	158.6	9.213
2.995	6.917	0.667	172.0	9.289
3.037	6.992	0.706	183.2	9.427
3.097	7.107	0.760	190.3	9.627
3.181	7.254	0.836	196.4	9.898
3.276	7.416	0.920	202.1	10.197
3.387	7.625	1.013	207.5	10.559
3.506	7.791	1.109	213.2	10.895
3.631	7.805	1.218	218.8	11.112
3.653	7.804	1.235	200.3	11.145
3.648	7.806	1.219	172.5	11.126
3.627	7.806	1.195	147.9	11.085
3.598	7.806	1.162	127.1	11.030
3.545	7.807	1.110	104.5	10.938
3.432	7.806	0.976	70.6	10.718
3.288	7.736	0.767	43.7	10.345
3.046	7.467	0.485	23.9	9.648
2.635	7.097	0.178	10.4	8.694
1.807	6.401	0.153	1.2	7.334
0.594	5.109	0.114	-2.0	5.103

0.084	3.148	0.088	-3.4	2.912
0.073	1.950	0.066	-5.5	1.832
0.076	0.514	0.053	-5.3	0.564
0.073	0.114	0.046	-5.8	0.205
0.073	0.094	0.045	-6.2	0.186
0.072	0.091	0.044	-6.2	0.182
0.070	0.089	0.044	-6.2	0.178
0.073	0.089	0.043	-6.4	0.180
0.069	0.087	0.043	-6.0	0.175
0.068	0.085	0.043	-6.2	0.173
0.069	0.086	0.043	-6.1	0.174
0.069	0.085	0.042	-6.1	0.172
0.069	0.083	0.042	-6.0	0.169
0.069	0.086	0.042	-6.1	0.172
0.068	0.086	0.042	-6.1	0.171

In Situ Pressuremeter Data

Golder
Sound Transit Redmond Link Downtown Extension
Hole No: DRLE-G031
Test: RLR-002
Depth: 23.5FT
09/18/2017

Oper: Mayfield/Okbay
Job #1657705
Time of Test: 03:30 PM
Inst: 05

Unknown Membrane Corrections
Report was printed from a .P file,
which doesn't save corrections information.

Arm 1 (mm)	Arm 2 (mm)	Arm 3 (mm)	Pressure (psi)	Strain (%)
0.000	0.000	0.000	-5.7	0.000
-0.001	0.005	0.000	-5.9	0.004
0.010	0.010	0.001	0.1	0.018
0.025	0.030	0.001	5.9	0.049
0.051	0.015	-0.001	11.1	0.058
0.061	0.127	-0.003	16.0	0.163
0.067	0.531	-0.005	20.0	0.521
0.069	0.884	-0.007	23.9	0.831
0.100	1.190	-0.009	28.4	1.126
0.193	1.484	-0.010	32.2	1.465
0.300	1.754	-0.011	36.0	1.794
0.421	1.989	-0.012	39.7	2.105
0.550	2.203	-0.013	43.3	2.405
0.657	2.378	-0.013	47.1	2.654
0.750	2.543	-0.013	50.9	2.881
0.876	2.704	-0.013	54.4	3.132
0.973	2.855	-0.014	58.2	3.349
1.054	2.998	-0.012	61.7	3.546
1.067	3.030	-0.009	60.8	3.589
1.069	3.059	-0.010	59.9	3.615
1.067	3.070	-0.009	58.7	3.623
1.063	3.064	-0.010	57.4	3.614
1.048	3.059	-0.010	54.7	3.597
1.029	3.047	-0.009	51.5	3.571
0.999	3.021	-0.009	47.8	3.521
0.960	2.985	-0.010	44.2	3.454
0.912	2.913	-0.010	40.1	3.349
0.919	2.899	-0.010	42.9	3.343
0.998	2.988	-0.010	52.1	3.491
1.076	3.110	-0.010	60.2	3.666
1.157	3.280	-0.009	66.3	3.888

1.263	3.478	-0.006	72.5	4.156
1.356	3.674	-0.004	78.1	4.413
1.446	3.871	-0.002	83.7	4.668
1.537	4.073	0.002	89.4	4.927
1.575	4.166	0.005	88.6	5.046
1.573	4.166	0.005	84.6	5.043
1.559	4.160	0.005	78.3	5.024
1.520	4.137	0.005	70.0	4.971
1.475	4.094	0.005	63.6	4.892
1.427	4.043	0.003	57.4	4.804
1.368	3.976	0.003	52.1	4.693
1.411	4.003	0.003	62.9	4.754
1.456	4.048	0.003	69.7	4.834
1.500	4.094	0.003	76.4	4.914
1.544	4.145	0.004	82.9	4.999
1.591	4.216	0.005	89.1	5.103
1.651	4.352	0.005	95.2	5.276
1.750	4.509	0.011	101.1	5.506
1.824	4.709	0.014	106.7	5.749
1.896	4.845	0.017	112.3	5.934
1.962	4.999	0.021	118.1	6.130
2.042	5.110	0.023	123.0	6.301
2.115	5.227	0.026	128.7	6.470
2.162	5.332	0.029	132.3	6.606
2.163	5.338	0.029	126.3	6.612
2.155	5.338	0.028	118.0	6.603
2.142	5.334	0.028	110.2	6.589
2.122	5.322	0.027	101.3	6.559
2.093	5.307	0.026	92.0	6.519
2.044	5.261	0.023	81.9	6.434
2.012	5.229	0.022	78.0	6.375
2.025	5.232	0.022	85.8	6.391
2.050	5.246	0.023	93.1	6.425
2.083	5.266	0.023	101.0	6.472
2.116	5.294	0.024	109.6	6.527
2.153	5.329	0.025	119.6	6.592
2.200	5.381	0.026	129.9	6.680
2.257	5.484	0.033	139.7	6.828
2.479	5.621	0.041	148.5	7.150
2.586	5.748	0.048	156.5	7.361
2.696	5.901	0.055	164.7	7.599
2.790	6.065	0.065	172.9	7.835
2.864	6.247	0.072	180.9	8.066
2.933	6.400	0.074	188.3	8.262
3.005	6.546	0.078	196.2	8.457
3.063	6.656	0.079	197.5	8.606
3.070	6.669	0.078	185.3	8.622
3.057	6.670	0.078	168.1	8.610
3.039	6.663	0.077	150.7	8.587
3.015	6.638	0.075	134.5	8.540
2.994	6.597	0.071	119.4	8.483
2.961	6.552	0.068	107.4	8.409
2.975	6.556	0.068	117.6	8.426
2.988	6.558	0.069	127.6	8.441

3.000	6.573	0.069	137.3	8.466
3.014	6.592	0.069	146.5	8.494
3.029	6.611	0.069	155.9	8.526
3.044	6.632	0.070	165.2	8.558
3.060	6.653	0.071	174.7	8.592
3.077	6.681	0.072	183.5	8.633
3.102	6.723	0.073	192.4	8.693
3.147	6.784	0.076	201.0	8.789
3.220	6.874	0.082	209.5	8.938
3.288	7.021	0.088	217.3	9.133
3.361	7.123	0.094	224.6	9.291
3.445	7.229	0.101	231.7	9.465
3.514	7.320	0.106	239.6	9.609
3.579	7.420	0.112	246.6	9.760
3.729	7.520	0.115	253.4	9.982
3.794	7.615	0.120	260.3	10.127
3.851	7.701	0.135	266.7	10.267
3.896	7.741	0.144	257.3	10.349
3.991	7.742	0.140	238.8	10.428
3.984	7.741	0.140	217.1	10.419
3.976	7.733	0.139	197.2	10.404
3.953	7.707	0.138	170.7	10.357
3.924	7.654	0.134	139.5	10.282
3.876	7.605	0.129	111.9	10.190
3.821	7.522	0.124	87.9	10.064
3.730	7.423	0.117	67.5	9.890
3.622	7.305	0.111	51.5	9.686
3.495	7.169	0.103	36.7	9.447
3.297	6.996	0.092	24.8	9.111
2.981	6.577	0.082	15.5	8.457
2.453	5.622	0.067	10.2	7.143
1.759	4.502	0.050	6.9	5.536
0.833	2.801	0.034	7.3	3.218
0.055	1.073	0.025	7.5	1.011
0.048	0.072	0.018	5.3	0.120
0.038	0.057	0.012	1.1	0.094
0.029	0.048	0.008	-1.7	0.074
0.025	0.034	0.005	-3.9	0.056
0.020	0.031	0.002	-5.1	0.047
0.019	0.035	0.003	-5.7	0.050
0.019	0.031	0.003	-5.8	0.046
0.019	0.030	0.002	-5.8	0.044
0.019	0.030	0.003	-5.9	0.045
0.019	0.029	0.002	-5.7	0.044
0.018	0.030	0.003	-5.8	0.045
0.017	0.029	0.002	-5.8	0.043
0.018	0.030	0.002	-6.0	0.045

In Situ Pressuremeter Data

Golder
Sound Transit Redmond Link Downtown Extension
Hole No: DRLE-G031
Test: RLR-003
Depth: 58FT
09/19/2017

Oper: Okbay
Job #1657705
Time of Test: 04:02 PM
Inst: 05

Unknown Membrane Corrections
Report was printed from a .P file,
which doesn't save corrections information.

Arm 1 (mm)	Arm 2 (mm)	Arm 3 (mm)	Pressure (psi)	Strain (%)
-0.001	0.000	0.000	-6.9	0.000
-0.001	-0.001	0.000	-7.0	-0.001
0.000	0.000	0.000	-7.3	0.000
0.000	0.000	0.001	-7.4	0.001
0.002	0.001	0.004	-5.9	0.006
0.007	0.005	0.018	-1.2	0.026
0.014	0.013	0.037	5.4	0.056
0.022	0.021	0.059	11.4	0.091
0.033	0.033	0.085	18.0	0.133
0.044	0.045	0.111	24.4	0.176
0.051	0.063	0.136	30.4	0.222
0.078	0.074	0.160	36.1	0.276
0.320	0.082	0.461	41.3	0.759
0.575	0.087	0.729	45.9	1.223
0.843	0.095	0.991	51.1	1.695
1.096	0.103	1.191	55.8	2.099
1.305	0.111	1.384	60.9	2.459
1.498	0.114	1.546	65.9	2.775
1.666	0.149	1.698	70.7	3.085
1.843	0.256	1.833	75.4	3.453
1.976	0.381	1.958	80.5	3.789
2.107	0.500	2.070	85.4	4.107
2.234	0.600	2.169	90.3	4.393
2.354	0.697	2.276	94.8	4.678
2.473	0.800	2.393	99.7	4.975
2.592	0.891	2.475	104.7	5.232
2.753	0.979	2.573	109.7	5.536
2.863	1.063	2.649	114.7	5.774
2.946	1.146	2.736	119.4	5.996
3.052	1.226	2.840	124.1	6.251
3.158	1.308	2.921	129.2	6.487

3.220	1.345	3.020	126.2	6.661
3.219	1.339	3.015	119.6	6.650
3.203	1.322	3.001	111.0	6.608
3.161	1.285	2.962	97.4	6.503
3.111	1.239	2.911	86.4	6.374
3.049	1.180	2.849	76.8	6.213
3.055	1.177	2.858	81.6	6.223
3.075	1.190	2.880	86.8	6.273
3.103	1.214	2.913	93.9	6.346
3.138	1.249	2.956	102.8	6.448
3.181	1.286	3.000	111.4	6.557
3.226	1.330	3.046	119.7	6.676
3.294	1.385	3.105	127.9	6.836
3.386	1.451	3.193	136.3	7.050
3.547	1.547	3.284	144.0	7.356
3.699	1.639	3.435	151.6	7.704
3.787	1.737	3.531	159.0	7.951
3.917	1.848	3.671	166.7	8.286
4.043	1.969	3.796	174.0	8.613
4.176	2.099	3.931	181.3	8.963
4.249	2.161	3.996	178.0	9.137
4.247	2.155	3.993	166.7	9.127
4.233	2.137	3.975	150.3	9.082
4.202	2.104	3.942	132.1	8.997
4.160	2.064	3.899	115.7	8.885
4.125	2.030	3.863	106.7	8.794
4.139	2.045	3.880	118.4	8.835
4.160	2.064	3.906	129.4	8.892
4.186	2.085	3.932	140.6	8.959
4.216	2.113	3.966	152.9	9.039
4.250	2.147	4.004	164.6	9.133
4.293	2.190	4.048	174.6	9.247
4.356	2.259	4.124	184.0	9.431
4.475	2.384	4.254	192.8	9.760
4.624	2.541	4.411	200.9	10.166
4.805	2.738	4.604	209.0	10.666
5.019	2.958	4.813	216.7	11.231
5.226	3.163	4.999	220.8	11.756
5.240	3.175	5.016	205.5	11.793
5.230	3.156	5.003	184.6	11.755
5.204	3.117	4.972	161.0	11.669
5.165	3.070	4.929	139.8	11.557
5.117	3.020	4.878	122.3	11.424
5.120	3.024	4.882	131.9	11.432
5.143	3.045	4.907	147.3	11.496
5.176	3.074	4.939	164.0	11.578
5.214	3.115	4.979	183.3	11.684
5.271	3.176	5.050	202.4	11.851
5.377	3.292	5.192	219.7	12.171
5.605	3.552	5.447	234.1	12.824
5.930	3.904	5.844	243.8	13.765
6.200	4.248	6.184	251.7	14.603
6.427	4.571	6.484	257.1	15.349
6.454	4.598	6.512	235.3	15.420

6.447	4.573	6.498	207.0	15.378
6.423	4.521	6.465	174.4	15.280
6.379	4.457	6.417	147.3	15.142
6.338	4.401	6.374	132.4	15.019
6.346	4.416	6.389	148.3	15.053
6.363	4.443	6.414	167.1	15.115
6.389	4.475	6.443	185.6	15.192
6.412	4.514	6.478	204.1	15.277
6.457	4.561	6.521	221.9	15.398
6.510	4.632	6.590	238.5	15.566
6.590	4.776	6.735	254.7	15.893
6.674	5.101	6.967	269.3	16.456
6.674	5.565	7.288	280.6	17.144
6.674	5.946	7.541	290.4	17.702
6.674	6.206	7.763	284.5	18.124
6.675	6.195	7.752	249.9	18.104
6.675	6.160	7.731	212.4	18.053
6.675	6.111	7.702	179.2	17.982
6.676	6.049	7.666	150.2	17.895
6.676	5.978	7.623	125.2	17.794
6.676	5.884	7.568	101.5	17.662
6.676	5.773	7.499	80.9	17.502
6.676	5.642	7.419	63.0	17.316
6.677	5.442	7.307	47.2	17.043
6.676	5.149	7.135	32.9	16.634
6.538	4.755	6.717	21.9	15.799
5.623	3.992	5.698	15.6	13.433
2.418	2.438	3.576	18.2	7.397
0.138	0.357	0.764	21.6	1.105
0.076	0.096	0.126	16.7	0.263
0.051	0.061	0.085	10.0	0.173
0.037	0.047	0.062	4.5	0.128
0.029	0.038	0.045	0.1	0.098
0.023	0.032	0.035	-3.0	0.079
0.020	0.029	0.027	-5.2	0.067
0.017	0.027	0.023	-6.6	0.059
0.017	0.026	0.021	-7.0	0.056

In Situ Pressuremeter Data

Golder
Sound Transit Redmond Link Downtown Extension
Hole No: DRLE-G031
Test: RLR-004
Depth: 56.5FT
09/19/2017

Oper: Okbay
Job #1657705
Time of Test: 04:18 PM
Inst: 05

Unknown Membrane Corrections
Report was printed from a .P file,
which doesn't save corrections information.

Arm 1 (mm)	Arm 2 (mm)	Arm 3 (mm)	Pressure (psi)	Strain (%)
0.001	0.001	0.002	-6.0	0.003
0.008	0.007	0.017	0.5	0.028
0.018	0.016	0.038	7.1	0.063
0.030	0.026	0.060	14.0	0.102
0.040	0.034	0.071	20.4	0.128
0.048	0.040	0.079	26.8	0.147
0.055	0.047	0.090	32.9	0.170
0.063	0.055	0.103	38.8	0.195
0.072	0.065	0.114	44.7	0.222
0.216	0.074	0.125	51.2	0.368
0.441	0.082	0.437	57.2	0.846
0.637	0.097	0.807	62.8	1.355
0.811	0.162	1.174	68.6	1.887
0.970	0.250	1.455	74.1	2.351
1.114	0.381	1.672	79.8	2.781
1.229	0.479	2.038	85.4	3.290
1.339	0.567	2.279	91.0	3.676
1.451	0.651	2.439	97.0	3.989
1.557	0.743	2.611	102.8	4.313
1.631	0.920	2.742	108.2	4.649
1.759	1.015	2.902	113.8	4.984
1.859	1.121	3.084	119.7	5.326
1.954	1.214	3.296	125.2	5.677
2.017	1.262	3.408	126.1	5.873
2.021	1.262	3.411	121.2	5.879
2.021	1.253	3.403	114.1	5.864
2.008	1.238	3.379	106.6	5.817
1.980	1.213	3.335	96.8	5.732
1.938	1.179	3.276	87.0	5.613
1.885	1.136	3.189	77.1	5.451
1.898	1.148	3.214	85.9	5.497

1.962	1.190	3.290	99.6	5.656
2.019	1.234	3.357	111.8	5.803
2.111	1.282	3.439	122.3	6.000
2.184	1.341	3.537	131.1	6.202
2.300	1.424	3.715	138.9	6.533
2.454	1.529	3.869	147.3	6.896
2.572	1.643	4.046	155.4	7.255
2.679	1.758	4.205	163.0	7.590
2.809	1.896	4.395	170.5	7.992
2.874	1.957	4.514	168.3	8.206
2.875	1.956	4.517	161.2	8.209
2.869	1.947	4.509	151.9	8.187
2.857	1.933	4.493	142.4	8.151
2.838	1.915	4.471	132.5	8.098
2.810	1.888	4.436	120.8	8.019
2.751	1.837	4.367	104.0	7.862
2.795	1.876	4.417	129.6	7.979
2.836	1.914	4.471	145.9	8.097
2.877	1.950	4.518	158.0	8.206
2.933	2.005	4.584	169.8	8.362
3.044	2.120	4.715	180.6	8.675
3.207	2.295	4.936	190.6	9.166
3.400	2.501	5.161	200.6	9.714
3.609	2.718	5.331	209.3	10.239
3.838	2.959	5.504	218.2	10.802
4.080	3.213	5.682	227.1	11.394
4.385	3.474	5.868	234.9	12.055
4.445	3.535	5.911	225.2	12.197
4.442	3.530	5.907	212.2	12.187
4.433	3.518	5.899	198.9	12.161
4.412	3.494	5.883	179.6	12.105
4.378	3.461	5.859	160.6	12.025
4.339	3.422	5.829	143.6	11.929
4.342	3.425	5.833	157.5	11.939
4.394	3.471	5.871	189.6	12.059
4.467	3.537	5.917	216.9	12.224
4.636	3.685	6.025	237.1	12.597
4.983	4.025	6.259	251.7	13.405
5.377	4.395	6.534	261.2	14.318
5.791	4.764	6.786	270.3	15.226
6.166	5.132	7.054	278.8	16.113
6.342	5.313	7.272	270.6	16.618
6.338	5.306	7.269	247.7	16.605
6.320	5.283	7.250	218.2	16.549
6.291	5.245	7.224	190.4	16.466
6.252	5.192	7.191	164.6	16.355
6.189	5.121	7.147	138.3	16.198
6.116	5.043	7.088	116.3	16.012
6.016	4.945	7.010	96.1	15.770
5.888	4.832	6.914	78.3	15.472
5.751	4.702	6.802	63.1	15.139
5.574	4.551	6.671	50.1	14.736
5.350	4.384	6.525	39.6	14.265
5.039	4.162	6.338	30.2	13.633

4.624	3.887	5.741	23.0	12.503
4.065	3.504	4.856	18.2	10.900
3.249	2.850	3.632	15.5	8.537
2.288	2.157	2.542	14.3	6.129
1.285	1.047	1.386	14.0	3.262
0.346	0.124	0.215	14.1	0.602
0.067	0.061	0.124	10.3	0.222
0.059	0.053	0.108	6.6	0.193
0.048	0.039	0.089	3.2	0.155
0.041	0.032	0.076	0.1	0.131
0.036	0.026	0.066	-2.2	0.112
0.033	0.022	0.059	-4.2	0.100
0.030	0.020	0.052	-6.0	0.089
0.028	0.018	0.048	-6.7	0.083

In Situ Pressuremeter Data

Golder Associate
Sound Transit Downtowen Redmond Link Extension
Hole No: DRLE-G018
Test: RLR-007
Depth: 55FT
10/24/2017

Oper: Mayfield
Job #1657705
Time of Test: 08:04 AM
Inst: 05

Unknown Membrane Corrections
Report was printed from a .P file,
which doesn't save corrections information.

Arm 1 (mm)	Arm 2 (mm)	Arm 3 (mm)	Pressure (psi)	Strain (%)
0.001	0.004	0.001	-0.4	0.006
0.004	0.008	0.002	4.2	0.013
0.011	0.019	0.004	16.7	0.031
0.018	0.028	0.008	29.6	0.049
0.025	0.041	0.009	42.9	0.069
0.033	0.052	0.009	55.5	0.085
0.040	0.064	0.009	68.8	0.104
0.051	0.078	0.014	85.5	0.130
0.063	0.093	0.032	102.9	0.171
0.073	0.104	0.043	114.9	0.199
0.084	0.118	0.058	128.7	0.234
0.096	0.134	0.075	145.8	0.276
0.107	0.153	0.093	162.0	0.319
0.117	0.173	0.108	176.6	0.359
0.126	0.242	0.123	189.7	0.441
0.136	0.388	0.136	202.5	0.590
0.145	0.501	0.150	215.0	0.710
0.156	0.612	0.158	227.9	0.826
0.168	0.722	0.217	240.0	0.983
0.181	0.851	0.323	252.0	1.202
0.194	0.979	0.428	263.3	1.418
0.206	1.122	0.538	274.2	1.651
0.248	1.271	0.652	284.8	1.921
0.347	1.434	0.781	295.2	2.264
0.451	1.589	0.913	305.1	2.607
0.556	1.748	1.049	314.2	2.958
0.542	1.744	1.043	267.4	2.935
0.501	1.695	1.000	229.8	2.816
0.477	1.670	0.978	213.6	2.753
0.453	1.641	0.954	199.0	2.685
0.434	1.620	0.936	193.6	2.634

0.451	1.645	0.954	217.7	2.688
0.466	1.666	0.973	234.2	2.736
0.487	1.695	0.999	254.3	2.804
0.516	1.734	1.034	276.5	2.895
0.551	1.785	1.077	295.9	3.010
0.595	1.849	1.131	309.8	3.153
0.654	1.933	1.201	320.6	3.341
0.746	2.056	1.307	330.4	3.623
0.861	2.213	1.444	339.7	3.982
0.998	2.394	1.605	348.9	4.402
1.135	2.577	1.764	357.2	4.824
1.278	2.768	1.929	365.2	5.262
1.434	2.969	2.117	373.3	5.740
1.585	3.171	2.297	380.6	6.208
1.732	3.371	2.483	387.5	6.676
1.845	3.522	2.619	371.9	7.025
1.821	3.493	2.591	317.8	6.951
1.788	3.456	2.555	281.9	6.857
1.751	3.412	2.513	251.9	6.747
1.718	3.373	2.475	232.1	6.650
1.722	3.382	2.483	251.0	6.669
1.730	3.391	2.492	265.0	6.694
1.738	3.402	2.503	277.6	6.720
1.754	3.421	2.521	298.4	6.768
1.774	3.445	2.545	321.3	6.829
1.796	3.474	2.573	342.6	6.899
1.829	3.517	2.614	363.9	7.002
1.899	3.610	2.699	383.9	7.222
2.044	3.799	2.875	399.1	7.669
2.249	4.059	3.133	409.6	8.305
2.463	4.337	3.415	418.3	8.983
2.702	4.639	3.728	426.5	9.733
2.925	4.936	4.036	434.0	10.460
3.112	5.184	4.296	431.4	11.070
3.105	5.173	4.283	375.2	11.039
3.077	5.139	4.251	327.2	10.954
3.048	5.105	4.216	298.7	10.866
3.015	5.066	4.179	273.0	10.769
3.021	5.082	4.191	308.0	10.801
3.036	5.100	4.210	335.8	10.848
3.053	5.121	4.230	360.6	10.901
3.073	5.147	4.258	385.2	10.966
3.106	5.193	4.307	410.2	11.081
3.159	5.264	4.384	423.9	11.258
3.273	5.407	4.534	437.7	11.615
3.452	5.632	4.777	446.5	12.183
3.662	5.896	5.063	453.4	12.851
3.876	6.114	5.346	459.4	13.477
4.099	6.321	5.615	464.9	14.092
4.288	6.495	5.817	455.6	14.586
4.284	6.493	5.808	407.7	14.570
4.269	6.481	5.792	367.5	14.530
4.235	6.450	5.755	323.6	14.439
4.194	6.408	5.709	287.3	14.324

4.186	6.406	5.709	309.2	14.317
4.203	6.424	5.731	349.6	14.368
4.227	6.447	5.760	386.7	14.436
4.262	6.483	5.799	425.6	14.534
4.361	6.571	5.885	456.7	14.777
4.481	6.679	5.990	465.5	15.070
4.633	6.809	6.123	472.8	15.435
4.816	6.968	6.261	479.0	15.854
5.029	7.156	6.432	484.7	16.358
5.268	7.349	6.597	489.2	16.882
5.449	7.499	6.730	467.8	17.288
5.432	7.479	6.712	382.0	17.235
5.374	7.431	6.670	319.6	17.101
5.298	7.364	6.617	266.7	16.926
5.205	7.282	6.555	219.2	16.715
5.105	7.193	6.468	181.1	16.471
4.997	7.089	6.377	146.9	16.204
4.755	6.861	6.182	95.4	15.617
4.483	6.591	5.933	60.0	14.921
4.125	6.215	5.571	34.8	13.959
3.573	5.588	4.799	18.0	12.247
2.268	3.967	3.025	11.1	8.124
0.265	1.242	0.607	11.5	1.855
0.137	0.141	0.146	4.3	0.372
0.120	0.116	0.097	-3.2	0.292
0.112	0.108	0.081	-7.1	0.265
0.111	0.106	0.077	-7.9	0.258
0.110	0.105	0.076	-7.9	0.256
0.110	0.105	0.075	-8.0	0.255

In Situ Pressuremeter Data

Golder Associate
Sound Transit Downtown Redmond Link Extension
Hole No: DRLE-G018
Test: RLR-008
Depth: 53.5FT
10/24/2017

Oper: Mayfield
Job #1657705
Time of Test: 08:15 AM
Inst: 05

Unknown Membrane Corrections
Report was printed from a .P file,
which doesn't save corrections information.

Arm 1 (mm)	Arm 2 (mm)	Arm 3 (mm)	Pressure (psi)	Strain (%)
0.007	0.007	0.006	2.6	0.018
0.019	0.017	0.022	15.3	0.052
0.031	0.026	0.045	29.1	0.092
0.042	0.037	0.067	41.5	0.130
0.053	0.050	0.089	54.6	0.171
0.065	0.064	0.109	66.6	0.213
0.077	0.075	0.127	78.2	0.249
0.088	0.088	0.143	90.4	0.284
0.096	0.100	0.161	101.4	0.320
0.105	0.112	0.172	112.9	0.347
0.110	0.125	0.262	123.3	0.444
0.113	0.137	0.539	133.3	0.699
0.132	0.150	0.840	143.1	0.993
0.414	0.160	1.112	152.3	1.487
0.658	0.169	1.400	160.9	1.963
0.841	0.283	1.566	169.8	2.368
1.003	0.583	1.764	176.4	2.949
1.001	0.591	1.761	157.0	2.950
0.976	0.526	1.731	136.2	2.843
0.943	0.433	1.689	119.5	2.695
0.925	0.389	1.670	113.5	2.623
0.908	0.332	1.652	107.3	2.543
0.919	0.357	1.673	122.0	2.593
0.939	0.406	1.700	132.4	2.678
0.970	0.470	1.743	145.9	2.800
1.012	0.560	1.802	159.1	2.968
1.068	0.703	1.886	170.6	3.216
1.158	0.899	2.004	180.6	3.572
1.301	1.178	2.178	189.7	4.096
1.491	1.499	2.403	198.2	4.742
1.696	1.765	2.623	206.1	5.348

1.923	2.011	2.864	213.5	5.975
2.125	2.225	3.074	211.0	6.524
2.110	2.203	3.054	183.6	6.472
2.096	2.185	3.035	170.0	6.426
2.075	2.157	3.009	156.5	6.361
2.044	2.117	2.972	141.4	6.265
2.006	2.066	2.924	126.8	6.143
1.998	2.060	2.920	135.6	6.128
2.015	2.089	2.945	151.4	6.192
2.037	2.124	2.975	165.5	6.269
2.066	2.169	3.013	180.1	6.368
2.100	2.229	3.061	193.9	6.493
2.156	2.318	3.138	206.7	6.688
2.285	2.491	3.296	219.0	7.092
2.526	2.767	3.551	228.4	7.771
2.858	3.102	3.881	236.5	8.645
3.288	3.514	4.279	243.7	9.733
3.658	3.863	4.626	244.4	10.668
3.661	3.861	4.623	222.2	10.666
3.648	3.841	4.604	198.4	10.619
3.622	3.799	4.570	174.9	10.528
3.584	3.744	4.525	155.1	10.407
3.539	3.684	4.470	138.6	10.266
3.548	3.706	4.487	159.4	10.308
3.566	3.736	4.513	176.2	10.374
3.591	3.773	4.544	192.9	10.457
3.623	3.823	4.585	210.0	10.566
3.669	3.896	4.647	225.9	10.724
3.774	4.047	4.767	240.2	11.055
4.056	4.365	5.059	252.2	11.839
4.489	4.803	5.479	260.4	12.971
4.977	5.320	5.979	266.8	14.292
5.330	5.695	6.334	254.9	15.242
5.317	5.682	6.317	217.1	15.202
5.300	5.665	6.301	200.3	15.156
5.277	5.641	6.281	185.0	15.097
5.250	5.609	6.255	170.2	15.021
5.220	5.573	6.226	158.9	14.939
5.230	5.594	6.242	182.4	14.980
5.250	5.620	6.261	201.2	15.038
5.276	5.654	6.285	220.8	15.113
5.311	5.688	6.315	238.8	15.201
5.391	5.758	6.381	255.8	15.392
5.644	5.916	6.539	270.3	15.892
6.102	6.185	6.798	279.7	16.757
6.417	6.504	7.102	287.5	17.581
6.693	6.809	7.400	289.1	18.351
6.674	6.788	7.374	218.2	18.289
6.620	6.726	7.312	168.7	18.131
6.551	6.644	7.234	128.9	17.927
6.459	6.534	7.132	94.1	17.660
6.344	6.384	6.992	63.9	17.302
6.197	6.192	6.804	40.7	16.838
5.774	5.838	6.529	21.7	15.915

4.856	4.596	5.745	11.5	13.331
3.050	2.632	3.750	10.0	8.274
0.676	0.636	1.275	11.2	2.271
0.133	0.195	0.169	6.3	0.436
0.106	0.139	0.121	-1.3	0.321
0.090	0.123	0.092	-7.3	0.268
0.089	0.122	0.088	-7.6	0.262
0.088	0.121	0.087	-7.7	0.260

In Situ Pressuremeter Data

Golder Associate
Sound Transit Downtown Redmond Link Extension
Hole No: DRLE-G018
Test: RLR-009
Depth: 74.5FT
10/24/2017

Oper: Okbay
Job #1657705
Time of Test: 09:56 AM
Inst: 05

Unknown Membrane Corrections
Report was printed from a .P file,
which doesn't save corrections information.

Arm 1 (mm)	Arm 2 (mm)	Arm 3 (mm)	Pressure (psi)	Strain (%)
0.000	0.000	0.000	-7.2	0.000
0.007	0.001	0.001	2.1	0.009
0.017	0.003	0.003	12.5	0.022
0.026	0.005	0.005	20.5	0.033
0.035	0.008	0.006	28.7	0.045
0.042	0.011	0.008	36.4	0.055
0.051	0.016	0.010	43.9	0.069
0.056	0.018	0.013	51.1	0.080
0.063	0.022	0.020	58.3	0.096
0.067	0.027	0.026	65.2	0.109
0.076	0.033	0.040	71.9	0.135
0.082	0.038	0.054	78.9	0.156
0.086	0.043	0.067	85.9	0.177
0.088	0.048	0.075	92.9	0.190
0.091	0.053	0.083	99.6	0.203
0.094	0.058	0.090	107.0	0.218
0.099	0.065	0.102	117.3	0.240
0.106	0.075	0.122	125.9	0.273
0.109	0.082	0.129	134.8	0.287
0.112	0.087	0.137	144.3	0.303
0.125	0.095	0.144	153.3	0.327
0.179	0.102	0.149	163.2	0.386
0.246	0.109	0.154	172.4	0.455
0.318	0.115	0.157	181.7	0.528
0.405	0.124	0.164	191.3	0.619
0.488	0.132	0.204	200.4	0.734
0.579	0.140	0.291	209.3	0.898
0.665	0.148	0.356	218.1	1.038
0.759	0.156	0.426	226.6	1.189
0.863	0.167	0.506	235.5	1.361
0.959	0.178	0.581	243.6	1.521

1.059	0.188	0.663	252.0	1.690
1.169	0.202	0.752	260.4	1.876
1.282	0.226	0.840	269.5	2.074
1.412	0.299	0.949	279.5	2.348
1.554	0.404	1.070	289.3	2.673
1.698	0.508	1.182	298.8	2.987
1.792	0.575	1.255	299.1	3.193
1.802	0.575	1.257	289.6	3.204
1.801	0.569	1.253	278.0	3.194
1.799	0.562	1.247	267.1	3.180
1.793	0.552	1.239	253.8	3.157
1.786	0.540	1.229	241.2	3.131
1.774	0.524	1.215	226.3	3.094
1.759	0.504	1.199	210.8	3.049
1.742	0.482	1.180	196.7	2.997
1.727	0.465	1.165	187.5	2.955
1.736	0.476	1.176	210.0	2.983
1.752	0.494	1.194	234.5	3.031
1.771	0.515	1.214	257.3	3.085
1.795	0.538	1.235	275.0	3.144
1.833	0.570	1.267	291.7	3.236
1.897	0.620	1.319	304.6	3.382
1.995	0.700	1.401	315.2	3.609
2.127	0.807	1.515	325.4	3.921
2.270	0.920	1.635	335.0	4.251
2.426	1.036	1.760	344.3	4.600
2.601	1.163	1.894	353.8	4.982
2.759	1.286	2.023	362.9	5.344
2.925	1.412	2.158	371.4	5.717
3.079	1.533	2.285	375.0	6.070
3.083	1.533	2.286	355.6	6.074
3.079	1.525	2.280	334.1	6.057
3.073	1.513	2.269	309.6	6.030
3.061	1.497	2.256	288.0	5.994
3.047	1.478	2.240	268.3	5.949
3.026	1.454	2.219	248.7	5.890
3.011	1.438	2.205	241.5	5.849
3.016	1.443	2.210	257.6	5.864
3.022	1.450	2.217	274.1	5.883
3.030	1.461	2.226	289.7	5.908
3.039	1.471	2.235	304.9	5.934
3.049	1.484	2.246	321.1	5.965
3.062	1.499	2.259	336.2	6.000
3.080	1.516	2.275	350.2	6.047
3.111	1.544	2.303	363.5	6.123
3.164	1.591	2.354	375.2	6.256
3.260	1.674	2.446	386.0	6.495
3.415	1.802	2.585	396.4	6.866
3.590	1.946	2.744	406.0	7.285
3.776	2.096	2.913	414.7	7.729
3.994	2.265	3.099	424.2	8.232
4.211	2.428	3.286	432.5	8.730
4.431	2.593	3.475	440.6	9.233
4.573	2.698	3.600	433.2	9.559

4.573	2.691	3.596	406.0	9.548
4.569	2.680	3.588	373.5	9.527
4.561	2.664	3.578	344.1	9.496
4.546	2.641	3.561	315.8	9.445
4.524	2.612	3.537	290.9	9.378
4.493	2.577	3.506	266.9	9.292
4.492	2.577	3.505	283.4	9.291
4.499	2.584	3.511	304.9	9.310
4.507	2.594	3.519	323.8	9.333
4.516	2.606	3.528	342.6	9.361
4.528	2.618	3.540	360.2	9.394
4.541	2.634	3.554	378.6	9.433
4.558	2.652	3.569	396.2	9.478
4.574	2.668	3.585	407.3	9.519
4.596	2.690	3.606	418.3	9.577
4.631	2.720	3.639	428.4	9.664
4.687	2.770	3.695	438.2	9.806
4.789	2.856	3.790	447.7	10.056
4.927	2.972	3.922	456.1	10.395
5.108	3.112	4.085	463.6	10.820
5.279	3.269	4.270	470.6	11.270
5.457	3.437	4.473	477.8	11.750
5.638	3.601	4.673	484.5	12.231
5.830	3.771	4.881	490.8	12.731
6.020	3.950	5.120	496.4	13.264
6.038	3.955	5.138	436.2	13.297
6.019	3.919	5.109	362.6	13.219
5.970	3.839	5.040	298.3	13.041
5.909	3.745	4.952	246.8	12.826
5.838	3.640	4.851	202.7	12.581
5.747	3.524	4.744	165.4	12.303
5.615	3.388	4.615	132.2	11.952
5.467	3.241	4.476	105.1	11.571
5.296	3.074	4.316	82.1	11.134
5.096	2.885	4.117	63.1	10.615
4.828	2.641	3.853	47.1	9.934
4.337	2.275	3.445	32.8	8.824
2.745	1.166	2.068	23.7	5.246
0.150	0.193	0.206	20.3	0.483
0.090	0.152	0.119	9.6	0.318
0.074	0.136	0.085	1.1	0.259
0.065	0.127	0.066	-4.3	0.226
0.060	0.122	0.056	-6.9	0.209
0.059	0.120	0.054	-7.7	0.205
0.059	0.119	0.052	-7.7	0.201
0.058	0.119	0.053	-7.7	0.201
0.058	0.118	0.051	-7.7	0.199

In Situ Pressuremeter Data

Golder Associate
Sound Transit Downtown Redmond Link Extension
Hole No: DRLE-G018
Test: RLR-010
Depth: 73FT
10/24/2017

Oper: Okbay
Job #1657705
Time of Test: 10:09 AM
Inst: 05

Unknown Membrane Corrections
Report was printed from a .P file,
which doesn't save corrections information.

Arm 1 (mm)	Arm 2 (mm)	Arm 3 (mm)	Pressure (psi)	Strain (%)
0.001	0.001	0.000	-6.4	0.002
0.006	0.008	0.011	0.8	0.022
0.018	0.021	0.044	11.8	0.074
0.031	0.037	0.080	23.2	0.131
0.040	0.049	0.100	34.2	0.168
0.052	0.061	0.117	46.9	0.204
0.068	0.086	0.256	63.0	0.363
0.083	0.151	0.484	79.0	0.634
0.220	0.340	0.666	95.7	1.081
0.381	0.509	0.847	110.9	1.530
0.555	0.687	1.051	125.8	2.019
0.758	0.898	1.275	140.9	2.580
0.995	1.150	1.545	154.5	3.245
1.310	1.472	1.897	167.9	4.113
1.661	1.821	2.284	179.5	5.067
1.843	1.988	2.492	179.4	5.557
1.852	1.995	2.504	172.2	5.581
1.848	1.990	2.502	164.5	5.571
1.836	1.976	2.491	153.5	5.537
1.821	1.958	2.476	143.2	5.495
1.802	1.937	2.458	133.3	5.443
1.776	1.908	2.432	121.7	5.372
1.747	1.875	2.405	111.5	5.293
1.757	1.884	2.416	122.8	5.321
1.774	1.901	2.432	133.8	5.364
1.790	1.918	2.450	143.2	5.411
1.812	1.941	2.472	153.4	5.469
1.839	1.970	2.499	162.7	5.542
1.878	2.010	2.539	171.8	5.646
1.953	2.087	2.620	180.9	5.852
2.093	2.227	2.780	188.8	6.238

2.314	2.443	3.029	196.2	6.840
2.556	2.672	3.305	202.5	7.496
2.818	2.916	3.599	208.5	8.198
3.102	3.190	3.919	214.6	8.969
3.371	3.438	4.212	218.5	9.679
3.423	3.484	4.268	211.7	9.814
3.423	3.484	4.267	204.0	9.813
3.417	3.477	4.262	193.4	9.797
3.408	3.466	4.252	182.2	9.770
3.396	3.451	4.239	171.5	9.733
3.379	3.432	4.222	160.2	9.687
3.359	3.408	4.200	148.9	9.628
3.337	3.383	4.177	138.9	9.567
3.318	3.362	4.157	133.3	9.513
3.343	3.389	4.184	159.2	9.585
3.375	3.425	4.221	182.2	9.678
3.429	3.483	4.281	204.4	9.831
3.675	3.717	4.551	225.1	10.488
4.298	4.271	5.205	239.3	12.095
5.020	4.919	5.967	249.4	13.967
5.569	5.449	6.579	256.1	15.450
5.933	5.829	6.973	257.5	16.448
6.032	5.941	7.070	256.2	16.719
6.185	6.112	7.195	262.1	17.112
6.427	6.390	7.372	267.1	17.725
6.654	6.698	7.555	269.2	18.354
6.666	6.726	7.568	247.7	18.400
6.648	6.701	7.556	213.1	18.350
6.609	6.644	7.526	177.8	18.238
6.550	6.552	7.476	144.1	18.059
6.483	6.445	7.418	117.2	17.853
6.394	6.318	7.351	93.9	17.604
6.268	6.164	7.267	73.2	17.284
6.116	5.989	7.171	56.2	16.912
5.922	5.782	7.044	42.3	16.448
5.657	5.512	6.836	31.0	15.796
5.260	4.992	6.415	22.0	14.621
4.462	4.146	5.602	17.1	12.466
2.928	2.567	3.474	18.6	7.868
1.139	0.665	1.577	20.9	2.967
0.091	0.094	0.156	19.5	0.301
0.076	0.086	0.131	14.0	0.258
0.063	0.070	0.102	8.7	0.206
0.053	0.058	0.083	3.9	0.170
0.045	0.052	0.069	-0.1	0.145
0.041	0.046	0.056	-2.8	0.126
0.038	0.043	0.049	-5.0	0.114
0.035	0.041	0.044	-6.4	0.105
0.035	0.040	0.041	-7.1	0.102
0.034	0.039	0.040	-7.5	0.099
0.034	0.038	0.039	-7.4	0.097

APPENDIX F

IN SITU TESTS - SLUG WELL DATA

Problems were encountered before and during the slug tests in wells DRLE-G034 and DRLE-G036 that may introduce error in the results. The DRLE-G034 well screen was not fully saturated, and well DRLE-G036 was completely dry. While taking measurements of the depth of the wells DRLE-G034 and DRLE-G036, it was discovered that there was bentonite within the well casing of each of these wells. The hydraulic conductivities of each slug tests performed in wells DRLE-G034 and DRLE-G036 include large sources of error.

Table F1. Summary of results from slug tests conducted in wells DRLE-G027, DRLE-G034, and DRLE-G036 between 3/1/2018 – 3/2/2018.

Well	Slug Test	Hydraulic Conductivity (ft/day)
DRLE-G027	Falling Head 1	31
DRLE-G027	Falling Head 2	35
DRLE-G027	Falling Head 3	37
DRLE-G027	Rising Head 1	36
DRLE-G027	Rising Head 2	33
DRLE-G027	Rising Head 3	31
DRLE-G034	Falling Head 1	1
DRLE-G034	Falling Head 2	0.7
DRLE-G034	Rising Head 1	0.5
DRLE-G034	Rising Head 2	0.5
DRLE-G036	Falling Head 1	2
DRLE-G036	Falling Head 2	0.04
DRLE-G036	Falling Head 3	0.3
DRLE-G036	Falling Head 4	0.3

18300 NE Union Hill Road, Suite 200, Redmond, Washington, USA 98052
T: +1 425 883-0777 F: +1 425 882-5498

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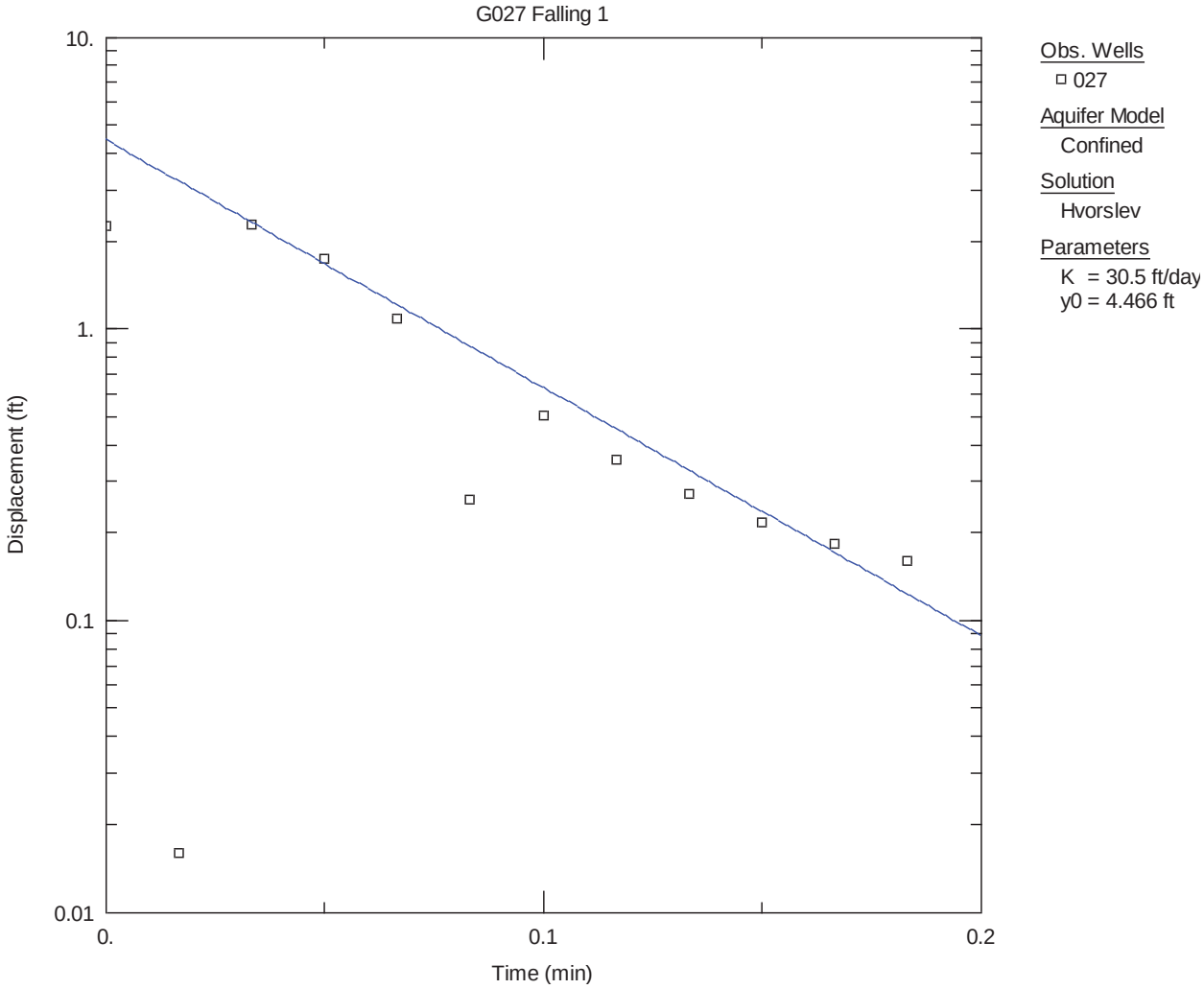


Figure F1. Falling head 1 slug test conducted in DRLE-G027 on 3/1/18. A solid slug 2 inches in diameter and 6 ft in length was used to displace water.

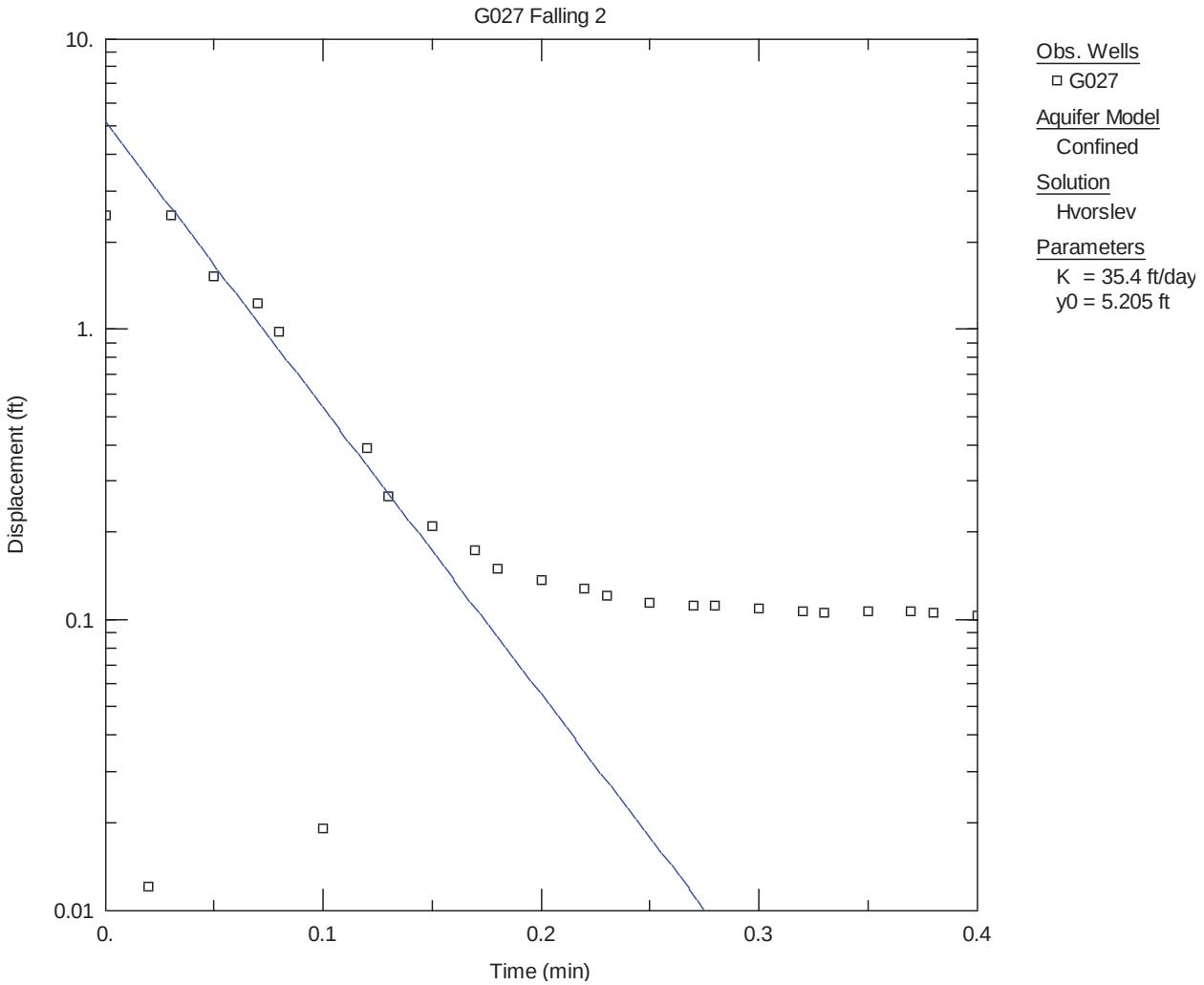


Figure F2. Falling head 2 slug test conducted in DRLE-G027 on 3/1/18. A solid slug 2 inches in diameter and 6 ft in length was used to displace water.

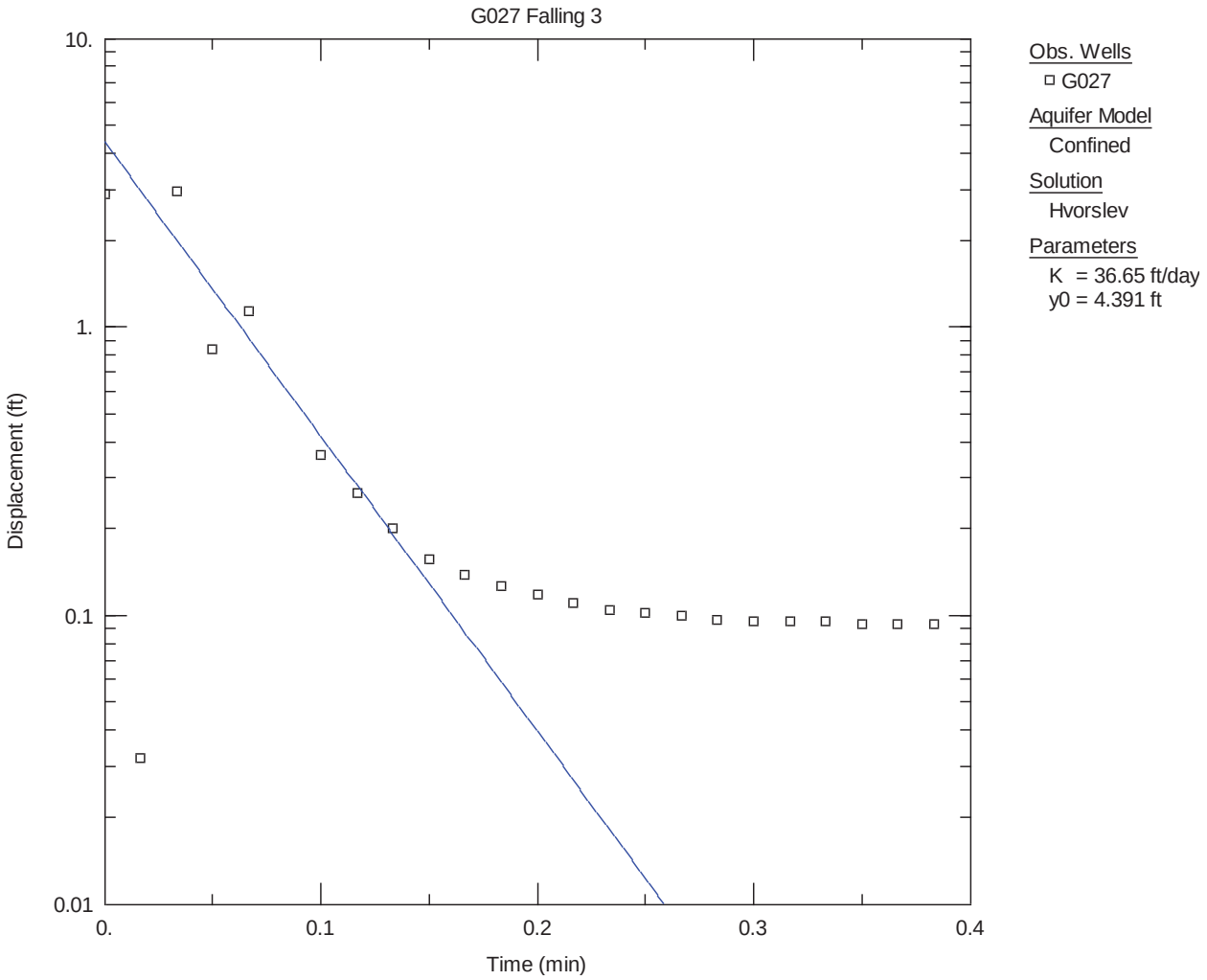


Figure F3. Falling head 3 slug test conducted in DRLE-G027 on 3/1/18. A solid slug 2 inches in diameter and 6 ft in length was used to displace water.

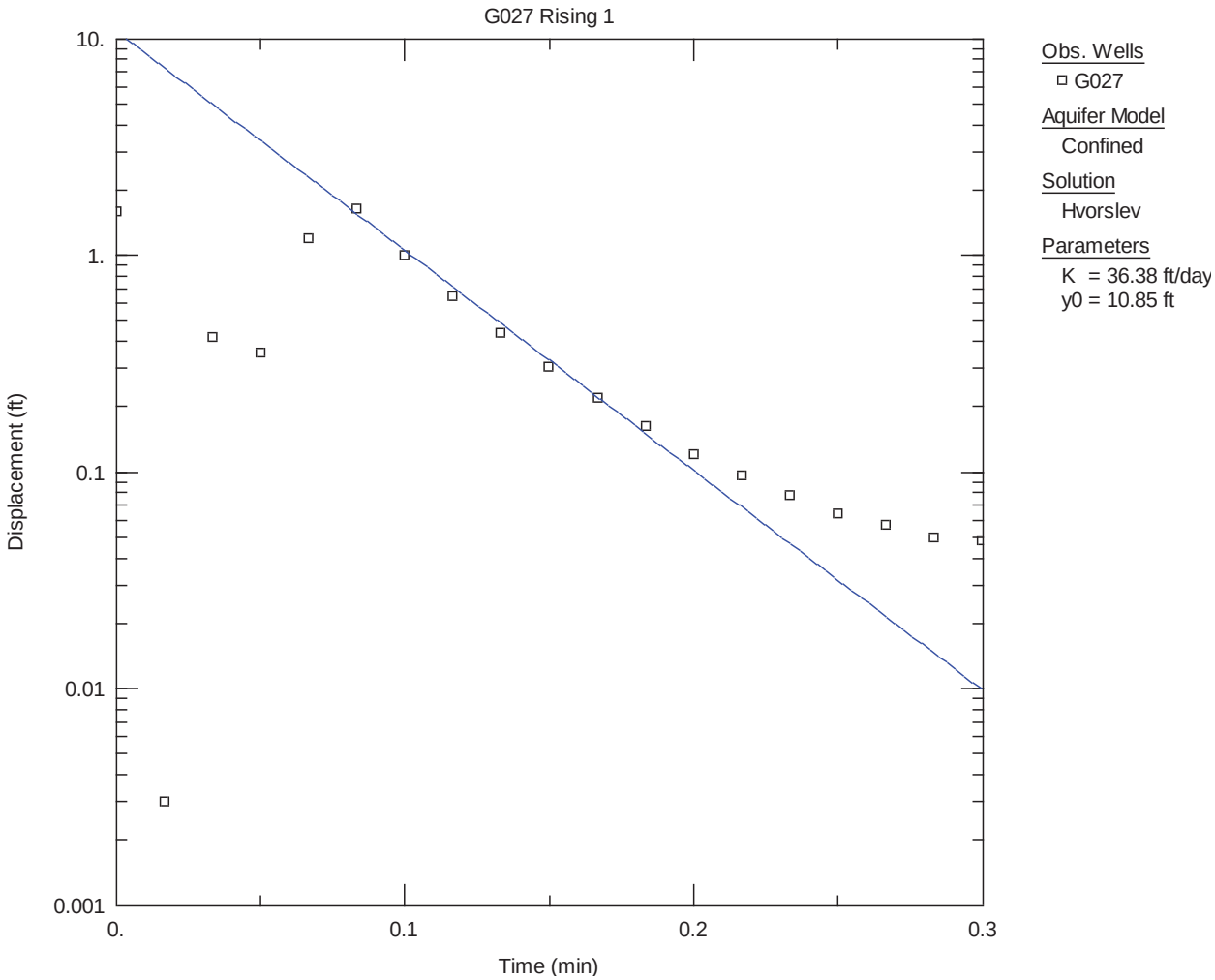


Figure F4. Rising head 1 slug test conducted in DRLE-G027 on 3/1/18. A solid slug 2 inches in diameter and 6 ft in length was used to displace water.

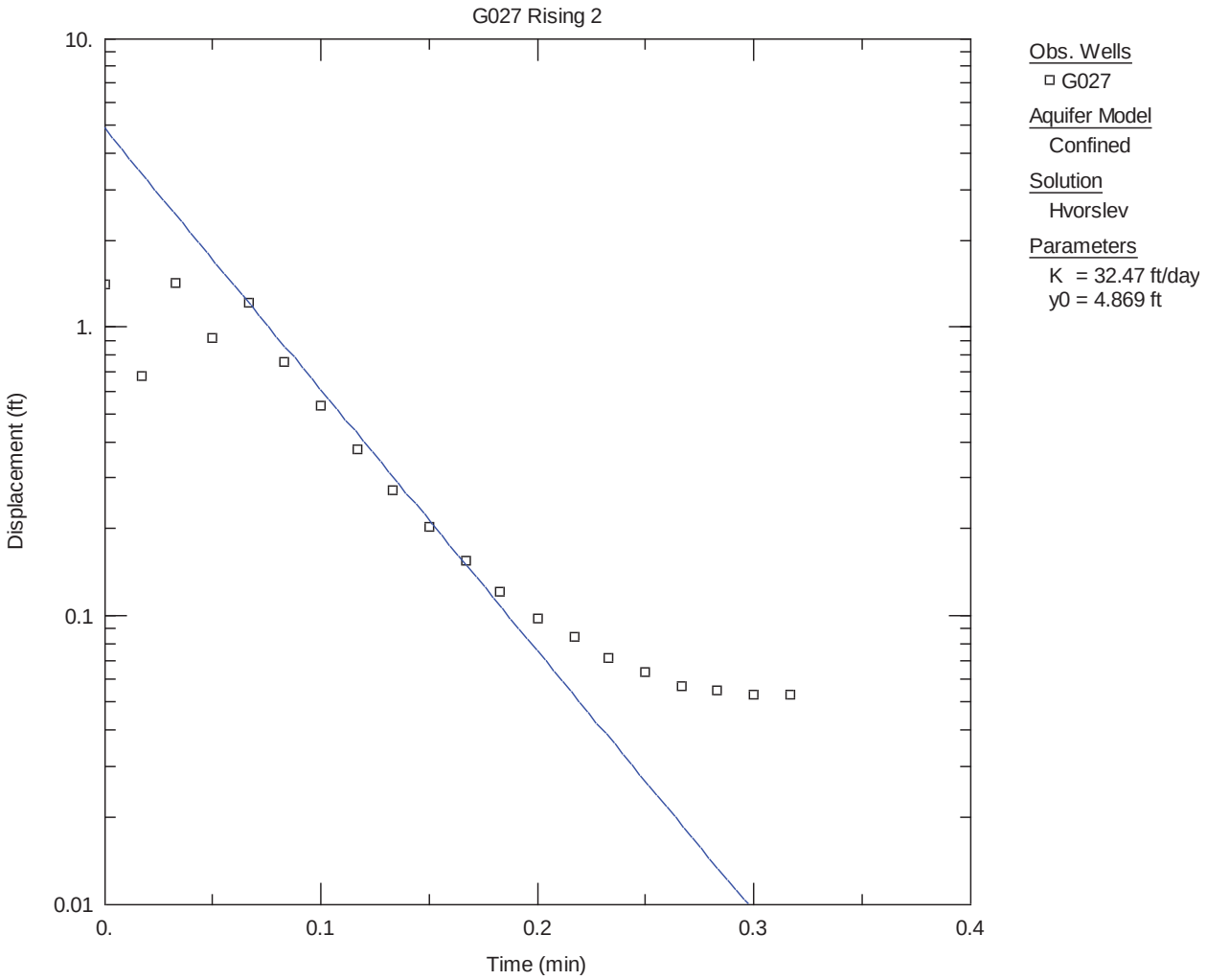


Figure F5. Rising head 2 slug test conducted in DRLE-G027 on 3/1/18. A solid slug 2 inches in diameter and 6 ft in length was used to displace water.

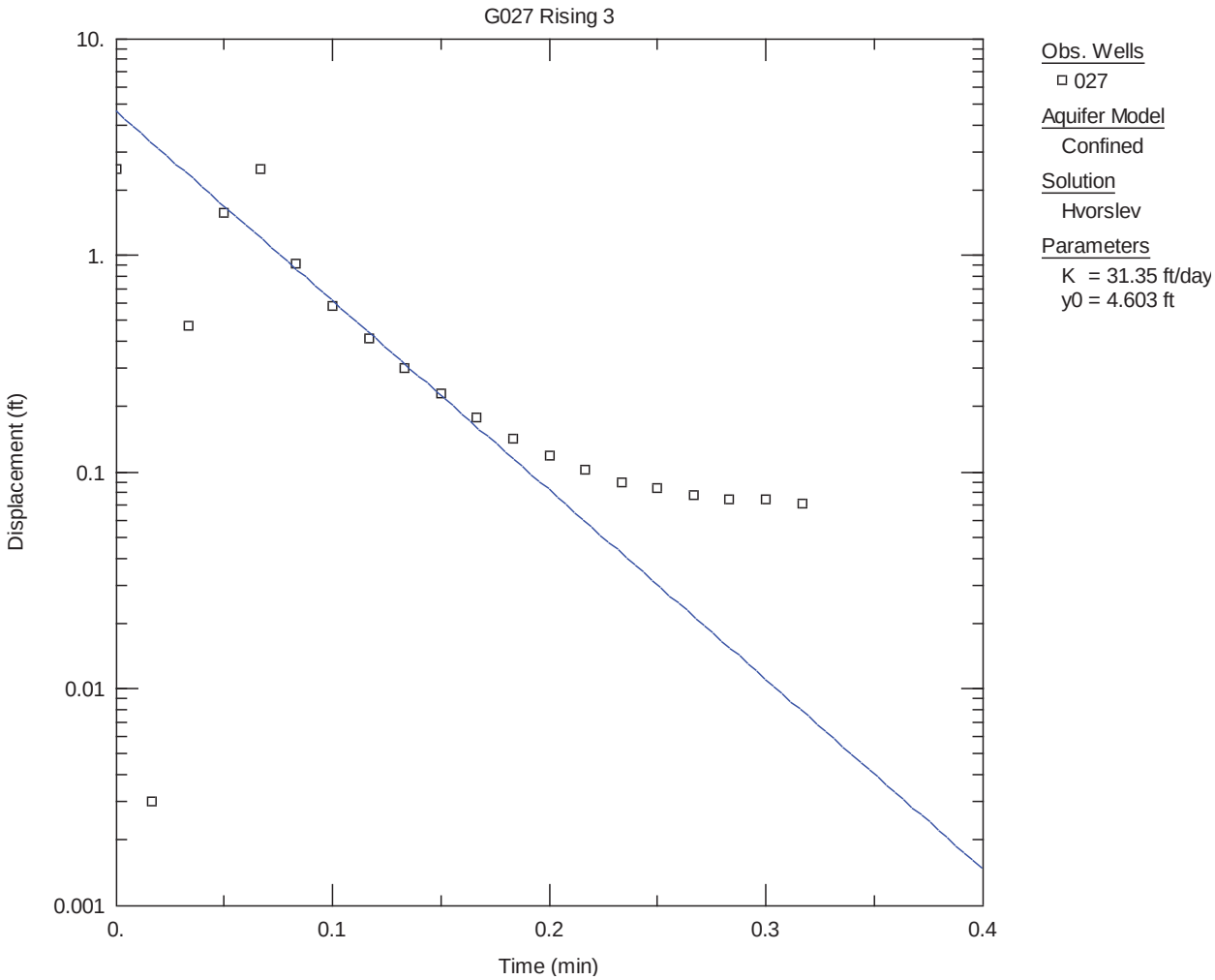


Figure F6. Rising head 3 slug test conducted in DRLE-G027 on 3/1/18. A solid slug 2 inches in diameter and 6 ft in length was used to displace water.

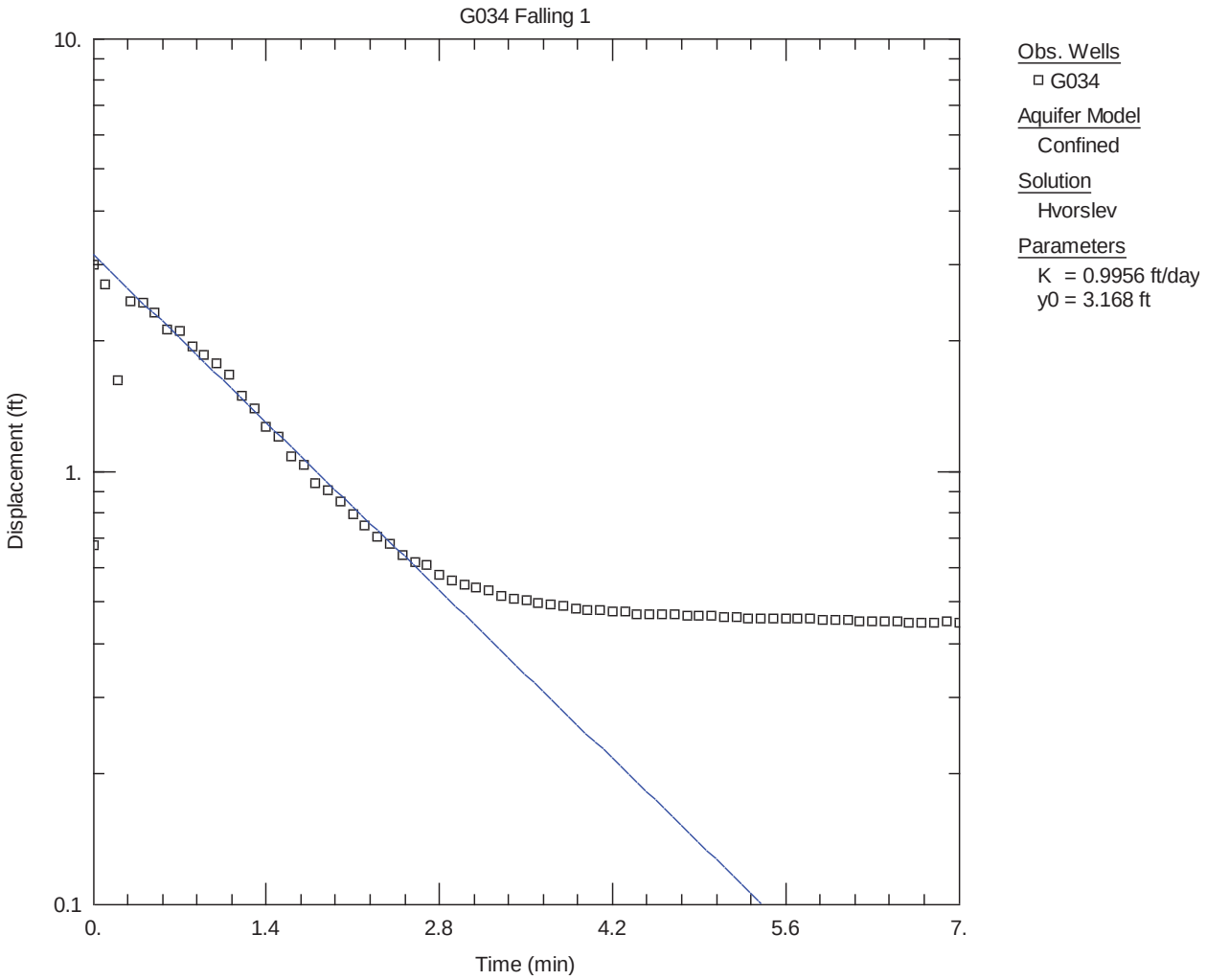


Figure F7. Falling head 1 slug test conducted in DRLE-G034 on 3/1/18. A solid slug 2 inches in diameter and 6 ft in length was used to displace water. Only 3 ft of the solid slug was submerged due to the shallow depth of the well.

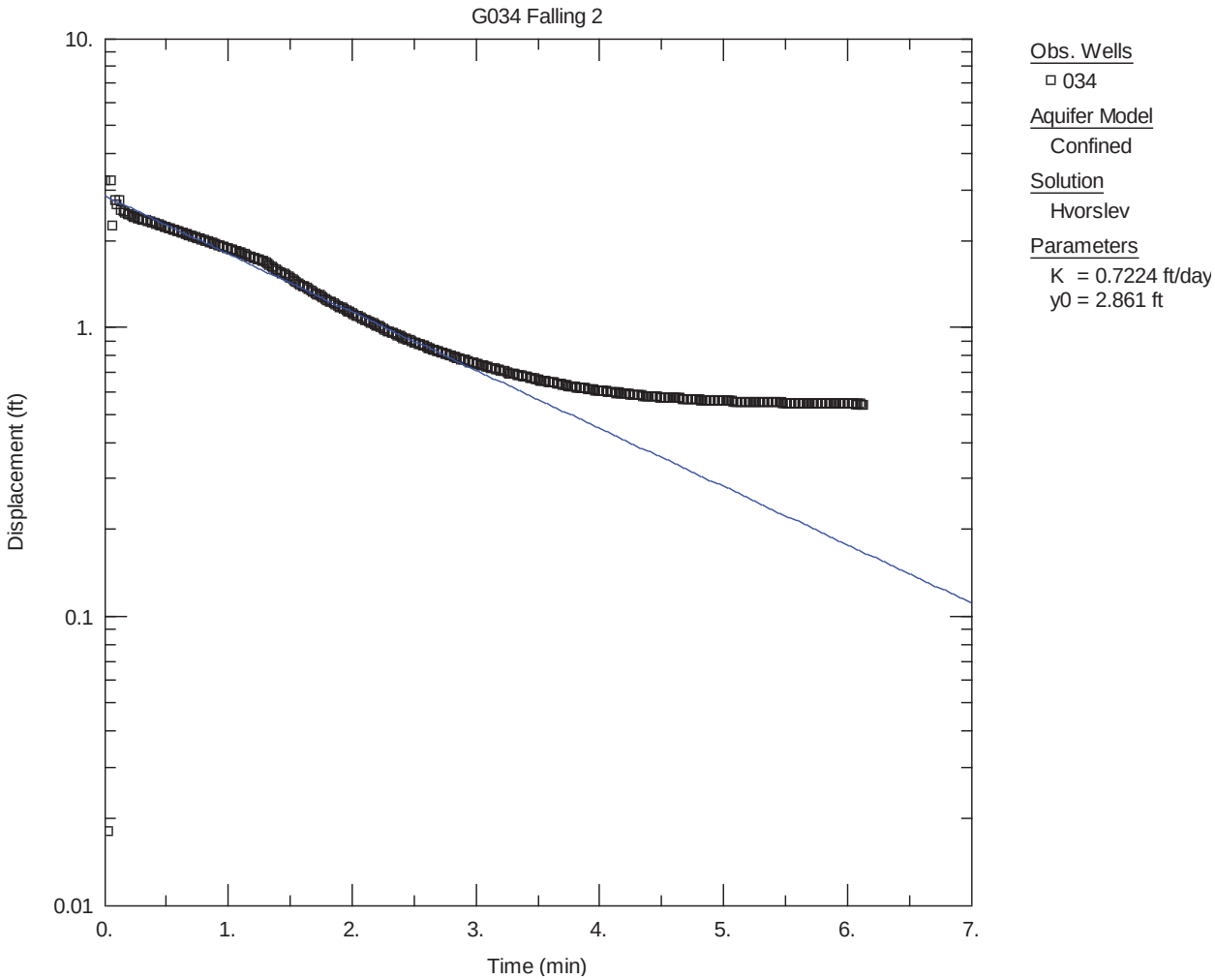


Figure F8. Falling head 2 slug test conducted in DRLE-G034 on 3/1/18. A solid slug 2 inches in diameter and 6 ft in length was used to displace water. Only 3 ft of the solid slug was submerged due to the shallow depth of the well.

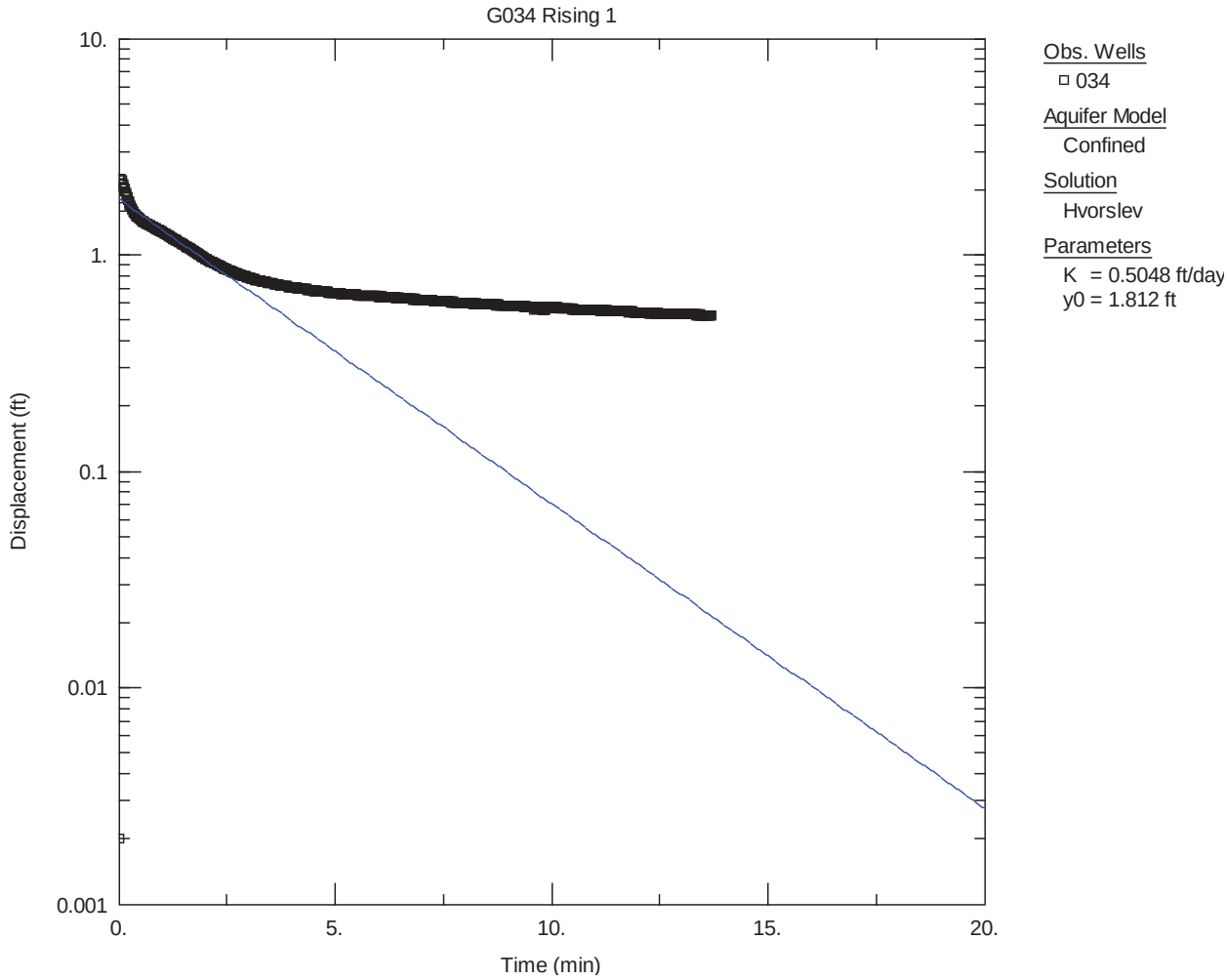


Figure F9. Rising head 1 slug test conducted in DRLE-G034 on 3/1/18. A solid slug 2 inches in diameter and 6 ft in length was used to displace water. Only 3 ft of the solid slug was submerged due to the shallow depth of the well.

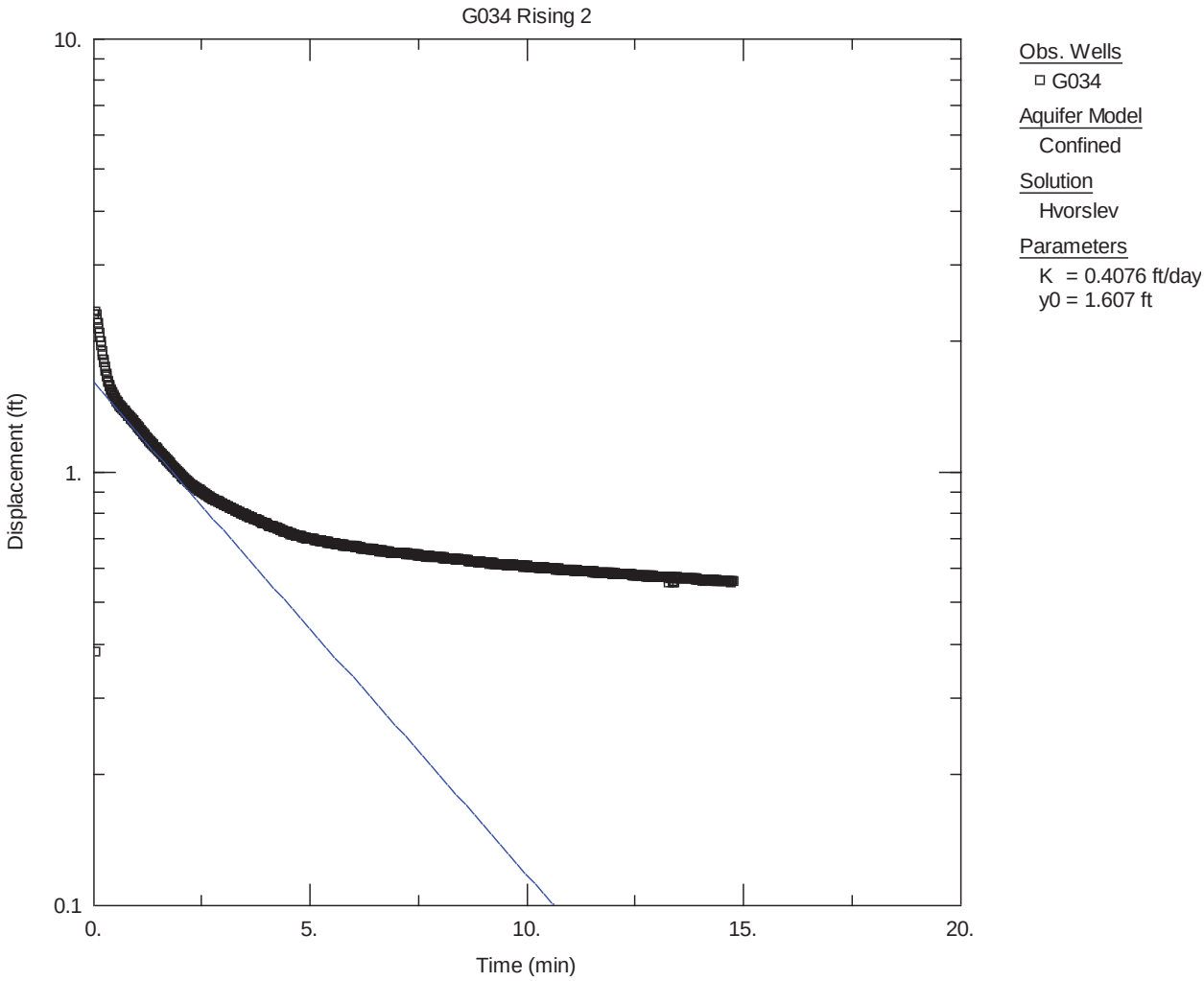


Figure F10. Rising head 2 slug test conducted in DRLE-G034 on 3/1/18. A solid slug 2 inches in diameter and 6 ft in length was used to displace water. Only 3 ft of the solid slug was submerged due to the shallow depth of the well.

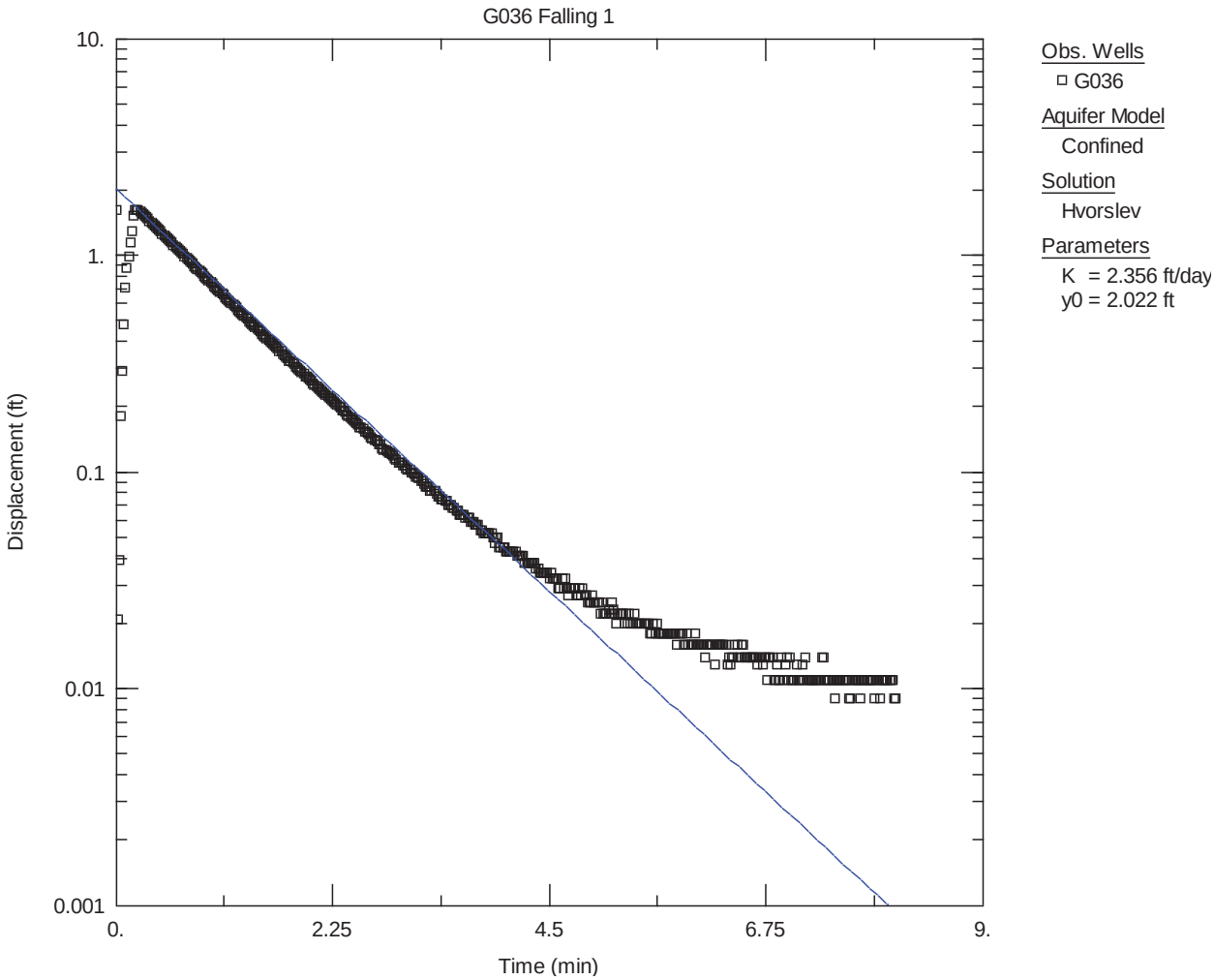


Figure F11. Falling head 1 slug test conducted in DRLE-G036 on 3/2/18. Slug tests were conducted by adding slugs of water to the well.

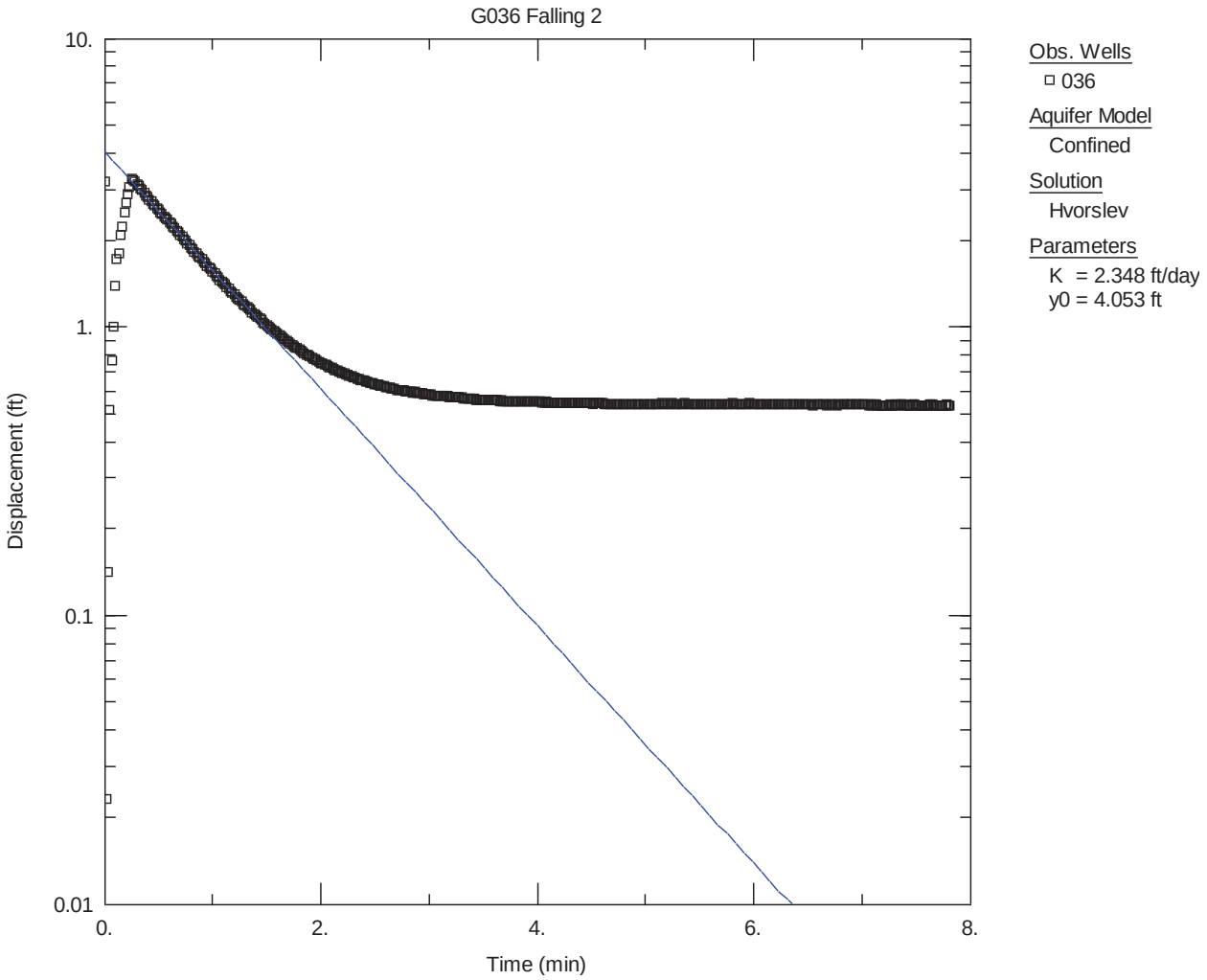


Figure F12. Falling head 2 slug test conducted in DRLE-G036 on 3/2/18. Slug tests were conducted by adding slugs of water to the well.

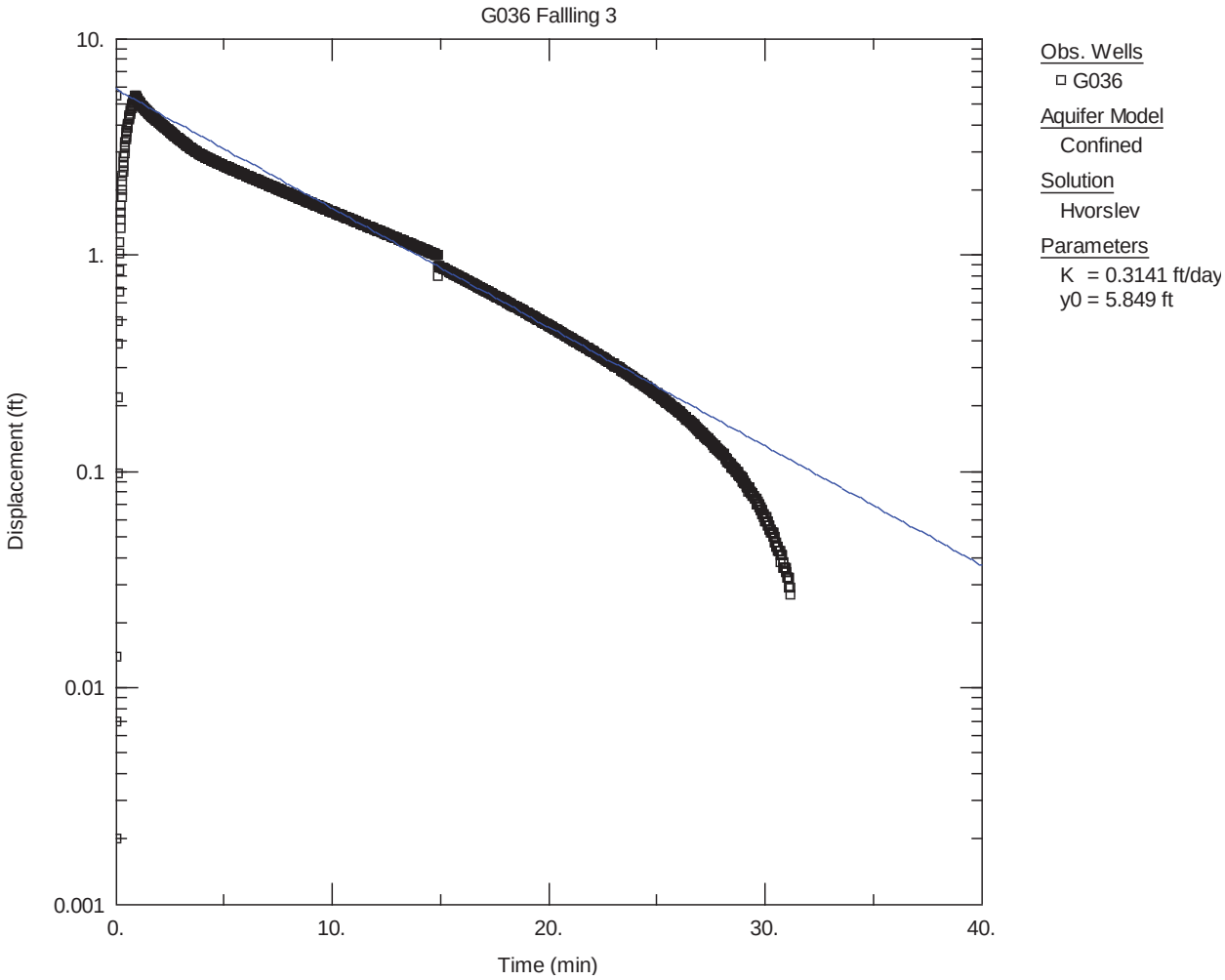


Figure F13. Falling head 3 slug test conducted in DRLE-G036 on 3/2/18. Slug tests were conducted by adding slugs of water to the well.

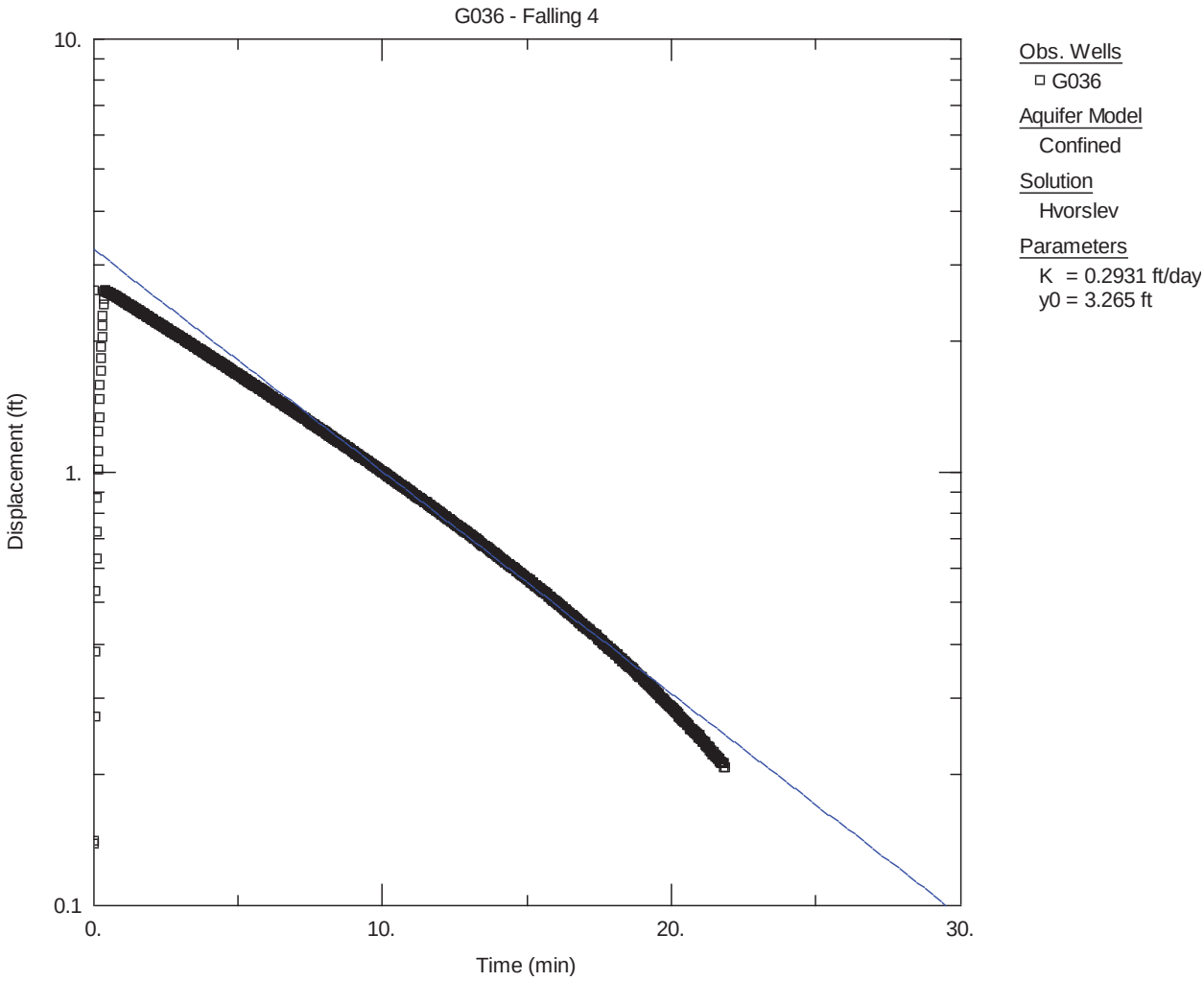


Figure F14. Falling head 1 slug test conducted in DRLE-G036 on 3/2/18. Slug tests were conducted by adding slugs of water to the well.

APPENDIX G

LABORATORY TESTS – SOIL TESTING (HAYRE MCELROY AND ASSOCIATES, LLC)

Hayre McElroy & Associates, LLC

Moisture Contents

Moisture Content Test Results (ASTM D2216) - ST-DRLE P#17-940/1657705

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
054-1	G1 S2	2.5'	12/13/2017	12/19/2017	A16	16.30	497.80	465.20	**7.3**
054-2	G1 S5	10'	12/13/2017	12/19/2017	G19	15.70	436.30	404.30	**8.2**
054-3	G1 S8	20'	12/13/2017	12/19/2017	B26	15.90	452.40	424.30	**6.9**
054-4	G1 S10	30'	12/13/2017	12/19/2017	G13	16.20	341.30	317.10	**8.0**
054-5	G1 S14	50'	12/13/2017	12/19/2017	F30	16.00	451.80	439.40	**2.9**
054-6	G1 S17	65'	12/13/2017	12/19/2017	F13	15.80	548.20	478.70	**15.0**
8023-1	G02 S3	7.5	2/19/2018	2/21/2018	1	16.0	358.9	323.4	**11.5**
8023-2	G02 S5	12.5	2/19/2018	2/21/2018	2	16.3	355.2	325.8	**9.5**
8023-3	G02 S7	20	2/19/2018	2/21/2018	3	15.8	304.3	276.6	**10.6**
8023-4	G02 S9	30	2/19/2018	2/21/2018	4	16.0	532.1	465.5	**14.8**
054-7	G3 S2	5'	12/13/2017	12/19/2017	F49	16.30	392.00	364.70	**7.8**
054-8	G3 S4	10'	12/13/2017	12/19/2017	F53	15.80	219.80	214.10	**2.9**
054-9	G3 S7	20'	12/13/2017	12/19/2017	G29	16.10	295.20	273.60	**8.4**
054-10	G3 S9	30'	12/13/2017	12/19/2017	F16	16.40	290.90	261.60	**11.9**
054-11	G3 S13	50'	12/13/2017	12/19/2017	F69	15.70	403.30	384.10	**5.2**
054-12	G3 S18	80'	12/13/2017	12/19/2017	F57	16.10	369.90	322.40	**15.5**
054-13	G4 S2	2.5'	12/13/2017	12/19/2017	A14	16.00	192.40	179.50	**7.9**
054-14	G4 S4	7.5'	12/13/2017	12/19/2017	F45	15.90	150.60	142.40	**6.5**
054-15	G4 S6	12.5'	12/13/2017	12/19/2017	A18	16.10	302.10	285.07	**6.3**
054-16	G4 S9	25'	12/13/2017	12/19/2017	F33	16.10	185.00	173.00	**7.6**
054-17	G4 S11	35'	12/13/2017	12/19/2017	A17	16.10	237.60	212.40	**12.8**
054-18	G4 S14	50'	12/13/2017	12/19/2017	F54	15.60	149.30	137.70	**9.5**
054-19	G5 S1	0.5'	12/13/2017	12/19/2017	F7	15.70	176.20	160.40	**10.9**
054-20	G5 S4	7.5'	12/13/2017	12/19/2017	B5	16.00	171.20	162.60	**5.9**
054-21	G5 S7	15'	12/13/2017	12/19/2017	FOR	16.00	353.60	331.65	**7.0**
054-22	G5 S9	25'	12/13/2017	12/19/2017	B22	15.90	142.40	133.10	**7.9**
054-23	G5 S11	35'	12/13/2017	12/19/2017	B13	15.80	101.40	100.10	**1.5**
054-24	G5 S14	50'	12/13/2017	12/19/2017	F72	15.90	210.20	204.30	**3.1**
054-25B	G6 S2	10'	12/13/2017	12/19/2017	B4	16.00	176.50	158.40	**12.7**
054-26	G6 S3A	12.5'	12/13/2017	12/19/2017	F4	15.90	101.30	91.70	**12.7**
054-25A	G6 S1	7.5'	12/13/2017	12/19/2017	A31	16.20	331.90	295.60	**13.0**
054-27	G6 S5	20'	12/13/2017	12/19/2017	ZZ	16.40	160.00	145.40	**11.3**
054-28	G6 S11	50'	12/13/2017	12/19/2017	G17	15.90	168.90	141.40	**21.9**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
054-29	G7 S2	5'	12/13/2017	12/19/2017	G27	16.00	210.90	189.27	**12.5**
054-30	G7 S3A	7.5'	12/13/2017	12/19/2017	F21	15.80	194.90	168.10	**17.6**
054-31	G7 S4	10'	12/13/2017	12/19/2017	F67	16.20	235.70	198.20	**20.6**
054-32	G7 S5	12.5'	12/13/2017	12/19/2017	F11	15.80	105.00	91.10	**18.5**
054-32B	G7 S6	15'	12/13/2017	12/19/2017	XYZ	16.00	261.10	218.30	**21.2**
054-33	G7 S8	25'	12/13/2017	12/19/2017	G28	16.10	383.50	317.40	**21.9**
054-34	G7 S11A	40'	12/13/2017	12/19/2017	F31	15.80	181.00	150.80	**22.4**
054-35	G8 S1	5'	12/13/2017	12/19/2017	G39	15.90	188.90	177.30	**7.2**
054-36	G8 S3	10'	12/13/2017	12/19/2017	G34	15.90	204.50	188.60	**9.2**
054-37	G8 S5	15'	12/13/2017	12/19/2017	G38	15.90	322.30	295.30	**9.7**
054-38	G10 S2	7.5'	12/13/2017	12/19/2017	B24	15.80	201.90	191.10	**6.2**
054-39	G10 S6	20'	12/13/2017	12/19/2017	A26	16.10	238.90	220.60	**8.9**
054-40	G10 S8	30'	12/13/2017	12/19/2017	B192-2	15.80	220.90	187.20	**19.7**
054-41	G11 S1	7.5'	12/13/2017	12/19/2017	C10	15.90	165.70	151.40	**10.6**
054-42	G11 S2	10'	12/13/2017	12/19/2017	C11	15.80	255.00	202.50	**28.1**
054-43	G11 S4	15'	12/13/2017	12/19/2017	B17	15.70	191.60	159.60	**22.2**
054-44	G11 S5	20'	12/13/2017	12/19/2017	B11	16.00	278.70	249.20	**12.7**
054-45	G12 S2	5'	12/13/2017	12/19/2017	A6	16.10	307.10	269.20	**15.0**
054-46	G12 S3	7.5'	12/13/2017	12/19/2017	B21	15.90	224.90	209.10	**8.2**
054-47	G12 S5	12.5'	12/13/2017	12/19/2017	B	16.30	215.90	198.50	**9.5**
054-48	G12 S8	25'	12/13/2017	12/19/2017	F29	15.90	236.20	225.90	**4.9**
054-49	G12 S10	35'	12/13/2017	12/19/2017	F40	16.10	213.10	177.00	**22.4**
054-50	G13 S1	2.5'	12/13/2017	12/19/2017	F14	15.90	324.70	292.90	**11.5**
054-51	G13 S2	5'	12/13/2017	12/19/2017	G42	16.10	131.50	120.42	**10.6**
054-52	G13 S5	12.5'	12/13/2017	12/19/2017	F18	16.00	229.90	219.10	**5.3**
054-53	G13 S7	20'	12/13/2017	12/19/2017	F10	16.10	367.40	311.00	**19.1**
054-54	G14 S2	5'	12/13/2017	12/19/2017	F51	16.00	151.50	132.20	**16.6**
054-55	G14 S4	10'	12/13/2017	12/19/2017	F22	15.80	182.00	156.60	**18.0**
054-56	G14 S7	20'	12/13/2017	12/19/2017	G31	16.20	189.60	164.40	**17.0**
054-57	G14 S9	30'	12/13/2017	12/19/2017	F48	16.20	342.30	280.62	**23.3**
054-58	G14 S9	40'	12/13/2017	12/19/2017	G16	15.70	279.50	223.41	**27.0**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
054-59	G15 S3	7.5'	12/13/2017	12/19/2017	F23	15.90	185.90	168.10	**11.7**
054-60	G15 S5	12.5'	12/13/2017	12/19/2017	F19	15.80	387.20	355.50	**9.3**
054-61	G15 S7	20'	12/13/2017	12/19/2017	B20	15.80	355.00	315.38	**13.2**
054-62	G15 S8	25'	12/13/2017	12/19/2017	C2	15.80	279.60	245.67	**14.8**
054-63	G15 S10	35'	12/13/2017	12/19/2017	B12	15.90	221.50	168.70	**34.6**
054-64	G15 S11	40'	12/13/2017	12/19/2017	A5	16.20	217.10	188.80	**16.4**
054-65	G15 S13	50'	12/13/2017	12/19/2017	B7	15.90	184.90	157.70	**19.2**
054-66	G15 S14	55'	12/13/2017	12/19/2017	B23	16.00	207.00	174.11	**20.8**
054-67	G15 S15	60'	12/13/2017	12/19/2017	B3	16.00	182.40	152.90	**21.5**
054-68	G15 S17	70'	12/13/2017	12/19/2017	B6	15.80	81.30	70.60	**19.5**
054-69	G15 S18	75'	12/13/2017	12/19/2017	B12	15.90	157.60	133.42	**20.6**
054-70	G15 S19	80'	12/13/2017	12/19/2017	A23	15.90	138.60	114.30	**24.7**
054-71	G15 S21	90'	12/13/2017	12/19/2017	A25	16.20	167.00	136.70	**25.1**
8003-1	G016 S-2	5.0'-6.5'	11/3/2017	11/7/2017	A-12	16.2	444.9	387.2	**15.6**
8003-2	G016 S-3	7.5'-9'	11/3/2017	11/7/2017	C-12	15.9	246.6	219.2	**13.5**
8003-3	G016 S-5	12.5'-14'	11/3/2017	11/7/2017	A-14	15.8	320.2	275.1	**17.4**
8003-4	G016 S-6	15'-16.5'	11/3/2017	11/7/2017	C-4	15.7	206.7	177.8	**17.8**
8003-5	G016 S-9	30'-31.5'	11/3/2017	11/7/2017	F-2	15.8	213.1	183.4	**17.7**
8003-6	G016 S-10	35'-36.5'	11/3/2017	11/7/2017	A-17	16.0	407.1	348.6	**17.6**
8003-7	G016 S-11	40'-41.5'	11/3/2017	11/7/2017	F-4	15.8	245.6	209.9	**18.4**
8003-8	G016 S-12	45'-46.5'	11/3/2017	11/7/2017	A-29	16.1	102.20	97.50	**5.8**
8003-9	G016 S-13	50'-51.5'	11/3/2017	11/7/2017	F-73	15.9	296.60	237.9	**26.5**
8003-10	G016 S-15	60'-61.5'	11/3/2017	11/7/2017	F-9	15.7	441.00	375.8	**18.1**
8003-11	G016 S-16	65'-66.5'	11/3/2017	11/7/2017	C-3	15.8	261.7	215.6	**23.1**
8003-12	G016 S-17	70-71.5'	11/3/2017	11/7/2017	C-1	15.7	324.0	255.6	**28.5**
8003-13	G016 S-18	75'-76.5'	11/3/2017	11/7/2017	A-18	15.8	428.9	344.5	**25.7**
8003-14	G016 S-19	80-81.5'	11/3/2017	11/7/2017	G-15	15.7	262.9	207.4	**29.0**
8003-15	G016 S-20	85-86.5'	11/3/2017	11/7/2017	F-52	15.9	351.7	276.3	**29.0**
8003-16	G016 S-22	95'-96.5'	11/3/2017	11/7/2017	G-18	15.7	391.8	314.2	**26.0**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
054-105	G17 S1	5'	12/13/2017	12/19/2017	F69	15.80	189.00	162.40	**18.1**
054-106	G17 S2	7.5'	12/13/2017	12/19/2017	G29	16.00	97.90	84.30	**19.9**
054-107	G17 S3	10'	12/13/2017	12/19/2017	F16	15.80	282.50	229.84	**24.6**
054-108	G17 S4	12.5'	12/13/2017	12/19/2017	A16	16.10	237.40	159.82	**54.0**
054-109	G17 S6	20'	12/13/2017	12/19/2017	B26	15.90	169.90	139.20	**24.9**
054-110	G17 S8	30'	12/13/2017	12/19/2017	G13	15.80	263.10	249.59	**5.8**
054-111	G17 S10	40'	12/13/2017	12/19/2017	F13	15.80	181.30	175.50	**3.6**
054-112	G17 S13	55'	12/13/2017	12/19/2017	F30	15.90	239.10	220.30	**9.2**
054-113	G17-A S3	7.5'	12/13/2017	12/19/2017	G21	16.00	241.60	195.15	**25.9**
054-114	G17-A S4	10'	12/13/2017	12/19/2017	C11	15.80	155.40	135.30	**16.8**
054-115	G17-A S5	12.5'	12/13/2017	12/19/2017	B19	15.80	342.30	281.95	**22.7**
054-116	G17-A S6	15'	12/13/2017	12/19/2017	G8	15.90	132.10	102.20	**34.6**
054-117	G17-A S7	20'	12/13/2017	12/19/2017	C10	15.90	56.60	50.10	**19.0**
054-118	G17-A S8	25'	12/13/2017	12/19/2017	B19	16.10	223.90	210.20	**7.1**
054-119	G17-A S10	35'	12/13/2017	12/19/2017	F12	15.80	243.40	221.89	**10.4**
054-120	G17-A S11	40'	12/13/2017	12/19/2017	F29	15.70	278.00	259.20	**7.7**
054-121	G17-A S13	50'	12/13/2017	12/19/2017	B17	15.70	389.30	355.30	**10.0**
054-122	G17-A S15	60'	12/13/2017	12/19/2017	B22	15.90	285.10	273.10	**4.7**
054-123	G17-A S17	70'	12/13/2017	12/19/2017	F72	15.90	248.00	201.60	**25.0**
054-124	G17-A S18	75'	12/13/2017	12/19/2017	B13	15.80	267.80	212.57	**28.1**
054-125	G17-A S20	85'	12/13/2017	12/19/2017	B5	15.90	75.50	62.00	**29.3**
054-126	G17-A S21	90'	12/13/2017	12/19/2017	A5	16.20	160.40	127.90	**29.1**
054-127	G17-A S22	95'	12/13/2017	12/19/2017	XYZ	16.00	75.90	62.10	**29.9**
054-128	G17-A S23	100'	12/13/2017	12/19/2017	G28	16.00	122.10	97.20	**30.7**
054-129	G17-A S25	110'	12/13/2017	12/19/2017	F3	15.90	100.40	85.50	**21.4**
054-130	G17-A S27	120'	12/13/2017	12/19/2017	F21	15.70	137.30	111.00	**27.6**
054-131	G17-A S29	130'	12/13/2017	12/19/2017	F19	15.70	119.10	89.10	**40.9**
054-132	G17-A S31	140'	12/13/2017	12/19/2017	A26	16.10	95.30	82.90	**18.6**
054-133	G17-A S32	145'	12/13/2017	12/19/2017	A7	16.50	123.00	113.00	**10.4**
054-134	G17-A S34	155'	12/13/2017	12/19/2017	G25	15.80	128.10	107.90	**21.9**
054-135	G17-A S36	165'	12/13/2017	12/19/2017	G24	16.20	121.00	98.80	**26.9**
054-136	G17-A S37	170'	12/13/2017	12/19/2017	B8	16.00	107.10	86.90	**28.5**
054-137	G17-A S38	180'	12/13/2017	12/19/2017	F66	15.80	99.00	75.10	**40.3**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
054-138	G17-A S39	190'	12/13/2017	12/19/2017	G20	15.80	151.00	120.80	**28.8**
054-139	G17-A S40	200'	12/13/2017	12/19/2017	G14	15.70	124.90	97.20	**34.0**
054-140	G17-A S41	210'	12/13/2017	12/19/2017	B25	15.90	107.40	84.00	**34.4**
054-141	G17-A S42A	220'	12/13/2017	12/19/2017	A29	16.20	212.10	194.00	**10.2**
054-142	G17-A S43	230'	12/13/2017	12/19/2017	X7	192.90	434.80	409.00	**11.9**
8003-17	G018 S-1	2.5'-4'	11/3/2017	11/7/2017	G-16	15.8	274.1	189.6	**48.6**
8003-18	G018 S-2	5'-6.5'	11/3/2017	11/7/2017	B-4	15.9	374.3	265.4	**43.6**
8003-19	G018 S-3	7.5'-9'	11/3/2017	11/7/2017	F-71	15.9	333.9	251.3	**35.1**
8003-20	G018 S-4	9'-10.5'	11//3/2017	11/7/2017	G-24	15.9	281.1	177.2	**64.4**
8003-21	G018 S-5	10.5'-12'	11/3/2017	11/7/2017	G-25	15.7	360.0	257.4	**42.4**
8003-22	G018 S-6	12'-13.5'	11/3/2017	11/7/2017	G-20	15.8	284.3	215.5	**34.5**
8003-23	G018 S-7	21'-22.5'	11/3/2017	11/7/2017	AB22	15.7	125.3	122.7	**2.4**
8003-24	G018 S-11	40-41.5'	11/3/2017	11/7/2017	B-25	15.9	564.7	464.1	**22.4**
8003-25	G018 S-14	60-61.5	11/3/2017	11/7/2017	A-4	15.8	552.0	428.2	**30.0**
8003-27	G018 S-17	77.5'-79'	11/3/2017	11/7/2017	G-8	15.8	576.6	445.3	**30.6**
8003-28	G018 S-19	85'-86.5'	11/3/2017	11/7/2017	G-14	15.9	510.0	383.4	**34.4**
8003-29	G018 S-20	90'-91.5'	11/3/2017	11/7/2017	G-3	15.6	483.4	372.0	**31.3**
8003-30	G018 S-21	95'-96.5'	11/3/2017	11/7/2017	G-7	15.9	550.6	409.3	**35.9**
8003-31	G018 S-22	100'-101.5'	11/3/2017	11/7/2017	B-9	15.9	473.4	372.4	**28.3**
8003-32	G018 S-23	105'-106.5'	11/3/2017	11/7/2017	ABL3	16.0	564.9	431.8	**32.0**
8003-33	G018 S-25	115'-116.5'	11/3/2017	11/7/2017	G-1	15.7	452.2	333.6	**37.3**
8003-34	G018 S-26	120'-121.5'	11/3/2017	11/7/2017	A-21	15.9	392.4	293.1	**35.8**
8003-35	G018 S-27	125'-126.5'	11/3/2017	11/7/2017	X-7	193.3	246.1	235.4	**25.4**
8003-36	G018 S-28	130'-131.5'	11/3/2017	11/7/2017	X-8	194.1	621.5	512.8	**34.1**
8003-37	G018 S-29	140'-141.5'	11/3/2017	11/7/2017	A-44	190.1	223.0	213.6	**40.0**
8003-38	G018 S-31	150'-151.5'	11/3/2017	11/7/2017	X-6	196.2	695.7	619.2	**18.1**
8003-39	G018 S-33	160'-161.5'	11/3/2017	11/7/2017	X-9	231.2	624.2	515.9	**38.0**
8003-40	G018 S-34	170'-171.5'	11/3/2017	11/7/2017	X-5	198.3	581.7	486.7	**32.9**
8003-41	G018 S-35	175'-176.5'	11/3/2017	11/7/2017	9A	161.9	666.2	532.0	**36.3**
8003-42	G018 S-37	185'-186.5'	11/3/2017	11/7/2017	AB	157.6	592.9	487.3	**32.0**
8003-43	G018 S-38	190'-191.5'	11/3/2017	11/7/2017	AJ	164.9	612.2	507.9	**30.4**
8003-44	G018 S-39	200'-201.5'	11/3/2017	11/7/2017	A-7	16.4	211.1	190.9	**11.6**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
7992-1	G019 S-1	0'-1.5'	9/29/2017	10/3/2017	A-15	18.0	134.9	102.5	**38.3**
7992-2	G019 S-2	2.5'-4'	9/29/2017	10/3/2017	A-16	16.2	138.6	101.1	**44.2**
7992-3	G019 S-3	5'-6.5'	9/29/2017	10/3/2017	A-22	16.1	181.2	76.6	**172.9**
7992-4	G019 S-6	12.5'-14'	9/29/2017	10/3/2017	B-14	15.9	288.5	256.7	**13.2**
7992-5	G019 S-7	15'-16.5'	9/29/2017	10/3/2017	B-21	15.8	130.8	120.4	**9.9**
7992-6	G019 S-10	30'-31'.5"	9/29/2017	10/3/2017	A-2	16.9	311.6	267.6	**17.6**
7992-7	G019 S-12	40'-41.5'	9/29/2017	10/3/2017	A-9	16.4	326.1	258.1	**28.1**
7992-8	G019 S-14	50'-51.5'	9/29/2017	10/3/2017	B-5	16.20	222.10	174.20	**30.3**
7992-9	G019 S-16	60'-61.5'	9/29/2017	10/3/2017	B-3	16.60	308.80	244.4	**28.3**
7992-10	G019 S-18	70'-71.5'	9/29/2017	10/3/2017	B-8	16.2	274.50	218.40	**27.7**
7980-1	G019 S-19a	75'-76.5'	8/10/2017	8/11/2017	A-26	16.4	356.6	275.5	**31.3**
7980-2	G019 S-19b	75'-76.5'	8/10/2017	8/11/2017	A-191	16.2	371.9	287.5	**31.1**
7980-3	G019 S-21	85'-86.5'	8/10/2017	8/11/2017	B-4	16.6	445.9	335.6	**34.6**
7980-4	G019 S-23	95'-96.5'	8/10/2017	8/11/2017	A-19	16.0	470.9	346.2	**37.8**
7980-5	G019 S-25	105'-106.5'	8/10/2017	8/11/2017	A-13	16.1	421.1	321.6	**32.6**
7980-6	G019 S-27	115'-116.5'	8/10/2017	8/11/2017	AB23	16.0	461.2	370.3	**25.7**
7980-7	G019 S-29	125'-126.5'	8/10/2017	8/11/2017	B-9	15.8	480.6	368.6	**31.7**
7992-11	G019 S-31	135'-136'.5"	9/29/2017	10/3/2017	B-10	16.9	389.1	314.3	**25.2**
7992-12	G019 S-32	140'-141'.5"	9/29/2017	10/3/2017	For	16.0	387.8	322.10	**21.5**
7992-13	G019 S-35	155'-156.5'	929/2017	10/3/2017	A-29	16.0	551.8	478.2	**15.9**
7992-14	G020 S-1	0.0'-1.5'	9/29/2017	10/3/2017	B	16.0	55.7	51.8	**10.9**
7992-15	G020 S-2	2.5'-4'	9/29/2017	10/3/2017	A-10	16.2	316.0	290.4	**9.3**
7992-16	G020 S-4	7.5'-9'	9/29/2017	10/3/2017	A-7	16.3	289.6	263.6	**10.5**
7992-17	G020 S-5	10'-11.5'	9/29/2017	10/3/2017	B-1	15.9	405.5	370.40	**9.9**
7992-18	G020 S-7	15'-16.5'	9/29/2017	10/3/2017	B-26	15.9	387.9	356.8	**9.1**
7992-19	G020 S-11	35'-36.5'	9/29/2017	10/3/2017	B-17	16.6	384.6	321.7	**20.6**
7992-20	G020 S-13	45'-46.5'	9/29/2017	10/3/2017	A-23	16.4	279.2	227.4	**24.5**
7992-21	G020 S-14	50'-51.5'	9/29/2017	10/3/2017	B-6	16.1	398.1	320.1	**25.7**
7992-22	G020 S-16	60'-61.5'	9/29/2017	10/3/2017	B-2	16.1	566.5	455.3	**25.3**
7992-23	G020 S-19	75'-76.5'	9/29/2017	10/3/2017	A-12	16.4	427.6	340.8	**26.8**
7980-8	G020 S-20	80'-81.5'	8/10/2017	8/11/2017	zz	16.1	488.8	378.6	**30.4**
7980-8	G020 S-20	80'-81.5'	8/10/2017	8/11/2017	ZZ	16.10	488.80	378.60	**30.4**
7980-9	G020 S-22	90'-91.5'	8/10/2017	8/11/2017	B-192	15.7	509.7	383.4	**34.3**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
7980-9	G020 S-22	90'-91.5'	8/10/2017	8/11/2017	B-192	15.70	509.70	383.4	**34.3**
7980-10	G020 S-24	100'-101.5'	8/10/2017	8/11/2017	B-2	17.0	545.8	423.0	**30.2**
7980-10	G020 S-24	100'-101.5'	8/10/2017	8/11/2017	B-2	17.0	545.80	423.00	**30.2**
7980-11	G020 S-25	105'-106.5	8/10/2017	8/11/2017	B-3	15.8	496.4	378.7	**32.4**
7980-11	G020 S-25	105'-106.5'	8/10/2017	8/11/2017	B-3	15.8	496.4	378.7	**32.4**
7980-12	G020 S-26	110'-111.5'	8/10/2017	8/11/2017	A-1	16.1	413.1	312.7	**33.9**
7980-12	G020 S-26	110'-111.5'	8/10/2017	8/11/2017	A-1	16.1	413.1	312.70	**33.9**
7980-13	G020 S-28	120'-121.5'	8/10/2017	8/11/2017	A-27	16.0	457.4	344.4	**34.4**
7980-14	G020 S-31	135'-136.5'	8/10/2017	8/11/2017	B-28	16.6	447.1	344.4	**31.3**
7980-15	G020 S-33	145'-146.5'	8/10/2017	8/11/2017	A-31	15.8	401.3	315.1	**28.8**
7995-1	G020 S-34	150'-151.5'	10/17/2017	10/18/2017	B-18	15.8	343.8	285.5	**21.6**
7992-24	G020 S-35	155'-156.5'	9/29/2017	10/3/2017	B-19	16.1	631.0	522.6	**21.4**
7992-25	G020 S-36	160'-161.5'	9/29/2017	10/3/2017	A-14	15.8	450.4	383.2	**18.3**
7980-16	G020 S-37	165'-166.5'	8/10/2017	8/11/2017	A-3	16.1	400.2	307.5	**31.8**
7980-17	G020 S-40	180'-181.5'	8/10/2017	8/11/2017	B-27	15.7	278.9	223.80	**26.5**
7992-26	G021 S-1	0'-1.5'	9/29/2017	10/3/2017	A-4	16.4	183.6	136.7	**39.0**
7992-27	G021 S-2	2.5'-3.5'	9/29/2017	10/3/2017	B-18	15.8	278.1	206.5	**37.5**
7992-28	G021 S-3	5'-6'	9/29/2017	10/3/2017	A-18	15.9	115.7	88.5	**37.5**
7992-29	G021 S-4	7.5'-9'	9/29/2017	10/3/2017	A-17	16.0	282.3	258.4	**9.9**
7992-30	G021 S-6	12.5'-14'	9/29/2017	10/3/2017	B-20	17.60	404.60	364.00	**11.7**
7992-31	G021 S-8	20'-21.5	9/29/2017	10/3/2017	Ab-22	16.00	113.30	105.9	**8.2**
7992-32	G021 S-10	30'-31.5'	9/29/2017	10/3/2017	B-25	15.7	535.60	484.50	**10.9**
7992-33	G021 S-12	40'-41.5	9/29/2017	10/3/2017	C-1	16.0	482.8	438.7	**10.4**
7992-34	G022 S-1	0'1.5"	9/29/2017	10/3/2017	C-3	15.8	270.0	205.90	**33.7**
7992-35	G022 S-2	5'-6.5'	929/2017	10/3/2017	C-4	16.0	248.1	107.0	**155.1**
7992-36	G022 S-4	10'-11.5'	9/29/2017	10/3/2017	C-5	15.7	149.0	143.0	**4.7**
7992-37	G022 S-6	15'-16.5'	9/29/2017	10/3/2017	C-6	15.9	459.9	418.2	**10.4**
7992-38	G022 S-8	25'-26.5'	9/29/2017	10/3/2017	C-7	16.0	560.7	516.8	**8.8**
7992-39	G022 S-10	35'-36.5'	9/29/2017	10/3/2017	C-8	15.8	417.9	347.30	**21.3**
7992-40	G022 S-12	45'-46.5'	9/29/2017	10/3/2017	C-9	15.8	442.4	363.9	**22.6**
7992-41	G023 S-1	3.6'-4.0	9/29/2017	10/3/2017	C-10	15.8	232.1	181.3	**30.7**
7992-42	G023 S-2	5'-6.5'	9/29/2017	10/3/2017	C-11	15.8	329.8	140.5	**151.8**
7992-43	G023 S-6	15'-17.5'	9/29/2017	10/3/2017	C-12	15.9	488.5	445.9	**9.9**
7992-44	G023 S-9	30'-31.5'	9/29/2017	10/3/2017	C-13	15.8	385.9	341.9	**13.5**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
7995-2	G024 S-1	0.0'-1.5'	10/17/2017	10/18/2017	G-1	15.7	331.0	274.7	**21.7**
7995-3	G024 S-2	2.5'-4'	10/17/2017	10/18/2017	G-2	15.7	293.1	243.4	**21.8**
7995-4	G024 S-3	5'-6.5'	10/17/2017	10/18/2017	G-3	15.6	313.2	231.0	**38.2**
7995-5	G024 S-4	7.5'-9'	10/17/2017	10/18/2017	G-4	15.8	332.2	226.8	**50.0**
7995-6	G024 S-5A	10'-11'.5"	10/17/2017	10/18/2017	G-5	15.7	333.5	221.2	**54.6**
7995-7	G024 S-5B	10'-11'.5"	10/17/2017	10/18/2017	G-6	15.7	198.0	85.3	**161.9**
7995-8	G024 S-6	15.5'-17'	10/17/2017	10/18/2017	G-7	15.8	331.90	256.00	**31.6**
7995-9	G024 S-10	35'-36.5'	10/17/2017	10/18/2017	G-8	15.7	372.60	337.6	**10.9**
7995-10	G025 S-1	5'-6.5'	10/17/2017	10/18/2017	G-9	15.8	327.00	262.80	**26.0**
7995-11	G025 S-3	10'-11.5'	10/17/2017	10/18/2017	G-10	15.6	323.5	239.2	**37.7**
7995-12	G025 S-4A	15'-16.5'	10/17/2017	10/18/2017	G-11	15.6	260.1	93.00	**215.9**
7995-13	G025 S-6	25'-26.5'	10/17/2017	10/18/2017	G-12	15.7	360.9	329.0	**10.2**
7995-14	G027 S-1	2.5'-4.0'	10/17/2017	10/18/2017	G-13	15.6	308.5	303.4	**1.8**
7995-15	G027 S-3	7.5'-9.0'	10/17/2017	10/18/2017	G-14	15.7	349.8	336.4	**4.2**
7995-16	G027 S-4	10'-11.5'	10/17/2017	10/18/2017	G-15	15.7	561.0	535.4	**4.9**
7995-17	G027 S-5	12.5'-14.0'	10/17/2017	10/18/2017	G-16	15.6	354.8	332.60	**7.0**
7995-18	G027 S-6	15'-16.5'	10/17/2017	10/18/2017	G-17	15.8	305.8	276.7	**11.2**
7995-19	G027 S-7	20'-21.5'	10/17/2017	10/18/2017	G-18	15.8	257.5	220.5	**18.1**
7995-20	G027 S-9B	30.5'-31.5'	10/17/2017	10/18/2017	G-19	15.8	379.1	339.6	**12.2**
7995-21	G027 S-13	50'-51.5'	10/17/2017	10/18/2017	G-20	15.8	200.3	166.2	**22.7**
7995-23	G028 S-2	10'-11.5'	10/17/2017	10/18/2017	G-22	15.8	233.1	215.6	**8.8**
7995-24	G028 S-4	15'-16.5'	10/17/2017	10/18/2017	G-23	15.8	325.7	225.1	**48.1**
7995-22	G028 S-1	17.5'-9.0'	10/17/2017	10/18/2017	G-21	15.8	361.8	352.4	**2.8**
7995-25	G028 S-5	20'-21.5'	10/17/2017	10/18/2017	G-24	15.8	316.3	287.9	**10.4**
7995-26	G028 S-6	25'-26.5'	10/17/2017	10/18/2017	G-25	15.8	456.8	419.4	**9.3**
8023-5	G029 S1	5	2/19/2018	2/21/2018	5	16.1	453.3	406.4	**12.0**
8023-6	G029 S3	12.5	2/19/2018	2/21/2018	6	15.9	155.1	132.8	**19.1**
8023-7	G029 S5	20	2/19/2018	2/21/2018	7	15.8	243.5	217.7	**12.8**
8023-8	G029 S6	25	2/19/2018	2/21/2018	8	15.9	611.4	558.9	**9.7**
8023-9	G029 S8	35	2/19/2018	2/21/2018	9	15.8	93.5	84.2	**13.7**
8023-10	G029 S10	45	2/19/2018	2/21/2018	10	16.1	273.1	221.2	**25.3**
8023-11	G029 S11	50	2/19/2018	2/21/2018	11	15.8	481.7	400.0	**21.3**
8023-12	G029 S12	55	2/19/2018	2/21/2018	12	16.0	279.3	219.6	**29.3**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
8023-13	G029 S13	60	2/19/2018	2/21/2018	13	15.8	334.3	262.9	**28.9**
8023-14	G029 S15	70	2/19/2018	2/21/2018	14	15.9	288.1	227.9	**28.4**
8023-15	G029 S17	80	2/19/2018	2/21/2018	15	15.9	267.6	213.3	**27.5**
8023-16	G029 S18	85	2/19/2018	2/21/2018	16	16.2	284.7	212.3	**36.9**
8023-17	G029 S19	90	2/19/2018	2/21/2018	17	16.6	247.9	200.3	**25.9**
8023-18	G029 S21	100	2/19/2018	2/21/2018	18	15.9	340.6	270.0	**27.8**
7995-28	G031 S-1	2.5'-4.0'	10/17/2017	10/18/2017	G-26	15.8	133.0	118.3	**14.3**
7995-29	G031 S-5	18.5'-20'	10/17/2017	10/18/2017	G-27	16.0	115.1	105.1	**11.2**
7995-30	G031 S-8	37'-38.5'	10/17/2017	10/18/2017	G-28	16.0	347.3	317.1	**10.0**
7995-31	G031 S-11	50'-51.5'	10/17/2017	10/18/2017	G-29	15.8	369.80	317.90	**17.2**
7995-32	G031 S-14	65'-66.5'	10/17/2017	10/18/2017	G-30	15.9	500.70	404.8	**24.7**
7995-33	G031 S-15	70'-71.5'	10/17/2017	10/18/2017	G-31	15.8	462.40	319.20	**47.2**
7995-34	G031 S-20	95'-96.5'	10/17/2017	10/18/2017	G-32	15.8	408.2	300.6	**37.8**
7995-35	G031 S-21	100'-101.5'	10/17/2017	10/18/2017	G-33	15.8	402.6	312.00	**30.6**
7995-36	G031 S-23	110'-111.5	10/17/2017	10/18/2017	G-34	15.8	409.2	298.5	**39.2**
7995-37	G031 S-24	115'-116.5'	10/17/2017	10/18/2017	G-35	16.0	344.8	301.8	**15.0**
7995-38	G031 S-25	120'-121.5'	10/17/2017	10/18/2017	G-36	16.1	227.2	184.6	**25.3**
7995-39	G031 S-26	125'-126.5'	10/17/2017	10/18/2017	C-14	15.8	267.7	201.9	**35.4**
7995-40	G031 S-28	135'-136.5'	10/17/2017	10/18/2017	G-38	15.8	452.1	435.20	**4.0**
7995-41	G031 S-30	145'-146.5'	10/17/2017	10/18/2017	G-39	16.0	548.0	378.8	**46.6**
7995-42	G031 S-31	150'-151.5'	10/17/2017	10/18/2017	G-40	15.7	563.4	444.3	**27.8**
7995-43	G031 S-32	155'-156.5'	10/17/2017	10/18/2017	G-41	16.1	228.9	187.0	**24.5**
7995-44	G031 S-40	195'-196.5'	10/17/2017	10/18/2017	G-42	15.8	550.8	497.4	**11.1**
054-72	G33 S21	5'	12/13/2017	12/19/2017	B10	15.80	242.70	185.10	**34.0**
054-73	G33 S3	7.5'	12/13/2017	12/19/2017	A1	16.20	279.44	224.74	**26.2**
054-74	G33 S5A/B	12.5'	12/13/2017	12/19/2017	B19	15.90	111.10	76.00	**58.4**
054-75	G33 S6	15'	12/13/2017	12/19/2017	B28	15.80	218.87	134.70	**70.8**
054-76	G33 S8	25'	12/13/2017	12/19/2017	A20	16.20	244.90	223.40	**10.4**
054-77	G33 S10	35'	12/13/2017	12/19/2017	F3	15.90	356.80	308.80	**16.4**
054-78	G33 S12	45'	12/13/2017	12/19/2017	C8	15.90	392.23	318.28	**24.5**
054-79	G33 S14	55'	12/13/2017	12/19/2017	F32	15.80	247.20	196.20	**28.3**
054-80	G33 S15B	60'	12/13/2017	12/19/2017	F6	15.86	285.63	229.66	**26.2**
054-81	G33 S16	65'	12/13/2017	12/19/2017	F12	15.80	264.60	213.20	**26.0**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
054-82	G33 S17	70'	12/13/2017	12/19/2017	F17	15.78	369.49	300.46	**24.2**
054-83	G33 S18	75'	12/13/2017	12/19/2017	C13	16.00	187.10	153.70	**24.3**
054-84	G33 S19	80'	12/13/2017	12/19/2017	C9	15.93	287.20	223.78	**30.5**
054-85	G33 S20	85'	12/13/2017	12/19/2017	A32	16.30	194.70	157.80	**26.1**
054-86	G33 S22	95'	12/13/2017	12/19/2017	A24	16.01	325.20	261.94	**25.7**
054-87	G33 S23	100'	12/13/2017	12/19/2017	B15	16.00	121.50	98.10	**28.5**
054-88	G33 S24	105'	12/13/2017	12/19/2017	G30	16.20	133.80	107.50	**28.8**
054-89	G33 S26	110'	12/13/2017	12/19/2017	F68	15.90	241.10	207.80	**17.4**
054-90	G33 S27	115'	12/13/2017	12/19/2017	F47	16.10	117.90	90.90	**36.1**
054-91	G33 S29	120'	12/13/2017	12/19/2017	F59	16.10	210.20	173.90	**23.0**
054-92	G33 S30A	125'	12/13/2017	12/19/2017	G21	15.90	233.50	202.70	**16.5**
054-94	G33 S32	135'	12/13/2017	12/19/2017	F50	15.90	134.50	106.80	**30.5**
054-95	G33 S33	140'	12/13/2017	12/19/2017	G18	15.80	121.80	97.20	**30.2**
054-96	G33 S34	145'	12/13/2017	12/19/2017	G8	15.90	117.80	92.50	**33.0**
054-97	G33 S35	150'	12/13/2017	12/19/2017	A4	16.20	130.20	101.10	**34.3**
054-98	G33 S36	155'	12/13/2017	12/19/2017	F71	16.00	89.50	71.00	**33.6**
054-99	G33 S38	160'	12/13/2017	12/19/2017	AB22	15.90	119.00	94.60	**31.0**
054-100	G33 S39	170'	12/13/2017	12/19/2017	A22	16.10	112.70	94.80	**22.7**
054-101	G33 S42A	180'	12/13/2017	12/19/2017	B14	15.80	124.90	105.90	**21.1**
054-102	G33 S45	195'	12/13/2017	12/19/2017	F64	15.90	235.80	217.40	**9.1**
054-103	G33 S46	215'	12/13/2017	12/19/2017	G7	16.19	435.11	386.51	**13.1**
054-104	G33 S47	225'	12/13/2017	12/19/2017	G1	15.80	250.60	229.40	**9.9**
7995-45	G034 S-4	7.5'-9'	10/17/2017	10/18/2017	F-1	15.8	336.1	251.5	**35.9**
7995-46	G034 S-5	10'-11.5'	10/17/2017	10/18/2017	F-2	15.8	368.6	279.3	**33.9**
7995-47	G034 S-7	15'-16.5'	10/17/2017	10/18/2017	F-3	15.8	260.7	229.3	**14.7**
7995-48	G034 S-9	25'-26.5'	10/17/2017	10/18/2017	F-4	15.8	422.7	387.8	**9.4**
7995-49	G034 S-11	35'-36.5'	10/17/2017	10/18/2017	F-5	15.8	160.3	147.8	**9.5**
7995-50	G034 S-14	50'-51.5'	10/17/2017	10/18/2017	F-6	15.8	246.6	225.7	**10.0**
7995-51	G034 S-15	55'-56.5'	10/17/2017	10/18/2017	F-7	15.8	260.5	240.5	**8.9**
7995-52	G034 S-19	75'-76.5'	10/17/2017	10/18/2017	F-8	15.8	293.2	272.0	**8.3**
7995-53	G034 S-23	95'-96.5'	10/17/2017	10/18/2017	F-9	15.8	535.5	487.7	**10.1**
7995-54	G034 S-26	110'-111.5'	10/17/2017	10/18/2017	F-10	15.8	528.2	465.3	**14.0**

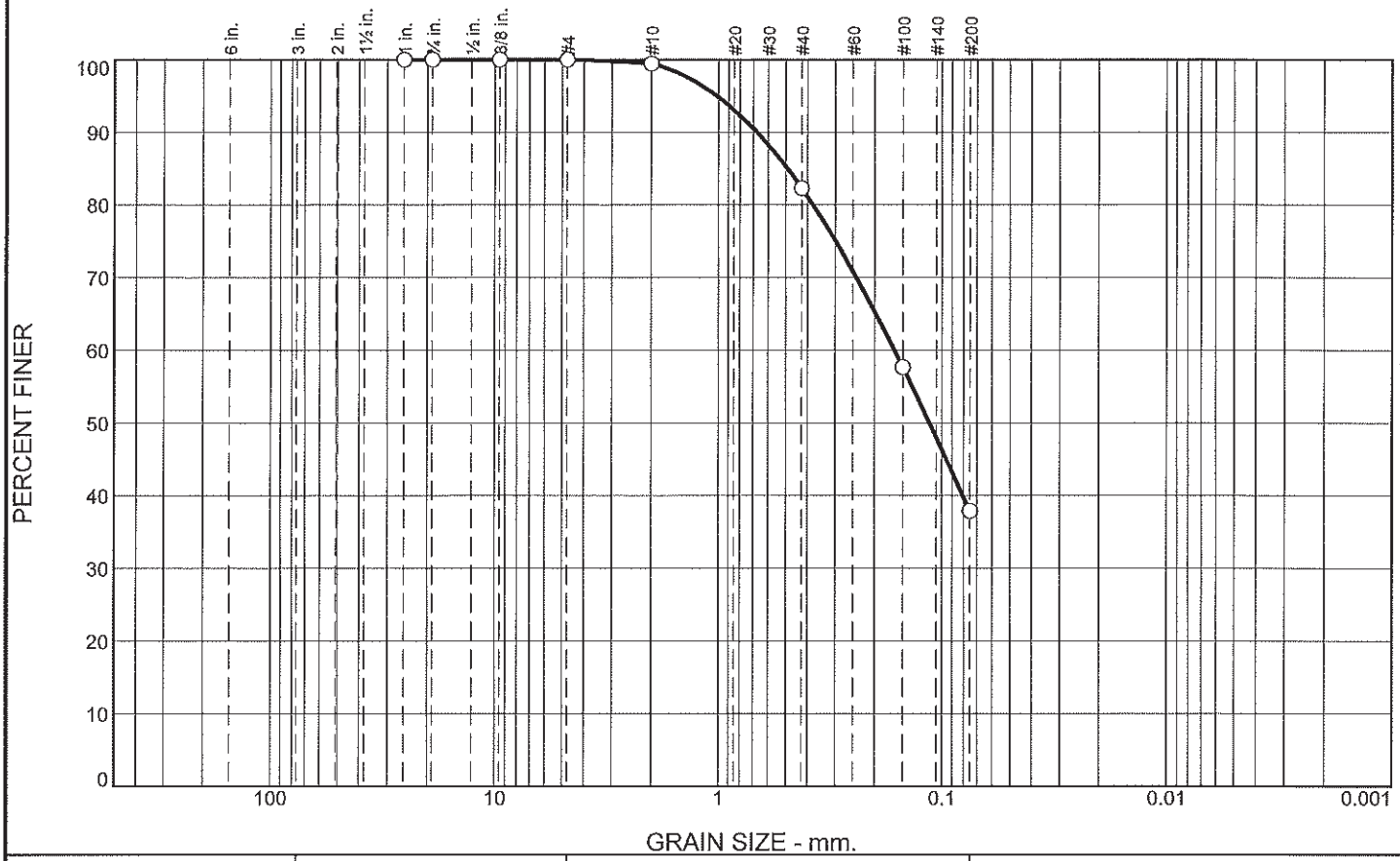
HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
8023-19	G034A S21	115	2/19/2018	2/21/2018	19	16.1	398.1	359.8	**11.1**
8023-20	G034A S4	125	2/19/2018	2/21/2018	20	16.0	397.3	359.6	**11.0**
8023-21	G034A S6	135	2/19/2018	2/21/2018	21	15.9	293.2	269.9	**9.2**
7995-55	G035 S-1	2.5'-4.0'	10/17/2017	10/18/2017	F-11	15.8	279.8	248.1	**13.6**
7995-56	G035 S-4	10'-11.5'	10/17/2017	10/18/2017	F-12	15.8	269.4	241.5	**12.4**
7995-57	G035 S-7	20'-31.5'	10/17/2017	10/18/2017	F-13	15.8	184.7	158.2	**18.6**
7995-58	G035 S-9	30'-31.5'	10/17/2017	10/18/2017	F-14	15.8	335.2	286.8	**17.9**
7995-59	G035 S-12	45'-46.5'	10/17/2017	10/18/2017	F-15	15.8	134.9	122.9	**11.2**
7995-60	G035 S-14	55'-56.5'	10/17/2017	10/18/2017	F-16	15.8	278.1	245.0	**14.4**
7995-61	G035 S-16	65'-66.5'	10/17/2017	10/18/2017	F-17	15.8	421.5	378.2	**11.9**
7995-62	G035 S-18	75'-76.5'	10/17/2017	10/18/2017	F-18	15.8	419.7	343.3	**23.3**
7995-63	G035 S-19	80'-81.5'	10/17/2017	10/18/2017	F-19	15.8	350.8	287.3	**23.4**
7995-64	G035 S-20	95'-96.5'	10/17/2017	10/18/2017	F-20	15.8	270.3	247.2	**10.0**
7995-65	G035 S-25	110'-111.5'	10/17/2017	10/18/2017	F-21	15.8	371.8	340.7	**9.6**
7995-66	G035 S-26	115'-116.5'	10/17/2017	10/18/2017	F-22	15.8	493.0	440.5	**12.4**
7995-67	G035 S-29	127.5'-129'	10/17/2017	10/18/2017	F-23	15.8	419.3	383.7	**9.7**
7995-68	G035 S-32	140'-141.5'	10/17/2017	10/18/2017	F-24	15.8	274.8	251.5	**9.9**
7995-69	G035 S-35	155'-156.5'	10/17/2017	10/18/2017	F-25	15.8	528.5	479.5	**10.6**
7995-70	G035 S-38	170'-171.5'	10/17/2017	10/18/2017	F-26	15.8	263.9	244.4	**8.5**
7995-71	G035 S-41	185'-186.5'	10/17/2017	10/18/2017	F-27	15.8	401.4	301.7	**34.9**
7995-72	G035 S-42	190'-191.5'	10/17/2017	10/18/2017	F-28	15.8	403.8	314.4	**29.9**
7995-73	G035 S-44	200'-201.5'	10/17/2017	10/18/2017	F-29	15.8	520.8	486.6	**7.3**
7995-74	G037 S-3	12.5'-14'	10/17/2017	10/18/2017	F-30	15.8	323.0	318.2	**1.6**
7995-75	G037 S-7	25'-26.5'	10/17/2017	10/18/2017	F-31	15.8	328.5	309.9	**6.3**
7995-76	G037 S-9	35'-36.5'	10/17/2017	10/18/2017	F-32	15.8	466.1	386.0	**21.6**
7995-77	G037 S-12	50'-51.5'	10/17/2017	10/18/2017	F-33	15.8	390.0	371.5	**5.2**
7995-78	G037 S-16	70'-71.5'	10/17/2017	10/18/2017	F-34	15.8	351.3	318.3	**10.9**
7995-79	G037 S-17	90'-91.5'	10/17/2017	10/18/2017	F-35	15.8	426.7	342.6	**25.7**
7995-80	G037 S-18	97.5'-99.5'	10/17/2017	10/18/2017	F-36	15.8	430.6	346.7	**25.4**
7995-81	G037 S-20	105'-106.5'	10/17/2017	10/18/2017	F-37	15.8	453.5	357.8	**28.0**
7995-82	G037 S-21	115'-116.5'	10/17/2017	10/18/2017	F-38	15.8	418.5	339.9	**24.3**
7995-83	G037 S-23	125'-126.5'	10/17/2017	10/18/2017	F-39	15.8	337.8	275.7	**23.9**
7995-84	G037 S-25	135'-136.5'	10/17/2017	10/18/2017	F-40	15.8	548.8	473.2	**16.5**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
7995-85	G037 S-27	145'-146.5	10/17/2017	10/18/2017	F-41	15.8	384.3	331.4	**16.8**
7995-86	G037 S-29	155'-156.5'	10/17/2017	10/18/2017	F-42	15.8	382.9	317.0	**21.9**
7995-87	G037 S-31	170'-171.5'	10/17/2017	10/18/2017	F-43	15.8	426.1	361.2	**18.8**
7995-88	G037 S-33	180'-181.5'	10/17/2017	10/18/2017	F-44	15.8	539.7	451.5	**20.2**
7995-89	G037 S-35	190'-191.5'	10/17/2017	10/18/2017	F-45	15.8	458.8	402.1	**14.7**
7995-90	G037 S-37	200'-201.5'	10/17/2017	10/18/2017	F-46	15.8	362.3	285.6	**28.4**
7995-91	G037 S-39	220'-221.5'	10/17/2017	10/18/2017	F-47	15.8	455.2	414.3	**10.3**
7995-92	G037 S-42	240'-241.5'	10/17/2017	10/18/2017	F-48	15.8	543.1	467.8	**16.7**
8023-22	G037A S3	12.5	2/19/2018	2/21/2018	22	15.9	455.2	428.2	**6.6**
8023-23	G037A S4	15	2/19/2018	2/21/2018	23	16.3	272.1	240.6	**14.0**
8023-24	G037A S7	30	2/19/2018	2/21/2018	24	15.9	261.6	246.1	**6.7**
8023-25	G037A S8	35	2/19/2018	2/21/2018	25	16.0	435.4	382.8	**14.3**
8023-26	G037A S10	45	2/19/2018	2/21/2018	26	15.7	442.0	407.6	**8.8**
8023-27	G037A S11	50	2/19/2018	2/21/2018	27	16.0	186.6	168.8	**11.6**
8023-28	G037A S13	60	2/19/2018	2/21/2018	28	15.9	101.3	98.2	**3.7**
8023-29	G037A S14	65	2/19/2018	2/21/2018	29	16.0	549.3	487.1	**13.2**
8023-30	G037A S16	75	2/19/2018	2/21/2018	30	15.8	399.0	316.2	**27.5**
8023-31	G037A S18	85	2/19/2018	2/21/2018	31	16.1	285.5	239.6	**20.6**
8023-32	G037A S22	100	2/19/2018	2/21/2018	32	15.9	109.4	90.1	**26.0**
8023-33	G037A S24	108-109.5	2/19/2018	2/21/2018	33	15.9	93.3	79.8	**21.0**
8023-34	G038 S2	7.5	2/19/2018	2/21/2018	34	16.1	111.4	92.1	**25.3**
8023-35	G038 S4	12.5	2/19/2018	2/21/2018	35	15.81	74.18	54.76	**49.9**
8023-36	G038 S5	15	2/19/2018	2/21/2018	36	15.84	126.76	86.06	**58.0**
8023-37	G038 S6	20	2/19/2018	2/21/2018	37	15.89	383.6	326.14	**18.5**
8023-38	G038 S8	30	2/19/2018	2/21/2018	38	15.85	365.97	335.92	**9.4**
8023-39	G038 S11	45	2/19/2018	2/21/2018	39	15.79	449.28	406.57	**10.9**
8023-40	G038 S13	55	2/19/2018	2/21/2018	40	16.17	359.76	318.26	**13.7**
8023-41	G038 S15	65	2/19/2018	2/21/2018	41	15.86	478.03	433.78	**10.6**
8023-42	G038 S19	85	2/19/2018	2/21/2018	42	15.98	293.84	239.88	**24.1**
8023-43	G038 S21	95	2/19/2018	2/21/2018	43	16.04	213.35	176.8	**22.7**
8023-44	G038 S22	100	2/19/2018	2/21/2018	44	15.96	117.47	92.55	**32.5**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
7995-93	G044 S-3	2.5'-4.5'	10/17/2017	10/18/2017	F-49	15.8	72.4	60.6	**26.3**
7995-94	G044 S-5	6.0'-7.5'	10/17/2017	10/18/2017	F-50	15.8	335.2	309.3	**8.8**
7995-95	G044 S-6	7.5'-7.7'	10/17/2017	10/18/2017	F-51	15.8	375.3	322.6	**17.2**
7995-96	G044 S-7	9.0'-10.5'	10/17/2017	10/18/2017	F-52	15.8	325.9	273.8	**20.2**
7995-97	G044 S-9	15'-16.5'	10/17/2017	10/18/2017	F-53	15.8	367.5	328.0	**12.7**
7995-98	G044 S-11	25'-26.5'	10/17/2017	10/18/2017	F-54	15.8	485.5	422.8	**15.4**
7995-99	G044 S-12	30'-31.5'	10/17/2017	10/18/2017	F-55	15.8	585.2	501.9	**17.1**
7995-100	G044 S-13	35.0'-36.5'	10/17/2017	10/18/2017	F-56	15.8	532.3	457.0	**17.1**
7995-101	G044 S-15	45'-46.5'	10/17/2017	10/18/2017	F-57	15.8	463.8	399.9	**16.6**
7995-102	G044 S-17	55'-56.5'	10/17/2017	10/18/2017	F-58	15.8	416.4	334.1	**25.9**
7995-103	G044 S-18	60'-61.5'	10/17/2017	10/18/2017	F-59	15.8	459.1	360.4	**28.6**
7995-104	G044 S-22	80'-81.5'	10/17/2017	10/18/2017	F-60	15.8	496.5	382.6	**31.1**
7995-105	G044 S-23	85'-86.5'	10/17/2017	10/18/2017	F-61	15.8	506.8	394.2	**29.8**
7995-106	G044 S-25	95'-96.5'	10/17/2017	10/18/2017	F-62	15.8	487.8	389.3	**26.4**
7995-107	G044 S-27	110'-111.5'	10/17/2017	10/18/2017	F-63	15.8	468.6	364.8	**29.7**
7995-108	G044 S-28A	115'-116.5'	10/17/2017	10/18/2017	F-64	15.8	301.6	236.8	**29.3**
7995-109	G044 S-29	120'-121.5'	10/17/2017	10/18/2017	F-65	15.8	552.8	409.9	**36.3**
7995-110	G044 S-31	130'-131.5'	10/17/2017	10/18/2017	F-66	15.8	433.4	330.2	**32.8**
7995-111	G044 S-32	135'-136.5'	10/17/2017	10/18/2017	F-67	15.8	459.5	368.3	**25.9**
7995-112	G044 S-33	140'-141.5'	10/17/2017	10/18/2017	F-68	15.8	362.9	298.6	**22.7**
7995-113	G044 S-35	150'-151.5'	10/17/2017	10/18/2017	F-69	15.8	301.9	263.5	**15.5**
7995-114	G044 S-37	160'-161.5'	10/17/2017	10/18/2017	F-70	15.8	373.3	289.7	**30.5**
7995-115	G044 S-38	165'-166.5'	10/17/2017	10/18/2017	F-71	15.8	370.5	273.6	**37.6**

HMA Sample #	Sample #	Depth	Date Received	Date of Test	Tare #	Wt of Tare	Tare+ Wet	Tare+ Dry	Moisture %
7995-116	G045 S-1	2.5'-4'	10/17/2017	10/18/2017	F-72	15.8	183.3	113.7	**71.1**
7995-117	G045 S-2	5'-6.5'	10/17/2017	10/18/2017	A-1	16.9	409.0	359.2	**14.5**
7995-118	G045 S-4	10'-11.5'	10/17/2017	10/18/2017	B-22	16.8	268.6	243.8	**10.9**
7995-119	G045 S-6	15'-16.5'	10/17/2017	10/18/2017	A-24	17.6	402.4	367.2	**10.1**
7995-120	G045 S-10	35'-36.5'	10/17/2017	10/18/2017	B	15.9	350.4	270.2	**31.5**
7995-121	G045 S-11	40'-41.5'	10/17/2017	10/18/2017	B-15	16.0	407.5	318.5	**29.4**
7995-122	G045 S-12	45'-46.5'	10/17/2017	10/18/2017	A-32	16.5	368.1	287.6	**29.7**
7995-123	G045 S-14	55'-56.5'	10/17/2017	10/18/2017	F-73	15.9	296.8	240.9	**24.8**
7995-124	G045 S-15	60'-61.5'	10/17/2017	10/18/2017	A-20	16.7	353.4	287.9	**24.2**
7995-125	G045 S-18	77.5'-79'	10/17/2017	10/18/2017	A-33	16.0	274.8	216.7	**28.9**
7995-126	G045 S-18	77.5'-79'	10/17/2017	10/18/2017	A-25	16.3	237.1	187.4	**29.0**
7995-127	G045 S-20E	85'-86.5'	10/17/2017	10/18/2017	ZZ	16.4	303.6	237.1	**30.1**
7995-128	G045 S-21	95'-96.5'	10/17/2017	10/18/2017	A-27	16.4	458.7	354.2	**30.9**
7995-129	G045 S-22	100'-101.5'	10/17/2017	10/18/2017	B-28	16.5	319.3	255.7	**26.6**
7995-130	G045 S-23	105'-106.5'	10/17/2017	10/18/2017	A-31	16.1	425.2	319.6	**34.8**
7995-131	G045 S-25	120'-121.5'	10/17/2017	10/18/2017	A-3	16.5	205.7	164.1	**28.2**
7995-132	G045 S-28	135'-136.5'	10/17/2017	10/18/2017	B-27	16.1	444.9	336.2	**34.0**
7995-133	G045 S-30	145'-146.5'	10/17/2017	10/18/2017	A-26	16.9	430.5	364.5	**19.0**
7995-134	G045 S-31	150'-151.5'	10/17/2017	10/18/2017	A-19	16.2	407.5	303.1	**36.4**
7995-135	G045 S-37	180'-181.5'	10/17/2017	10/18/2017	A-13	16.2	300.7	240.8	**26.7**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	1	17	44	38	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	100		
3/8"	100		
#4	100		
#10	99		
#40	82		
#100	58		
#200	38		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6755 D_{85}= 0.4928 D_{60}= 0.1635
D_{50}= 0.1140 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G17 / S3
Sample Number: 054-107 **Depth:** 10' **Date:** 12/28/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/28/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17 / S3
Depth: 10'
Sample Number: 054-107
Material Description: Silty SAND
Date: 12/28/2017
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 182.77
Tare Wt. = 15.80
Minus #200 from wash = 22.0%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
229.84	15.80	0.00	1"	0.00	100
			3/4"	0.00	100
			3/8"	0.00	100
			#4	0.00	100
			#10	1.20	99
			#40	37.90	82
			#100	90.60	58
			#200	132.90	38

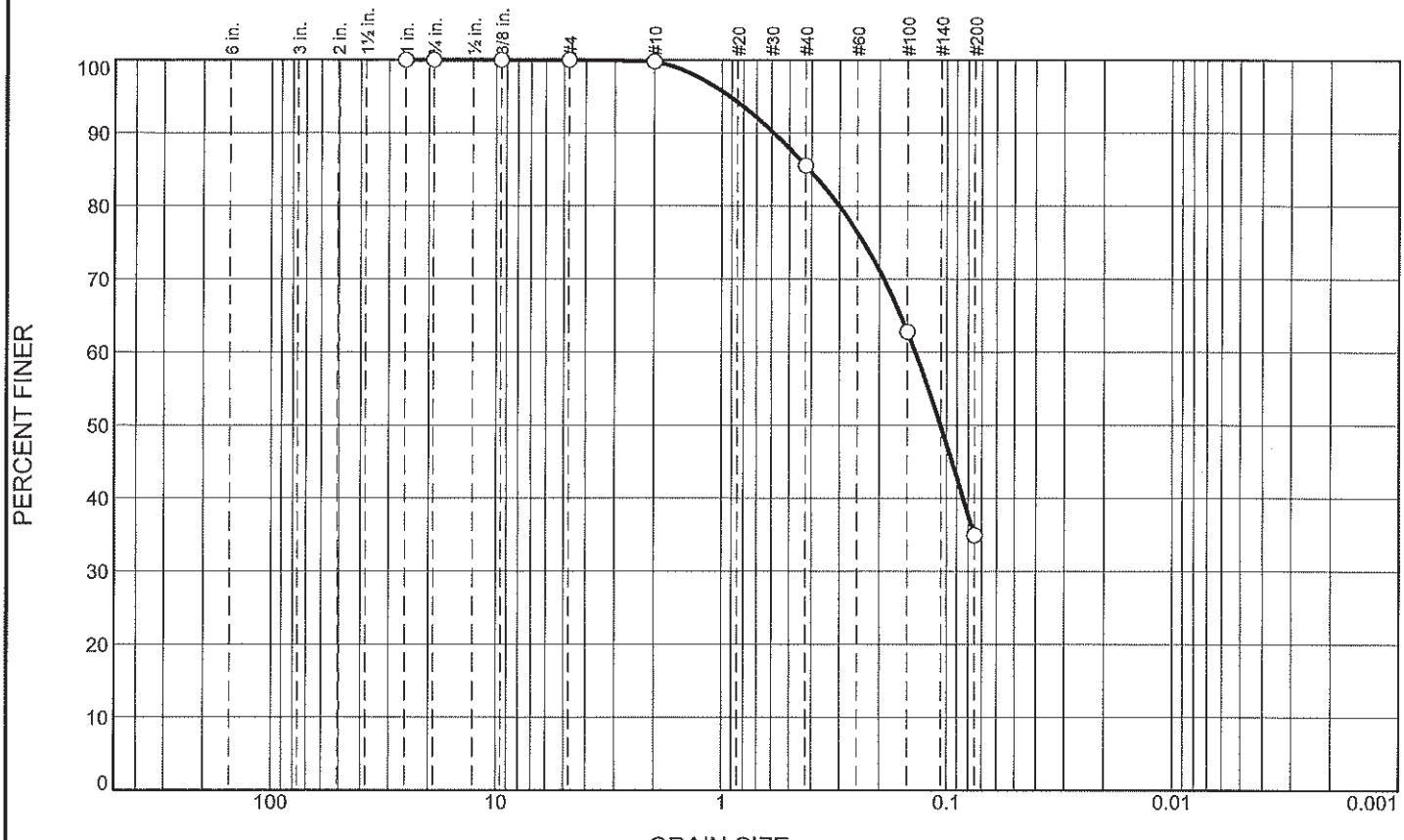
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	1	17	44	62			38

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.1140	0.1635	0.3782	0.4928	0.6755	1.0212

Fineness Modulus
0.83

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	14	51	35	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	100		
3/8"	100		
#4	100		
#10	100		
#40	86		
#100	63		
#200	35		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5892 D_{85}= 0.4101 D_{60}= 0.1384
D_{50}= 0.1067 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G17 / S4
Sample Number: 054-108 **Depth:** 12.5' **Date:** 12/27/207

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/28/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17 / S4
Depth: 12.5'
Sample Number: 054-108
Material Description: Silty SAND
Date: 12/27/207
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 129.92
Tare Wt. = 16.10
Minus #200 from wash = 20.8%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
159.82	16.10	0.00	1"	0.00	100
			3/4"	0.00	100
			3/8"	0.00	100
			#4	0.00	100
			#10	0.30	100
			#40	20.80	86
			#100	53.50	63
			#200	93.50	35

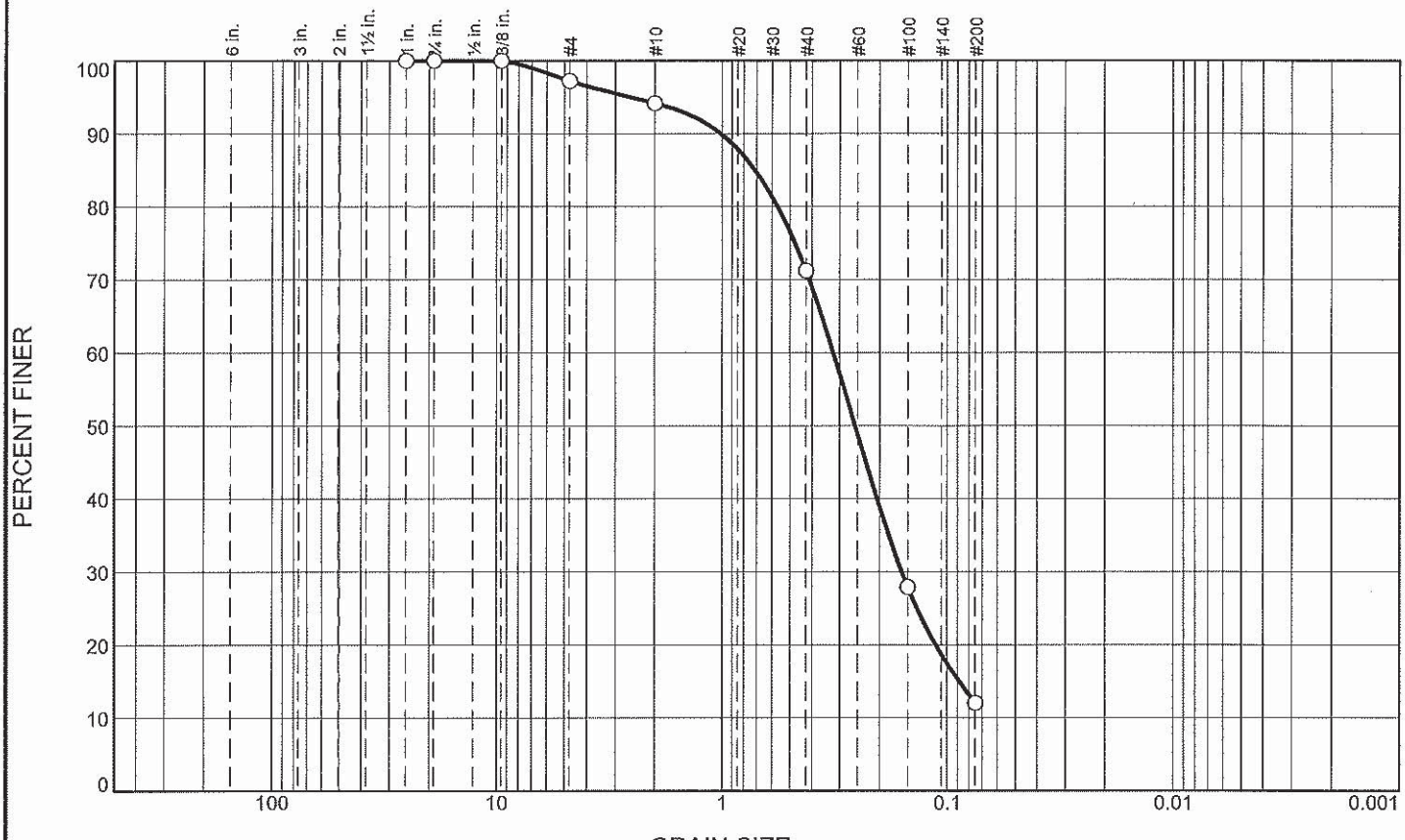
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	0	14	51	65			35

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.1067	0.1384	0.3015	0.4101	0.5892	0.9244

Fineness Modulus
0.70

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	3	3	23	59	12	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	100		
3/8"	100		
#4	97		
#10	94		
#40	71		
#100	28		
#200	12		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.0179 D_{85}= 0.7158 D_{60}= 0.3214
D_{50}= 0.2570 D_{30}= 0.1595 D_{15}= 0.0884
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G17A / S3
Sample Number: 054-113 **Depth:** 7.5' **Date:** 12/27/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD

GRAIN SIZE DISTRIBUTION TEST DATA

12/28/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S3
Depth: 7.5'
Sample Number: 054-113
Material Description: Silty SAND
Date: 12/27/2017
USCS Classification: SM
Tested by: GD

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 179.25
Tare Wt. = 16.00
Minus #200 from wash = 8.9%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
195.15	16.00	0.00	1"	0.00	100
			3/4"	0.00	100
			3/8"	0.00	100
			#4	5.00	97
			#10	10.50	94
			#40	51.60	71
			#100	129.20	28
			#200	157.60	12

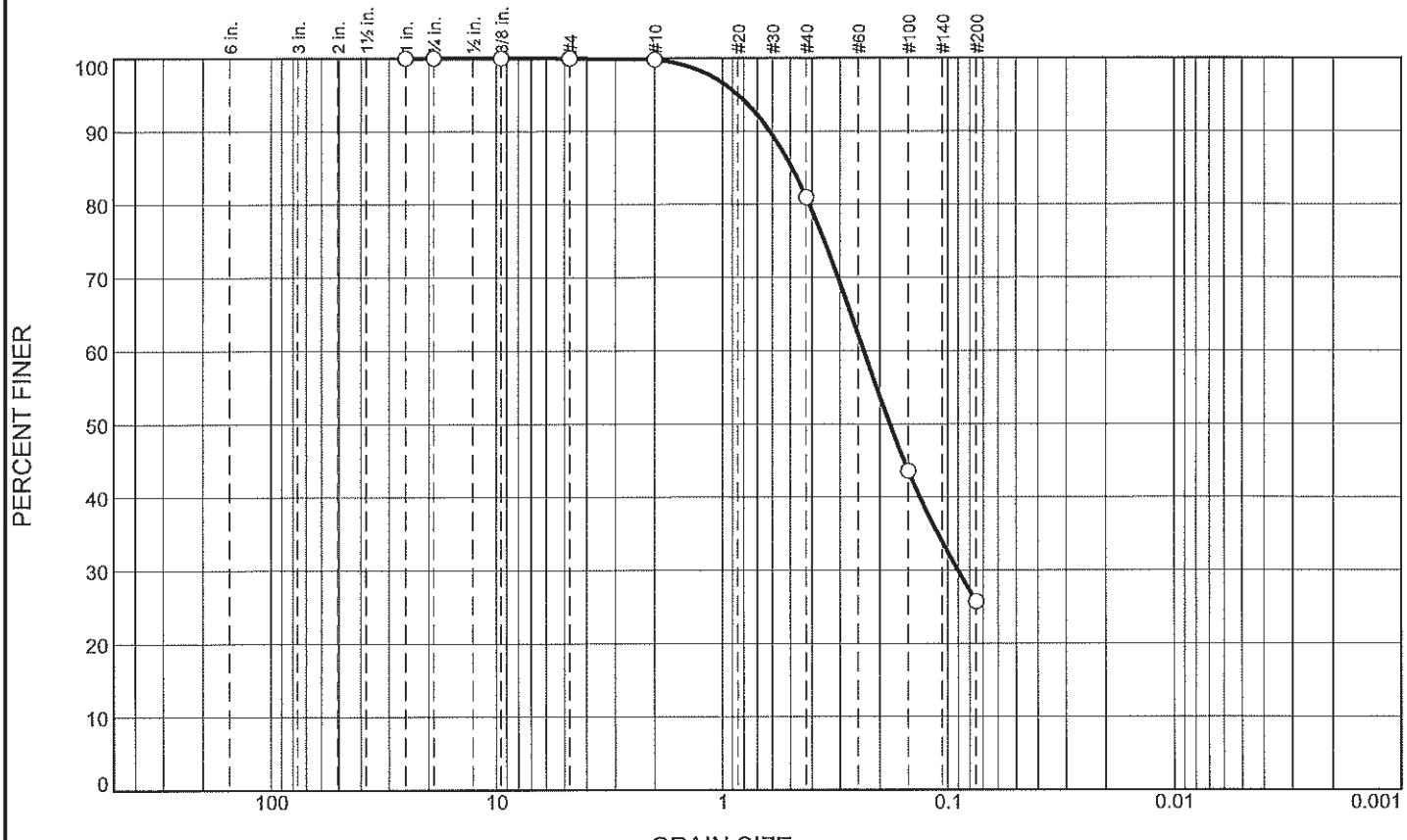
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	3	3	3	23	59	85			12

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0884	0.1128	0.1595	0.2570	0.3214	0.5686	0.7158	1.0179	2.5747

Fineness Modulus
1.51

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	19	55	26	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	100		
3/8"	100		
#4	100		
#10	100		
#40	81		
#100	44		
#200	26		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6178 D_{85}= 0.4927 D_{60}= 0.2363
D_{50}= 0.1811 D_{30}= 0.0904 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G17A / S5
Sample Number: 054-115 **Depth:** 12.5' **Date:** 12/28/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/28/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S5
Depth: 12.5'
Sample Number: 054-115
Material Description: Silty SAND
Date: 12/28/2017
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 238.68
Tare Wt. = 15.80
Minus #200 from wash = 16.3%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
281.95	15.80	0.00	1"	0.00	100
			3/4"	0.00	100
			3/8"	0.00	100
			#4	0.10	100
			#10	0.60	100
			#40	50.70	81
			#100	150.20	44
			#200	197.60	26

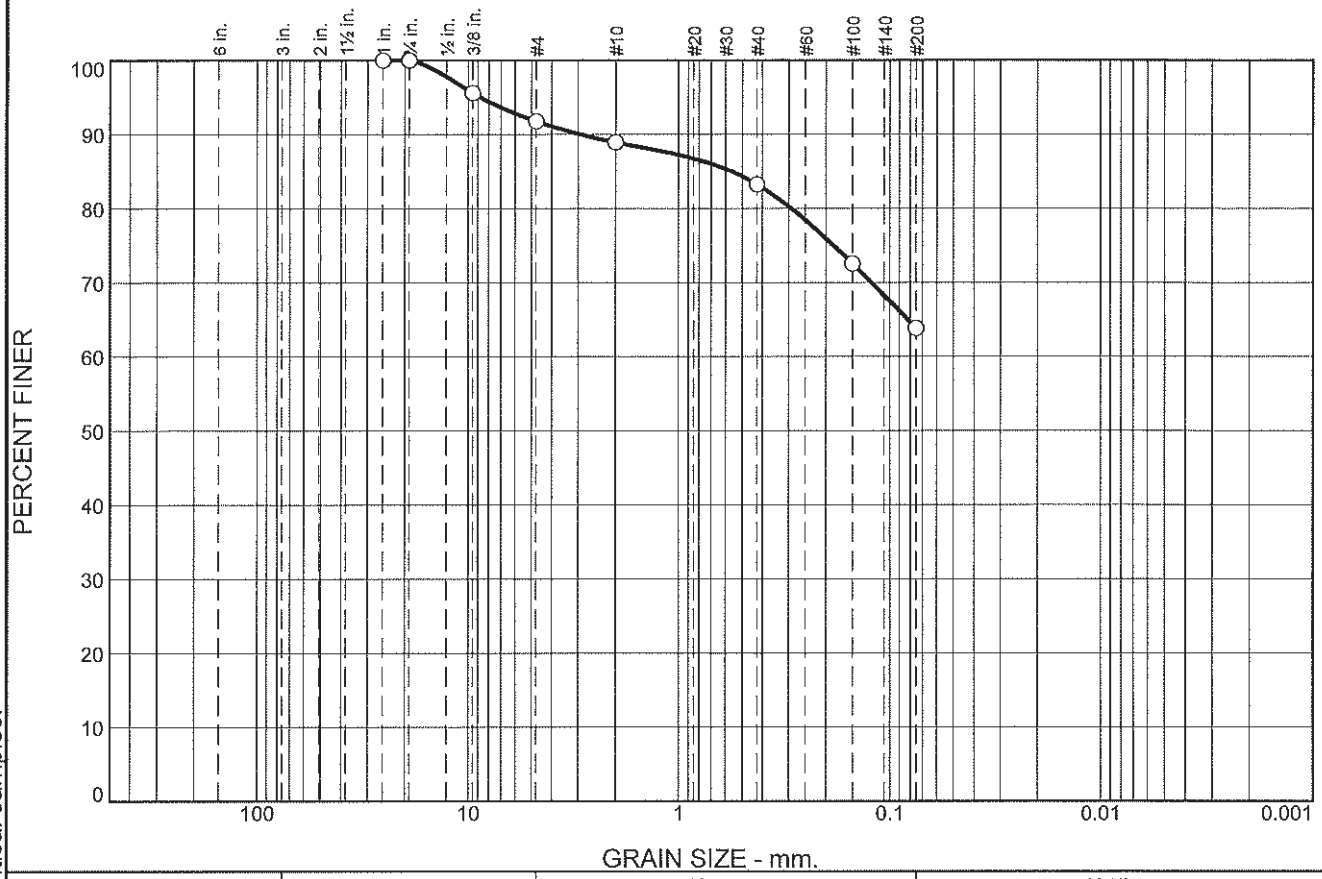
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	0	19	55	74			26

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0904	0.1811	0.2363	0.4118	0.4927	0.6178	0.8563

Fineness Modulus
1.00

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	8	3	6	19	64	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	100		
3/8"	96		
#4	92		
#10	89		
#40	83		
#100	73		
#200	64		

* (no specification provided)

Soil Description

Sandy SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.9401 D_{85}= 0.5642 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G17A/S-46
Sample Number: 054-103 **Depth:** 215' **Date:** 12/28/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A/S-46
Depth: 215'
Sample Number: 054-103
Material Description: Sandy SILT
Date: 12/28/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 153.25
Tare Wt. = 16.19
Minus #200 from wash = 63.0%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
386.51	16.19	0.00	1"	0.00	100
			3/4"	0.00	100
			3/8"	16.40	96
			#4	30.50	92
			#10	41.10	89
			#40	62.10	83
			#100	101.70	73
			#200	133.90	64

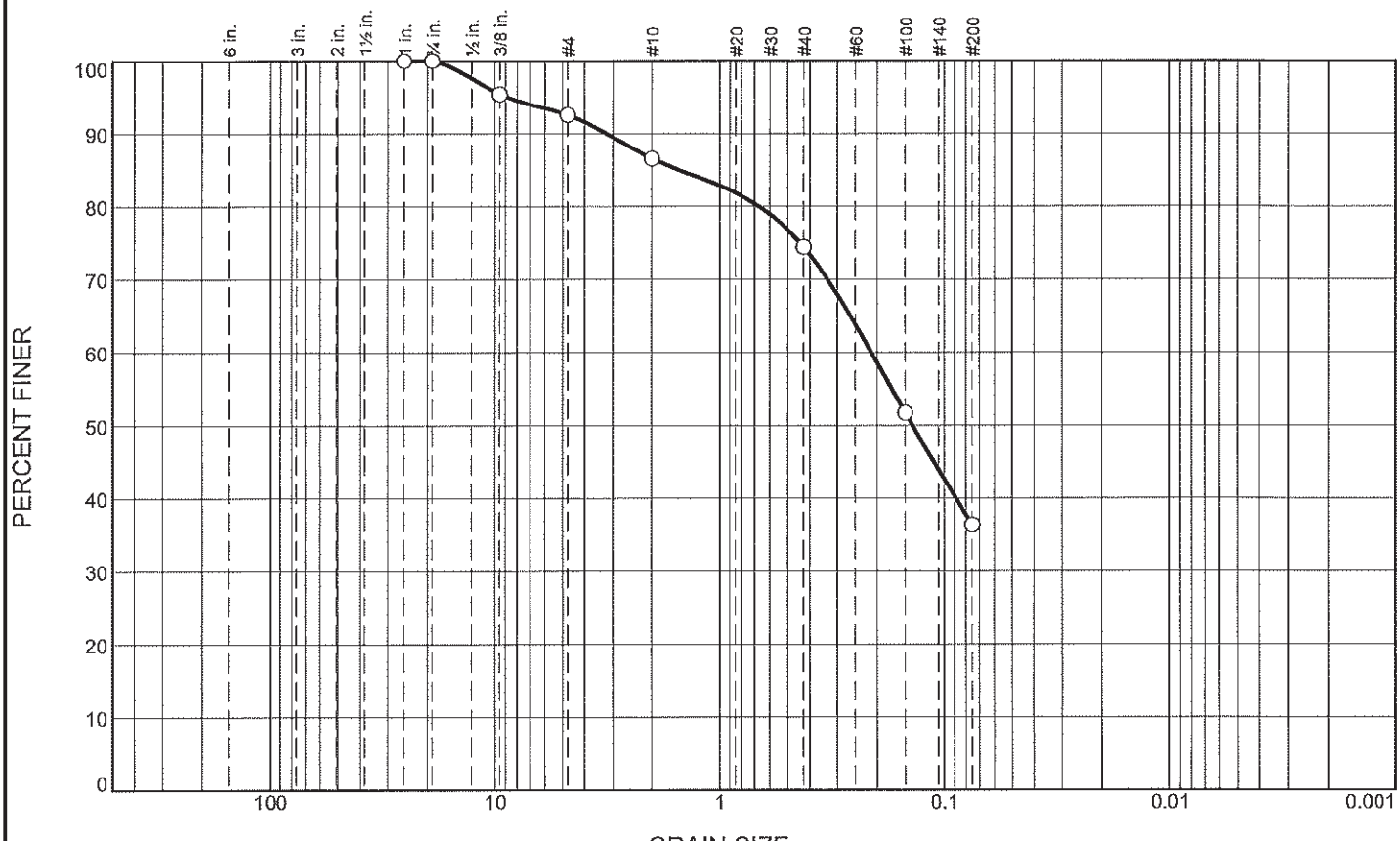
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	8	8	3	6	19	28			64

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
						0.2919	0.5642	2.9401	8.7840

Fineness Modulus
0.98

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	7	6	13	38	36	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	100		
3/8"	95		
#4	93		
#10	87		
#40	74		
#100	52		
#200	36		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 3.1971 D_{85}= 1.5146 D_{60}= 0.2126
D_{50}= 0.1393 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G17A / S43
Sample Number: 054-142 **Depth:** 230' **Date:** 12/27/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/28/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S43
Depth: 230'
Sample Number: 054-142
Material Description: Silty SAND
Date: 12/27/2017
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 347.08
Tare Wt. = 192.90
Minus #200 from wash = 27.6%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
406.00	192.90	0.00	1"	0.00	100
			3/4"	0.00	100
			3/8"	9.80	95
			#4	15.90	93
			#10	28.60	87
			#40	54.50	74
			#100	102.90	52
			#200	135.60	36

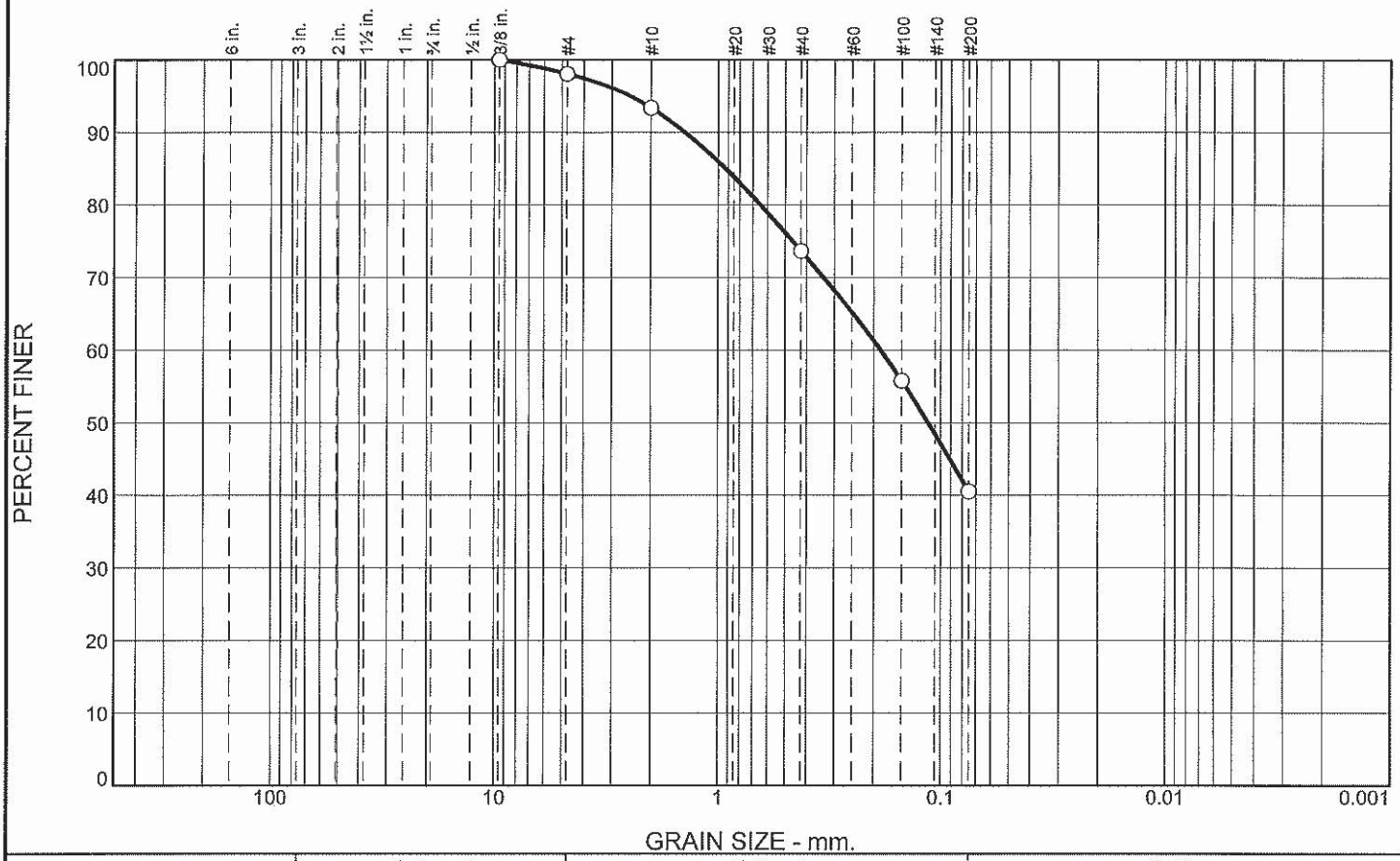
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	7	7	6	13	38	57			36

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.1393	0.2126	0.6709	1.5146	3.1971	8.8851

Fineness Modulus
1.42

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.9	4.7	19.7	33.2	40.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100.0		
#4	98.1		
#10	93.4		
#40	73.7		
#100	55.8		
#200	40.5		

* (no specification provided)

Soil Description

Silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.4071 D_{85}= 0.9294 D_{60}= 0.1865
D_{50}= 0.1140 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G018 S-4
Sample Number: 8003-20 **Depth:** 9'-10.5' **Date:** 11/10/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-4
Depth: 9'-10.5'
Sample Number: 8003-20
Material Description: Silty Sand
Date: 11/10/2017
USCS Classification: SM
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 128.30
Tare Wt. = 15.90
Minus #200 from wash = 30.3%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
177.20	15.90	3/8"	0.00	0.00	100.0
		#4	3.10	0.00	98.1
		#10	7.60	0.00	93.4
		#40	31.80	0.00	73.7
		#100	28.80	0.00	55.8
		#200	24.60	0.00	40.5

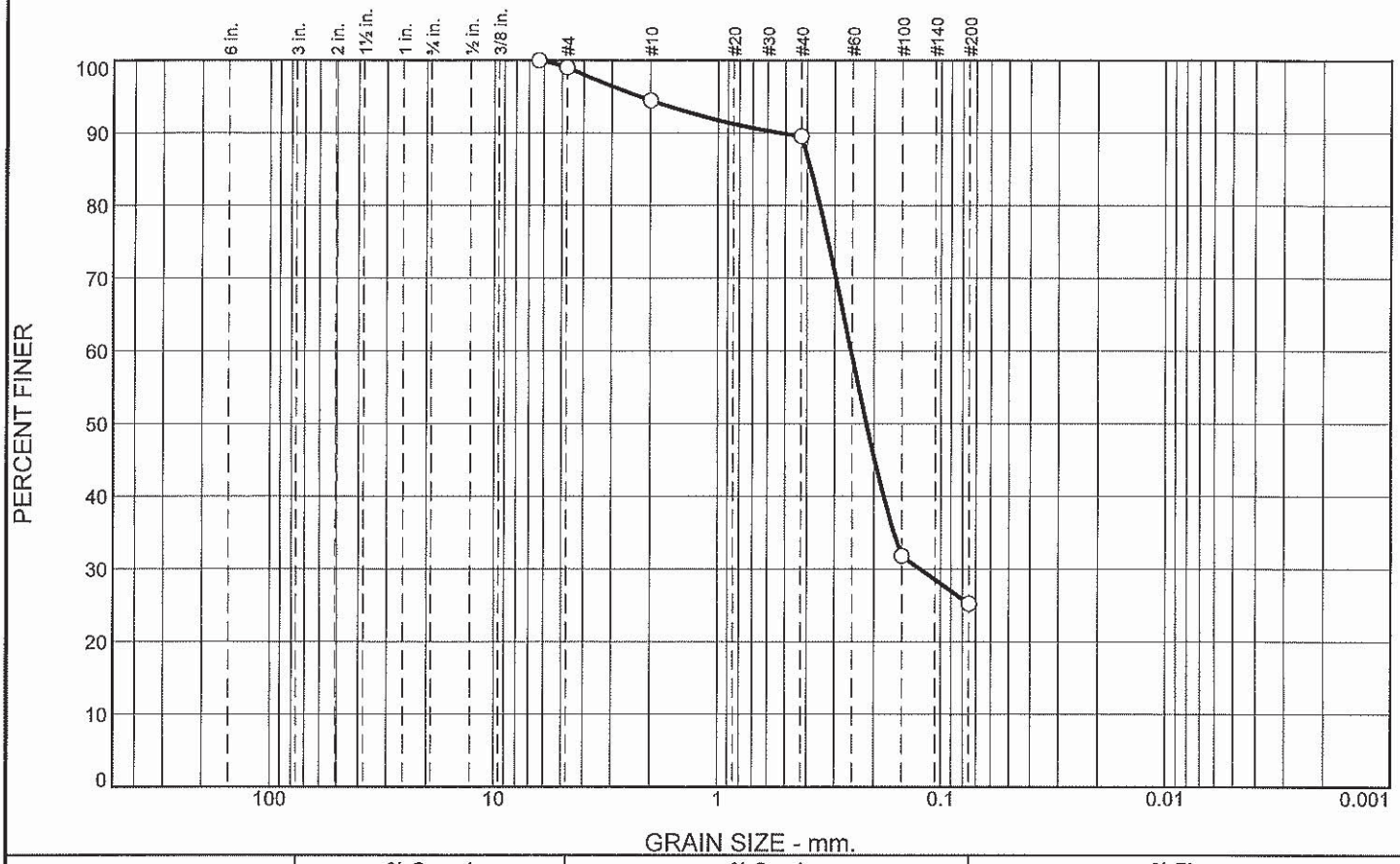
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	1.9	1.9	4.7	19.7	33.2	57.6			40.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.1140	0.1865	0.6485	0.9294	1.4071	2.4963

Fineness Modulus
1.16

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.0	4.6	4.9	64.3	25.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	99.0		
#10	94.4		
#40	89.5		
#100	31.8		
#200	25.2		

* (no specification provided)

Soil Description

Silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5351 D_{85}= 0.3852 D_{60}= 0.2538
D_{50}= 0.2164 D_{30}= 0.1240 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G018 S-6
Sample Number: 8003-22 **Depth:** 12'-13.5' **Date:** 11/10/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-6
Depth: 12'-13.5'
Sample Number: 8003-22
Material Description: Silty Sand
Date: 11/10/2017
USCS Classification: SM
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 205.90
Tare Wt. = 15.80
Minus #200 from wash = 4.8%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
215.50	15.80	1/4"	0.00	0.00	100.0
		#4	2.00	0.00	99.0
		#10	9.10	0.00	94.4
		#40	9.80	0.00	89.5
		#100	115.30	0.00	31.8
		#200	13.10	0.00	25.2

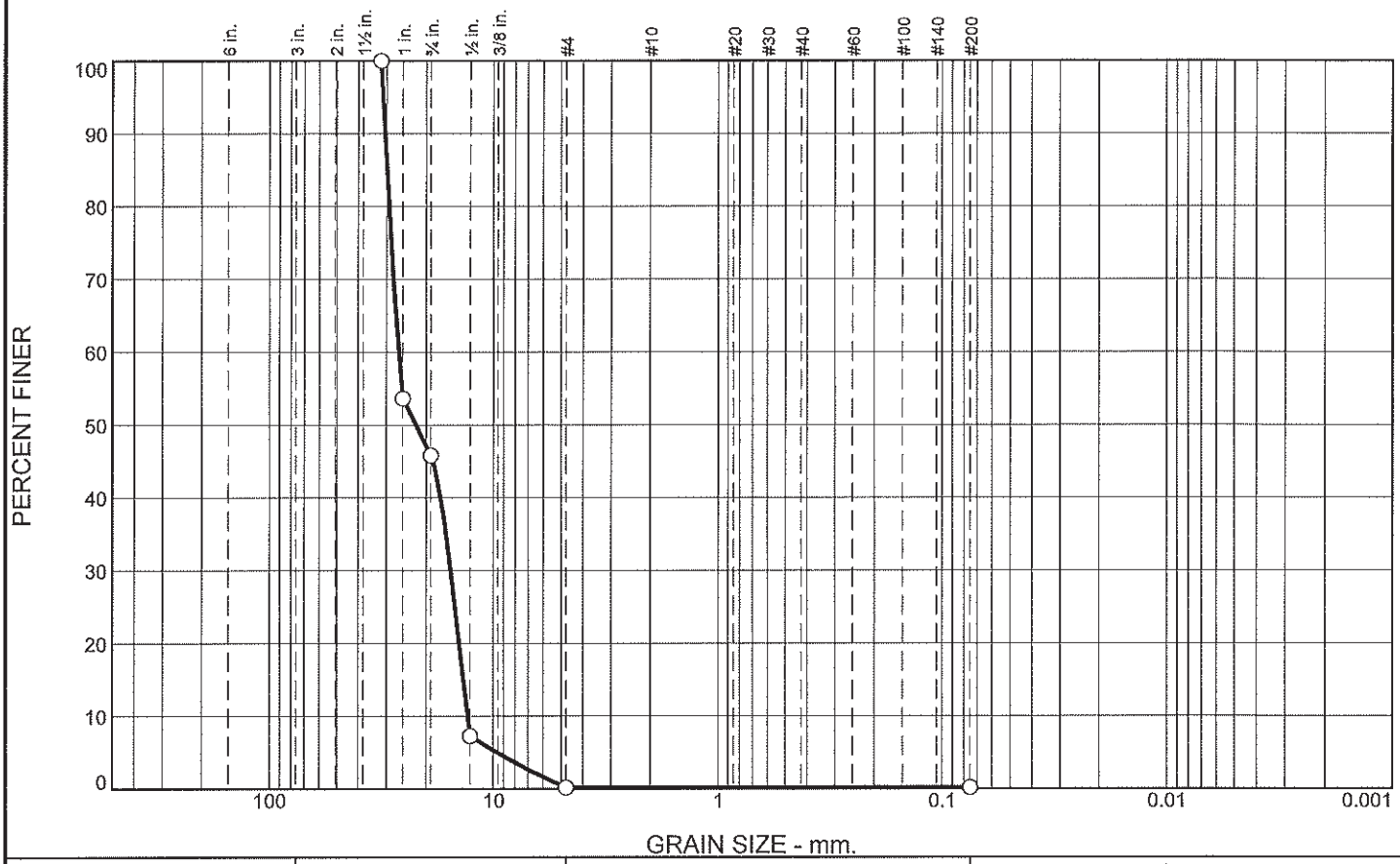
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	1.0	1.0	4.6	4.9	64.3	73.8			25.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.1240	0.2164	0.2538	0.3507	0.3852	0.5351	2.2569

Fineness Modulus
1.21

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	54.2	45.6	0.0	0.0	0.2		

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/4"	100.0		
1"	53.6		
3/4"	45.8		
1/2"	7.3		
#4	0.2		
#200	0.2		

* (no specification provided)

Soil Description

Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 30.5164 D_{85}= 29.9045 D_{60}= 26.5663
D_{50}= 22.2242 D_{30}= 15.5430 D_{15}= 13.6481
D_{10}= 13.0414 C_u= 2.04 C_c= 0.70

Classification

USCS= GP AASHTO=

Remarks

Location: G018 S-7
Sample Number: 8003-23 **Depth:** 21'-22.5' **Date:** 11/10/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-7
Depth: 21'-22.5'
Sample Number: 8003-23
Material Description: Gravel
Date: 11/10/2017
USCS Classification: GP
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 122.50
Tare Wt. = 15.70
Minus #200 from wash = 0.2%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
122.70	15.70	1 1/4"	0.00	0.00	100.0
		1"	49.60	0.00	53.6
		3/4"	8.40	0.00	45.8
		1/2"	41.20	0.00	7.3
		#4	7.60	0.00	0.2

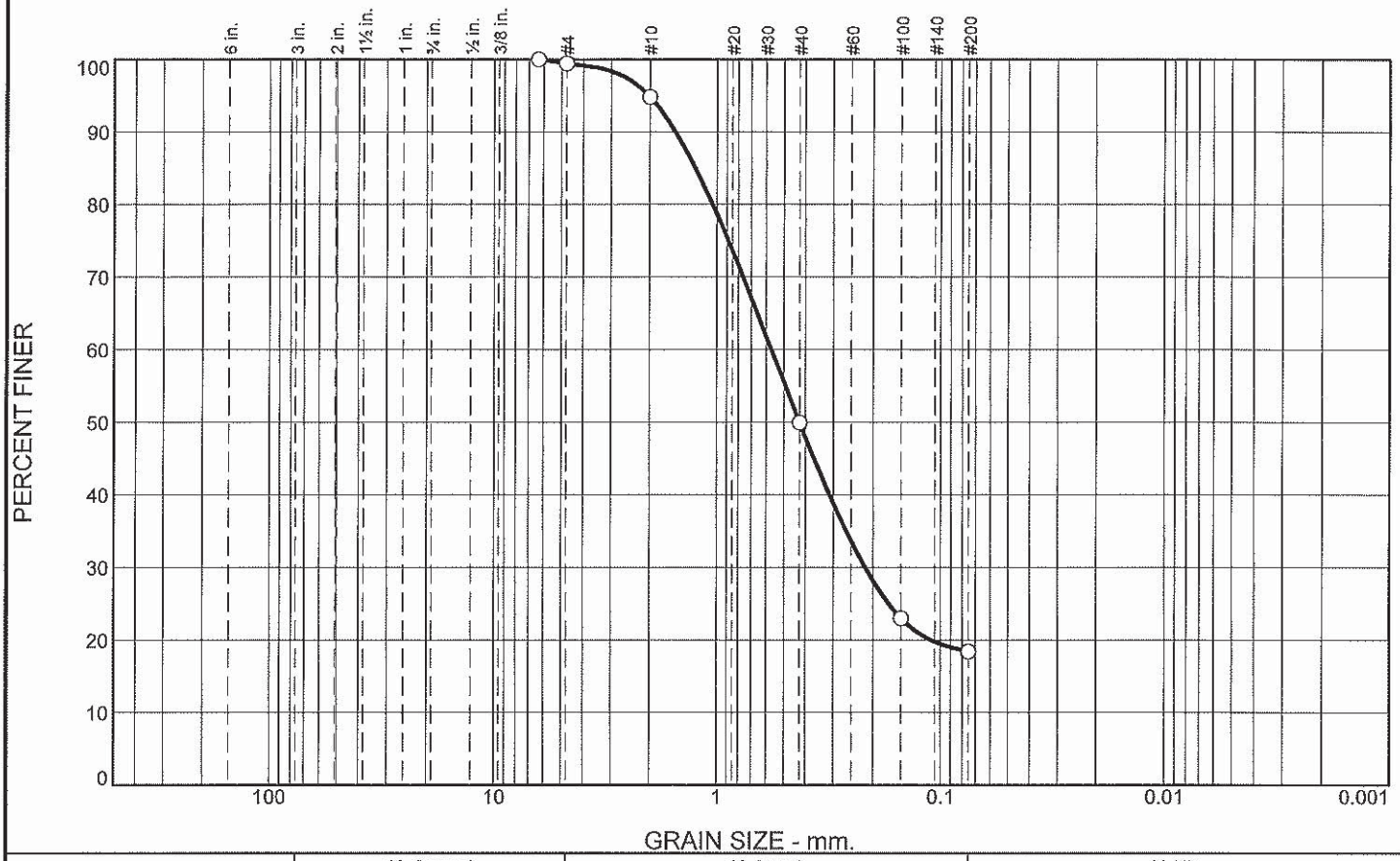
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	54.2	45.6	99.8	0.0	0.0		0.0			0.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
13.0414	13.6481	14.2513	15.5430	22.2242	26.5663	29.2879	29.9045	30.5164	31.1298

Fineness Modulus	C_u	C_c
7.48	2.04	0.70

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.6	4.6	44.9	31.5	18.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	99.4		
#10	94.8		
#40	49.9		
#100	23.0		
#200	18.4		

* (no specification provided)

Soil Description

Silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.5347 D_{85}= 1.2486 D_{60}= 0.5698
D_{50}= 0.4259 D_{30}= 0.2168 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G018 S-31
Sample Number: 8003-38 **Depth:** 150'-151.5' **Date:** 11/10/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-31
Depth: 150'-151.5'
Sample Number: 8003-38
Material Description: Silty Sand
Date: 11/10/2017
USCS Classification: SM
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 549.40
Tare Wt. = 196.20
Minus #200 from wash = 16.5%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
619.20	196.20	1/4"	0.00	0.00	100.0
		#4	2.40	0.00	99.4
		#10	19.60	0.00	94.8
		#40	189.80	0.00	49.9
		#100	114.00	0.00	23.0
		#200	19.30	0.00	18.4

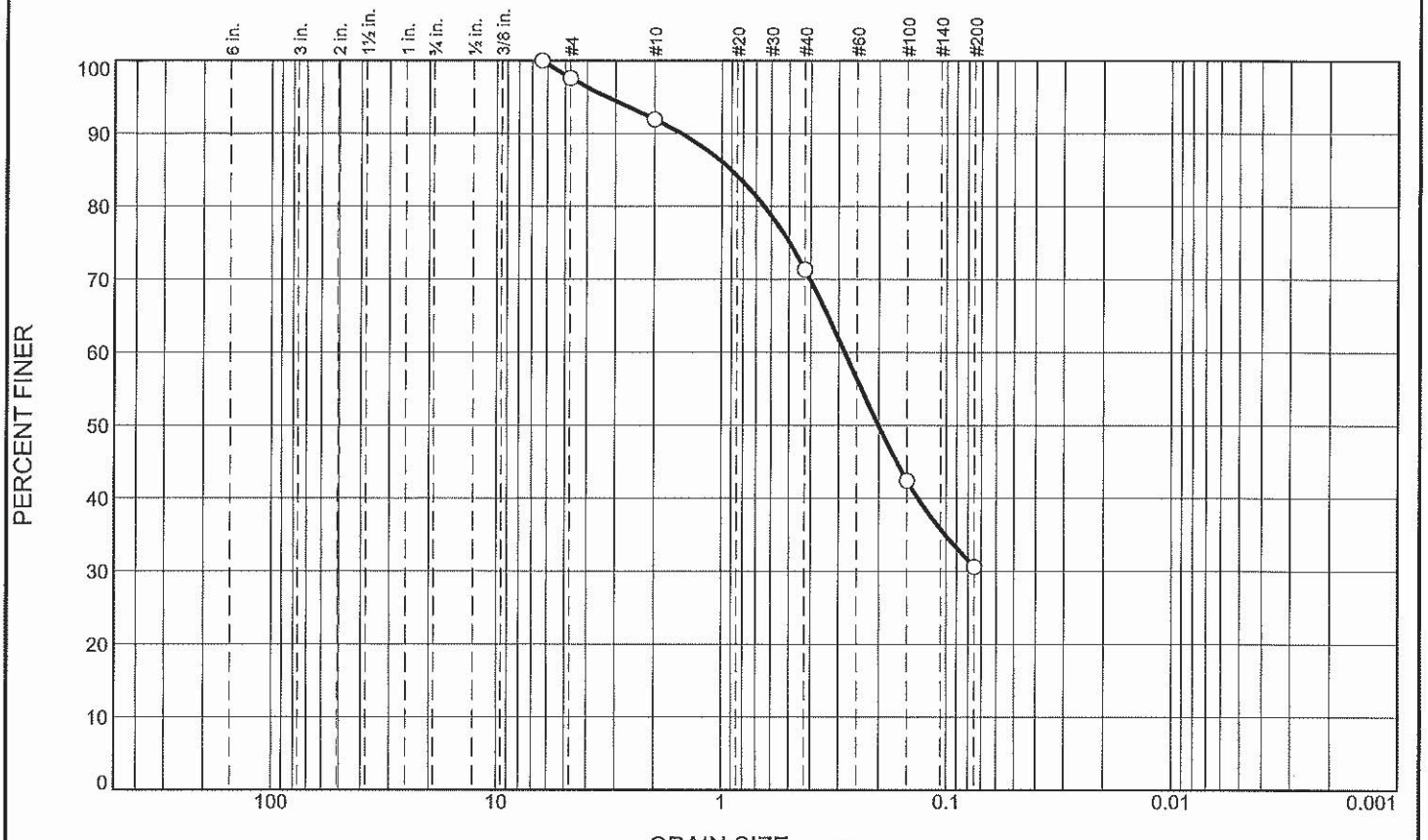
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.6	0.6	4.6	44.9	31.5	81.0			18.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.1104	0.2168	0.4259	0.5698	1.0455	1.2486	1.5347	2.0291

Fineness Modulus
1.97

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.4	5.7	20.6	40.7	30.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	97.6		
#10	91.9		
#40	71.3		
#100	42.4		
#200	30.6		

* (no specification provided)

Soil Description

Silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.5214 D_{85}= 0.9088 D_{60}= 0.2829
D_{50}= 0.2013 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G018 S-39
Sample Number: 8003-44 **Depth:** 200'-201.5' **Date:** 11/10/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-39
Depth: 200'-201.5'
Sample Number: 8003-44
Material Description: Silty Sand
Date: 11/10/2017
USCS Classification: SM
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 147.50
Tare Wt. = 16.40
Minus #200 from wash = 24.9%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
190.90	16.40	1/4"	0.00	0.00	100.0
		#4	4.20	0.00	97.6
		#10	9.90	0.00	91.9
		#40	35.90	0.00	71.3
		#100	50.50	0.00	42.4
		#200	20.60	0.00	30.6

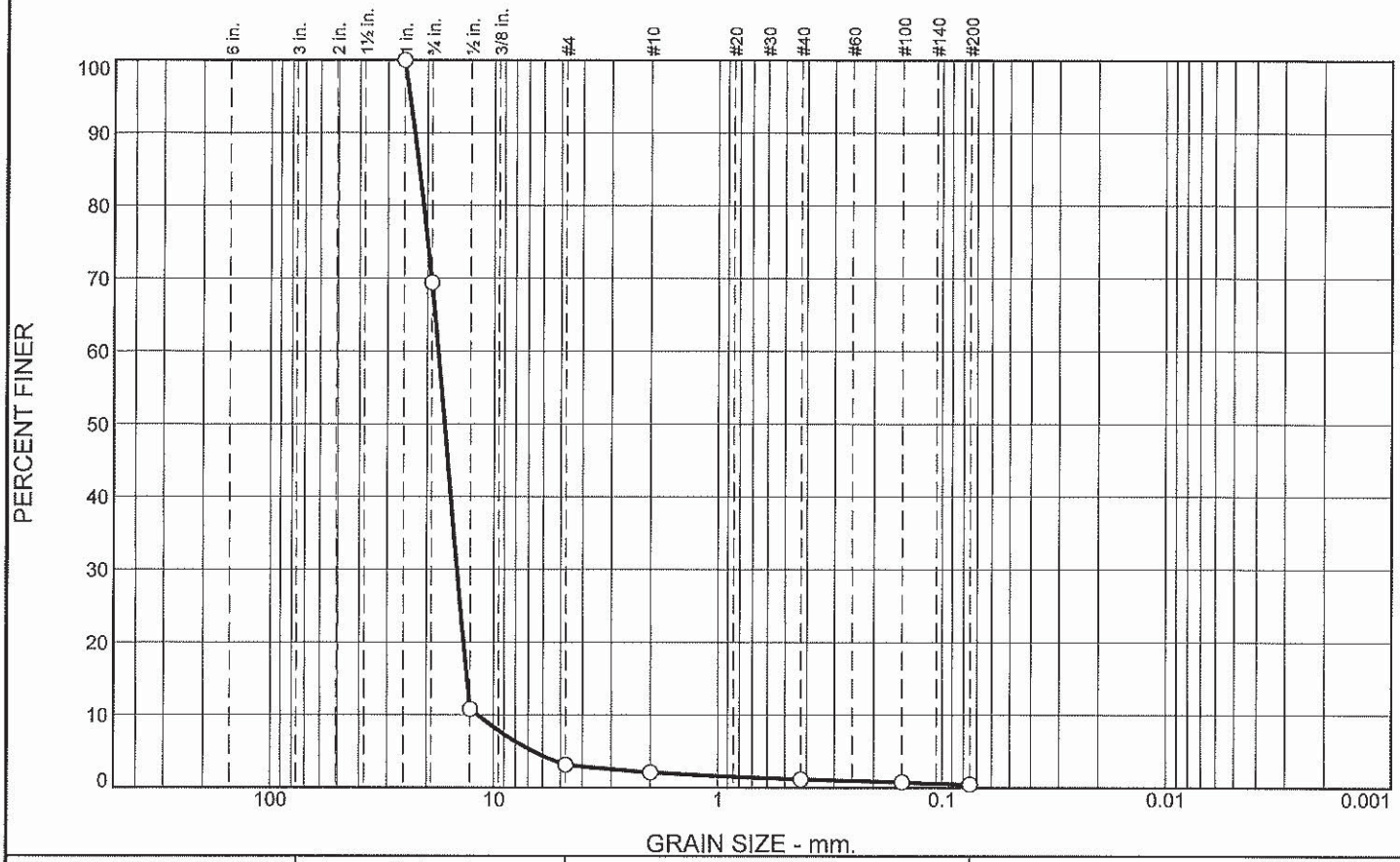
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	2.4	2.4	5.7	20.6	40.7	67.0			30.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.2013	0.2829	0.6446	0.9088	1.5214	3.2723

Fineness Modulus
1.39

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	30.6	66.2	1.1	1.0	0.6	0.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	69.4		
1/2"	10.8		
#4	3.2		
#10	2.1		
#40	1.1		
#100	0.8		
#200	0.5		

* (no specification provided)

Soil Description

Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 22.8625 D_{85}= 21.7621 D_{60}= 17.8159
D_{50}= 16.6786 D_{30}= 14.6532 D_{15}= 13.1543
D_{10}= 11.8065 C_u= 1.51 C_c= 1.02

Classification

USCS= GP AASHTO=

Remarks

Location: G019 S-7
Sample Number: 7992-5 **Depth:** 15'-16.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/11/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-7
Depth: 15'-16.5'
Sample Number: 7992-5
Material Description: Gravel
Date: 10/5/2017
USCS Classification: GP
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 119.40
Tare Wt. = 15.80
Minus #200 from wash = 1.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
120.40	15.80	1"	0.00	0.00	100.0
		3/4"	32.00	0.00	69.4
		1/2"	61.30	0.00	10.8
		#4	8.00	0.00	3.2
		#10	1.10	0.00	2.1
		#40	1.00	0.00	1.1
		#100	0.40	0.00	0.8
		#200	0.30	0.00	0.5

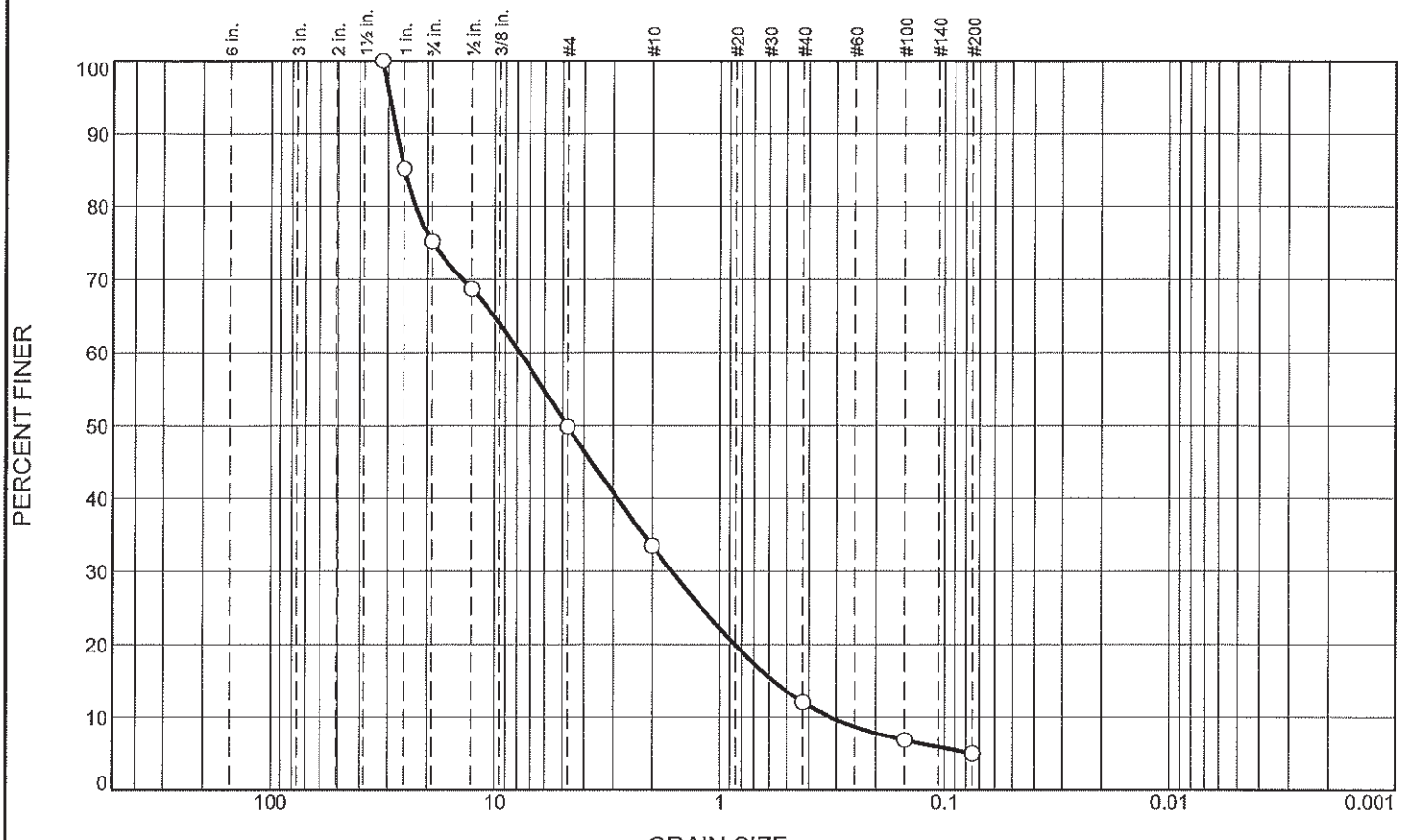
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	30.6	66.2	96.8	1.1	1.0	0.6	2.7			0.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
11.8065	13.1543	13.6668	14.6532	16.6786	17.8159	20.7803	21.7621	22.8625	24.0803

Fineness Modulus	C_u	C_c
7.12	1.51	1.02

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	24.8	25.4	16.3	21.5	7.0	5.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/4"	100.0		
1"	85.2		
3/4"	75.2		
1/2"	68.7		
#4	49.8		
#10	33.5		
#40	12.0		
#100	6.9		
#200	5.0		

* (no specification provided)

Soil Description

Gravel With Silt and Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 27.5310 D_{85}= 25.3095 D_{60}= 7.7882
D_{50}= 4.7863 D_{30}= 1.6354 D_{15}= 0.5761
D_{10}= 0.3193 C_u= 24.39 C_c= 1.08

Classification

USCS= GW-GM AASHTO=

Remarks

Location: G020 S-5
Sample Number: 7992-17 **Depth:** 10'-11.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/16/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-5
Depth: 10'-11.5'
Sample Number: 7992-17
Material Description: Gravel With Silt and Sand
Date: 10/5/2017
USCS Classification: GW-GM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 354.20
Tare Wt. = 15.90
Minus #200 from wash = 4.6%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
370.40	15.90	1 1/4"	0.00	0.00	100.0
		1"	52.50	0.00	85.2
		3/4"	35.50	0.00	75.2
		1/2"	23.10	0.00	68.7
		#4	66.70	0.00	49.8
		#10	58.00	0.00	33.5
		#40	76.00	0.00	12.0
		#100	18.30	0.00	6.9
		#200	6.60	0.00	5.0

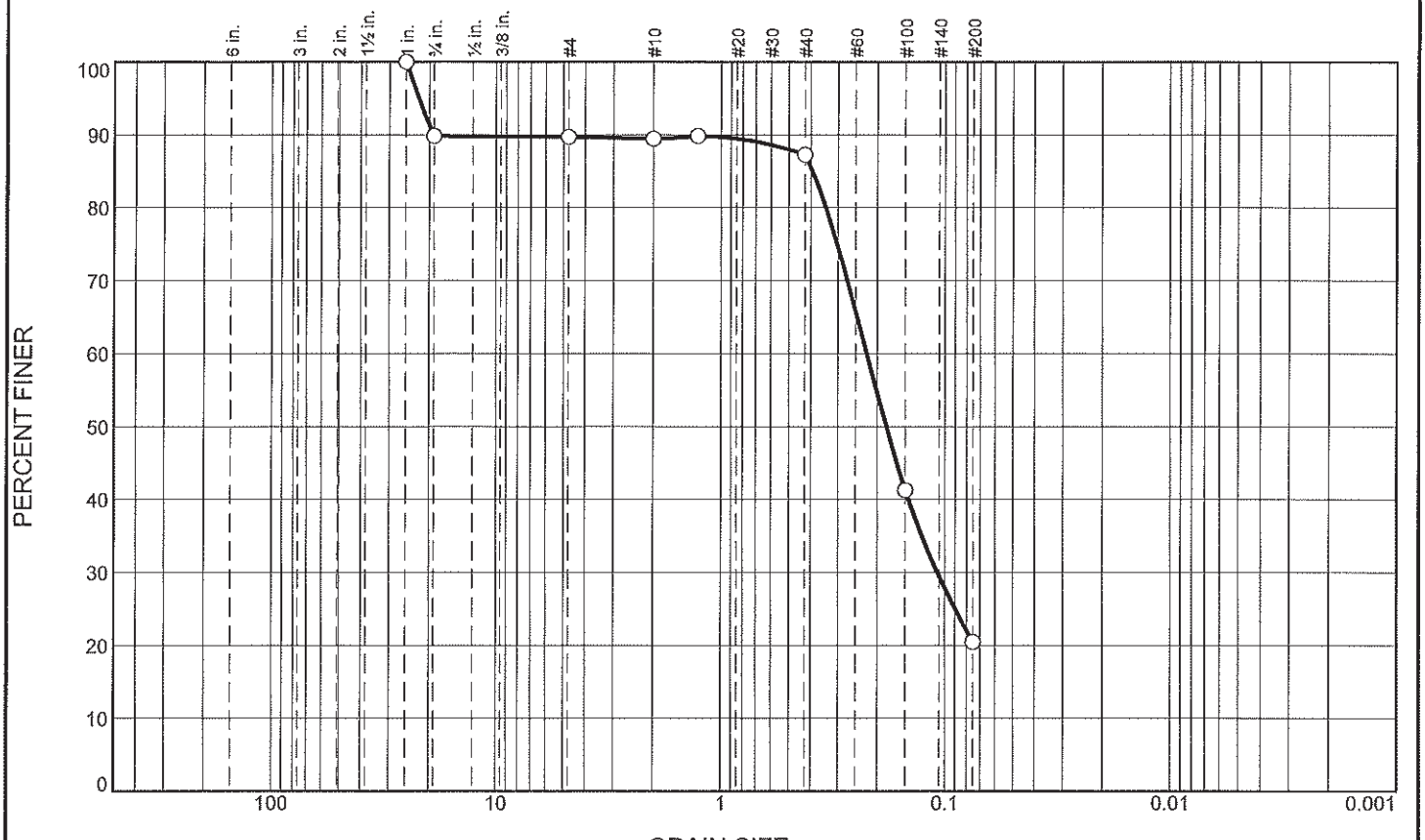
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	24.8	25.4	50.2	16.3	21.5	7.0	44.8			5.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.3193	0.5761	0.8600	1.6354	4.7863	7.7882	22.6107	25.3095	27.5310	29.6234

Fineness Modulus	C_u	C_c
5.18	24.39	1.08

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.2	0.1	0.3	2.1	66.8	20.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	89.8		
#4	89.7		
#10	89.4		
.1/2"	89.8		
#40	87.3		
#100	41.3		
#200	20.5		

* (no specification provided)

Soil Description

Silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 19.1790 D_{85}= 0.3933 D_{60}= 0.2232
D_{50}= 0.1824 D_{30}= 0.1081 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G020 S-11
Sample Number: 7992-19 **Depth:** 35'-36.5 **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/16/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-11
Depth: 35'-36.5
Sample Number: 7992-19
Material Description: Silty Sand
Date: 10/5/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 273.00
Tare Wt. = 16.60
Minus #200 from wash = 16.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
321.70	16.60	1"	0.00	0.00	100.0
		3/4"	31.10	0.00	89.8
		.1/2"	0.00	0.00	89.8
		#4	0.40	0.00	89.7
		#10	0.80	0.00	89.4
		#40	6.60	0.00	87.3
		#100	140.30	0.00	41.3
		#200	63.50	0.00	20.5

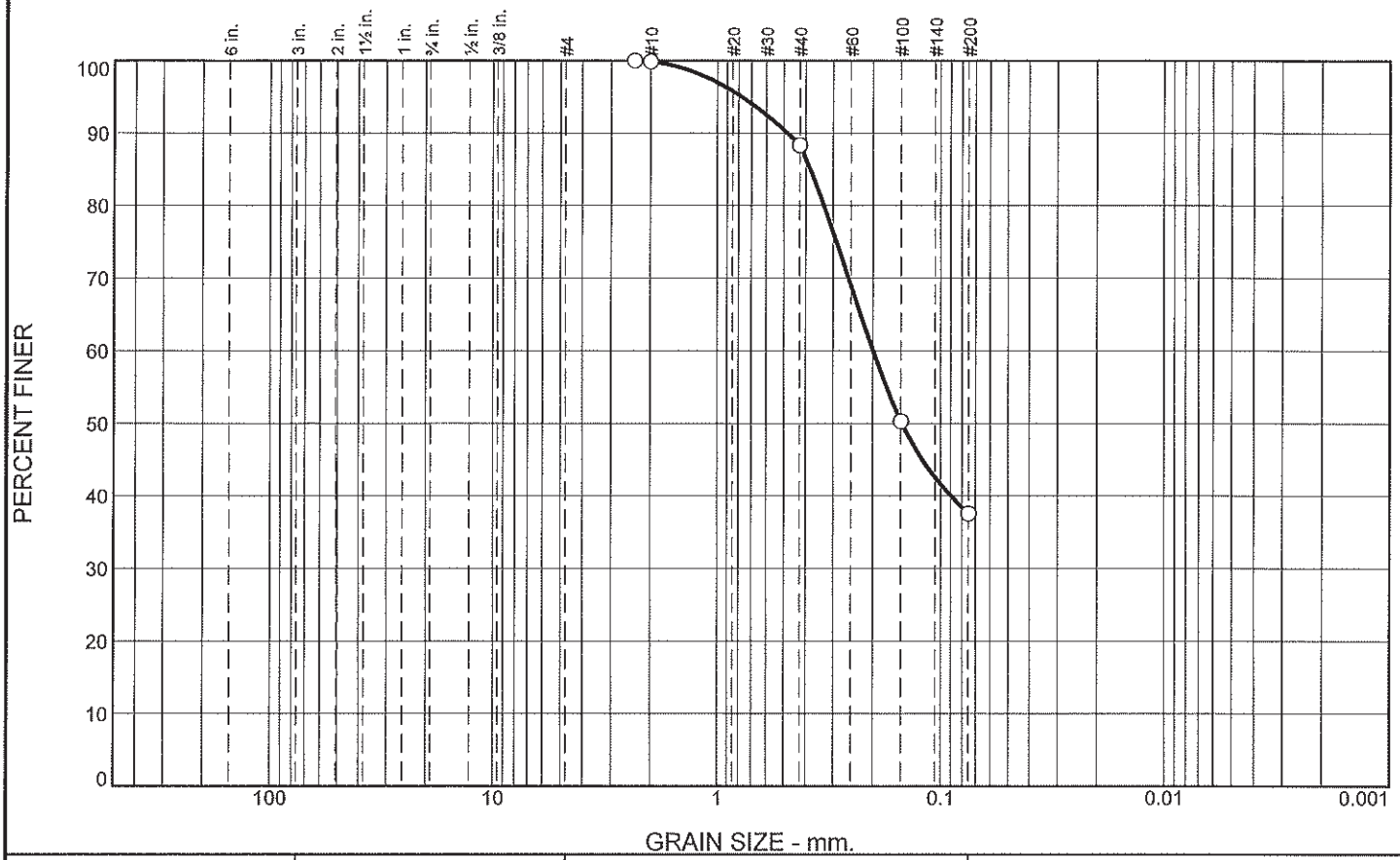
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	10.2	0.1	10.3	0.3	2.1	66.8	69.2			20.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.1081	0.1824	0.2232	0.3422	0.3933	19.1790	22.2853

Fineness Modulus
1.47

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	11.6	50.7	37.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#10	99.9		
#40	88.3		
#100	50.3		
#200	37.6		

* (no specification provided)

Soil Description

SILTY SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4843 D_{85}= 0.3816 D_{60}= 0.1996
D_{50}= 0.1485 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G020 S-34
Sample Number: 7995-1 **Depth:** 150'-151.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-34
Depth: 150'-151.5'
Sample Number: 7995-1
Material Description: SILTY SAND
Date: 10/21/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 187.20
Tare Wt. = 15.80
Minus #200 from wash = 36.4%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
285.50	15.80	#8	0.00	0.00	100.0
		#10	0.40	0.00	99.9
		#40	31.10	0.00	88.3
		#100	102.60	0.00	50.3
		#200	34.30	0.00	37.6

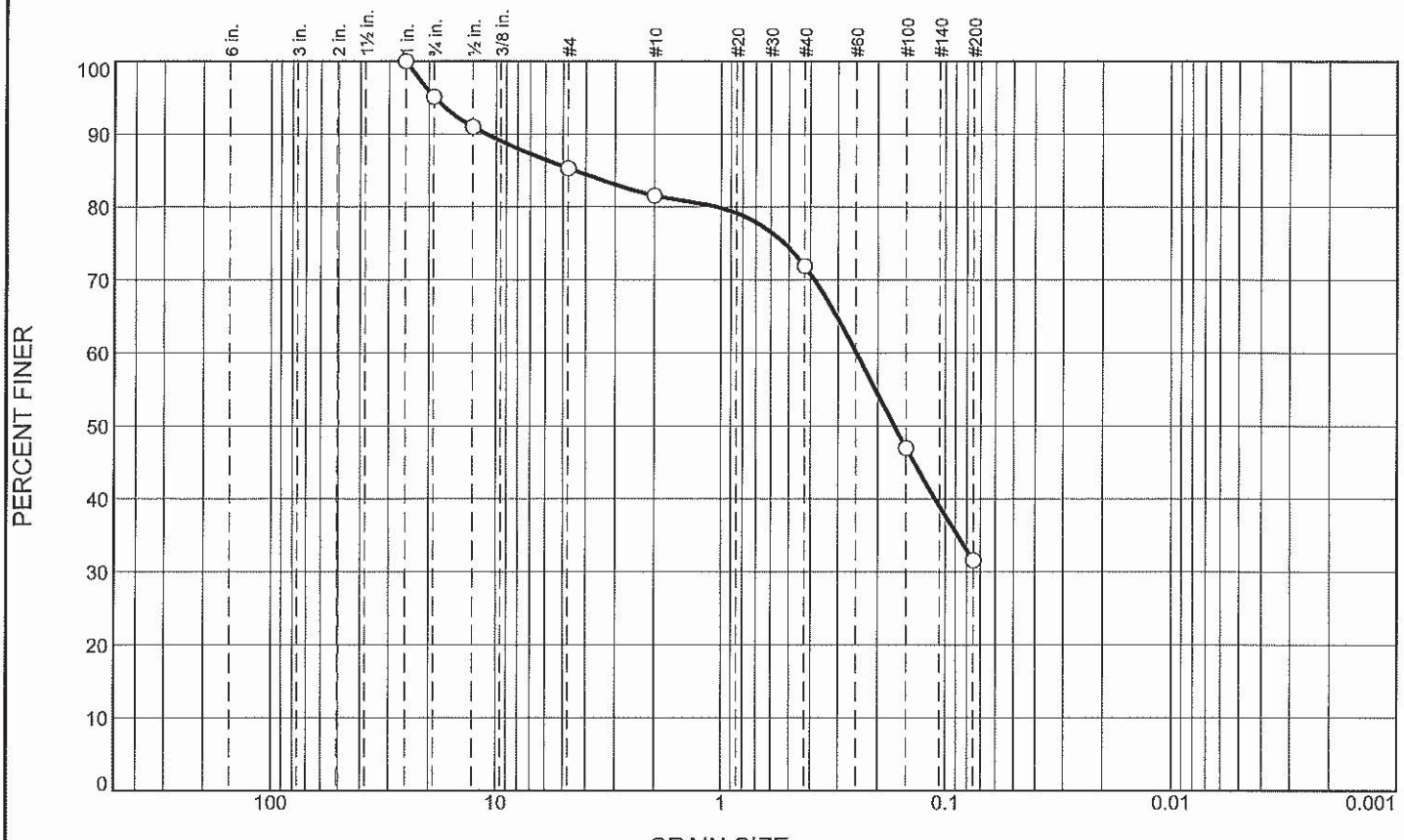
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.1	11.6	50.7	62.4			37.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.1485	0.1996	0.3311	0.3816	0.4843	0.7777

Fineness Modulus
0.83

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.9	9.8	3.8	9.6	40.3	31.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	95.1		
1/2"	91.0		
#4	85.3		
#10	81.5		
#40	71.9		
#100	47.0		
#200	31.6		

* (no specification provided)

Soil Description

Silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 11.1016 D_{85}= 4.4857 D_{60}= 0.2488
D_{50}= 0.1692 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G020 S-42
Sample Number: 7992-45 **Depth:** 190'-191.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/11/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-42
Depth: 190'-191.5'
Sample Number: 7992-45
Material Description: Silty Sand
Date: 10/5/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 249.20
Tare Wt. = 16.70
Minus #200 from wash = 27.5%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
337.50	16.70	1"	0.00	0.00	100.0
		3/4"	15.80	0.00	95.1
		1/2"	13.20	0.00	91.0
		#4	18.20	0.00	85.3
		#10	12.00	0.00	81.5
		#40	31.00	0.00	71.9
		#100	79.90	0.00	47.0
		#200	49.40	0.00	31.6

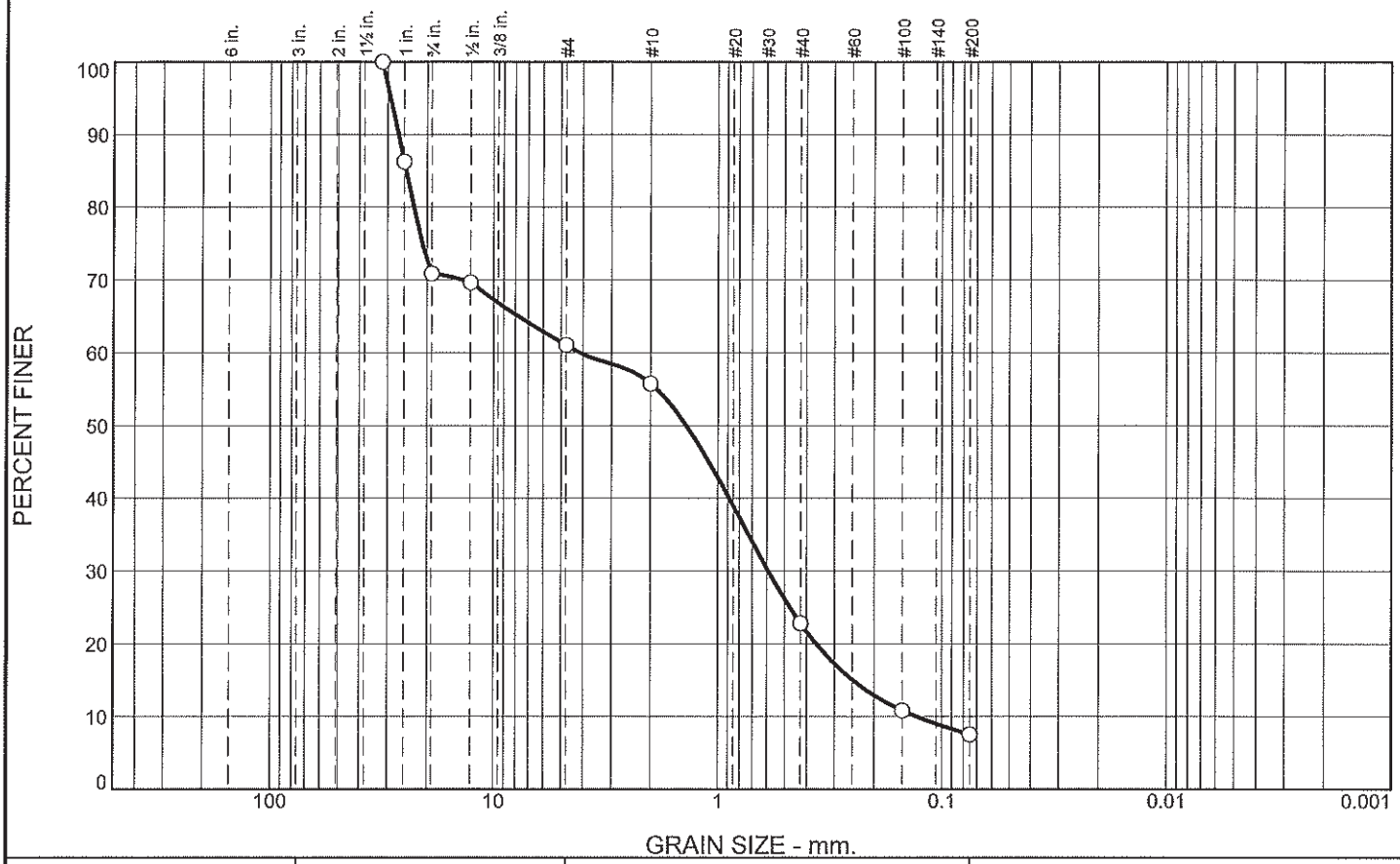
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	4.9	9.8	14.7	3.8	9.6	40.3	53.7			31.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.1692	0.2488	1.0465	4.4857	11.1016	18.9506

Fineness Modulus
1.80

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	29.1	9.8	5.4	32.9	15.3	7.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/4"	100.0		
1"	86.3		
3/4"	70.9		
1/2"	69.6		
#4	61.1		
#10	55.7		
#40	22.8		
#100	10.9		
#200	7.5		

* (no specification provided)

Soil Description

Sand with Silt and Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 26.9668 D_{85}= 24.8989 D_{60}= 4.1483
D_{50}= 1.3852 D_{30}= 0.5924 D_{15}= 0.2491
D_{10}= 0.1292 C_u= 32.10 C_c= 0.65

Classification

USCS= SP-SM AASHTO=

Remarks

Location: G021 S-6
Sample Number: 7992-30 **Depth:** 12.5'-14' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/16/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G021 S-6
Depth: 12.5'-14'
Sample Number: 7992-30
Material Description: Sand with Silt and Gravel
Date: 10/5/2017
USCS Classification: SP-SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 339.90
Tare Wt. = 17.60
Minus #200 from wash = 7.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
364.00	17.60	1 1/4"	0.00	0.00	100.0
		1"	47.60	0.00	86.3
		3/4"	53.30	0.00	70.9
		1/2"	4.40	0.00	69.6
		#4	29.60	0.00	61.1
		#10	18.40	0.00	55.7
		#40	114.10	0.00	22.8
		#100	41.40	0.00	10.9
		#200	11.50	0.00	7.5

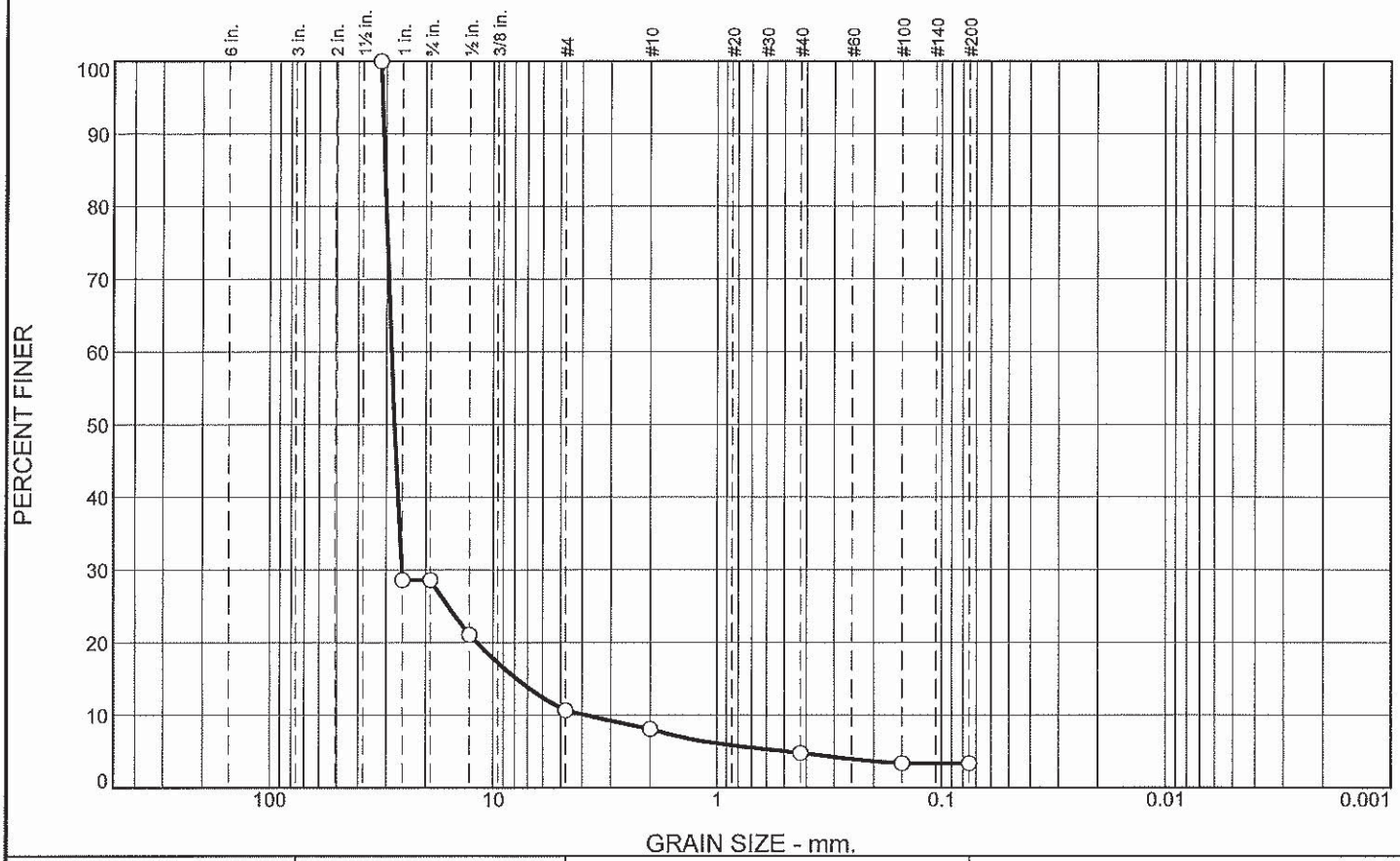
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	29.1	9.8	38.9	5.4	32.9	15.3	53.6			7.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1292	0.2491	0.3625	0.5924	1.3852	4.1483	22.9804	24.8989	26.9668	29.2494

Fineness Modulus	C_u	C_c
4.39	32.10	0.65

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	71.4	17.9	2.6	3.3	1.4	3.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/4"	100.0		
1"	28.6		
3/4"	28.6		
1/2"	21.1		
#4	10.7		
#10	8.1		
#40	4.8		
#100	3.4		
#200	3.4		

* (no specification provided)

Soil Description

Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 30.9553 D_{85}= 30.5617 D_{60}= 28.5661
D_{50}= 27.7101 D_{30}= 25.6025 D_{15}= 7.8548
D_{10}= 3.8446 C_u= 7.43 C_c= 5.97

Classification

USCS= GP AASHTO=

Remarks

Location: G022 S-4
Sample Number: 7992-36 **Depth:** 10'-11.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/11/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G022 S-4
Depth: 10'-11.5'
Sample Number: 7992-36
Material Description: Gravel
Date: 10/5/2017
USCS Classification: GP
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 140.50
Tare Wt. = 15.70
Minus #200 from wash = 2.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
143.00	15.70	1 1/4"	0.00	0.00	100.0
		1"	90.90	0.00	28.6
		3/4"	0.00	0.00	28.6
		1/2"	9.60	0.00	21.1
		#4	13.20	0.00	10.7
		#10	3.30	0.00	8.1
		#40	4.20	0.00	4.8
		#100	1.80	0.00	3.4
		#200	0.00	0.00	3.4

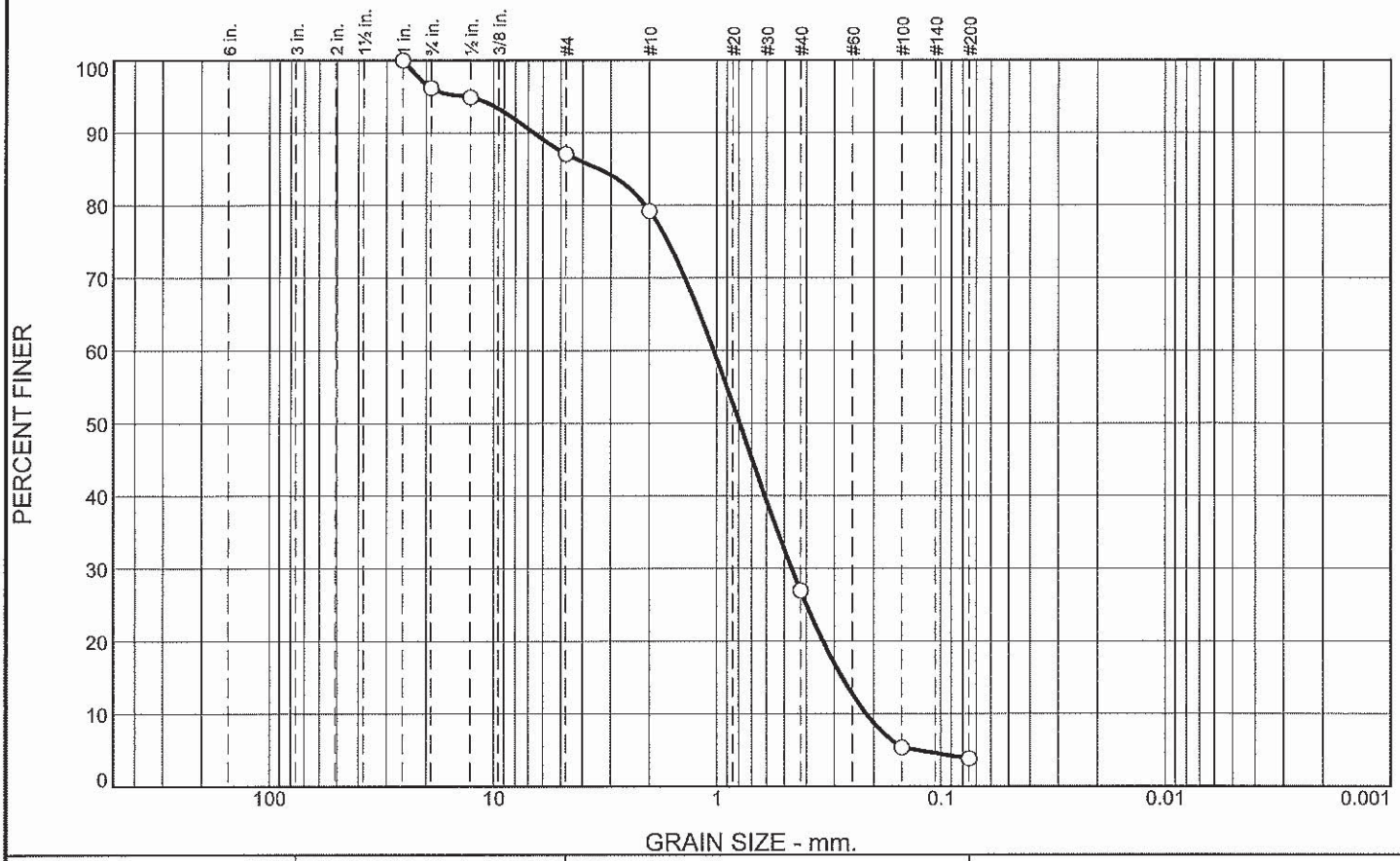
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	71.4	17.9	89.3	2.6	3.3	1.4	7.3			3.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
3.8446	7.8548	11.7961	25.6025	27.7101	28.5661	30.1688	30.5617	30.9553	31.3508

Fineness Modulus	C_u	C_c
7.16	7.43	5.97

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.8	9.2	7.8	52.3	23.1	3.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	96.2		
1/2"	94.9		
#4	87.0		
#10	79.2		
#40	26.9		
#100	5.3		
#200	3.8		

* (no specification provided)

Soil Description

SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 6.6416 D_{85}= 3.3943 D_{60}= 1.0322
D_{50}= 0.7922 D_{30}= 0.4653 D_{15}= 0.2774
D_{10}= 0.2165 C_u= 4.77 C_c= 0.97

Classification

USCS= SP AASHTO=

Remarks

Location: G028 S-1
Sample Number: 7995-22 **Depth:** 7.5'-9.0' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G028 S-1
Depth: 7.5'-9.0'
Sample Number: 7995-22
Material Description: SAND
Date: 10/21/2017
USCS Classification: SP
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 341.80
Tare Wt. = 15.80
Minus #200 from wash = 3.1%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
352.40	15.80	1"	0.00	0.00	100.0
		3/4"	12.90	0.00	96.2
		1/2"	4.30	0.00	94.9
		#4	26.40	0.00	87.0
		#10	26.40	0.00	79.2
		#40	175.90	0.00	26.9
		#100	72.70	0.00	5.3
		#200	5.10	0.00	3.8

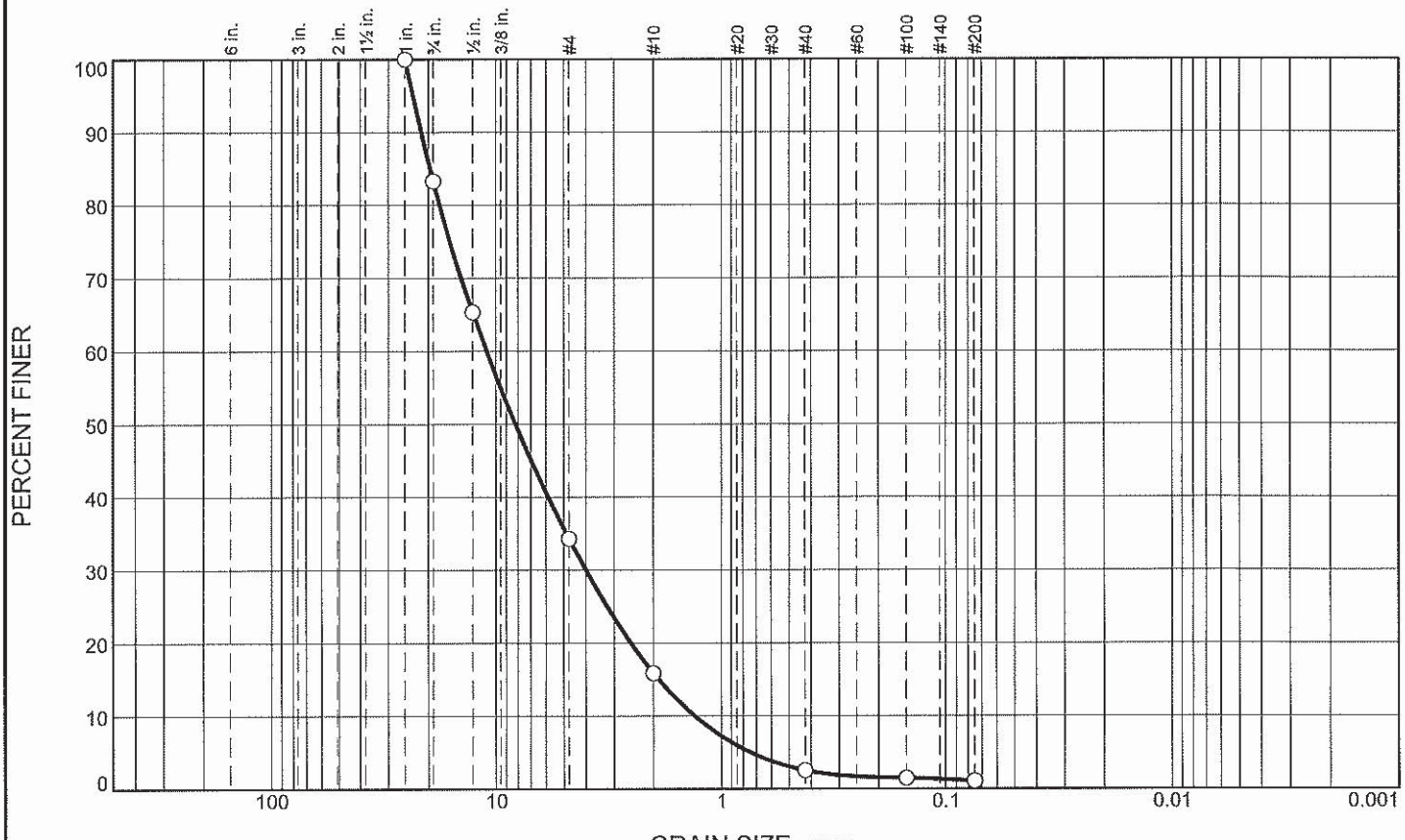
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	3.8	9.2	13.0	7.8	52.3	23.1	83.2			3.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.2165	0.2774	0.3378	0.4653	0.7922	1.0322	2.0915	3.3943	6.6416	13.3163

Fineness Modulus	C_u	C_c
3.15	4.77	0.97

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.7	49.0	18.4	13.4	1.4	1.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	83.3		
1/2"	65.3		
#4	34.3		
#10	15.9		
#40	2.5		
#100	1.5		
#200	1.1		

* (no specification provided)

Soil Description

GRAVEL WITH SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 21.4931 D_{85}= 19.6707 D_{60}= 11.0148
D_{50}= 8.2099 D_{30}= 4.0001 D_{15}= 1.8935
D_{10}= 1.3094 C_u= 8.41 C_c= 1.11

Classification

USCS= GW AASHTO=

Remarks

Location: G028 S-5
Sample Number: 7795-25 **Depth:** 20'-21.5' **Date:** 1021/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G028 S-5
Depth: 20'-21.5'
Sample Number: 7795-25
Material Description: GRAVEL WITH SAND
Date: 1021/2017
USCS Classification: GW
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 284.90
Tare Wt. = 15.80
Minus #200 from wash = 1.1%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
287.90	15.80	1"	0.00	0.00	100.0
		3/4"	45.50	0.00	83.3
		1/2"	48.90	0.00	65.3
		#4	84.40	0.00	34.3
		#10	50.10	0.00	15.9
		#40	36.30	0.00	2.5
		#100	2.90	0.00	1.5
		#200	1.00	0.00	1.1

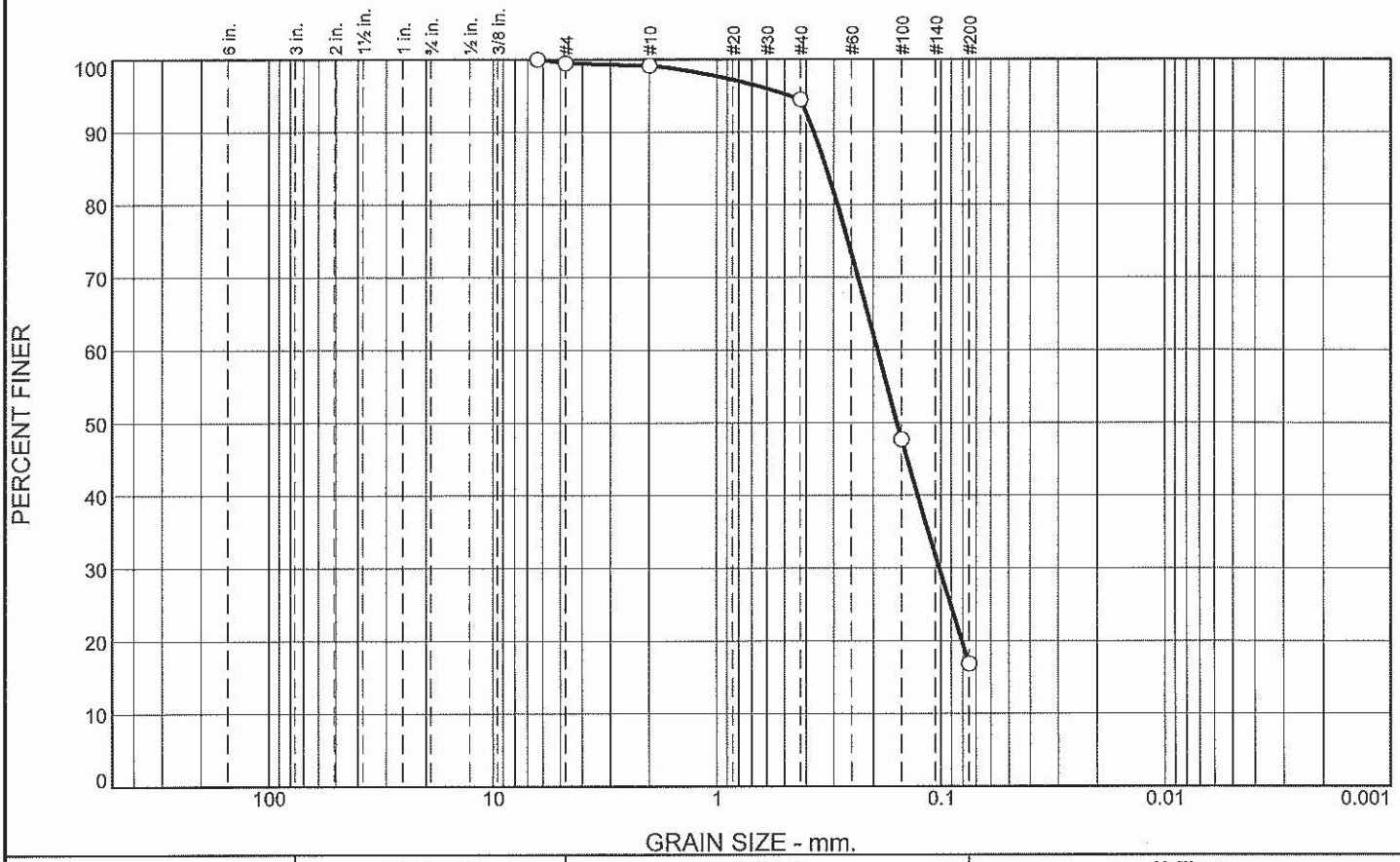
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	16.7	49.0	65.7	18.4	13.4	1.4	33.2			1.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
1.3094	1.8935	2.5226	4.0001	8.2099	11.0148	17.8675	19.6707	21.4931	23.3867

Fineness Modulus	C_u	C_c
5.93	8.41	1.11

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.5	0.4	4.7	77.5	16.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	99.5		
#10	99.1		
#40	94.4		
#100	47.7		
#200	16.9		

* (no specification provided)

Soil Description

SILTY SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3699 D_{85}= 0.3247 D_{60}= 0.1919
D_{50}= 0.1573 D_{30}= 0.1019 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G031 S-14
Sample Number: 7995-32 **Depth:** 65'-66.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-14
Depth: 65'-66.5'
Sample Number: 7995-32
Material Description: SILTY SAND
Date: 10/21/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 151.60
Tare Wt. = 15.80
Minus #200 from wash = 65.1%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
404.80	15.80	1/4"	0.00	0.00	100.0
		#4	2.00	0.00	99.5
		#10	1.40	0.00	99.1
		#40	18.20	0.00	94.4
		#100	181.90	0.00	47.7
		#200	119.90	0.00	16.9

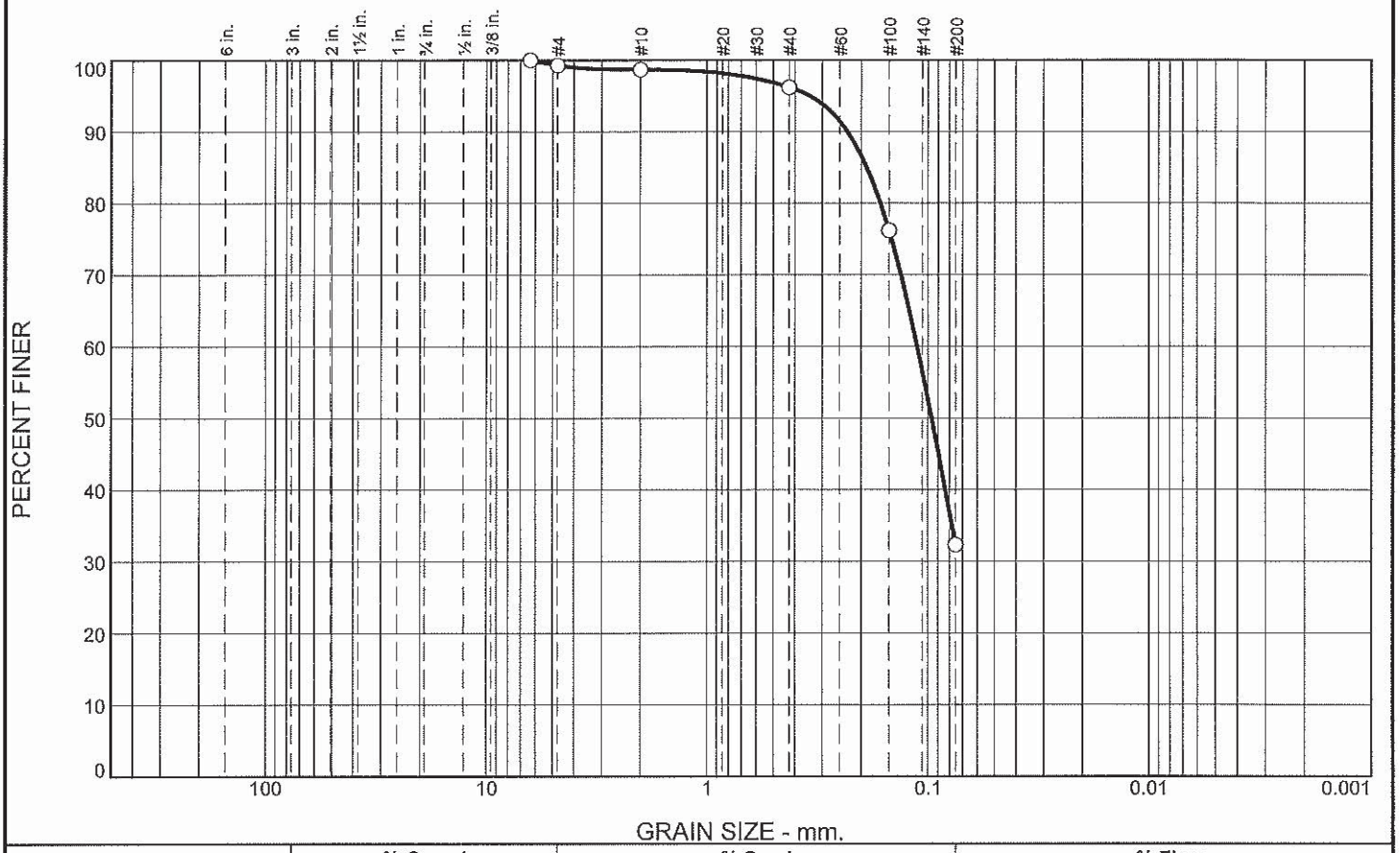
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.5	0.5	0.4	4.7	77.5	82.6			16.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0808	0.1019	0.1573	0.1919	0.2890	0.3247	0.3699	0.4797

Fineness Modulus
0.78

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	0.6	2.5	63.9	32.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	99.3		
#10	98.7		
#40	96.2		
#100	76.2		
#200	32.3		

* (no specification provided)

Soil Description

SILTY SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2312 D_{85}= 0.1893 D_{60}= 0.1120
D_{50}= 0.0963 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G031 S-15
Sample Number: 7995-33 **Depth:** 70'-71.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-15
Depth: 70'-71.5'
Sample Number: 7995-33
Material Description: SILTY SAND
Date: 10/21/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 292.80
Tare Wt. = 15.80
Minus #200 from wash = 8.7%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
319.20	15.80	1/4"	0.00	0.00	100.0
		#4	2.20	0.00	99.3
		#10	1.80	0.00	98.7
		#40	7.60	0.00	96.2
		#100	60.70	0.00	76.2
		#200	133.00	0.00	32.3

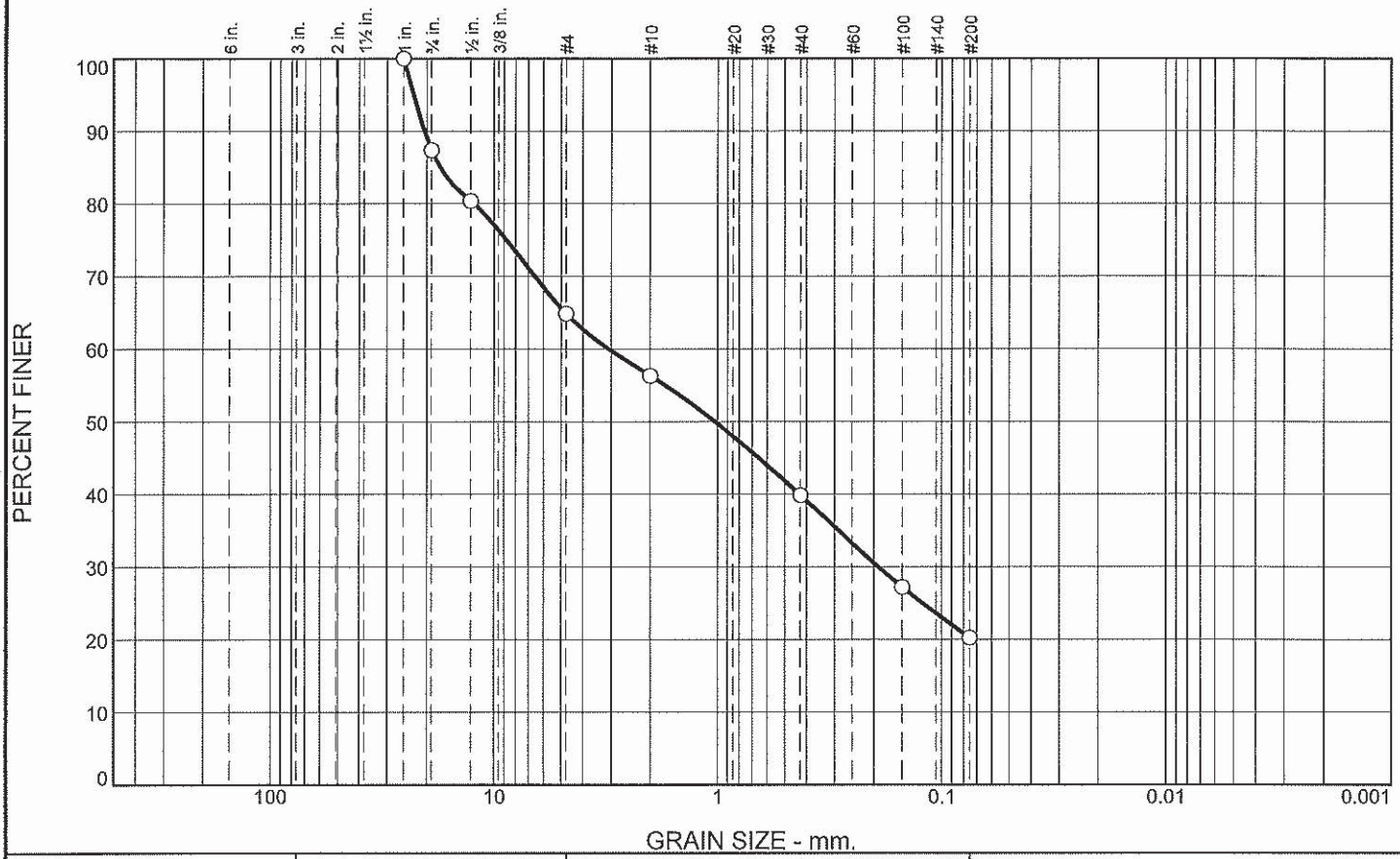
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.7	0.7	0.6	2.5	63.9	67.0			32.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0963	0.1120	0.1641	0.1893	0.2312	0.3432

Fineness Modulus
0.36

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.6	22.6	8.5	16.5	19.6	20.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	87.4		
1/2"	80.4		
#4	64.8		
#10	56.3		
#40	39.8		
#100	27.2		
#200	20.2		

* (no specification provided)

Soil Description

SILTY SAND WITH GRAVEL

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 20.4791 D_{85}= 17.4715 D_{60}= 3.0878
D_{50}= 1.0311 D_{30}= 0.1916 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G031 S-40
Sample Number: 7995-44 **Depth:** 195'-196.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-40
Depth: 195'-196.5' **Sample Number:** 7995-44
Material Description: SILTY SAND WITH GRAVEL
Date: 10/21/2017
USCS Classification: SM
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 418.30
Tare Wt. = 15.80
Minus #200 from wash = 16.4%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
497.40	15.80	1"	0.00	0.00	100.0
		3/4"	60.80	0.00	87.4
		1/2"	33.70	0.00	80.4
		#4	74.90	0.00	64.8
		#10	41.00	0.00	56.3
		#40	79.30	0.00	39.8
		#100	60.90	0.00	27.2
		#200	33.50	0.00	20.2

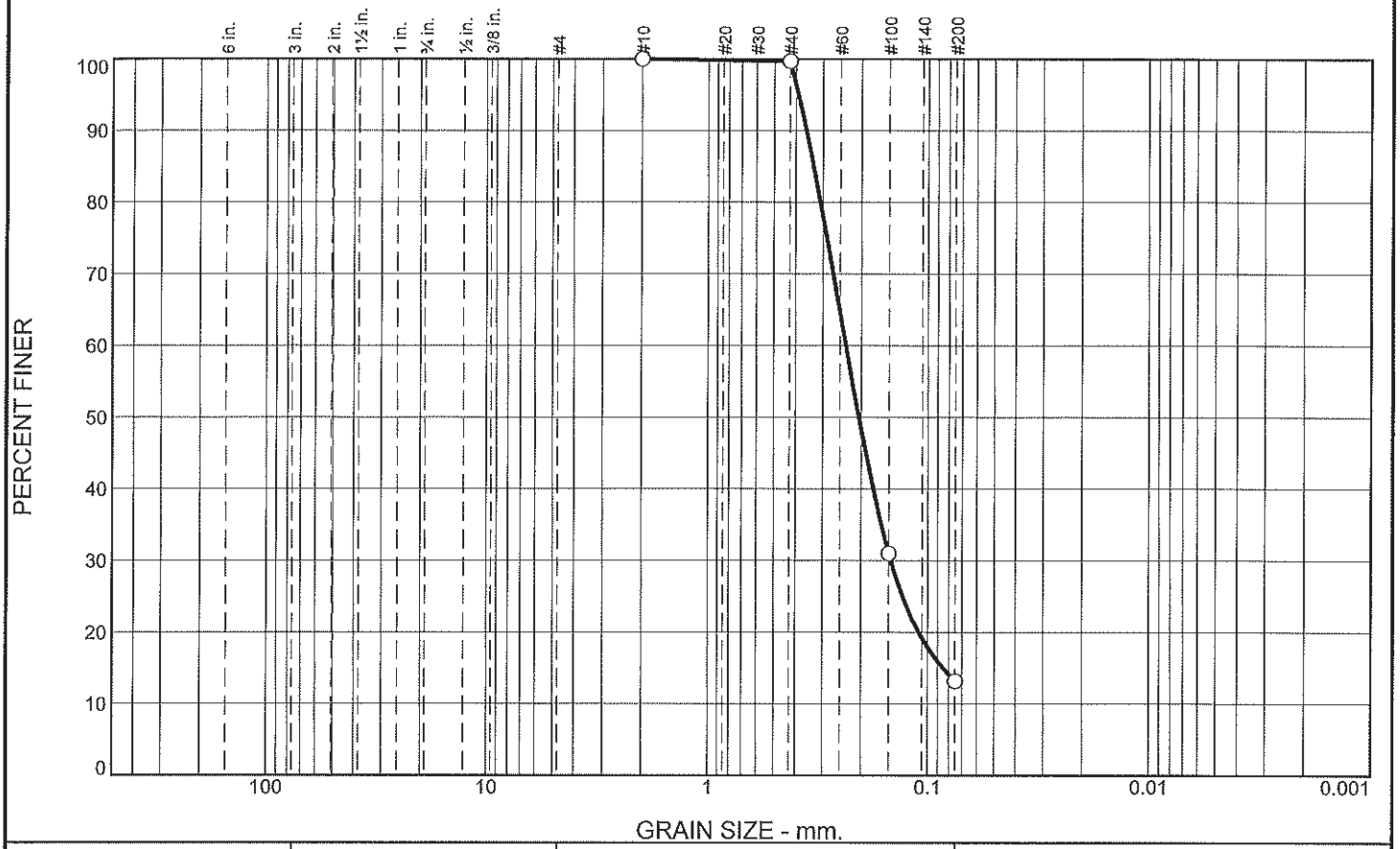
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	12.6	22.6	35.2	8.5	16.5	19.6	44.6			20.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.1916	1.0311	3.0878	12.3097	17.4715	20.4791	22.9341

Fineness Modulus
3.56

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	86.5	13.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.7		
#100	31.0		
#200	13.2		

* (no specification provided)

Soil Description

Silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3586 D_{85}= 0.3323 D_{60}= 0.2355
D_{50}= 0.2050 D_{30}= 0.1469 D_{15}= 0.0849
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G032 S-2
Sample Number: 8000-2 **Depth:** 5.0' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-2
Depth: 5.0'
Sample Number: 8000-2
Material Description: Silty Sand
Date: 11/5/17
USCS Classification: SM
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 369.00
Tare Wt. = 15.70
Minus #200 from wash = 11.5%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
414.70	15.70	#10	0.00	0.00	100.0
		#40	1.30	0.00	99.7
		#100	274.00	0.00	31.0
		#200	71.10	0.00	13.2

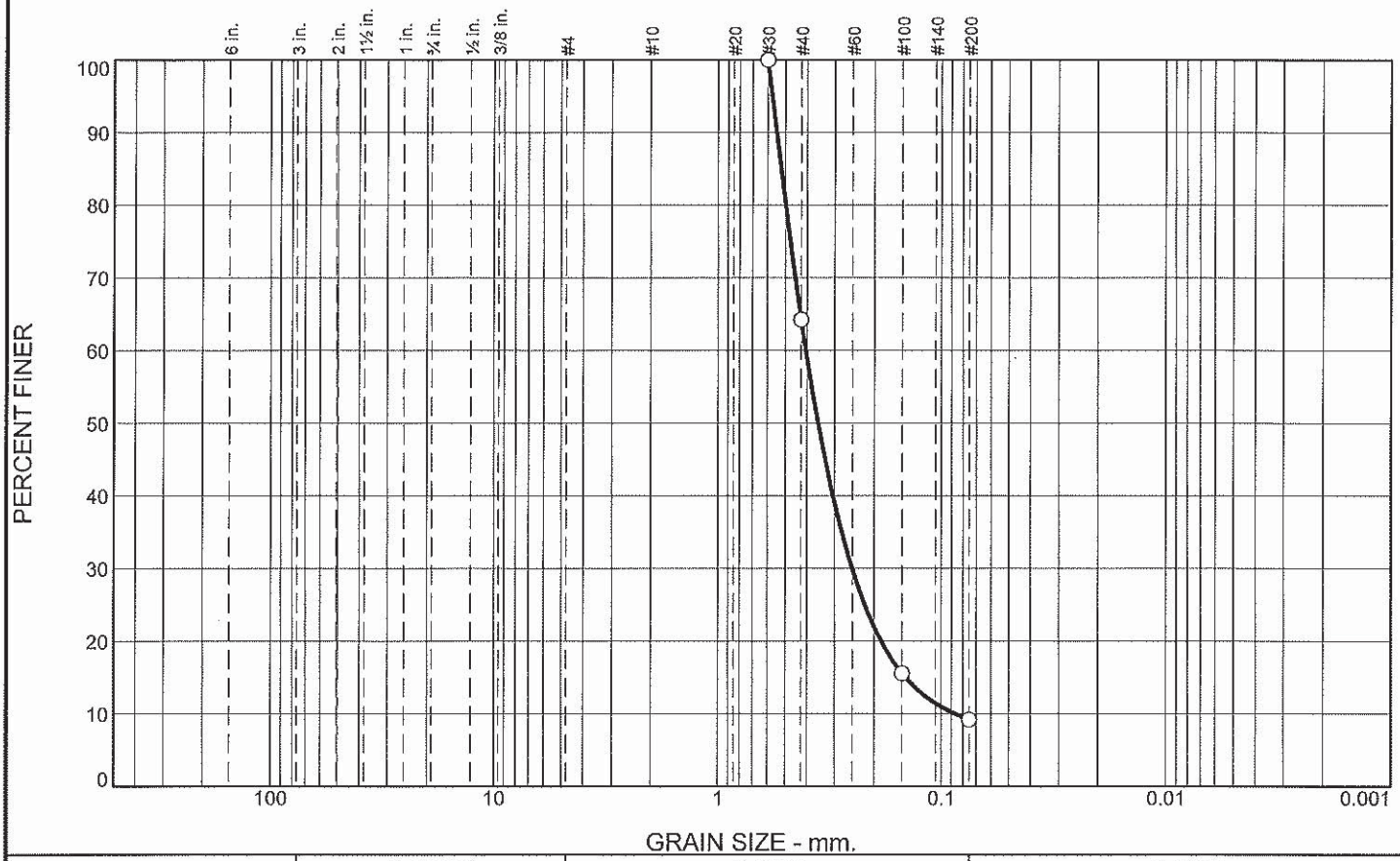
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	0.3	86.5	86.8			13.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0849	0.1100	0.1469	0.2050	0.2355	0.3092	0.3323	0.3586	0.3895

Fineness Modulus
0.92

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	35.7	55.1	9.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#40	64.3		
#100	15.6		
#200	9.2		

* (no specification provided)

Soil Description

Poorly graded Sand with Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5477 D_{85}= 0.5229 D_{60}= 0.4050
D_{50}= 0.3568 D_{30}= 0.2512 D_{15}= 0.1449
D_{10}= 0.0864 C_u= 4.68 C_c= 1.80

Classification

USCS= SP-SM AASHTO=

Remarks

Location: G032 S-16
Sample Number: 8000-10 **Depth:** 65' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-16
Depth: 65'
Sample Number: 8000-10
Material Description: Poorly graded Sand with Silt
Date: 11/5/17
USCS Classification: SP-SM
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 326.90
Tare Wt. = 15.80
Minus #200 from wash = 8.3%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
355.20	15.80	#30	0.00	0.00	100.0
		#40	121.30	0.00	64.3
		#100	165.30	0.00	15.6
		#200	21.60	0.00	9.2

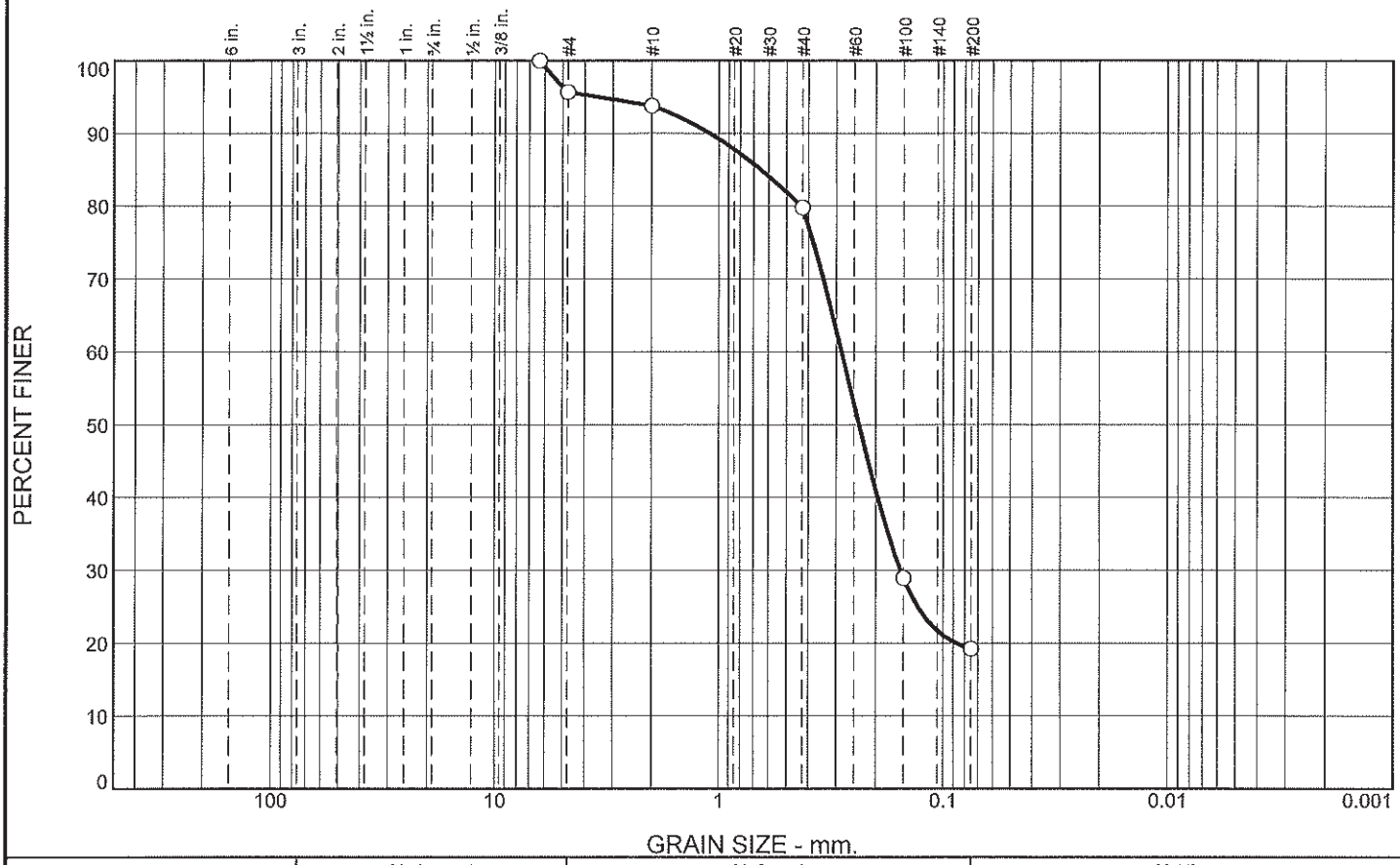
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	35.7	55.1	90.8			9.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0864	0.1449	0.1863	0.2512	0.3568	0.4050	0.4987	0.5229	0.5477	0.5733

Fineness Modulus	C_u	C_c
1.46	4.68	1.80

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.3	1.9	14.0	60.6	19.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4'	100.0		
#4	95.7		
#10	93.8		
#40	79.8		
#100	28.9		
#200	19.2		

* (no specification provided)

Soil Description

Silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.1037 D_{85}= 0.6520 D_{60}= 0.2851
D_{50}= 0.2377 D_{30}= 0.1549 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G032 S-48
Sample Number: 8000-27 **Depth:** 210' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-48
Depth: 210'
Sample Number: 8000-27
Material Description: Silty Sand
Date: 11/5/17
USCS Classification: SM
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 119.80
Tare Wt. = 15.90
Minus #200 from wash = 17.9%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
142.50	15.90	1/4'	0.00	0.00	100.0
		#4	5.50	0.00	95.7
		#10	2.40	0.00	93.8
		#40	17.70	0.00	79.8
		#100	64.40	0.00	28.9
		#200	12.30	0.00	19.2

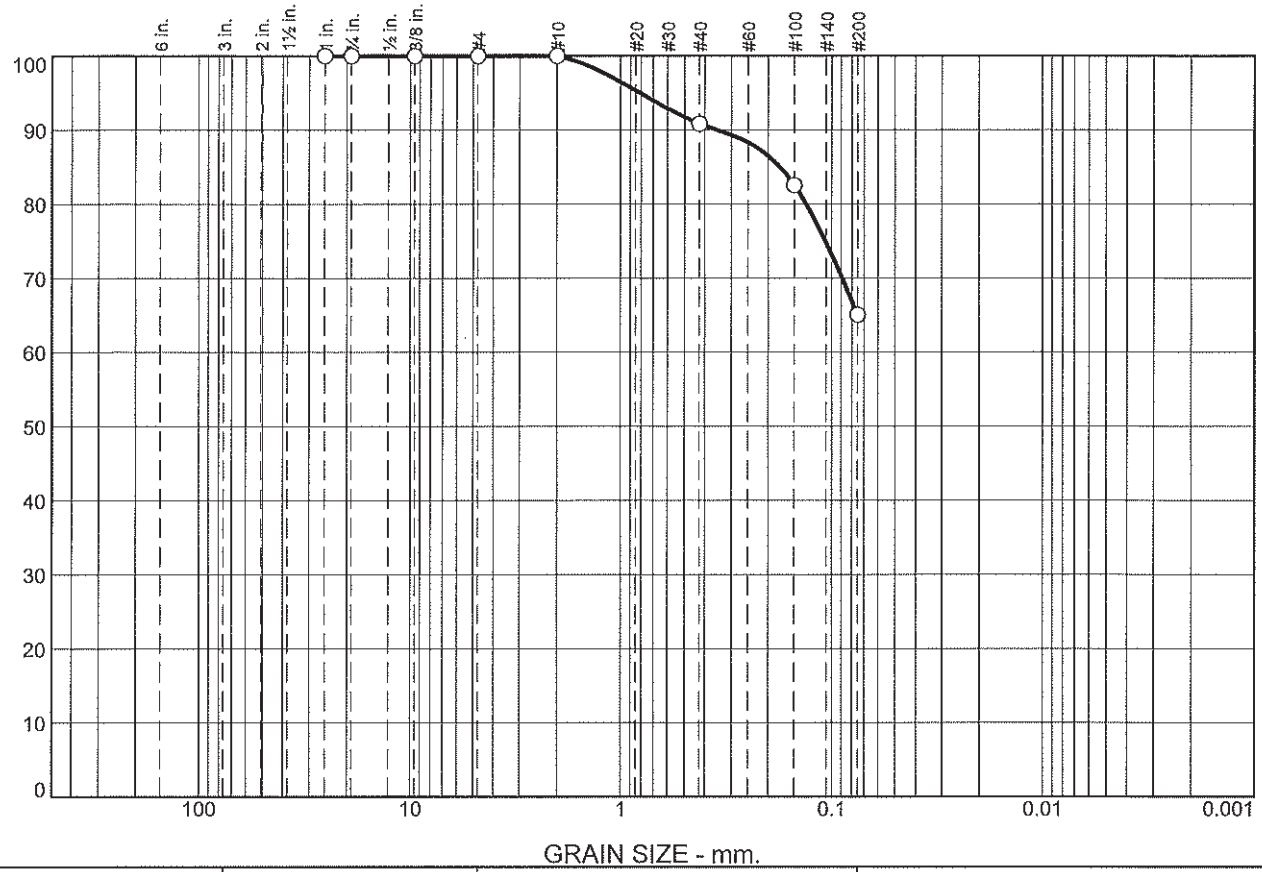
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	4.3	4.3	1.9	14.0	60.6	76.5			19.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0874	0.1549	0.2377	0.2851	0.4321	0.6520	1.1037	3.5219

Fineness Modulus
1.44

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	9	26	65	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	100		
3/8"	100		
#4	100		
#10	100		
#40	91		
#100	83		
#200	65		

* (no specification provided)

Soil Description

Sandy SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3514 D_{85}= 0.1758 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Location: G33 / S3
Sample Number: 054-73 **Depth:** 7.5' **Date:** 12/27/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S3
Depth: 7.5'
Sample Number: 054-73
Material Description: Sandy SILT
Date: 12/27/2017
USCS Classification: ML
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 94.16
Tare Wt. = 16.20
Minus #200 from wash = 62.6%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
224.74	16.20	0.00	1"	0.00	100
			3/4"	0.00	100
			3/8"	0.00	100
			#4	0.00	100
			#10	0.00	100
			#40	19.10	91
			#100	36.40	83
			#200	72.90	65

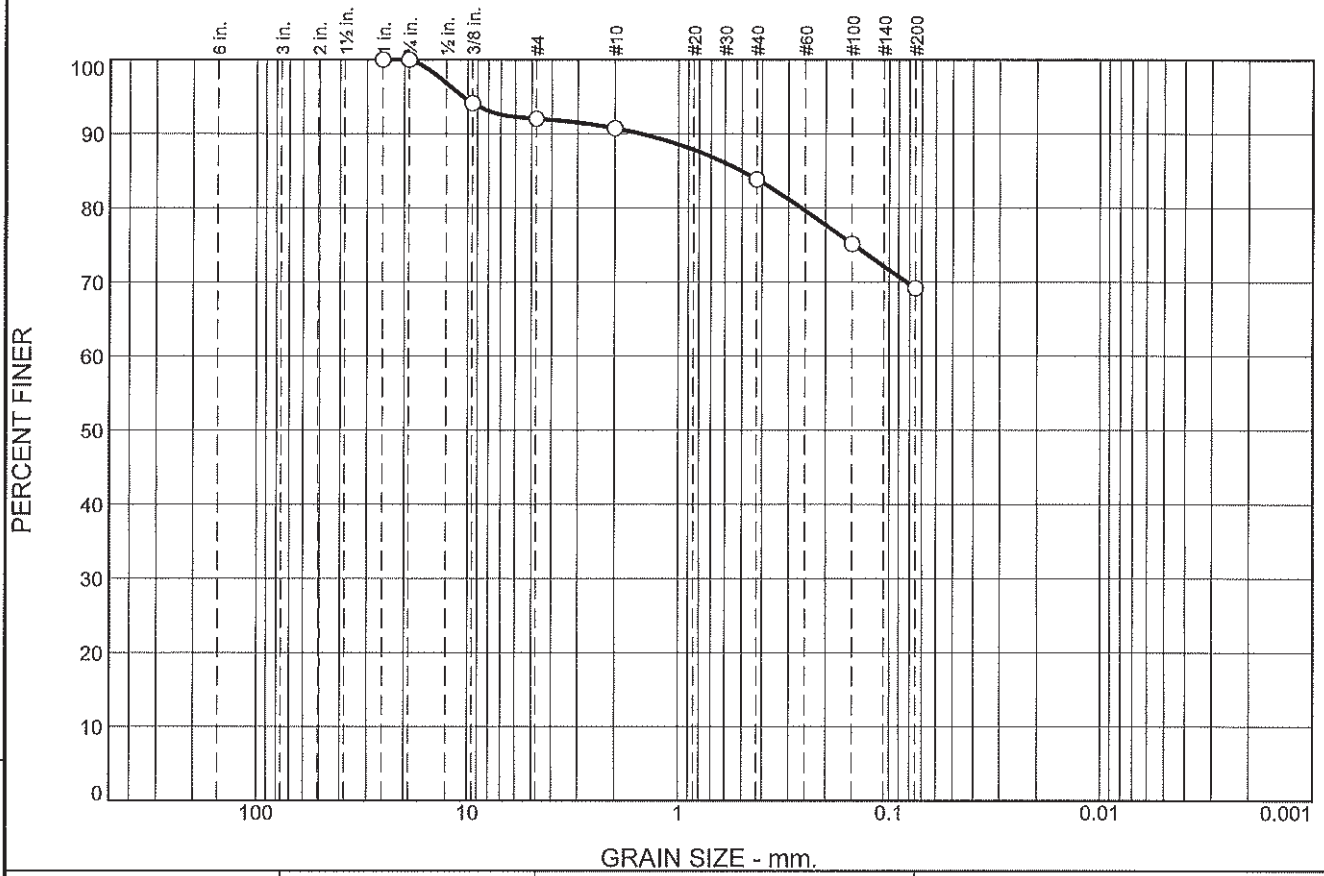
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	0	9	26	35			65

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
						0.1319	0.1758	0.3514	0.8144

Fineness Modulus
0.38

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	8	1	7	15	69	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	100		
3/8"	94		
#4	92		
#10	91		
#40	84		
#100	75		
#200	69		

* (no specification provided)

Soil Description

Sandy SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.5144 D_{85}= 0.5049 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Location: G33 / S6
Sample Number: 054-75 **Depth:** 15' **Date:** 12/28/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S6
Depth: 15'
Sample Number: 054-75
Material Description: Sandy SILT
Date: 12/28/2017
USCS Classification: ML
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 53.11
Tare Wt. = 15.80
Minus #200 from wash = 69.4%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
137.70	15.80	0.00	1"	0.00	100
			3/4"	0.00	100
			3/8"	7.20	94
			#4	9.70	92
			#10	11.30	91
			#40	19.70	84
			#100	30.30	75
			#200	37.60	69

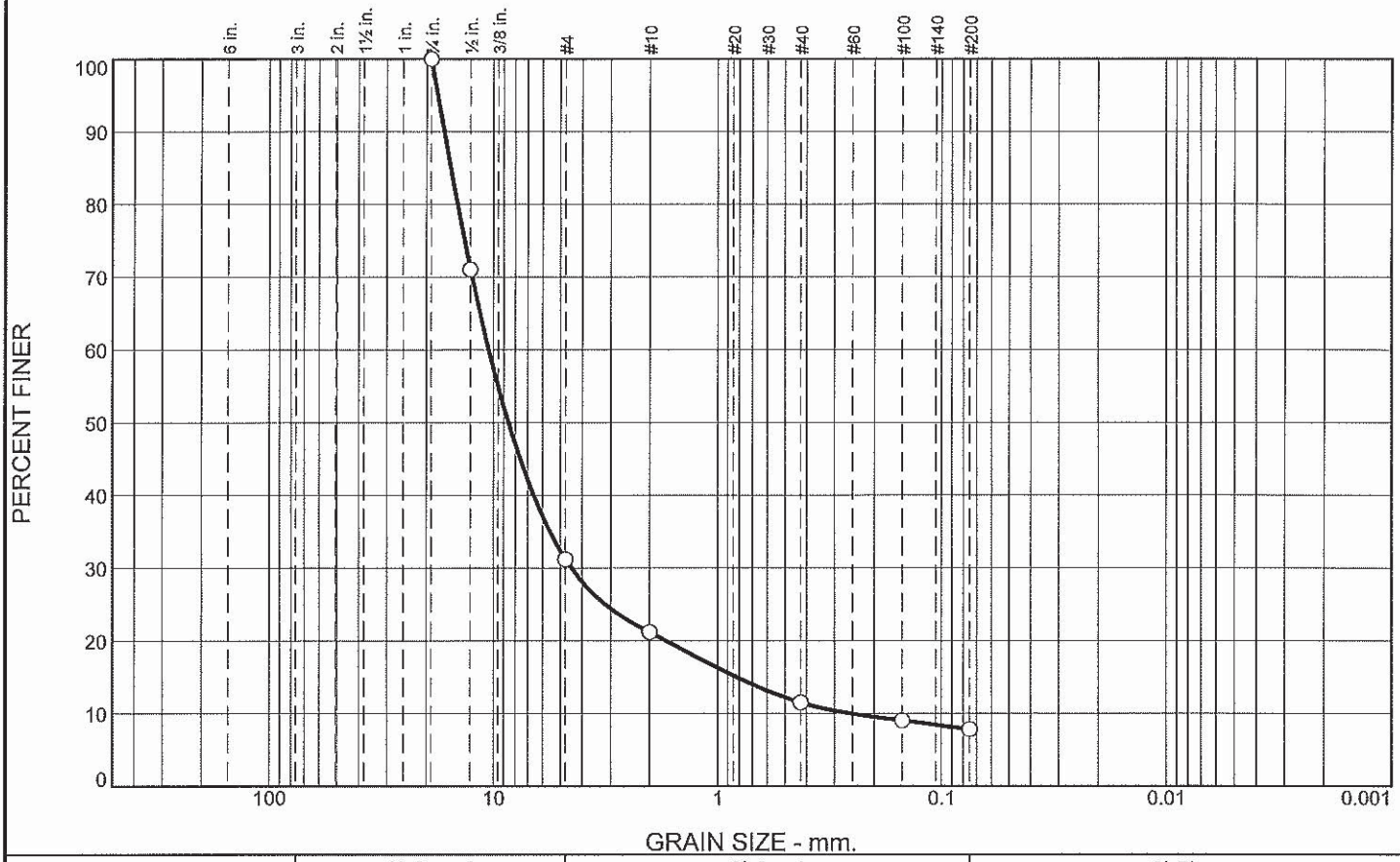
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	8	8	1	7	15	23			69

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
						0.2610	0.5049	1.5144	10.5906

Fineness Modulus
0.91

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	68.8	10.0	9.7	3.7	7.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	71.1		
#4	31.2		
#10	21.2		
#40	11.5		
#100	9.0		
#200	7.8		

* (no specification provided)

Soil Description

GRAVEL WITH SILT AND SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 16.6635 D_{85}= 15.5628 D_{60}= 10.5266
D_{50}= 8.5818 D_{30}= 4.4733 D_{15}= 0.8222
D_{10}= 0.2544 C_u= 41.38 C_c= 7.47

Classification

USCS= SW-SM AASHTO=

Remarks

Location: G034 S-7
Sample Number: 7995-47 **Depth:** 15'-16.8' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G034 S-7
Depth: 15'-16.8'
Sample Number: 7995-47
Material Description: GRAVEL WITH SILT AND SAND
Date: 10/21/2017
USCS Classification: SW-SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 213.30
Tare Wt. = 15.80
Minus #200 from wash = 7.5%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
229.30	15.80	3/4"	0.00	0.00	100.0
		1/2"	61.80	0.00	71.1
		#4	85.10	0.00	31.2
		#10	21.40	0.00	21.2
		#40	20.60	0.00	11.5
		#100	5.30	0.00	9.0
		#200	2.60	0.00	7.8

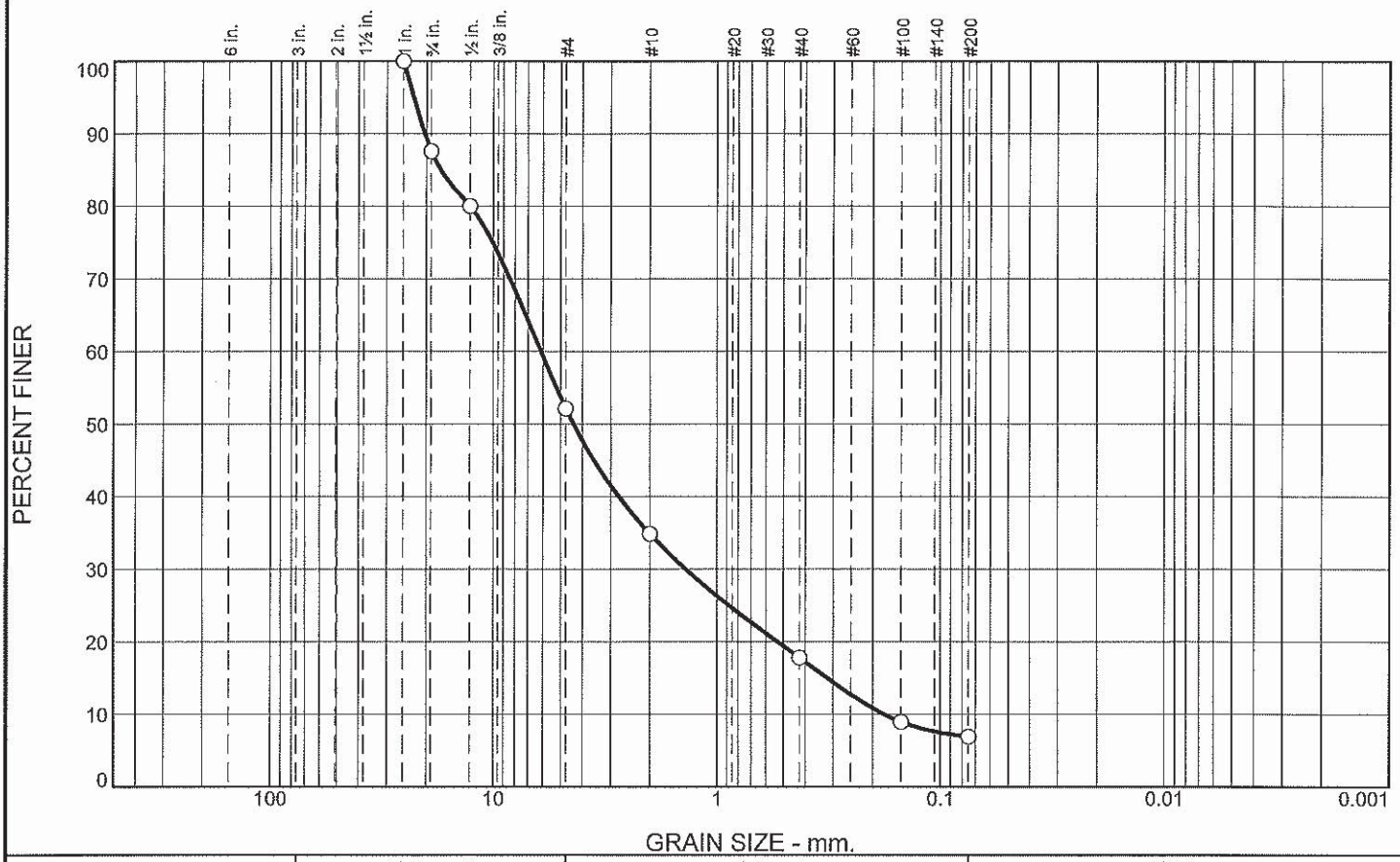
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	68.8	68.8	10.0	9.7	3.7	23.4			7.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.2544	0.8222	1.6976	4.4733	8.5818	10.5266	14.5083	15.5628	16.6635	17.8217

Fineness Modulus	C_u	C_c
5.42	41.38	7.47

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.4	35.5	17.2	17.1	10.9	6.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	87.6		
1/2"	80.0		
#4	52.1		
#10	34.9		
#40	17.8		
#100	9.0		
#200	6.9		

* (no specification provided)

Soil Description

GRAVEL WITH SILT AND SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 20.3995 D_{85}= 17.2909 D_{60}= 6.1518
D_{50}= 4.3889 D_{30}= 1.3841 D_{15}= 0.3194
D_{10}= 0.1783 C_u= 34.51 C_c= 1.75

Classification

USCS= GW-GM AASHTO=

Remarks

Location: G034 S-14
Sample Number: 7995-50 **Depth:** 50'-51.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G034 S-14
Depth: 50'-51.5'
Sample Number: 7995-50
Material Description: GRAVEL WITH SILT AND SAND
Date: 10/21/2017
USCS Classification: GW-GM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 212.80
Tare Wt. = 15.70
Minus #200 from wash = 6.1%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
225.70	15.70	1"	0.00	0.00	100.0
		3/4"	26.10	0.00	87.6
		1/2"	15.90	0.00	80.0
		#4	58.50	0.00	52.1
		#10	36.30	0.00	34.9
		#40	35.80	0.00	17.8
		#100	18.60	0.00	9.0
		#200	4.30	0.00	6.9

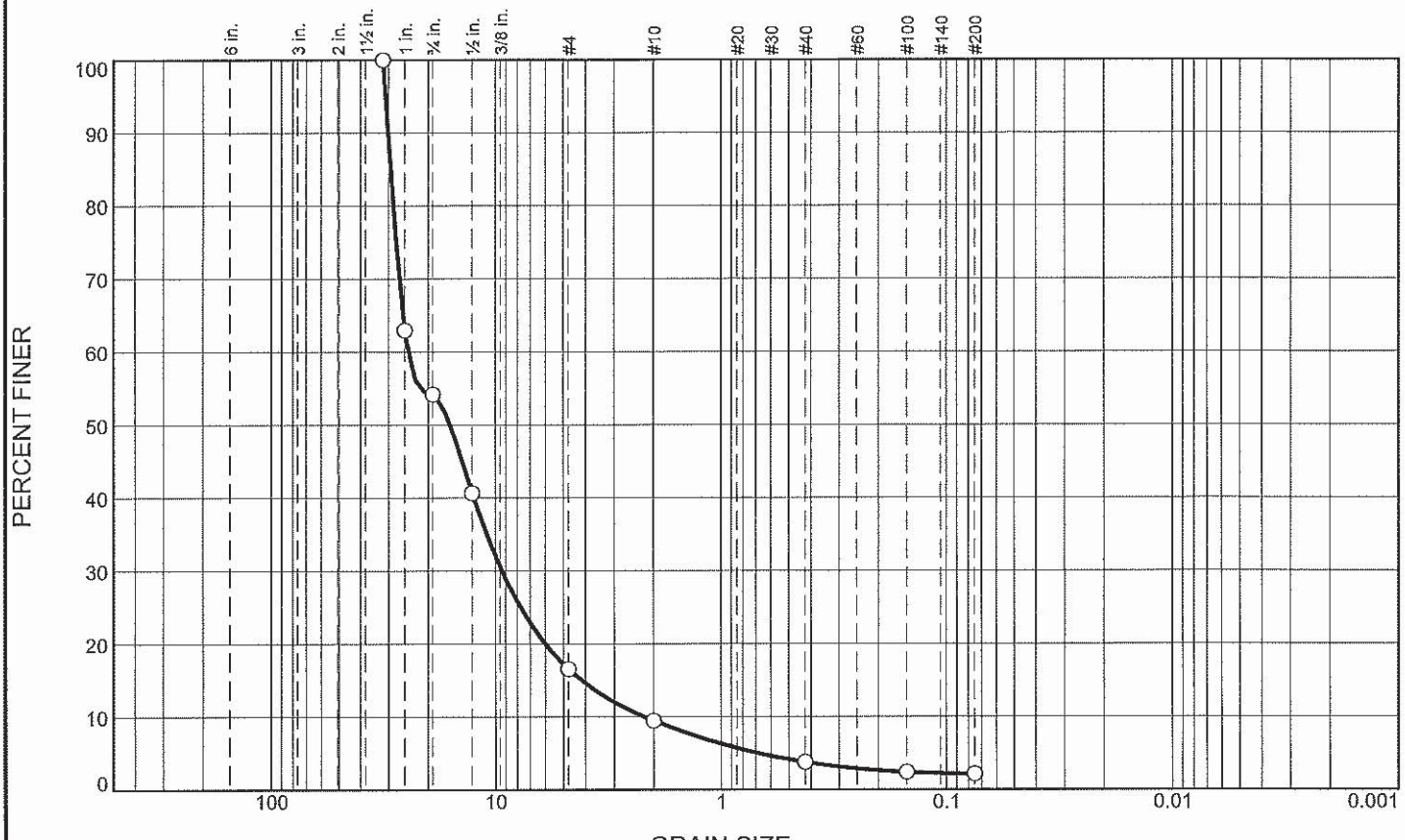
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	12.4	35.5	47.9	17.2	17.1	10.9	45.2			6.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1783	0.3194	0.5326	1.3841	4.3889	6.1518	12.7000	17.2909	20.3995	22.8974

Fineness Modulus	C_u	C_c
4.77	34.51	1.75

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	45.8	37.7	7.0	5.7	1.7	2.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/4"	100.0		
1"	62.9		
3/4"	54.2		
1/2"	40.7		
#4	16.5		
#10	9.5		
#40	3.8		
#100	2.4		
#200	2.1		

* (no specification provided)

Soil Description

GRAVEL

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 30.1718 D_{85}= 29.3874 D_{60}= 24.5748
D_{50}= 15.9649 D_{30}= 9.3631 D_{15}= 4.1644
D_{10}= 2.1989 C_u= 11.18 C_c= 1.62

Classification

USCS= GW AASHTO=

Remarks

Location: G034 S-15
Sample Number: 7995-51 **Depth:** 55'-56.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G034 S-15
Depth: 55'-56.5'
Sample Number: 7995-51
Material Description: GRAVEL
Date: 10/21/2017
USCS Classification: GW
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 235.60
Tare Wt. = 15.70
Minus #200 from wash = 2.2%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
240.50	15.70	1 1/4"	0.00	0.00	100.0
		1"	83.30	0.00	62.9
		3/4"	19.70	0.00	54.2
		1/2"	30.40	0.00	40.7
		#4	54.20	0.00	16.5
		#10	15.90	0.00	9.5
		#40	12.80	0.00	3.8
		#100	3.10	0.00	2.4
		#200	0.60	0.00	2.1

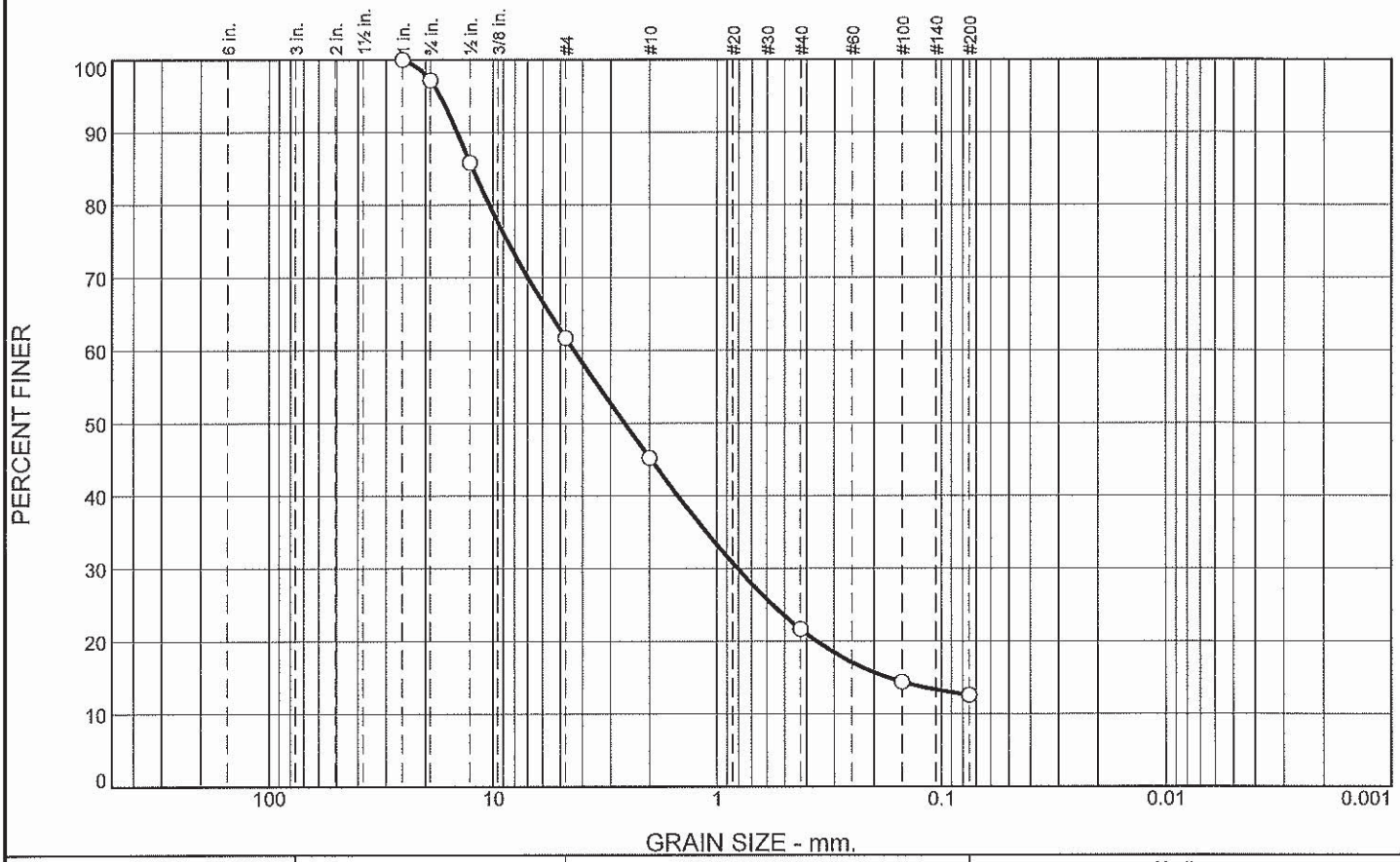
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	45.8	37.7	83.5	7.0	5.7	1.7	14.4			2.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
2.1989	4.1644	6.0131	9.3631	15.9649	24.5748	28.5903	29.3874	30.1718	30.9558

Fineness Modulus	C_u	C_c
6.71	11.18	1.62

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.9	35.4	16.5	23.5	9.1	12.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	97.1		
1/2"	85.8		
#4	61.7		
#10	45.2		
#40	21.7		
#100	14.4		
#200	12.6		

* (no specification provided)

Soil Description

SILTY SAND WITH GRAVEL

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 14.4973 D_{85}= 12.3640 D_{60}= 4.3631
D_{50}= 2.5968 D_{30}= 0.8097 D_{15}= 0.1729
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G034 S-23
Sample Number: 7995-53 **Depth:** 95'-96.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G034 S-23
Depth: 95'-96.5' **Sample Number:** 7995-53
Material Description: SILTY SAND WITH GRAVEL
Date: 10/21/2017
USCS Classification: SM
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 431.00
Tare Wt. = 15.70
Minus #200 from wash = 12.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
487.70	15.70	1"	0.00	0.00	100.0
		3/4"	13.50	0.00	97.1
		1/2"	53.40	0.00	85.8
		#4	113.80	0.00	61.7
		#10	77.90	0.00	45.2
		#40	111.20	0.00	21.7
		#100	34.20	0.00	14.4
		#200	8.60	0.00	12.6

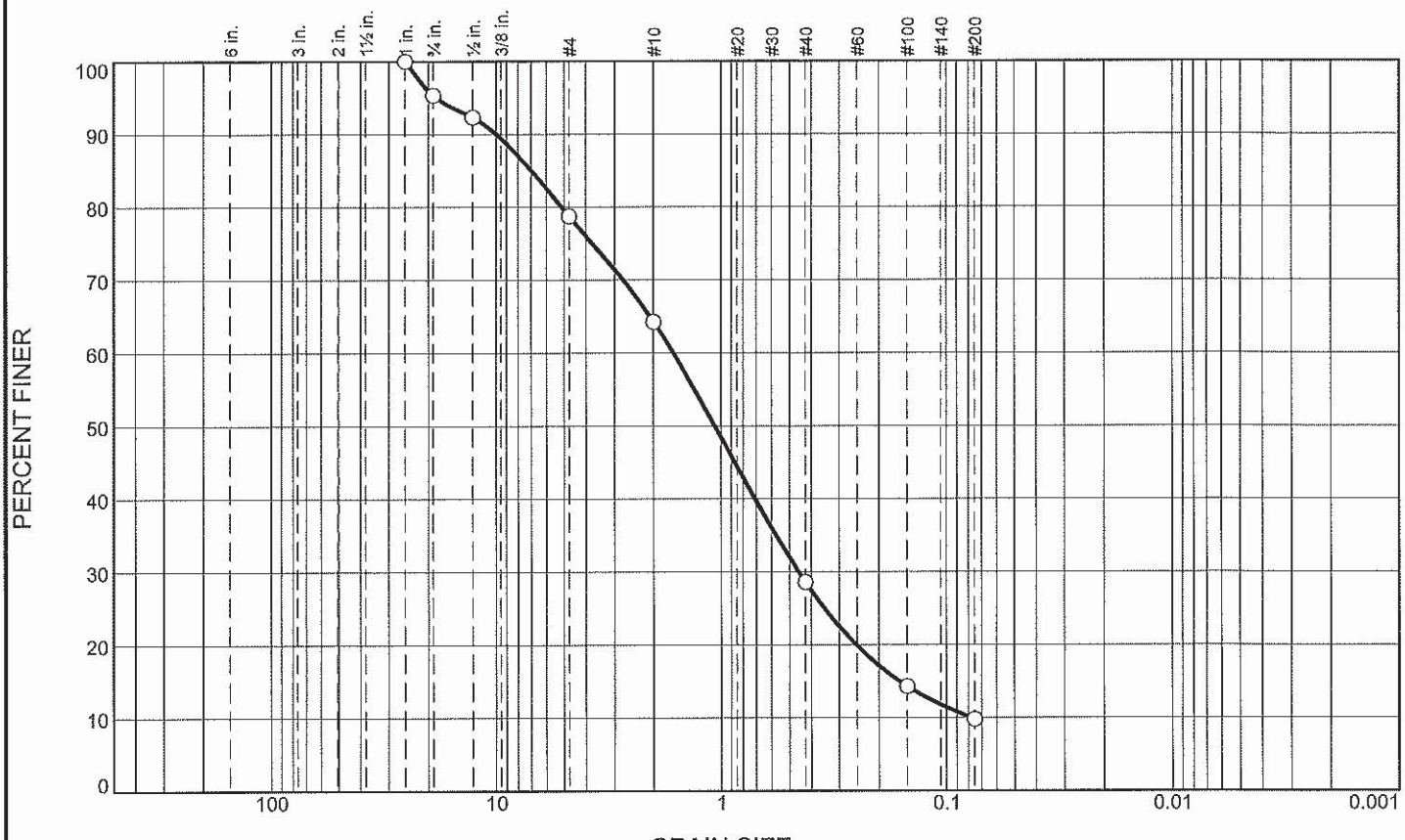
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	2.9	35.4	38.3	16.5	23.5	9.1	49.1			12.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.1729	0.3602	0.8097	2.5968	4.3631	10.4139	12.3640	14.4973	17.2540

Fineness Modulus
4.21

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.7	16.6	14.5	35.6	18.8	9.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	95.3		
1/2"	92.3		
#4	78.7		
#10	64.2		
#40	28.6		
#100	14.3		
#200	9.8		

* (no specification provided)

Soil Description

SAND WITH SILT AND GRAVEL

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 10.0106 D_{85}= 7.0044 D_{60}= 1.6330
D_{50}= 1.0673 D_{30}= 0.4559 D_{15}= 0.1623
D_{10}= 0.0776 C_u= 21.04 C_c= 1.64

Classification

USCS= SW-SM AASHTO=

Remarks

Location: G034 S-26
Sample Number: 7995-54 **Depth:** 110'-111.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G034 S-26
Depth: 110'-111.5'
Sample Number: 7995-54
Material Description: SAND WITH SILT AND GRAVEL
Date: 10/21/2017
USCS Classification: SW-SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 425.30
Tare Wt. = 15.80
Minus #200 from wash = 8.9%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
465.30	15.80	1"	0.00	0.00	100.0
		3/4"	21.10	0.00	95.3
		1/2"	13.50	0.00	92.3
		#4	61.10	0.00	78.7
		#10	65.00	0.00	64.2
		#40	160.30	0.00	28.6
		#100	64.20	0.00	14.3
		#200	20.20	0.00	9.8

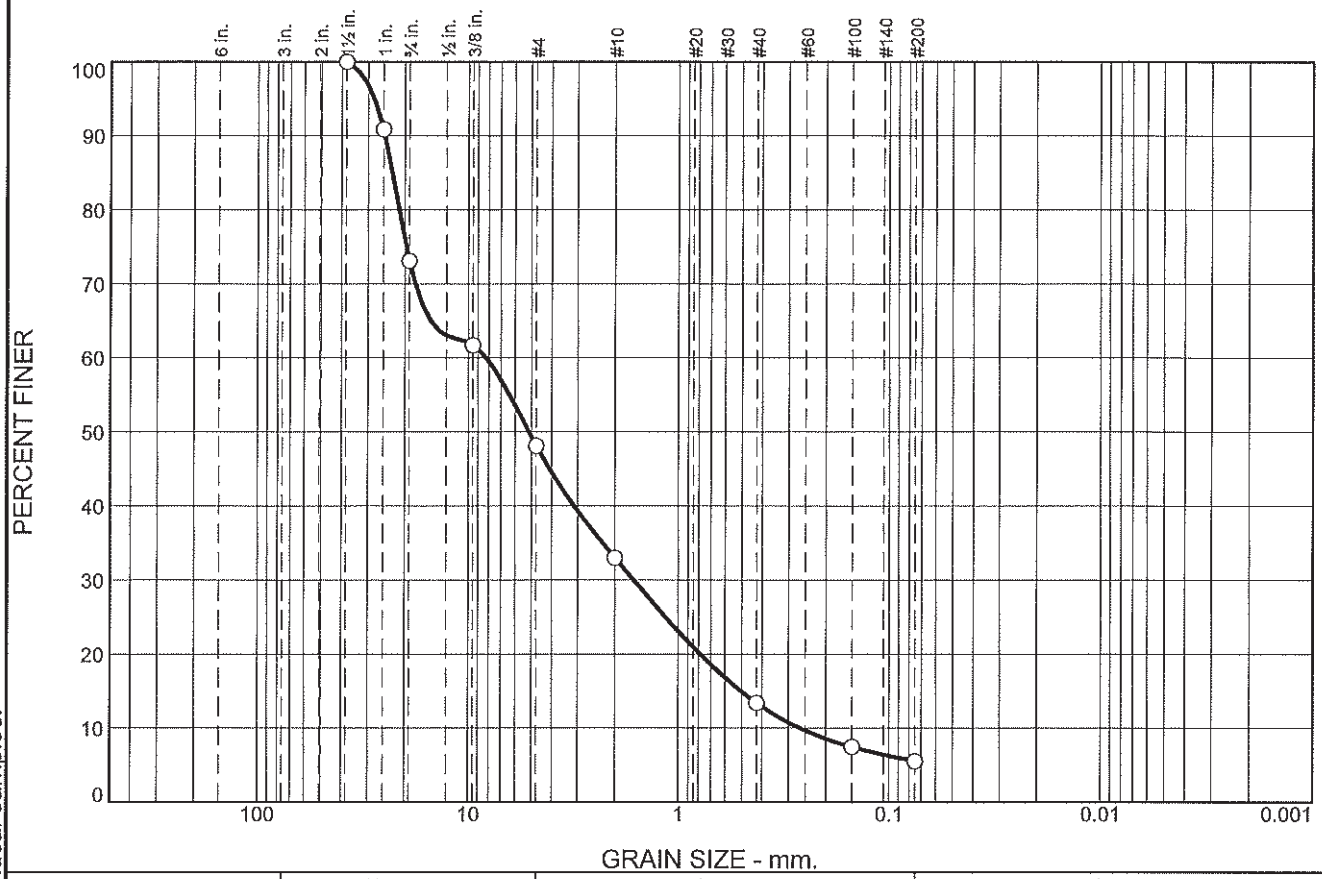
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	4.7	16.6	21.3	14.5	35.6	18.8	68.9			9.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0776	0.1623	0.2527	0.4559	1.0673	1.6330	5.1438	7.0044	10.0106	18.5467

Fineness Modulus	C_u	C_c
3.44	21.04	1.64

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	26.9	25.0	15.1	19.6	7.9	5.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2"	100.0		
1"	90.9		
3/4"	73.1		
3/8"	61.7		
#4	48.1		
#10	33.0		
#40	13.4		
#100	7.4		
#200	5.5		

* (no specification provided)

Soil Description

GRAVEL with Silt and Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 24.9854 D_{85}= 22.9915 D_{60}= 8.2435
D_{50}= 5.1616 D_{30}= 1.6320 D_{15}= 0.5052
D_{10}= 0.2651 C_u= 31.10 C_c= 1.22

Classification

USCS= GW-GM AASHTO=

Remarks

Location: G34A S4
Sample Number: 8023-20 **Depth:** 125' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G34A S4
Depth: 125'
Sample Number: 8023-20
Material Description: GRAVEL with Silt and Sand
Date: 2/22/2018
USCS Classification: GW-GM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 340.74
Tare Wt. = 15.99
Minus #200 from wash = 5.5%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
359.62	15.99	0.00	1 1/2"	0.00	100.0
			1"	31.40	90.9
			3/4"	92.36	73.1
			3/8"	131.56	61.7
			#4	178.38	48.1
			#10	230.23	33.0
			#40	297.64	13.4
			#100	318.03	7.4
			#200	324.64	5.5

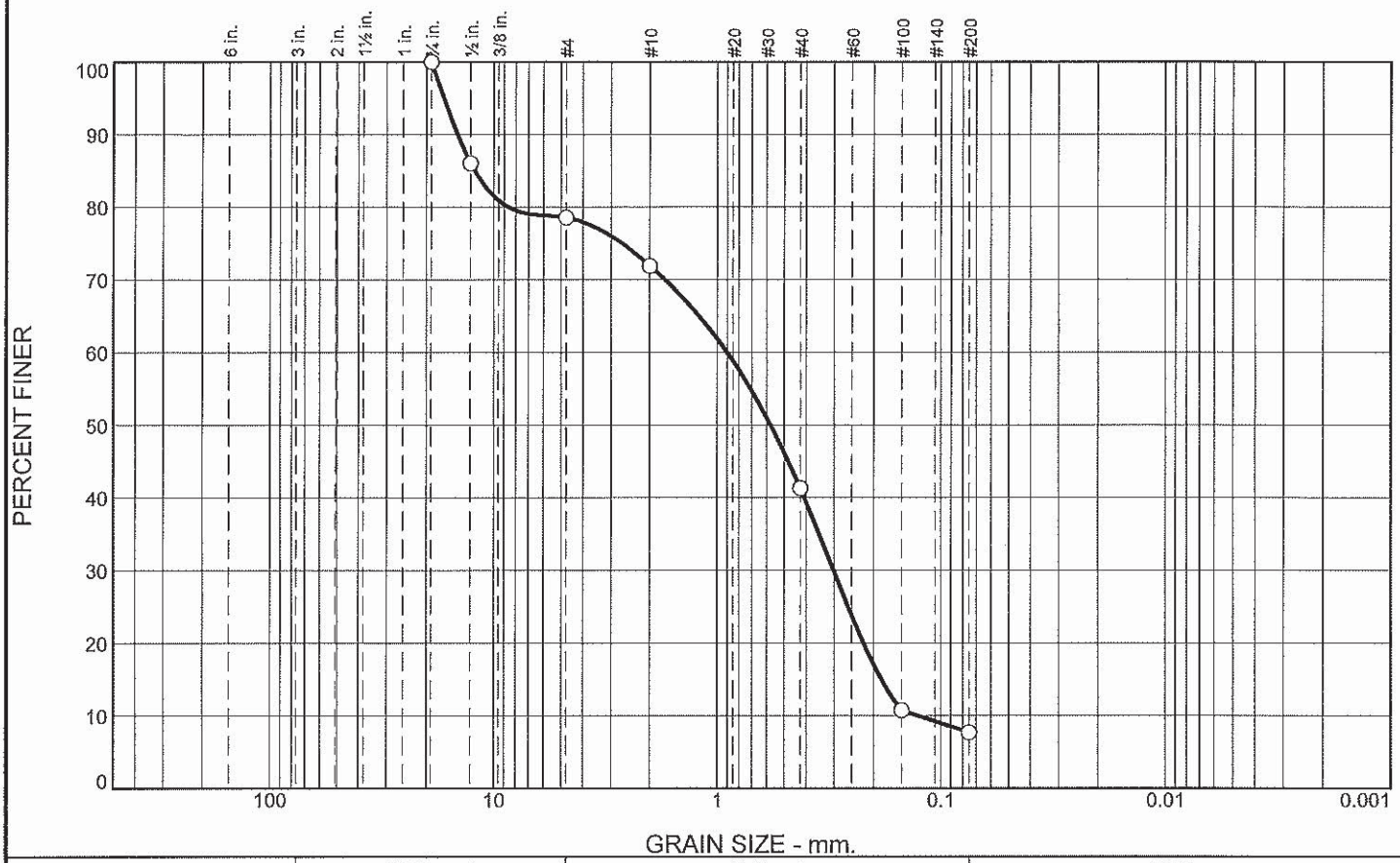
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	26.9	25.0	51.9	15.1	19.6	7.9	42.6			5.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.2651	0.5052	0.7877	1.6320	5.1616	8.2435	21.3145	22.9915	24.9854	28.0899

Fineness Modulus	C_u	C_c
5.21	31.10	1.22

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	21.4	6.7	30.6	33.6	7.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	86.0		
#4	78.6		
#10	71.9		
#40	41.3		
#100	10.7		
#200	7.7		

* (no specification provided)

Soil Description

SAND WITH SILT AND GRAVEL

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 14.5247 D_{85}= 12.1865 D_{60}= 0.9049
D_{50}= 0.5777 D_{30}= 0.3024 D_{15}= 0.1850
D_{10}= 0.1267 C_u= 7.14 C_c= 0.80

Classification

USCS= SW-SM AASHTO=

Remarks

Location: G035 S-9
Sample Number: 7995-58 **Depth:** 30'-31.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G035 S-9
Depth: 30'-31.5'
Sample Number: 7995-58
Material Description: SAND WITH SILT AND GRAVEL
Date: 10/21/2017
USCS Classification: SW-SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 266.90
Tare Wt. = 15.80
Minus #200 from wash = 7.3%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
286.80	15.80	3/4"	0.00	0.00	100.0
		1/2"	37.90	0.00	86.0
		#4	20.20	0.00	78.6
		#10	18.10	0.00	71.9
		#40	82.90	0.00	41.3
		#100	82.80	0.00	10.7
		#200	8.20	0.00	7.7

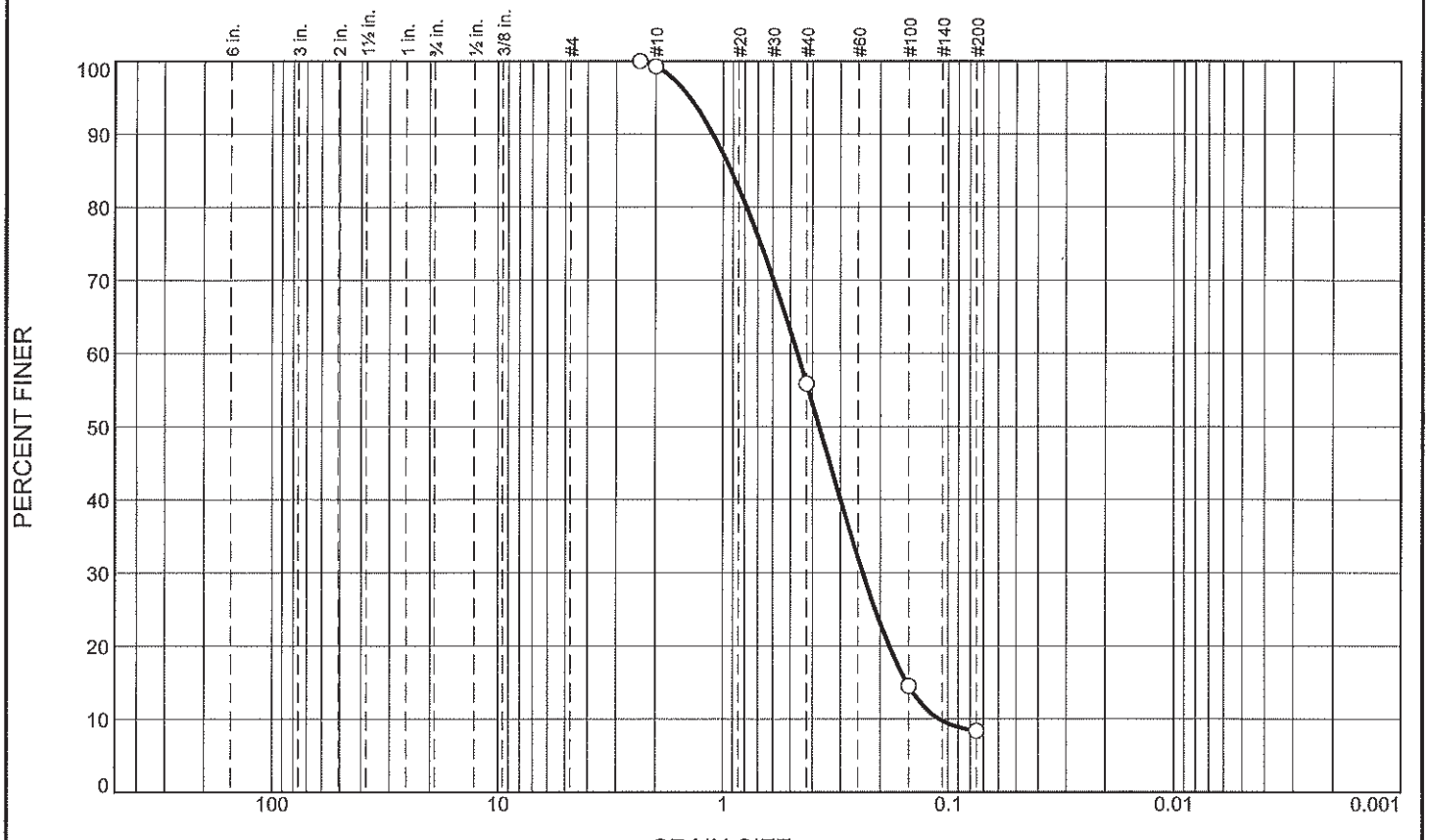
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	21.4	21.4	6.7	30.6	33.6	70.9			7.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1267	0.1850	0.2221	0.3024	0.5777	0.9049	8.6367	12.1865	14.5247	16.7215

Fineness Modulus	C_u	C_c
3.11	7.14	0.80

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.7	43.4	47.5	8.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#10	99.3		
#40	55.9		
#100	14.5		
#200	8.4		

* (no specification provided)

Soil Description

SAND WITH SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.1111 D_{85}= 0.9226 D_{60}= 0.4669
D_{50}= 0.3733 D_{30}= 0.2391 D_{15}= 0.1531
D_{10}= 0.1098 C_u= 4.25 C_c= 1.12

Classification

USCS= SW-SM AASHTO=

Remarks

Location: G035 S-18
Sample Number: 7995-62 **Depth:** 75'-76.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G035 S-18
Depth: 75'-76.5'
Sample Number: 7995-62
Material Description: SAND WITH SILT
Date: 10/21/2017
USCS Classification: SW-SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 321.50
Tare Wt. = 15.80
Minus #200 from wash = 6.7%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
343.30	15.80	#8	0.00	0.00	100.0
		#10	2.40	0.00	99.3
		#40	142.10	0.00	55.9
		#100	135.40	0.00	14.5
		#200	20.10	0.00	8.4

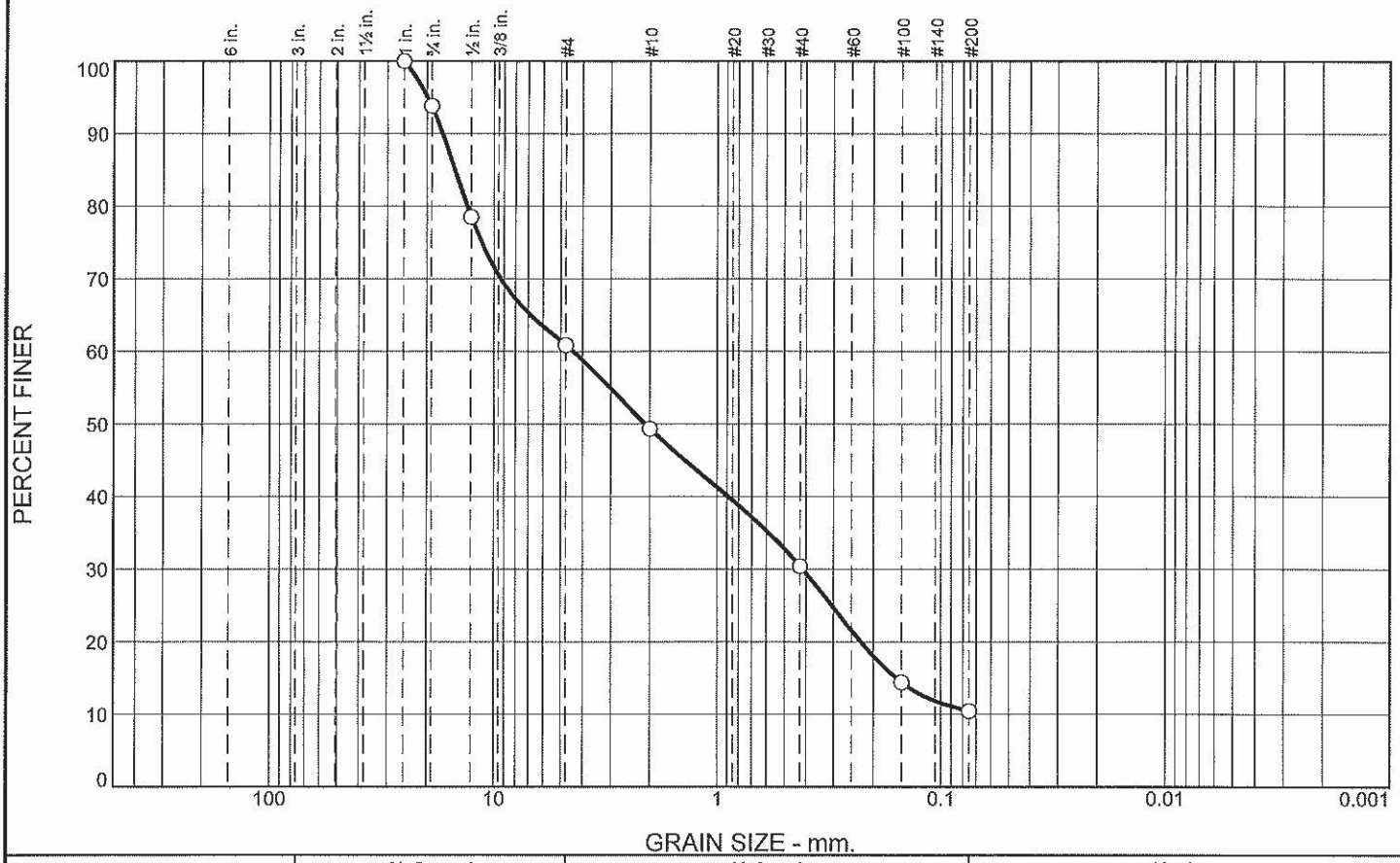
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.7	43.4	47.5	91.6			8.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1098	0.1531	0.1830	0.2391	0.3733	0.4669	0.7860	0.9226	1.1111	1.4076

Fineness Modulus	C_u	C_c
1.84	4.25	1.12

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.2	33.0	11.4	19.0	19.9	10.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	93.8		
1/2"	78.5		
#4	60.8		
#10	49.4		
#40	30.4		
#100	14.4		
#200	10.5		

* (no specification provided)

Soil Description

SAND WITH SILT AND GRAVEL

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 17.0320 D_{85}= 15.0014 D_{60}= 4.4216
D_{50}= 2.1017 D_{30}= 0.4143 D_{15}= 0.1585
D_{10}= C_u= C_c=

Classification

USCS= SW-SM AASHTO=

Remarks

Location: G035 S-26
Sample Number: 7995-66 **Depth:** 115'-116.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G035 S-26
Depth: 115'-116.5' **Sample Number:** 7995-66
Material Description: SAND WITH SILT AND GRAVEL
Date: 10/21/2017
USCS Classification: SW-SM
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 399.30
Tare Wt. = 15.80
Minus #200 from wash = 9.7%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
440.50	15.80	1"	0.00	0.00	100.0
		3/4"	26.30	0.00	93.8
		1/2"	64.90	0.00	78.5
		#4	75.10	0.00	60.8
		#10	48.80	0.00	49.4
		#40	80.50	0.00	30.4
		#100	67.90	0.00	14.4
		#200	16.80	0.00	10.5

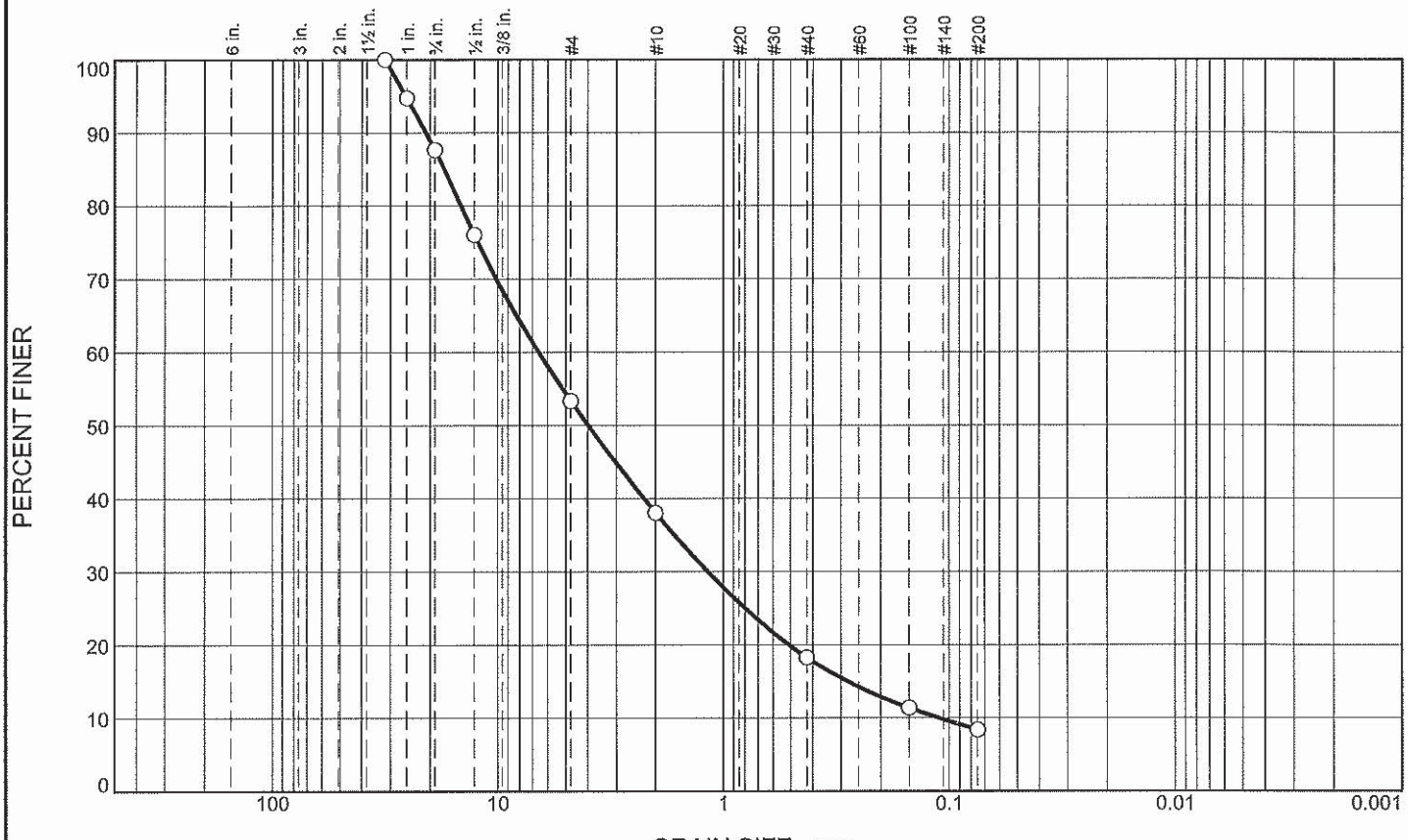
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	6.2	33.0	39.2	11.4	19.0	19.9	50.3			10.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.1585	0.2272	0.4143	2.1017	4.4216	13.2200	15.0014	17.0320	19.8753

Fineness Modulus
4.06

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.4	34.3	15.3	19.7	9.9	8.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/4"	100.0		
1"	94.7		
3/4"	87.6		
1/2"	76.0		
#4	53.3		
#10	38.0		
#40	18.3		
#100	11.4		
#200	8.4		

* (no specification provided)

Soil Description

GRAVEL WITH SILT AND SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 20.9084 D_{85}= 17.3339 D_{60}= 6.5982
D_{50}= 3.9878 D_{30}= 1.1707 D_{15}= 0.2802
D_{10}= 0.1107 C_u= 59.63 C_c= 1.88

Classification

USCS= GW-GM AASHTO=

Remarks

Location: G035 S-35
Sample Number: 7995-69 **Depth:** 155'-156.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G035 S-35
Depth: 155'-156.5' **Sample Number:** 7995-69
Material Description: GRAVEL WITH SILT AND SAND
Date: 10/21/2017
USCS Classification: GW-GM
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 445.90
Tare Wt. = 15.80
Minus #200 from wash = 7.2%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
479.50	15.80	1 1/4"	0.00	0.00	100.0
		1"	24.60	0.00	94.7
		3/4"	32.90	0.00	87.6
		1/2"	53.80	0.00	76.0
		#4	105.10	0.00	53.3
		#10	70.90	0.00	38.0
		#40	91.60	0.00	18.3
		#100	32.00	0.00	11.4
		#200	13.90	0.00	8.4

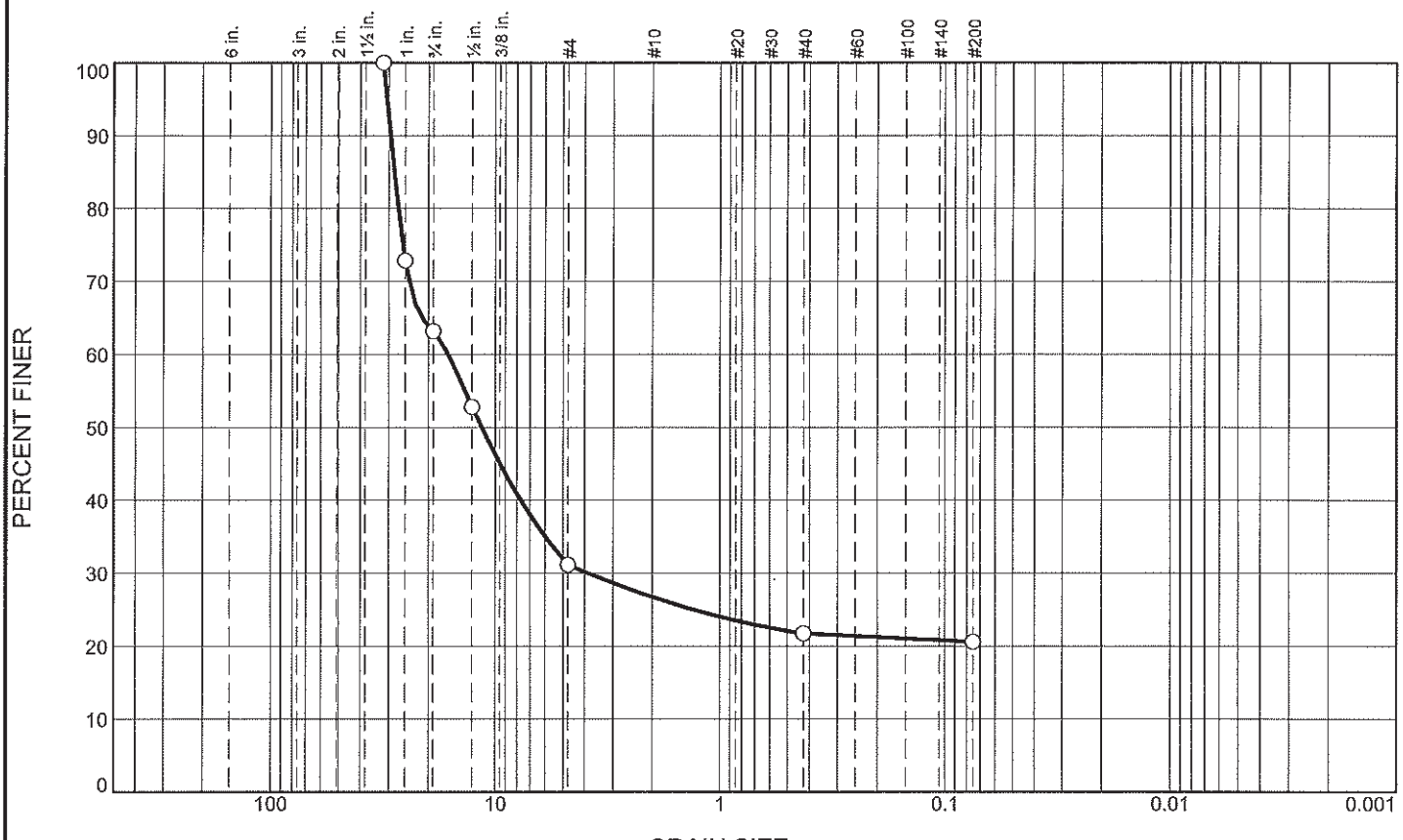
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	12.4	34.3	46.7	15.3	19.7	9.9	44.9			8.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1107	0.2802	0.5094	1.1707	3.9878	6.5982	14.5881	17.3339	20.9084	25.7288

Fineness Modulus	C_u	C_c
4.71	59.63	1.88

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	36.8	32.1	4.4	4.9	1.2	20.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/4"	100.0		
1"	72.9		
3/4"	63.2		
1/2"	52.8		
#4	31.1		
#40	21.8		
#200	20.6		

* (no specification provided)

Soil Description

SILTY GRAVEL

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 29.5560 D_{85}= 28.4545 D_{60}= 16.3660
D_{50}= 11.5165 D_{30}= 3.8766 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO=

Remarks

Location: G035 S-44
Sample Number: 7995-73 **Depth:** 200'-201.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G035 S-44
Depth: 200'-201.5'
Sample Number: 7995-73
Material Description: SILTY GRAVEL
Date: 10/21/2017
USCS Classification: GM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 455.40
Tare Wt. = 15.80
Minus #200 from wash = 6.6%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
486.60	15.80	1 1/4"	0.00	0.00	100.0
		1"	127.80	0.00	72.9
		3/4"	45.60	0.00	63.2
		1/2"	48.90	0.00	52.8
		#4	101.90	0.00	31.1
		#40	44.20	0.00	21.8
		#200	5.50	0.00	20.6

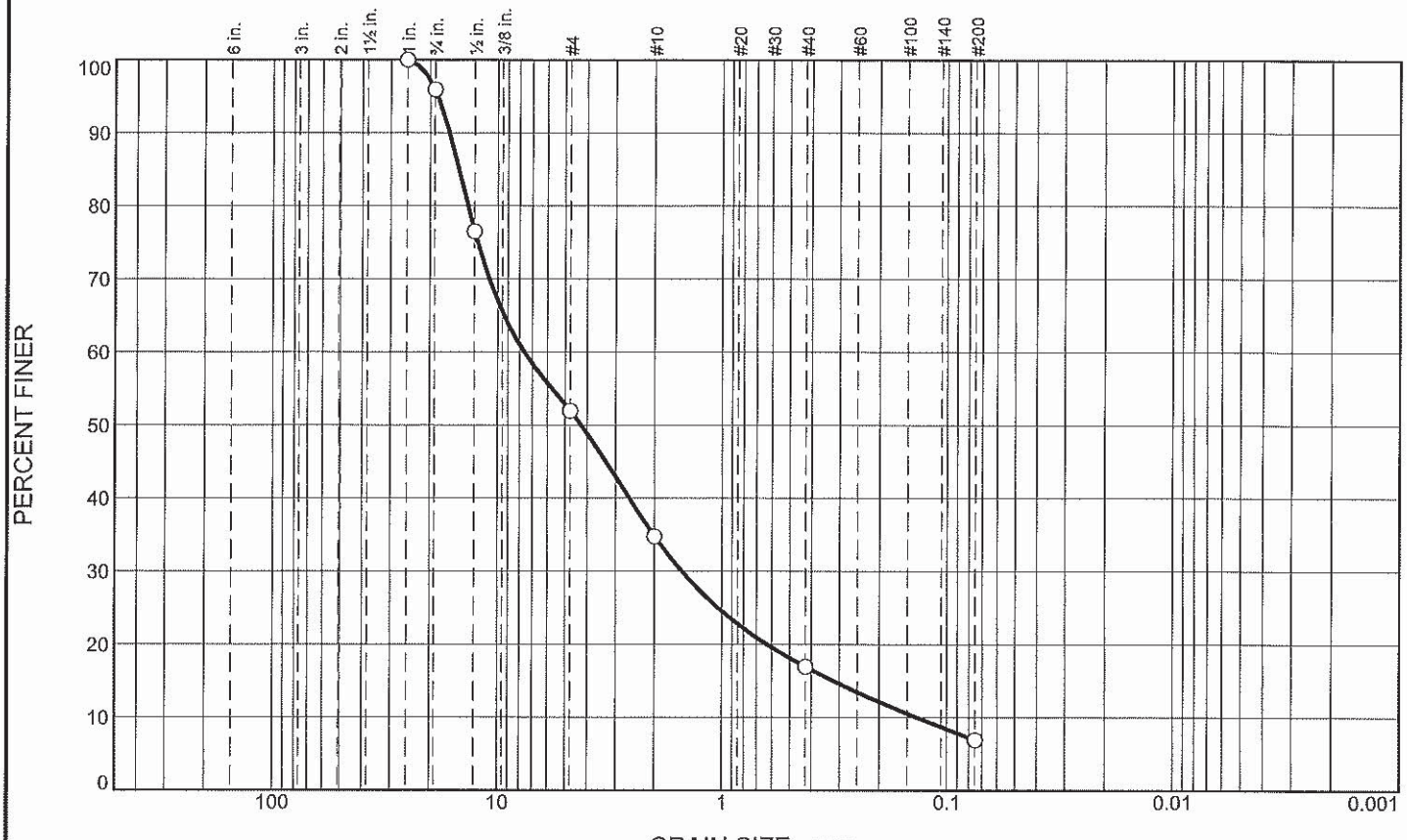
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	36.8	32.1	68.9	4.4	4.9	1.2	10.5			20.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			3.8766	11.5165	16.3660	27.3030	28.4545	29.5560	30.6455

Fineness Modulus
5.43

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.1	43.9	17.2	17.9	10.0	6.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	95.9		
1/2"	76.5		
#4	52.0		
#10	34.8		
#40	16.9		
#200	6.9		

* (no specification provided)

Soil Description

Gravel with Silt and Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 16.4669 D_{85}= 14.9407 D_{60}= 7.6285
D_{50}= 4.2586 D_{30}= 1.5076 D_{15}= 0.3192
D_{10}= 0.1358 C_u= 56.17 C_c= 2.19

Classification

USCS= GW-GM AASHTO=

Remarks

Location: G036 S-11
Sample Number: 8000-32 **Depth:** 35'-36.5' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036 S-11
Depth: 35'-36.5'
Sample Number: 8000-32
Material Description: Gravel with Silt and Sand
Date: 11/5/17
USCS Classification: GW-GM
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 324.10
Tare Wt. = 15.80
Minus #200 from wash = 6.5%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
345.70	15.80	1"	0.00	0.00	100.0
		3/4"	13.50	0.00	95.9
		1/2"	64.00	0.00	76.5
		#4	81.00	0.00	52.0
		#10	56.70	0.00	34.8
		#40	58.80	0.00	16.9
		#200	33.10	0.00	6.9

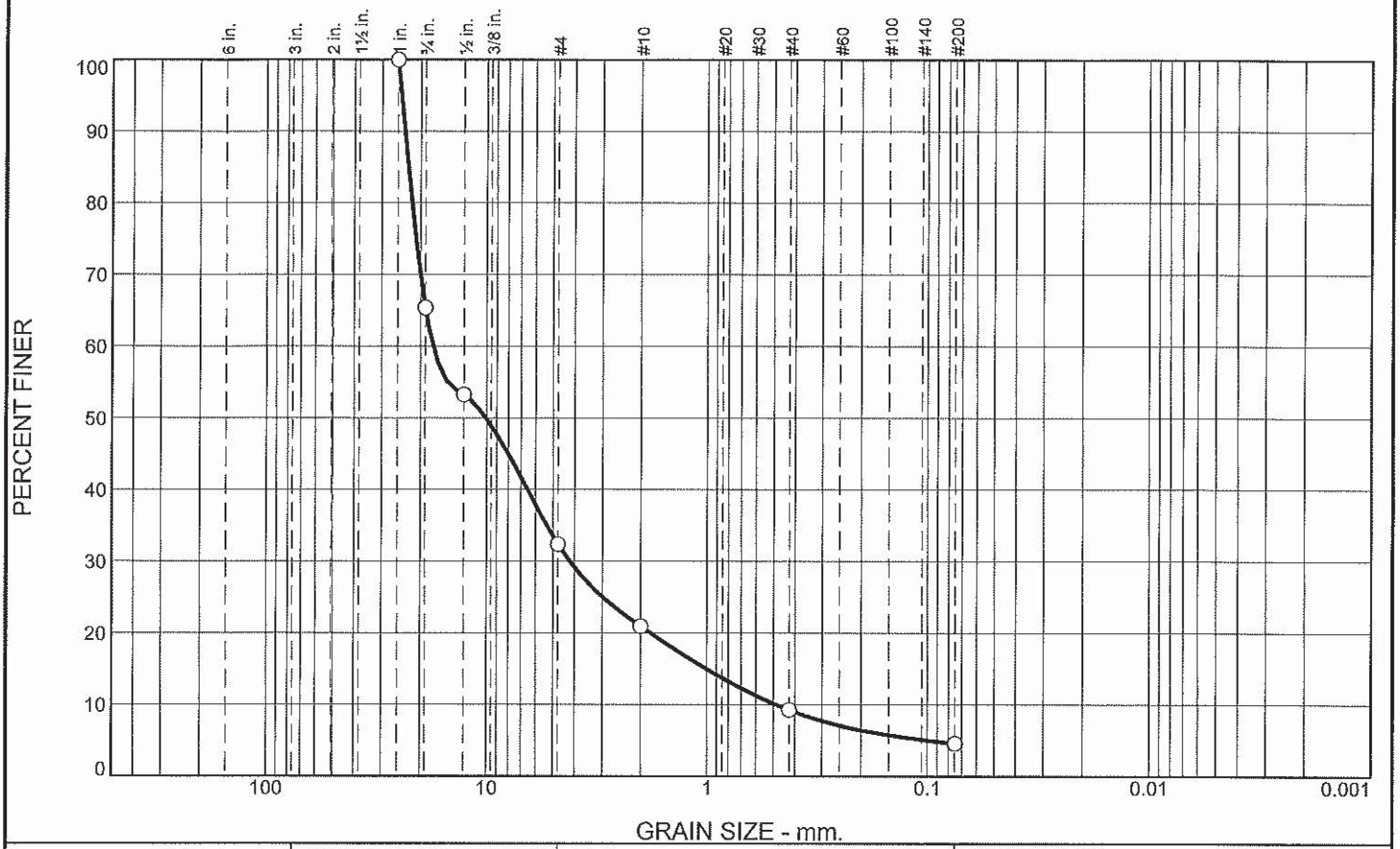
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	4.1	43.9	48.0	17.2	17.9	10.0	45.1			6.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1358	0.3192	0.6312	1.5076	4.2586	7.6285	13.6047	14.9407	16.4669	18.5281

Fineness Modulus	C_u	C_c
4.77	56.17	2.19

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	34.6	33.0	11.5	11.6	4.7	4.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	65.4		
1/2"	53.2		
#4	32.4		
#10	20.9		
#40	9.3		
#200	4.6		

* (no specification provided)

Soil Description

Gravel with Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 23.6315 D_{85}= 22.7653 D_{60}= 17.5630
D_{50}= 10.1179 D_{30}= 4.2026 D_{15}= 1.0046
D_{10}= 0.4854 C_u= 36.18 C_c= 2.07

Classification

USCS= GW AASHTO=

Remarks

Location: G036 S-17
Sample Number: 8000-35 **Depth:** 65'-66.5 **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036 S-17
Depth: 65'-66.5 **Sample Number:** 8000-35
Material Description: Gravel with Sand
Date: 11/5/17
USCS Classification: GW
Tested by: SR **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 266.70
Tare Wt. = 15.90
Minus #200 from wash = 4.2%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
277.60	15.90	1"	0.00	0.00	100.0
		3/4"	90.60	0.00	65.4
		1/2"	31.80	0.00	53.2
		#4	54.60	0.00	32.4
		#10	29.90	0.00	20.9
		#40	30.50	0.00	9.3
		#200	12.30	0.00	4.6

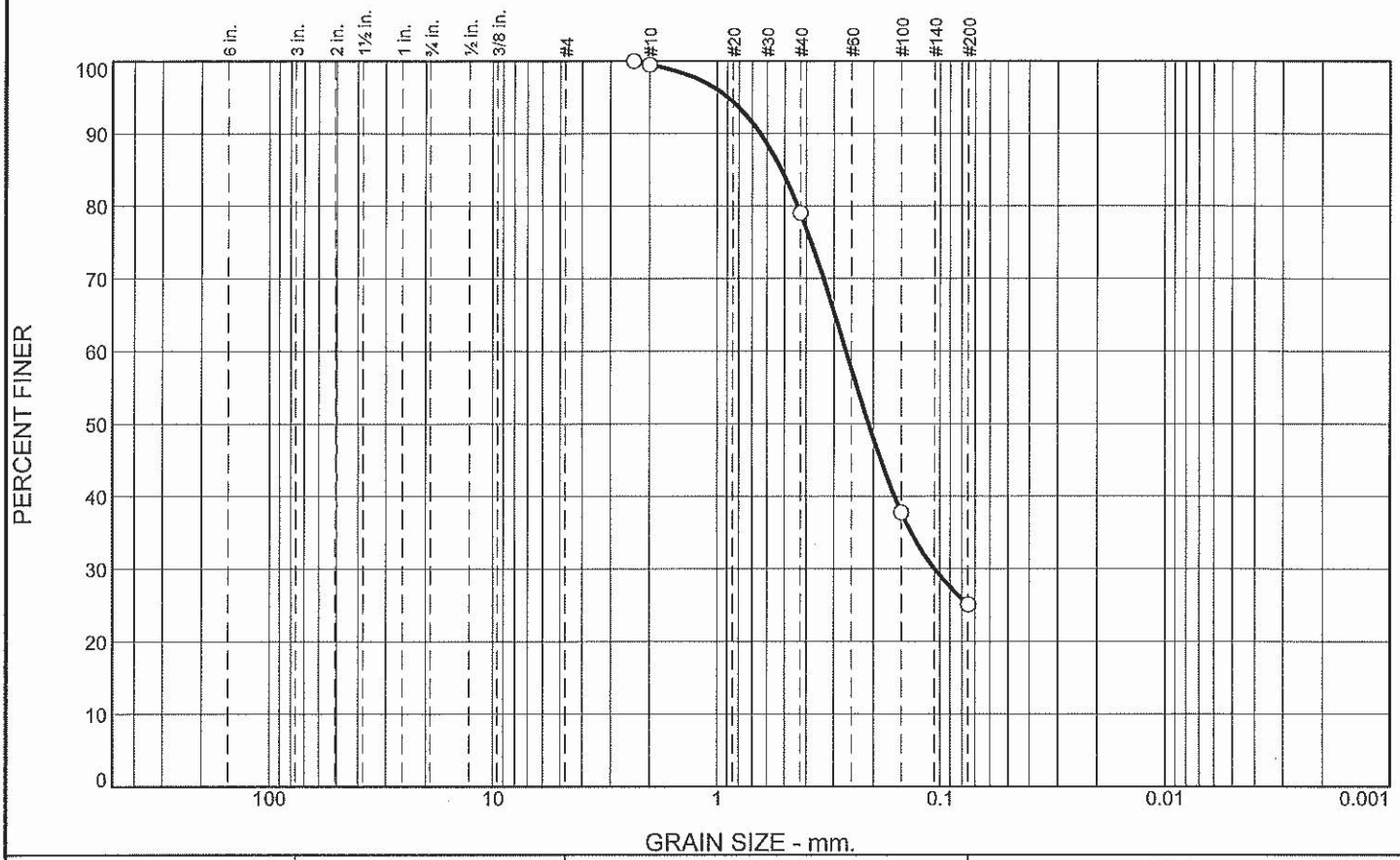
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	34.6	33.0	67.6	11.5	11.6	4.7	27.8			4.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.4854	1.0046	1.8037	4.2026	10.1179	17.5630	21.8929	22.7653	23.6315	24.5056

Fineness Modulus	C_u	C_c
5.90	36.18	2.07

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.5	20.5	53.9	25.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#10	99.5		
#40	79.0		
#100	37.8		
#200	25.1		

* (no specification provided)

Soil Description

SILTY SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6449 D_{85}= 0.5183 D_{60}= 0.2655
D_{50}= 0.2102 D_{30}= 0.1062 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G037 S-25
Sample Number: 7995-84 **Depth:** 135'-136.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-25
Depth: 135'-136.5'
Sample Number: 7995-84
Material Description: SILTY SAND
Date: 10/21/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 380.60
Tare Wt. = 15.80
Minus #200 from wash = 20.2%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
473.20	15.80	#8	0.00	0.00	100.0
		#10	2.30	0.00	99.5
		#40	93.70	0.00	79.0
		#100	188.60	0.00	37.8
		#200	57.90	0.00	25.1

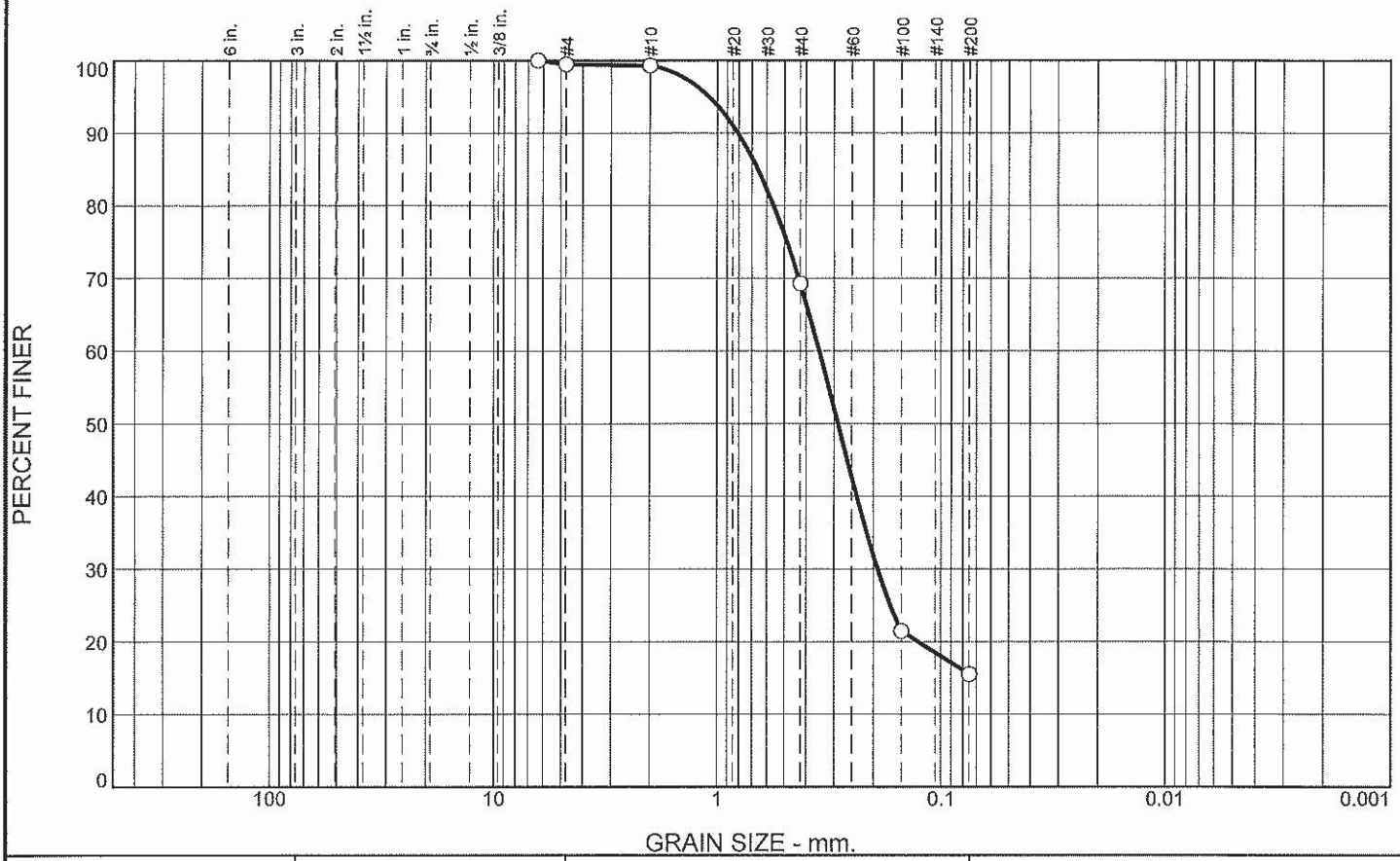
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.5	20.5	53.9	74.9			25.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.1062	0.2102	0.2655	0.4377	0.5183	0.6449	0.9000

Fineness Modulus
1.11

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.5	0.2	30.0	53.8	15.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	99.5		
#10	99.3		
#40	69.3		
#100	21.5		
#200	15.5		

* (no specification provided)

Soil Description

SILTY SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.8110 D_{85}= 0.6598 D_{60}= 0.3501
D_{50}= 0.2887 D_{30}= 0.1917 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G037 S-33
Sample Number: 7995-88 **Depth:** 180'-181.5' **Date:** 10/31/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-33
Depth: 180'-181.5'
Sample Number: 7995-88
Material Description: SILTY SAND
Date: 10/31/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 391.70
Tare Wt. = 15.80
Minus #200 from wash = 13.7%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
451.50	15.80	1/4"	0.00	0.00	100.0
		#4	2.30	0.00	99.5
		#10	0.80	0.00	99.3
		#40	130.70	0.00	69.3
		#100	208.40	0.00	21.5
		#200	25.80	0.00	15.5

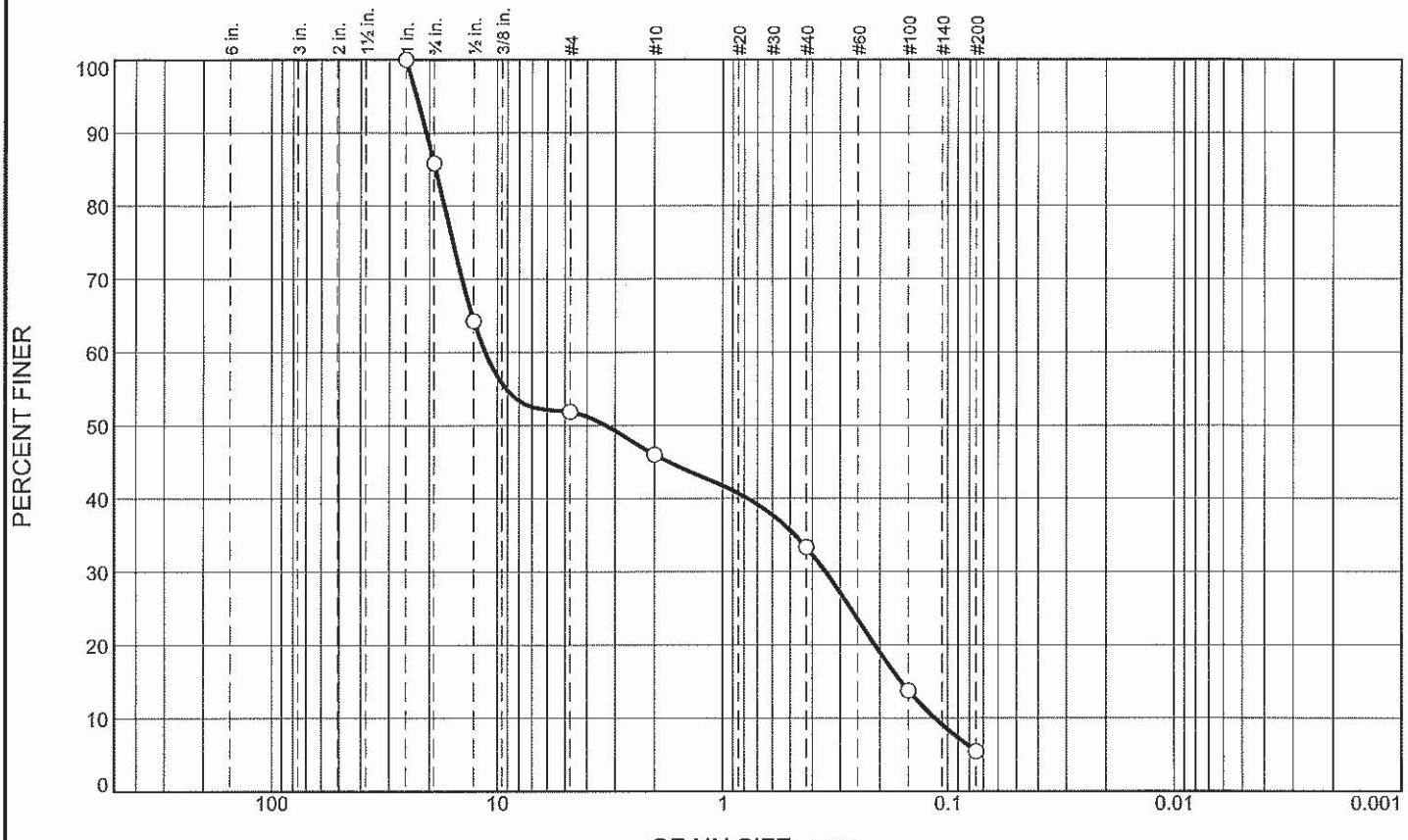
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.5	0.5	0.2	30.0	53.8	84.0			15.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.1264	0.1917	0.2887	0.3501	0.5599	0.6598	0.8110	1.0906

Fineness Modulus
1.50

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.2	33.9	5.9	12.6	27.9	5.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	85.8		
1/2"	64.2		
#4	51.9		
#10	46.0		
#40	33.4		
#100	13.8		
#200	5.5		

* (no specification provided)

Soil Description

GRAVEL WITH SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 20.6505 D_{85}= 18.7716 D_{60}= 11.3271
D_{50}= 3.3059 D_{30}= 0.3492 D_{15}= 0.1615
D_{10}= 0.1144 C_u= 99.03 C_c= 0.09

Classification

USCS= GW-GM AASHTO=

Remarks

Location: G037 S-39
Sample Number: 7995-91 **Depth:** 220'-221.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-39
Depth: 220'-221.5'
Sample Number: 7995-91
Material Description: GRAVEL WITH SILT
Date: 10/21/2017
USCS Classification: GW-GM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 353.10
Tare Wt. = 15.80
Minus #200 from wash = 15.4%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
414.30	15.80	1"	0.00	0.00	100.0
		3/4"	56.60	0.00	85.8
		1/2"	85.90	0.00	64.2
		#4	49.30	0.00	51.9
		#10	23.50	0.00	46.0
		#40	50.30	0.00	33.4
		#100	78.00	0.00	13.8
		#200	33.10	0.00	5.5

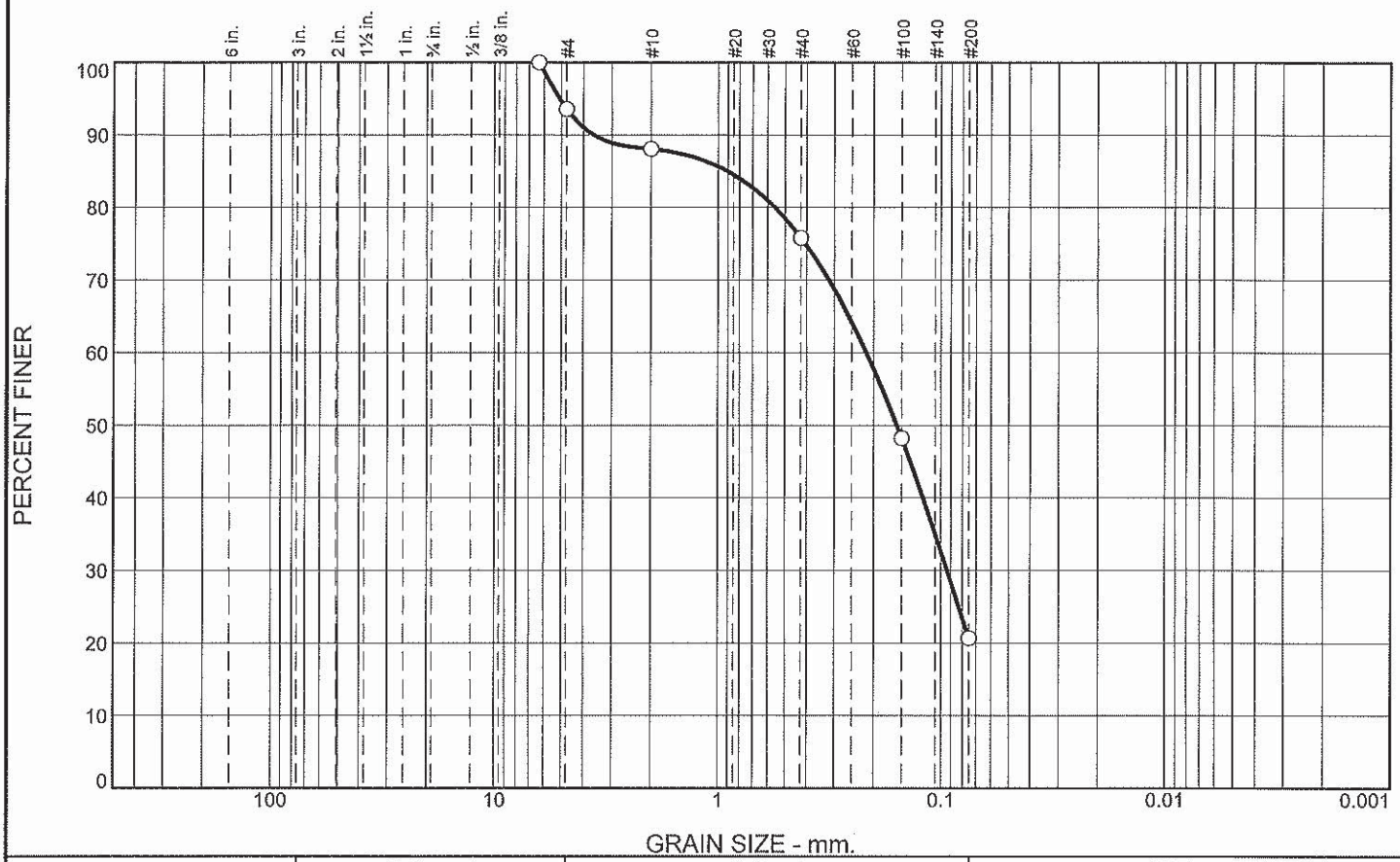
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	14.2	33.9	48.1	5.9	12.6	27.9	46.4			5.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1144	0.1615	0.2110	0.3492	3.3059	11.3271	17.1616	18.7716	20.6505	22.8602

Fineness Modulus	C_u	C_c
4.38	99.03	0.09

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.5	5.4	12.3	55.1	20.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	93.5		
#10	88.1		
#40	75.8		
#100	48.2		
#200	20.7		

* (no specification provided)

Soil Description

SILTY SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 3.6096 D_{85}= 0.9126 D_{60}= 0.2158
D_{50}= 0.1577 D_{30}= 0.0939 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G037 S-42
Sample Number: 7995-92 **Depth:** 240'-241.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-42
Depth: 240'-241.5'
Sample Number: 7995-92
Material Description: SILTY SAND
Date: 10/21/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 415.30
Tare Wt. = 15.80
Minus #200 from wash = 11.6%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
467.80	15.80	1/4"	0.00	0.00	100.0
		#4	29.20	0.00	93.5
		#10	24.80	0.00	88.1
		#40	55.30	0.00	75.8
		#100	124.70	0.00	48.2
		#200	124.60	0.00	20.7

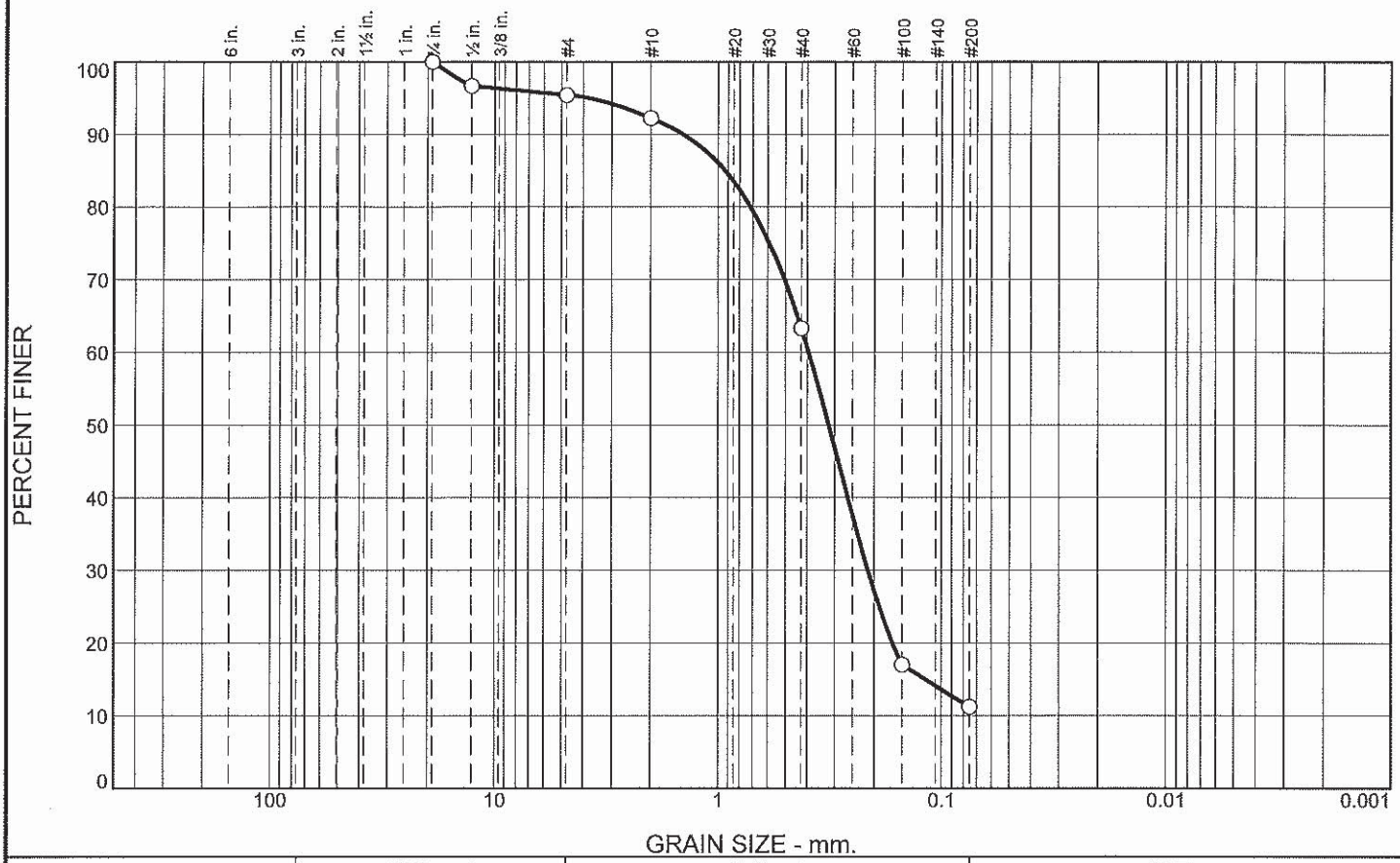
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	6.5	6.5	5.4	12.3	55.1	72.8			20.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0939	0.1577	0.2158	0.5572	0.9126	3.6096	5.1181

Fineness Modulus
1.34

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.6	3.2	28.9	52.1	11.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	96.7		
#4	95.4		
#10	92.2		
#40	63.3		
#100	17.0		
#200	11.2		

* (no specification provided)

Soil Description

SAND WITH SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.4391 D_{85}= 0.9321 D_{60}= 0.3941
D_{50}= 0.3202 D_{30}= 0.2135 D_{15}= 0.1180
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Location: G044 S-5
Sample Number: 7995-94 **Depth:** 6.0'-7.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-5
Depth: 6.0'-7.5'
Sample Number: 7995-94
Material Description: SAND WITH SILT
Date: 10/21/2017
USCS Classification: SP-SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 280.40
Tare Wt. = 15.80
Minus #200 from wash = 9.8%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
309.30	15.80	3/4"	0.00	0.00	100.0
		1/2"	9.80	0.00	96.7
		#4	3.70	0.00	95.4
		#10	9.40	0.00	92.2
		#40	84.80	0.00	63.3
		#100	135.90	0.00	17.0
		#200	17.00	0.00	11.2

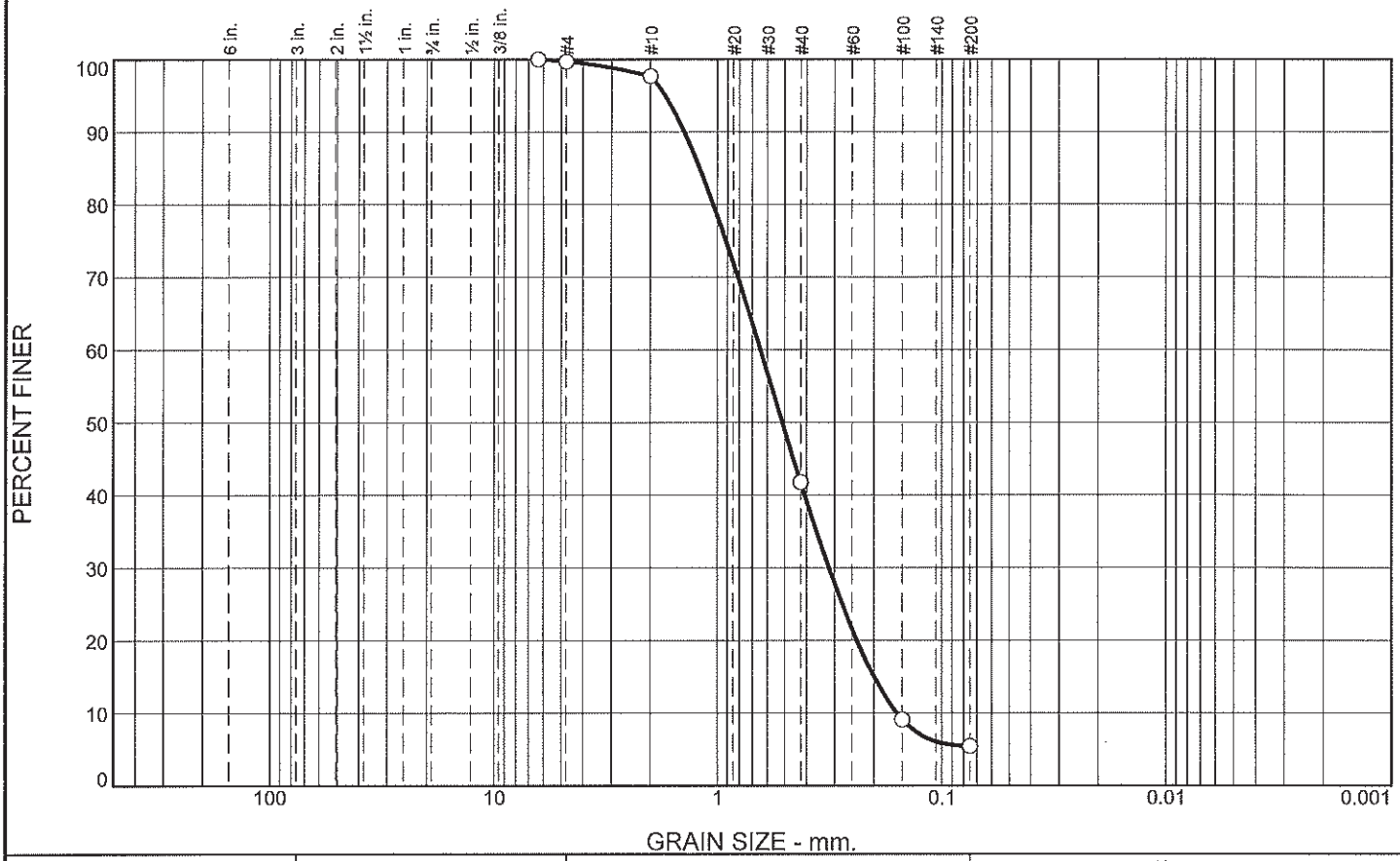
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	4.6	4.6	3.2	28.9	52.1	84.2			11.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.1180	0.1660	0.2135	0.3202	0.3941	0.7173	0.9321	1.4391	3.8072

Fineness Modulus
1.88

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	2.0	55.9	36.3	5.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	99.7		
#10	97.7		
#40	41.8		
#100	9.1		
#200	5.5		

* (no specification provided)

Soil Description

SAND WITH SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.4088 D_{85}= 1.2009 D_{60}= 0.6443
D_{50}= 0.5139 D_{30}= 0.3179 D_{15}= 0.1999
D_{10}= 0.1584 C_u= 4.07 C_c= 0.99

Classification

USCS= SW-SM AASHTO=

Remarks

Location: G044 S-6
Sample Number: 7995-95 **Depth:** 7.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-6
Depth: 7.5'
Sample Number: 7995-95
Material Description: SAND WITH SILT
Date: 10/21/2017
USCS Classification: SW-SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 307.40
Tare Wt. = 15.80
Minus #200 from wash = 5.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
322.60	15.80	1/4"	0.00	0.00	100.0
		#4	0.90	0.00	99.7
		#10	6.30	0.00	97.7
		#40	171.50	0.00	41.8
		#100	100.10	0.00	9.1
		#200	11.20	0.00	5.5

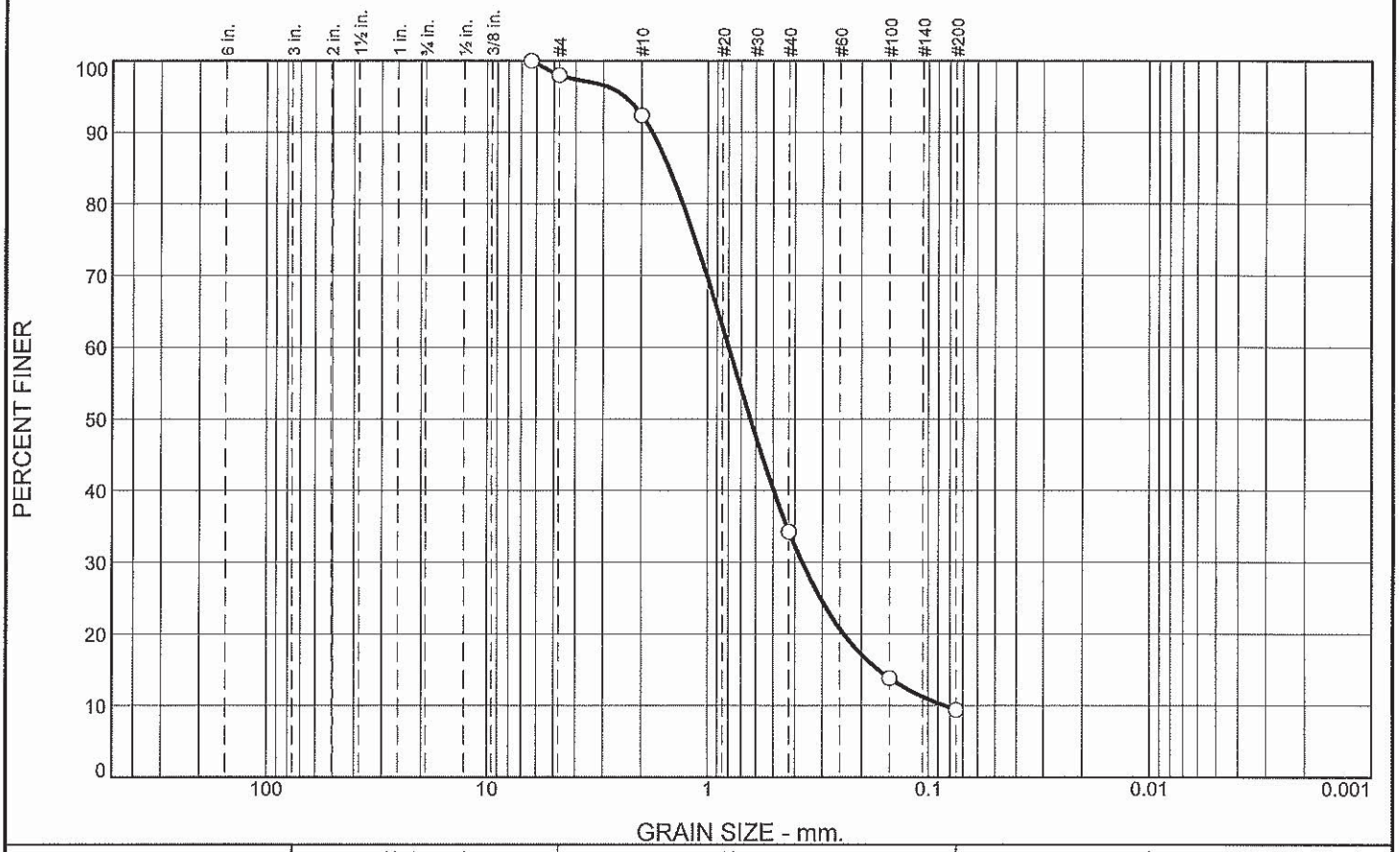
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.3	0.3	2.0	55.9	36.3	94.2			5.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1584	0.1999	0.2383	0.3179	0.5139	0.6443	1.0437	1.2009	1.4088	1.7210

Fineness Modulus	C_u	C_c
2.24	4.07	0.99

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.0	5.6	58.1	24.9	9.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	98.0		
#10	92.4		
#40	34.3		
#100	13.8		
#200	9.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.7928 D_{85}= 1.5014 D_{60}= 0.8001
D_{50}= 0.6362 D_{30}= 0.3710 D_{15}= 0.1684
D_{10}= 0.0843 C_u= 9.49 C_c= 2.04

Classification

USCS= AASHTO=

Remarks

Location: G044 S-7
Sample Number: 7995-96 **Depth:** 9'-10.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-7
Depth: 9'-10.5'
Sample Number: 7995-96
Material Description: SAND WITH SILT
Date: 10/21/2017
USCS Classification: SW-SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 252.00
Tare Wt. = 15.80
Minus #200 from wash = 8.4%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
273.80	15.80	1/4"	0.00	0.00	100.0
		#4	5.20	0.00	98.0
		#10	14.50	0.00	92.4
		#40	149.90	0.00	34.3
		#100	52.70	0.00	13.8
		#200	11.40	0.00	9.4

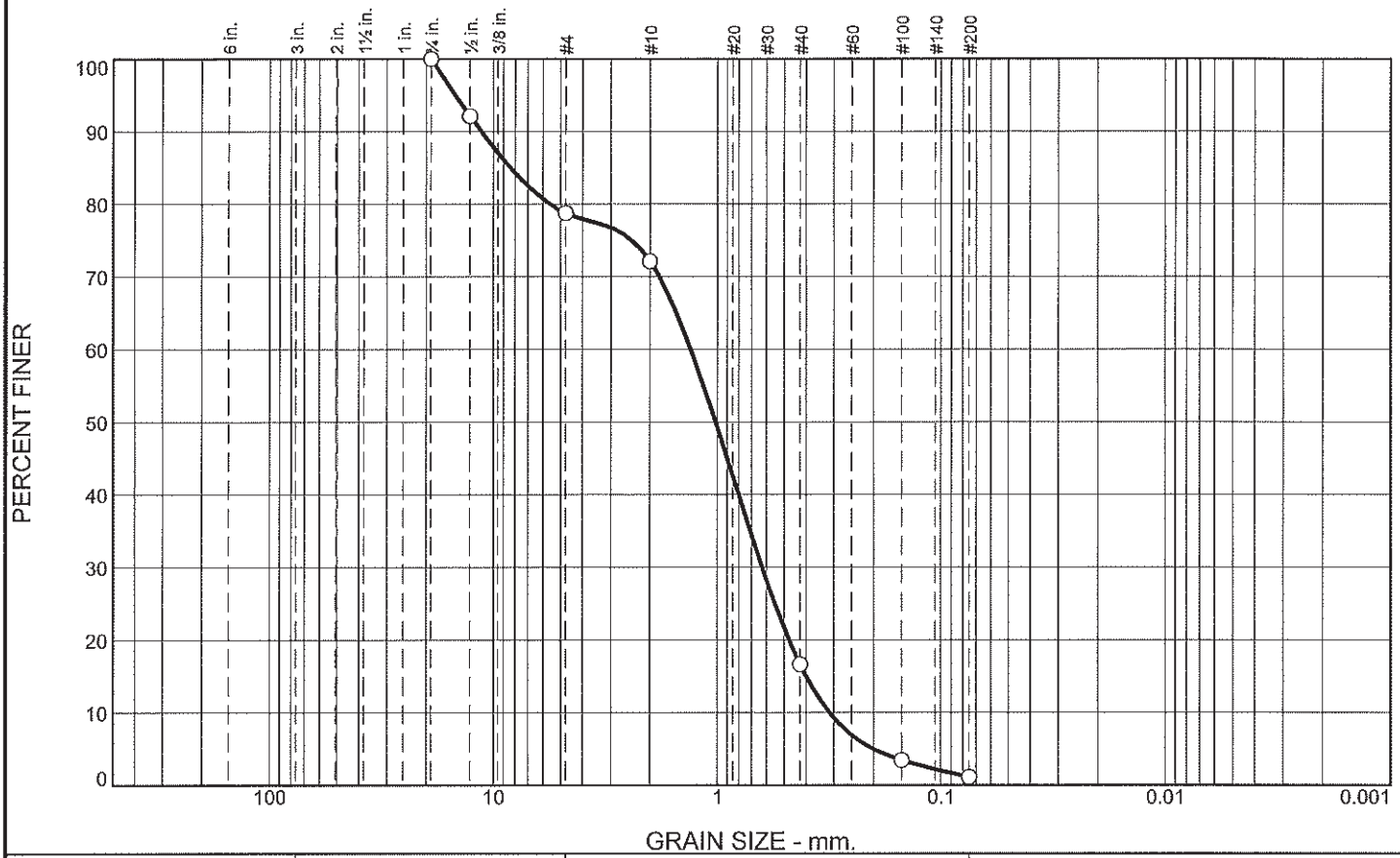
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	2.0	2.0	5.6	58.1	24.9	88.6			9.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0843	0.1684	0.2405	0.3710	0.6362	0.8001	1.2976	1.5014	1.7928	2.4008

Fineness Modulus	C_u	C_c
2.45	9.49	2.04

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	21.3	6.6	55.5	15.5	1.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	92.1		
#4	78.7		
#10	72.1		
#40	16.6		
#100	3.5		
#200	1.1		

* (no specification provided)

Soil Description

SAND WITH GRAVEL

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 11.3362 D_{85}= 8.3986 D_{60}= 1.3156
D_{50}= 1.0177 D_{30}= 0.6276 D_{15}= 0.3995
D_{10}= 0.3143 C_u= 4.19 C_c= 0.95

Classification

USCS= SP AASHTO=

Remarks

Location: G044 S-11
Sample Number: 7995-98 **Depth:** 25'-26.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-11
Depth: 25'-26.5'
Sample Number: 7995-98
Material Description: SAND WITH GRAVEL
Date: 10/21/2017
USCS Classification: SP
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 423.80
Tare Wt. = 15.80

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
422.80	15.80	3/4"	0.00	0.00	100.0
		1/2"	32.20	0.00	92.1
		#4	54.30	0.00	78.7
		#10	27.10	0.00	72.1
		#40	225.70	0.00	16.6
		#100	53.60	0.00	3.5
		#200	9.50	0.00	1.1

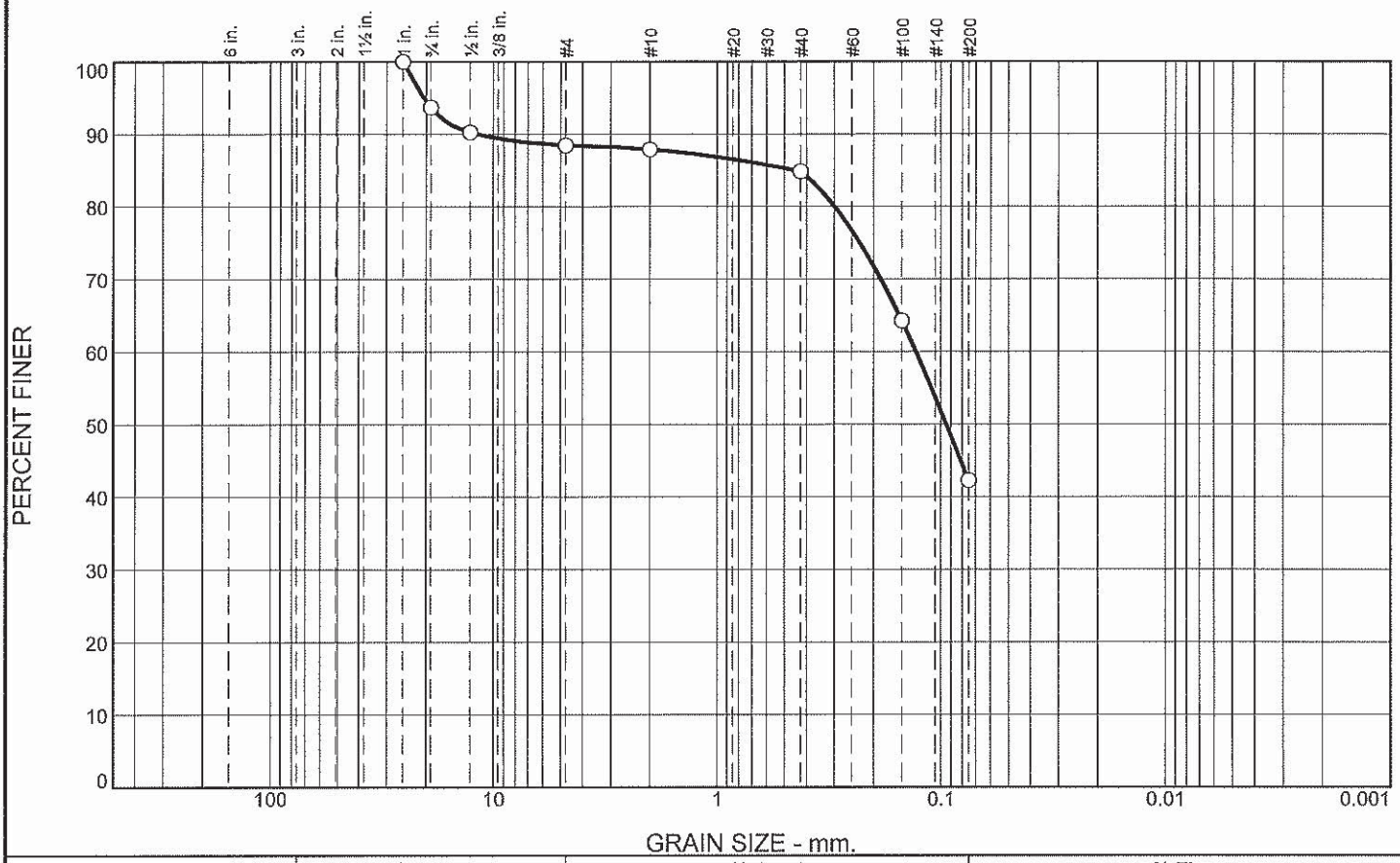
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	21.3	21.3	6.6	55.5	15.5	77.6			1.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.3143	0.3995	0.4756	0.6276	1.0177	1.3156	5.5995	8.3986	11.3362	14.7888

Fineness Modulus	C_u	C_c
3.63	4.19	0.95

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.3	5.3	0.5	3.1	42.5	42.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	93.7		
1/2"	90.3		
#4	88.4		
#10	87.9		
#40	84.8		
#100	64.2		
#200	42.3		

* (no specification provided)

Soil Description

SILTY SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 11.8007 D_{85}= 0.4525 D_{60}= 0.1297
D_{50}= 0.0947 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G044 S-17
Sample Number: 7995-102 **Depth:** 55'-56.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-17
Depth: 55'-56.5'
Sample Number: 7995-102
Material Description: SILTY SAND
Date: 10/21/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 201.70
Tare Wt. = 15.80
Minus #200 from wash = 41.6%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
334.10	15.80	1"	0.00	0.00	100.0
		3/4"	20.10	0.00	93.7
		1/2"	10.90	0.00	90.3
		#4	5.80	0.00	88.4
		#10	1.80	0.00	87.9
		#40	9.70	0.00	84.8
		#100	65.50	0.00	64.2
		#200	70.00	0.00	42.3

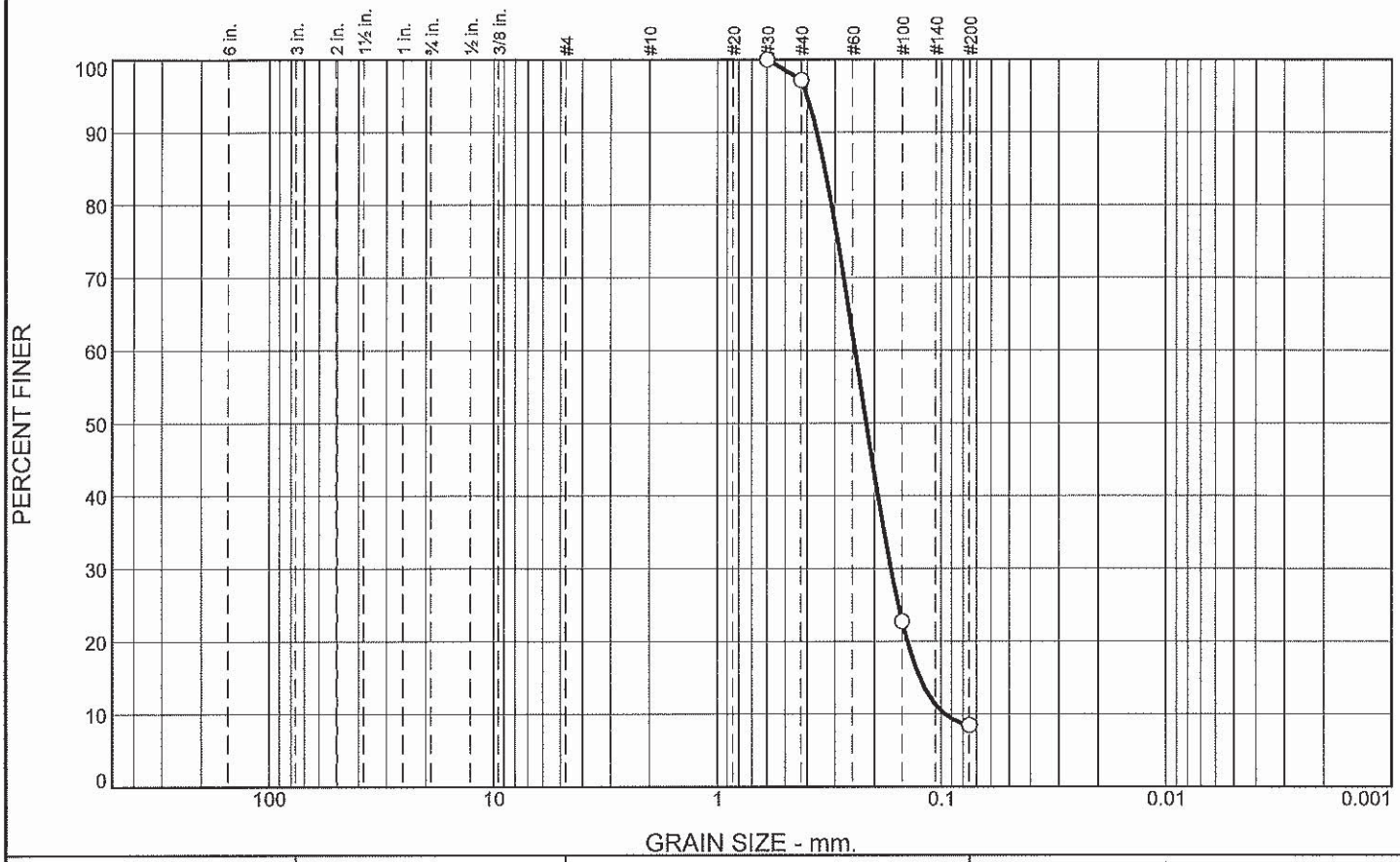
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	6.3	5.3	11.6	0.5	3.1	42.5	46.1			42.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0947	0.1297	0.2996	0.4525	11.8007	20.4628

Fineness Modulus
1.23

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	2.8	88.7	8.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#40	97.2		
#100	22.7		
#200	8.5		

* (no specification provided)

Soil Description

SAND WITH SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3616 D_{85}= 0.3336 D_{60}= 0.2437
D_{50}= 0.2171 D_{30}= 0.1686 D_{15}= 0.1247
D_{10}= 0.0967 C_u= 2.52 C_c= 1.21

Classification

USCS= SW-SM AASHTO=

Remarks

Location: G044 S-18
Sample Number: 7995-103 **Depth:** 60'-61.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-18
Depth: 60'-61.5'
Sample Number: 7995-103
Material Description: SAND WITH SILT
Date: 10/21/2017
USCS Classification: SW-SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 336.30
Tare Wt. = 15.80
Minus #200 from wash = 7.1%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
360.90	15.80	#30	0.00	0.00	100.0
		#40	9.80	0.00	97.2
		#100	256.80	0.00	22.7
		#200	49.30	0.00	8.5

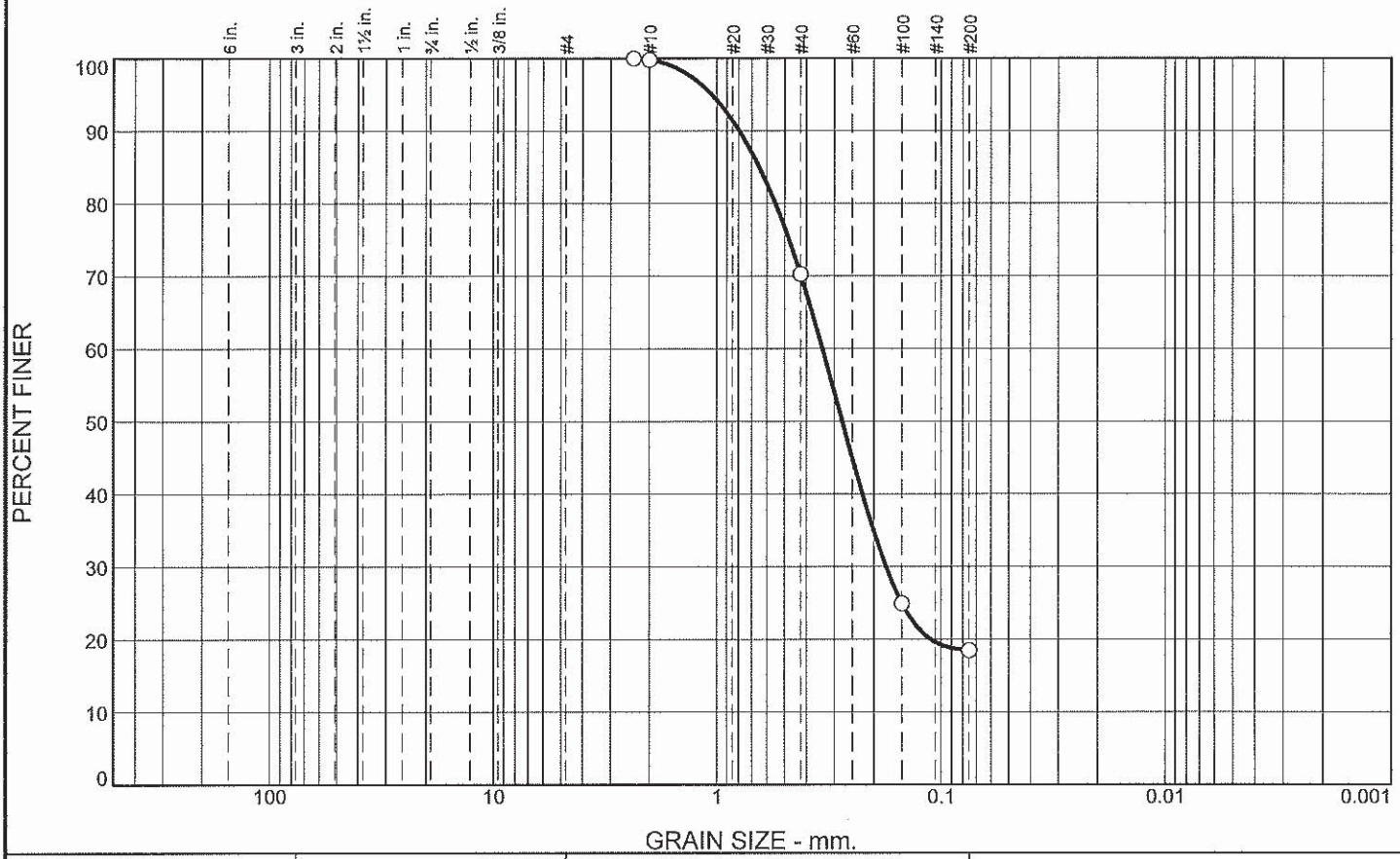
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	2.8	88.7	91.5			8.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0967	0.1247	0.1420	0.1686	0.2171	0.2437	0.3109	0.3336	0.3616	0.4001

Fineness Modulus	C_u	C_c
1.00	2.52	1.21

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	29.5	51.8	18.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#10	99.8		
#40	70.3		
#100	24.9		
#200	18.5		

* (no specification provided)

Soil Description

SILTY SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.7962 D_{85}= 0.6491 D_{60}= 0.3398
D_{50}= 0.2774 D_{30}= 0.1767 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G044 S-33
Sample Number: 7995-112 **Depth:** 140'-141.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-33
Depth: 140'-141.5'
Sample Number: 7995-112
Material Description: SILTY SAND
Date: 10/21/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 241.60
Tare Wt. = 15.80
Minus #200 from wash = 20.2%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
298.60	15.80	#8	0.00	0.00	100.0
		#10	0.60	0.00	99.8
		#40	83.50	0.00	70.3
		#100	128.20	0.00	24.9
		#200	18.20	0.00	18.5

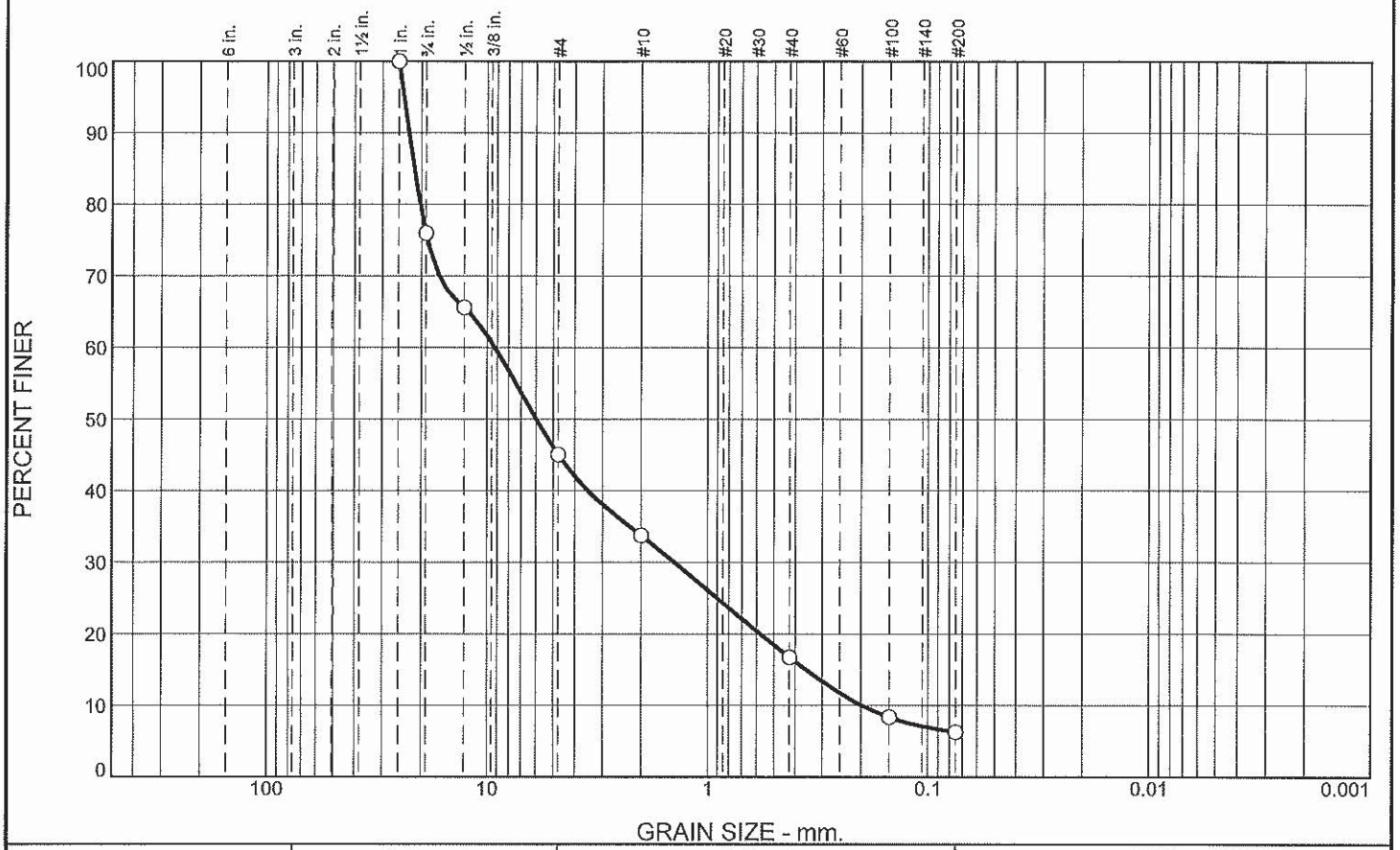
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.2	29.5	51.8	81.5			18.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.1116	0.1767	0.2774	0.3398	0.5504	0.6491	0.7962	1.0569

Fineness Modulus
1.42

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	24.0	31.0	11.3	17.0	10.4	6.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	76.0		
1/2"	65.6		
#4	45.0		
#10	33.7		
#40	16.7		
#100	8.4		
#200	6.3		

* (no specification provided)

Soil Description

GRAVEL WITH SILT AND SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 22.8451 D_{85}= 21.5791 D_{60}= 9.2523
D_{50}= 5.9939 D_{30}= 1.4155 D_{15}= 0.3575
D_{10}= 0.1977 C_u= 46.80 C_c= 1.10

Classification

USCS= GW-GM AASHTO=

Remarks

Location: G045 S-6
Sample Number: 7995-119 **Depth:** 15'-16.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-6
Depth: 15'-16.5' **Sample Number:** 7995-119
Material Description: GRAVEL WITH SILT AND SAND
Date: 10/21/2017
USCS Classification: GW-GM
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 344.50
Tare Wt. = 17.60
Minus #200 from wash = 6.5%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
367.20	17.60	1"	0.00	0.00	100.0
		3/4"	84.00	0.00	76.0
		1/2"	36.40	0.00	65.6
		#4	71.80	0.00	45.0
		#10	39.50	0.00	33.7
		#40	59.40	0.00	16.7
		#100	29.20	0.00	8.4
		#200	7.30	0.00	6.3

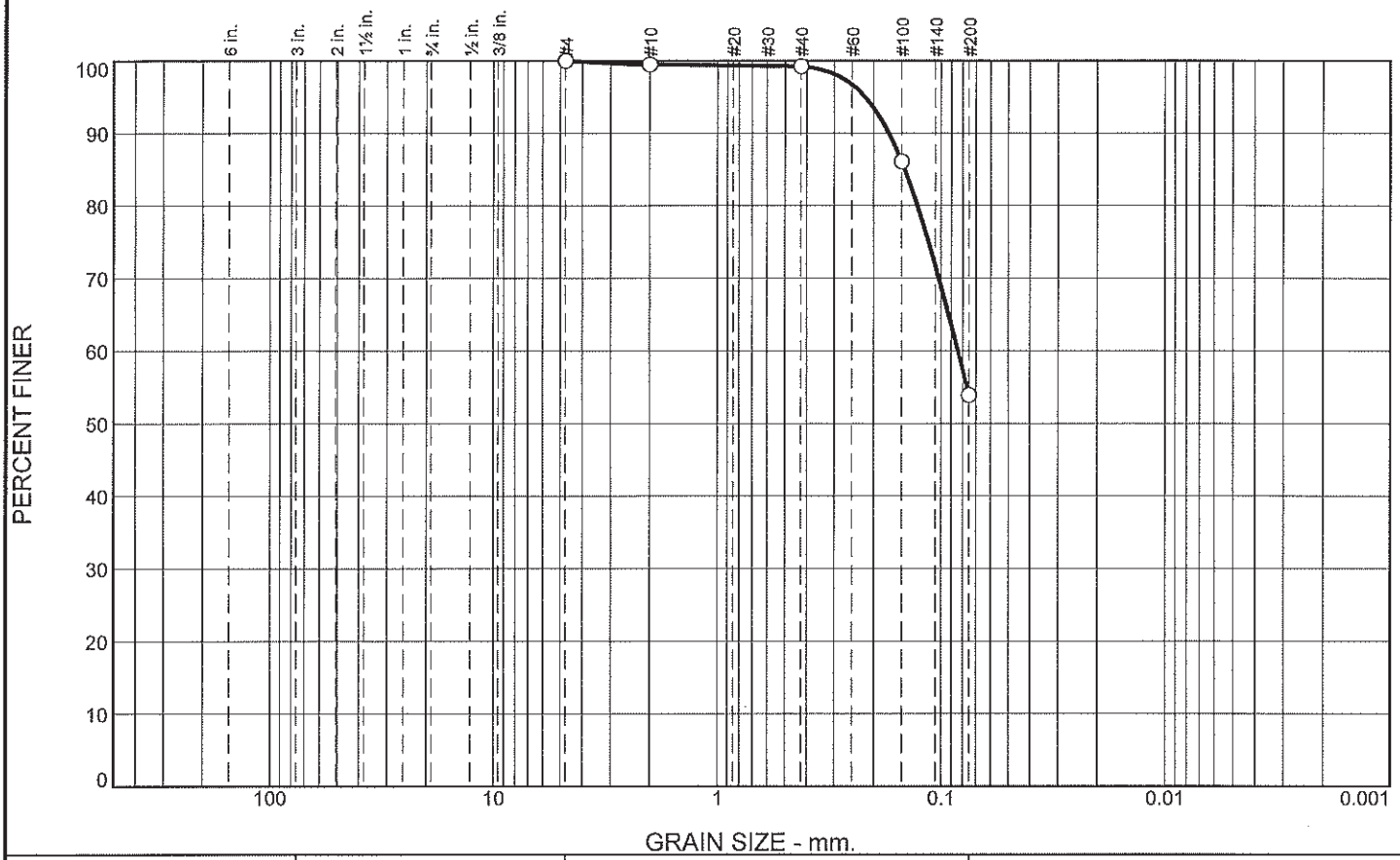
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	24.0	31.0	55.0	11.3	17.0	10.4	38.7			6.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1977	0.3575	0.5784	1.4155	5.9939	9.2523	20.2503	21.5791	22.8451	24.1059

Fineness Modulus	C_u	C_c
5.13	46.80	1.10

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.5	0.3	45.3	53.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.5		
#40	99.2		
#100	86.1		
#200	53.9		

* (no specification provided)

Soil Description

SANDY SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1713 D_{85}= 0.1453 D_{60}= 0.0842
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Location: G045 S-10
Sample Number: 7995-120 **Depth:** 35'-35.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-10
Depth: 35'-35.5'
Sample Number: 7995-120
Material Description: SANDY SILT
Date: 10/21/2017
USCS Classification: ML
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 185.60
Tare Wt. = 15.90
Minus #200 from wash = 33.3%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
270.20	15.90	#4	0.00	0.00	100.0
		#10	1.30	0.00	99.5
		#40	0.70	0.00	99.2
		#100	33.40	0.00	86.1
		#200	81.90	0.00	53.9

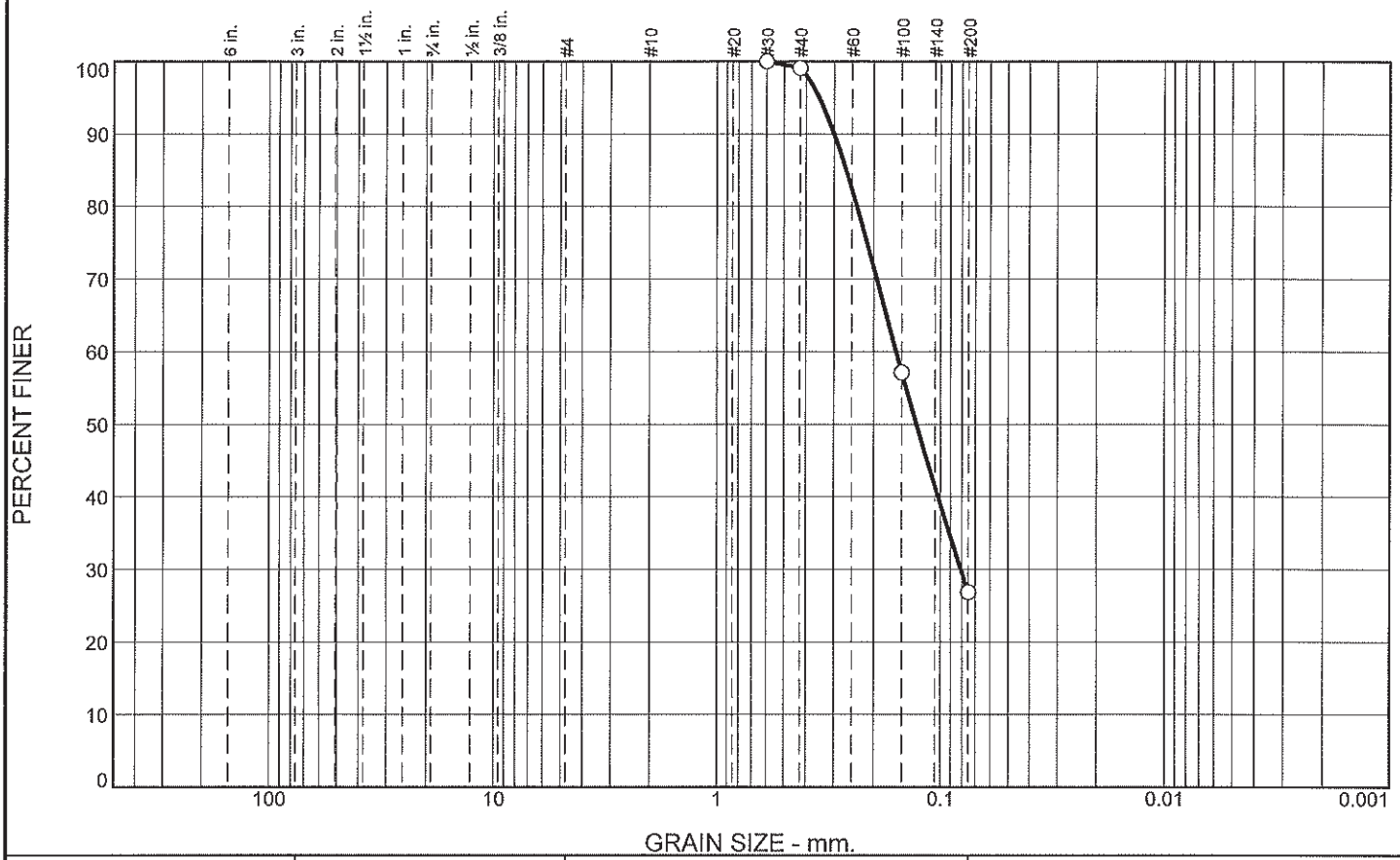
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.5	0.3	45.3	46.1			53.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
					0.0842	0.1275	0.1453	0.1713	0.2193

Fineness Modulus
0.18

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.9	72.2	26.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#40	99.1		
#100	57.1		
#200	26.9		

* (no specification provided)

Soil Description

SILTY SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3006 D_{85}= 0.2657 D_{60}= 0.1592
D_{50}= 0.1290 D_{30}= 0.0809 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G045 S-11
Sample Number: 7995-121 **Depth:** 40'-41.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-11
Depth: 40'-41.5'
Sample Number: 7995-121
Material Description: SILTY SAND
Date: 10/21/2017
USCS Classification: SM
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 276.10
Tare Wt. = 16.00
Minus #200 from wash = 14.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
318.50	16.00	#30	0.00	0.00	100.0
		#40	2.70	0.00	99.1
		#100	127.10	0.00	57.1
		#200	91.40	0.00	26.9

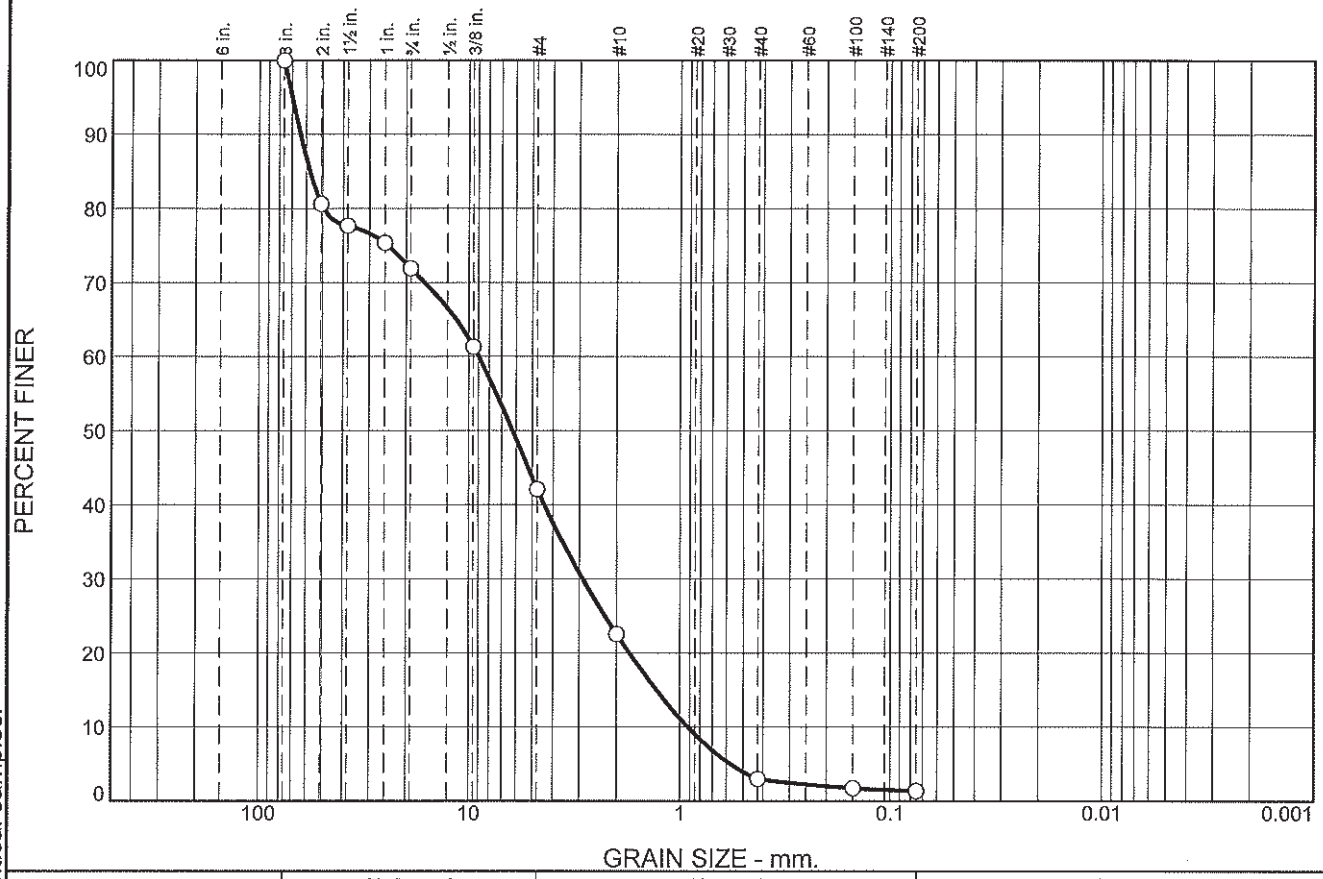
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	0.9	72.2	73.1			26.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0809	0.1290	0.1592	0.2379	0.2657	0.3006	0.3495

Fineness Modulus
0.53

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	28.1	29.8	19.6	19.5	1.6	1.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	80.6		
1 1/2"	77.6		
1"	75.3		
3/4"	71.9		
3/8"	61.3		
#4	42.1		
#10	22.5		
#40	3.0		
#100	1.7		
#200	1.4		

* (no specification provided)

Soil Description

Well Graded GRAVEL with Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 63.9175 D_{85}= 57.6339 D_{60}= 8.9989
D_{50}= 6.2410 D_{30}= 2.9008 D_{15}= 1.2944
D_{10}= 0.9156 C_u= 9.83 C_c= 1.02

Classification

USCS= GW AASHTO=

Remarks

Location: DRLE-TP1 / S1
Sample Number: 8041-1 **Depth:** 4.5 **Date:** 4/4/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

4/4/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: DRLE-TP1 / S1
Depth: 4.5 **Sample Number:** 8041-1
Material Description: Well Graded GRAVEL with Sand
Date: 4/4/2018
USCS Classification: GW
Tested by: GD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 4396.00
Tare Wt. = 597.35
Minus #200 from wash = 1.4%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
4448.60	597.35	0.00	3"	0.00	100.0
			2"	747.70	80.6
			1 1/2"	861.30	77.6
			1"	949.80	75.3
			3/4"	1082.60	71.9
			3/8"	1490.40	61.3
			#4	2230.80	42.1
			#10	2983.00	22.5
			#40	3736.60	3.0
			#100	3784.30	1.7
			#200	3798.90	1.4

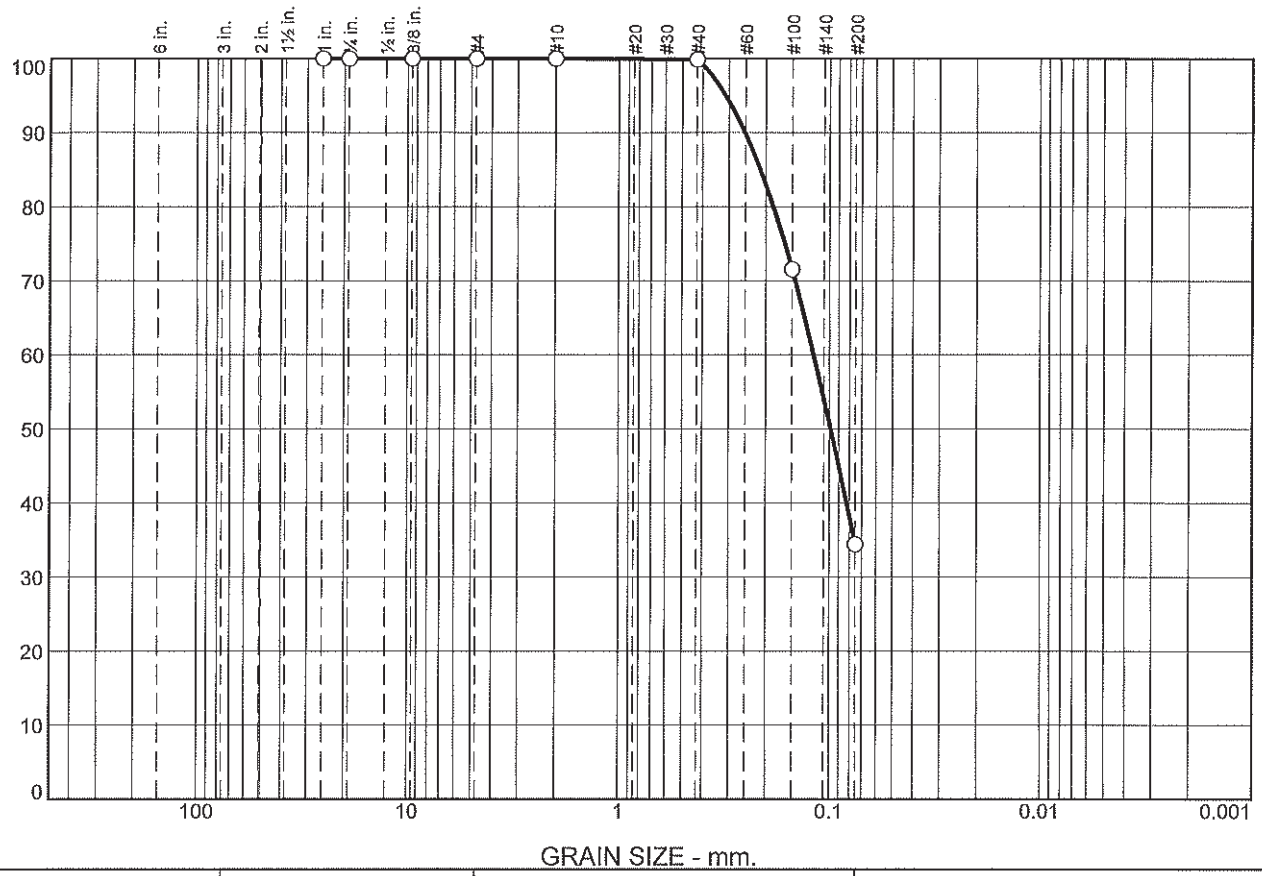
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	28.1	29.8	57.9	19.6	19.5	1.6	40.7			1.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.9156	1.2944	1.7405	2.9008	6.2410	8.9989	49.5615	57.6339	63.9175	69.9562

Fineness Modulus	C_u	C_c
5.98	9.83	1.02

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	65.5	34.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	100.0		
3/8"	100.0		
#4	100.0		
#10	100.0		
#40	99.9		
#100	71.6		
#200	34.4		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2519 D_{85}= 0.2127 D_{60}= 0.1184
D_{50}= 0.0985 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: DRLE-TP2 / S1
Sample Number: 8041-2 **Depth:** 3 **Date:** 4/4/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

4/4/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: DRLE-TP2 / S1
Depth: 3
Sample Number: 8041-2
Material Description: Silty SAND
Date: 4/4/2018
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 328.50
Tare Wt. = 16.14
Minus #200 from wash = 34.5%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
492.77	16.14	0.00	1"	0.00	100.0
			3/4"	0.00	100.0
			3/8"	0.00	100.0
			#4	0.00	100.0
			#10	0.00	100.0
			#40	0.60	99.9
			#100	135.60	71.6
			#200	312.70	34.4

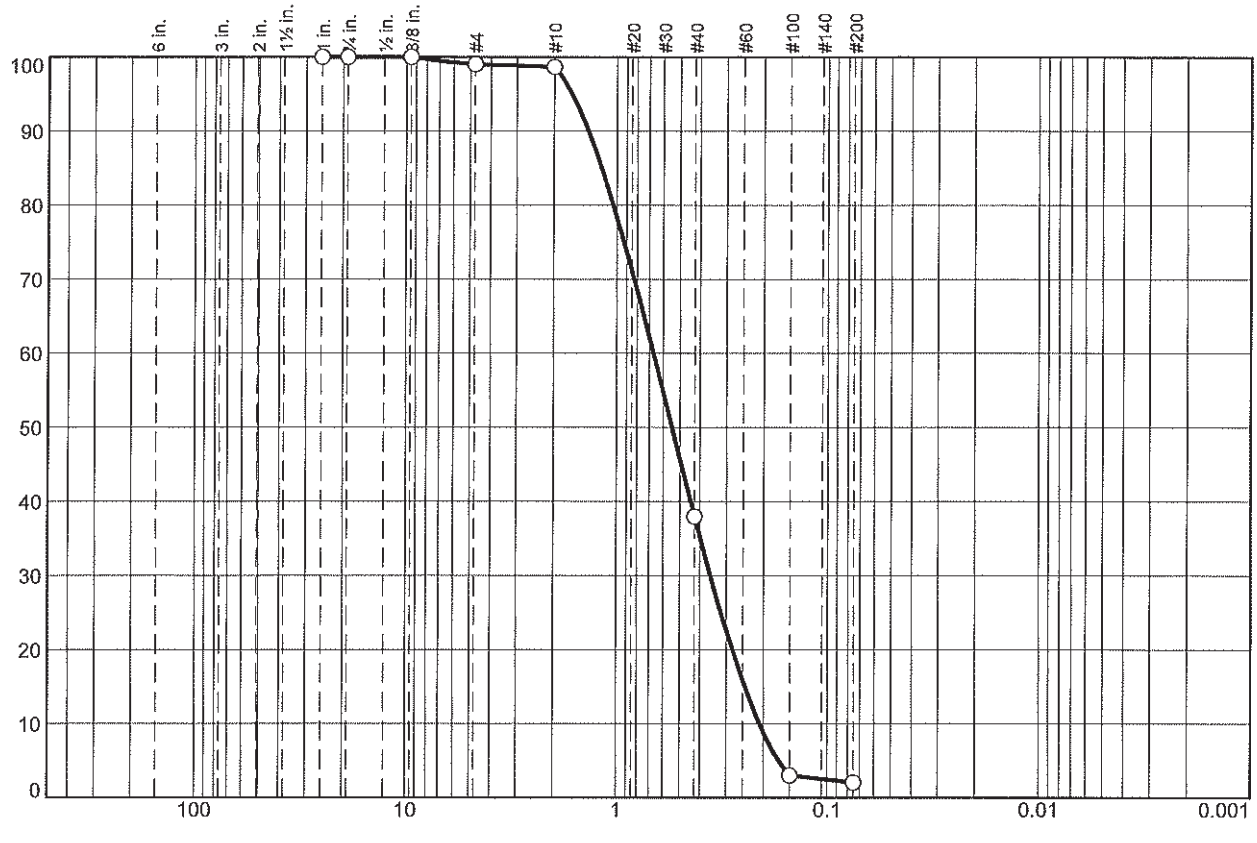
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	0.1	65.5	65.6			34.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0985	0.1184	0.1843	0.2127	0.2519	0.3118

Fineness Modulus
0.34

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.0	0.3	60.7	36.0	2.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	100.0		
3/8"	100.0		
#4	99.0		
#10	98.7		
#40	38.0		
#100	3.0		
#200	2.0		

* (no specification provided)

Soil Description

Poorly Graded SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.3740 D_{85}= 1.1873 D_{60}= 0.6702
D_{50}= 0.5458 D_{30}= 0.3570 D_{15}= 0.2445
D_{10}= 0.2085 C_u= 3.21 C_c= 0.91

Classification

USCS= SP AASHTO=

Remarks

Location: DRLE-TP3A / S1
Sample Number: 8041-3 **Depth:** 3 **Date:** 4/4/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

4/4/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: DRLE-TP3A / S1
Depth: 3 **Sample Number:** 8041-3
Material Description: Poorly Graded SAND
Date: 4/4/2018
USCS Classification: SP
Tested by: GD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 485.20
Tare Wt. = 15.94
Minus #200 from wash = 2.0%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
494.68	15.94	0.00	1"	0.00	100.0
			3/4"	0.00	100.0
			3/8"	0.00	100.0
			#4	4.70	99.0
			#10	6.30	98.7
			#40	297.00	38.0
			#100	464.30	3.0
			#200	469.00	2.0

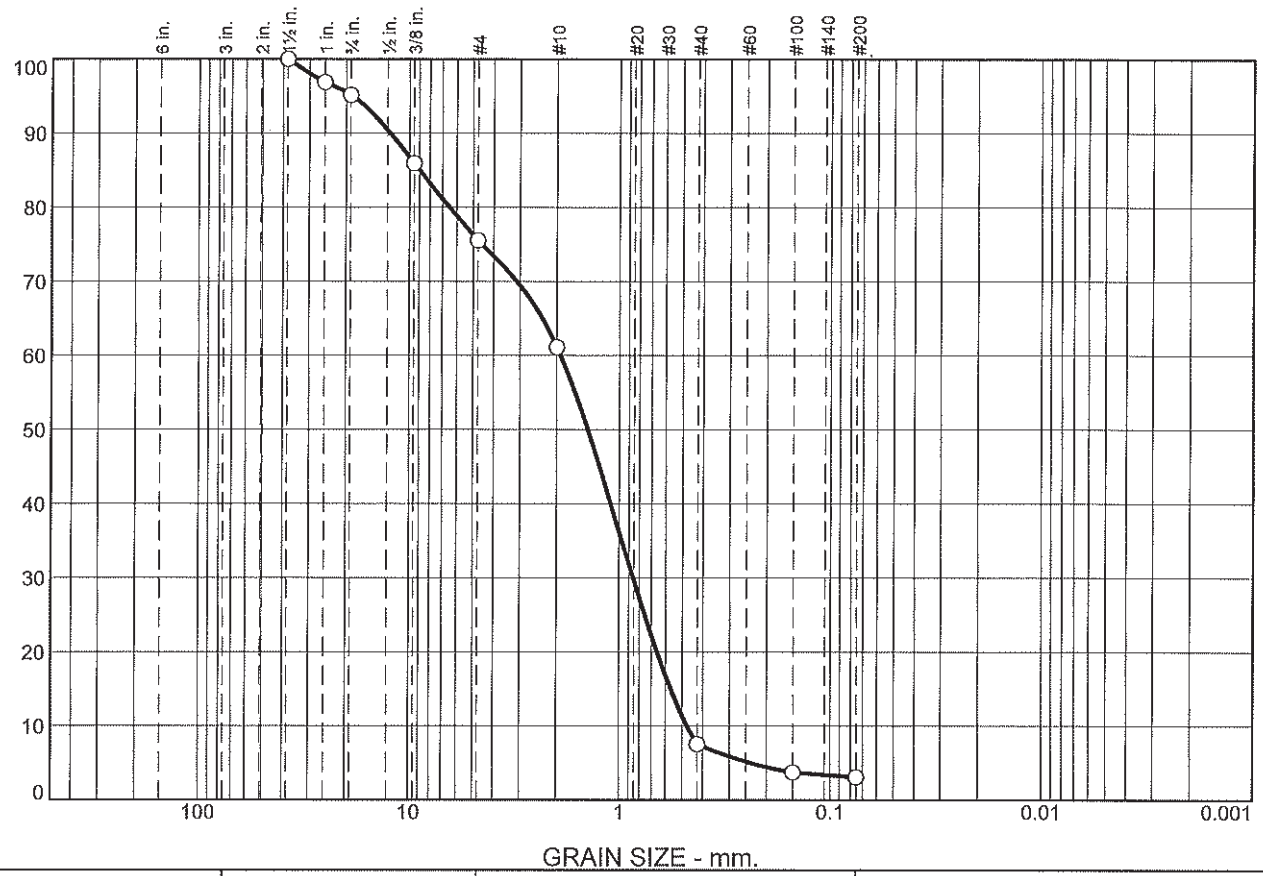
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	1.0	1.0	0.3	60.7	36.0	97.0			2.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.2085	0.2445	0.2806	0.3570	0.5458	0.6702	1.0436	1.1873	1.3740	1.6452

Fineness Modulus	C_u	C_c
2.37	3.21	0.91

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.8	19.7	14.4	53.5	4.5	3.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2"	100.0		
1"	96.9		
3/4"	95.2		
3/8"	85.9		
#4	75.5		
#10	61.1		
#40	7.6		
#100	3.7		
#200	3.1		

* (no specification provided)

Soil Description

Poorly Graded SAND with Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 12.3468 D_{85}= 8.9788 D_{60}= 1.9221
D_{50}= 1.4229 D_{30}= 0.8596 D_{15}= 0.5687
D_{10}= 0.4754 C_u= 4.04 C_c= 0.81

Classification

USCS= SP AASHTO=

Remarks

Location: DRLE-TP4 / S3
Sample Number: 8041-4 **Depth:** 3 **Date:** 4/4/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

4/4/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: DRLE-TP4 / S3
Depth: 3 **Sample Number:** 8041-4
Material Description: Poorly Graded SAND with Gravel
Date: 4/4/2018
USCS Classification: SP
Tested by: GD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 1374.10
Tare Wt. = 15.99
Minus #200 from wash = 2.7%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
1412.25	15.99	0.00	1 1/2"	0.00	100.0
			1"	43.30	96.9
			3/4"	67.50	95.2
			3/8"	196.30	85.9
			#4	341.50	75.5
			#10	543.10	61.1
			#40	1290.70	7.6
			#100	1344.00	3.7
			#200	1353.20	3.1

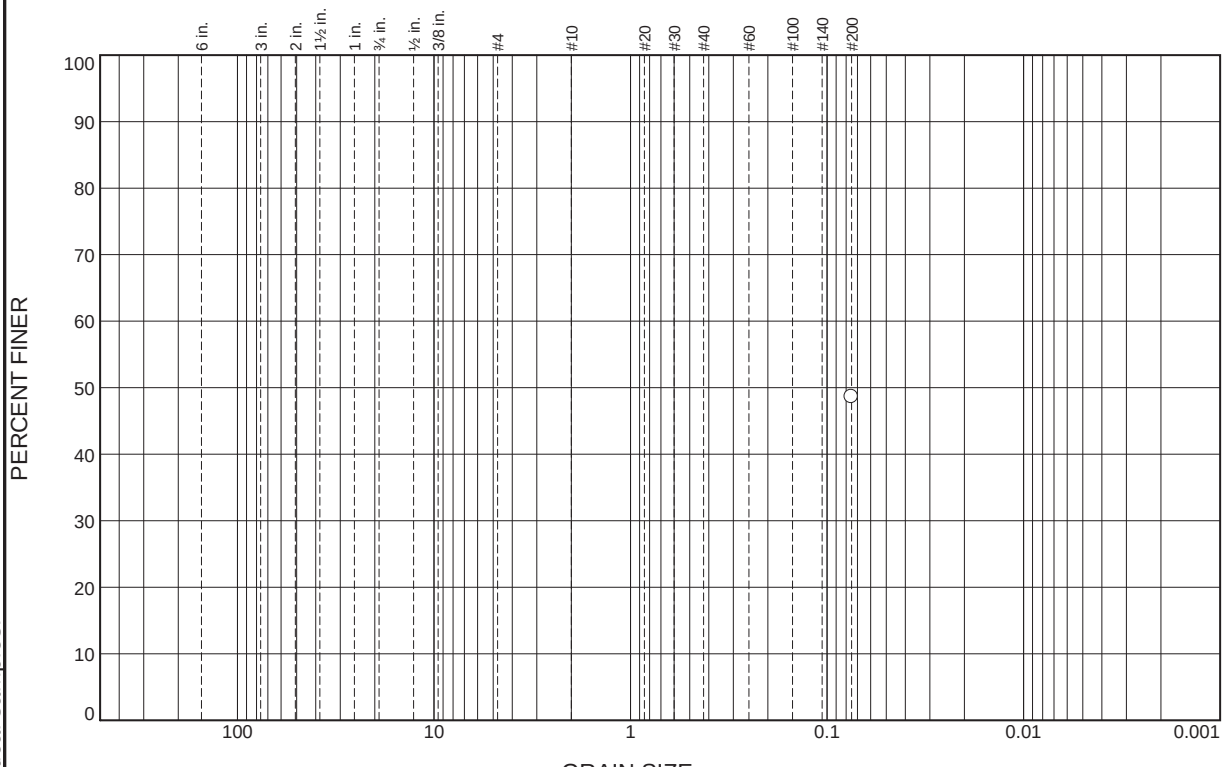
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	4.8	19.7	24.5	14.4	53.5	4.5	72.4			3.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.4754	0.5687	0.6605	0.8596	1.4229	1.9221	6.5084	8.9788	12.3468	18.6607

Fineness Modulus	C_u	C_c
4.09	4.04	0.81

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						48.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	48.6		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G1 / S5
Sample Number: 054-2 **Depth:** 10' **Date:** 12/19/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G1 / S5
Depth: 10'
Sample Number: 054-2
Material Description: Silty SAND
Date: 12/19/2018
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 215.36
Tare Wt. = 15.70
Minus #200 from wash = 48.6%

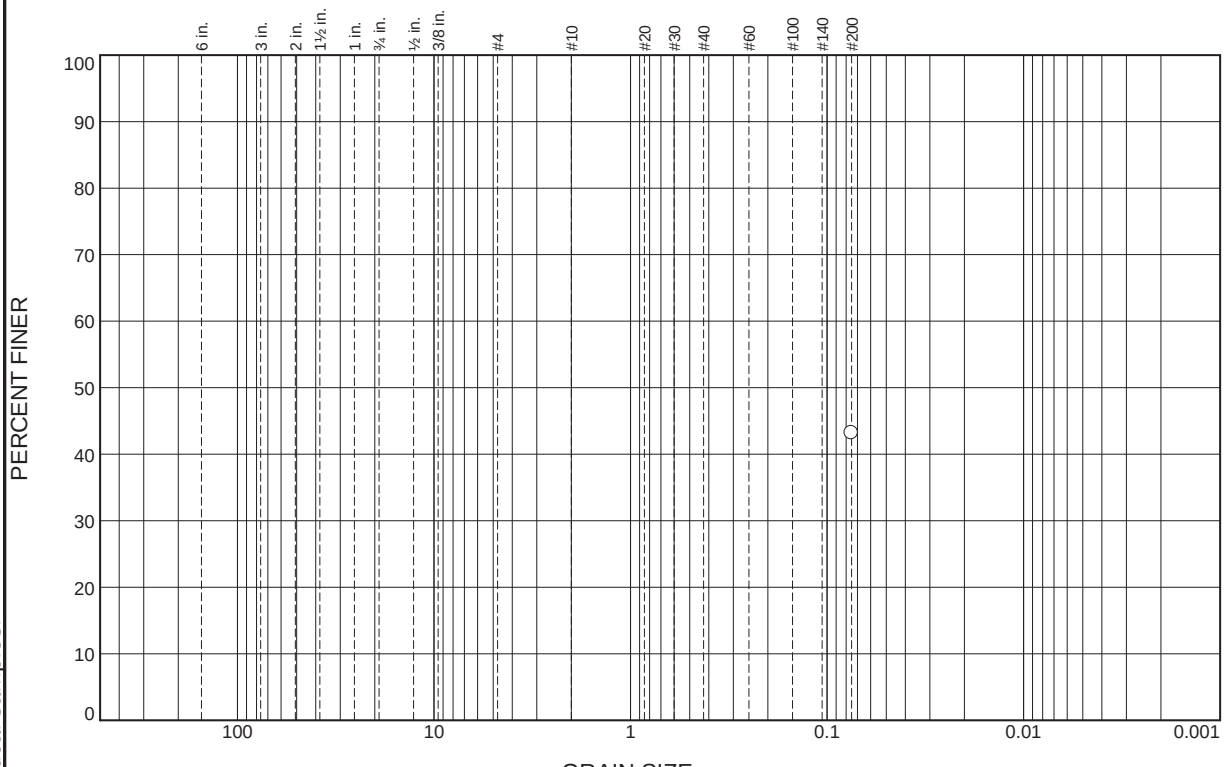
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
404.30	15.70	0.00	1"		
			3/4"		
			3/8"		
			#4		
			#10		
			#40		
			#100		
			#200		48.6

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										48.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						43.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	43.2		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G2 S3
Sample Number: 8023-1 **Depth:** 7.5' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/22/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G2 S3
Depth: 7.5'
Sample Number: 8023-1
Material Description: Silty SAND
Date: 2/22/2018
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 190.63
Tare Wt. = 16.01
Minus #200 from wash = 43.2%

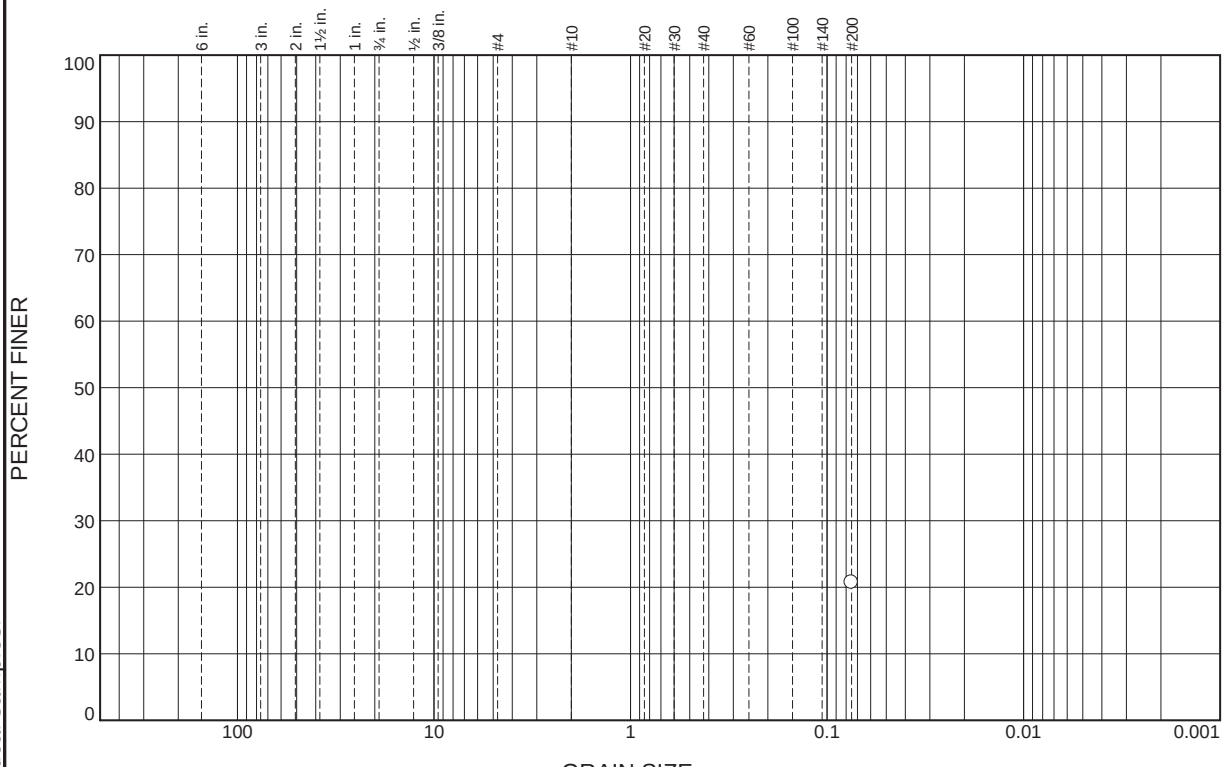
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
323.40	16.01	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										43.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						20.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	20.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G3 / S4
Sample Number: 054-8 **Depth:** 10' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G3 / S4
Depth: 10'
Sample Number: 054-8
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 173.02
Tare Wt. = 15.80
Minus #200 from wash = 20.7%

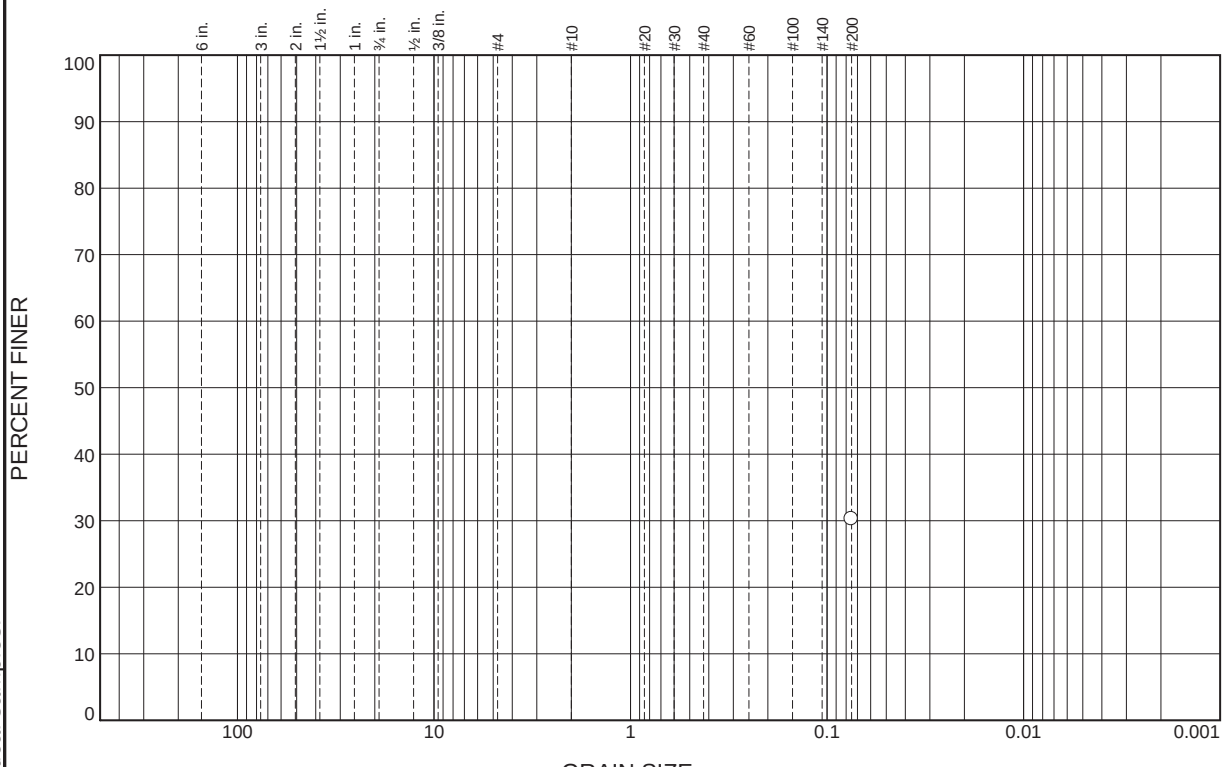
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
214.10	15.80	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										20.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						30.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	30.2		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G4 / S6
Sample Number: 054-15 **Depth:** 12.5' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

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GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G4 / S6
Depth: 12.5'
Sample Number: 054-15
Material Description: Silty SAND
Date: 12/22/2017
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 203.71
Tare Wt. = 16.10
Minus #200 from wash = 30.2%

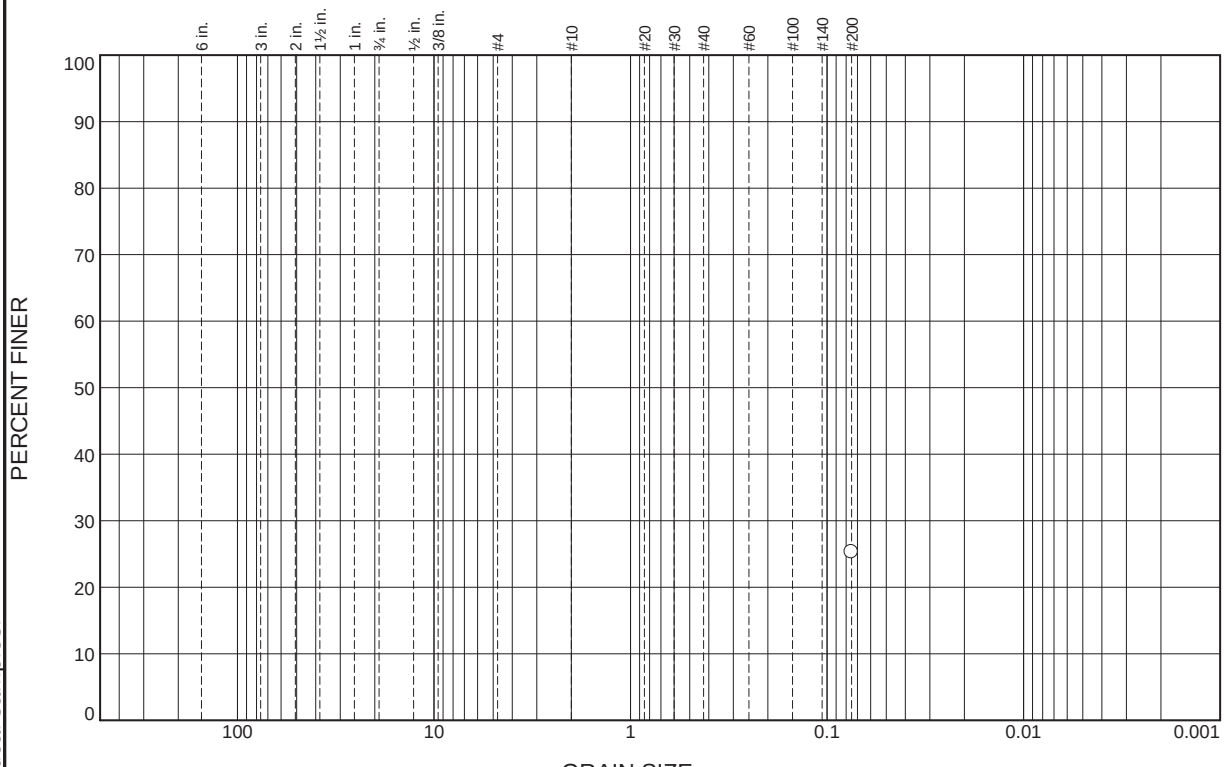
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
285.07	16.10	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										30.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						25.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	25.3		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G5 / S7
Sample Number: 054-21 **Depth:** 15' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G5 / S7
Depth: 15'
Sample Number: 054-21
Material Description: Silty SAND
Date: 12/22/2017
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 251.78
Tare Wt. = 16.00
Minus #200 from wash = 25.3%

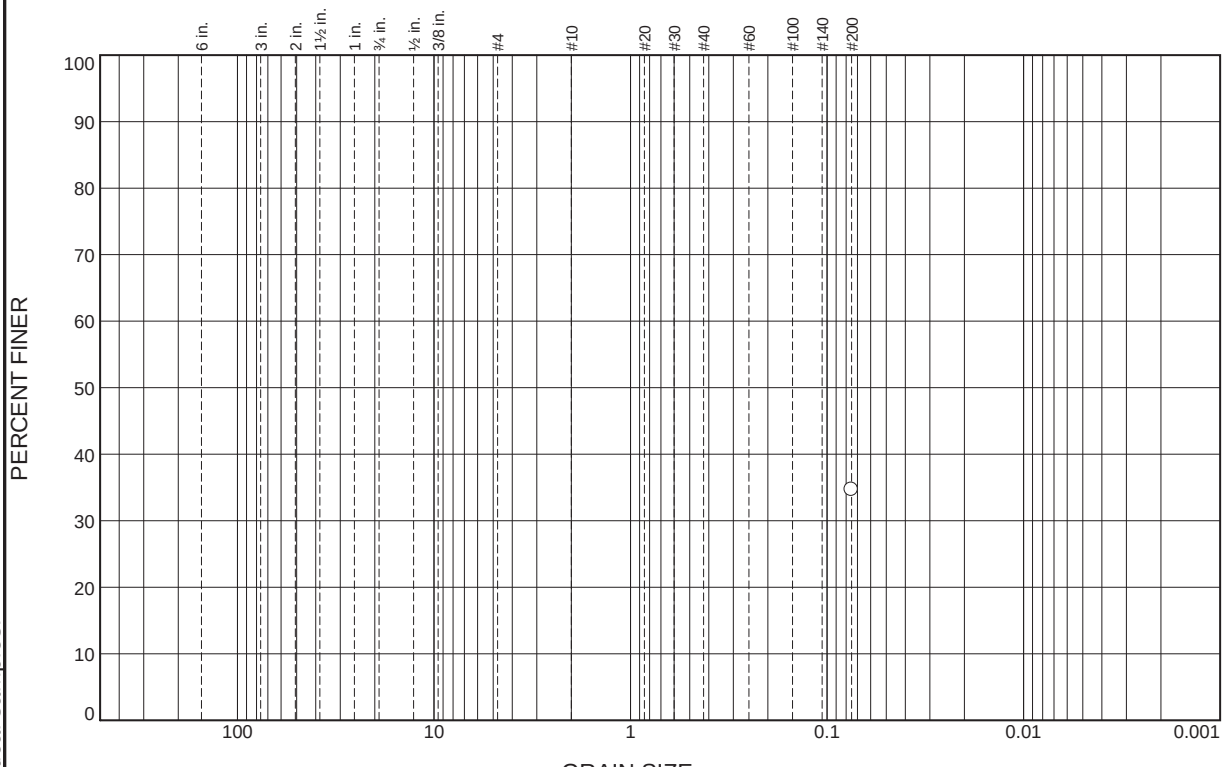
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
331.65	16.00	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										25.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						34.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	34.7		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G6 / S1
Sample Number: 054-25A **Depth:** 7.5' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G6 / S1
Depth: 7.5'
Sample Number: 054-25A
Material Description: Silty SAND
Date: 12/22/2017
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 198.72
Tare Wt. = 16.20
Minus #200 from wash = 34.7%

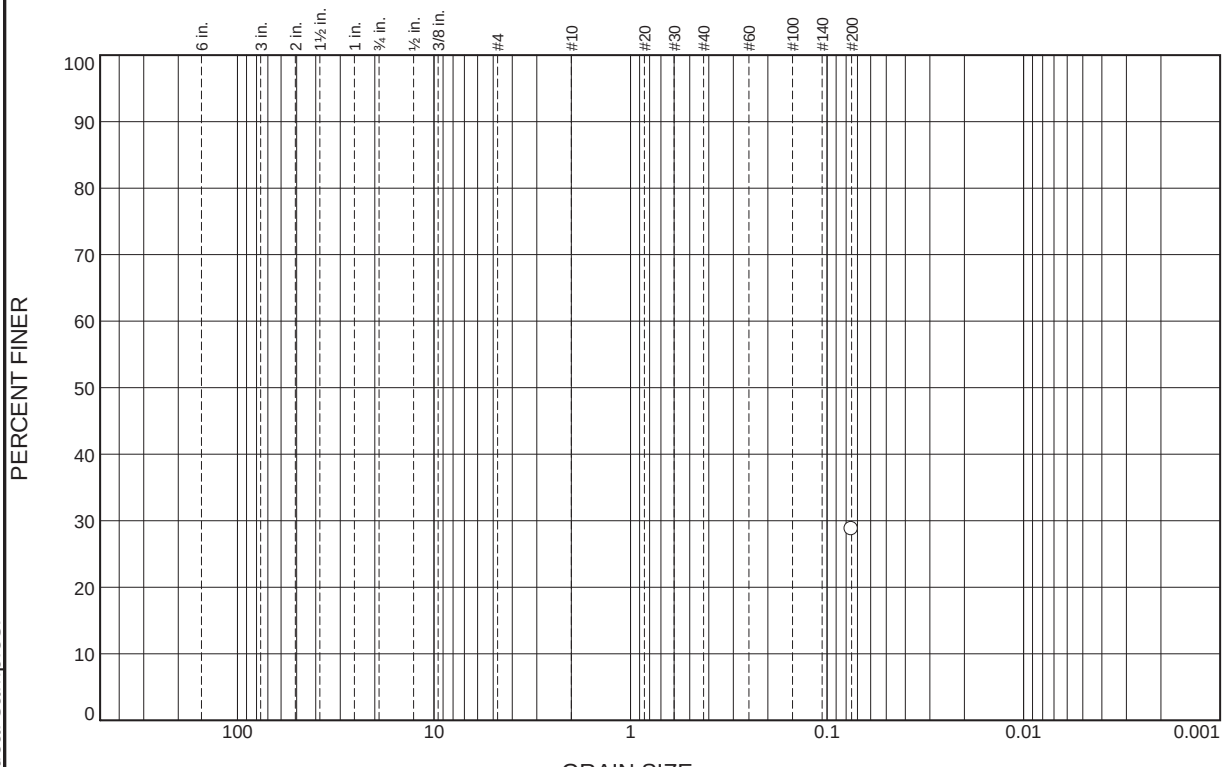
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
295.60	16.20	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										34.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						28.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	28.8		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G7 / S2
Sample Number: 054-29 **Depth:** 5' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G7 / S2
Depth: 5'
Sample Number: 054-29
Material Description: Silty SAND
Date: 12/22/2017
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 139.44
Tare Wt. = 16.00
Minus #200 from wash = 28.8%

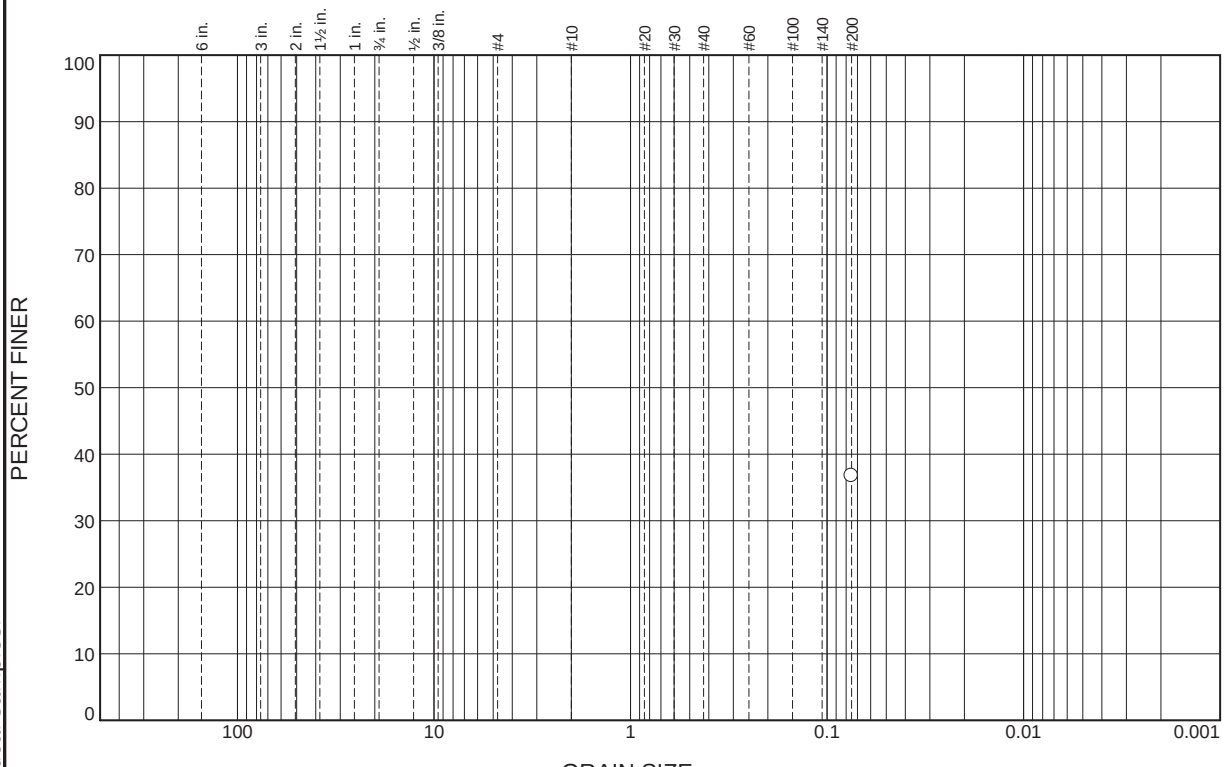
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
189.27	16.00	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										28.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						36.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	36.8		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G12 / S2
Sample Number: 054-45 **Depth:** 5' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G12 / S2
Depth: 5'
Sample Number: 054-45
Material Description: Silty SAND
Date: 12/22/2017
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 112.91
Tare Wt. = 16.10
Minus #200 from wash = 36.8%

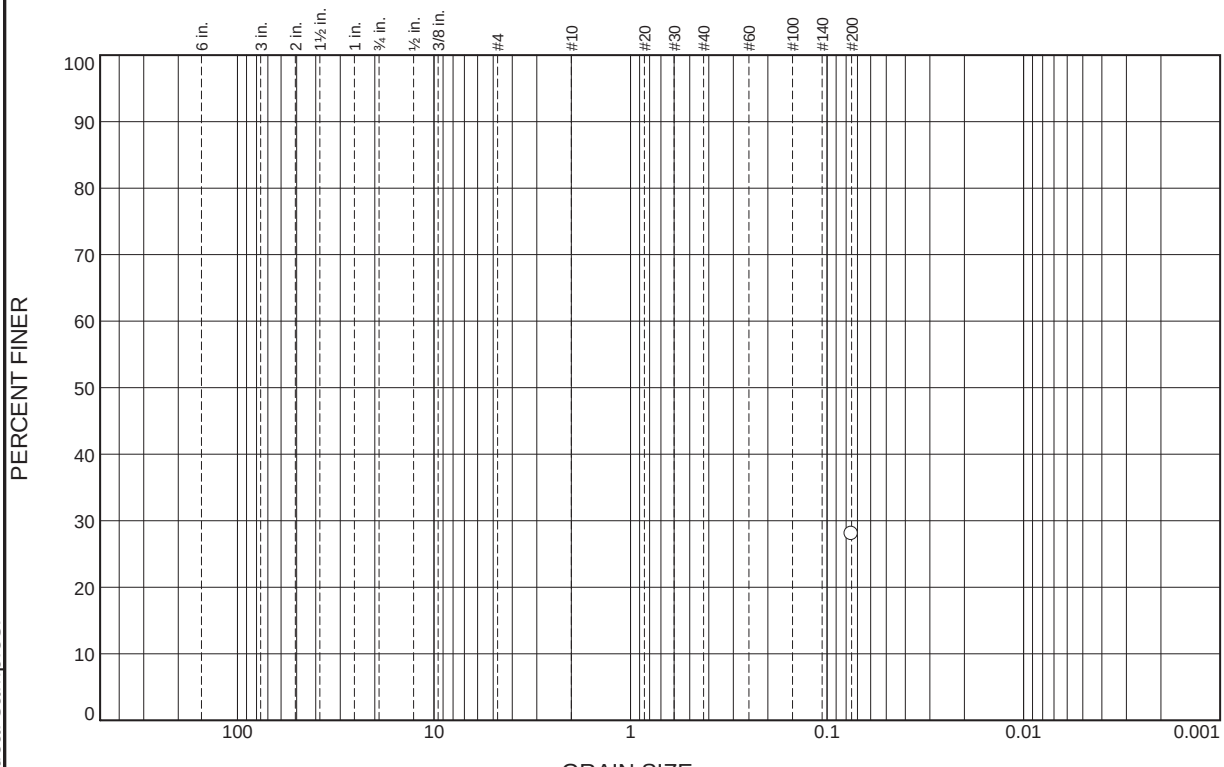
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
169.20	16.10	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										36.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						28.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	28.0		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G13 / S2
Sample Number: 054-51 **Depth:** 5' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G13 / S2
Depth: 5'
Sample Number: 054-51
Material Description: Silty SAND
Date: 12/22/2017
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 91.17
Tare Wt. = 16.10
Minus #200 from wash = 28.0%

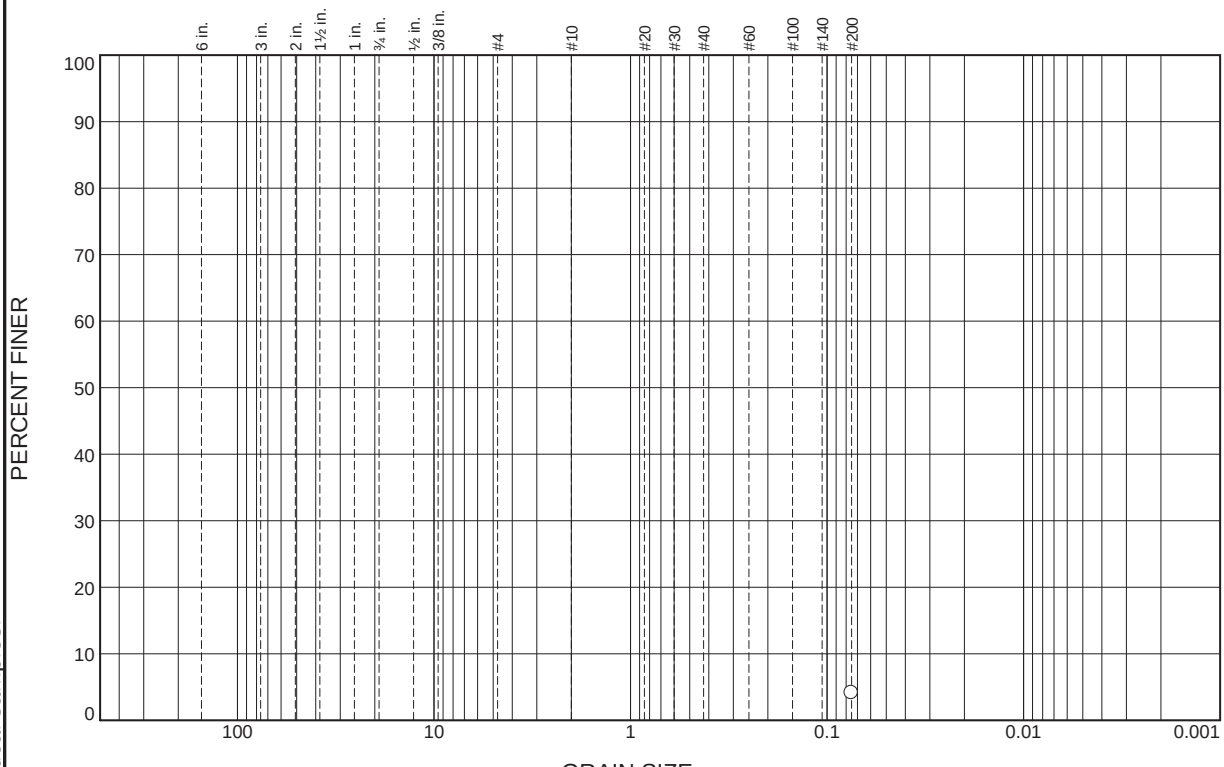
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
120.42	16.10	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										28.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						4.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	4.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G14 / S9
Sample Number: 054-57 **Depth:** 30' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G14 / S9
Depth: 30'
Sample Number: 054-57
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 269.74
Tare Wt. = 16.20
Minus #200 from wash = 4.1%

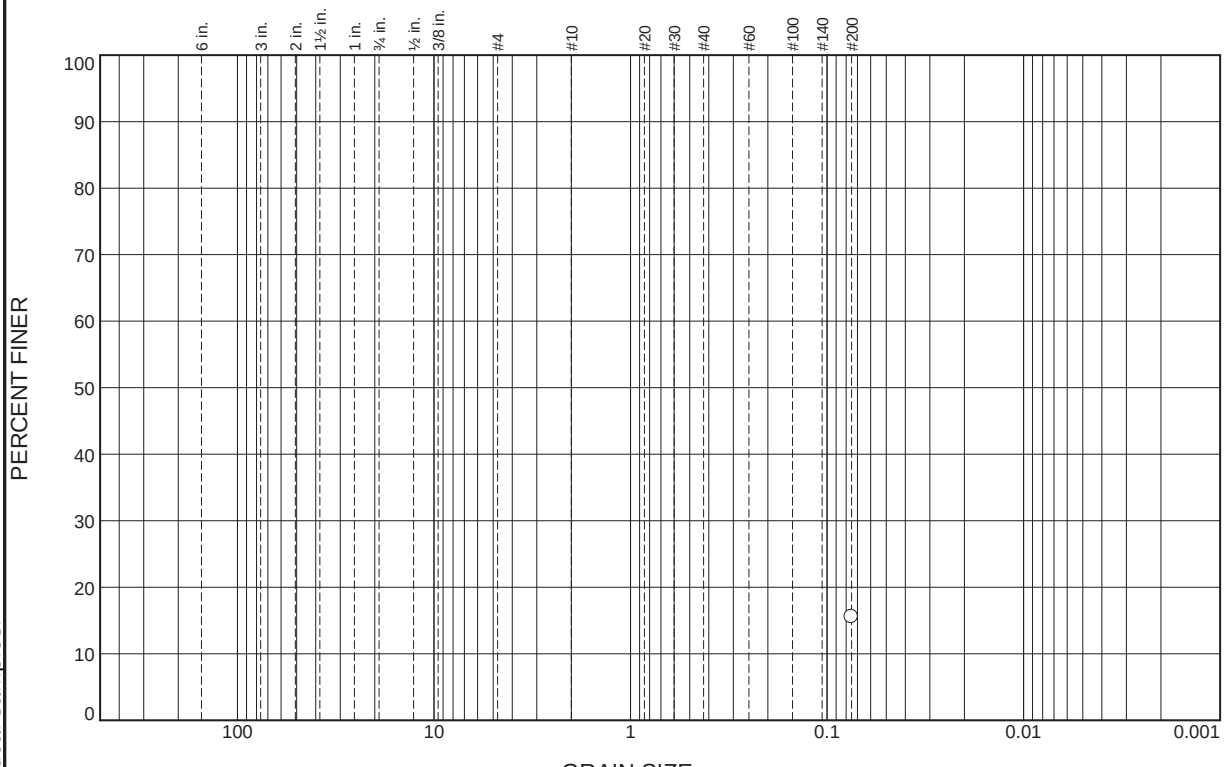
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
280.62	16.20	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										4.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						15.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	15.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G14 / S11
Sample Number: 054-58 **Depth:** 40' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G14 / S11
Depth: 40'
Sample Number: 054-58
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 191.12
Tare Wt. = 15.70
Minus #200 from wash = 15.5%

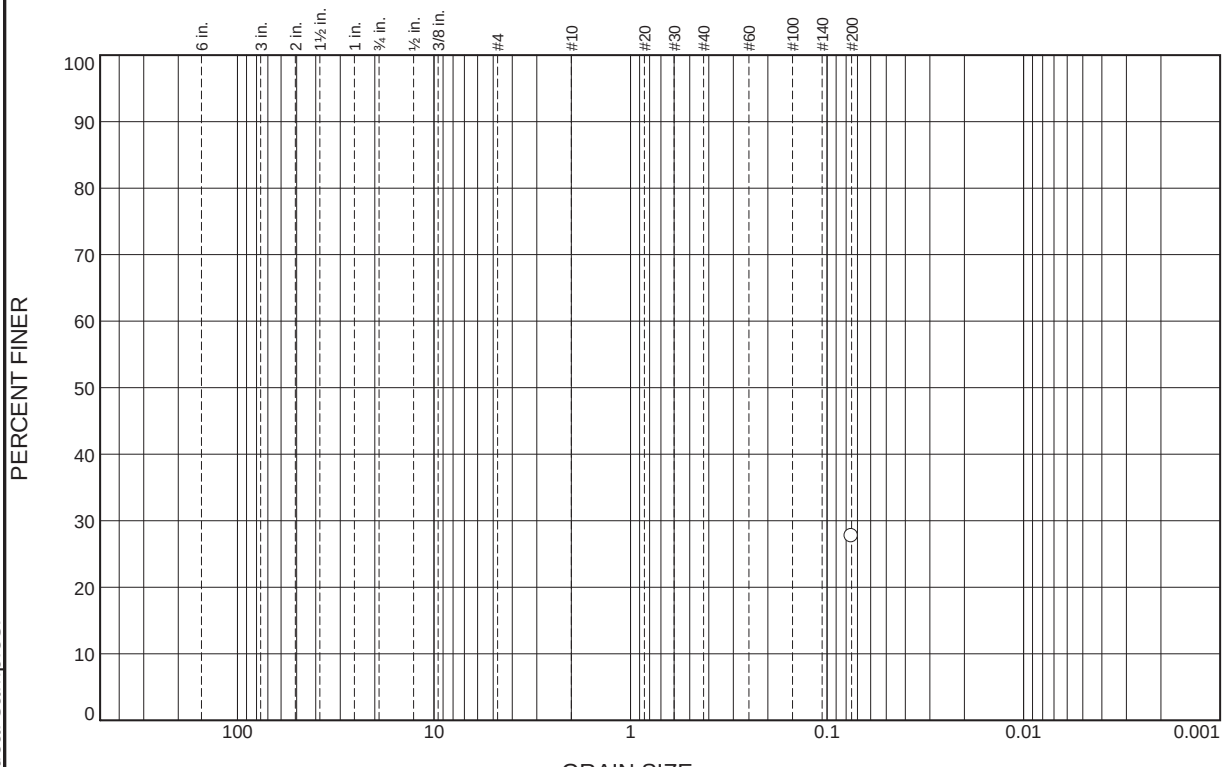
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
223.41	15.70	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										15.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						27.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	27.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G15 / S7
Sample Number: 054-61 **Depth:** 20' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G15 / S7
Depth: 20'
Sample Number: 054-61
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 232.39
Tare Wt. = 15.80
Minus #200 from wash = 27.7%

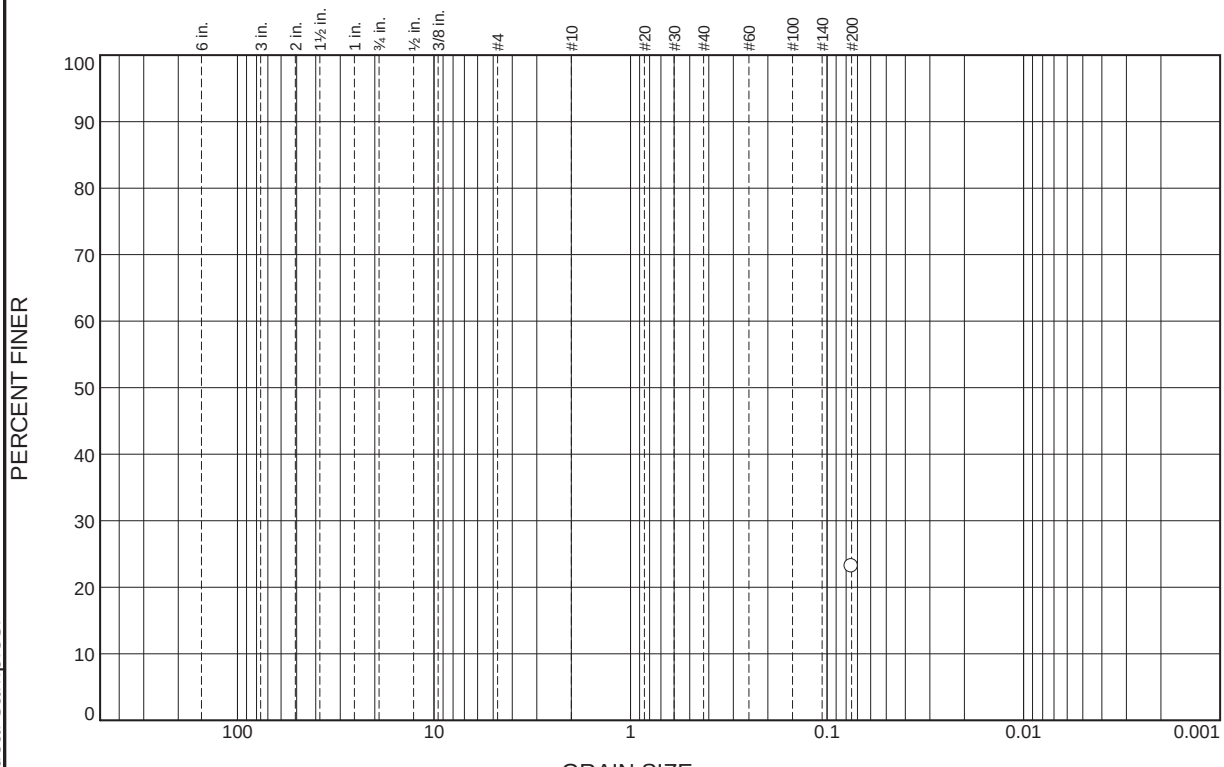
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
315.38	15.80	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										27.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						23.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	23.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G15 / S8
Sample Number: 054-62 **Depth:** 25' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G15 / S8
Depth: 25'
Sample Number: 054-62
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 192.44
Tare Wt. = 15.80
Minus #200 from wash = 23.2%

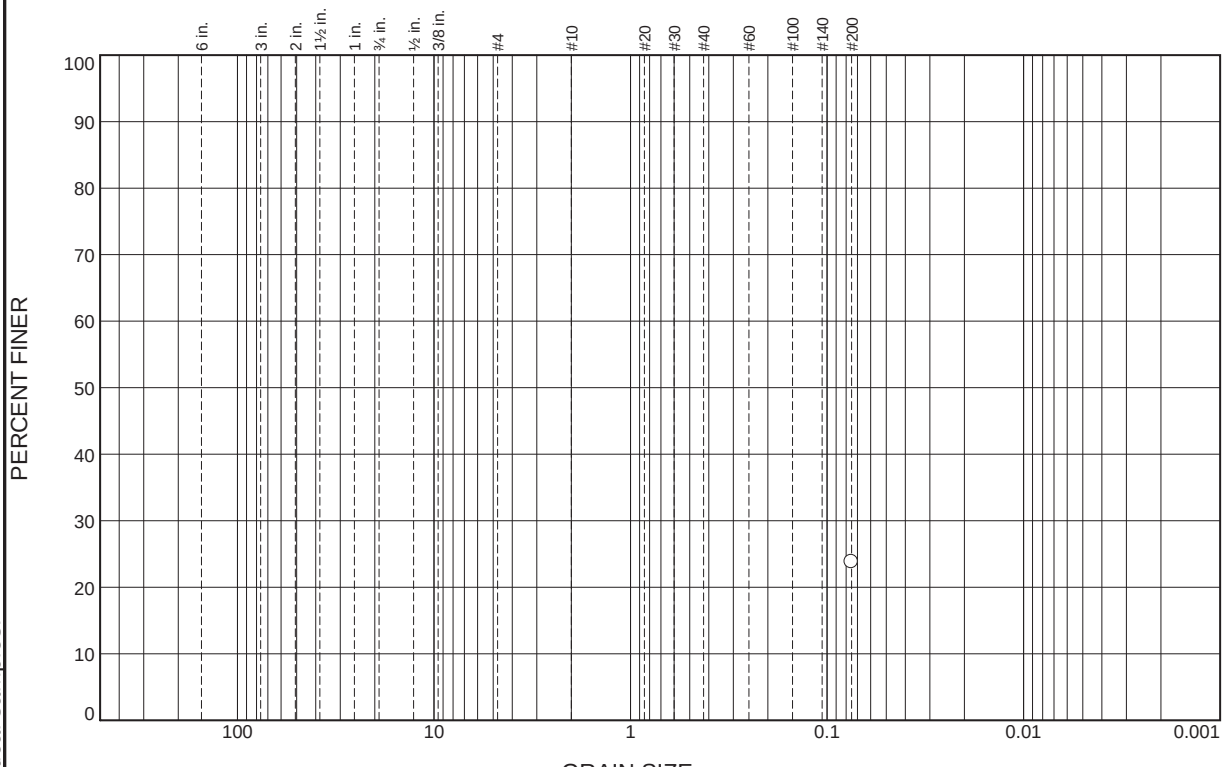
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
245.67	15.80	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										23.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						23.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	23.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G15 / S10
Sample Number: 054-63 **Depth:** 35' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G15 / S10
Depth: 35'
Sample Number: 054-63
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 132.32
Tare Wt. = 15.90
Minus #200 from wash = 23.8%

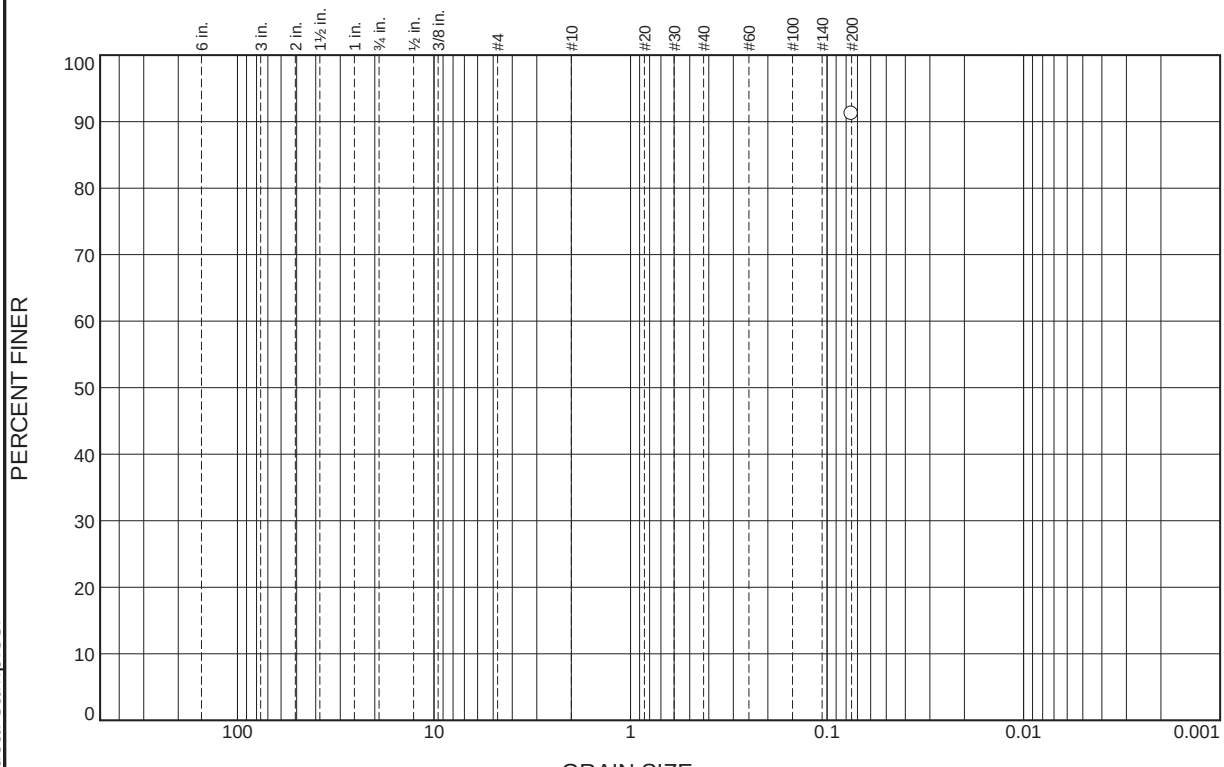
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
168.70	15.90	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										23.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						91.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	91.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G15 / S14
Sample Number: 054-66 **Depth:** 55' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G15 / S14
Depth: 55'
Sample Number: 054-66
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 29.94
Tare Wt. = 16.00
Minus #200 from wash = 91.2%

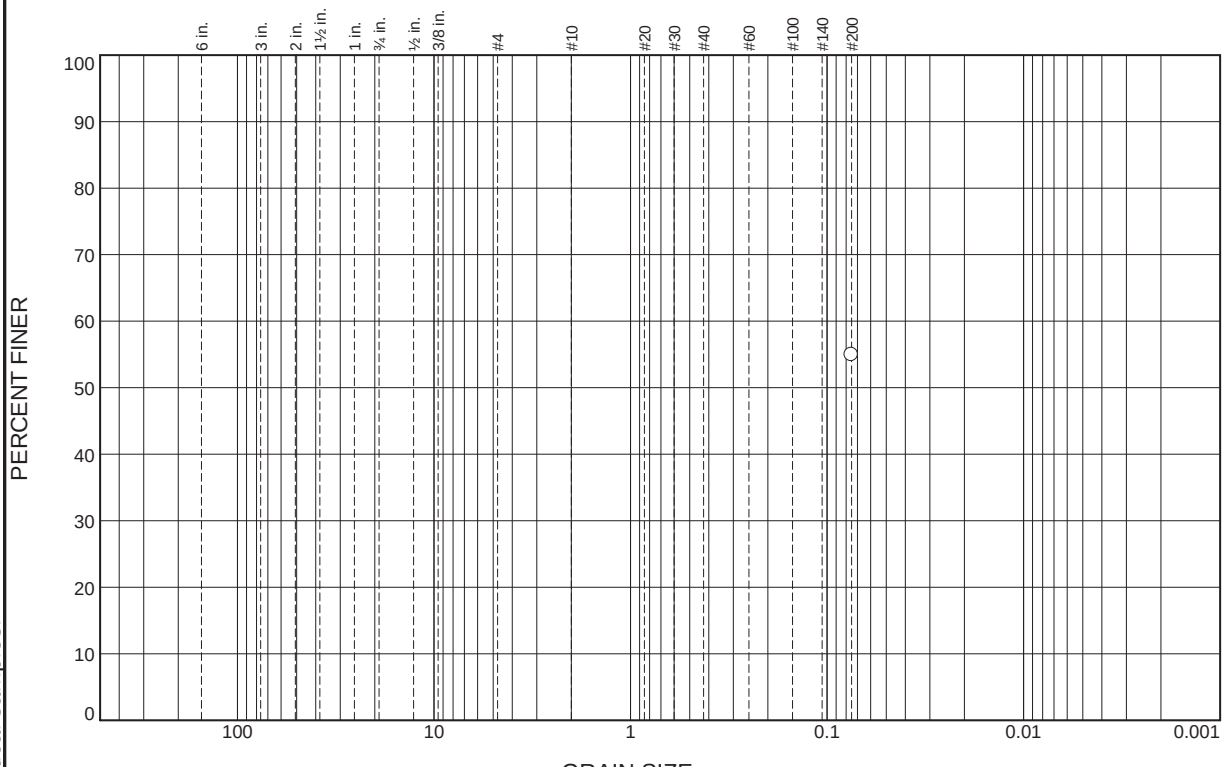
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
174.11	16.00	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										91.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						54.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	54.9		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G15 / S18
Sample Number: 054-69 **Depth:** 75' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G15 / S18
Depth: 75'
Sample Number: 054-69
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 68.86
Tare Wt. = 15.90
Minus #200 from wash = 54.9%

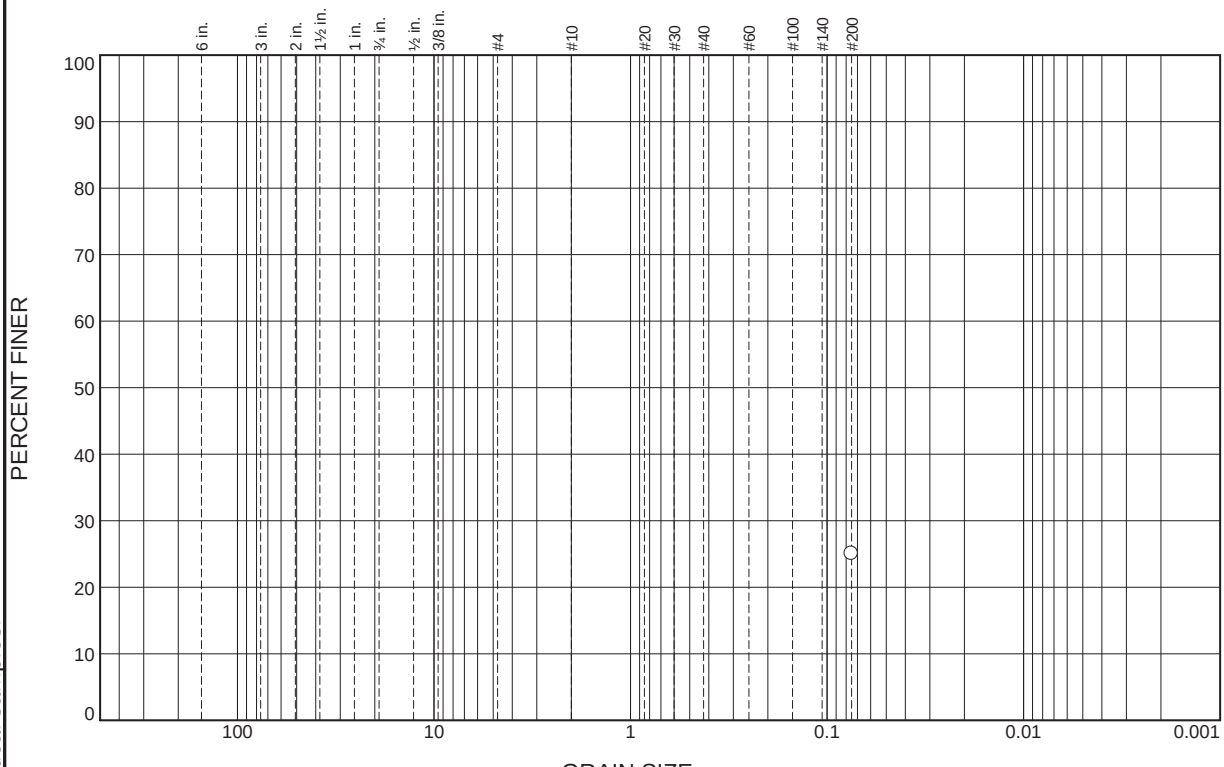
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
133.42	15.90	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										54.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						25.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	25.0		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G016 S-15
Sample Number: 8003-10 **Depth:** 60'-61.5' **Date:** 11/08/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G016 S-15
Depth: 60'-61.5'
Sample Number: 8003-10
Date: 11/08/2017
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 285.60
Tare Wt. = 15.70
Minus #200 from wash = 25.0%

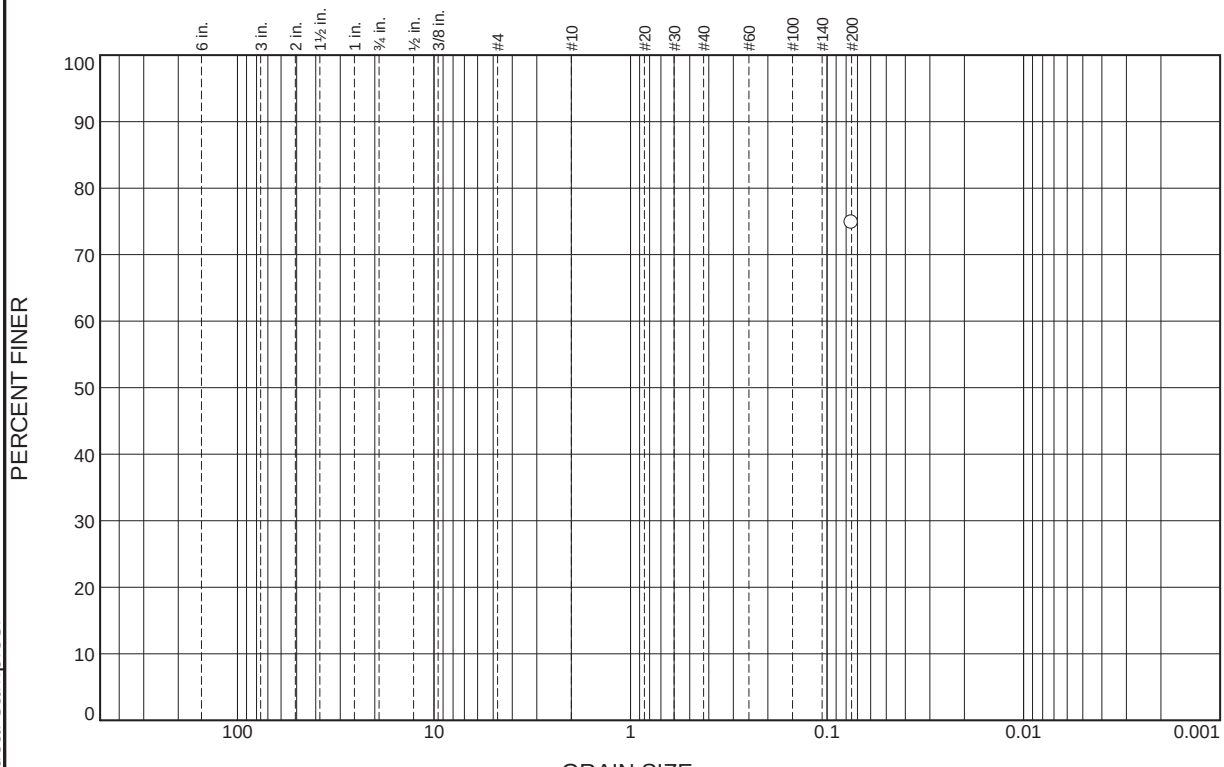
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
375.80	15.70	#200			25.0

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										25.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						74.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	74.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G016 S-17
Sample Number: 8003-12 **Depth:** 70'-71.5' **Date:** 11/08/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

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GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G016 S-17
Depth: 70'-71.5'
Sample Number: 8003-12
Date: 11/08/2017
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 76.10
Tare Wt. = 15.70
Minus #200 from wash = 74.8%

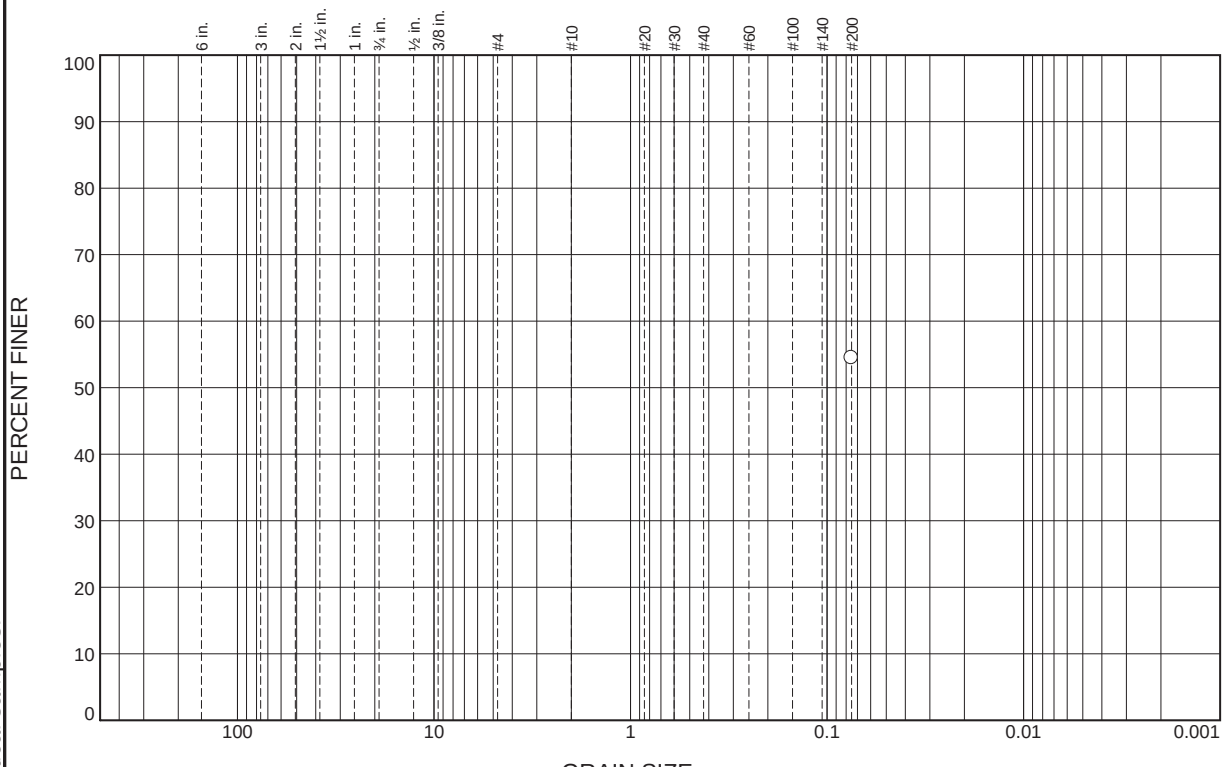
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
255.60	15.70	#200			74.8

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										74.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						54.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	54.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G016 S-22
Sample Number: 8003-16 **Depth:** 95'-96.5' **Date:** 11/08/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

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GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G016 S-22
Depth: 95'-96.5'
Sample Number: 8003-16
Date: 11/08/2017
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 151.60
Tare Wt. = 15.70
Minus #200 from wash = 54.5%

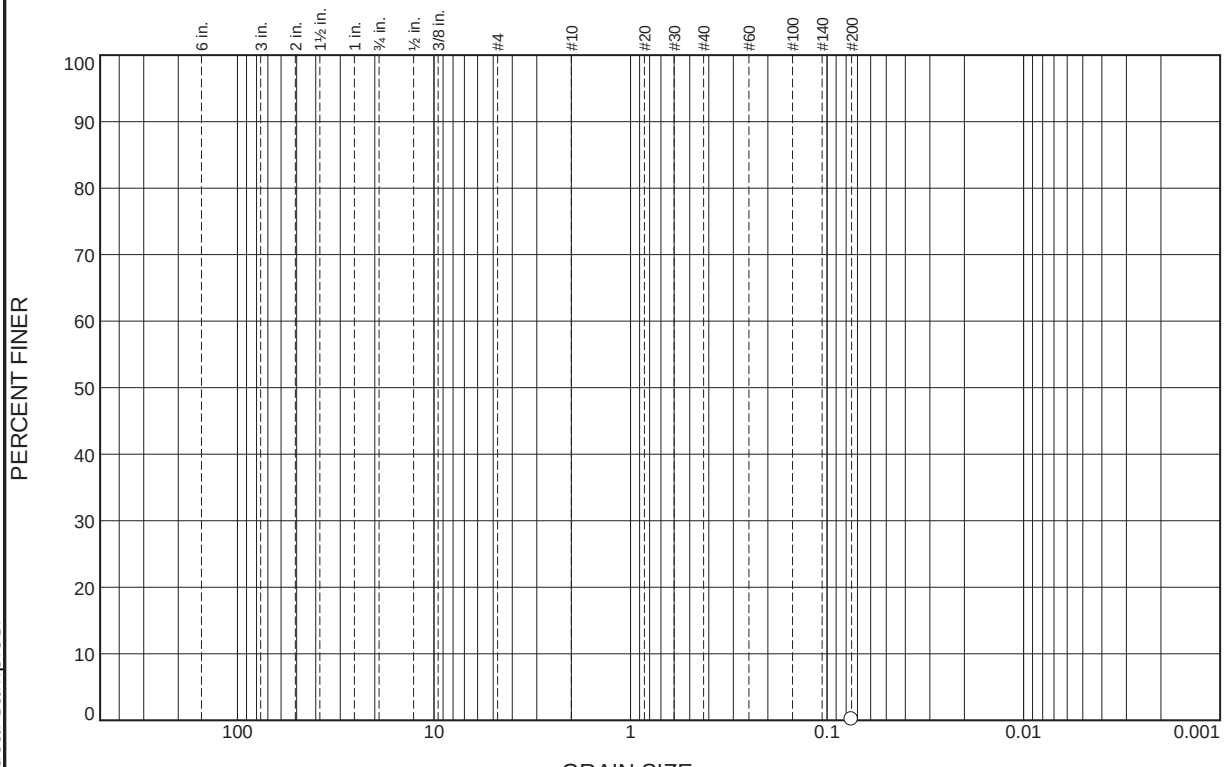
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
314.20	15.70	#200			54.5

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										54.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						0.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	0.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G17 / S8
Sample Number: 054-110 **Depth:** 30' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

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GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17 / S8
Depth: 30'
Sample Number: 054-110
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 249.22
Tare Wt. = 15.80
Minus #200 from wash = 0.2%

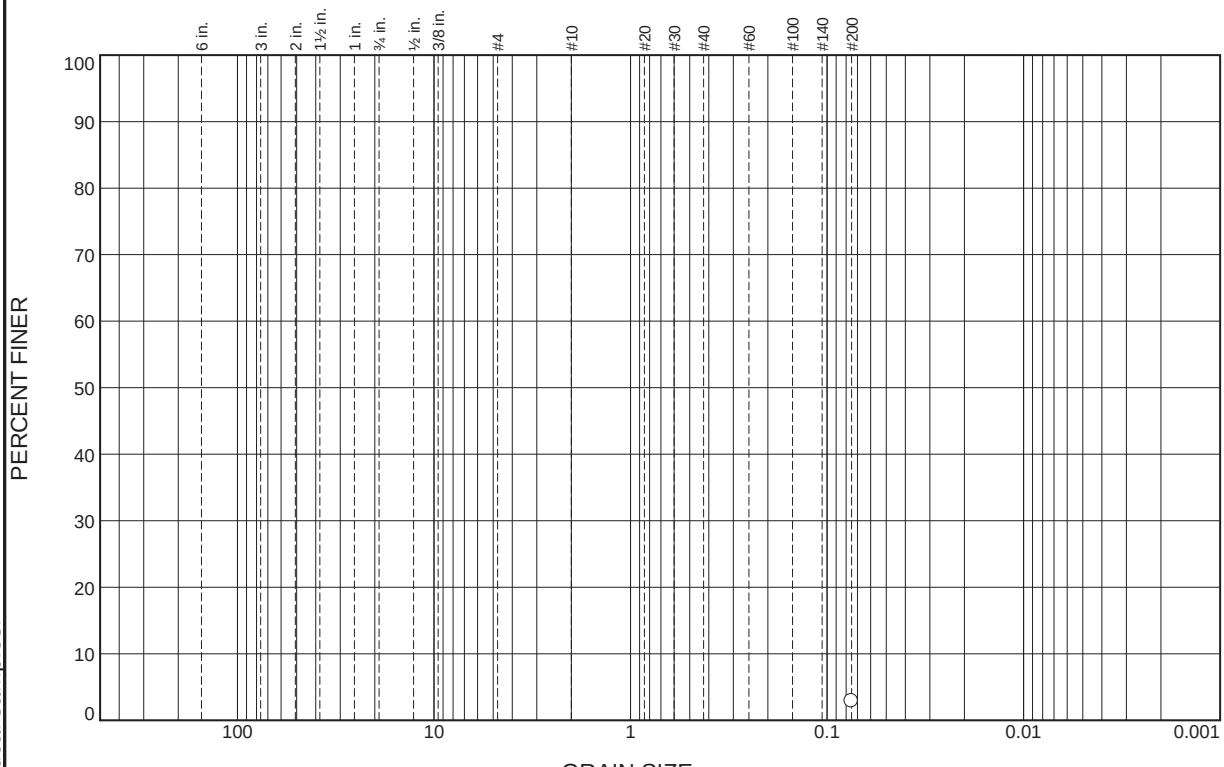
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
249.60	15.80	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										0.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						2.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	2.9		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G17A / S10
Sample Number: 054-119 **Depth:** 35' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

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GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S10
Depth: 35'
Sample Number: 054-119
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 215.92
Tare Wt. = 15.80
Minus #200 from wash = 2.9%

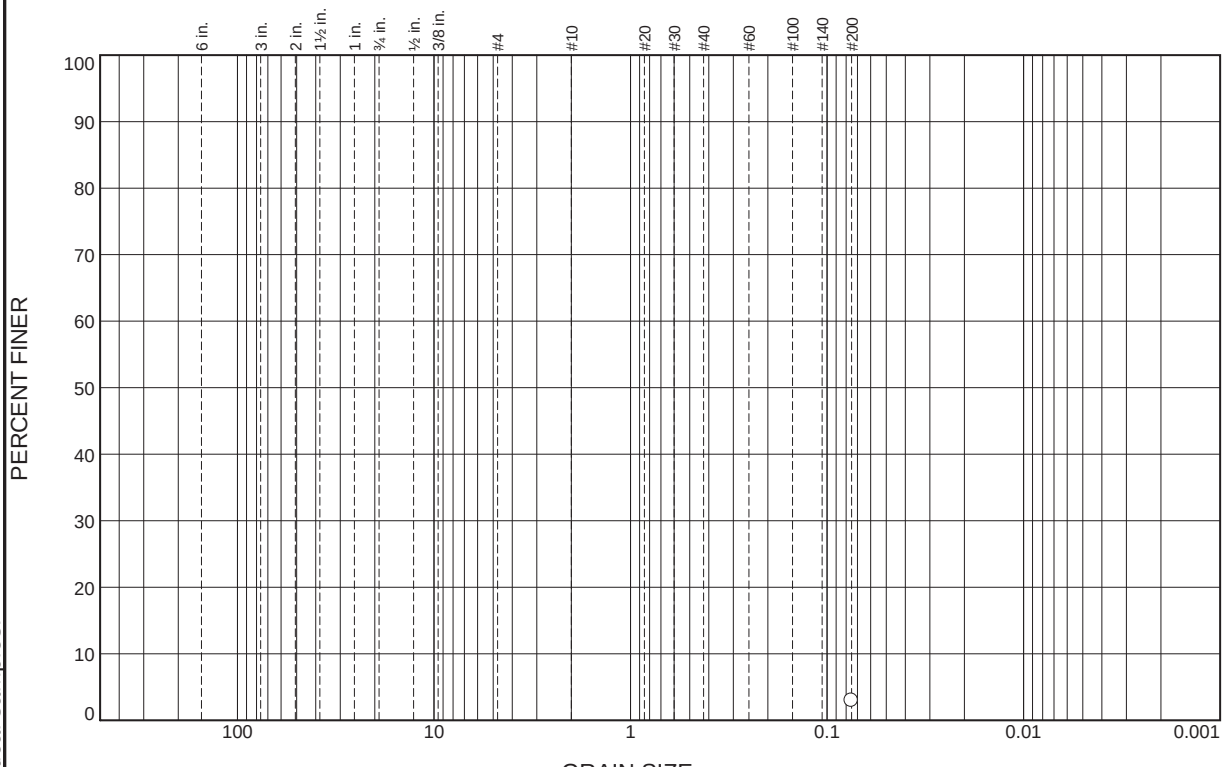
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
221.89	15.80	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										2.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						3.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	3.0		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G17A / S13
Sample Number: 054-121 **Depth:** 50' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

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GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S13
Depth: 50'
Sample Number: 054-121
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 345.19
Tare Wt. = 15.70
Minus #200 from wash = 3.0%

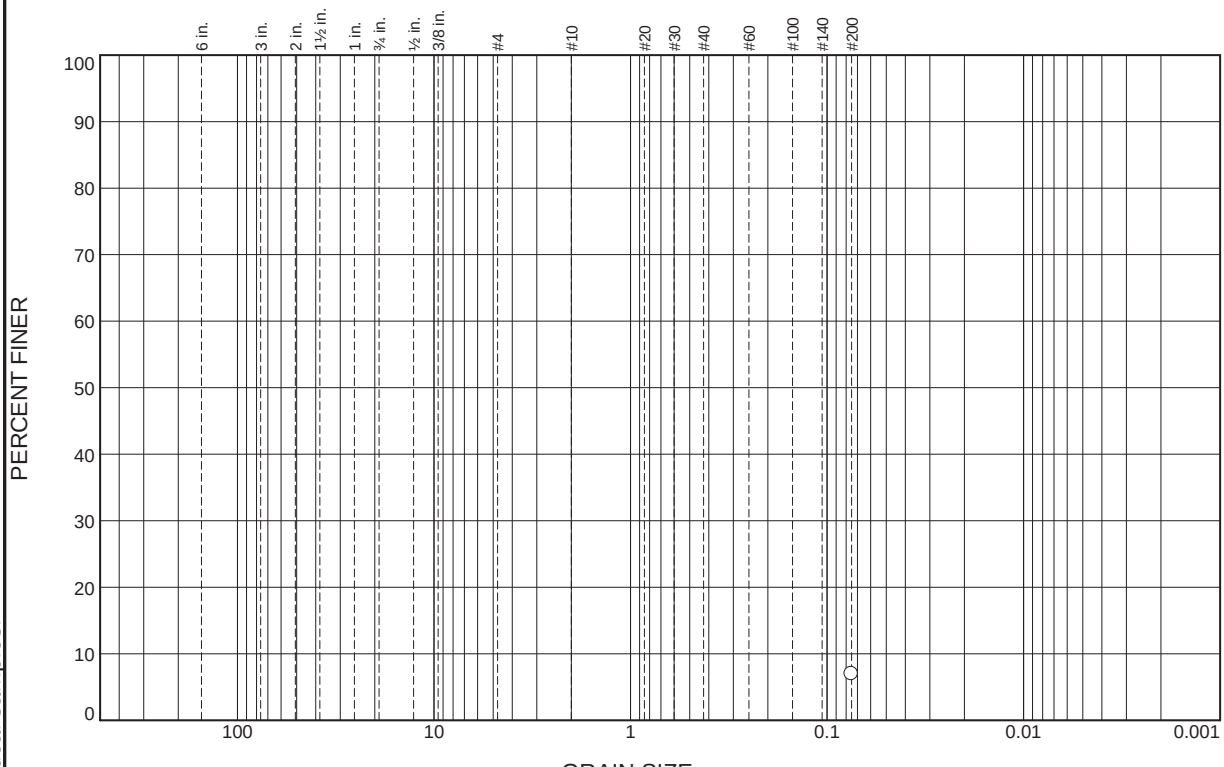
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
355.30	15.70	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										3.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						7.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	7.0		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G17A / S18
Sample Number: 054-124 **Depth:** 75' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S18
Depth: 75'
Sample Number: 054-124
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 198.82
Tare Wt. = 15.80
Minus #200 from wash = 7.0%

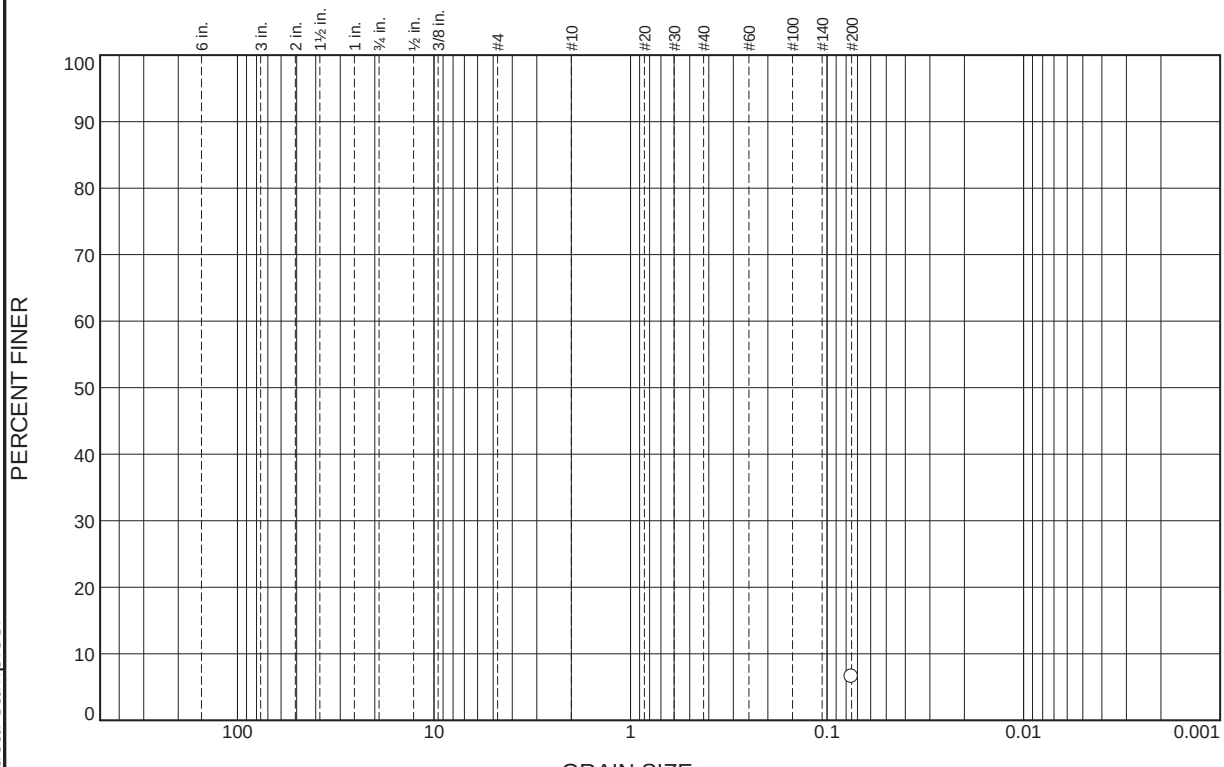
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
212.57	15.80	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										7.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						6.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	6.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G018 S-11
Sample Number: 8003-24 **Depth:** 40'-41.5' **Date:** 11/08/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-11
Depth: 40'-41.5'
Sample Number: 8003-24
Date: 11/08/2017
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 434.70
Tare Wt. = 15.90
Minus #200 from wash = 6.6%

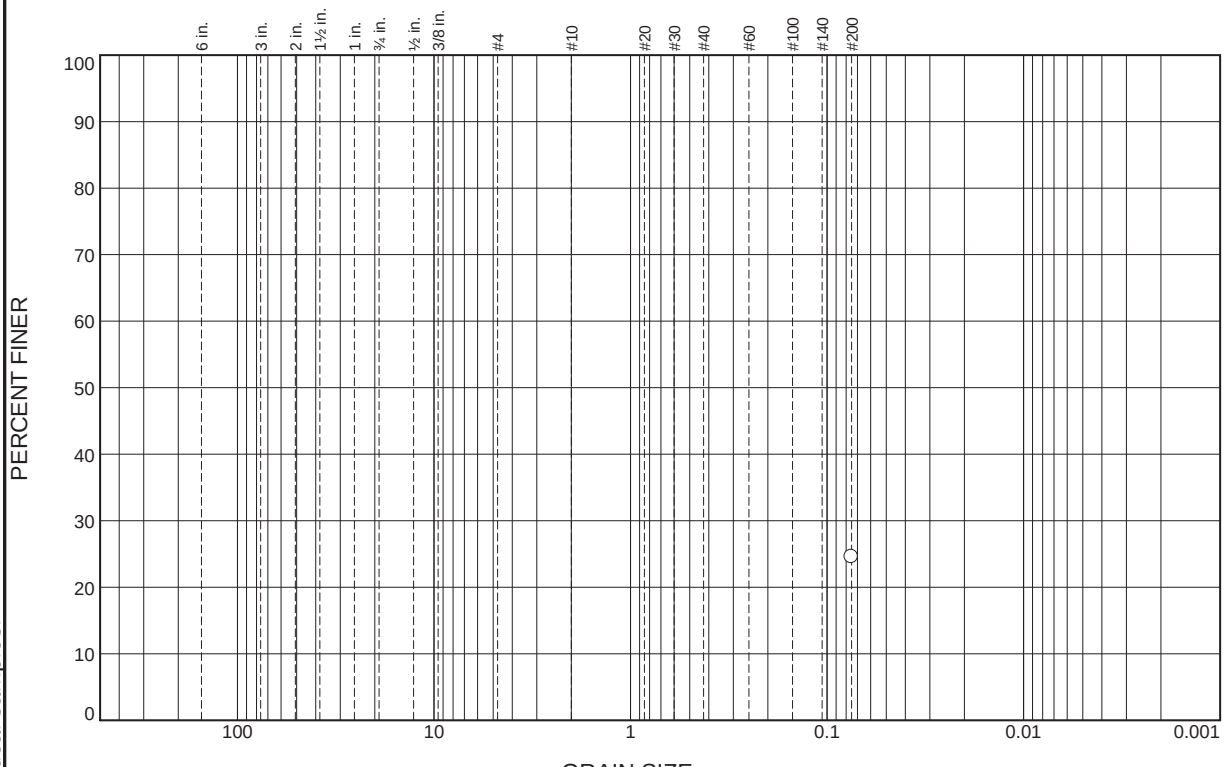
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
464.10	15.90	#200			6.6

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										6.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						24.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	24.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G018 S-14
Sample Number: 8003-25 **Depth:** 60'-61.5' **Date:** 11/08/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

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GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-14
Depth: 60'-61.5'
Sample Number: 8003-25
Date: 11/08/2017
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 326.80
Tare Wt. = 15.80
Minus #200 from wash = 24.6%

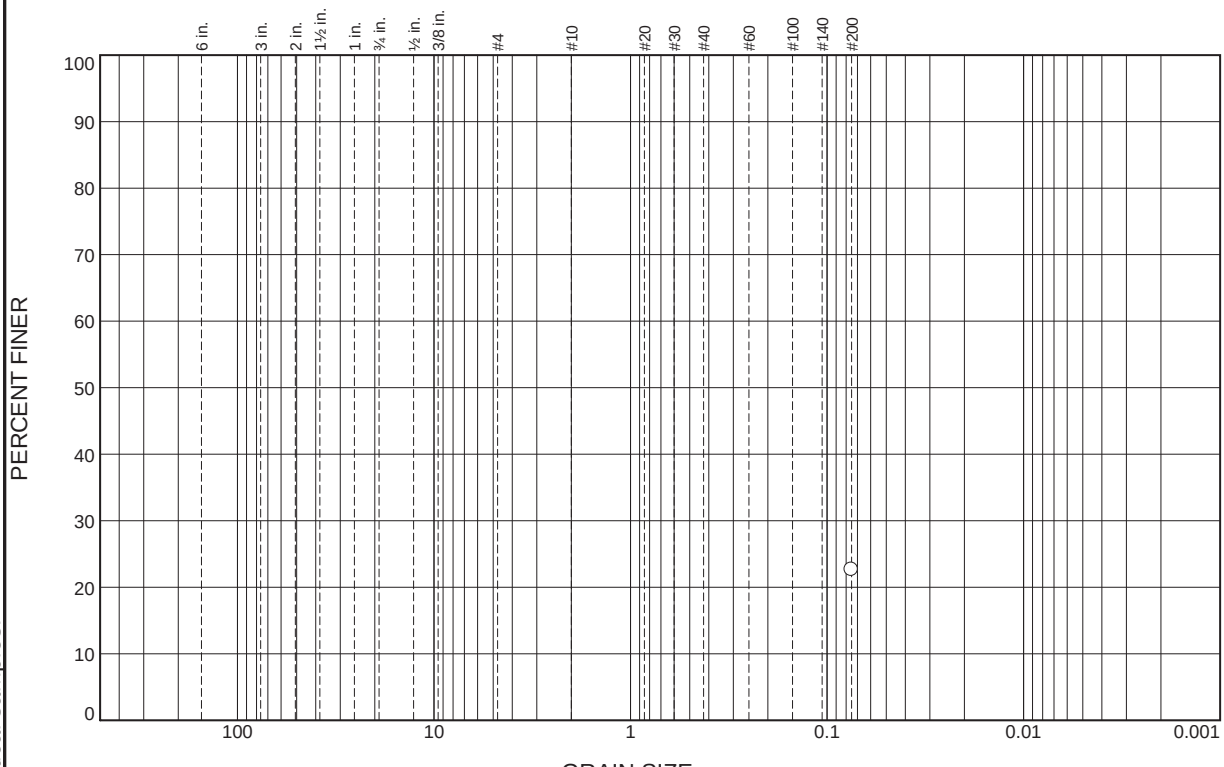
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
428.20	15.80	#200			24.6

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										24.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						22.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	22.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G018 S-17
Sample Number: 8003-27 **Depth:** 77.5'-79' **Date:** 11/8/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-17
Depth: 77.5'-79'
Sample Number: 8003-27
Date: 11/8/2017
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 348.10
Tare Wt. = 15.80
Minus #200 from wash = 22.6%

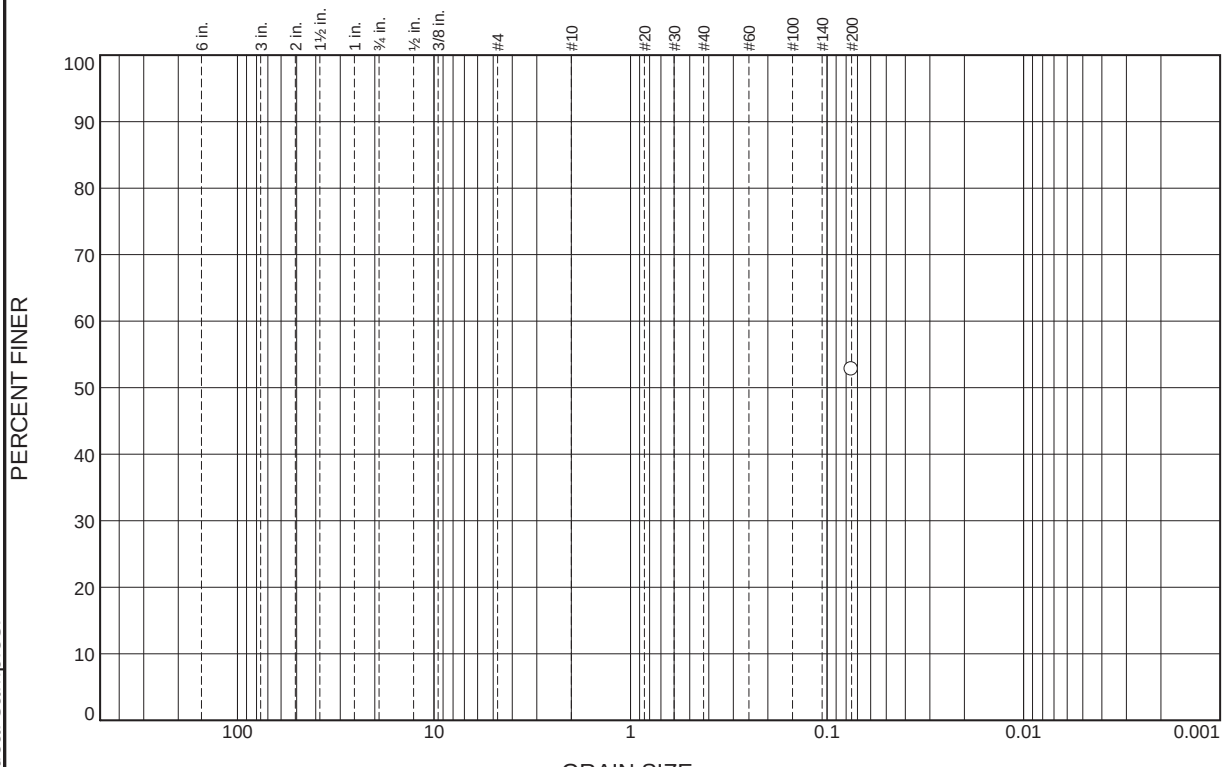
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
445.30	15.80	#200			22.6

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										22.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						52.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	52.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G018 S-34
Sample Number: 8003-40 **Depth:** 170'-171.5' **Date:** 11/8/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-34
Depth: 170'-171.5'
Sample Number: 8003-40
Date: 11/8/2017
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 334.50
Tare Wt. = 198.30
Minus #200 from wash = 52.8%

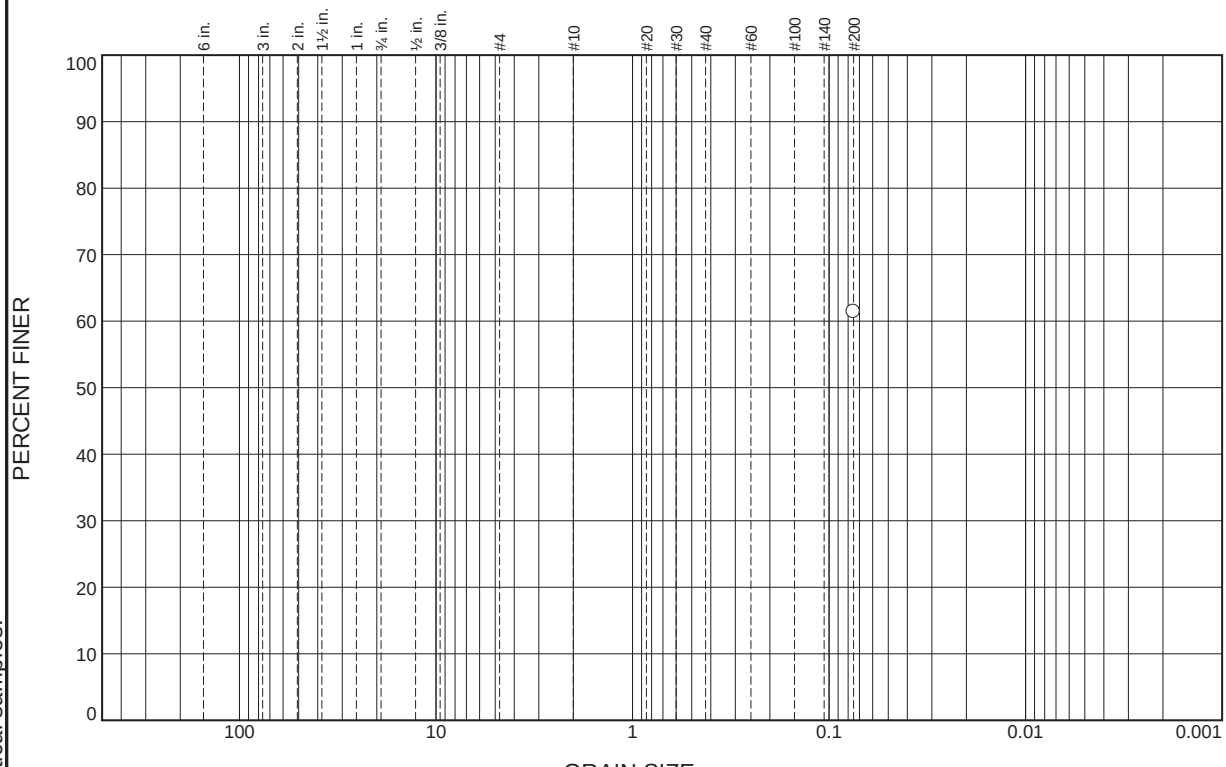
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
486.70	198.30	#200			52.8

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										52.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						61.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	61.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G018 S-37
Sample Number: 8003-42 **Depth:** 185'-186.5' **Date:** 11/8/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-37
Depth: 185'-186.5' **Sample Number:** 8003-42
Date: 11/8/2017
Tested by: SR **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 284.80
Tare Wt. = 157.60
Minus #200 from wash = 61.4%

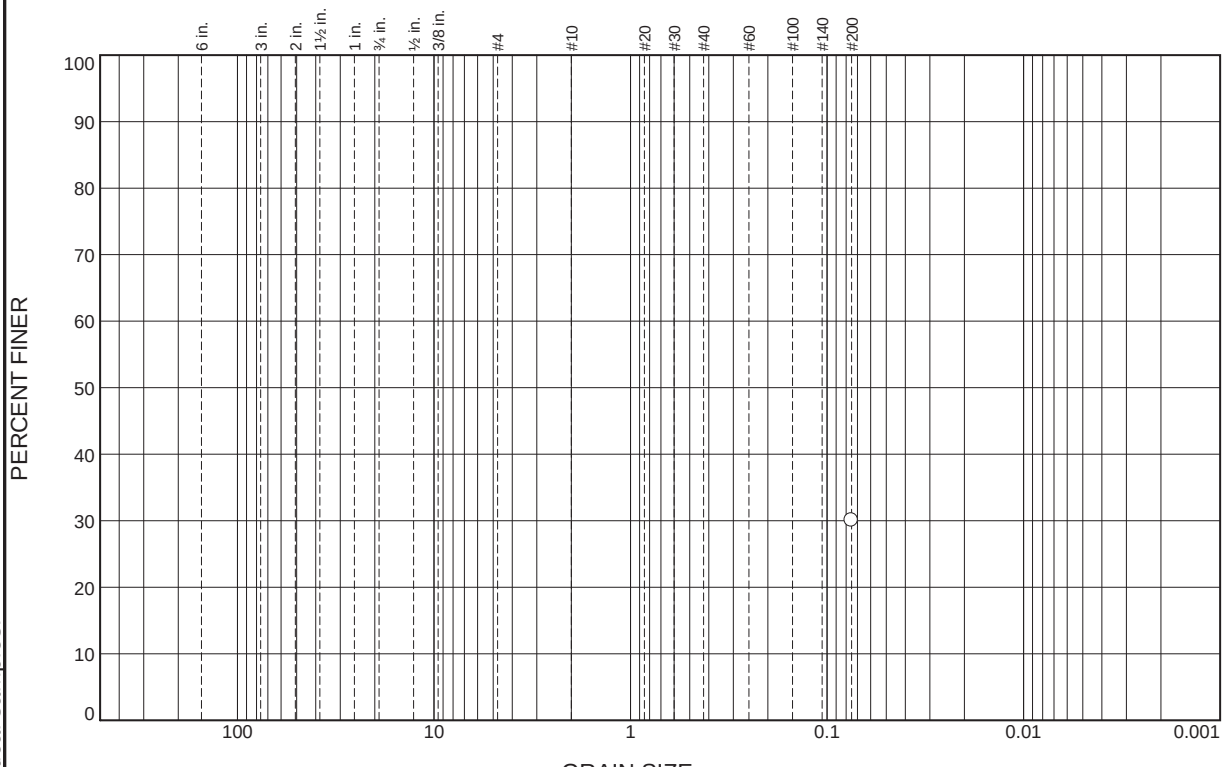
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
487.30	157.60	#200			61.4

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										61.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						30.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	30.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G019 S-12
Sample Number: 7992-7 **Depth:** 40'-41.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-12
Depth: 40'-41.5'
Sample Number: 7992-7
Date: 10/5/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 185.40
Tare Wt. = 16.40
Minus #200 from wash = 30.1%

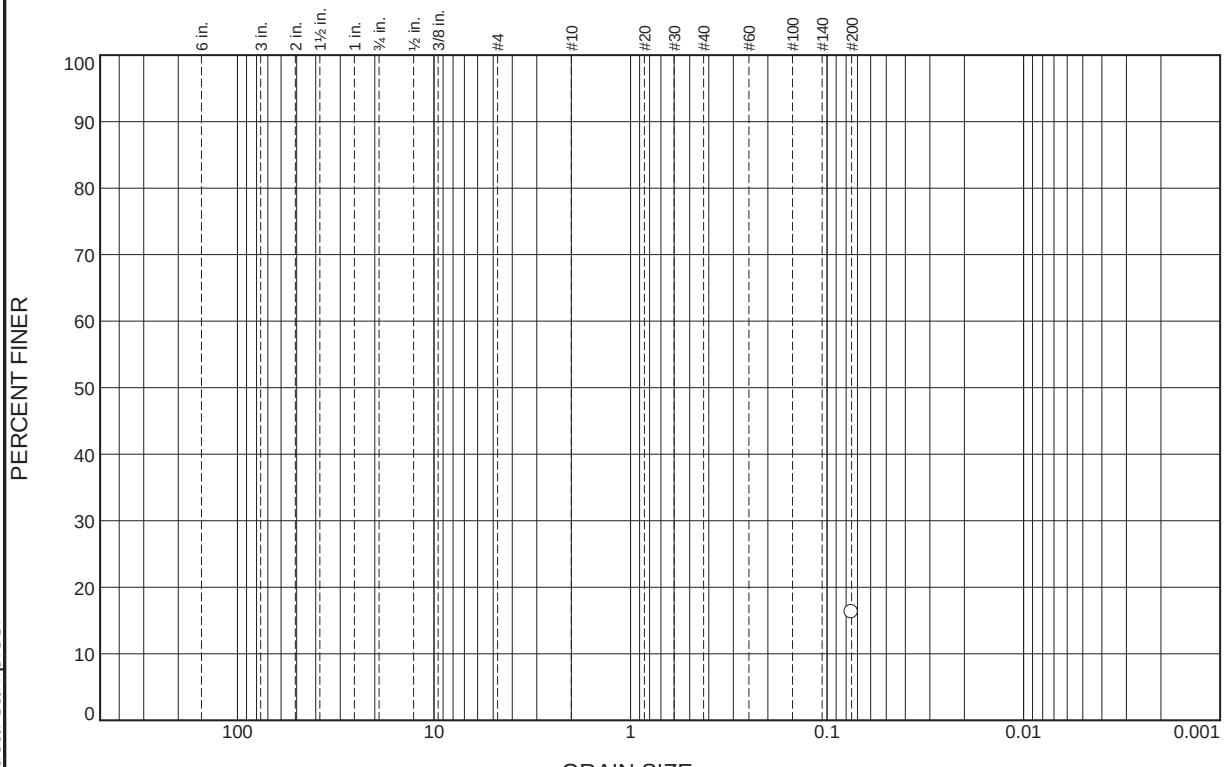
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
258.10	16.40	#200			30.1

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										30.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						16.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	16.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G019 S-16
Sample Number: 7992-9 **Depth:** 60'-61.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-16
Depth: 60'-61.5'
Sample Number: 7992-9
Date: 10/5/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 207.30
Tare Wt. = 16.60
Minus #200 from wash = 16.3%

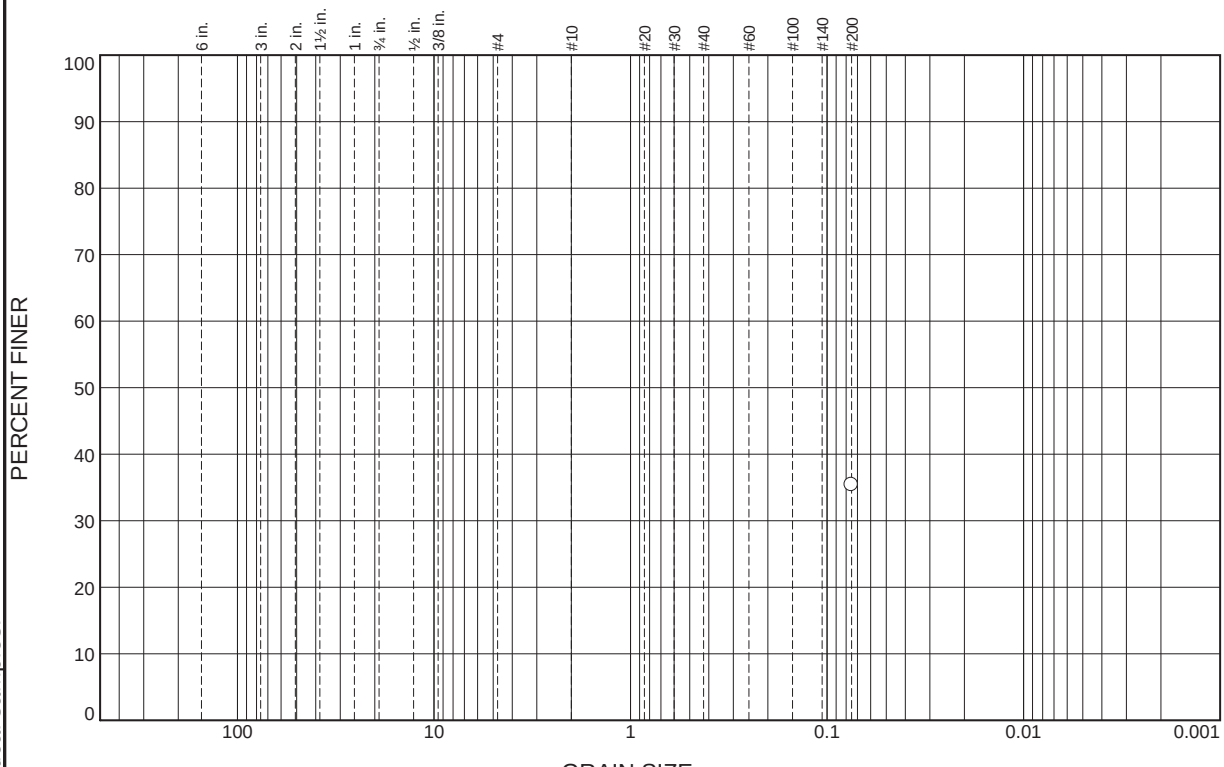
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
244.40	16.60	#200			16.3

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										16.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						35.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	35.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G019 S-31
Sample Number: 7992-11 **Depth:** 135'-136.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-31
Depth: 135'-136.5' **Sample Number:** 7992-11
Date: 10/5/2017
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 209.00
Tare Wt. = 16.90
Minus #200 from wash = 35.4%

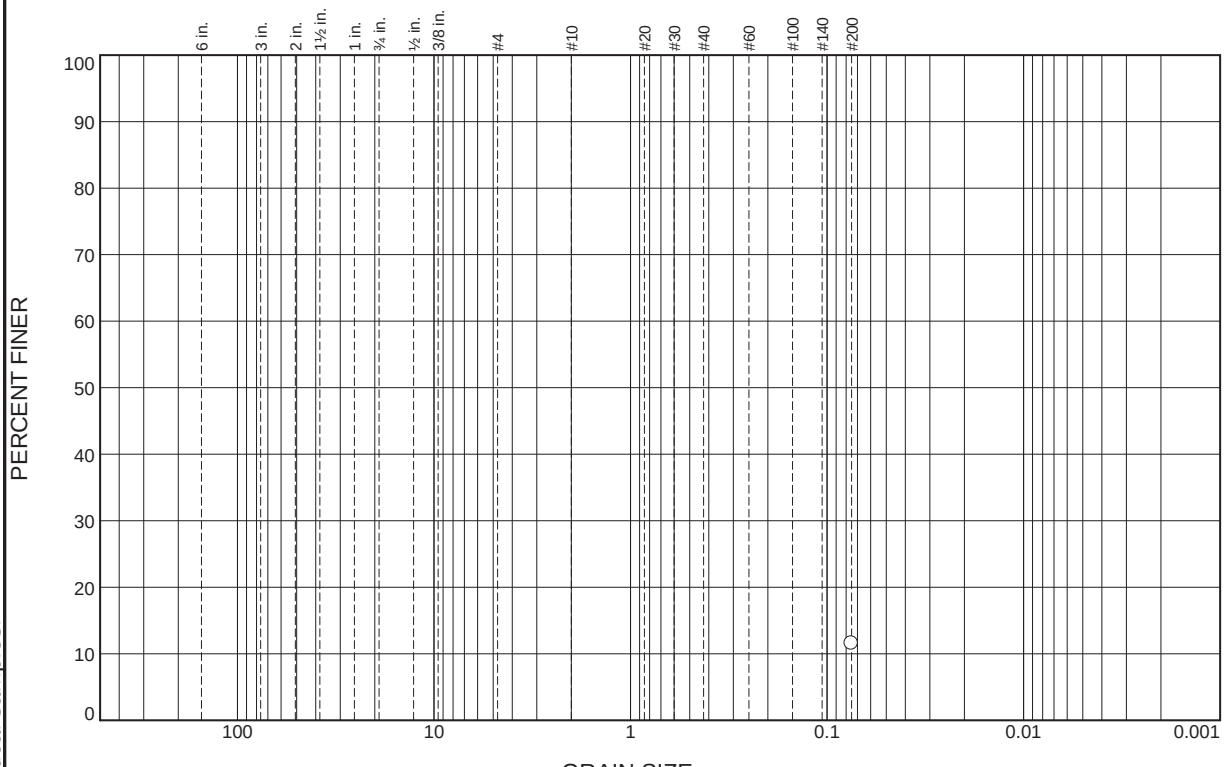
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
314.30	16.90	#200			35.4

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										35.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						11.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	11.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G020 S-13
Sample Number: 7992-20 **Depth:** 45'-46.5 **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-13
Depth: 45'-46.5 **Sample Number:** 7992-20
Date: 10/5/2017
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 203.00
Tare Wt. = 16.40
Minus #200 from wash = 11.6%

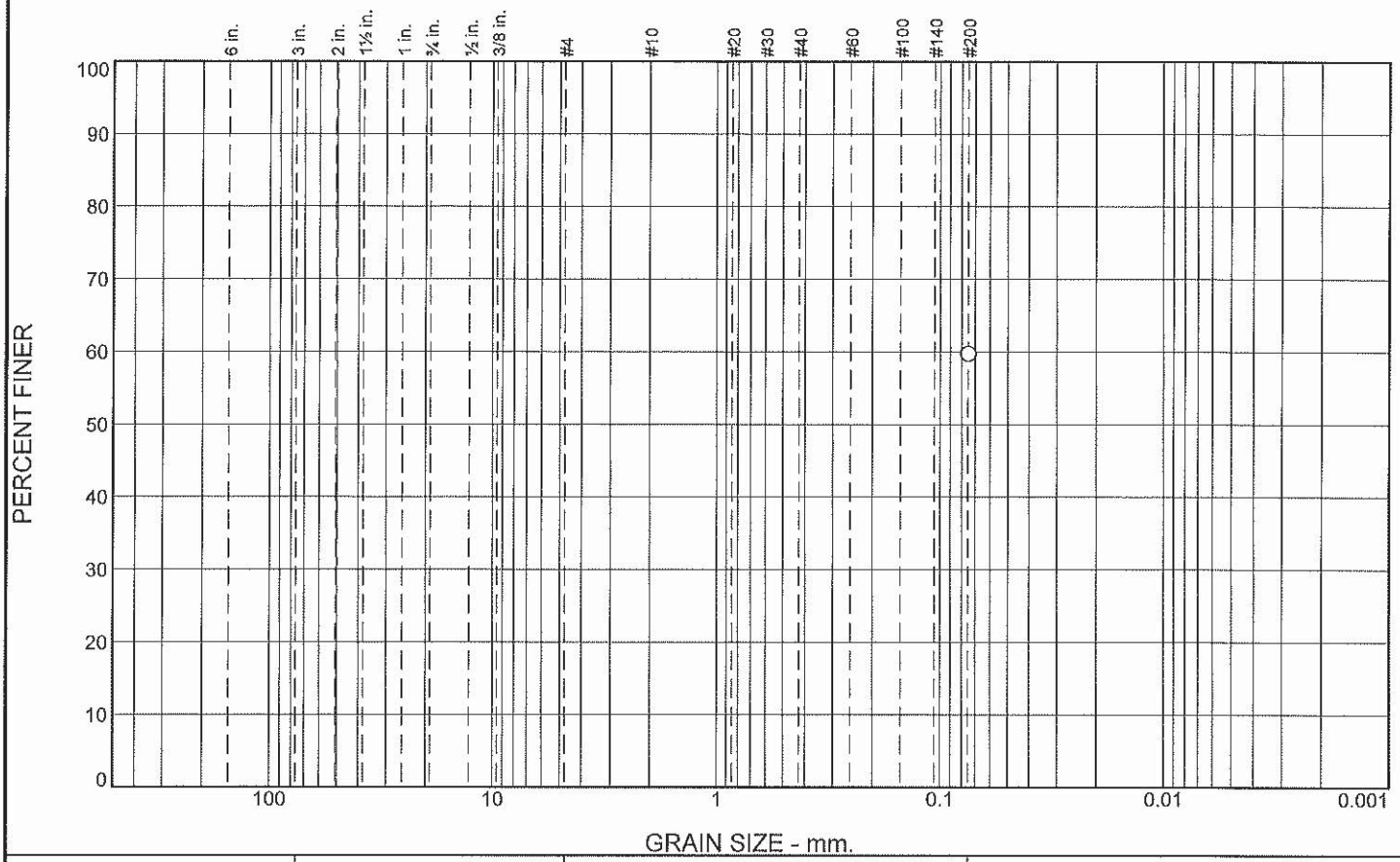
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
227.40	16.40	#200			11.6

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										11.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						59.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	59.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G020 S-20 80'-81.5'
Sample Number: 7980-8

Date: 08/12/2017

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** **Project:** ST-DRLE **Project No:** 1657705 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

8/14/2017

Project: ST-DRLE
Project Number: 1657705
Location: G020 S-20 80'-81.5'
Sample Number: 7980-8
Date: 08/12/2017
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 114.20
Tare Wt. = 16.10
Minus #200 from wash = 59.7%

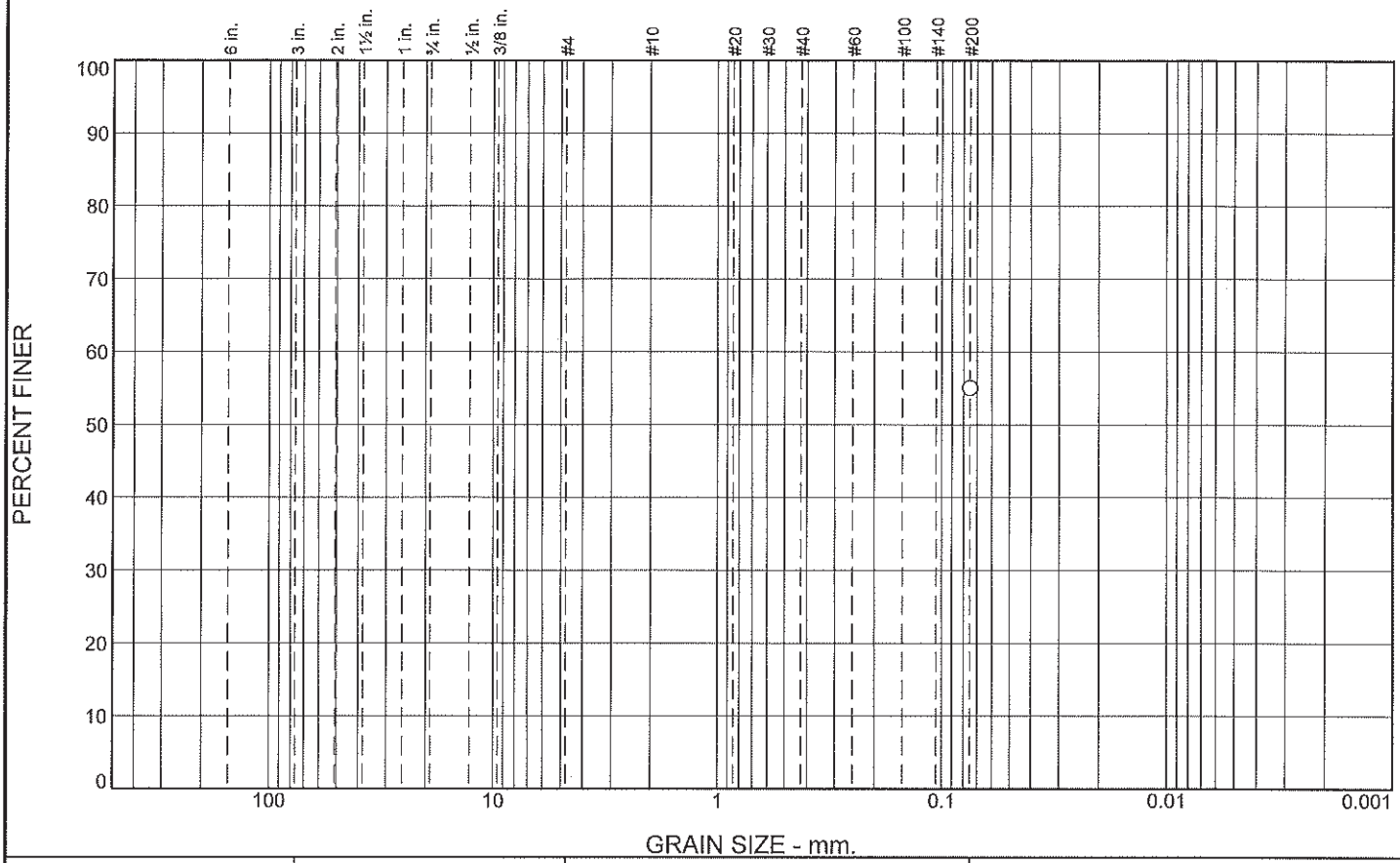
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
259.70	16.10	#200			59.7

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										59.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						55.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	55.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G020 S-24 100'-101.5'
Sample Number: 7980-10

Date: 08/12/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client:
Project: ST-DRLE
Project No: 1657705
Figure

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

8/14/2017

Project: ST-DRLE
Project Number: 1657705
Location: G020 S-24 100'-101.5'
Sample Number: 7980-10
Date: 08/12/2017
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 130.90
Tare Wt. = 17.00
Minus #200 from wash = 55.1%

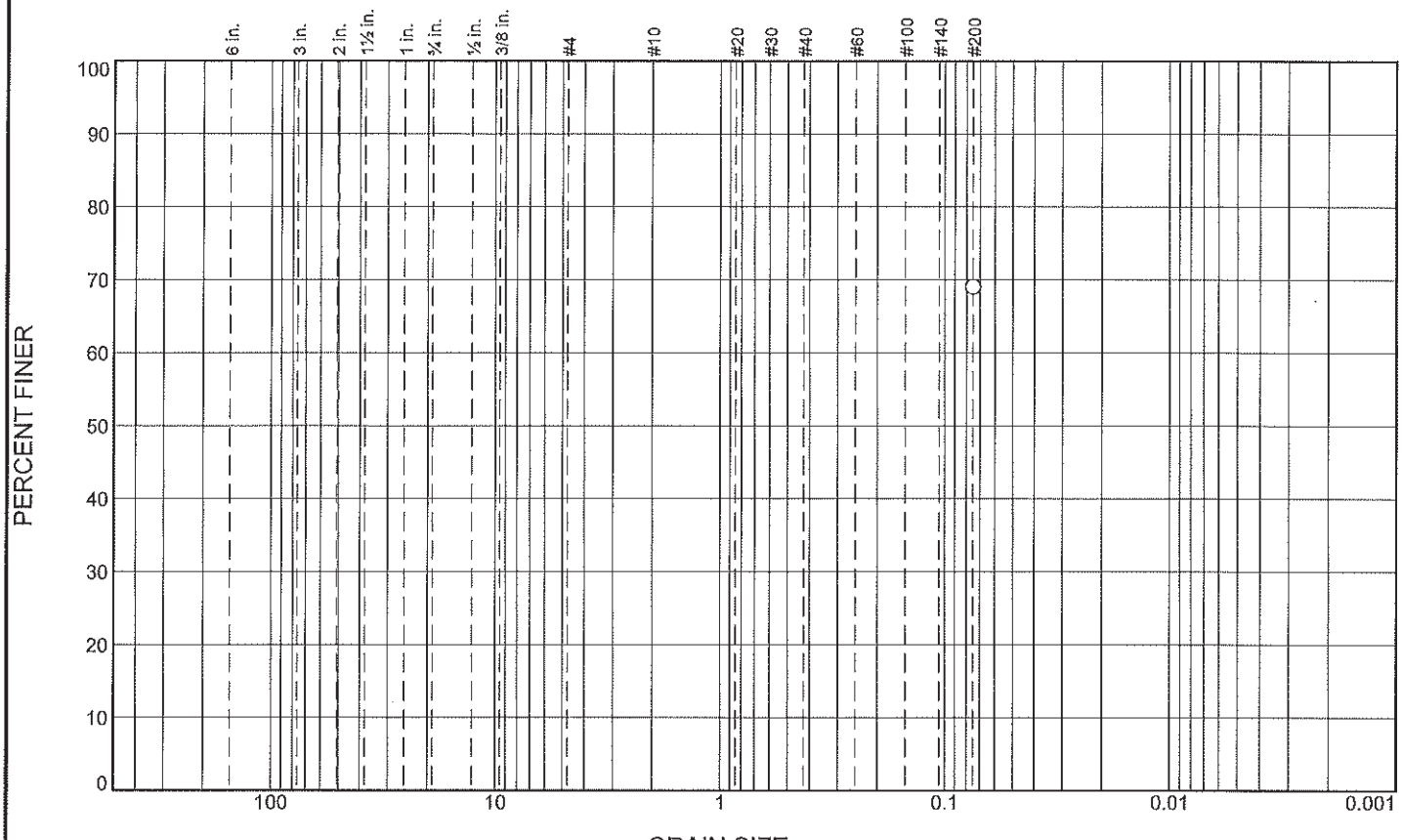
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
270.40	17.00	#200			55.1

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										55.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						69.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	69.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G020 S-25 105'-106.5'
Sample Number: 7980-11

Date: 08/12/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client:
Project: ST-DRLE
Project No: 1657705
Figure

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

8/14/2017

Project: ST-DRLE
Project Number: 1657705
Location: G020 S-25 105'-106.5'
Sample Number: 7980-11
Date: 08/12/2017
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 81.50
Tare Wt. = 15.80
Minus #200 from wash = 69.1%

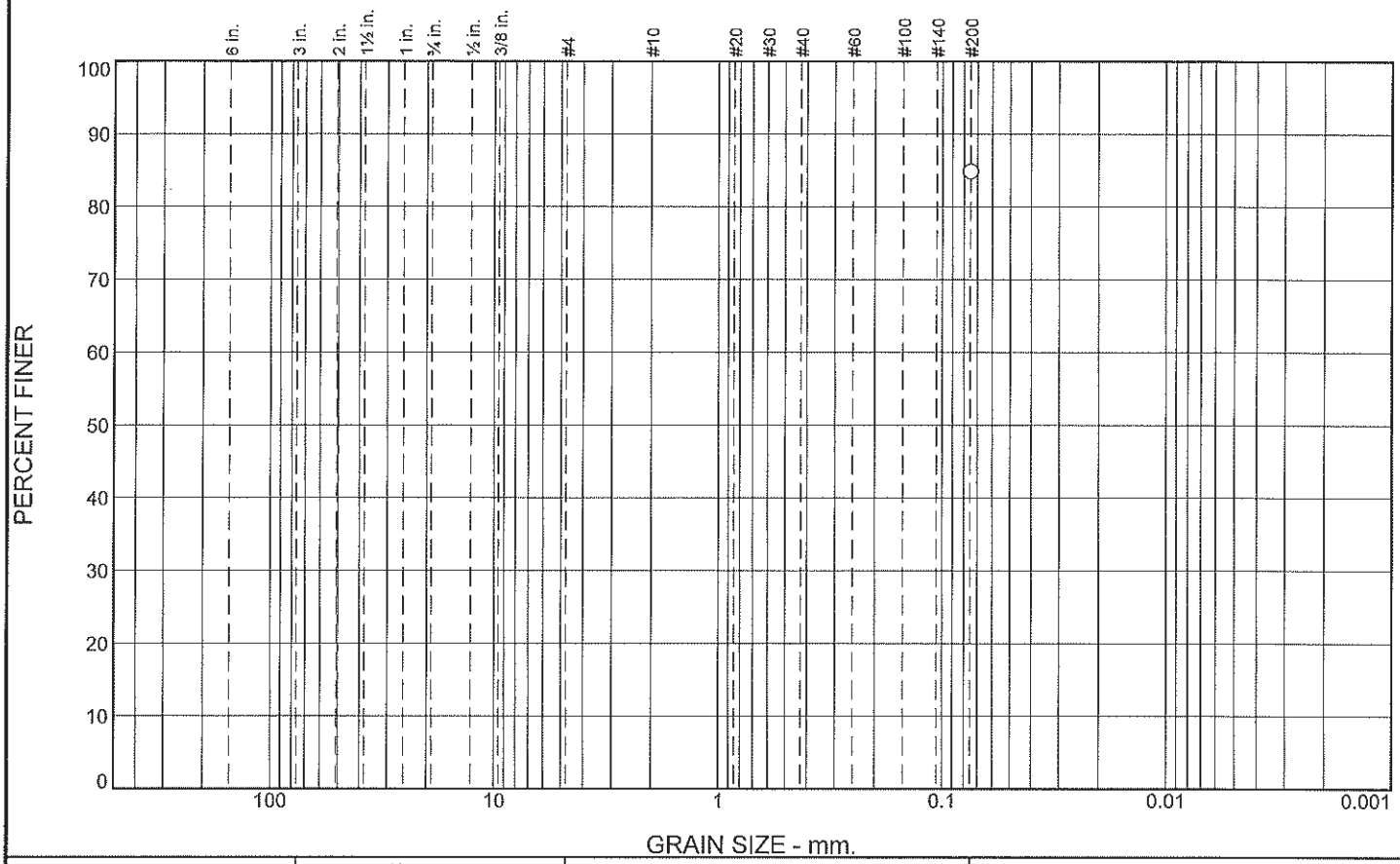
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
228.10	15.80	#200			69.1

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										69.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						84.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	84.9		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G020 S-26 110'-111.5'
Sample Number: 7980-12

Date: 08/14/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client:
Project: ST-DRLE
Project No: 1657705 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

8/15/2017

Project: ST-DRLE
Project Number: 1657705
Location: G020 S-26 110'-111.5'
Sample Number: 7980-12
Date: 08/14/2017
Tested by: BH **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 35.20
Tare Wt. = 16.10
Minus #200 from wash = 84.9%

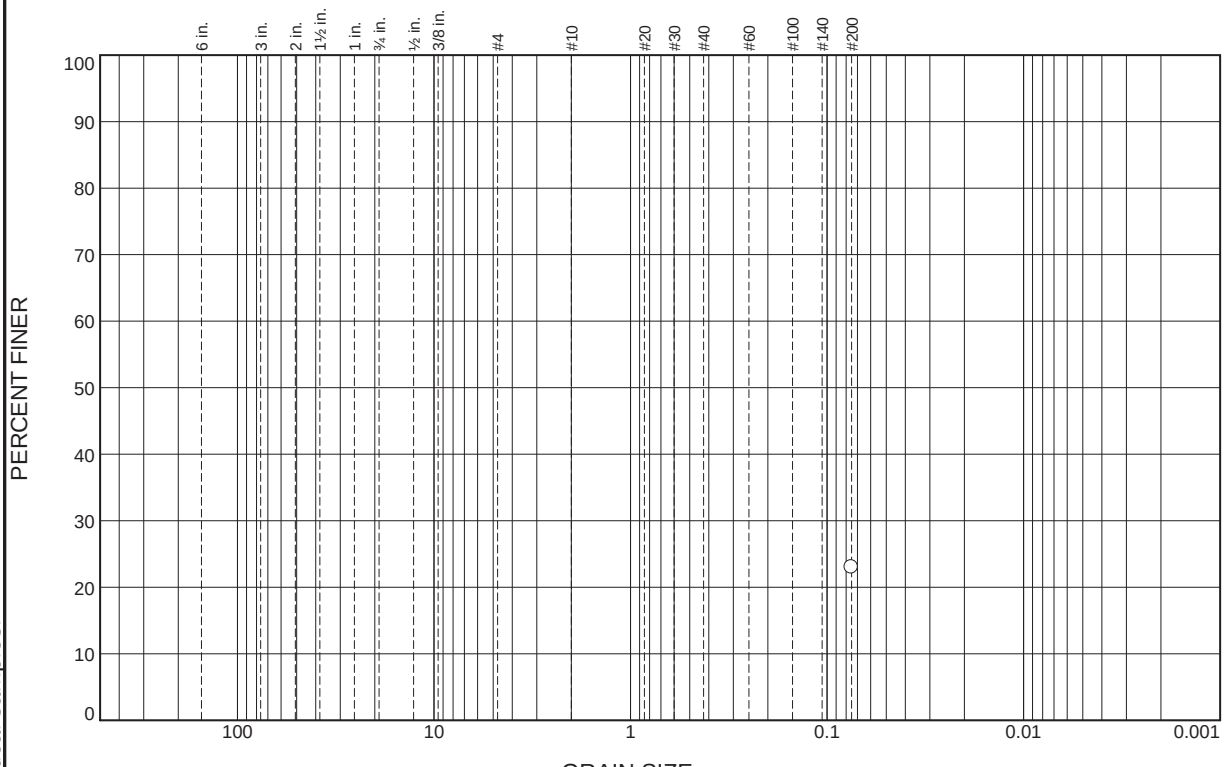
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
142.20	16.10	#200			84.9

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										84.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						23.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	23.0		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G020 S-35
Sample Number: 7992-24 **Depth:** 155'-156.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-35
Depth: 155'-156.5'
Sample Number: 7992-24
Date: 10/5/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 406.00
Tare Wt. = 16.10
Minus #200 from wash = 23.0%

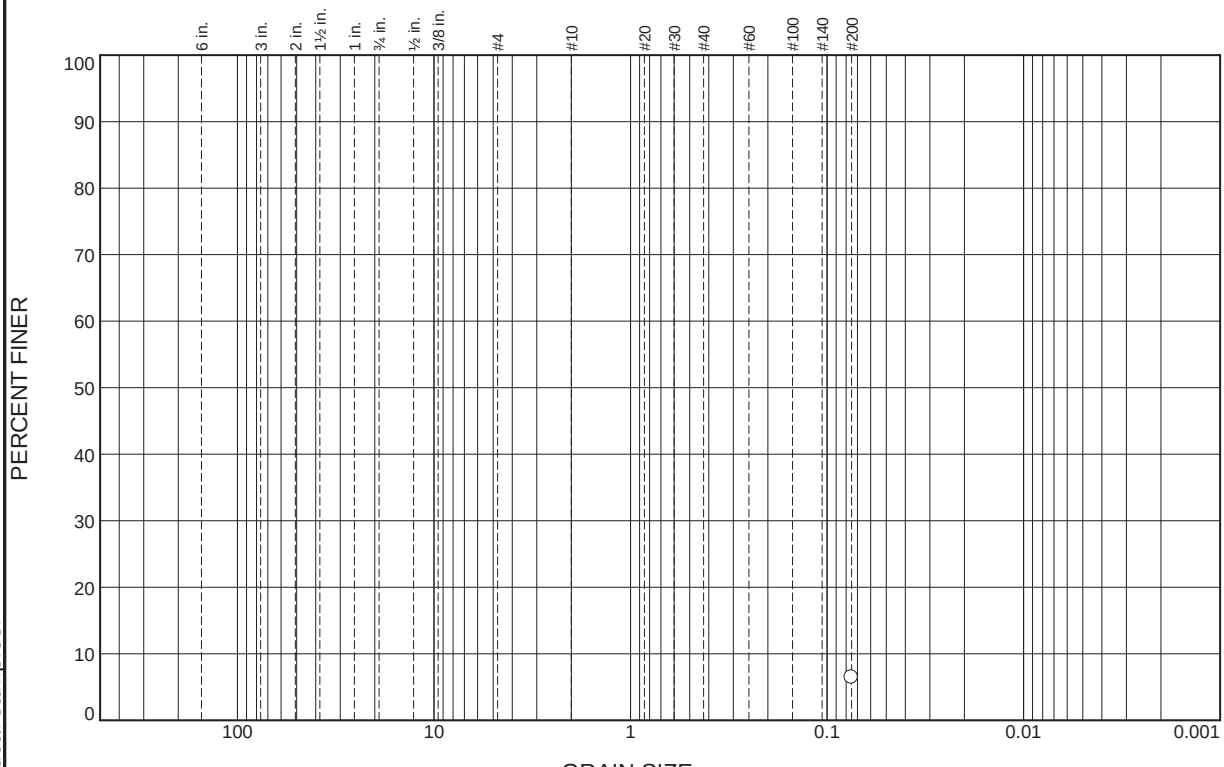
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
522.60	16.10	#200			23.0

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										23.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						6.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	6.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G022 S-10
Sample Number: 7992-39 **Depth:** 35'-36.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G022 S-10
Depth: 35'-36.5'
Sample Number: 7992-39
Date: 10/5/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 325.90
Tare Wt. = 15.80
Minus #200 from wash = 6.5%

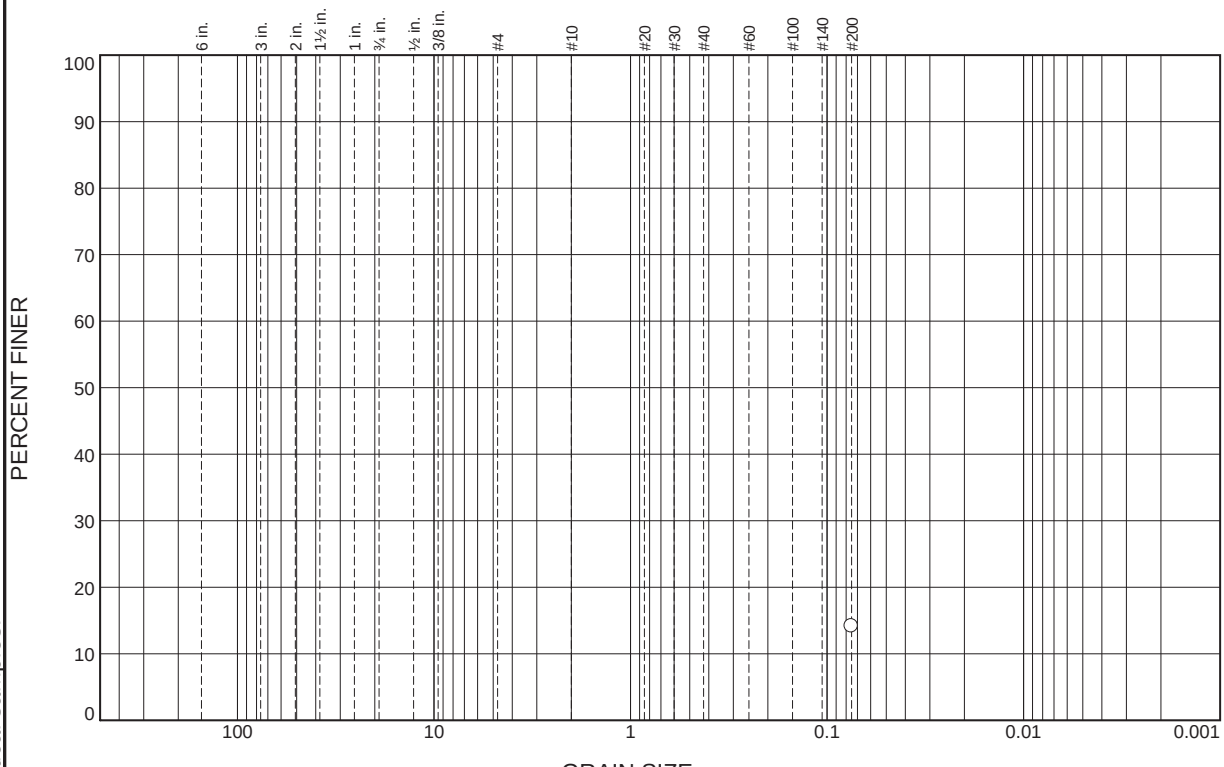
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
347.30	15.80	#200			6.5

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										6.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						14.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	14.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G022 S-12
Sample Number: 7992-40 **Depth:** 45'-46.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G022 S-12
Depth: 45'-46.5'
Sample Number: 7992-40
Date: 10/5/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 314.60
Tare Wt. = 15.80
Minus #200 from wash = 14.2%

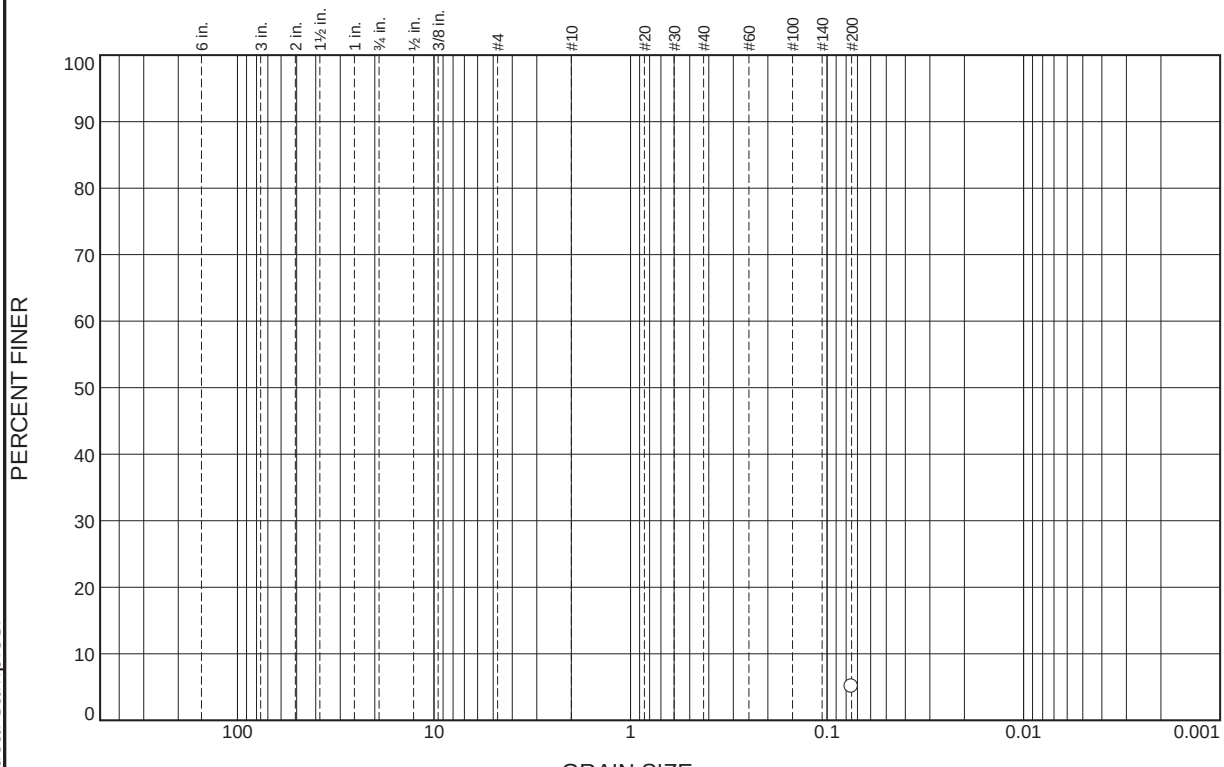
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
363.90	15.80	#200			14.2

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										14.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						5.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	5.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G023 S-9
Sample Number: 7992-44 **Depth:** 30'-31.5' **Date:** 10/5/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G023 S-9
Depth: 30'-31.5'
Sample Number: 7992-44
Date: 10/5/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 325.30
Tare Wt. = 15.80
Minus #200 from wash = 5.1%

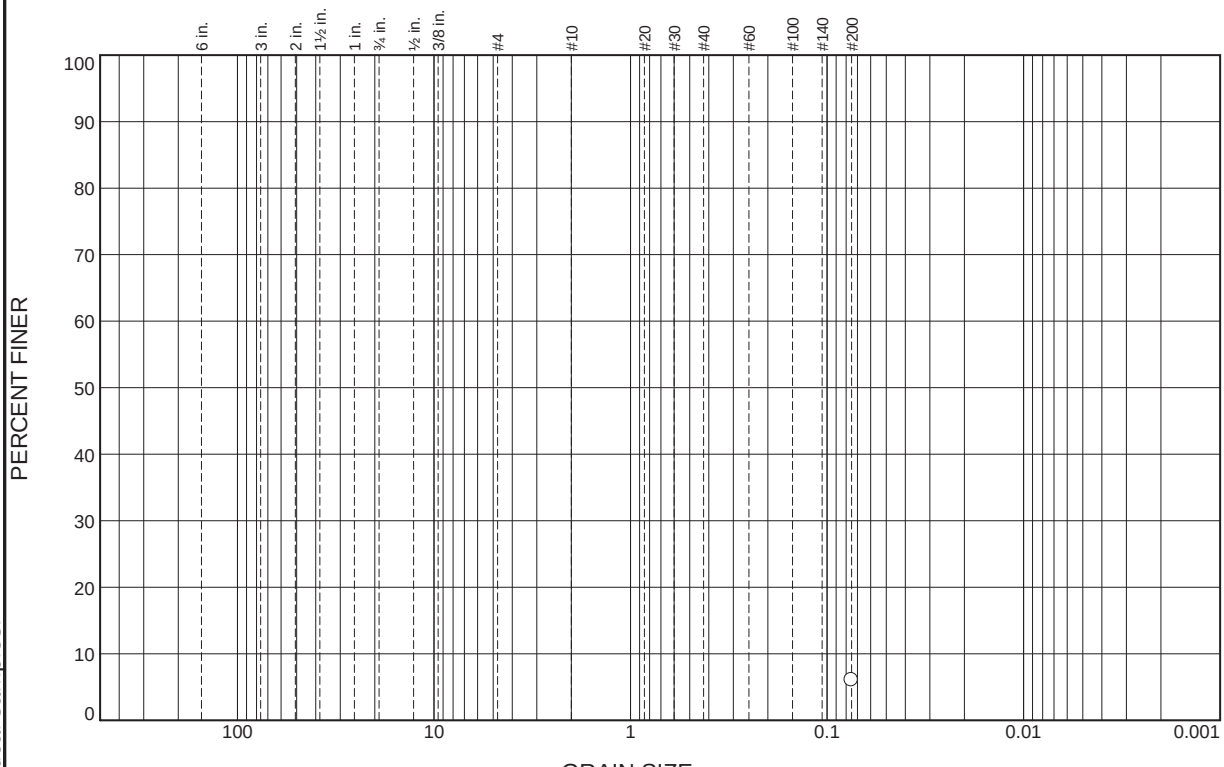
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
341.90	15.80	#200			5.1

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										5.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						6.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	6.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G027 S-7
Sample Number: 7995-19 **Depth:** 20'-21.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G027 S-7
Depth: 20'-21.5'
Sample Number: 7995-19
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 208.10
Tare Wt. = 15.70
Minus #200 from wash = 6.1%

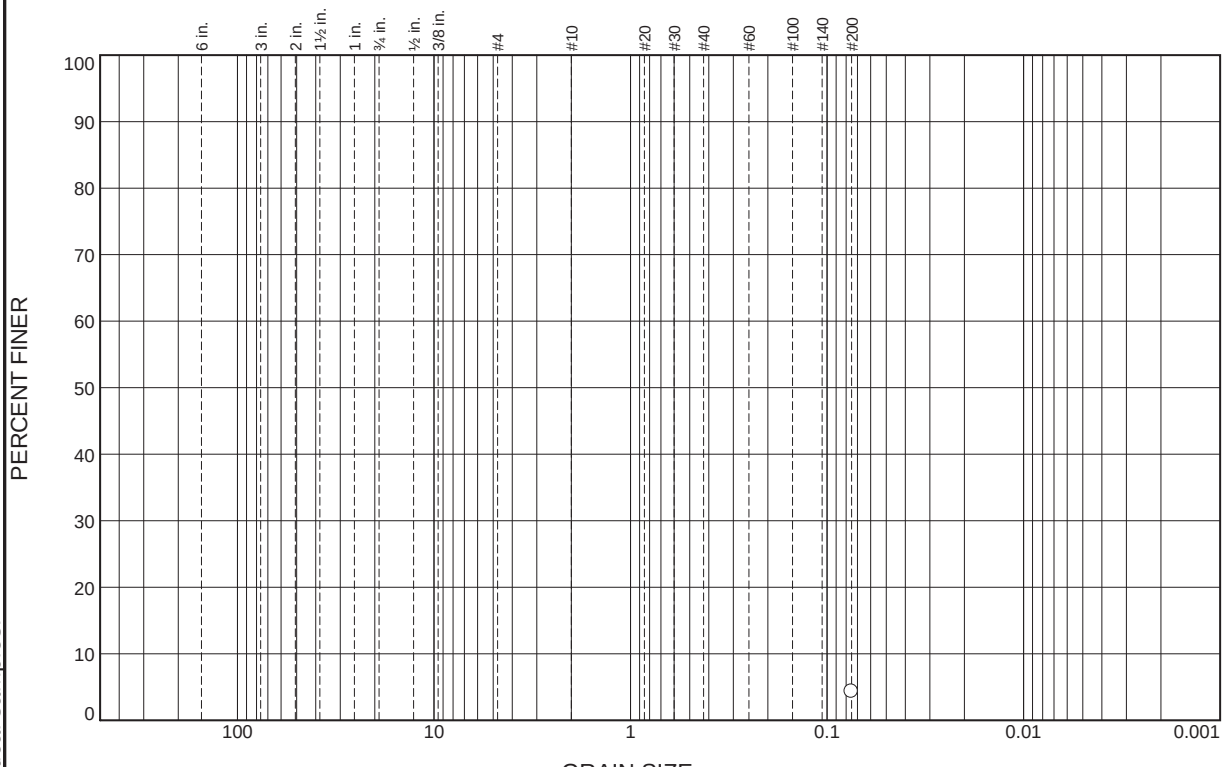
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
220.50	15.70	#200			6.1

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										6.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						4.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	4.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G028 S-6
Sample Number: 7995-26 **Depth:** 25'-26.5' **Date:** 10/27/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

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GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G028 S-6
Depth: 25'-26.5'
Sample Number: 7995-26
Date: 10/27/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 401.90
Tare Wt. = 15.70
Minus #200 from wash = 4.3%

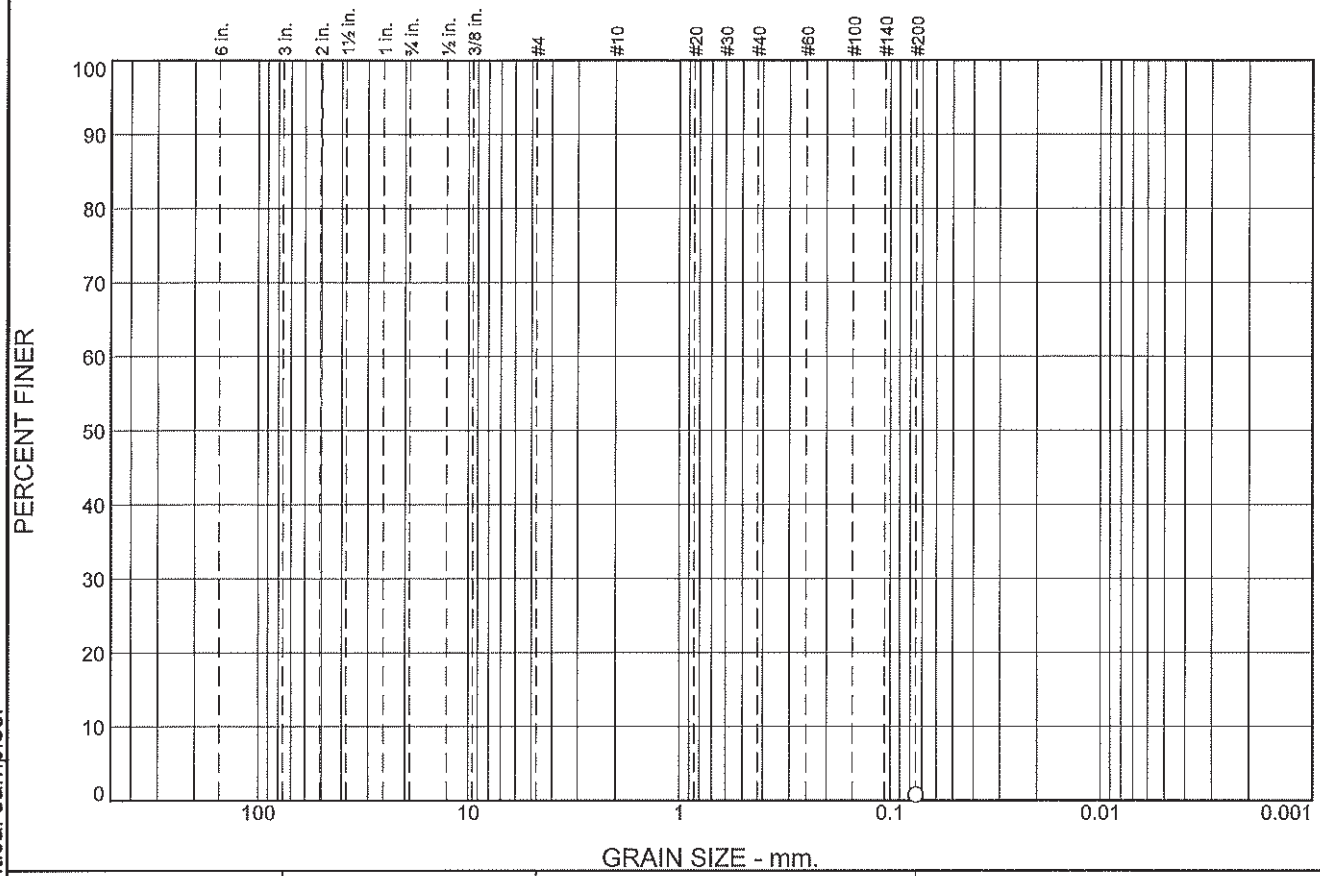
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
419.40	15.70	#200			4.3

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										4.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						0.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	0.8		

* (no specification provided)

Soil Description

SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP AASHTO=

Remarks

Location: G29 S3
Sample Number: 8023-7 **Depth:** 20' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

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GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G29 S3
Depth: 20'
Sample Number: 8023-7
Material Description: SAND
Date: 2/22/2018
USCS Classification: SP
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 216.14
Tare Wt. = 15.76
Minus #200 from wash = 0.8%

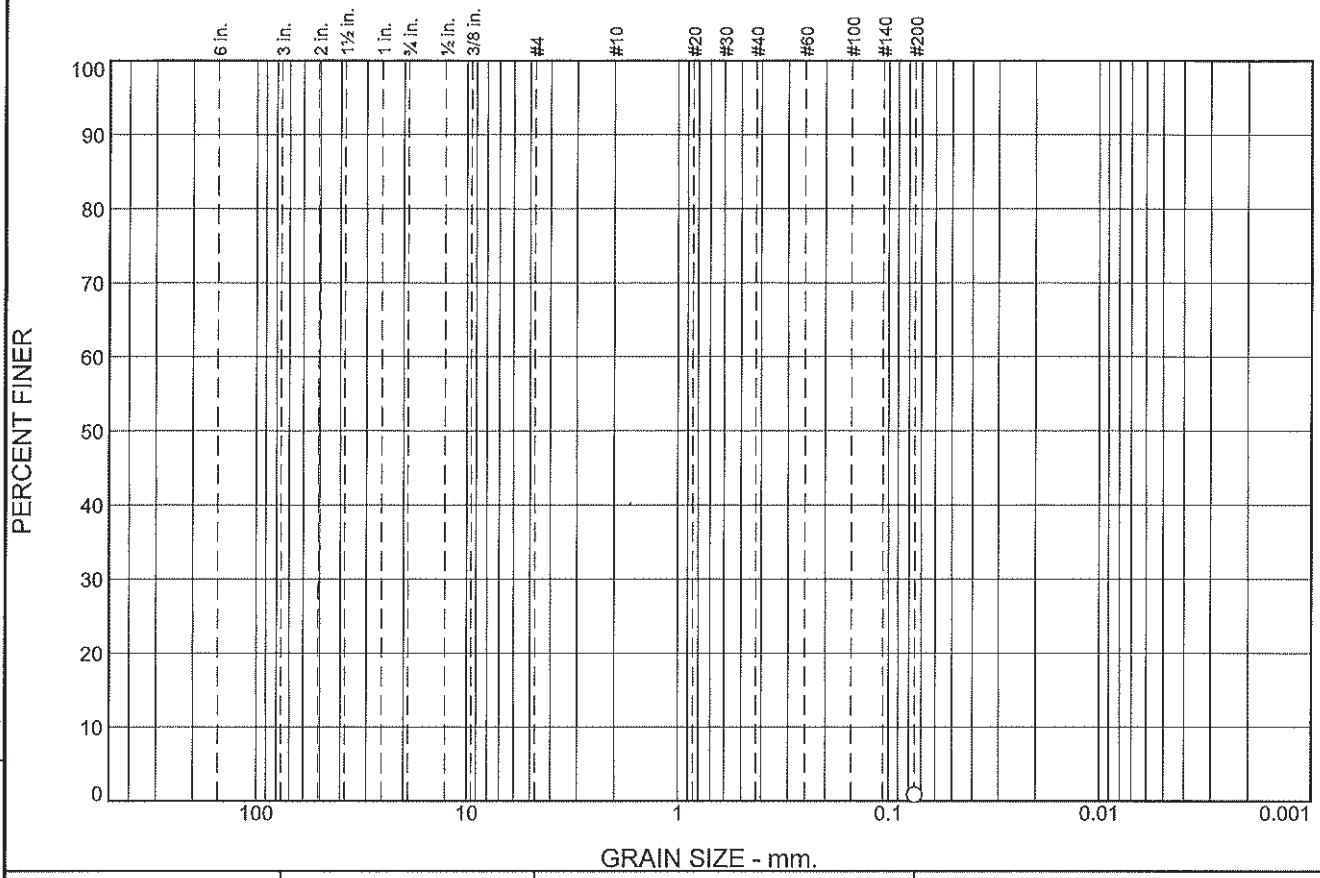
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
217.71	15.76	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										0.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						0.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	0.9		

* (no specification provided)

Soil Description

SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP AASHTO=

Remarks

Location: G29 S8
Sample Number: 8023-9 **Depth:** 35' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G29 S8
Depth: 35'
Sample Number: 8023-9
Material Description: SAND
Date: 2/22/2018
USCS Classification: SP
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 83.57
Tare Wt. = 15.82
Minus #200 from wash = 0.9%

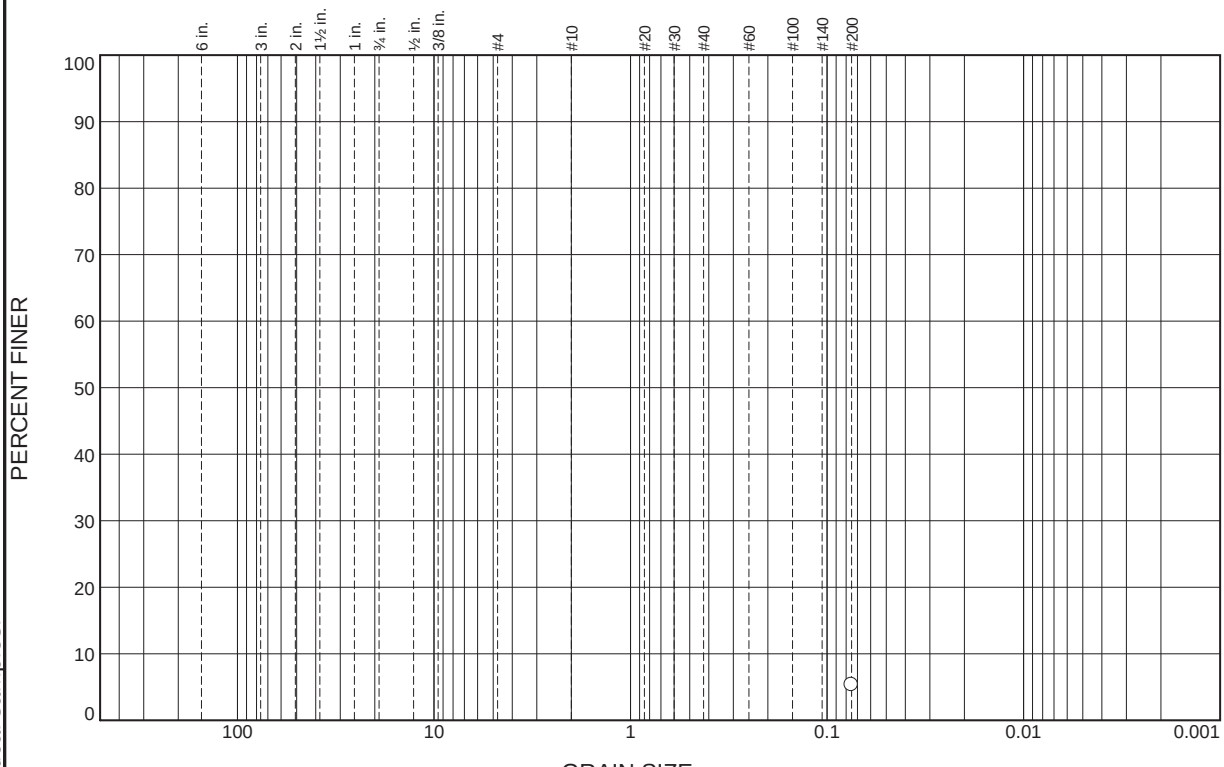
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
84.18	15.82	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										0.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						5.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	5.3		

* (no specification provided)

Soil Description

Poorly Graded SAND with Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Location: G29 S11
Sample Number: 8023-11 **Depth:** 50' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G29 S11
Depth: 50'
Sample Number: 8023-11
Material Description: SAND with Silt
Date: 2/22/2018
USCS Classification: SP-SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 379.46
Tare Wt. = 15.80
Minus #200 from wash = 5.3%

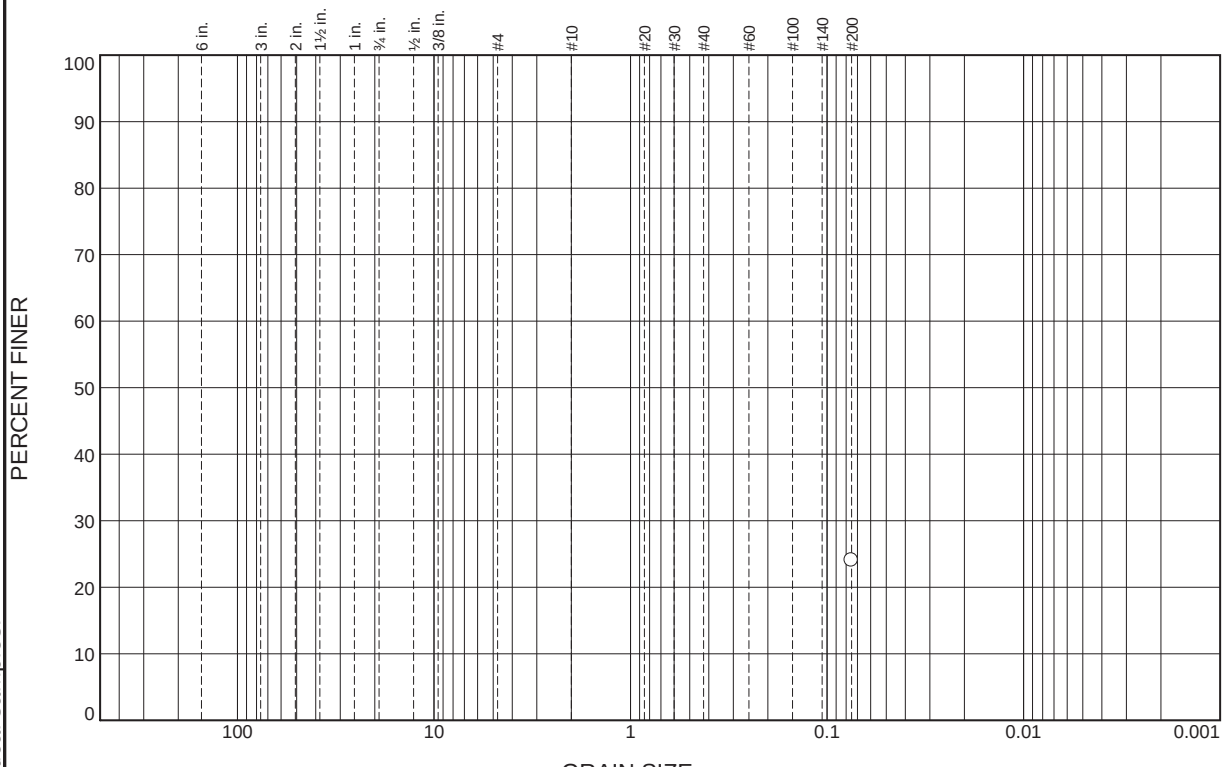
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
399.98	15.80	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										5.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						24.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	24.1		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G29 S13
Sample Number: 8023-13 **Depth:** 60' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/22/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G29 S13
Depth: 60'
Sample Number: 8023-13
Material Description: Silty SAND
Date: 2/22/2018
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 203.43
Tare Wt. = 15.81
Minus #200 from wash = 24.1%

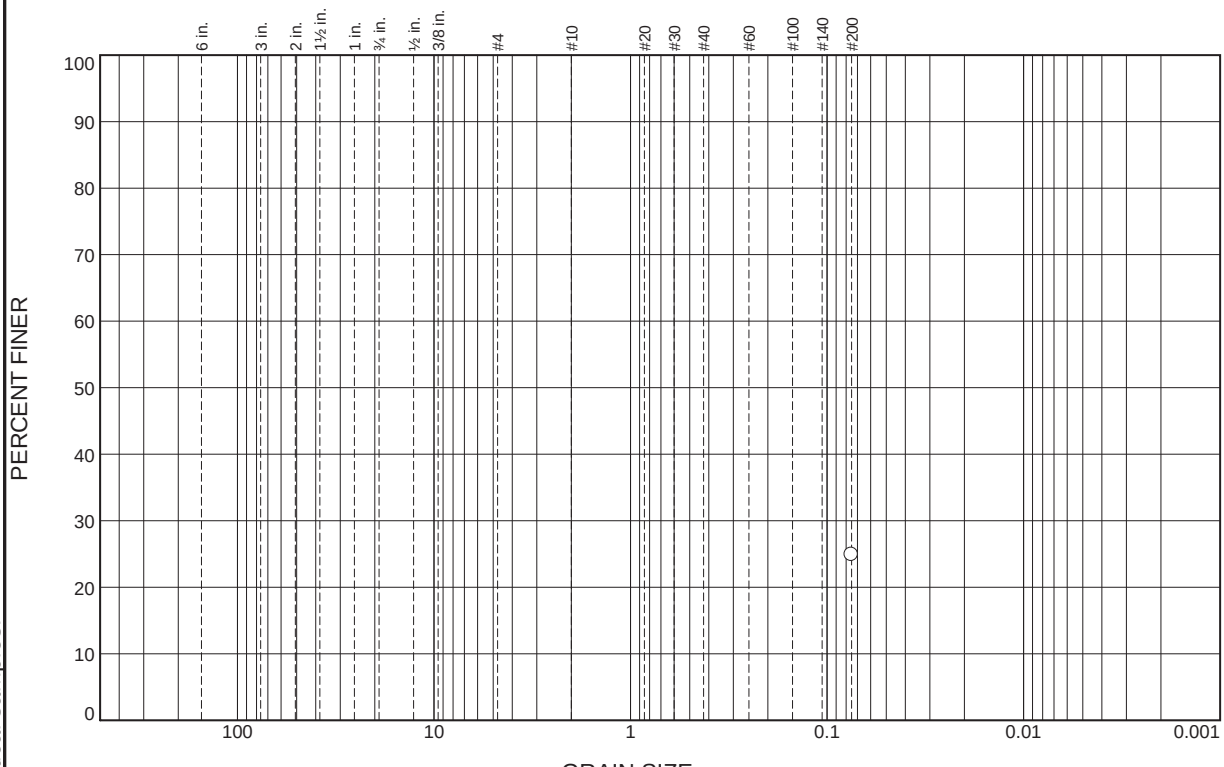
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
262.87	15.81	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										24.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						24.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	24.9		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G29 S15
Sample Number: 8023-14 **Depth:** 70' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

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GRAIN SIZE DISTRIBUTION TEST DATA

2/22/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G29 S15
Depth: 70'
Sample Number: 8023-14
Material Description: Silty SAND
Date: 2/22/2018
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 175.08
Tare Wt. = 15.87
Minus #200 from wash = 24.9%

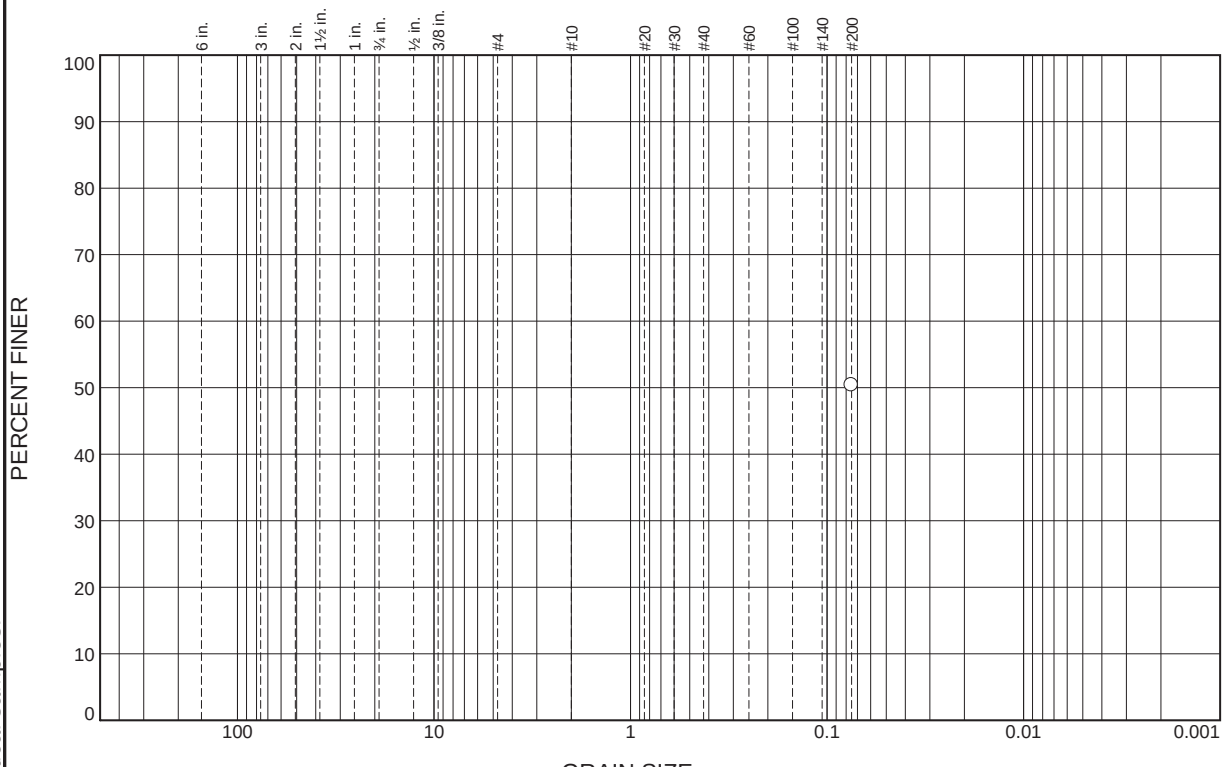
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
227.89	15.87	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										24.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						50.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	50.4		

* (no specification provided)

Soil Description

Sandy SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Location: G29 S18
Sample Number: 8023-16 **Depth:** 85' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/22/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G29 S18
Depth: 85'
Sample Number: 8023-16
Material Description: Sandy SILT
Date: 2/22/2018
USCS Classification: ML
Tested by: GD

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 113.52
Tare Wt. = 16.18
Minus #200 from wash = 50.4%

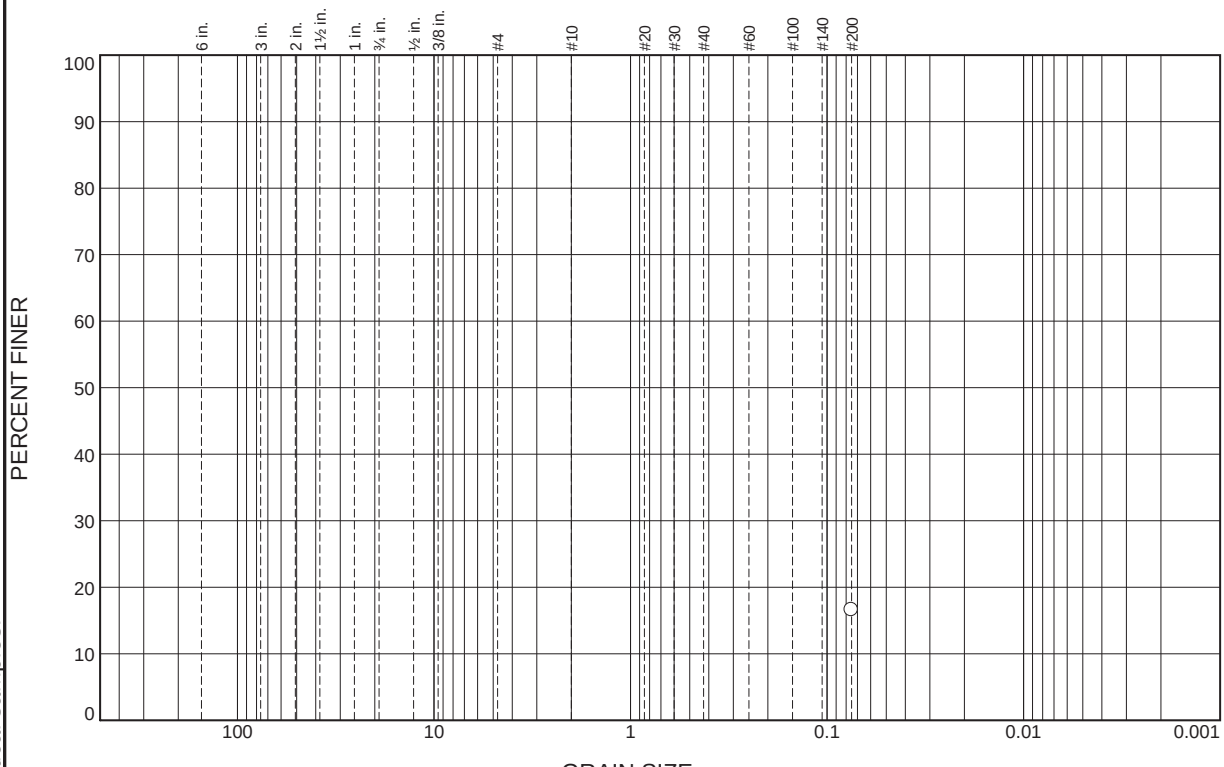
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
212.32	16.18	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										50.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						16.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	16.6		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G29 S21
Sample Number: 8023-18 **Depth:** 100' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G29 S21
Depth: 100'
Sample Number: 8023-18
Material Description: Silty SAND
Date: 2/22/2018
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 227.85
Tare Wt. = 15.92
Minus #200 from wash = 16.6%

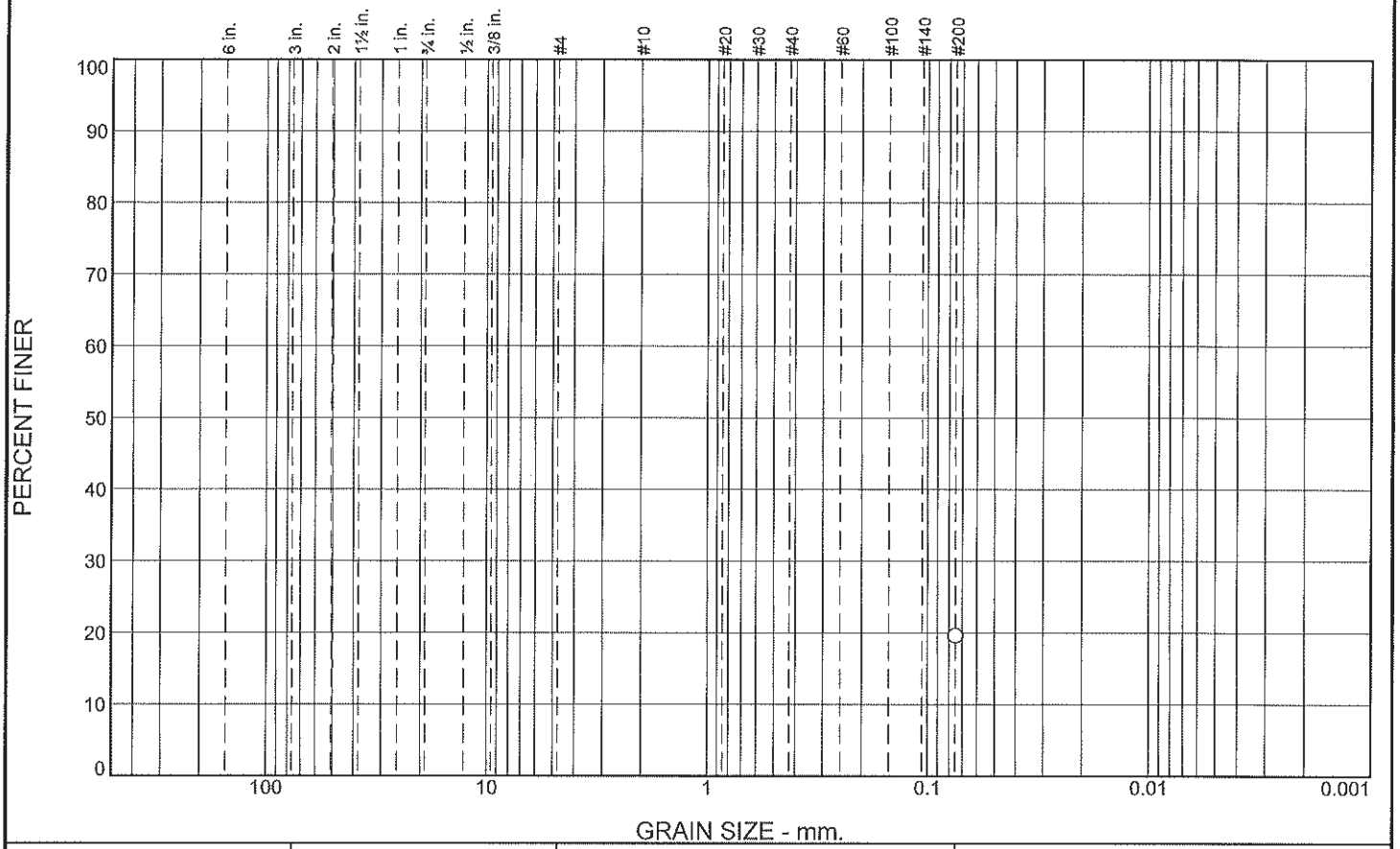
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
269.98	15.92	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										16.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						19.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	19.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G032 S-17
Sample Number: 8000-11 **Depth:** 70'
Date: 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-17
Depth: 70'
Sample Number: 8000-11
Date: 11/5/17
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 235.20
Tare Wt. = 15.80
Minus #200 from wash = 19.6%

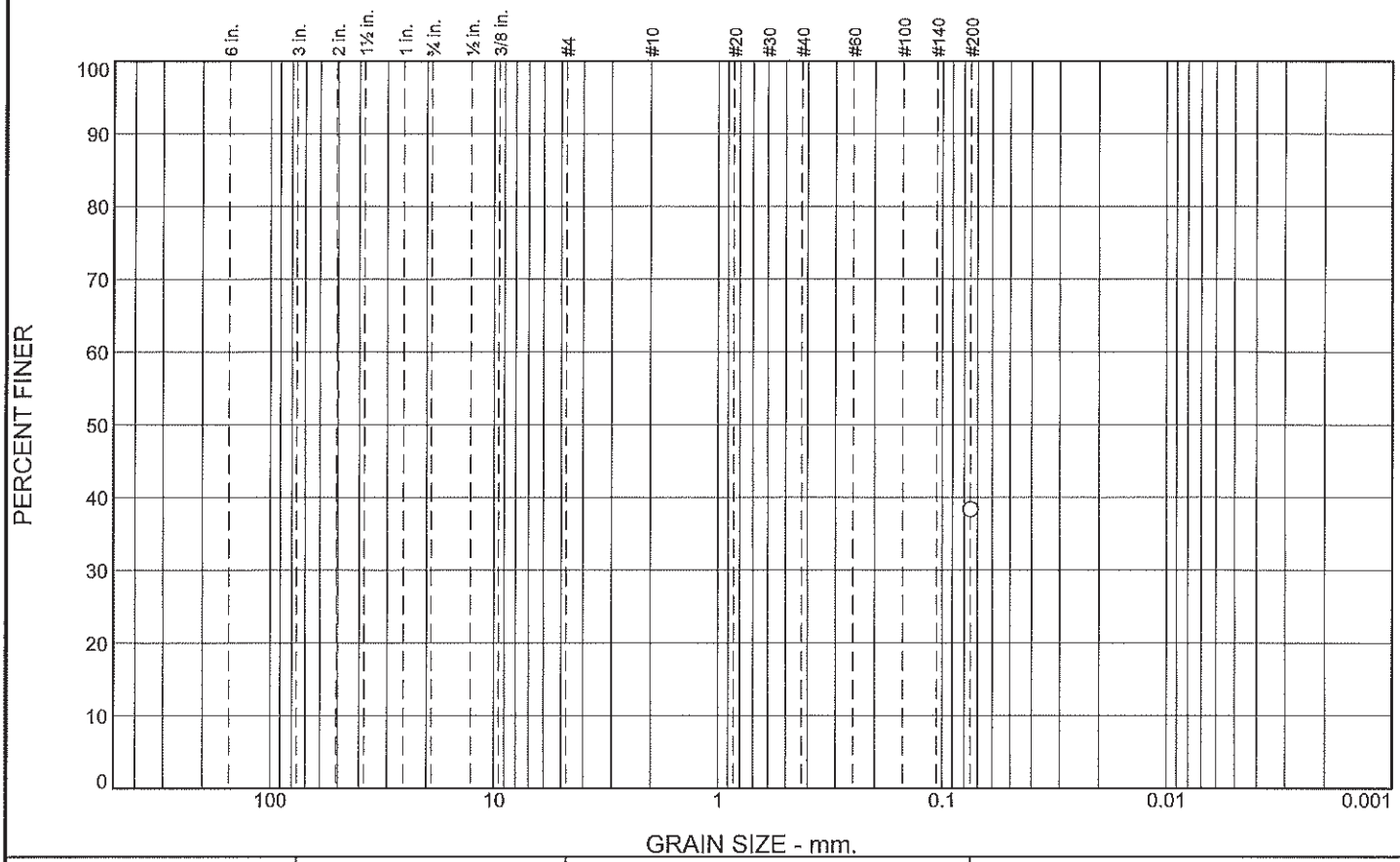
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
288.80	15.80	#200			19.6

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										19.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						38.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	38.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G032 S-29
Sample Number: 8000-17 **Depth:** 130' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-29
Depth: 130'
Sample Number: 8000-17
Date: 11/5/17
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 198.60
Tare Wt. = 15.80
Minus #200 from wash = 38.4%

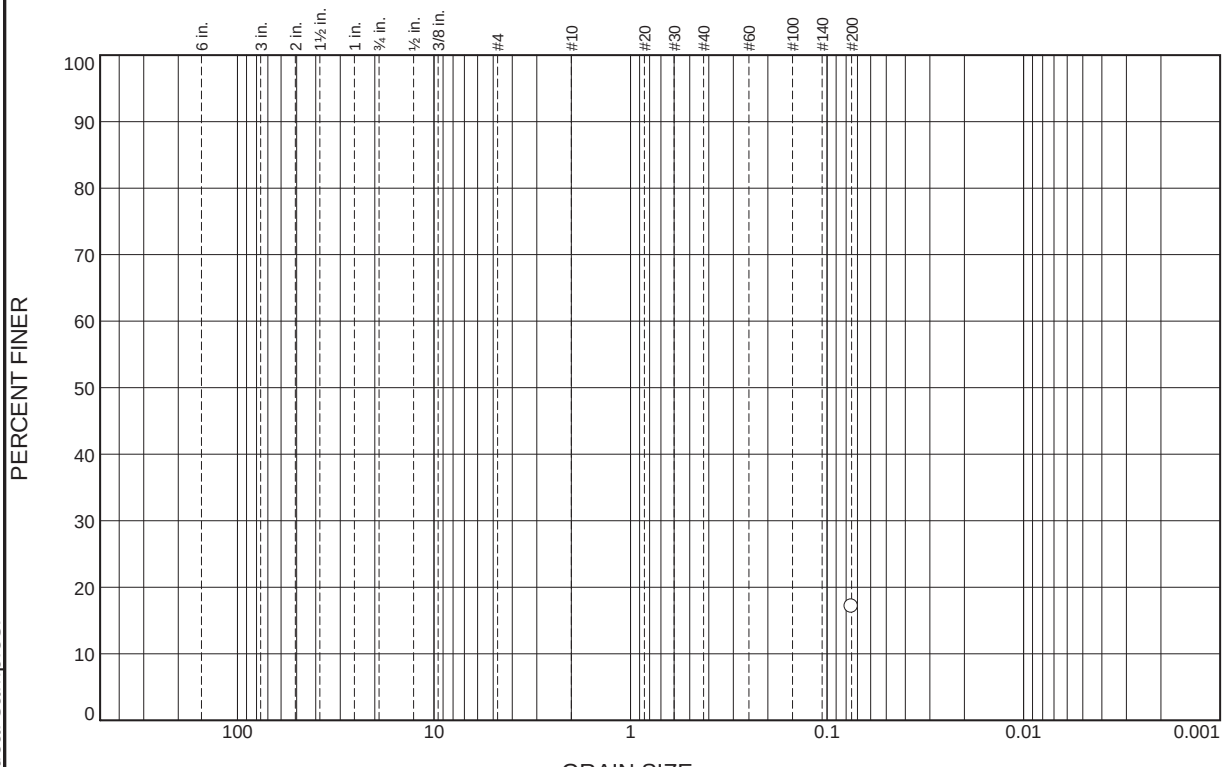
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
312.40	15.80	#200			38.4

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										38.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						17.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	17.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G33 / S12
Sample Number: 054-78 **Depth:** 45' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S12
Depth: 45'
Sample Number: 054-78
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 266.50
Tare Wt. = 15.90
Minus #200 from wash = 17.1%

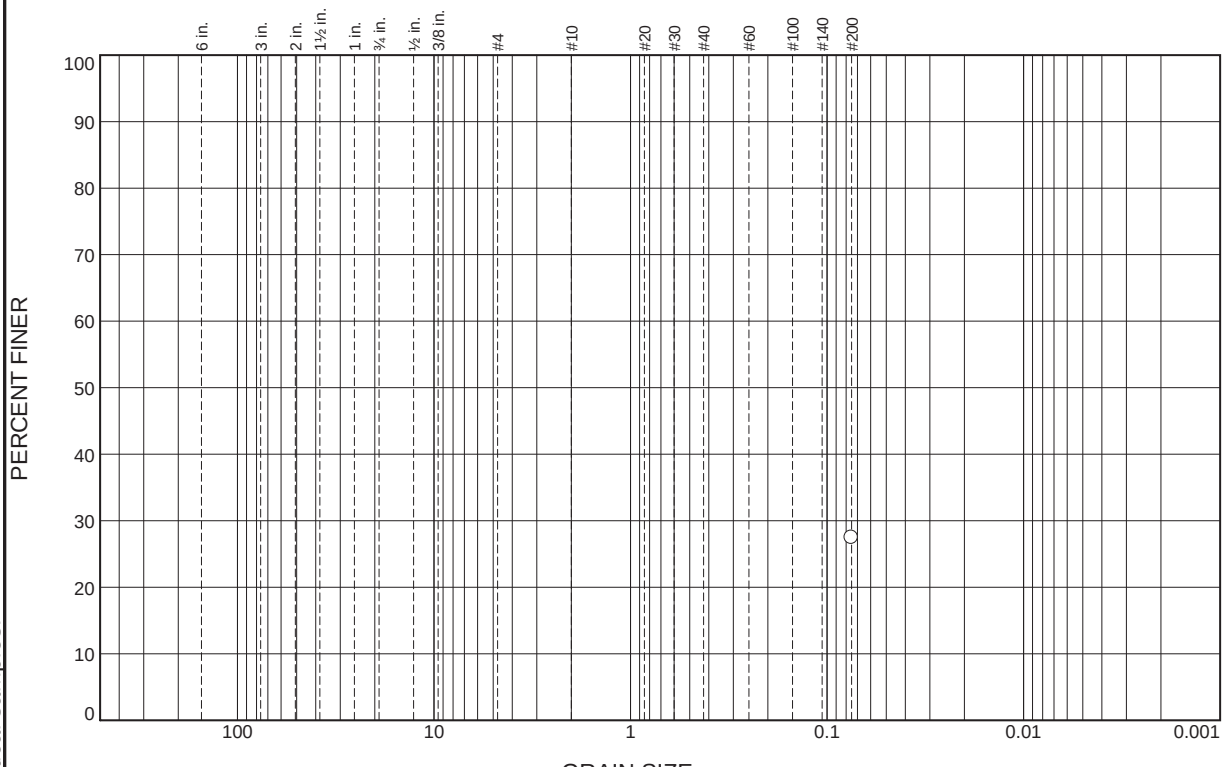
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
318.28	15.90	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										17.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						27.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	27.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G33 / S15B
Sample Number: 054-80 **Depth:** 60' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S15B
Depth: 60'
Sample Number: 054-80
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 170.97
Tare Wt. = 15.86
Minus #200 from wash = 27.5%

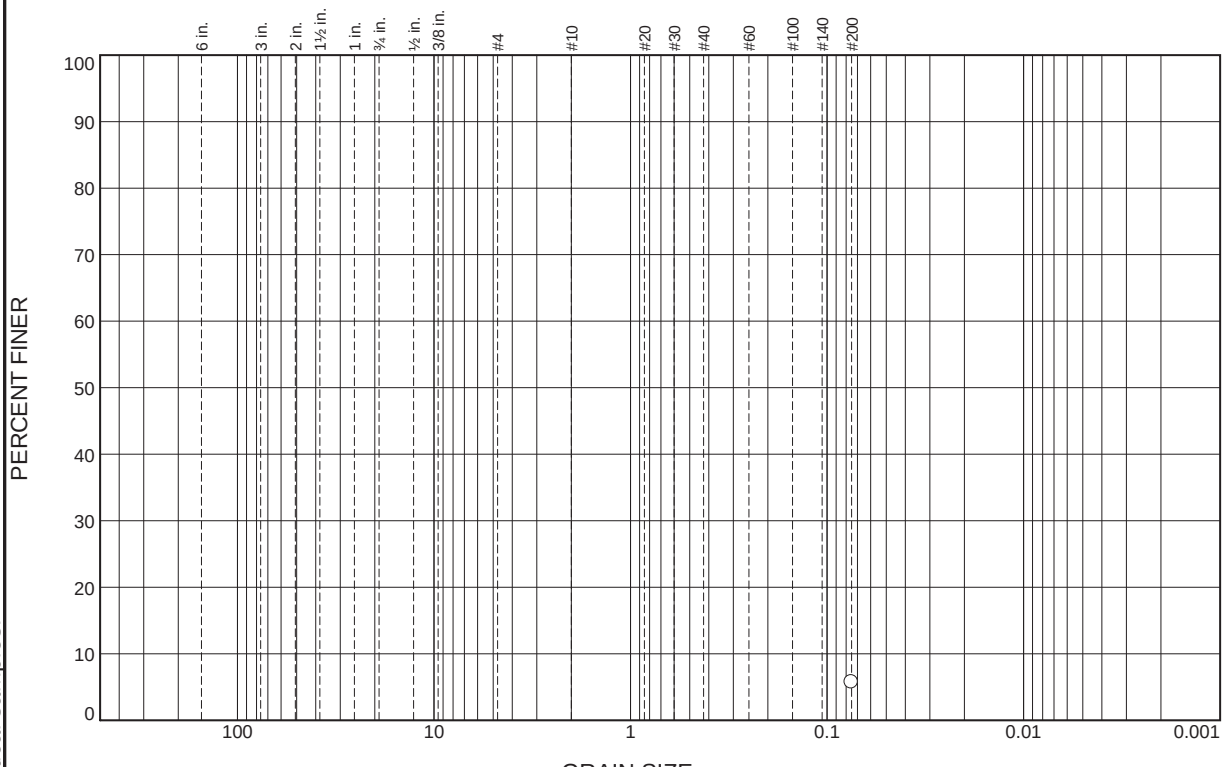
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
229.66	15.86	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										27.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						5.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	5.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G33 / S17
Sample Number: 054-82 **Depth:** 70' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S17
Depth: 70'
Sample Number: 054-82
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 284.11
Tare Wt. = 15.78
Minus #200 from wash = 5.7%

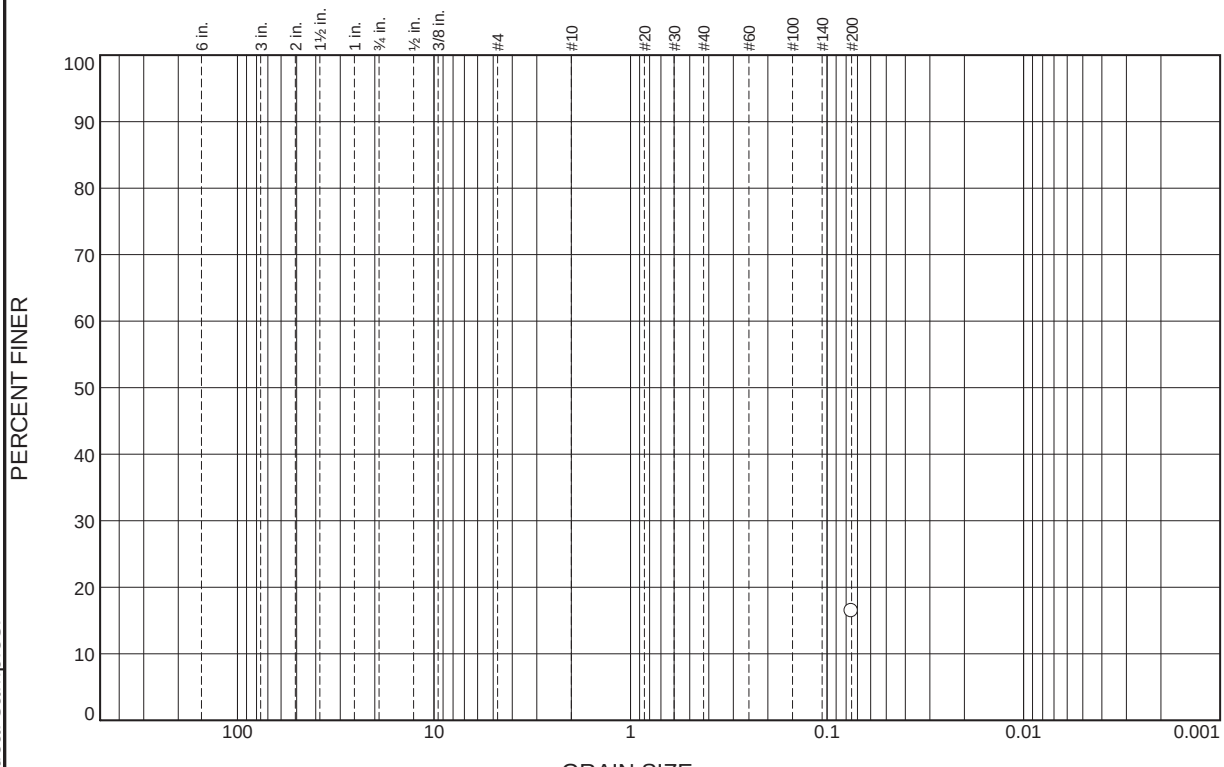
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
300.46	15.78	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										5.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						16.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	16.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G33 / S19
Sample Number: 054-84 **Depth:** 80' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S19
Depth: 80'
Sample Number: 054-84
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 189.65
Tare Wt. = 15.93
Minus #200 from wash = 16.4%

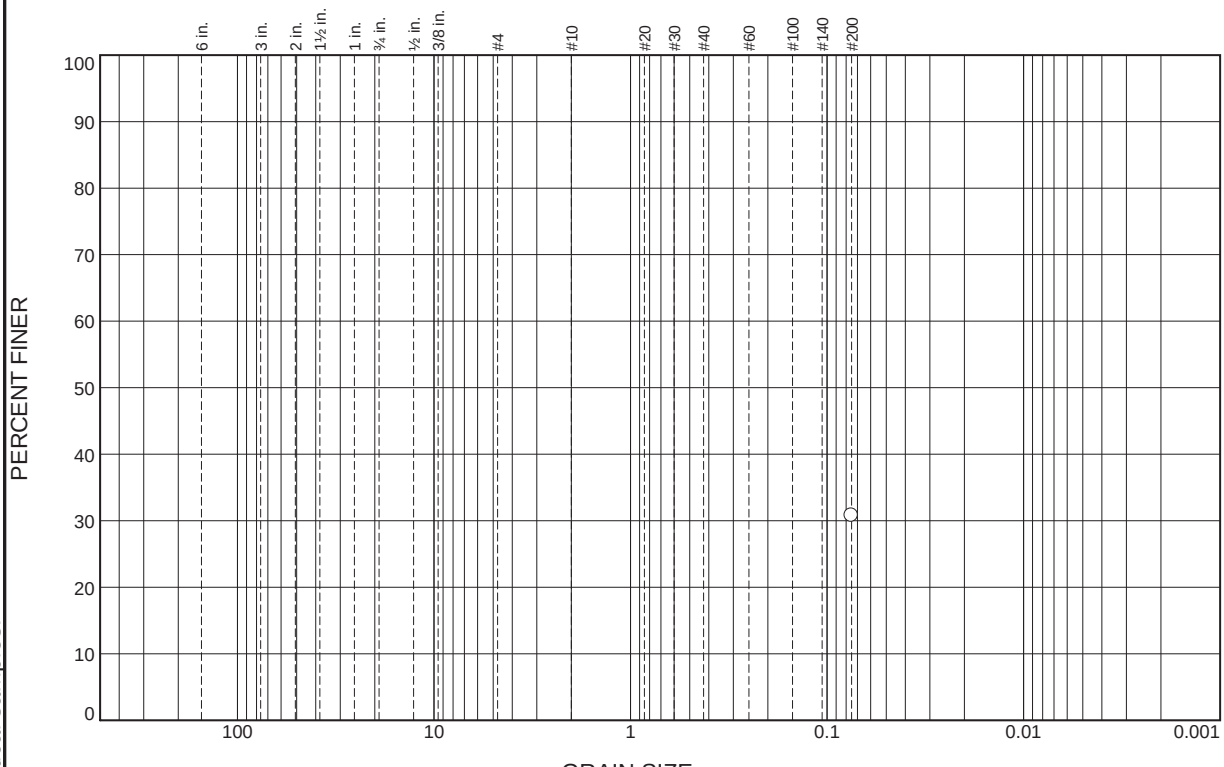
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
223.78	15.93	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										16.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						30.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	30.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G33 / S22
Sample Number: 054-86 **Depth:** 95' **Date:** 12/22/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S22
Depth: 95'
Sample Number: 054-86
Date: 12/22/2017
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 186.22
Tare Wt. = 16.01
Minus #200 from wash = 30.8%

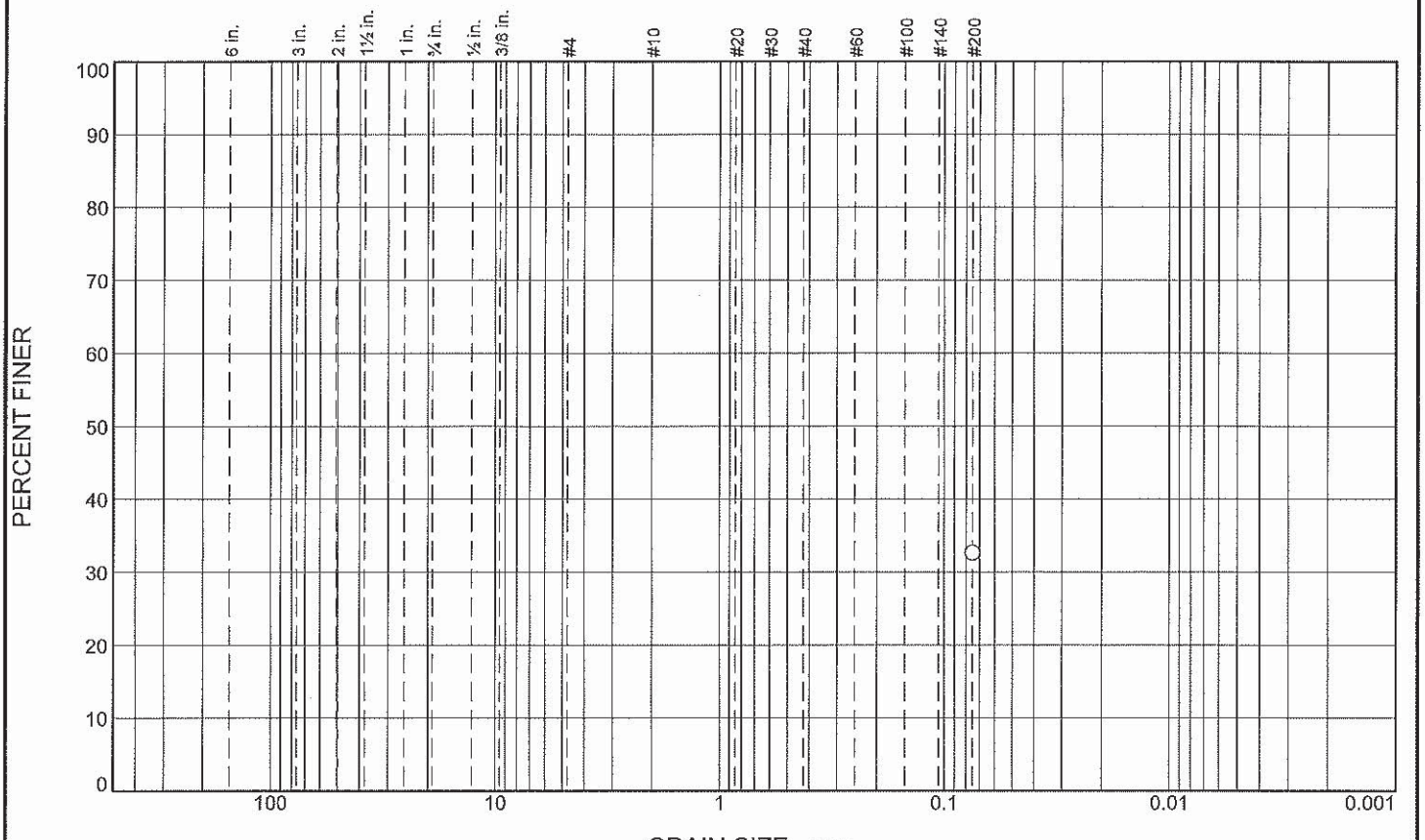
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
261.94	16.01	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										30.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						32.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	32.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G036 S-2
Sample Number: 8000-28 **Depth:** 2.5'-4' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036 S-2
Depth: 2.5'-4'
Sample Number: 8000-28
Date: 11/5/17
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 178.60
Tare Wt. = 15.80
Minus #200 from wash = 32.6%

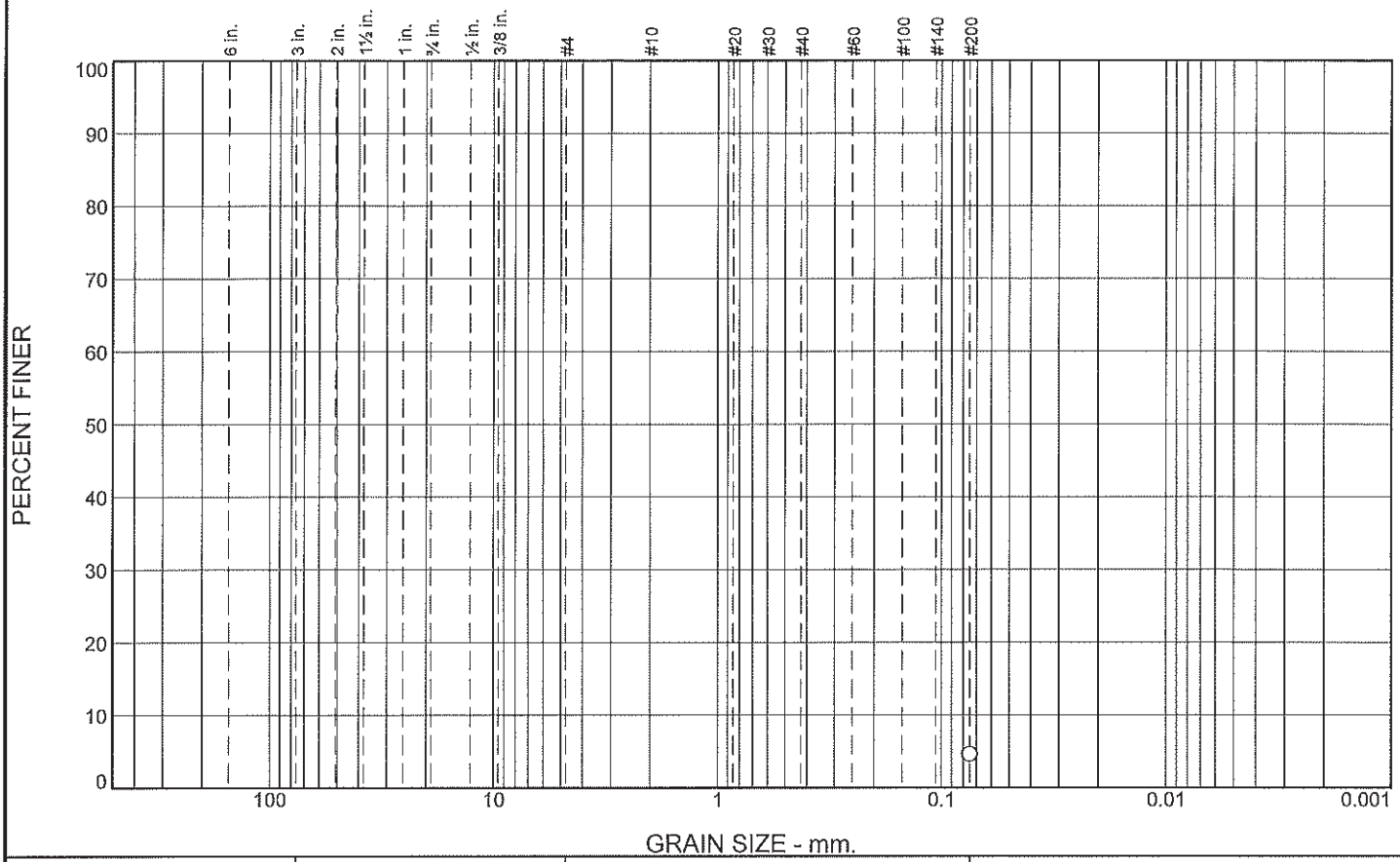
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
257.50	15.80	#200			32.6

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										32.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						4.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	4.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G036 S-4
Sample Number: 8000-29 **Depth:** 7.5'-9' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036 S-4
Depth: 7.5'-9'
Sample Number: 8000-29
Date: 11/5/17
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 402.80
Tare Wt. = 15.80
Minus #200 from wash = 4.6%

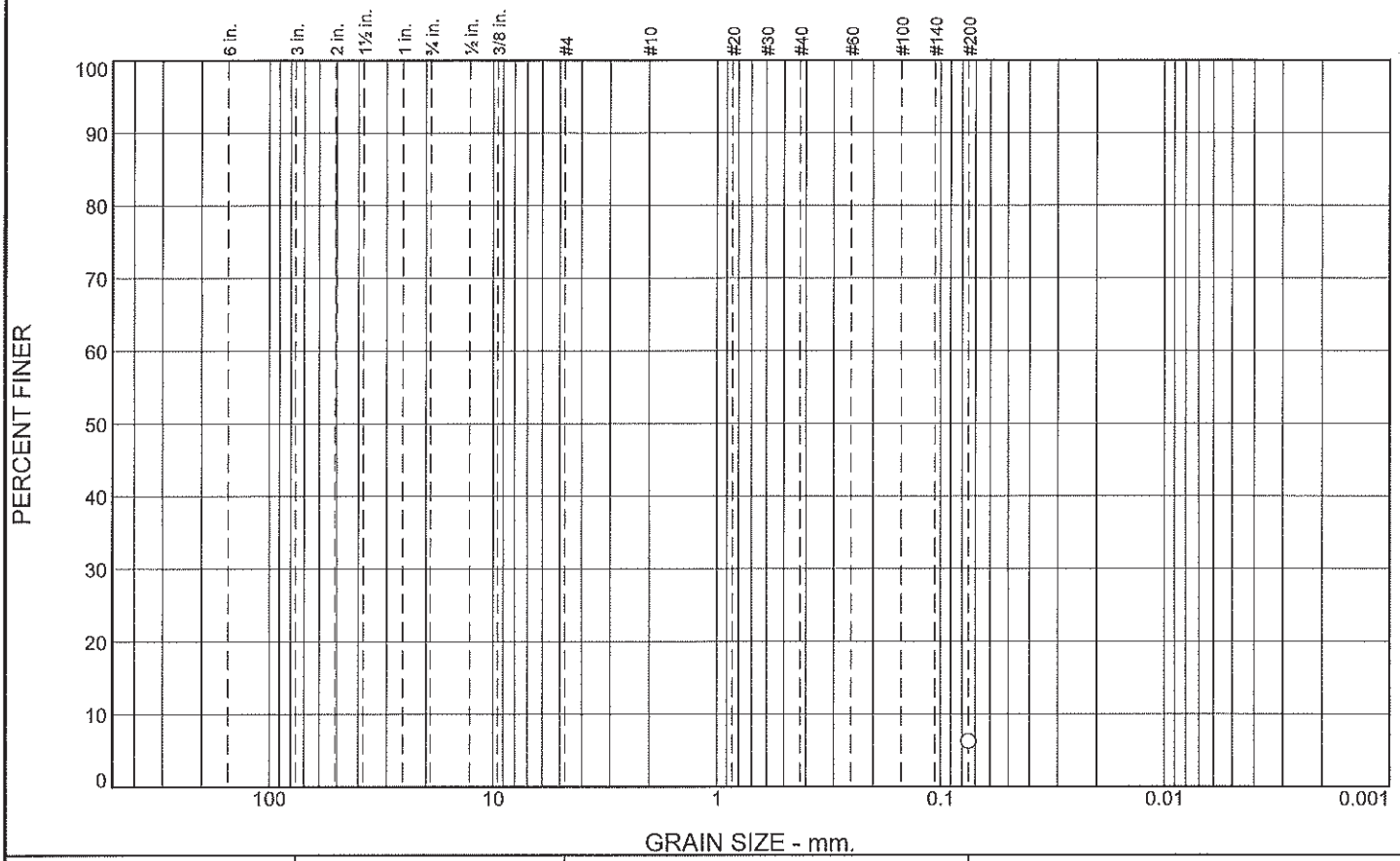
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
421.60	15.80	#200			4.6

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										4.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						6.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	6.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G036 S-8
Sample Number: 8000-30 **Depth:** 20'-21.5' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036 S-8
Depth: 20'-21.5'
Sample Number: 8000-30
Date: 11/5/17
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 182.90
Tare Wt. = 15.80
Minus #200 from wash = 6.3%

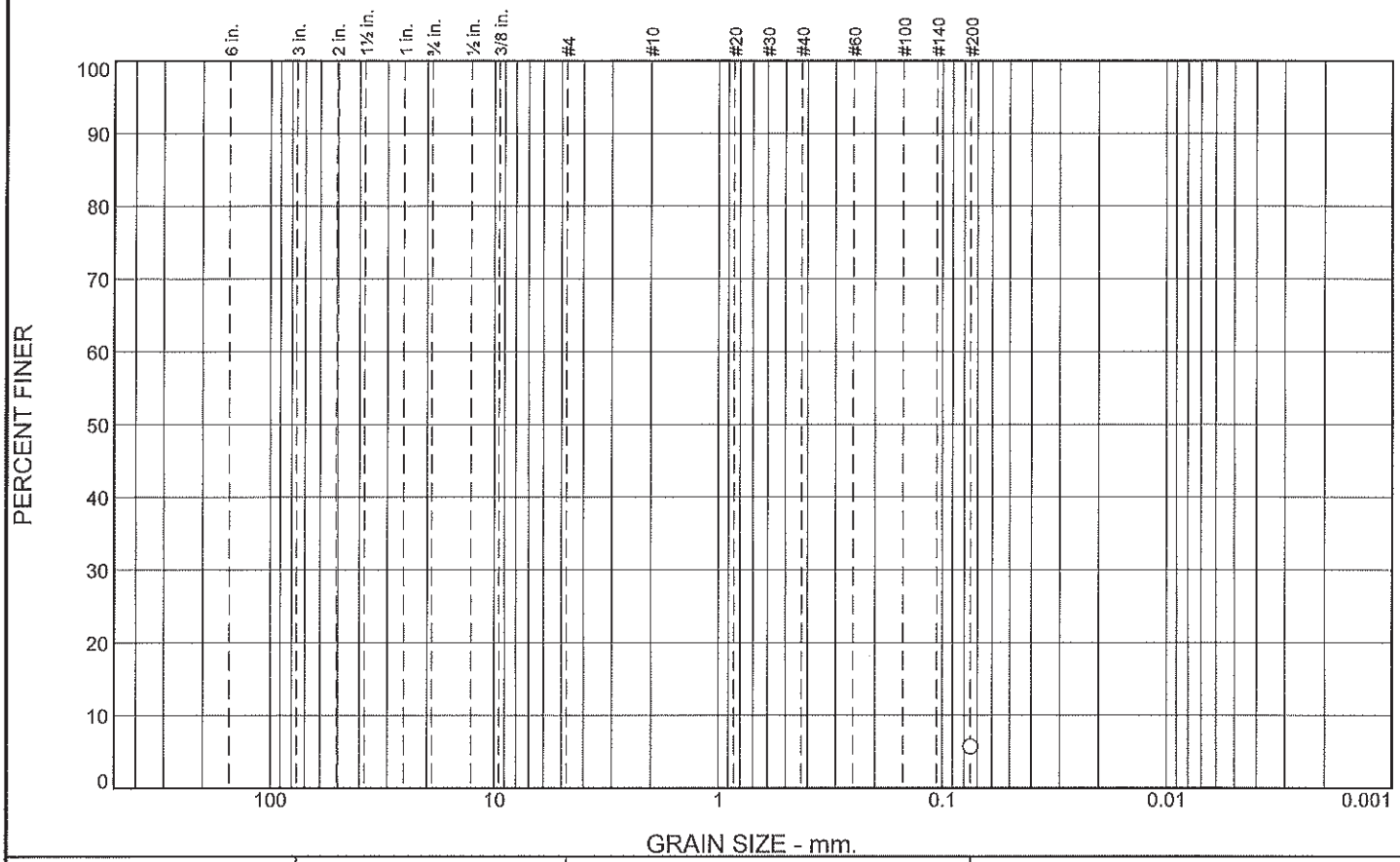
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
194.10	15.80	#200			6.3

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										6.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						5.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	5.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G036 S-13
Sample Number: 8000-33 **Depth:** 45'-46.5' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036 S-13
Depth: 45'-46.5'
Sample Number: 8000-33
Date: 11/5/17
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 324.70
Tare Wt. = 15.80
Minus #200 from wash = 5.7%

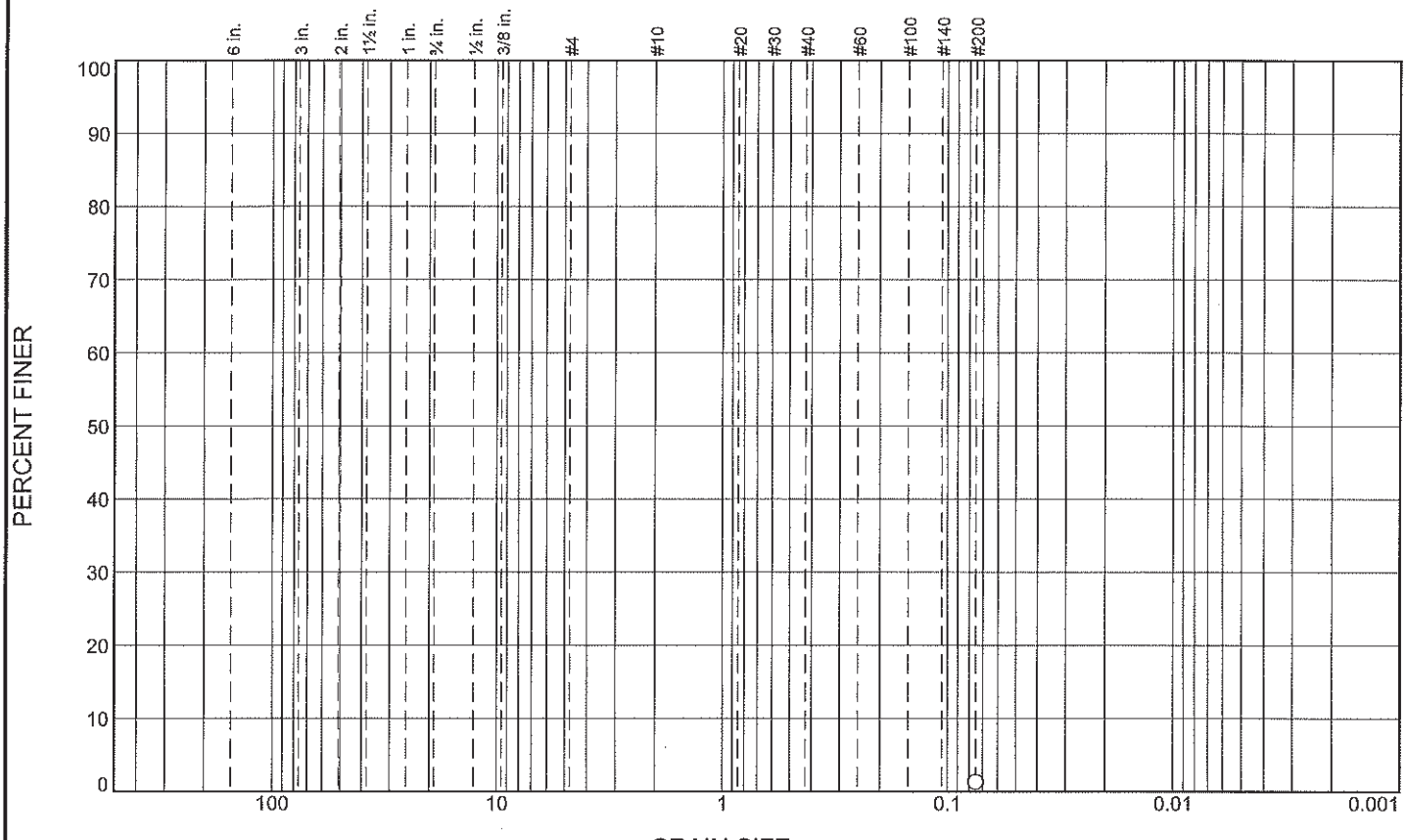
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
343.50	15.80	#200			5.7

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										5.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						1.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	1.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G036 S-15
Sample Number: 8000-34 **Depth:** 55'-56.5' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036 S-15
Depth: 55'-56.5'
Sample Number: 8000-34
Date: 11/5/17
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 105.40
Tare Wt. = 15.70
Minus #200 from wash = 1.3%

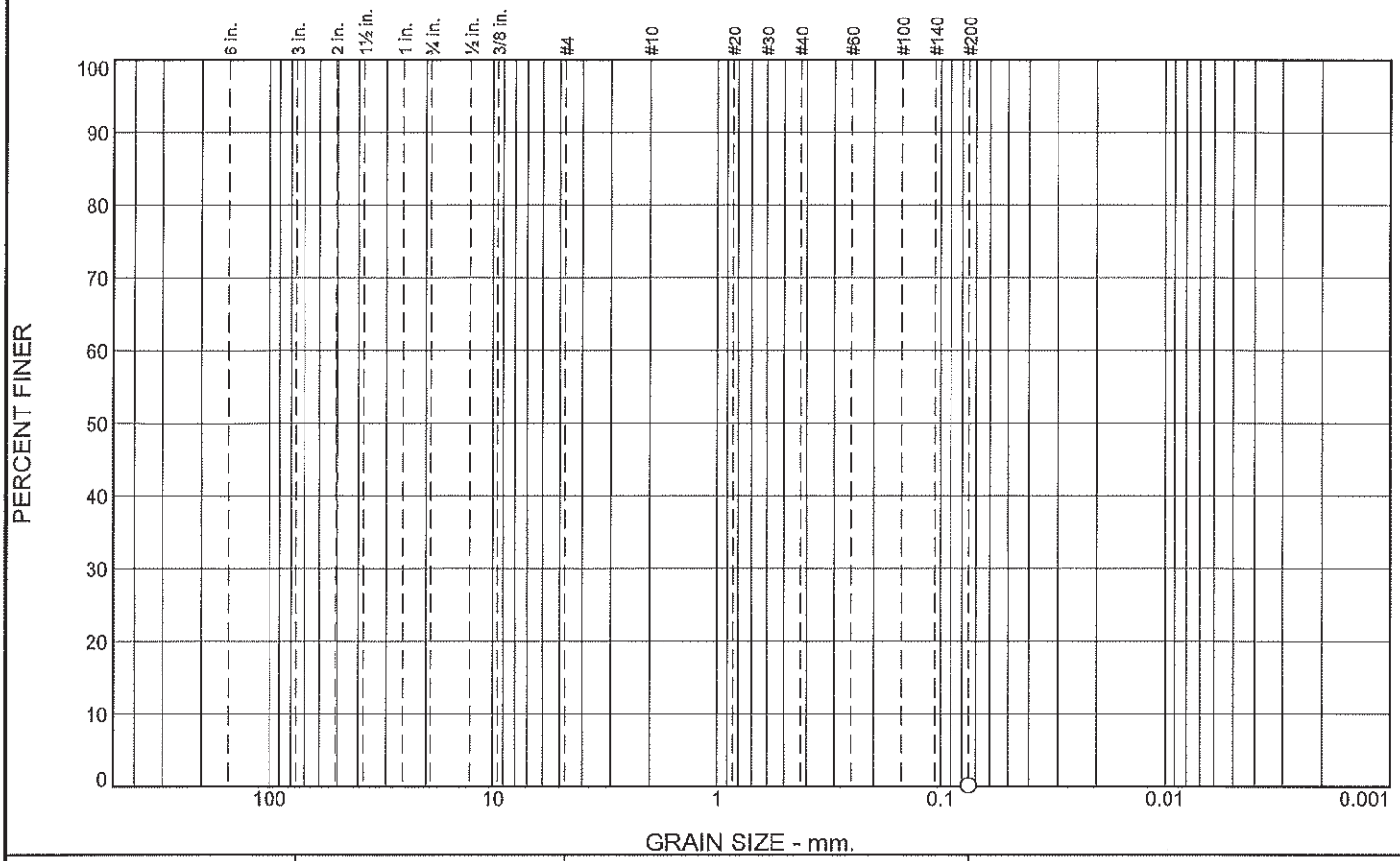
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
106.60	15.70	#200			1.3

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										1.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						0.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	0.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G036A S-4
Sample Number: 8000-38 **Depth:** 65'-66.5' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036A S-4
Depth: 65'-66.5'
Sample Number: 8000-38
Date: 11/5/17
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 165.20
Tare Wt. = 15.80
Minus #200 from wash = 0.2%

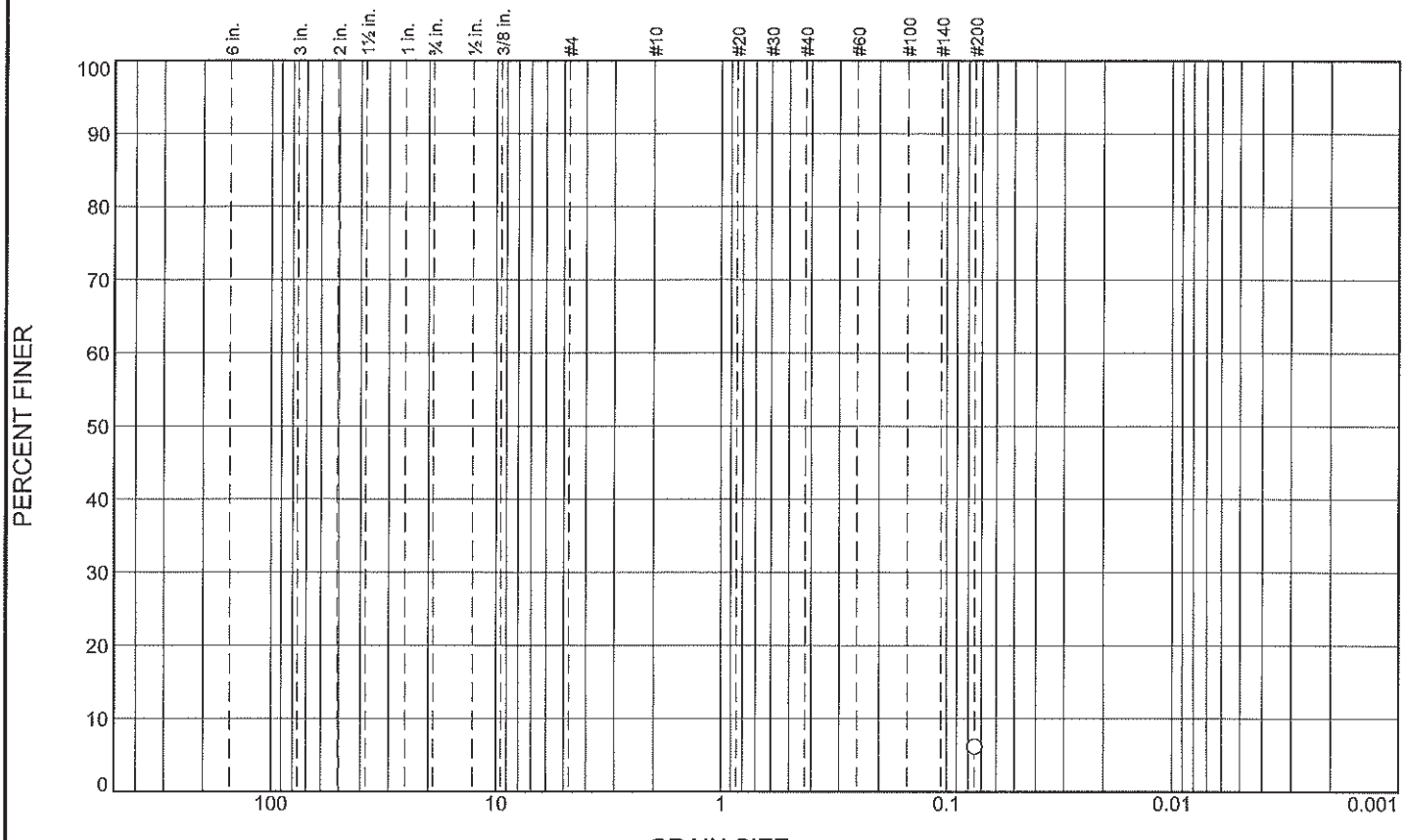
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
165.50	15.80	#200			0.2

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										0.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						6.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	6.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G036A S-8
Sample Number: 8000-40 **Depth:** 85'-86.5' **Date:** 11/5/17

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: SR **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036A S-8
Depth: 85'-86.5'
Sample Number: 8000-40
Date: 11/5/17
Tested by: SR
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 260.30
Tare Wt. = 15.90
Minus #200 from wash = 6.2%

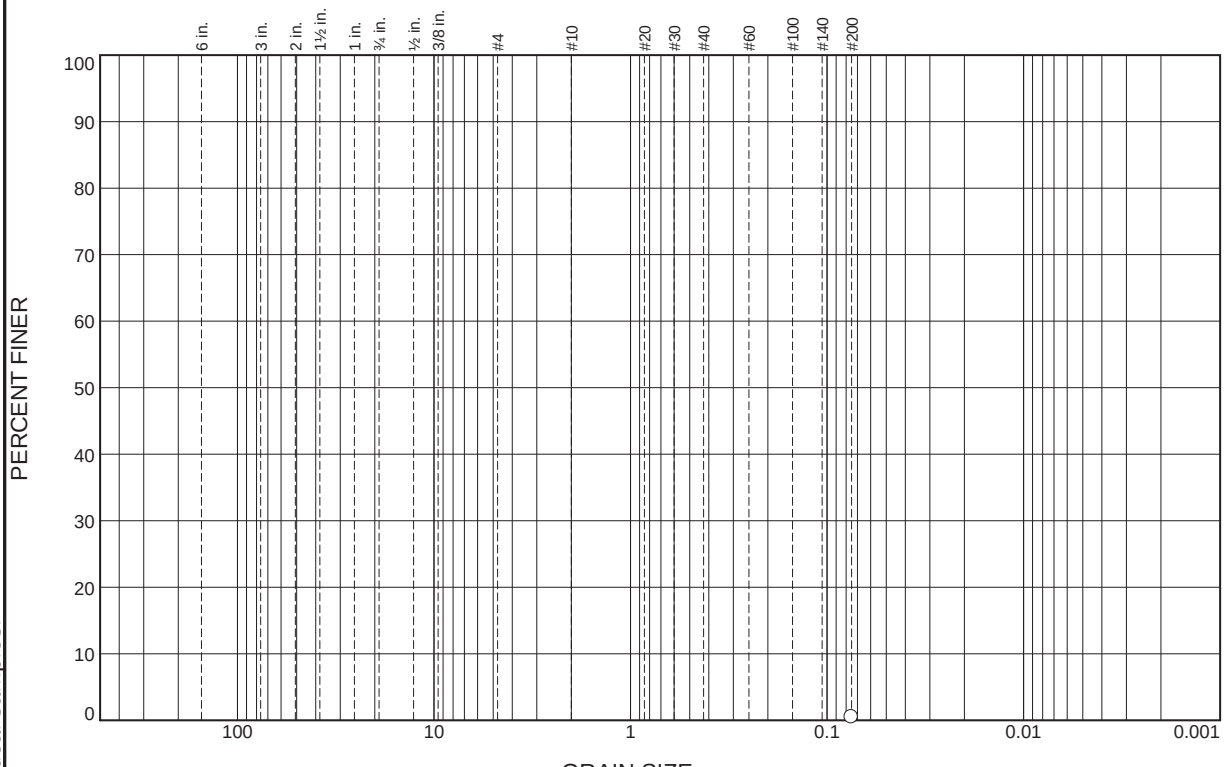
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
276.40	15.90	#200			6.2

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										6.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						0.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	0.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G037 S-12
Sample Number: 7995-77 **Depth:** 50'-51.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-12
Depth: 50'-51.5'
Sample Number: 7995-77
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 370.20
Tare Wt. = 15.80
Minus #200 from wash = 0.5%

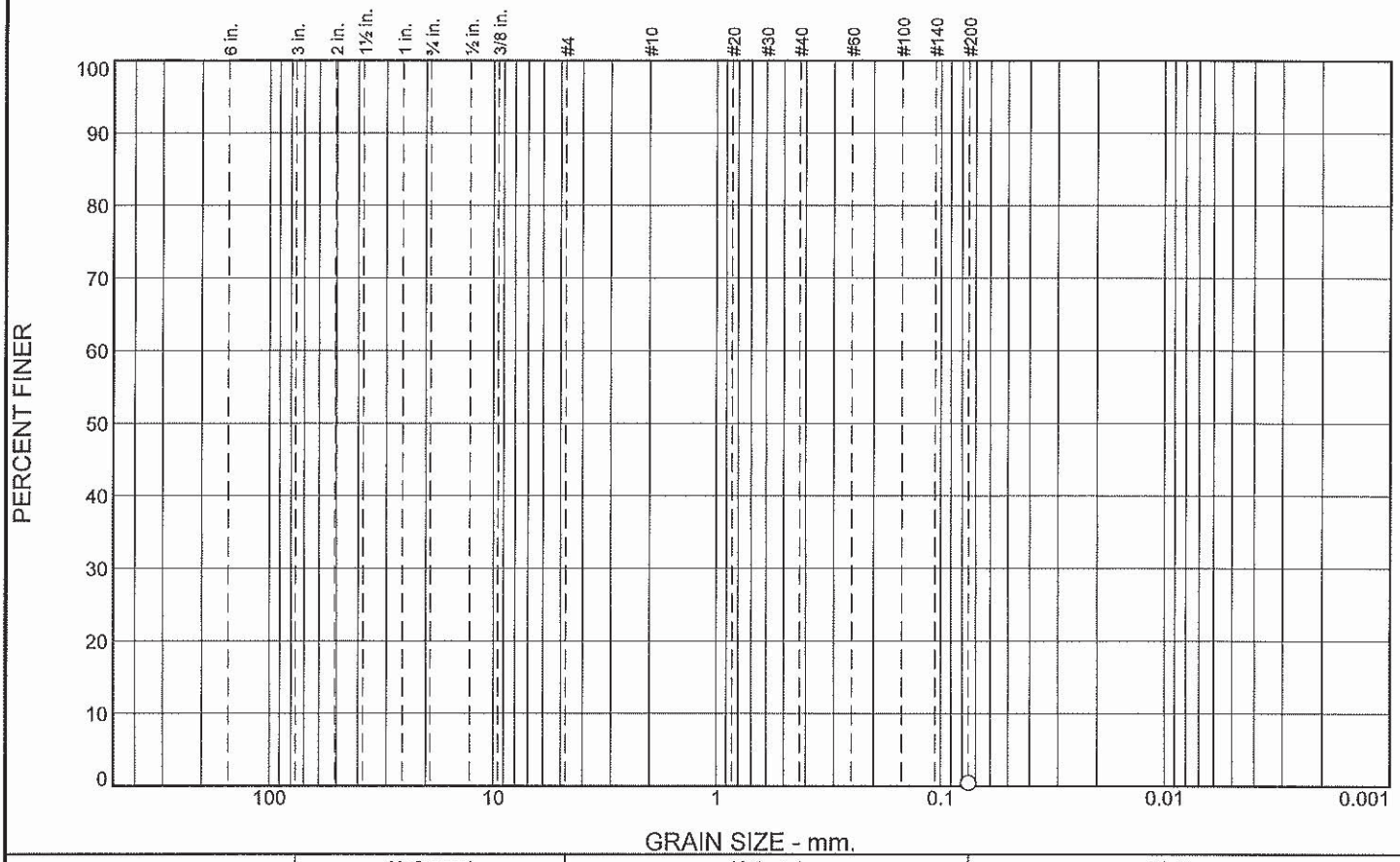
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
371.90	15.80	#200			0.5

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										0.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						0.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	0.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G037 S-13
Sample Number: 7995-77 **Depth:** 50'-51.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-13
Depth: 50'-51.5'
Sample Number: 7995-77
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 370.20
Tare Wt. = 15.80
Minus #200 from wash = 0.5%

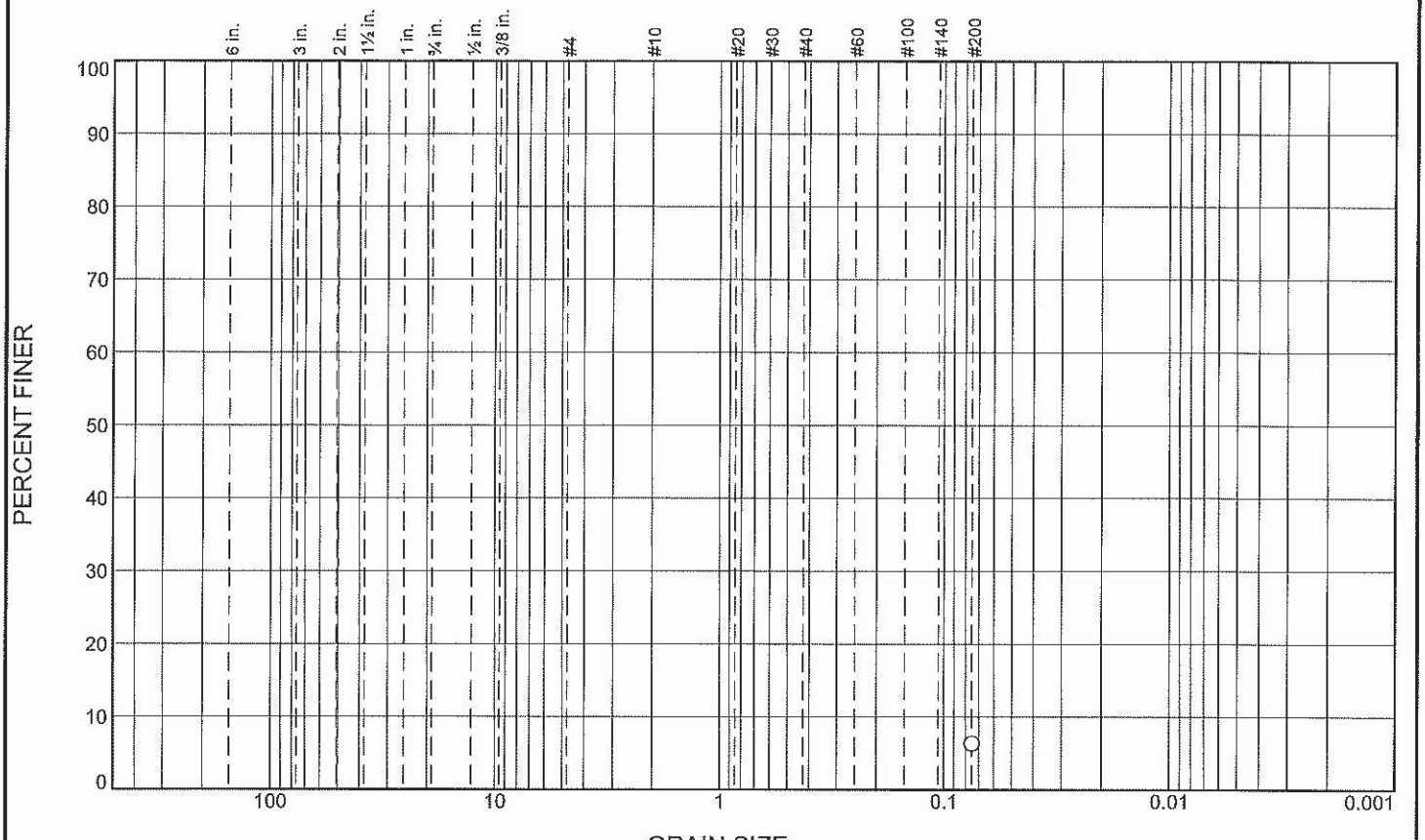
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
371.90	15.80	#200			0.5

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										0.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						6.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	6.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G037 S-16
Sample Number: 7995-78 **Depth:** 70'-71.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-16
Depth: 70'-71.5'
Sample Number: 7995-78
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 299.10
Tare Wt. = 15.80
Minus #200 from wash = 6.3%

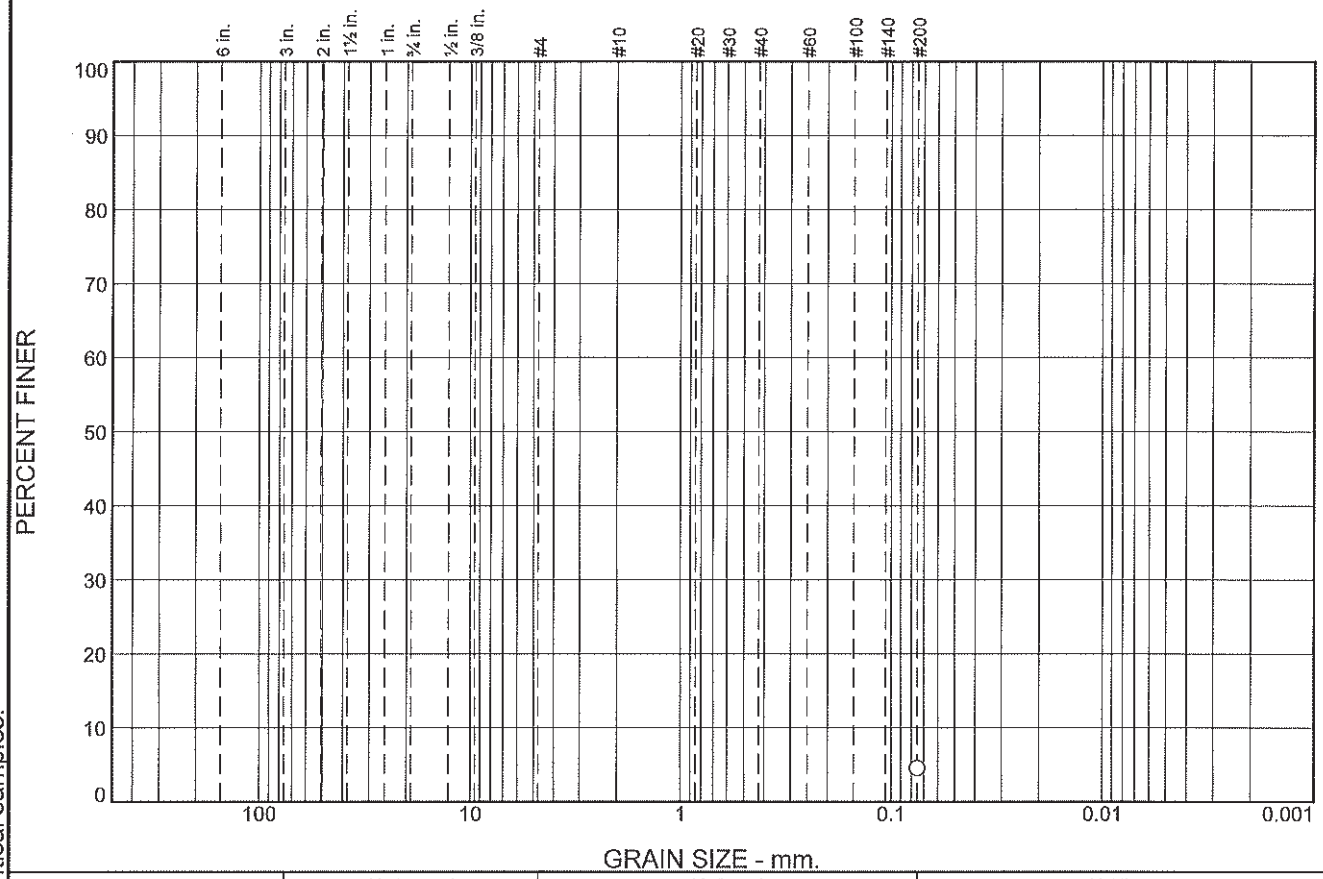
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
318.30	15.80	#200			6.3

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										6.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						4.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	4.5		

* (no specification provided)

Soil Description

SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP AASHTO=

Remarks

Location: G37A S8
Sample Number: 8023-25 **Depth:** 35' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G37A S8
Depth: 35'
Sample Number: 8023-25
Material Description: SAND
Date: 2/22/2018
USCS Classification: SP
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 366.15
Tare Wt. = 15.99
Minus #200 from wash = 4.5%

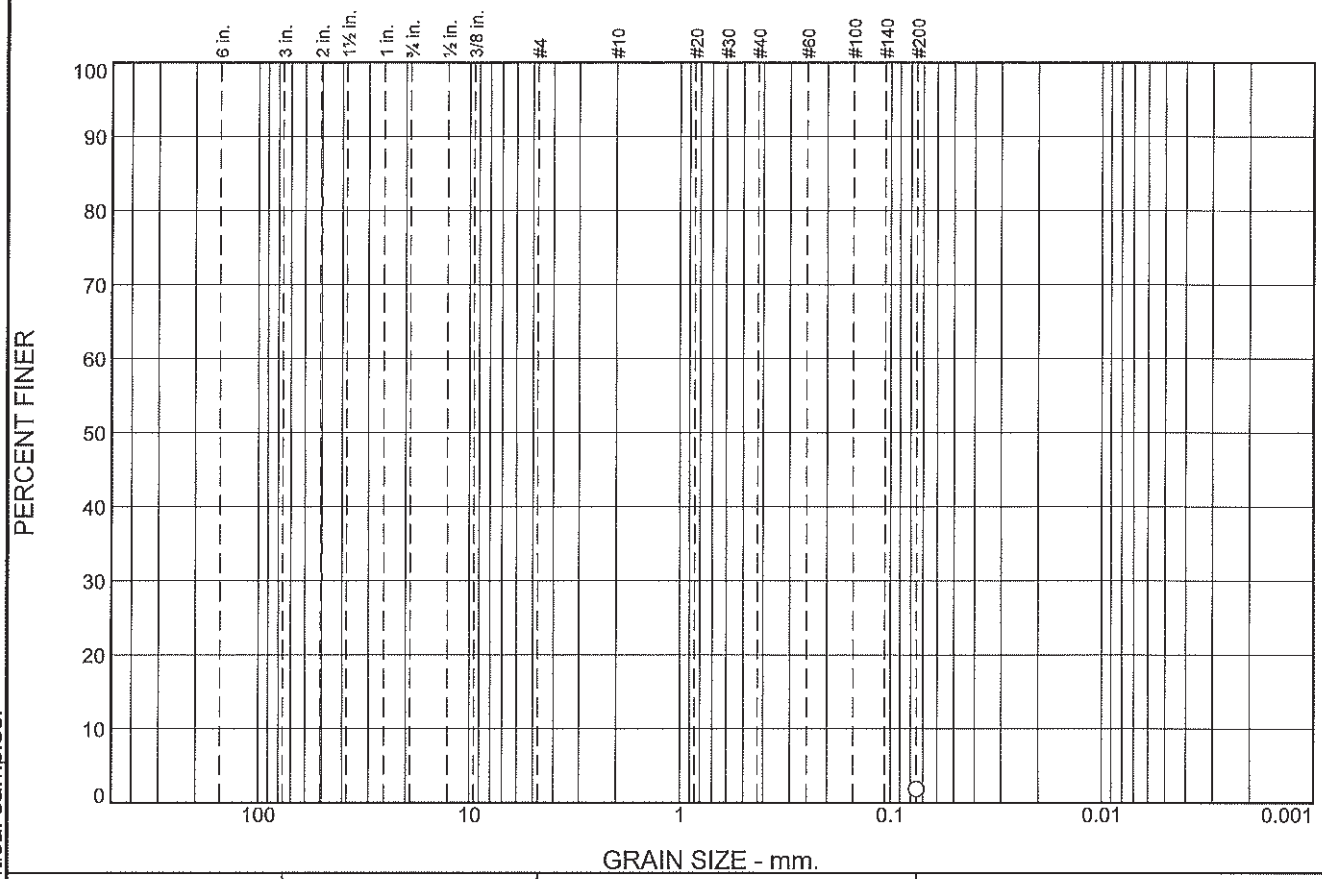
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
382.79	15.99	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										4.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						1.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	1.9		

* (no specification provided)

Soil Description

SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP AASHTO=

Remarks

Location: G37A S11
Sample Number: 8023-27 **Depth:** 50' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G37A S11
Depth: 50'
Sample Number: 8023-27
Material Description: SAND
Date: 2/22/2018
USCS Classification: SP
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 166.00
Tare Wt. = 16.01
Minus #200 from wash = 1.9%

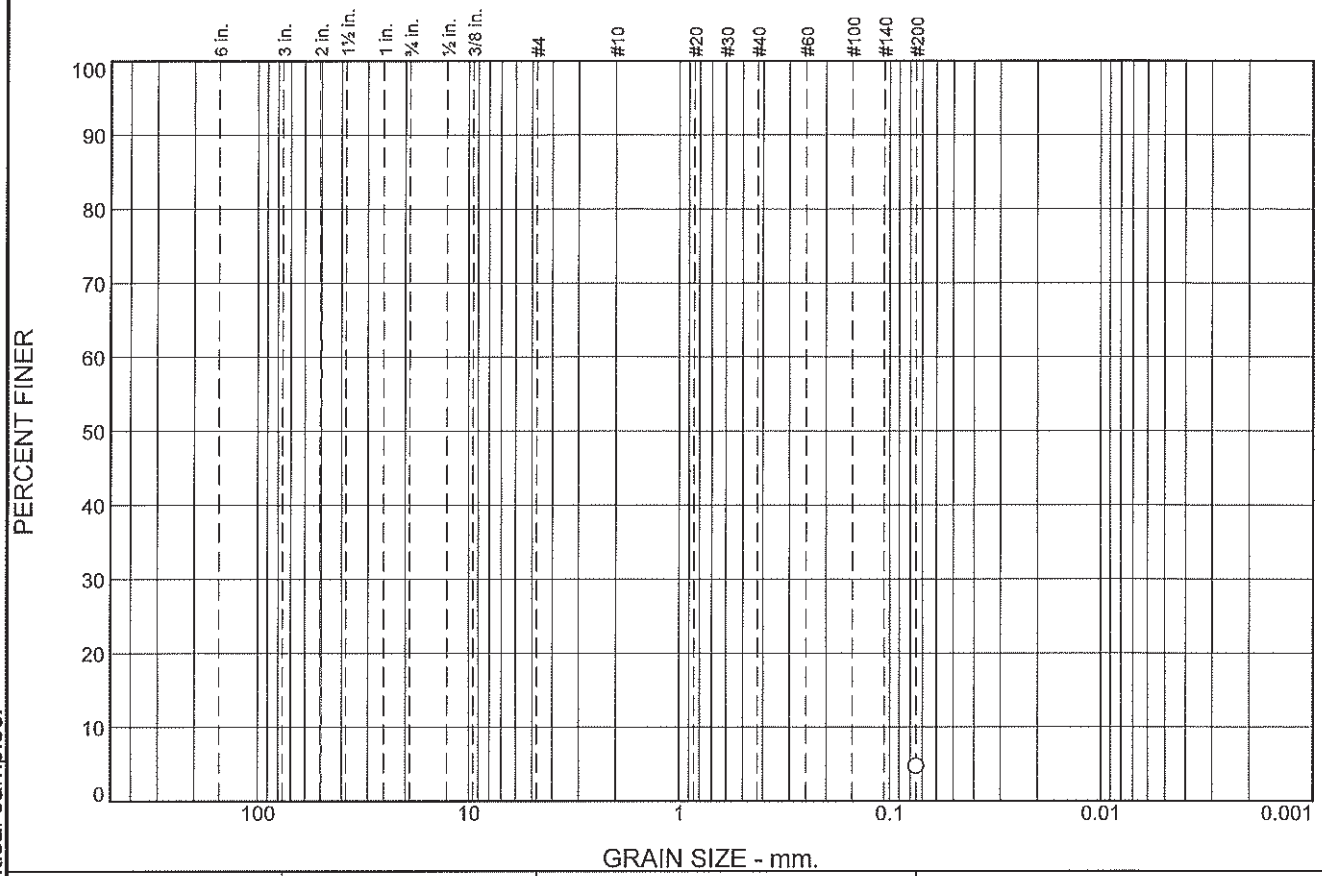
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
168.84	16.01	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										1.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						4.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	4.8		

* (no specification provided)

Soil Description

SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP AASHTO=

Remarks

Location: G37A S14
Sample Number: 8023-29 **Depth:** 65' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G37A S14
Depth: 65'
Sample Number: 8023-29
Material Description: SAND
Date: 2/22/2018
USCS Classification: SP
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 464.63
Tare Wt. = 16.01
Minus #200 from wash = 4.8%

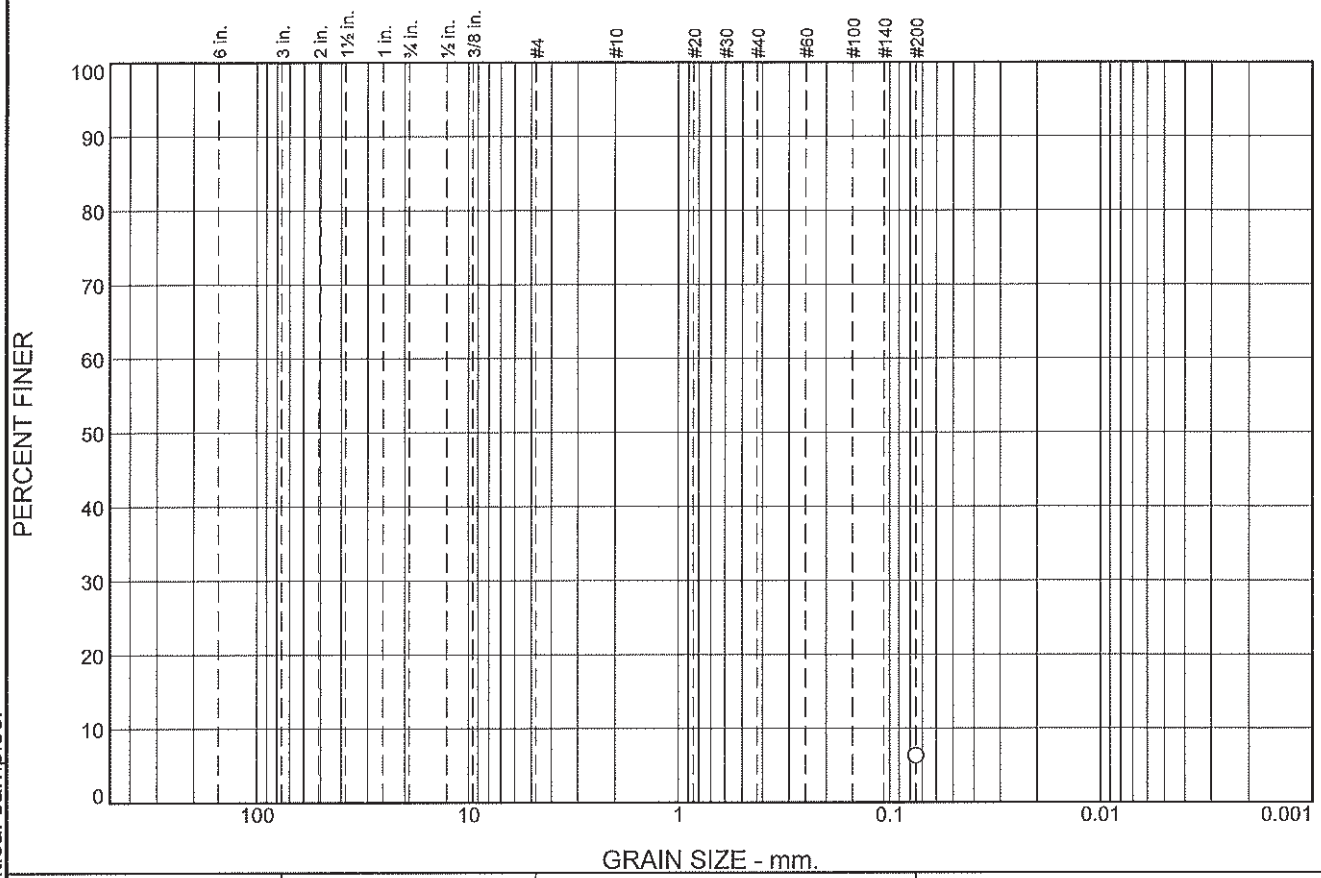
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
487.13	16.01	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										4.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						6.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	6.4		

* (no specification provided)

Soil Description

SAND with Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Location: G37A S16
Sample Number: 8023-30 **Depth:** 75' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G37A S16
Depth: 75'
Sample Number: 8023-30
Material Description: SAND with Silt
Date: 2/22/2018
USCS Classification: SP-SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 297.15
Tare Wt. = 15.81
Minus #200 from wash = 6.4%

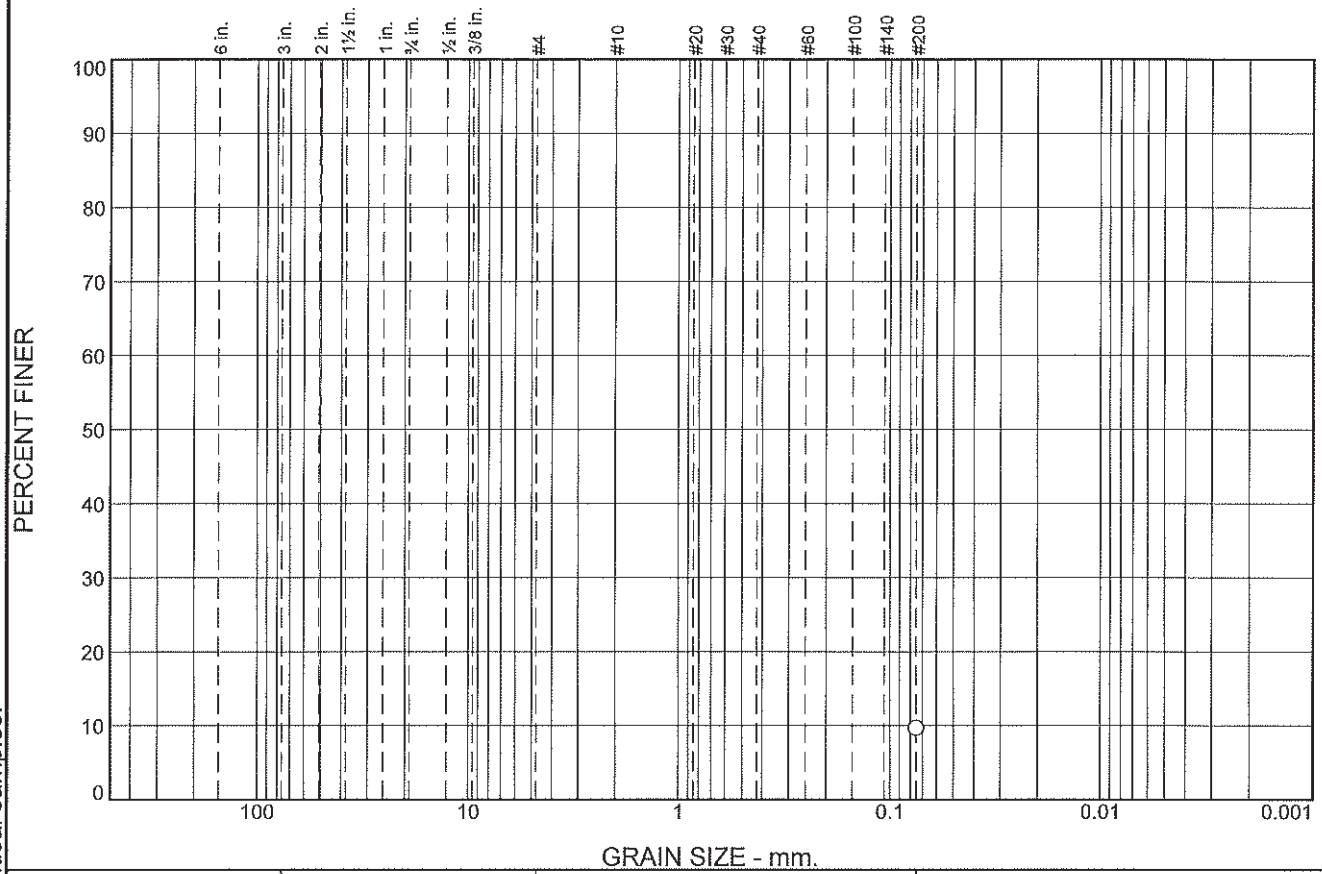
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
316.24	15.81	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										6.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						9.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	9.7		

* (no specification provided)

Soil Description

SAND with Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Location: G38 S6
Sample Number: 8023-37 **Depth:** 20' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G38 S6
Depth: 20'
Sample Number: 8023-37
Material Description: SAND with Silt
Date: 2/22/2018
USCS Classification: SP-SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 296.07
Tare Wt. = 15.89
Minus #200 from wash = 9.7%

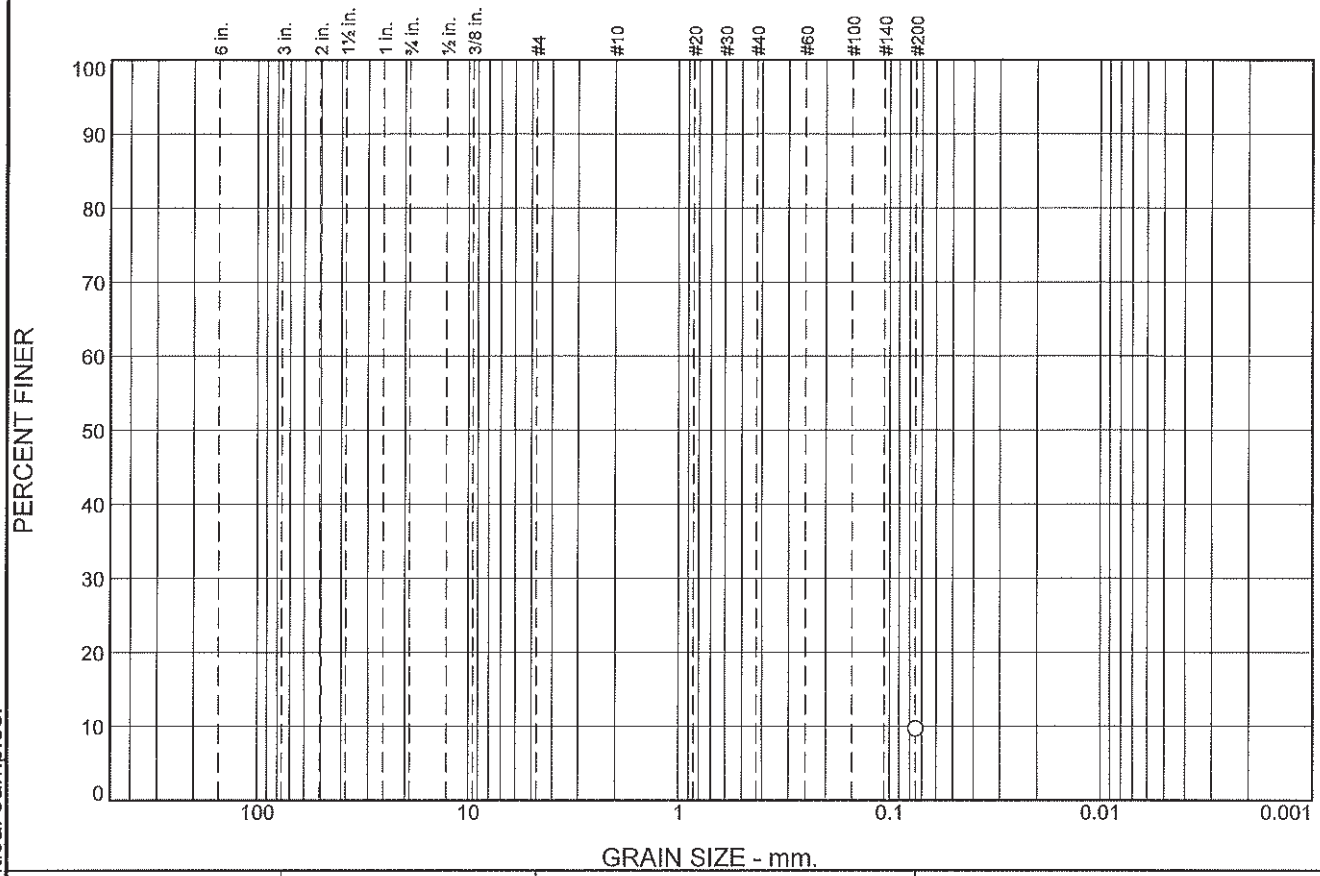
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
326.14	15.89	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										9.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						9.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	9.7		

* (no specification provided)

Soil Description

SAND with Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Location: G38 S6
Sample Number: 8023-37 **Depth:** 20' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G38 S6
Depth: 20'
Sample Number: 8023-37
Material Description: SAND with Silt
Date: 2/22/2018
USCS Classification: SP-SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 296.07
Tare Wt. = 15.89
Minus #200 from wash = 9.7%

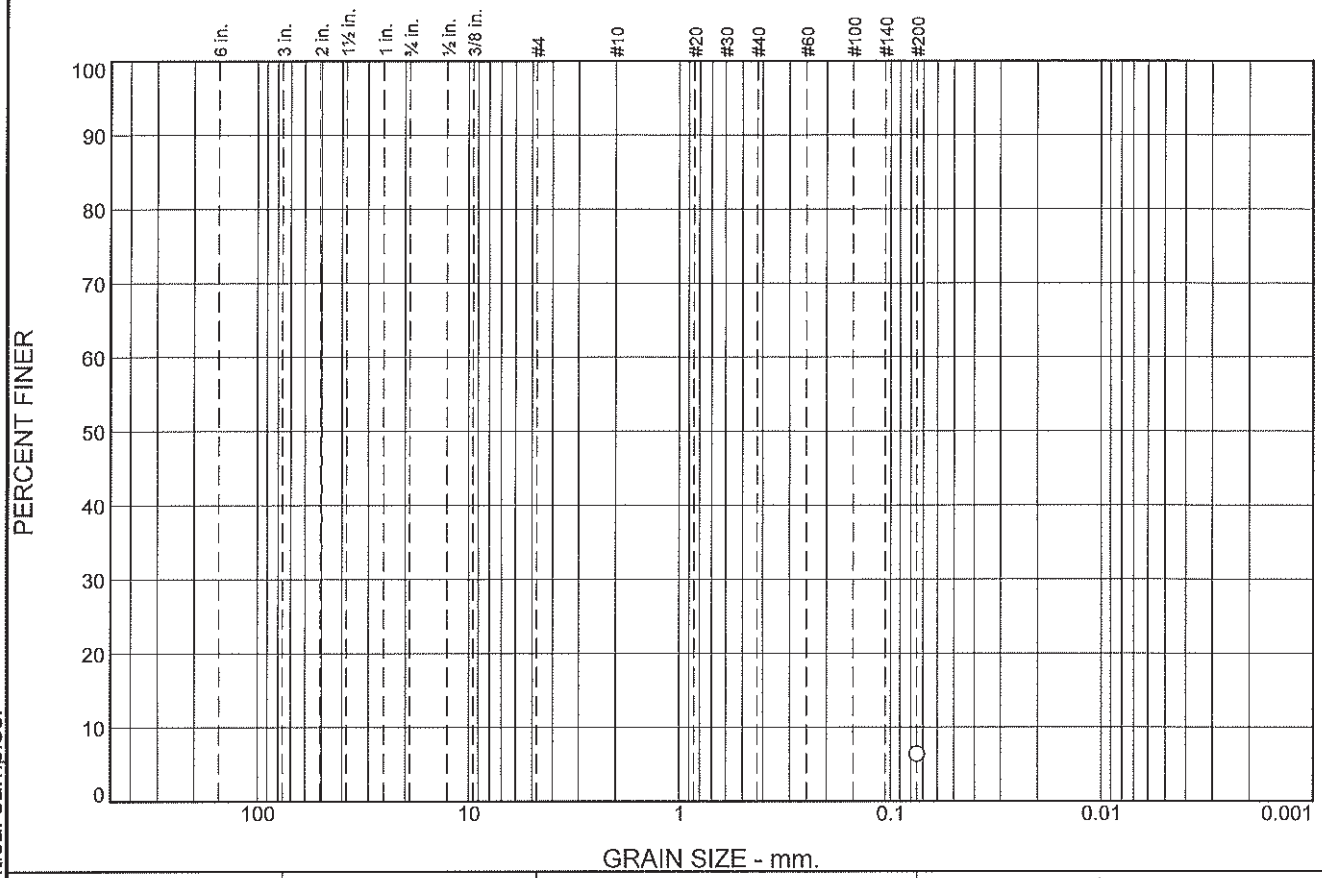
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
326.14	15.89	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										9.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						6.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	6.4		

* (no specification provided)

Soil Description

SAND with Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Location: G38 S11
Sample Number: 8023-39 **Depth:** 45' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G38 S11
Depth: 45'
Sample Number: 8023-39
Material Description: SAND with Silt
Date: 2/22/2018
USCS Classification: SP-SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 381.55
Tare Wt. = 15.79
Minus #200 from wash = 6.4%

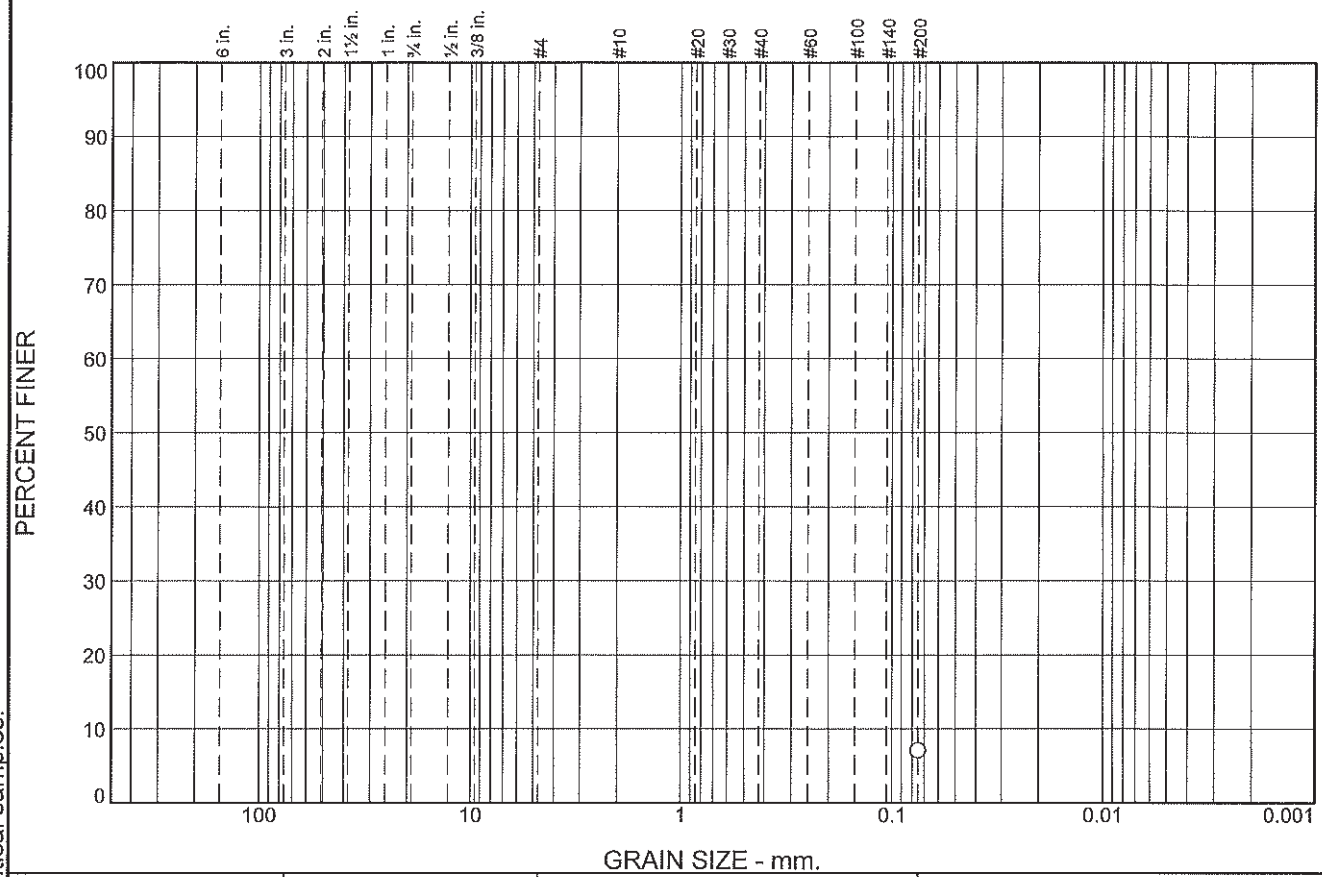
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
406.57	15.79	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										6.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						7.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	7.1		

* (no specification provided)

Soil Description

SAND with Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Location: G38 S13
Sample Number: 8023-40 **Depth:** 55' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G38 S13
Depth: 55'
Sample Number: 8023-40
Material Description: SAND with Silt
Date: 2/22/2018
USCS Classification: SP-SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 296.82
Tare Wt. = 16.17
Minus #200 from wash = 7.1%

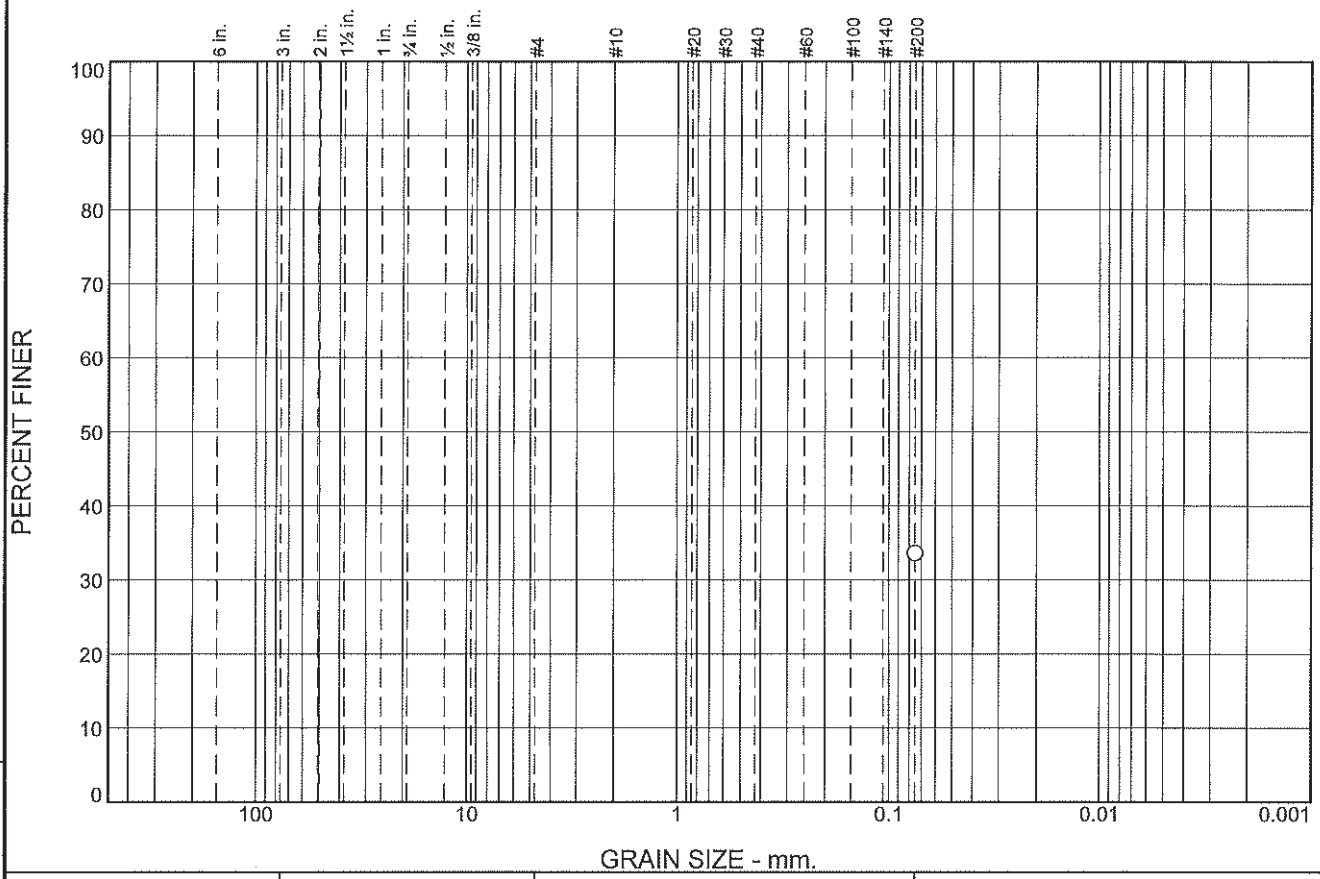
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
318.26	16.17	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										7.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						33.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	33.6		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: G38 S21
Sample Number: 8023-43 **Depth:** 95' **Date:** 2/22/2018

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

2/22/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G38 S21
Depth: 95'
Sample Number: 8023-43
Material Description: Silty SAND
Date: 2/22/2018
USCS Classification: SM
Tested by: GD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 122.71
Tare Wt. = 16.04
Minus #200 from wash = 33.6%

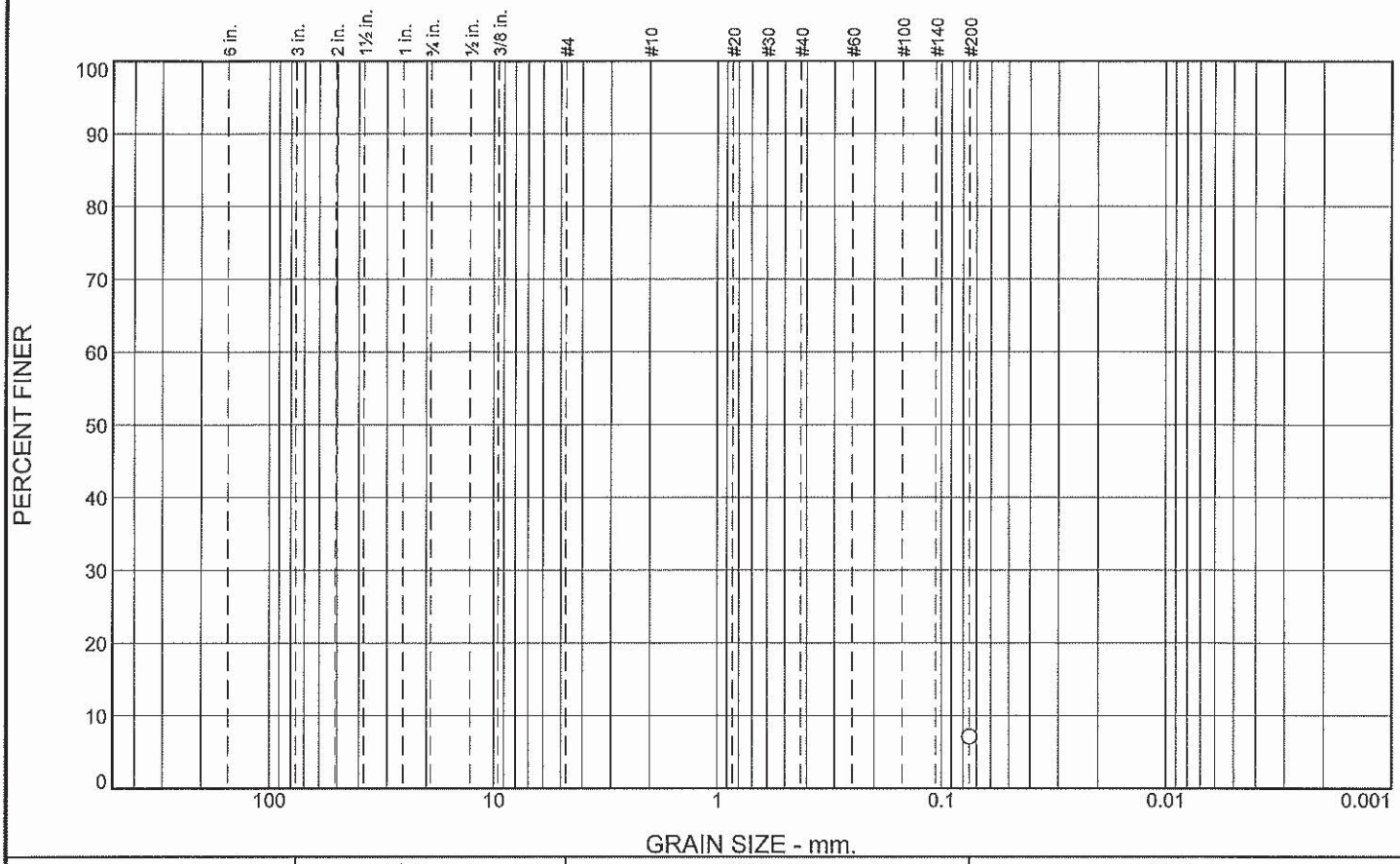
Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
176.80	16.04	0.00			

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										33.6

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						7.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	7.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G044 S-12
Sample Number: 7995-99 **Depth:** 30'-31.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-12
Depth: 30'-31.5'
Sample Number: 7995-99
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 467.20
Tare Wt. = 15.80
Minus #200 from wash = 7.1%

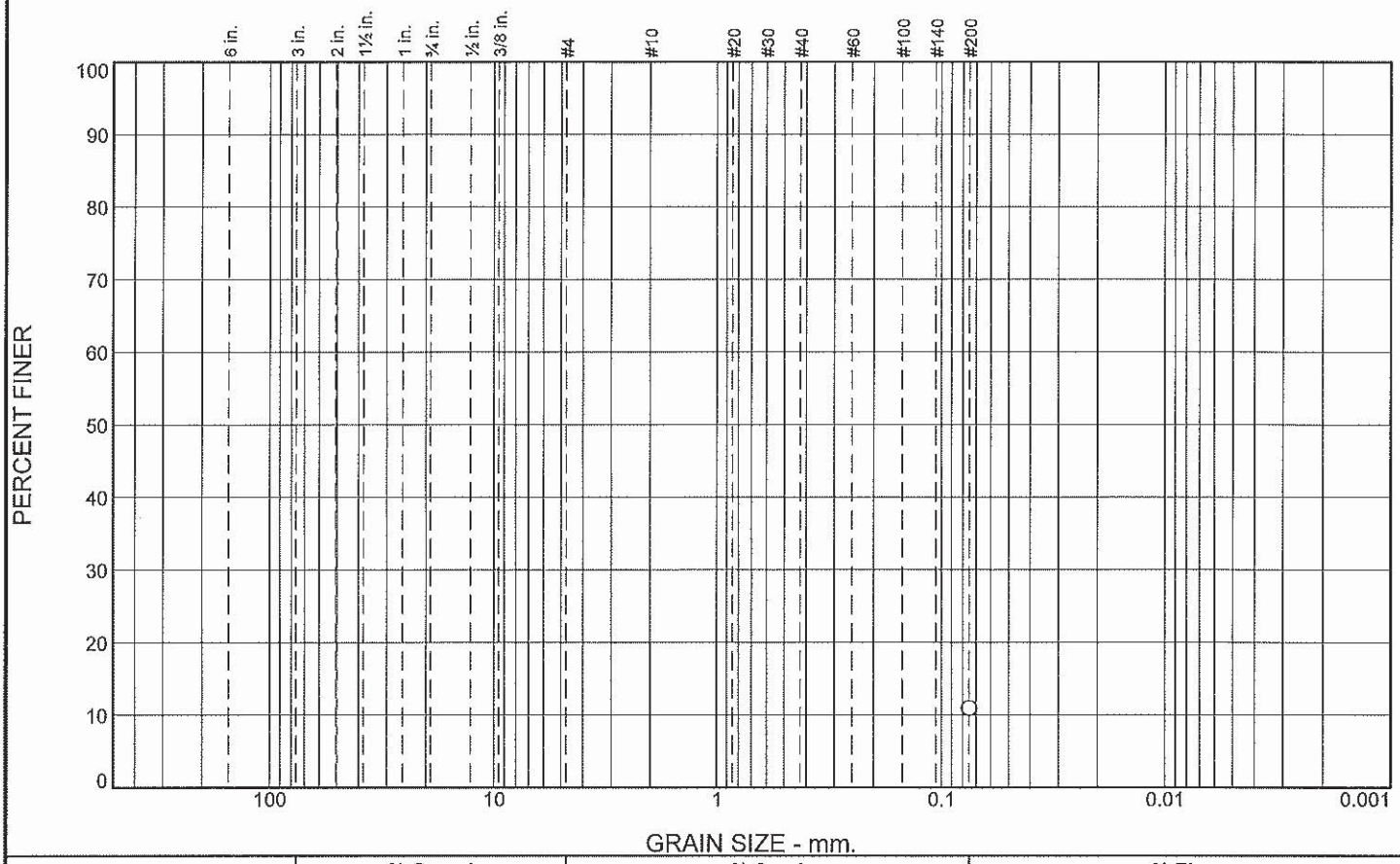
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
501.90	15.80	#200			7.1

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										7.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						10.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	10.9		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G044 S-13
Sample Number: 7995-100 **Depth:** 35'-36.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-13
Depth: 35'-36.5'
Sample Number: 7995-100
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 408.70
Tare Wt. = 15.80
Minus #200 from wash = 10.9%

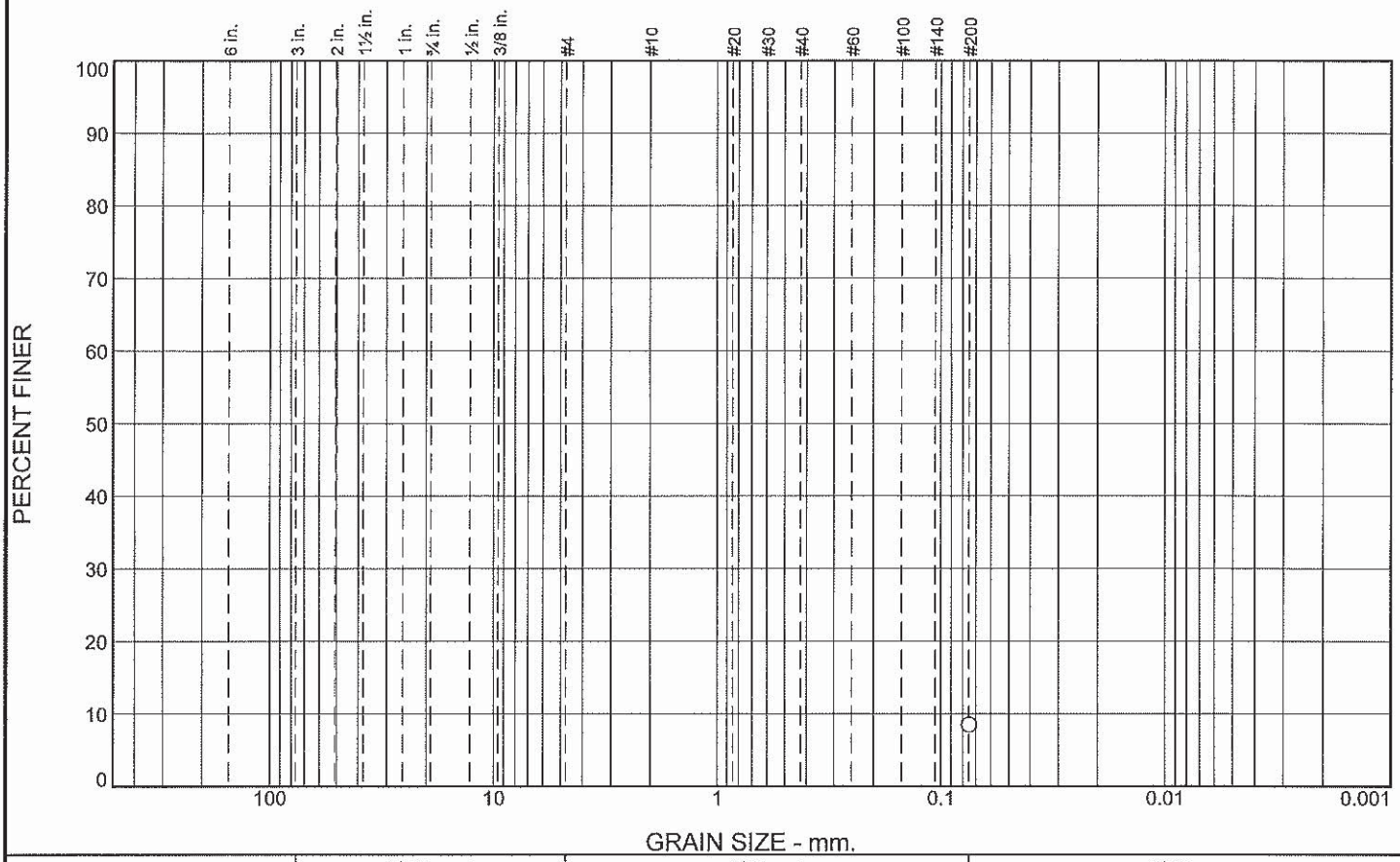
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
457.00	15.80	#200			10.9

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										10.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						8.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	8.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G045 S-2
Sample Number: 7995-117 **Depth:** 5'-6.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-2
Depth: 5'-6.5'
Sample Number: 7995-117
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 330.00
Tare Wt. = 16.90
Minus #200 from wash = 8.5%

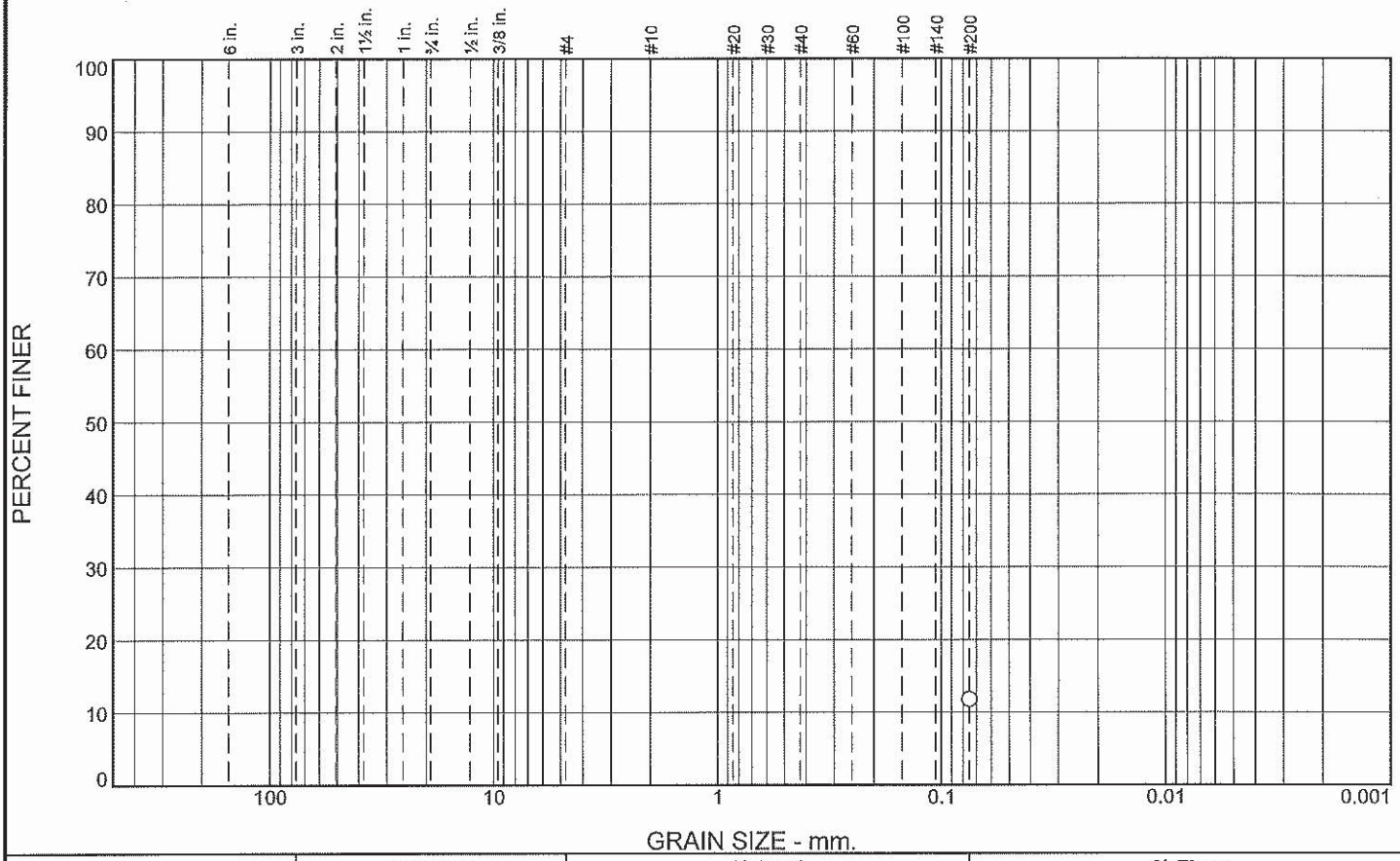
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
359.20	16.90	#200			8.5

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										8.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						11.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	11.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G045 S-12
Sample Number: 7995-122 **Depth:** 45'-46.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-12
Depth: 45'-46.5'
Sample Number: 7995-122
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 255.60
Tare Wt. = 16.50
Minus #200 from wash = 11.8%

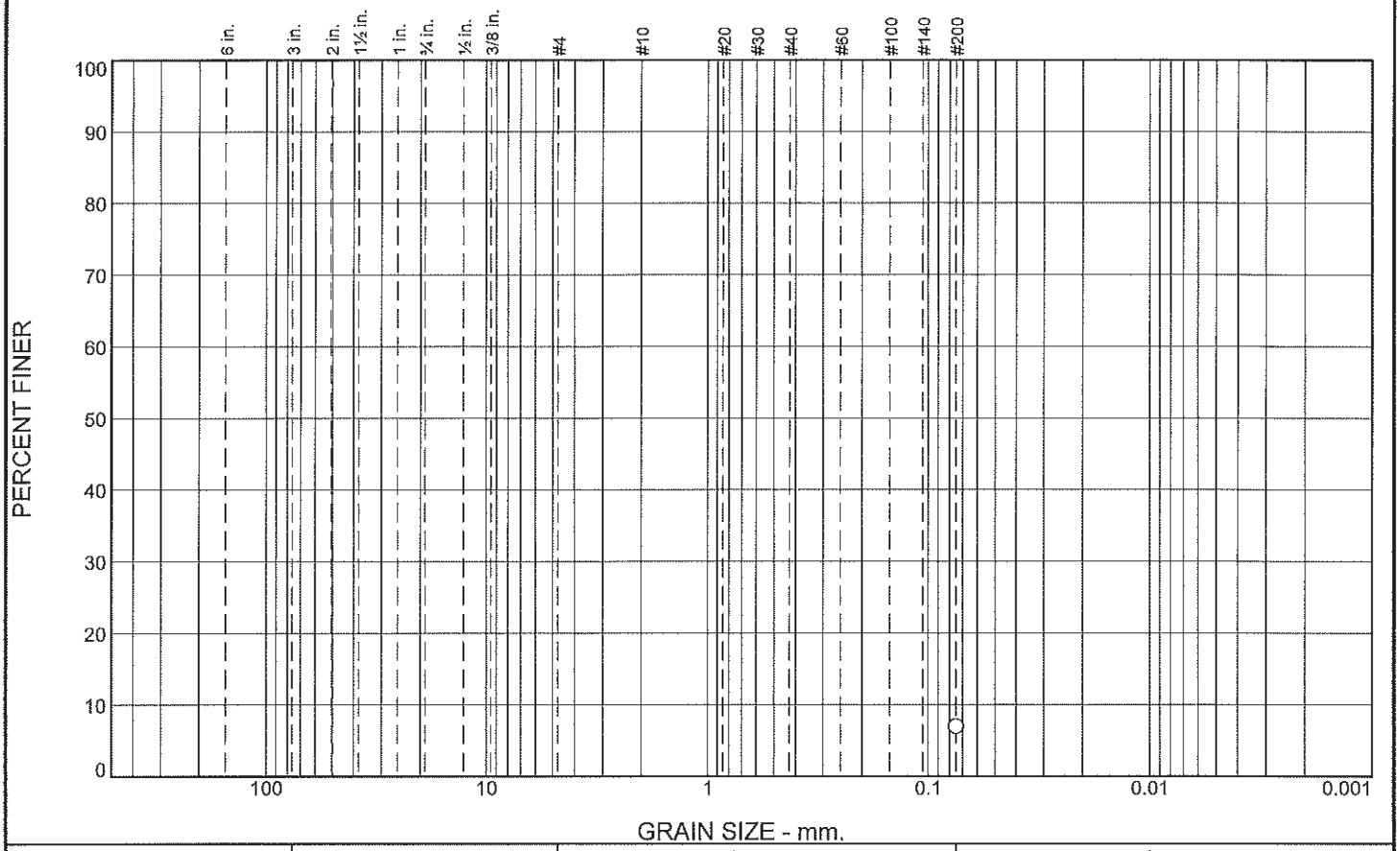
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
287.60	16.50	#200			11.8

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										11.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						7.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	7.0		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G045 S-15
Sample Number: 7995-124 **Depth:** 60'-61.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-15
Depth: 60'-61.5'
Sample Number: 7995-124
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 268.90
Tare Wt. = 16.70
Minus #200 from wash = 7.0%

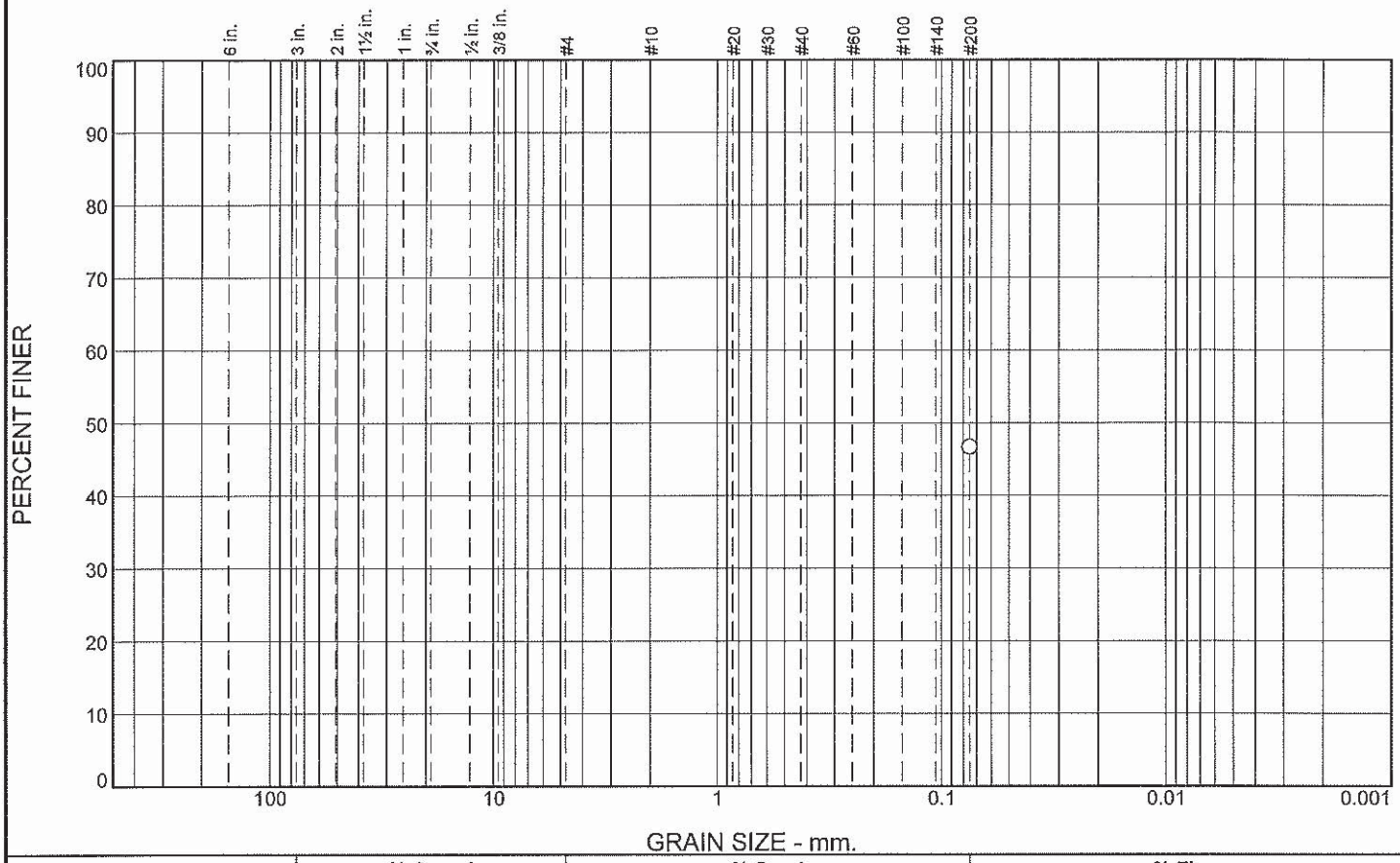
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
287.90	16.70	#200			7.0

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										7.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						46.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	46.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G045 S-18
Sample Number: 7995-126 **Depth:** 77.5'-79' **Date:** 10/27/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-18
Depth: 77.5'-79'
Sample Number: 7995-126
Date: 10/27/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 107.50
Tare Wt. = 16.30
Minus #200 from wash = 46.7%

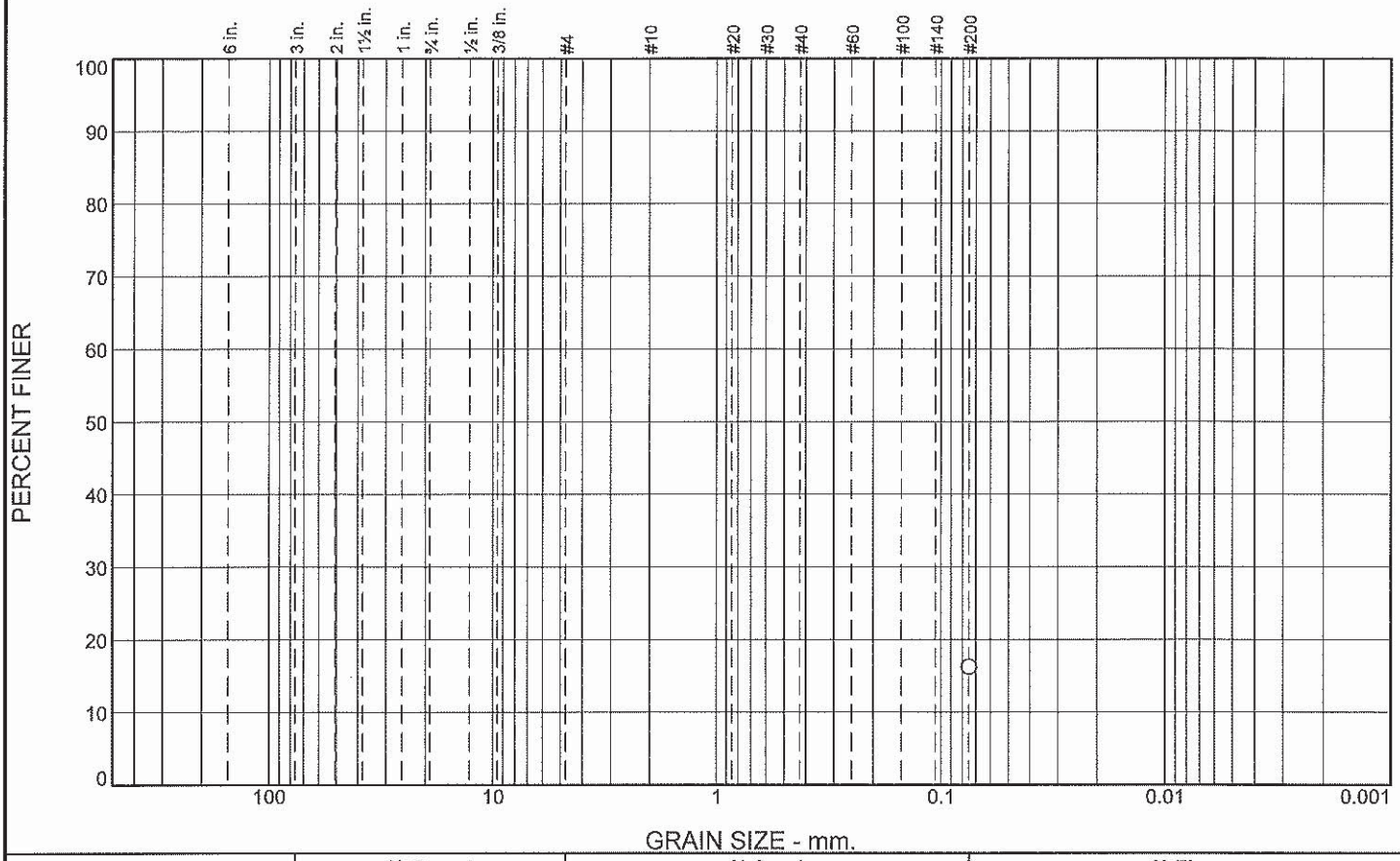
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
187.40	16.30	#200			46.7

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										46.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						16.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	16.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G045 S-22
Sample Number: 7995-129 **Depth:** 100'-101.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-22
Depth: 100'-101.5'
Sample Number: 7995-129
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 216.80
Tare Wt. = 16.50
Minus #200 from wash = 16.3%

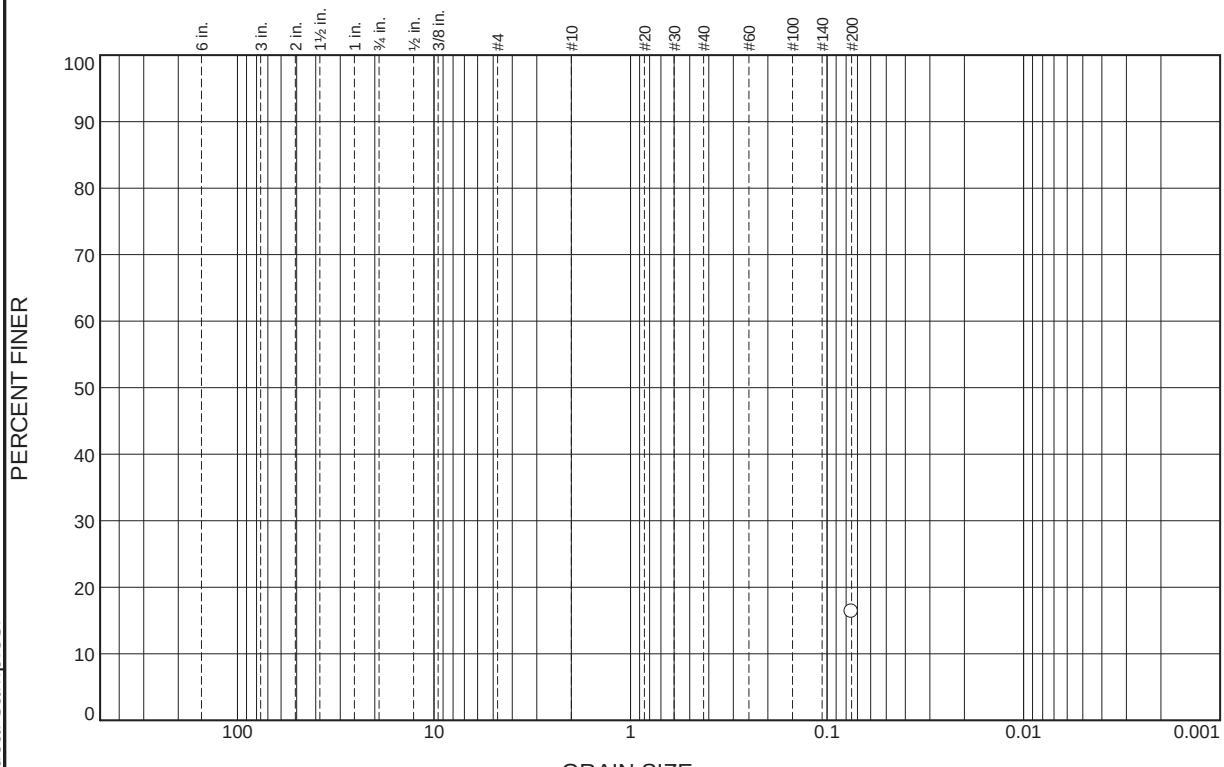
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
255.70	16.50	#200			16.3

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										16.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						16.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	16.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G045 S-29
Sample Number: 7995-133 **Depth:** 145'-146.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

GRAIN SIZE DISTRIBUTION TEST DATA

3/13/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-29
Depth: 145'-146.5'
Sample Number: 7995-133
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 307.70
Tare Wt. = 16.90
Minus #200 from wash = 16.3%

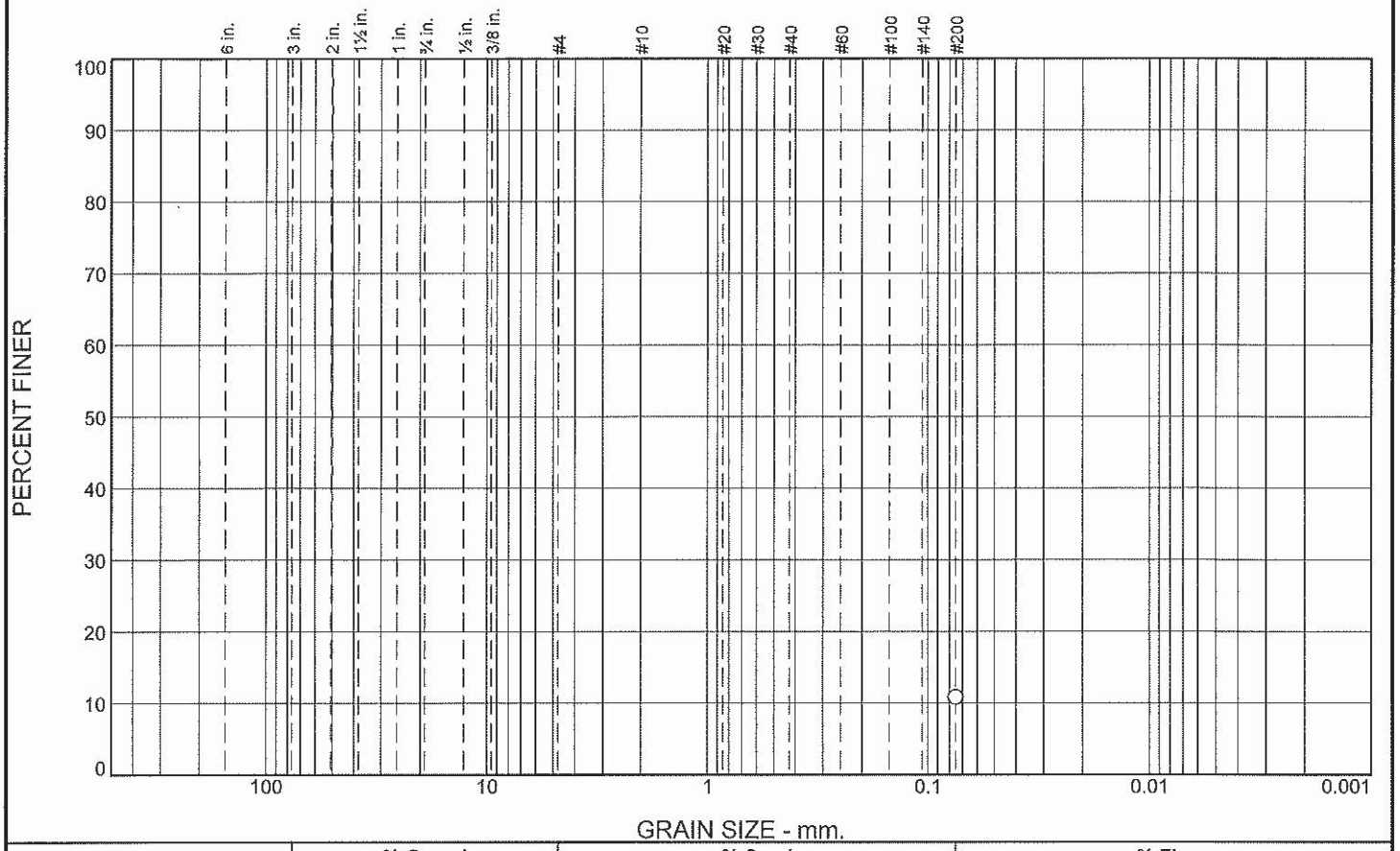
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
364.50	16.90	#200			16.3

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										16.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						10.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	10.9		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: G045 S-37
Sample Number: 7995-135 **Depth:** 180'-181.5' **Date:** 10/21/2017

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-37
Depth: 180'-181.5'
Sample Number: 7995-135
Date: 10/21/2017
Tested by: BH
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 216.40
Tare Wt. = 16.20
Minus #200 from wash = 10.9%

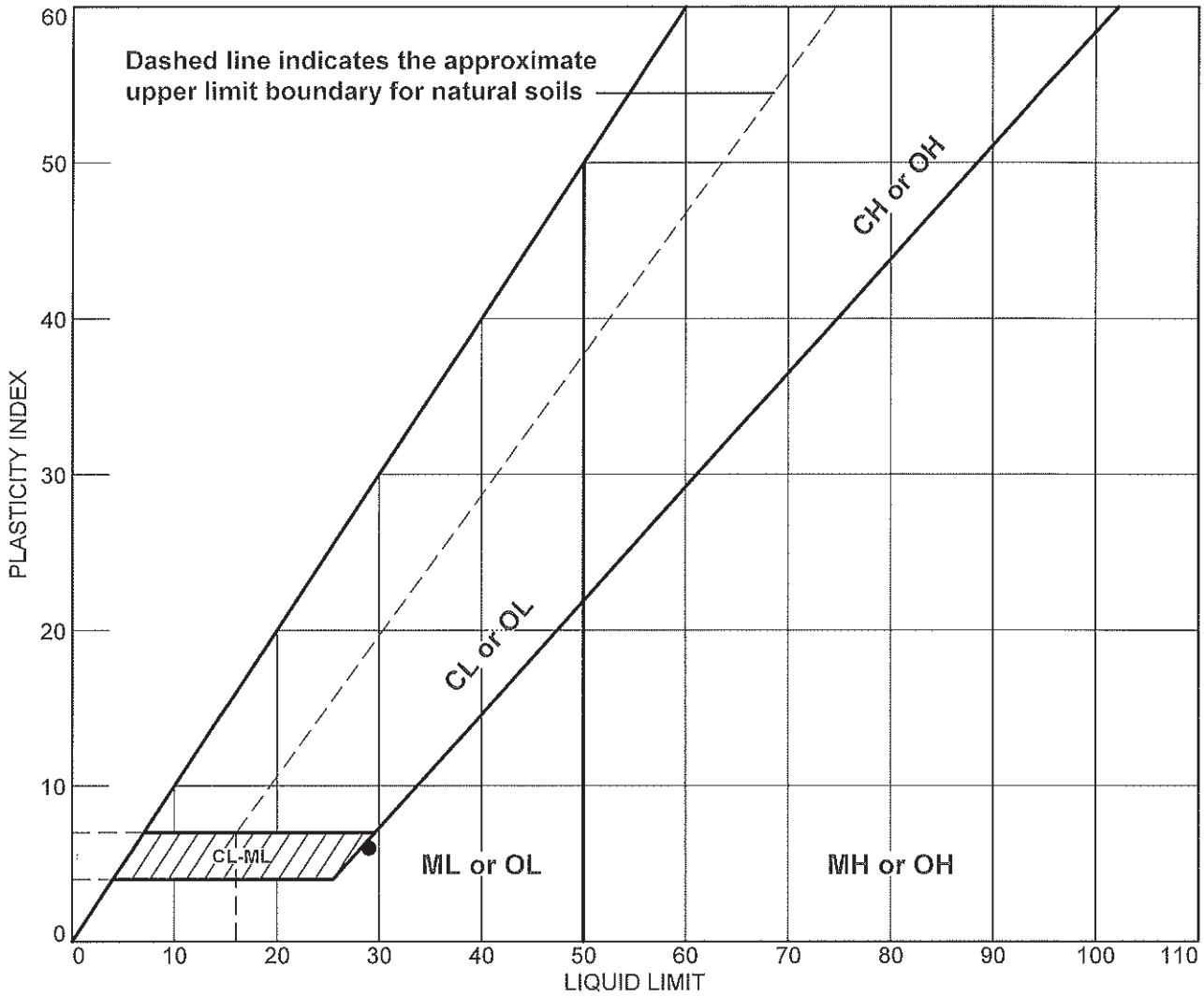
Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
240.80	16.20	#200			10.9

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
										10.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G7 / S5	054-32	12.5'	18.5	23	29	6	ML

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940
Figure

Tested By: GD **Checked By:** JAM

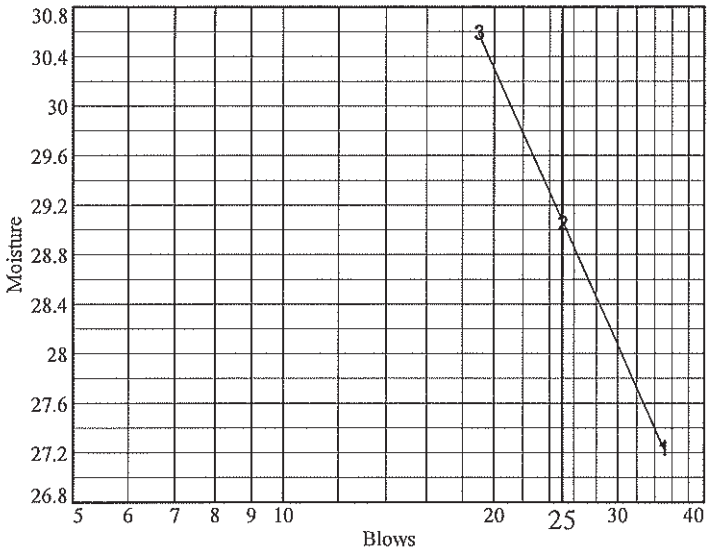
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G7 / S5
Depth: 12.5'
Sample Number: 054-32
USCS: ML
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	27.94	25.86	27.19			
Dry+Tare	24.87	23.12	24.02			
Tare	13.6	13.69	13.66			
# Blows	35	25	19			
Moisture	27.2	29.1	30.6			



Liquid Limit= 29
Plastic Limit= 23
Plasticity Index= 6
Natural Moisture= 18.5
Liquidity Index= -0.8

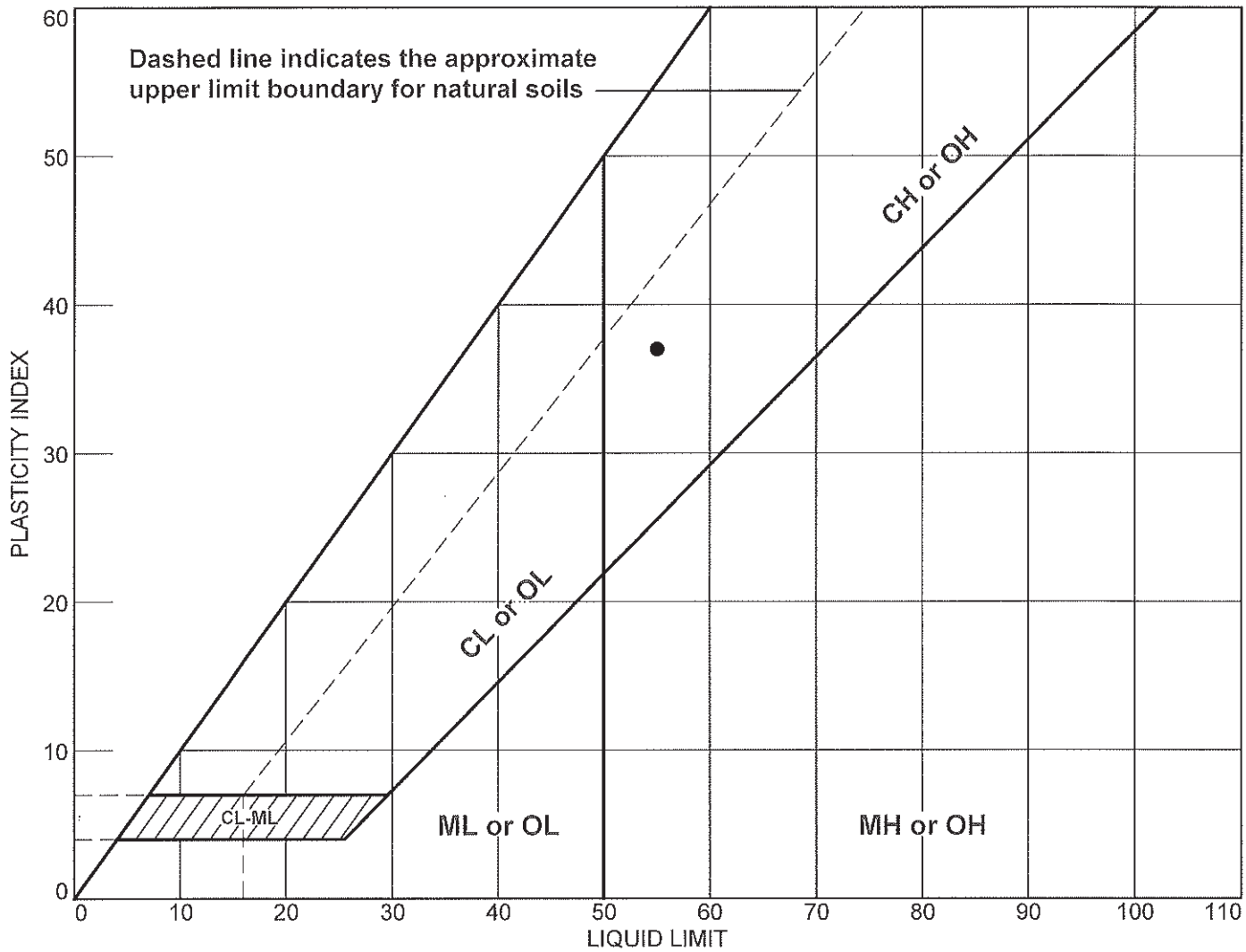
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.69				
Dry+Tare	22.62				
Tare	13.66				
Moisture	23.1				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
105	91.1	15.8	18.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G15 / S13	054-65	50'	19.0	18	55	37	CH

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

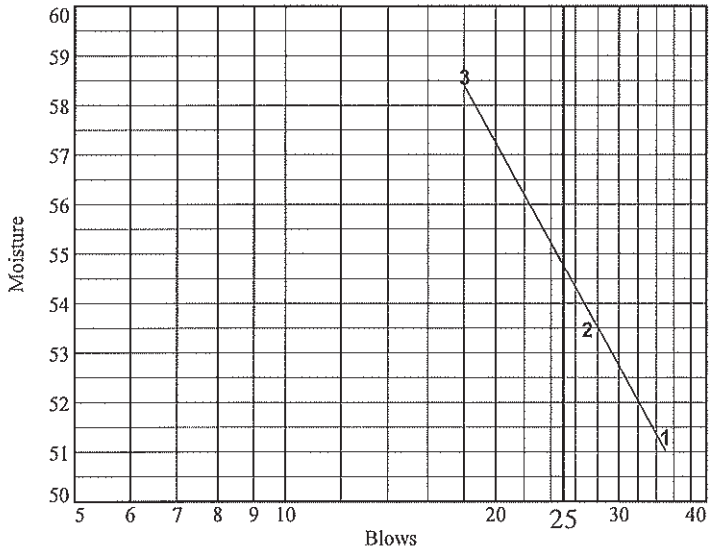
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G15 / S13
Depth: 50'
Sample Number: 054-65
USCS: CH
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	18.83	21.85	22.56			
Dry+Tare	16.26	19.00	18.36			
Tare	11.25	13.67	11.19			
# Blows	35	27	18			
Moisture	51.3	53.5	58.6			



Liquid Limit= 55
Plastic Limit= 18
Plasticity Index= 37
Natural Moisture= 19.0
Liquidity Index= 0.0

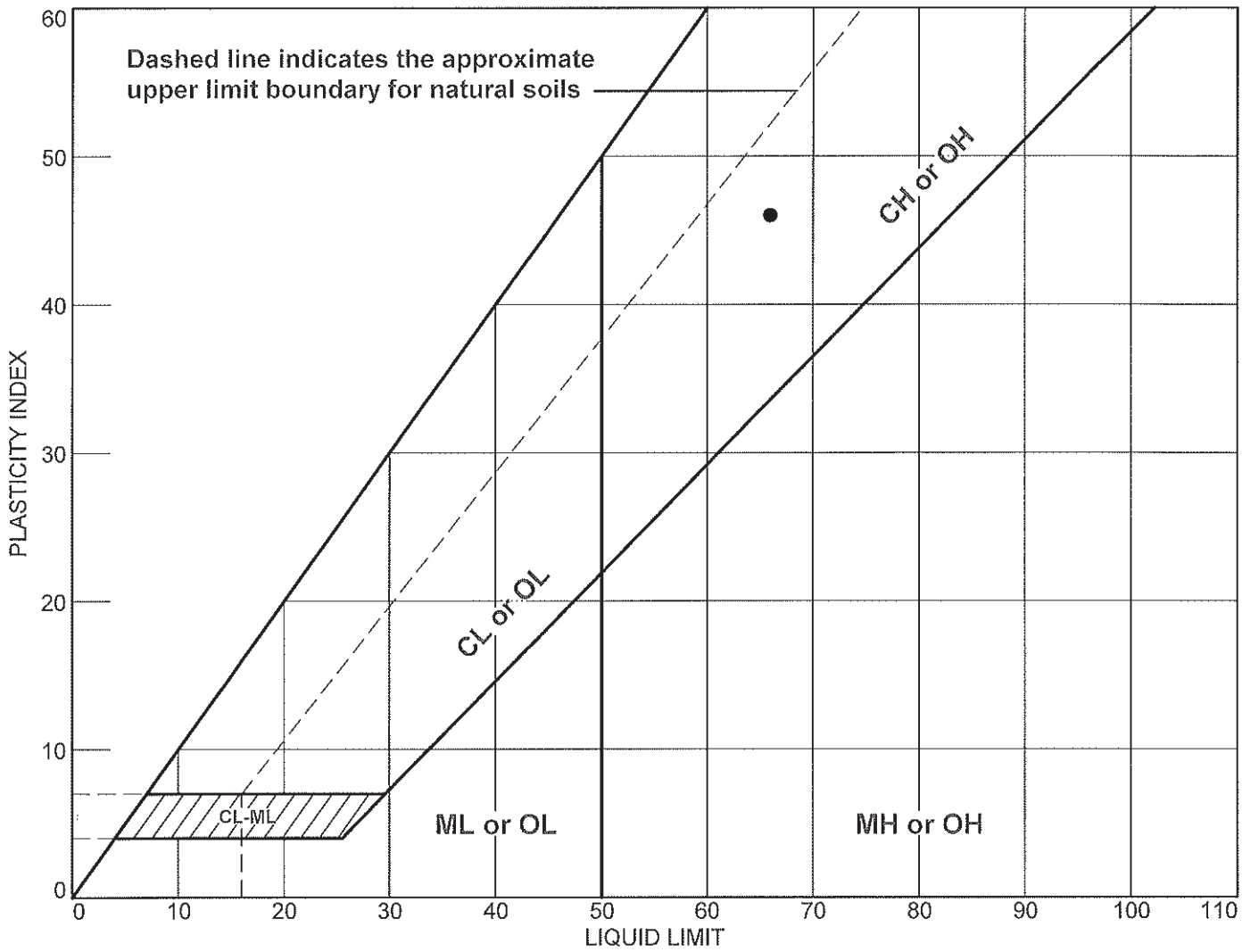
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.02	22.02	22.02		
Dry+Tare	20.41	20.41	20.41		
Tare	11.31	11.31	11.31		
Moisture	17.7	17.7	17.7		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
184.91	157.9	15.9	19.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G15 / S17	054-68	70'	19.5	20	66	46	CH

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

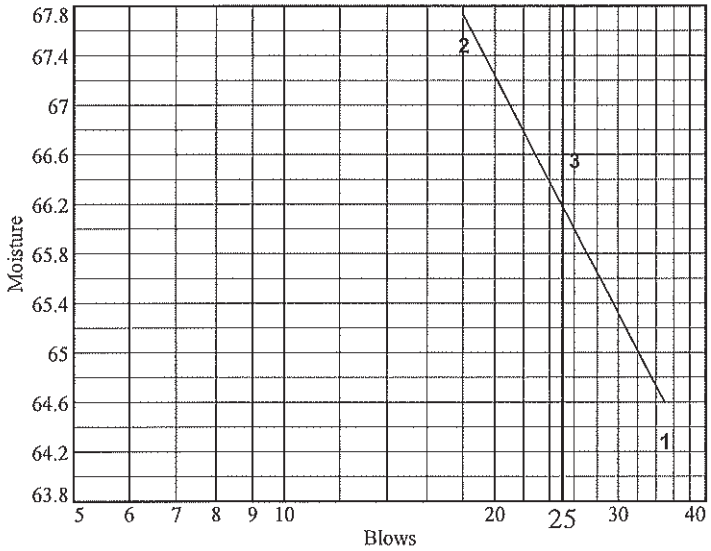
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G15 / S17
Depth: 70'
Sample Number: 054-68
USCS: CH
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	20.16	24.57	28.41			
Dry+Tare	17.73	20.17	22.5			
Tare	13.95	13.65	13.62			
# Blows	35	18	26			
Moisture	64.3	67.5	66.6			



Liquid Limit= 66
Plastic Limit= 20
Plasticity Index= 46
Natural Moisture= 19.5
Liquidity Index= 0.0

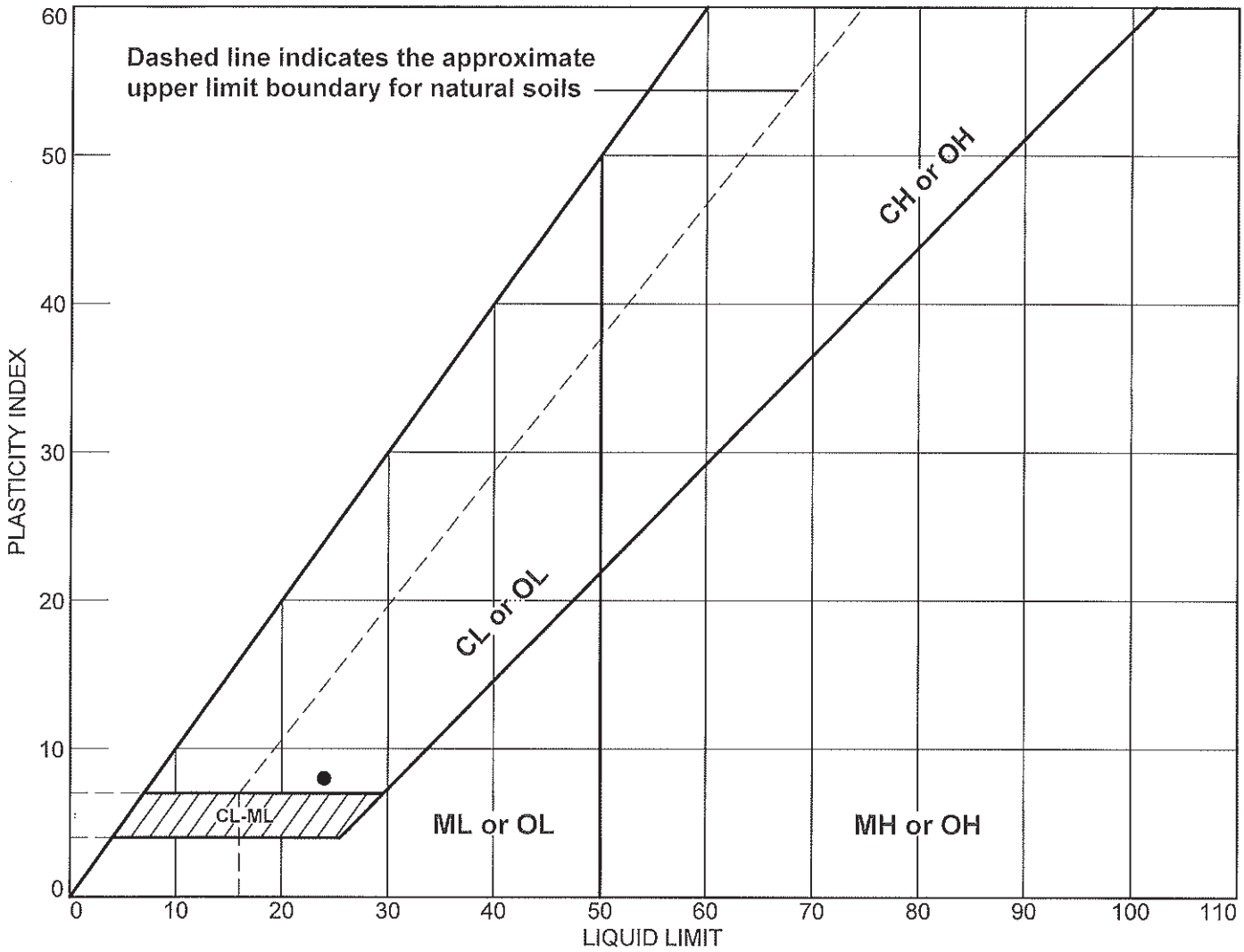
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.68				
Dry+Tare	22.85				
Tare	13.74				
Moisture	20.1				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
81.3	70.6	15.8	19.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G016 S-3 7.5'-9'	8003-2	7.5'-9'	13.5	16	24	8	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

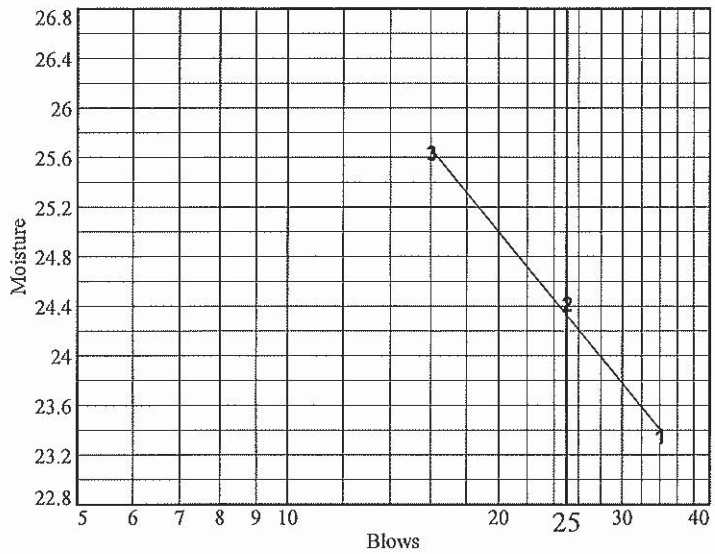
LIQUID AND PLASTIC LIMIT TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G016 S-3
Depth: 7.5'-9'
Sample Number: 8003-2
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.08	27.74	27.00			
Dry+Tare	24.89	24.49	24.28			
Tare	11.23	11.18	13.67			
# Blows	34	25	16			
Moisture	23.4	24.4	25.6			



Liquid Limit= 24
Plastic Limit= 16
Plasticity Index= 8
Natural Moisture= 13.5
Liquidity Index= -0.3

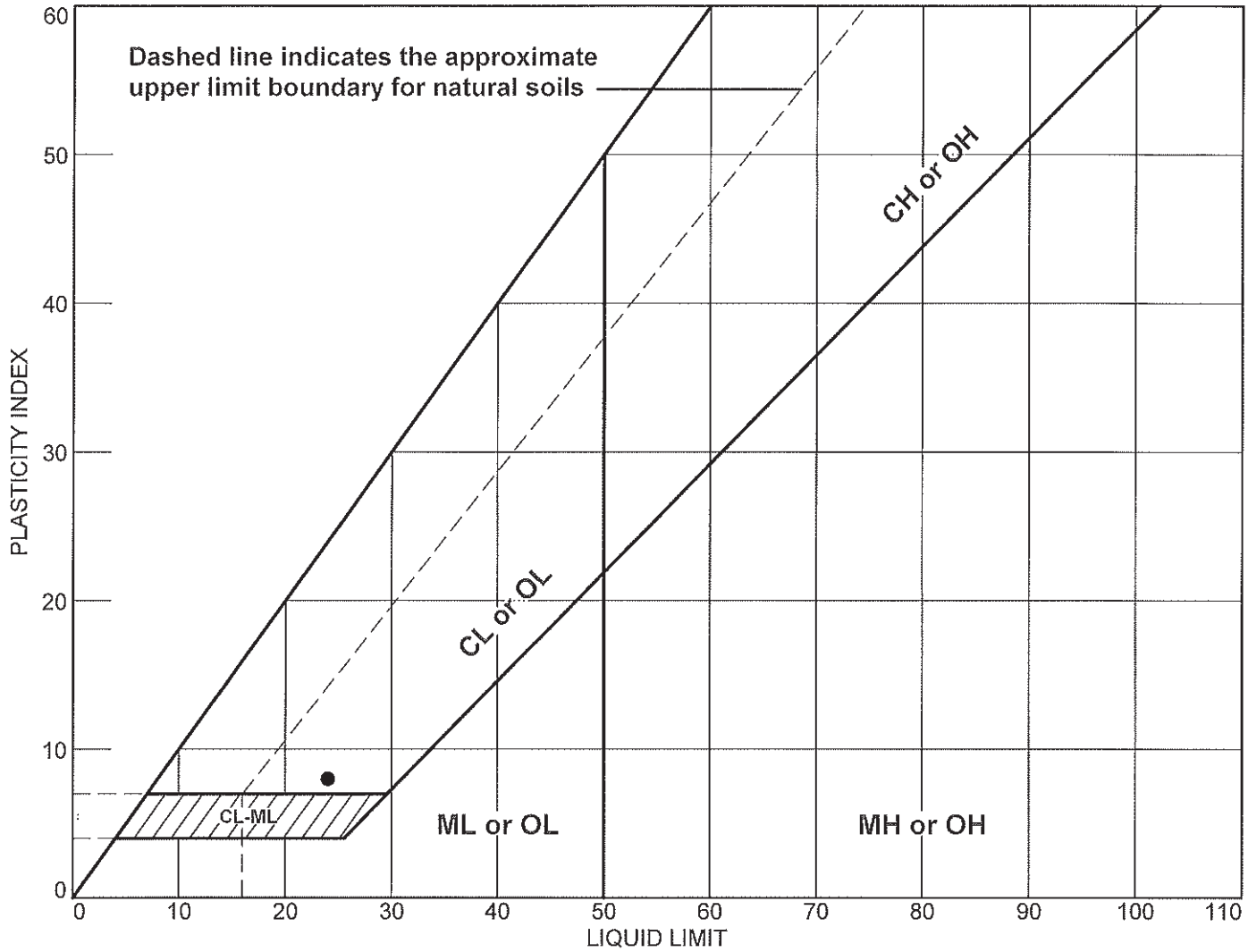
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.33	21.33	21.33		
Dry+Tare	20.28	20.28	20.28		
Tare	13.73	13.73	13.73		
Moisture	16.0	16.0	16.0		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
246.6	219.2	15.9	13.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G016 S-6 15'-16.5'	8003-4	15'-16.5'	17.8	16	24	8	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

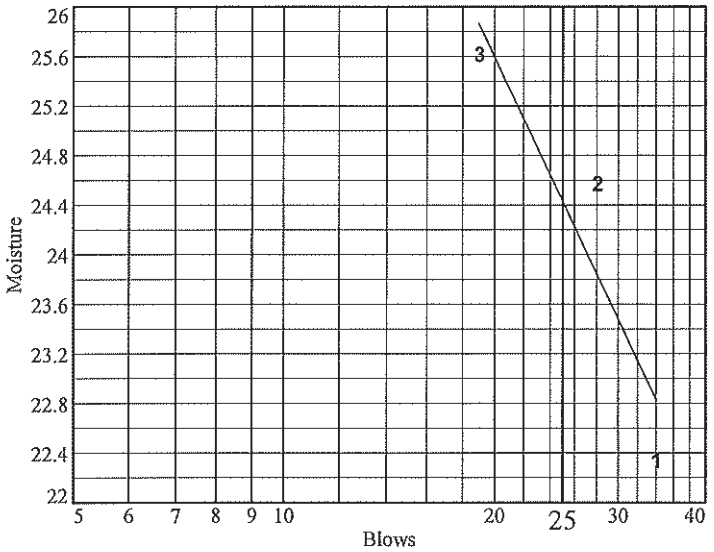
LIQUID AND PLASTIC LIMIT TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G016 S-6
Depth: 15'-16.5'
Sample Number: 8003-4
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	29.46	32.16	30.91			
Dry+Tare	26.58	28.53	27.39			
Tare	13.69	13.76	13.65			
# Blows	34	28	19			
Moisture	22.3	24.6	25.6			



Liquid Limit= 24
Plastic Limit= 16
Plasticity Index= 8
Natural Moisture= 17.8
Liquidity Index= 0.2

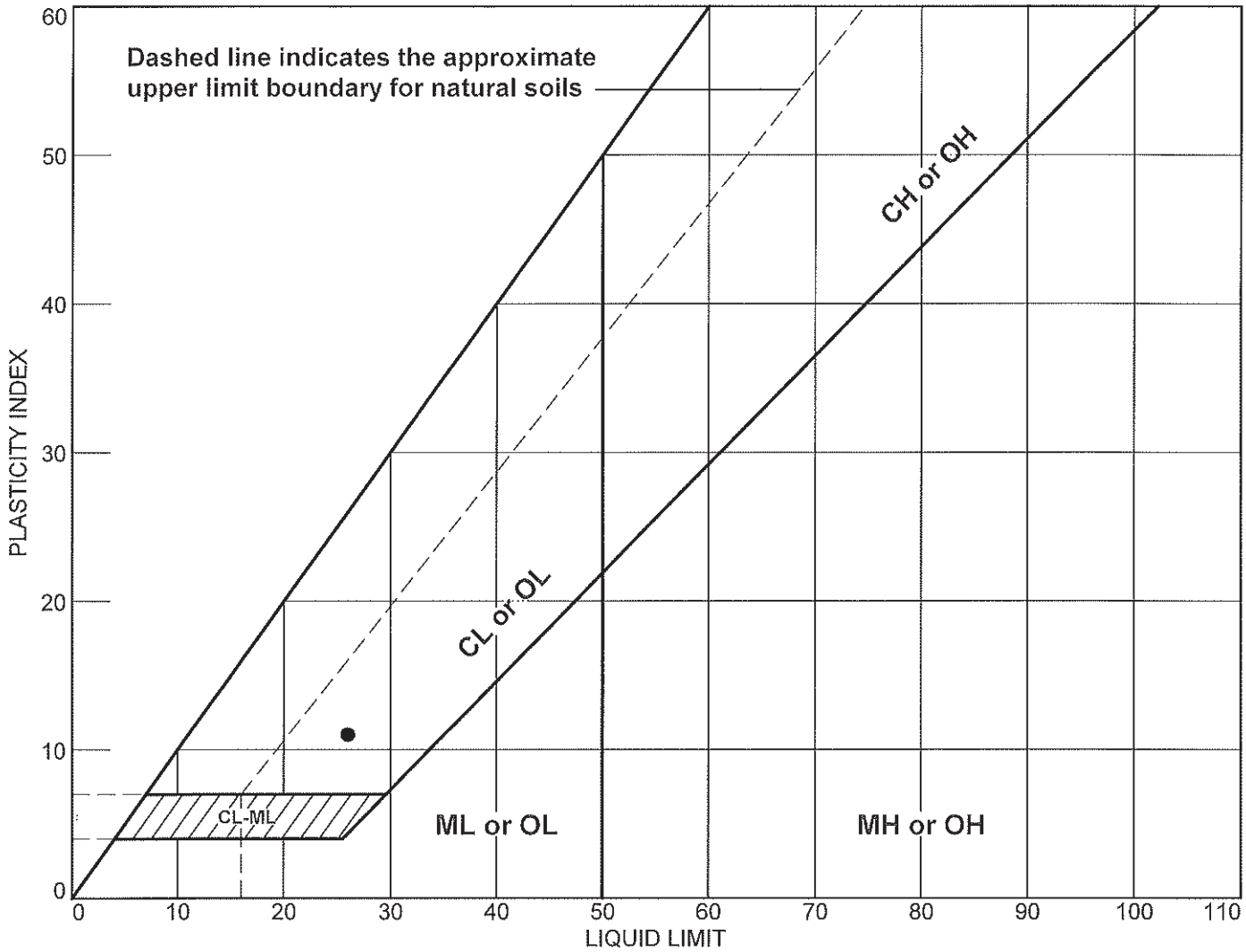
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.35	21.35	21.35		
Dry+Tare	20.29	20.29	20.29		
Tare	13.63	13.63	13.63		
Moisture	15.9	15.9	15.9		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
206.7	177.8	15.7	17.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G016 S-9 30'-31.5'	8003-5	30'-31.5'	17.7	15	26	11	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

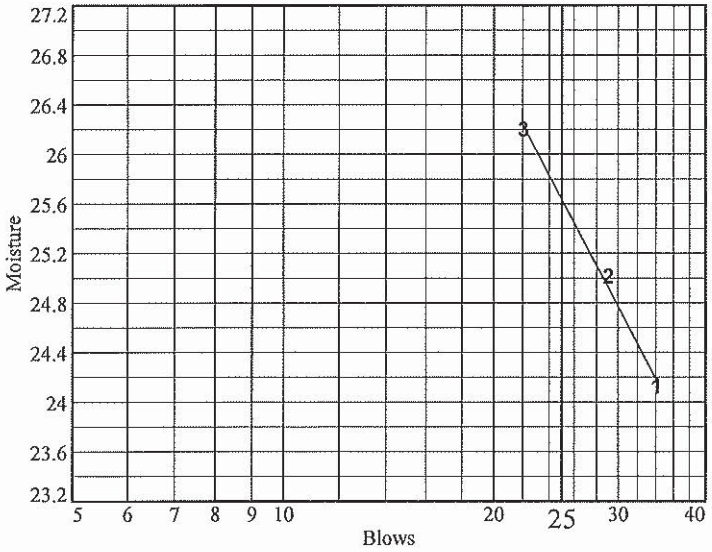
LIQUID AND PLASTIC LIMIT TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G016 S-9
Depth: 30'-31.5'
Sample Number: 8003-5
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	31.08	29.69	33.54			
Dry+Tare	27.67	26.48	29.41			
Tare	13.54	13.65	13.65			
# Blows	34	29	22			
Moisture	24.1	25.0	26.2			



Liquid Limit= 26
Plastic Limit= 15
Plasticity Index= 11
Natural Moisture= 17.7
Liquidity Index= 0.2

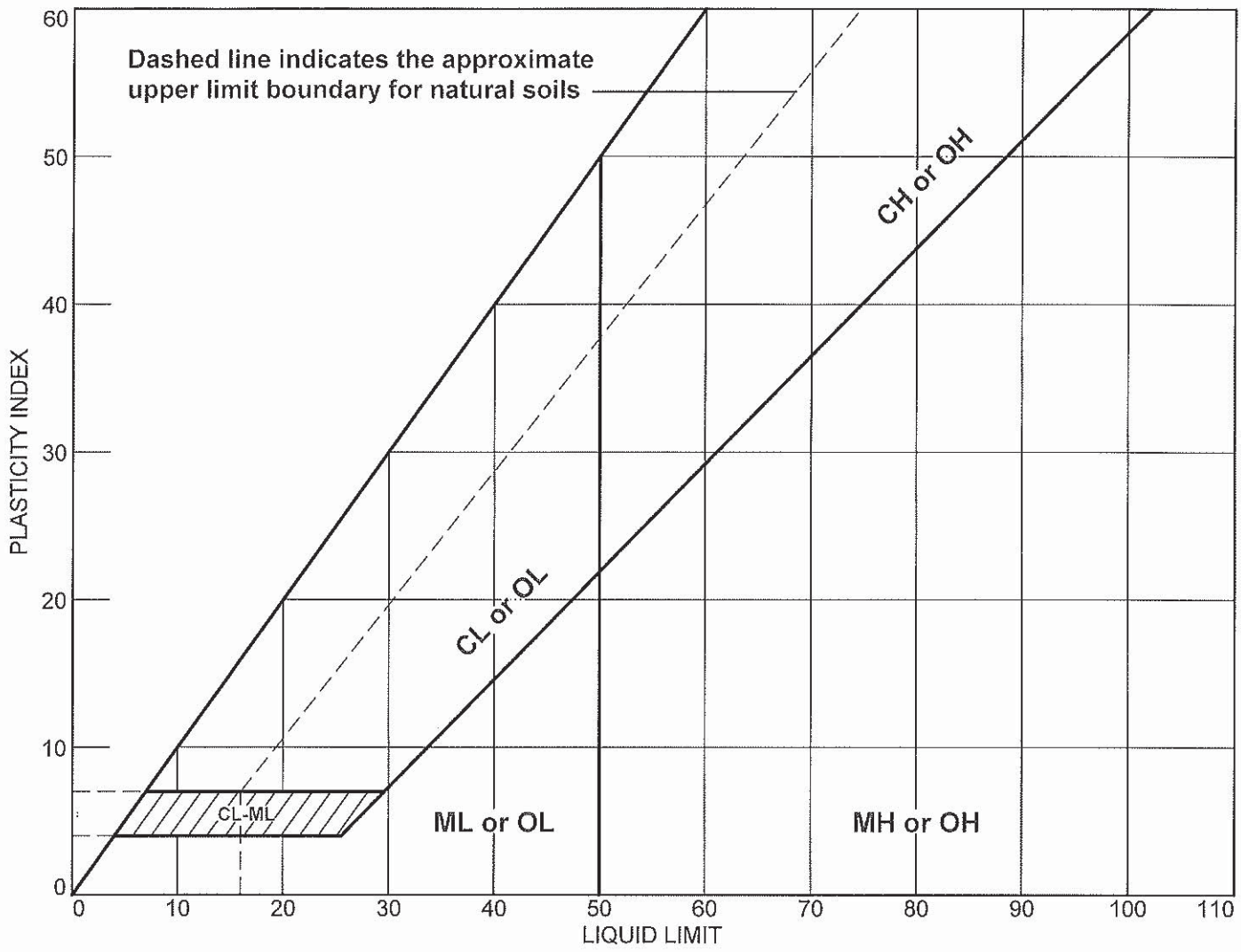
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.48	21.48	21.48		
Dry+Tare	20.45	20.45	20.45		
Tare	13.65	13.65	13.65		
Moisture	15.1	15.1	15.1		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
213.1	183.4	15.8	17.7

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G016 S-11 40'-41.5'	8003-7	40'-41.5'	18.4	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

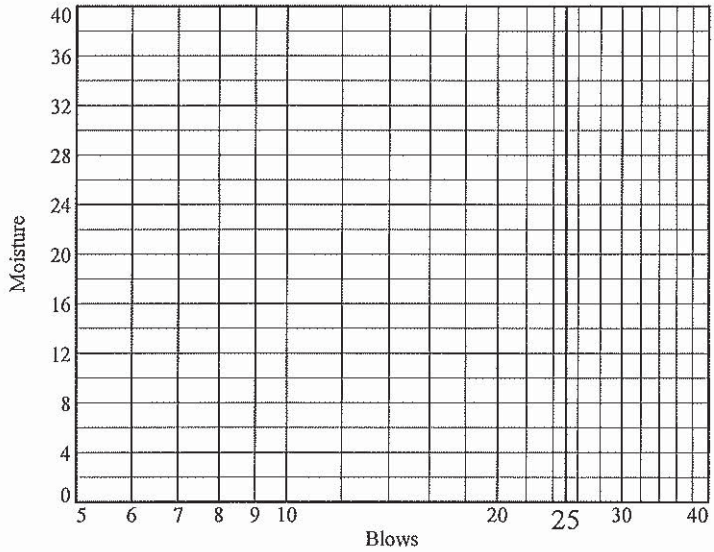
LIQUID AND PLASTIC LIMIT TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G016 S-11
Depth: 40'-41.5'
Sample Number: 8003-7
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 18.4

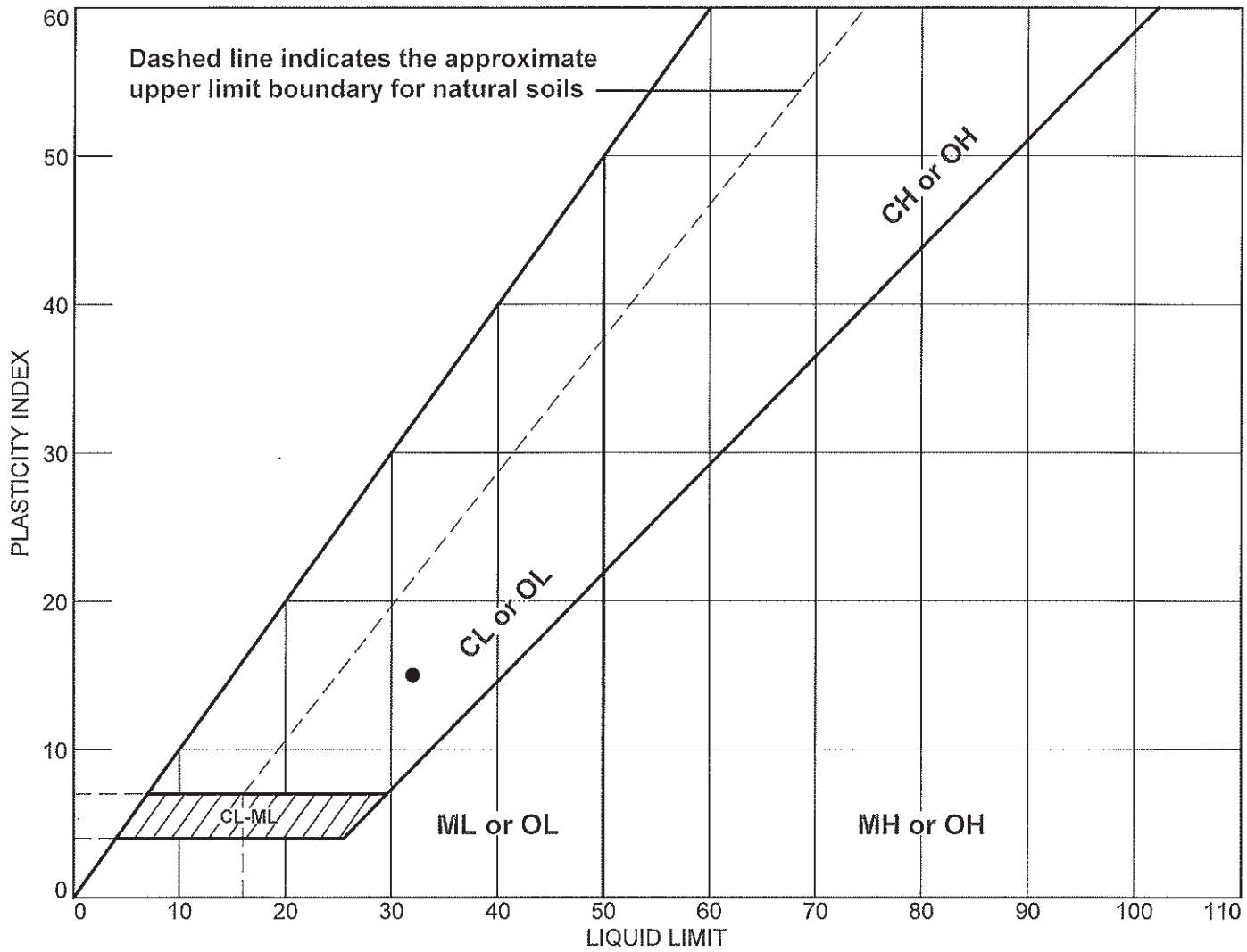
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
245.6	209.9	15.8	18.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G016 S-13 50'-51.5'	8003-9	50'-51.5'	26.4	17	32	15	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

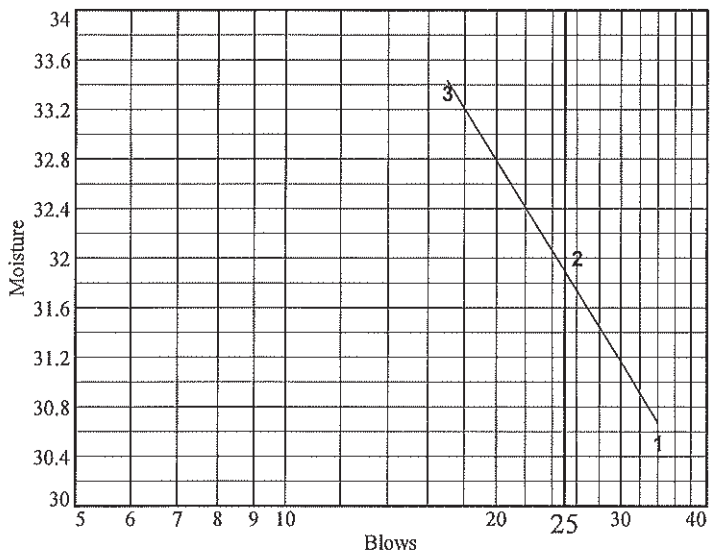
LIQUID AND PLASTIC LIMIT TEST DATA

11/15/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G016 S-13
Depth: 50'-51.5'
Sample Number: 8003-9
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.34	28.50	29.46			
Dry+Tare	24.92	24.90	25.52			
Tare	13.71	13.65	13.70			
# Blows	34	26	17			
Moisture	30.5	32.0	33.3			



Liquid Limit= 32
Plastic Limit= 17
Plasticity Index= 15
Natural Moisture= 26.4
Liquidity Index= 0.6

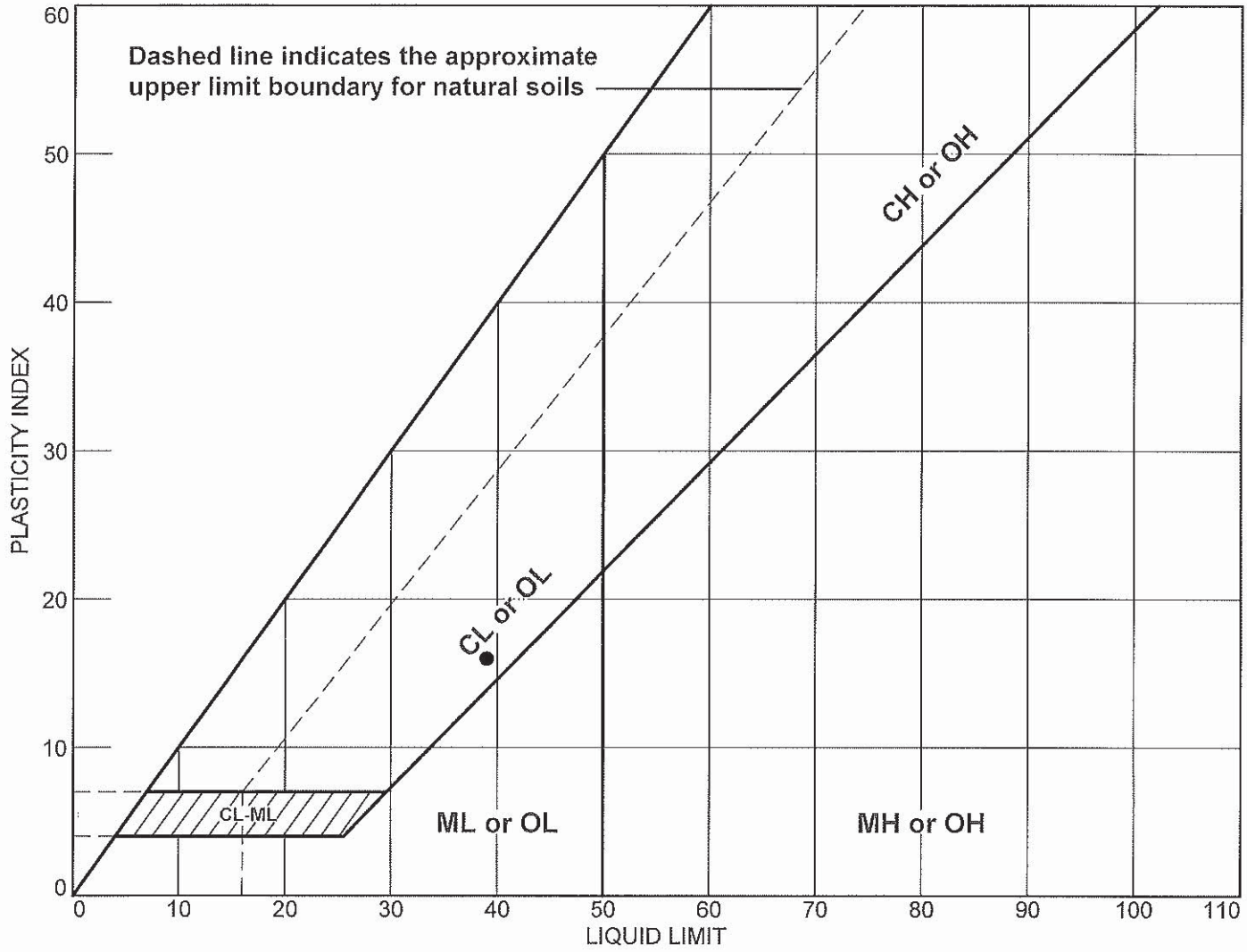
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.22	22.22	22.22		
Dry+Tare	21.03	21.03	21.03		
Tare	13.92	13.92	13.92		
Moisture	16.7	16.7	16.7		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
296.60	237.9	15.9	26.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G016 S-16 65'-66.5'	8003-11	65'-66.5'	23.1	23	39	16	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

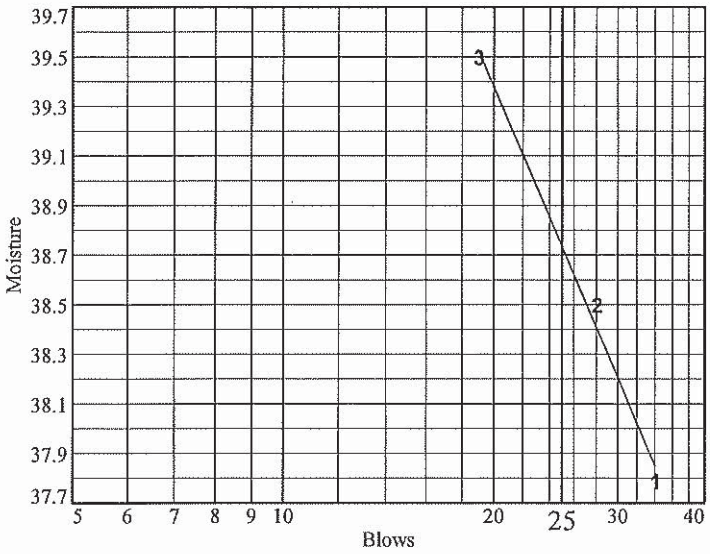
LIQUID AND PLASTIC LIMIT TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G016 S-16
Depth: 65'-66.5'
Sample Number: 8003-11
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	24.41	25.44	28.56			
Dry+Tare	21.47	22.21	24.31			
Tare	13.69	13.82	13.55			
# Blows	34	28	19			
Moisture	37.8	38.5	39.5			



Liquid Limit= 39
Plastic Limit= 23
Plasticity Index= 16
Natural Moisture= 23.1
Liquidity Index= 0.0

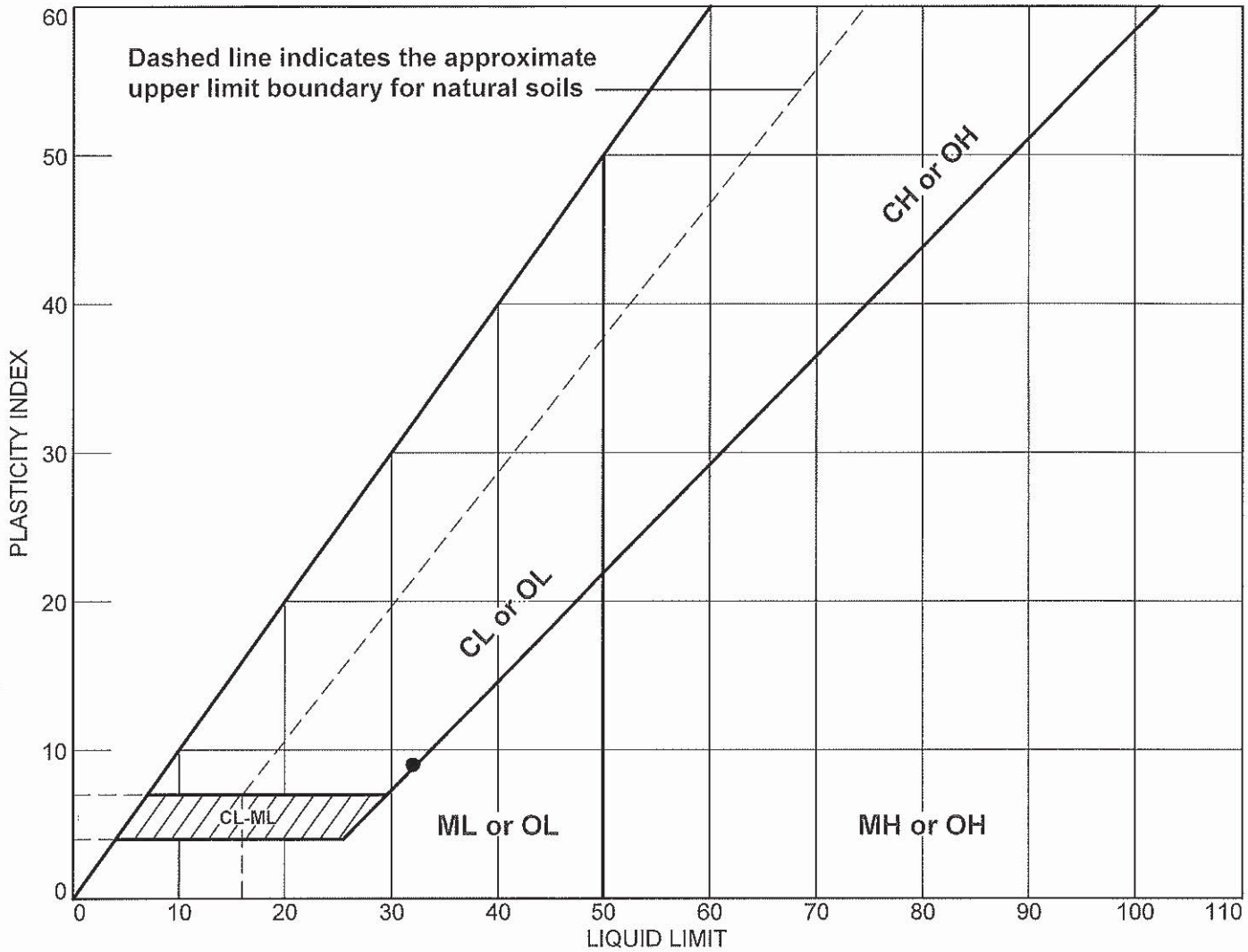
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.12	20.12	20.12		
Dry+Tare	19.21	19.21	19.21		
Tare	13.68	13.68	16.68		
Moisture	16.5	16.5	36.0		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
261.7	215.6	15.8	23.1

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G016 S-19 80'-81.5'	8003-14	80'-81.5'	29.0	23	32	9	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

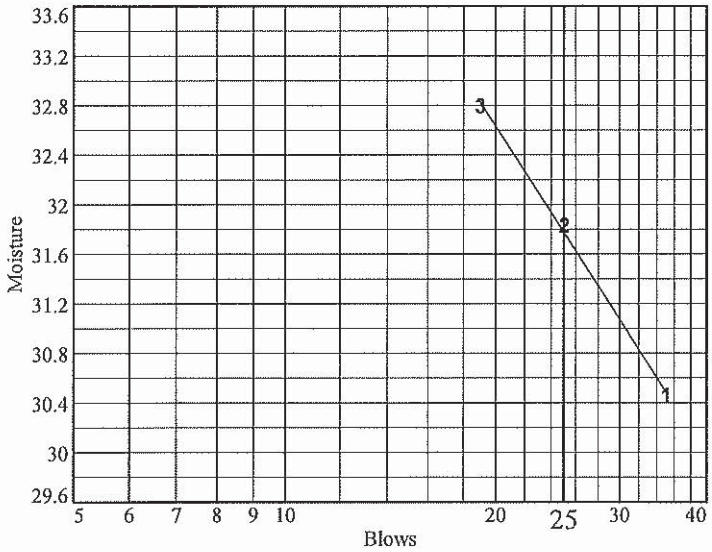
LIQUID AND PLASTIC LIMIT TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G016 S-19
Depth: 80'-81.5'
Sample Number: 8003-14
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	32.03	27.46	25.22			
Dry+Tare	27.75	24.13	22.35			
Tare	13.70	13.67	13.60			
# Blows	35	25	19			
Moisture	30.5	31.8	32.8			



Liquid Limit= 32
Plastic Limit= 23
Plasticity Index= 9
Natural Moisture= 29.0
Liquidity Index= 0.7

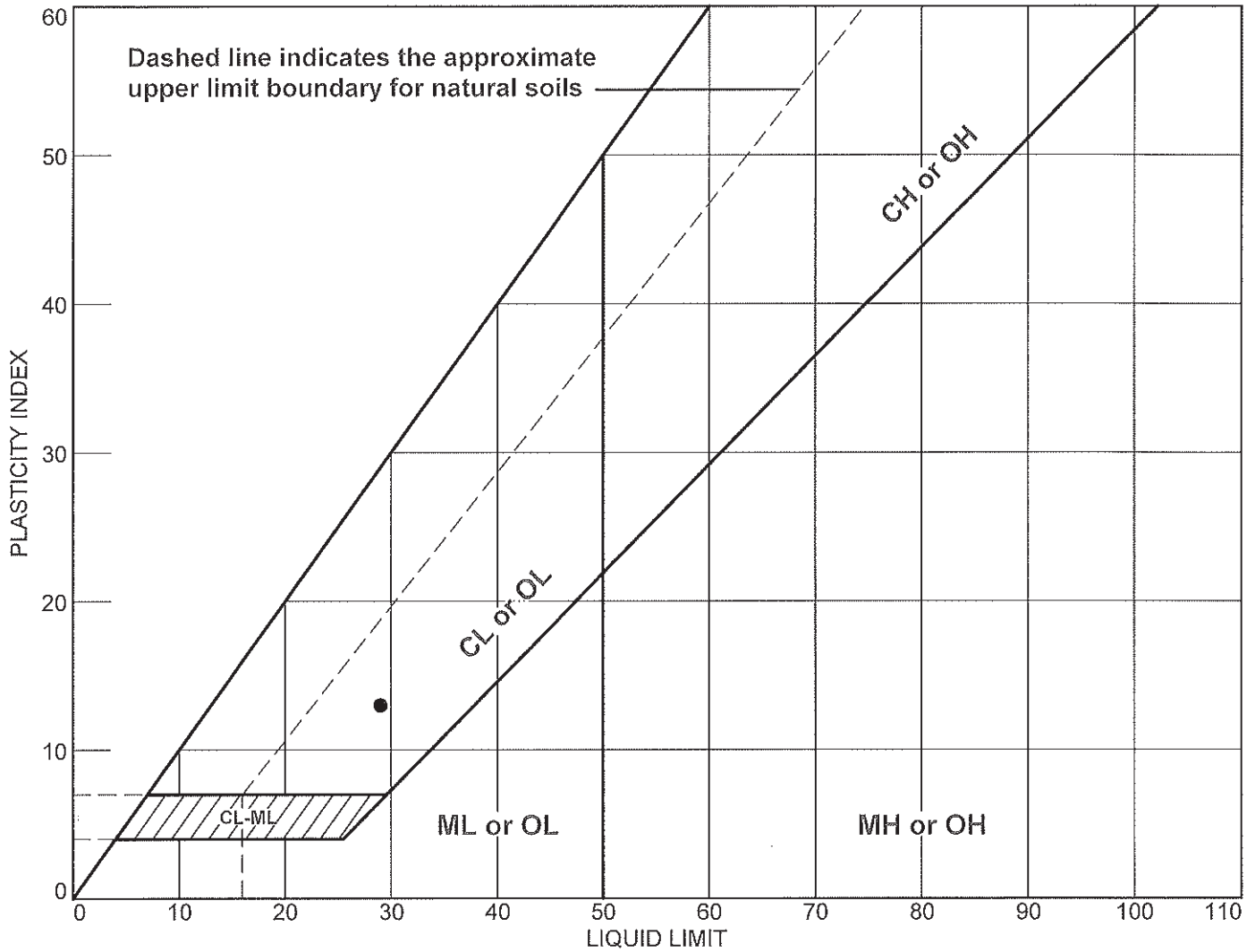
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.81	21.81	21.81		
Dry+Tare	20.27	20.27	20.27		
Tare	13.53	13.53	13.53		
Moisture	22.8	22.8	22.8		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
262.9	207.4	15.7	29.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G17 / S2	054-106	7.5'	19.9	16	29	13	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

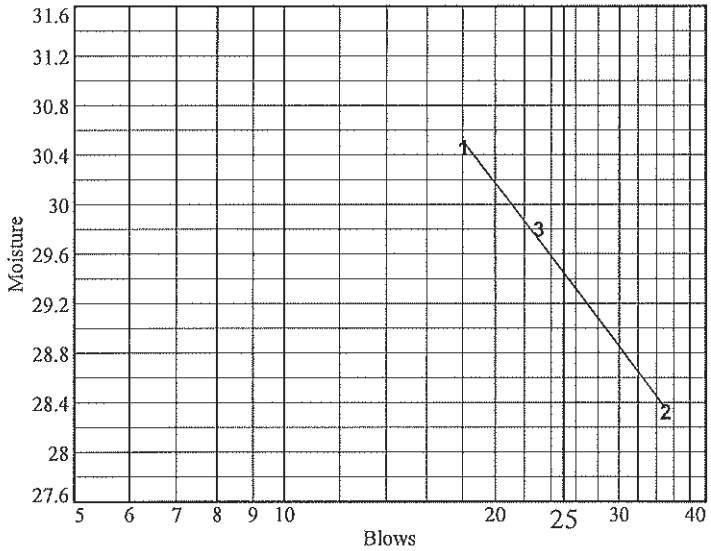
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17 / S2
Depth: 7.5'
Sample Number: 054-106
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.49	21.9	24.88			
Dry+Tare	25.06	20.09	22.32			
Tare	13.8	13.7	13.73			
# Blows	18	35	23			
Moisture	30.5	28.3	29.8			



Liquid Limit= 29
Plastic Limit= 16
Plasticity Index= 13
Natural Moisture= 19.9
Liquidity Index= 0.3

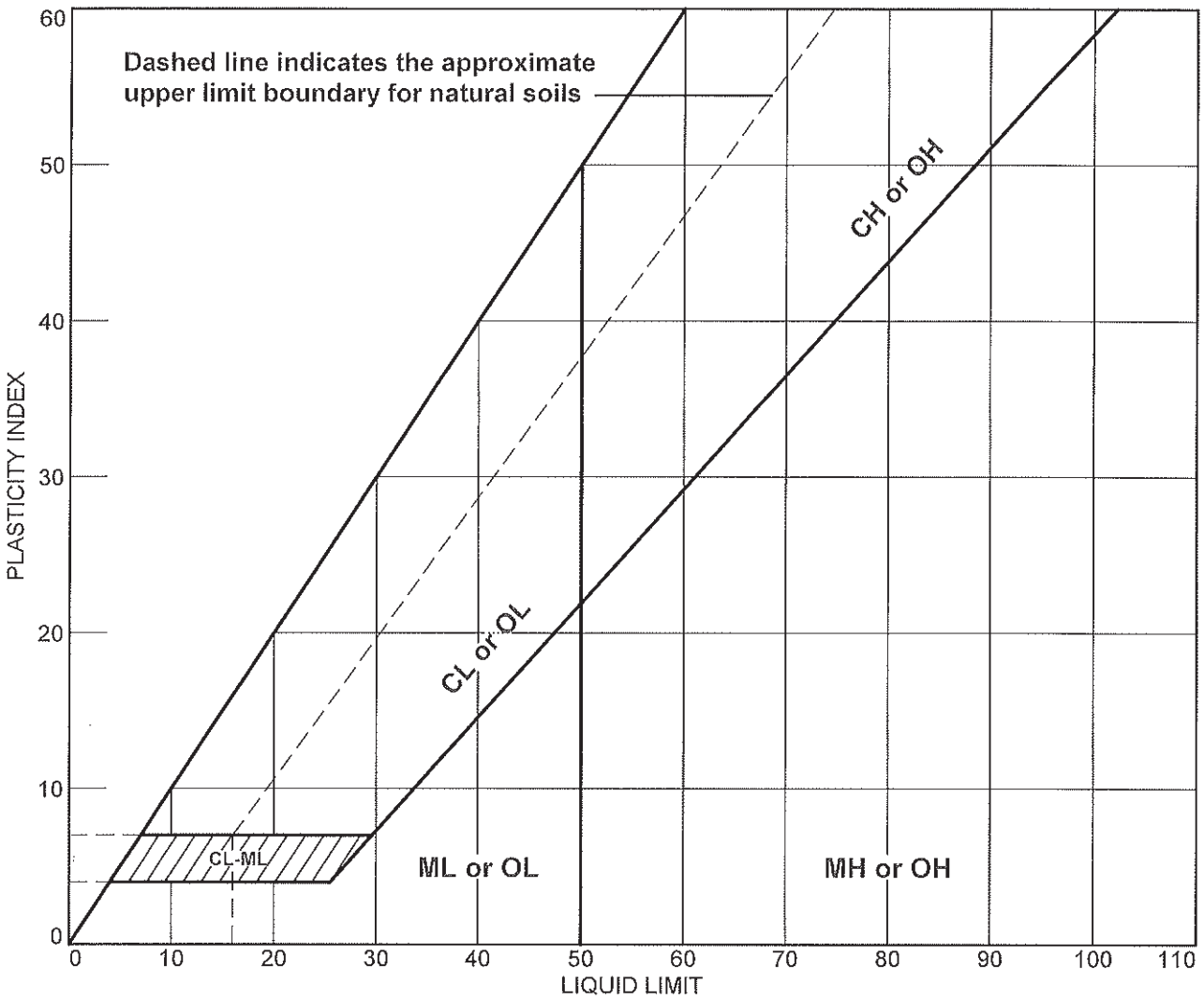
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.15				
Dry+Tare	22.38				
Tare	11.24				
Moisture	15.9				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
97.9	84.3	16.0	19.9

LIQUID AND PLASTIC LIMITS TEST REPORT



These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G17A / S6	054-116	15'	34.6	NP	NV	NP	NP

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

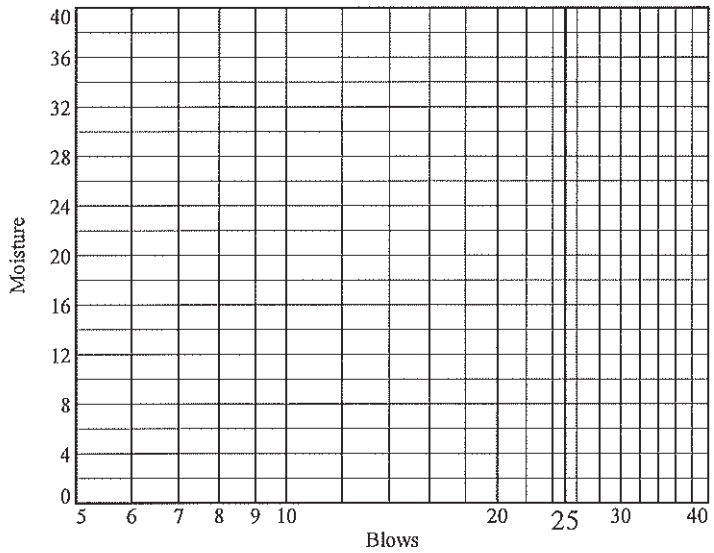
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S6
Depth: 15'
Sample Number: 054-116
Material Description: NON PLASTIC
USCS: NP
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 34.6

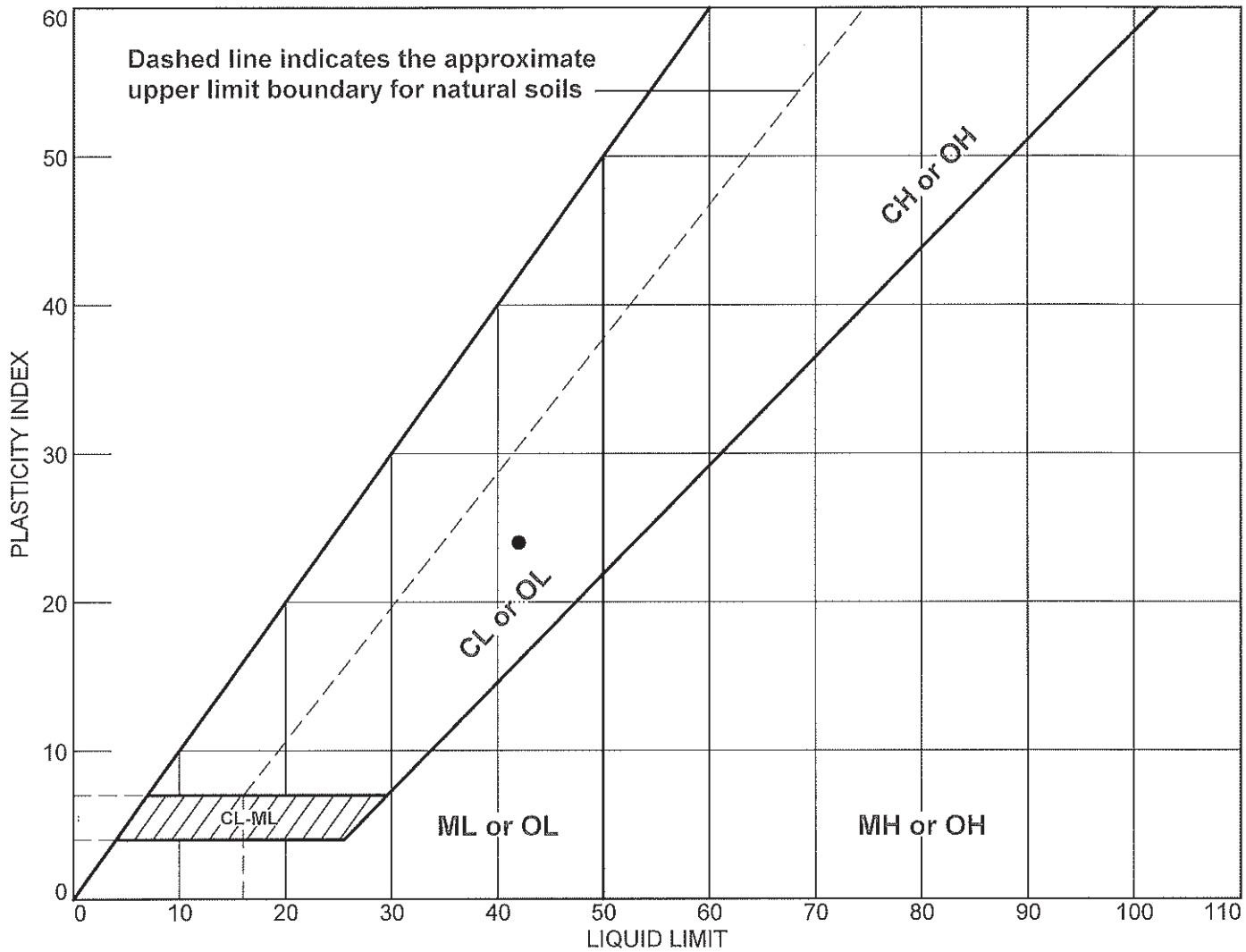
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
132.1	102.2	15.9	34.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G17A / S20	054-125	85'	29.3	18	42	24	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

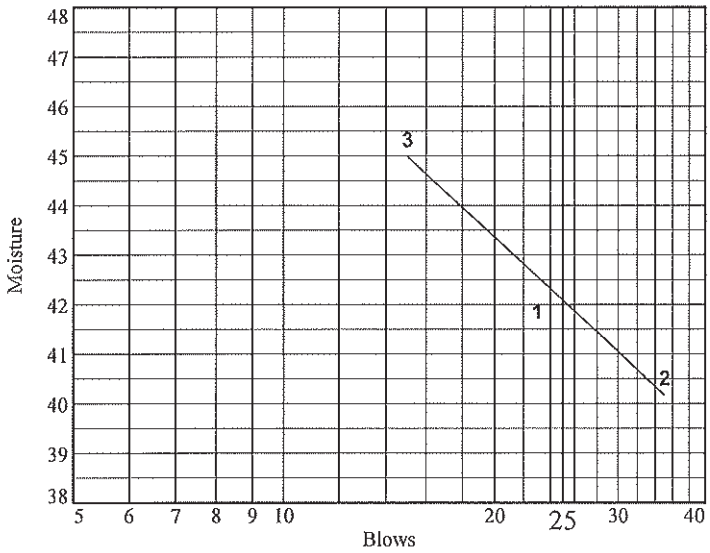
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S20
Depth: 85'
Sample Number: 054-125
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	22.46	21.74	27.22			
Dry+Tare	19.91	19.41	22.99			
Tare	13.82	13.66	13.66			
# Blows	23	35	15			
Moisture	41.9	40.5	45.3			



Liquid Limit= 42
Plastic Limit= 18
Plasticity Index= 24
Natural Moisture= 29.3
Liquidity Index= 0.5

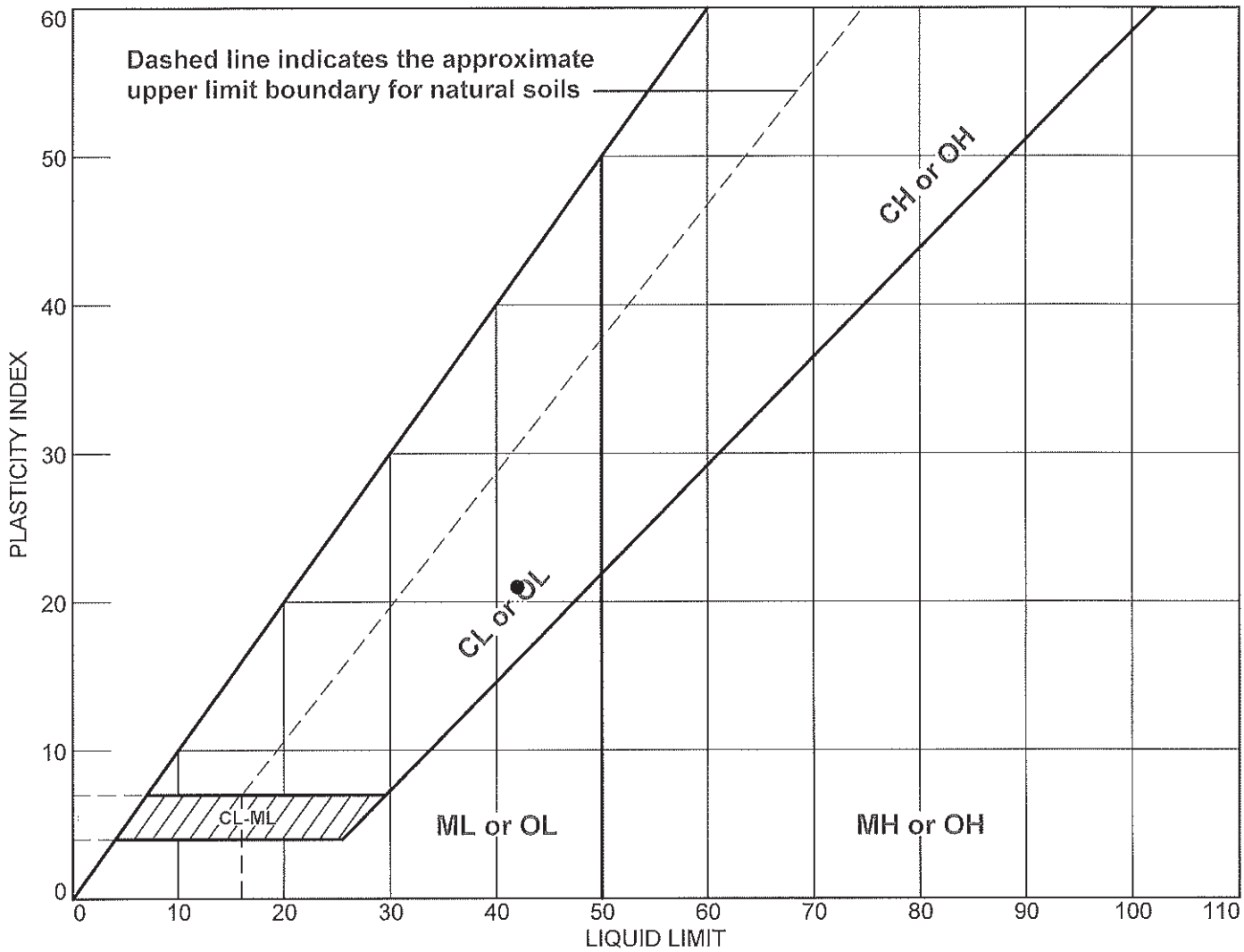
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.99				
Dry+Tare	23.25				
Tare	13.74				
Moisture	18.3				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
75.5	62	15.9	29.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G17A / S22	054-127	95'	29.9	21	42	21	CL

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

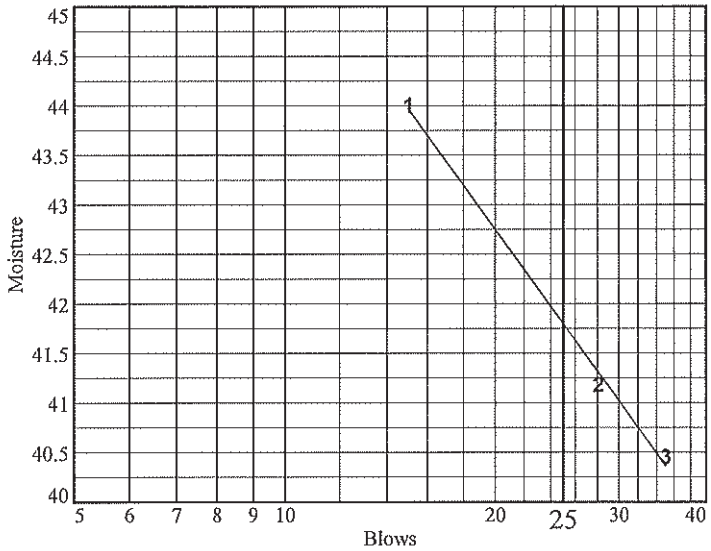
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S22
Depth: 95'
Sample Number: 054-127
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	20.71	20.28	21.6			
Dry+Tare	18.58	17.64	18.61			
Tare	13.74	11.23	11.22			
# Blows	15	28	35			
Moisture	44.0	41.2	40.5			



Liquid Limit= 42
Plastic Limit= 21
Plasticity Index= 21
Natural Moisture= 29.9
Liquidity Index= 0.4

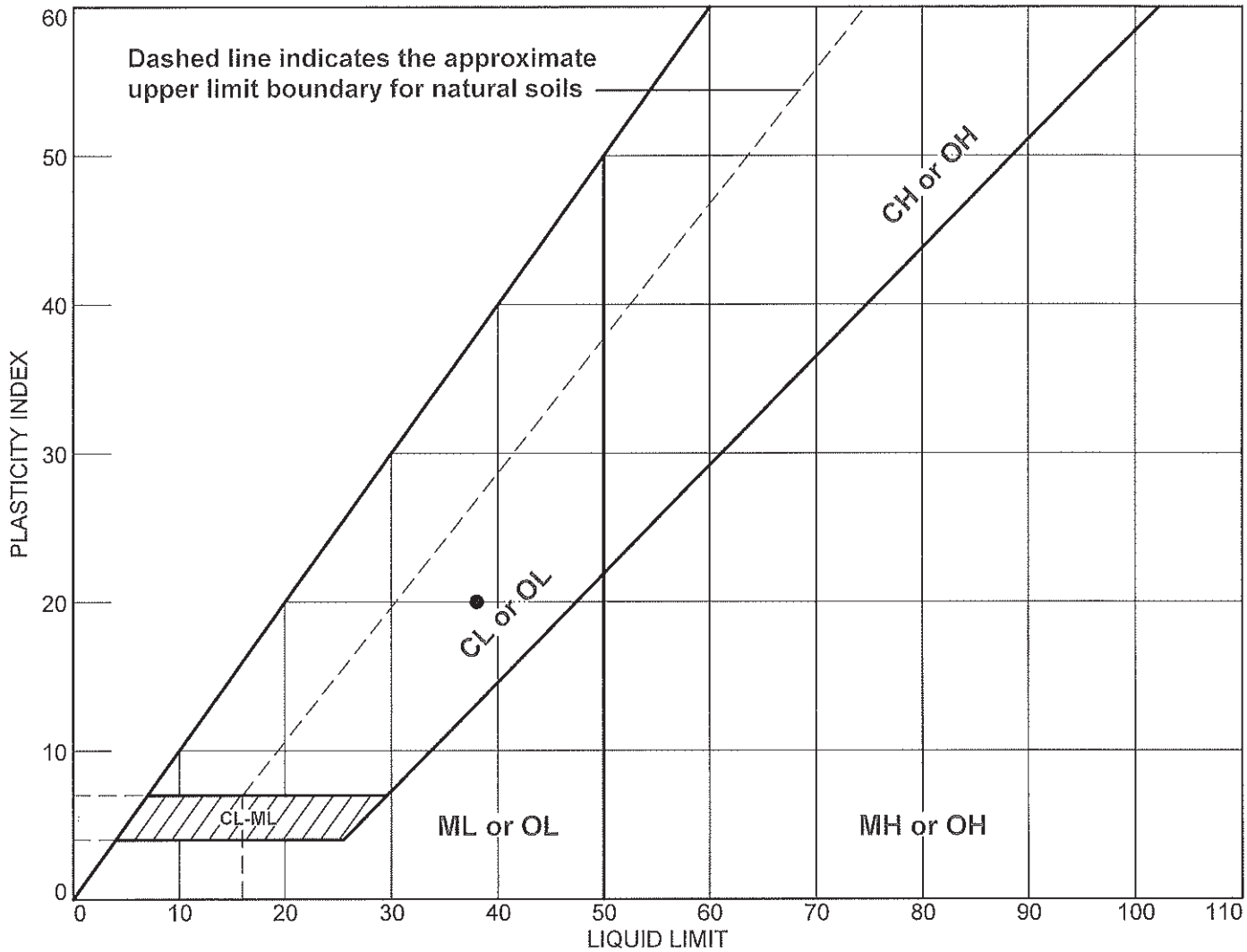
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.75				
Dry+Tare	19.07				
Tare	11.2				
Moisture	21.3				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
75.9	62.1	16.0	29.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G17A / S25	054-129	110'	21.4	18	38	20	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

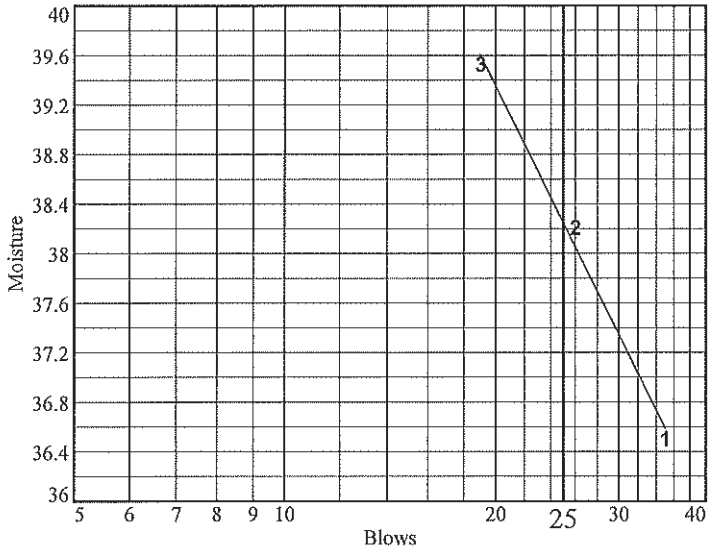
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S25
Depth: 110'
Sample Number: 054-129
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	22.41	23.18	21.99			
Dry+Tare	20.07	20.57	19.63			
Tare	13.66	13.74	13.66			
# Blows	35	26	19			
Moisture	36.5	38.2	39.5			



Liquid Limit= 38
Plastic Limit= 18
Plasticity Index= 20
Natural Moisture= 21.4
Liquidity Index= 0.2

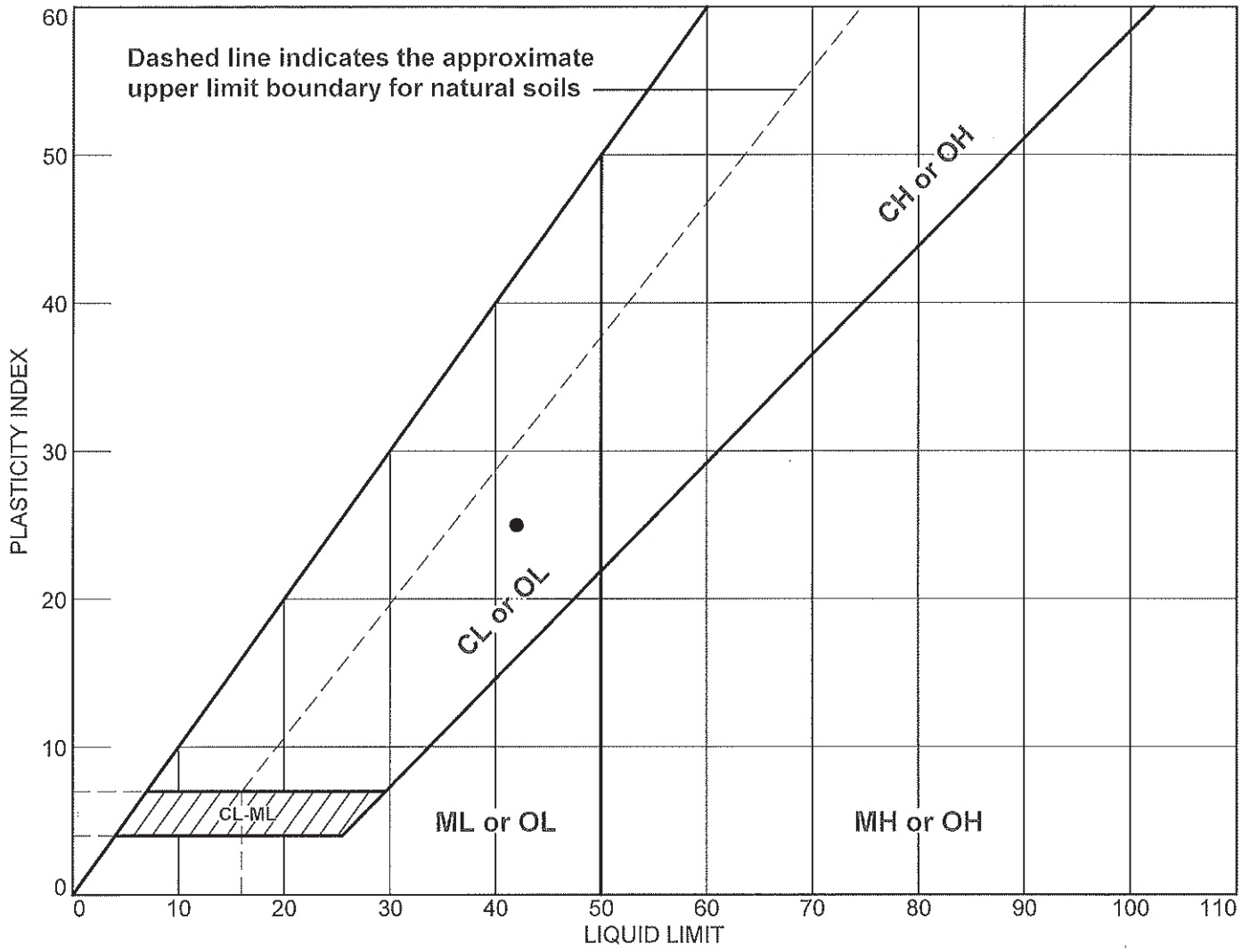
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.93				
Dry+Tare	23.21				
Tare	13.66				
Moisture	18.0				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
100.4	85.5	15.9	21.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G17A / S31	054-132	140'	18.6	17	42	25	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

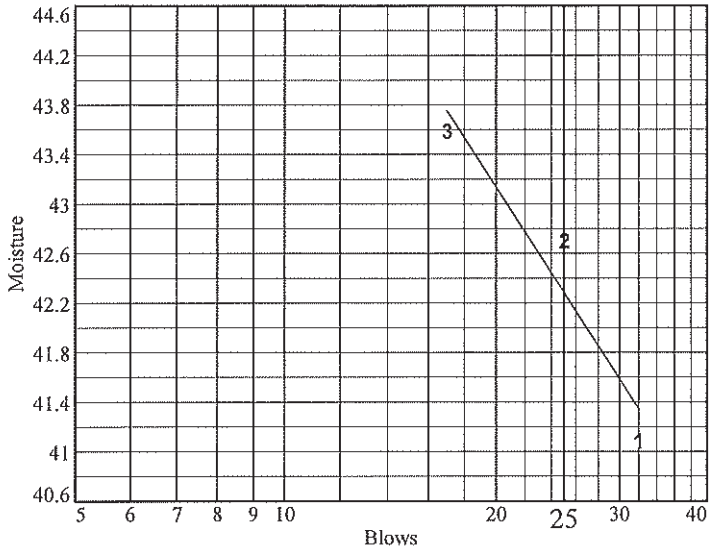
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S31
Depth: 140'
Sample Number: 054-132
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	25.01	27.11	25.38			
Dry+Tare	21.69	23.1	21.81			
Tare	13.61	13.71	13.62			
# Blows	32	25	17			
Moisture	41.1	42.7	43.6			



Liquid Limit= 42
Plastic Limit= 17
Plasticity Index= 25
Natural Moisture= 18.6
Liquidity Index= 0.1

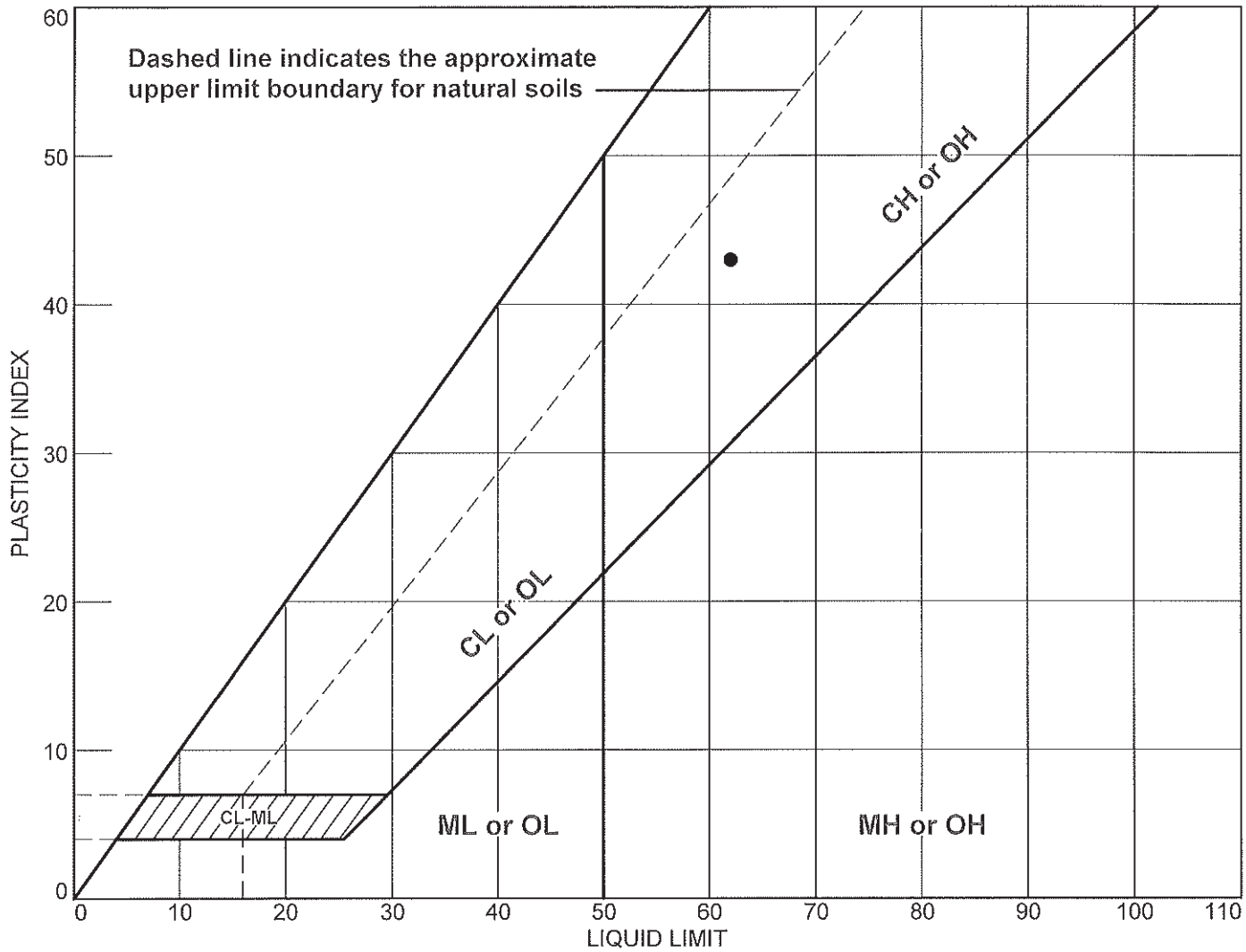
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.72				
Dry+Tare	21.44				
Tare	13.7				
Moisture	16.5				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
95.3	82.9	16.1	18.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G17A /S37	054-136	170'	28.5	19	62	43	CH

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

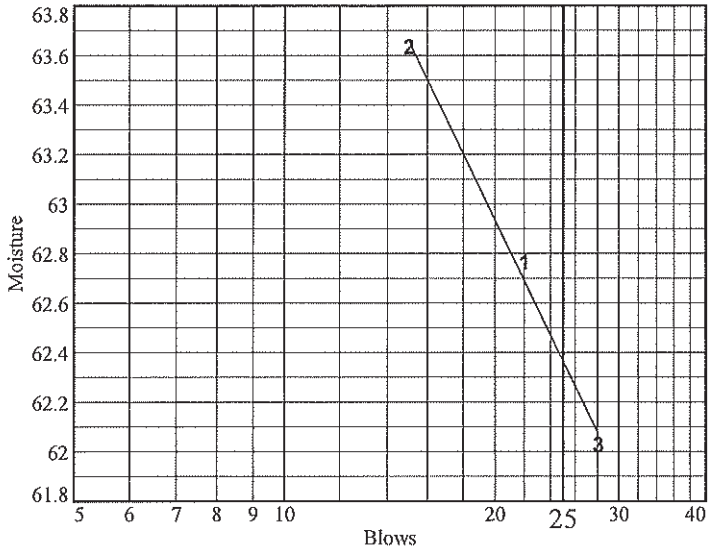
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S37
Depth: 170'
Sample Number: 054-136
USCS: CH
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	19.43	19.7	19.75			
Dry+Tare	16.21	16.34	16.45			
Tare	11.08	11.06	11.13			
# Blows	22	15	28			
Moisture	62.8	63.6	62.0			



Liquid Limit= 62
Plastic Limit= 19
Plasticity Index= 43
Natural Moisture= 28.5
Liquidity Index= 0.2

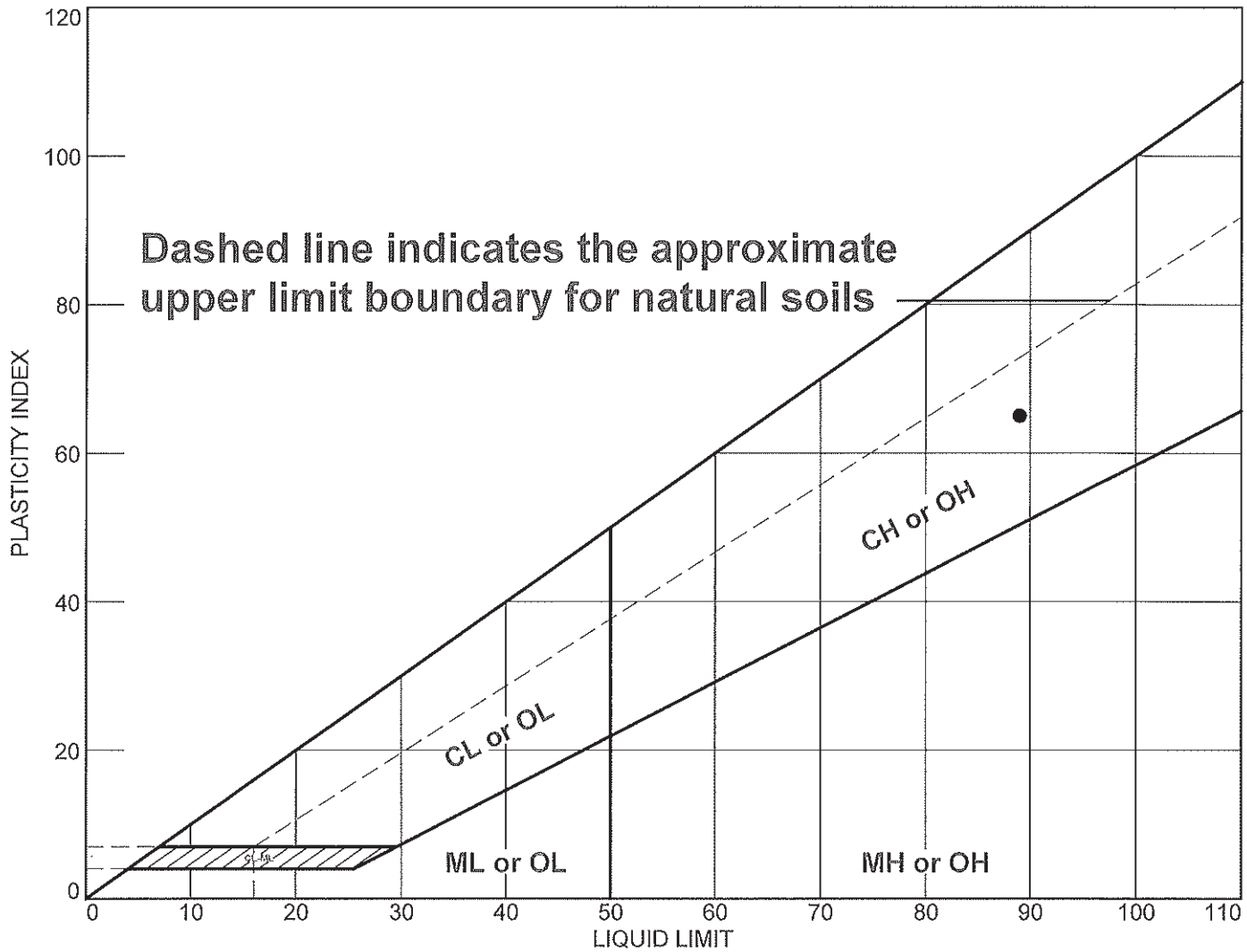
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.1				
Dry+Tare	19.50				
Tare	11.27				
Moisture	19.4				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
107.1	86.9	16.0	28.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G17A / S40	054-139	200'	34.0	24	89	65	CH

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

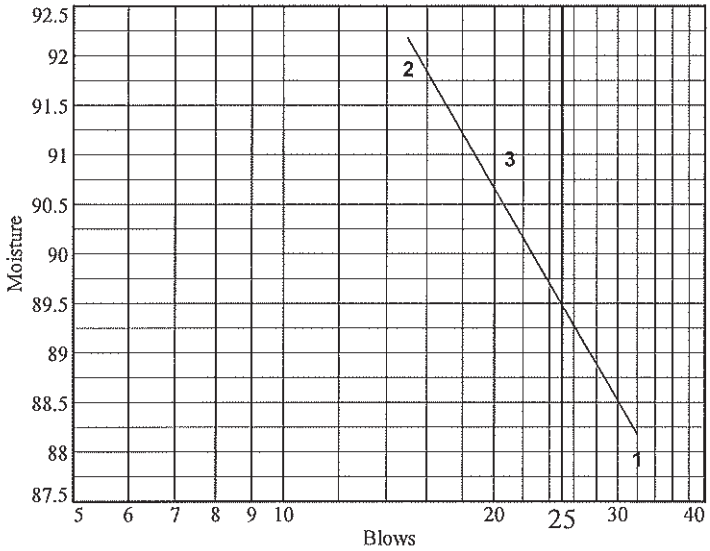
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G17A / S40
Depth: 200'
Sample Number: 054-139
USCS: CH
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	18.74	20.72	20.31			
Dry+Tare	15.17	17.33	17.19			
Tare	11.11	13.64	13.76			
# Blows	32	15	21			
Moisture	87.9	91.9	91.0			



Liquid Limit= 89
Plastic Limit= 24
Plasticity Index= 65
Natural Moisture= 34.0
Liquidity Index= 0.2

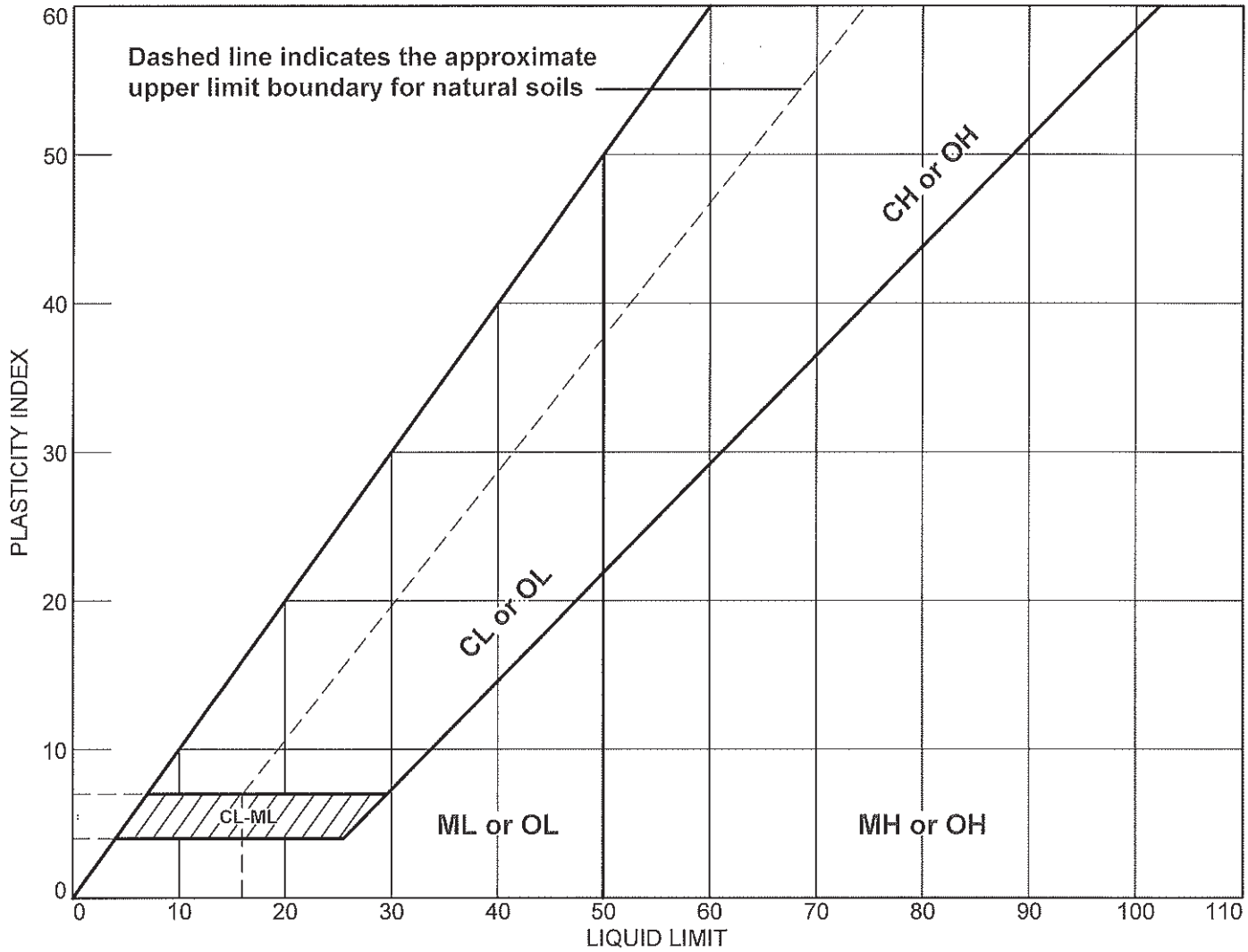
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.05				
Dry+Tare	22.00				
Tare	13.6				
Moisture	24.4				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
124.9	97.2	15.7	34.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G018 S-2 5'-6.5'	8003-18	5'-6.5'	43.6	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

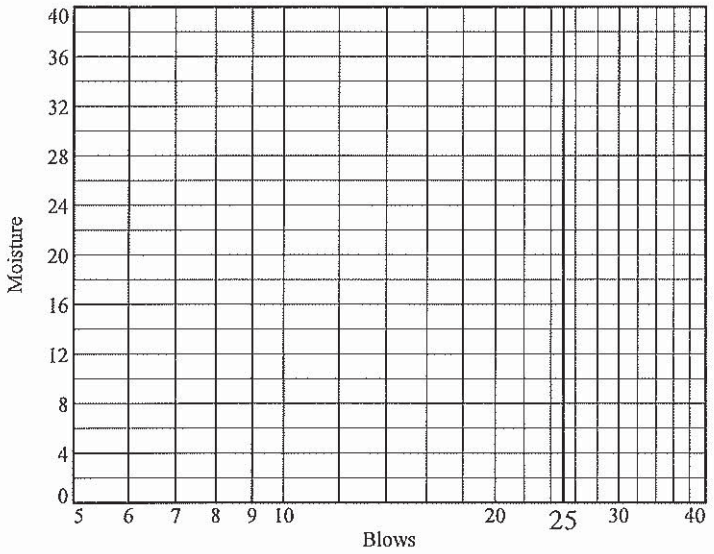
LIQUID AND PLASTIC LIMIT TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-2
Depth: 5'-6.5'
Sample Number: 8003-18
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 43.6

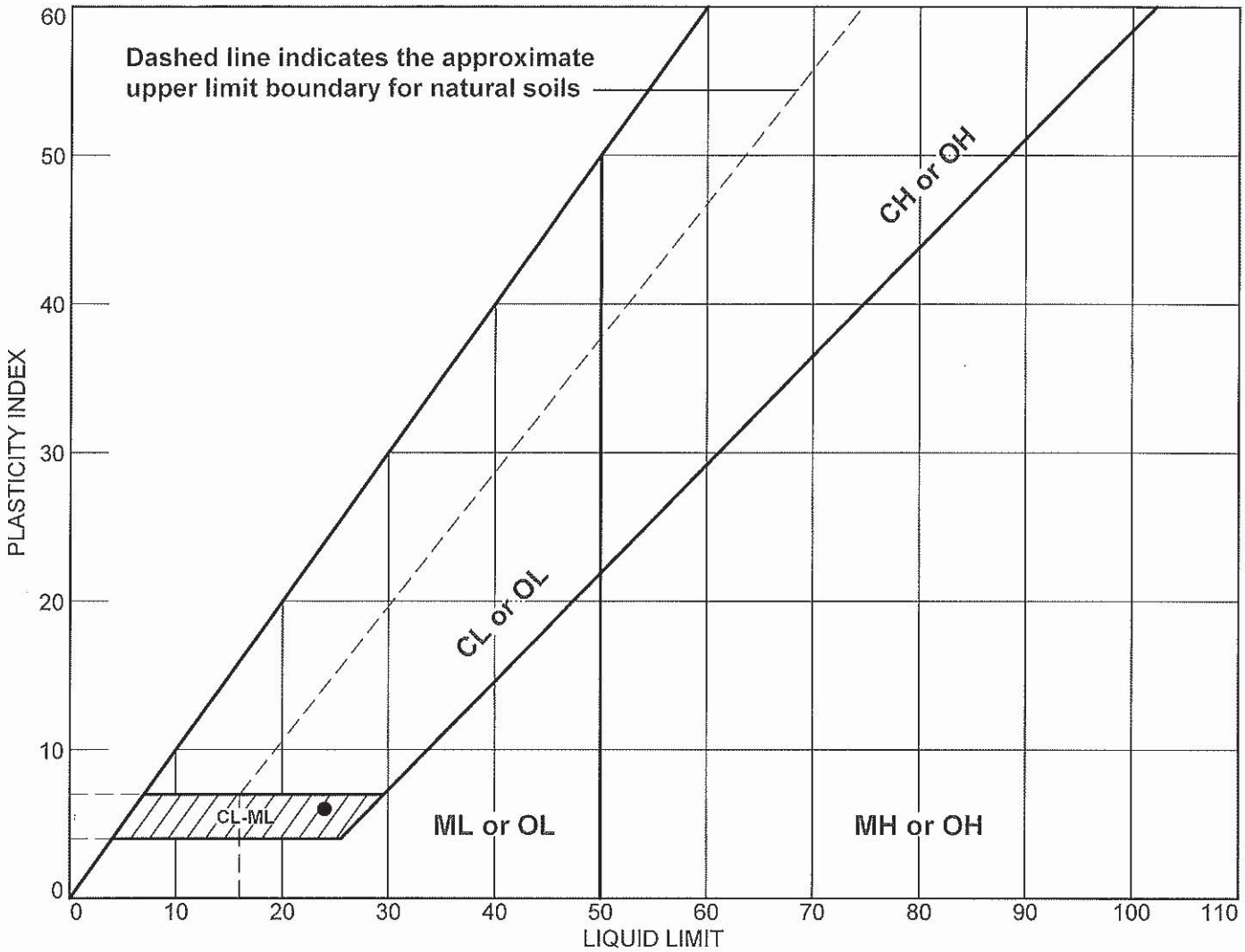
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
374.3	265.4	15.9	43.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G018 S-20 90'-91.5'	8003-29	90'-91.5'	31.3	18	24	6	CL-ML

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

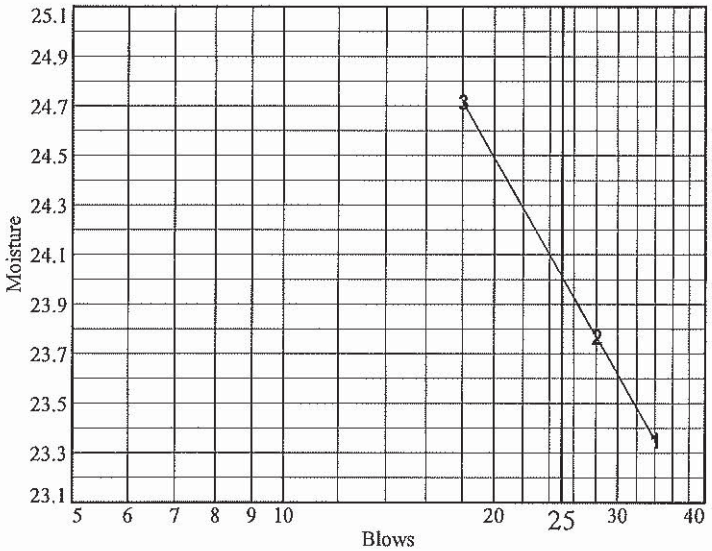
LIQUID AND PLASTIC LIMIT TEST DATA

11/16/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-20
Depth: 90'-91.5'
Sample Number: 8003-29
USCS: CL-ML
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	30.94	29.46	26.83			
Dry+Tare	27.68	26.42	24.21			
Tare	13.72	13.63	13.61			
# Blows	34	28	18			
Moisture	23.4	23.8	24.7			



Liquid Limit= 24
Plastic Limit= 18
Plasticity Index= 6
Natural Moisture= 31.3
Liquidity Index= 2.2

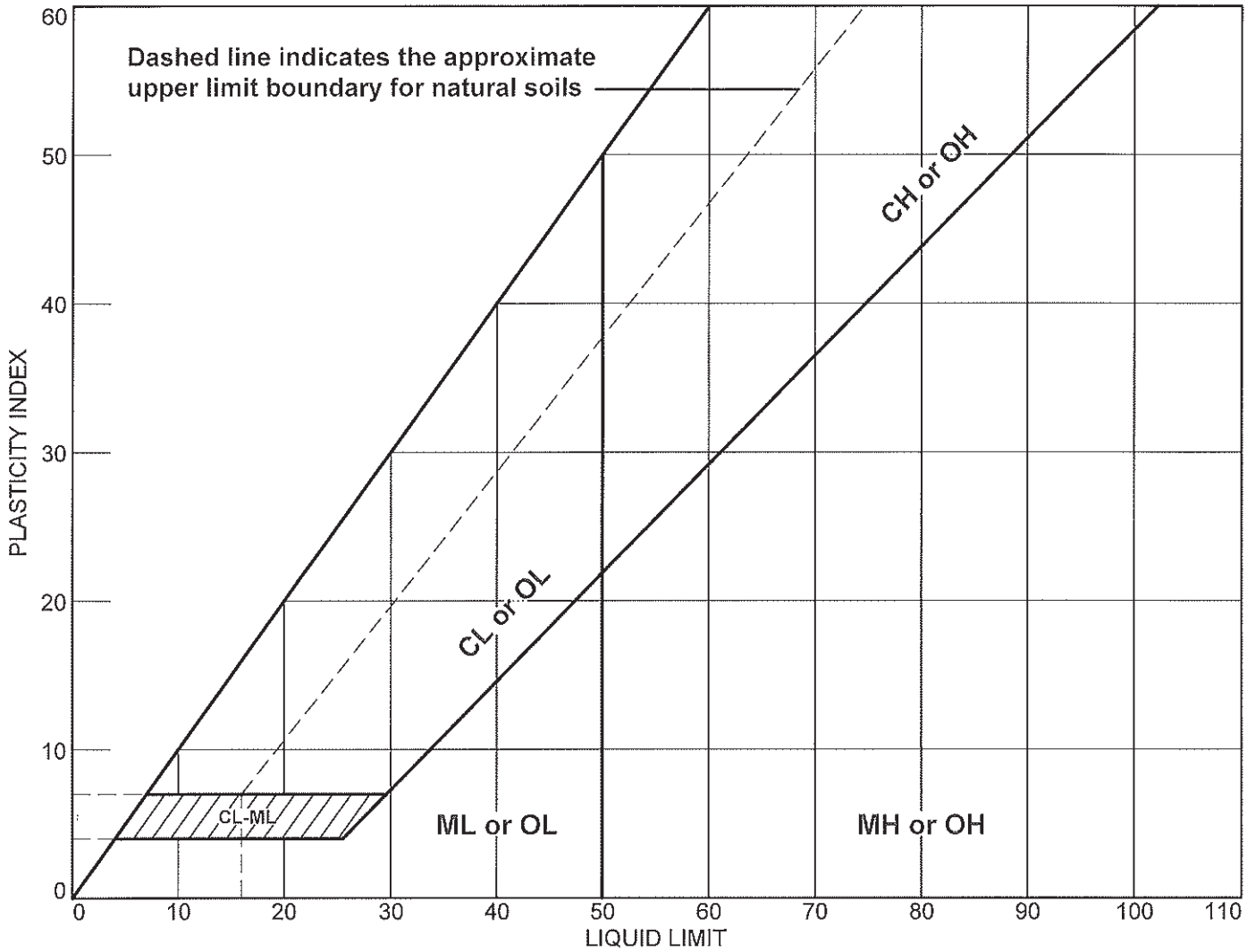
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.00	23.00	23.00		
Dry+Tare	21.59	21.59	21.59		
Tare	13.63	13.63	13.63		
Moisture	17.7	17.7	17.7		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
483.4	372.0	15.6	31.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G018 S-22 100'-101.5'	8003-31	100'-101.5'	28.3	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

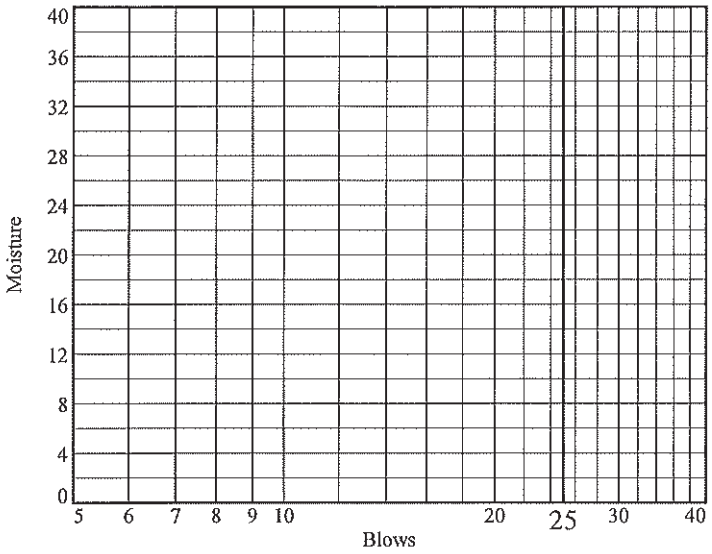
LIQUID AND PLASTIC LIMIT TEST DATA

11/14/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-22
Depth: 100'-101.5'
Sample Number: 8003-31
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 28.3

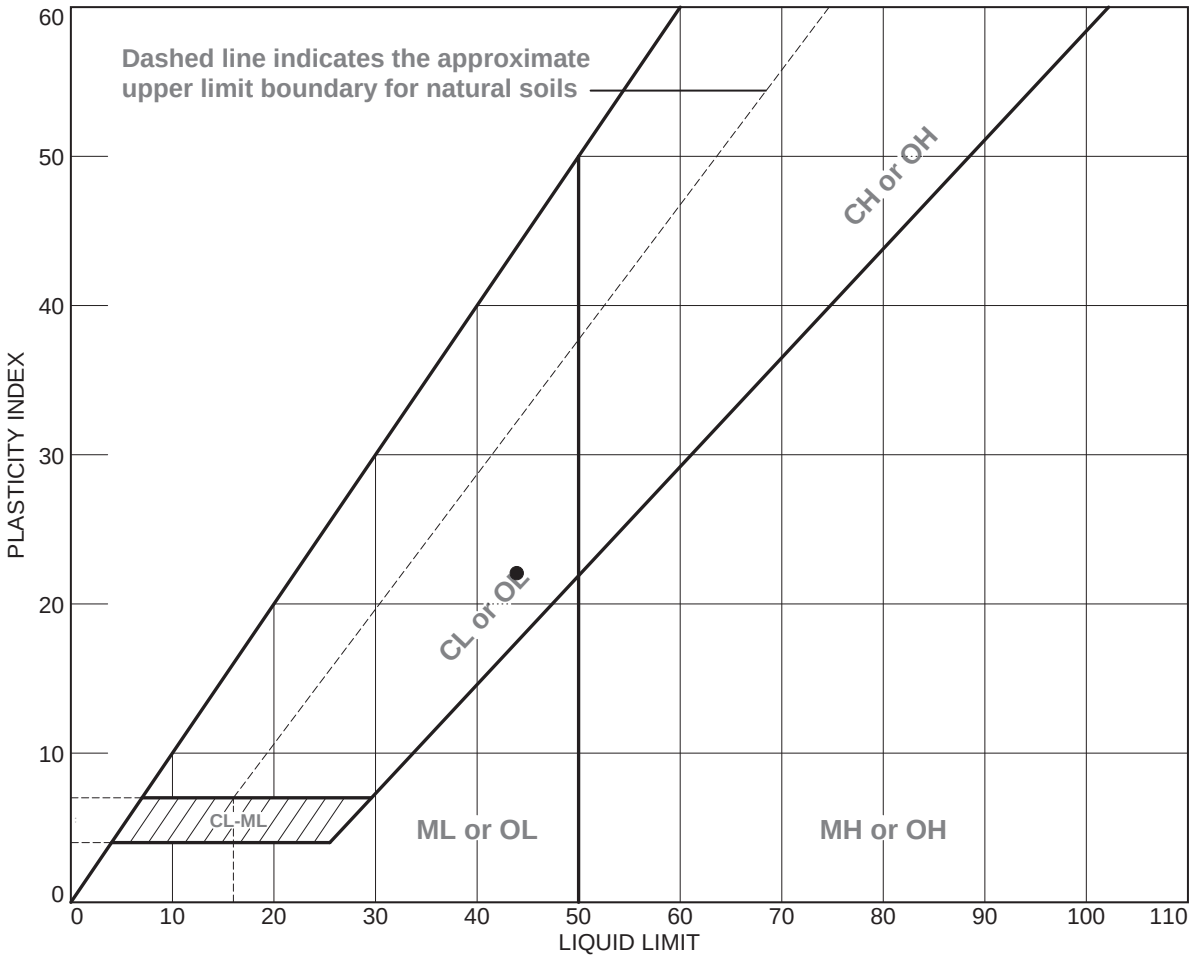
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
473.4	372.4	15.9	28.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G018 S-26 120'-121.5'	8003-34	120'-121.5'	35.8	22	44	22	CL

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

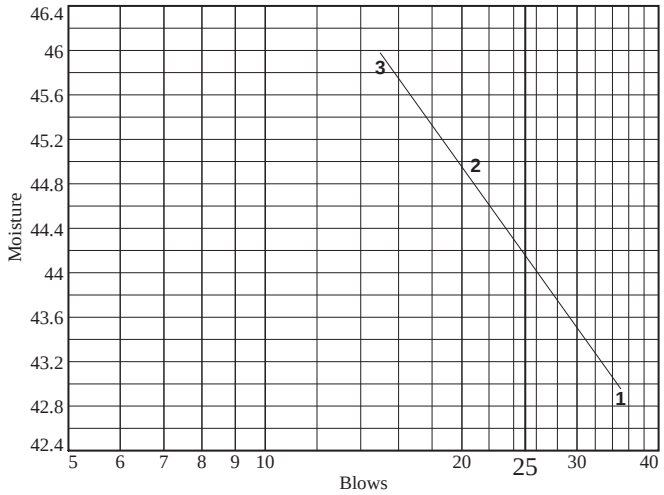
LIQUID AND PLASTIC LIMIT TEST DATA

3/14/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-26
Depth: 120'-121.5'
Sample Number: 8003-34
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	21.14	23.32	24.06			
Dry+Tare	18.16	19.56	20.02			
Tare	11.21	11.20	11.21			
# Blows	35	21	15			
Moisture	42.9	45.0	45.9			

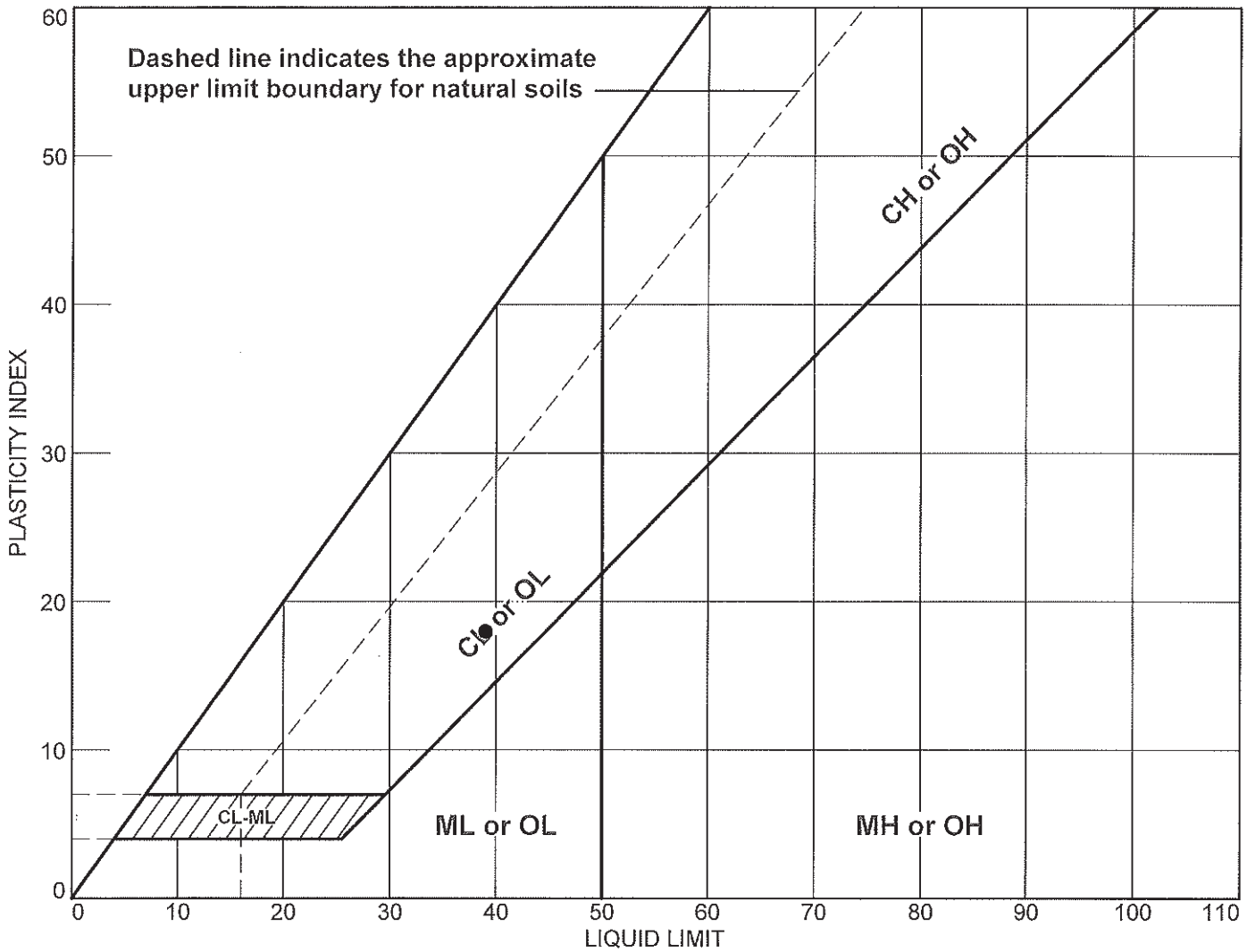


Liquid Limit= 44
Plastic Limit= 22
Plasticity Index= 22
Natural Moisture= 35.8
Liquidity Index= 0.6

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.25				
Dry+Tare	19.45				
Tare	11.18				
Moisture	21.8				

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G018 S-28 130'-131.5'	8000-36	130'-131.5'	34.1	21	39	18	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

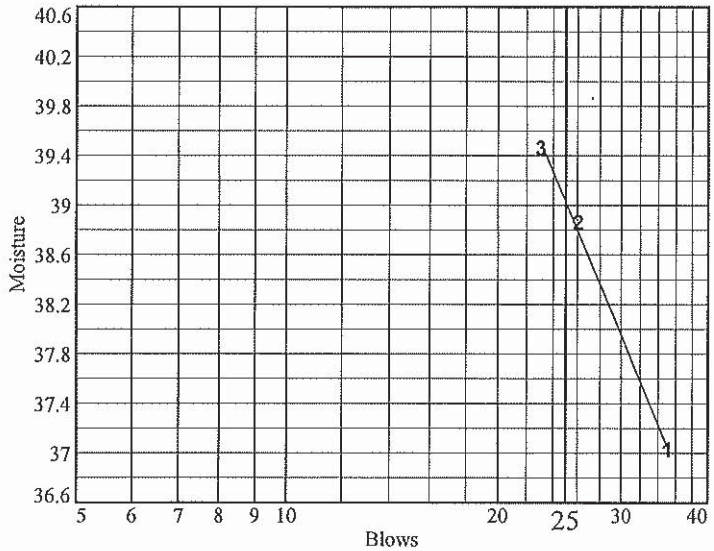
LIQUID AND PLASTIC LIMIT TEST DATA

11/15/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-28
Depth: 130'-131.5'
Sample Number: 8000-36
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	23.55	29.06	27.36			
Dry+Tare	20.88	24.75	23.52			
Tare	13.67	13.66	13.79			
# Blows	35	26	23			
Moisture	37.0	38.9	39.5			



Liquid Limit= 39
Plastic Limit= 21
Plasticity Index= 18
Natural Moisture= 34.1
Liquidity Index= 0.7

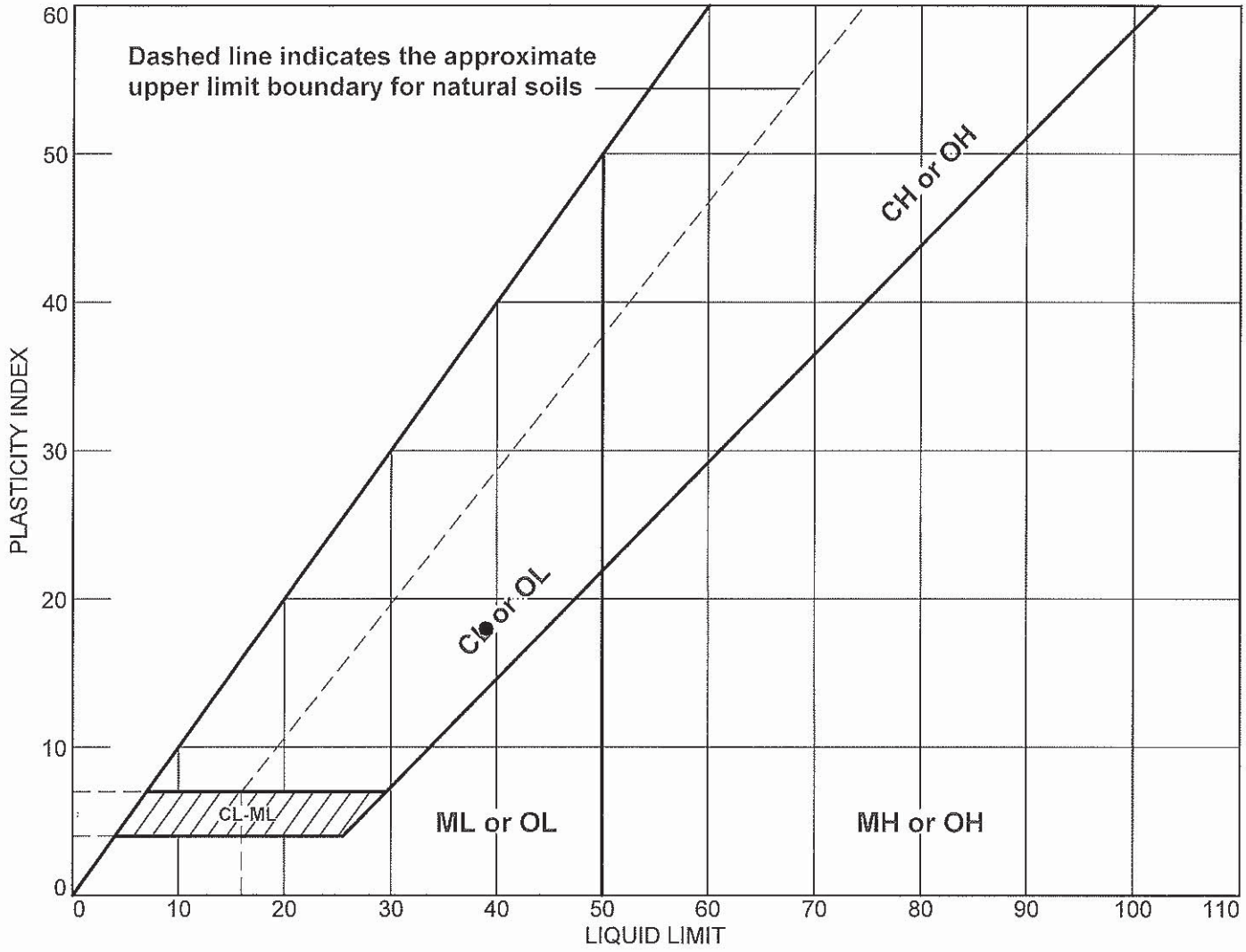
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.06	22.06	22.06		
Dry+Tare	20.59	20.59	20.59		
Tare	13.59	13.59	13.59		
Moisture	21.0	21.0	21.0		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
621.5	512.8	194.1	34.1

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G018 S-33 160'-161.5'	8003-39	160'-161.5'	38.0	21	39	18	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

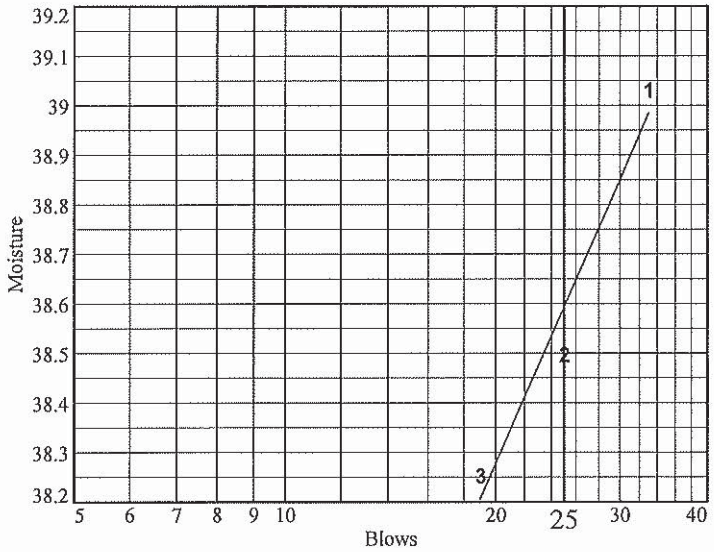
LIQUID AND PLASTIC LIMIT TEST DATA

11/15/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-33
Depth: 160'-161.5'
Sample Number: 8003-39
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	27.27	28.44	27.27			
Dry+Tare	23.48	24.34	23.59			
Tare	13.77	13.69	13.97			
# Blows	33	25	19			
Moisture	39.0	38.5	38.3			



Liquid Limit= 39
Plastic Limit= 21
Plasticity Index= 18
Natural Moisture= 38.0
Liquidity Index= 0.9

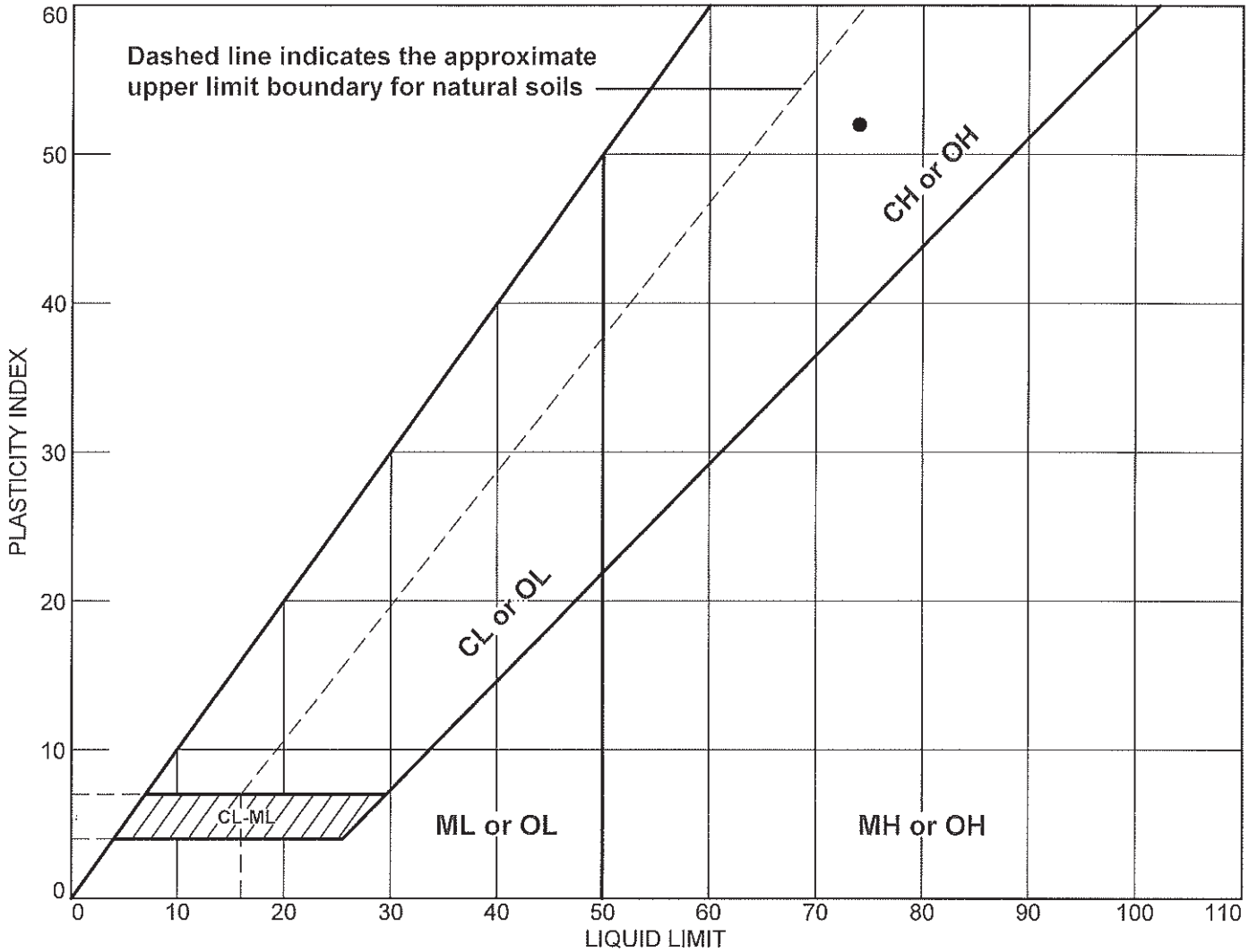
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.08	22.08	22.08		
Dry+Tare	20.65	20.65	20.65		
Tare	13.70	13.70	13.70		
Moisture	20.6	20.6	20.6		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
624.2	515.9	231.2	38.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G018 S-35 175'-176.5'	8003-41	175'-176.5'	36.3	22	74	52	CH

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

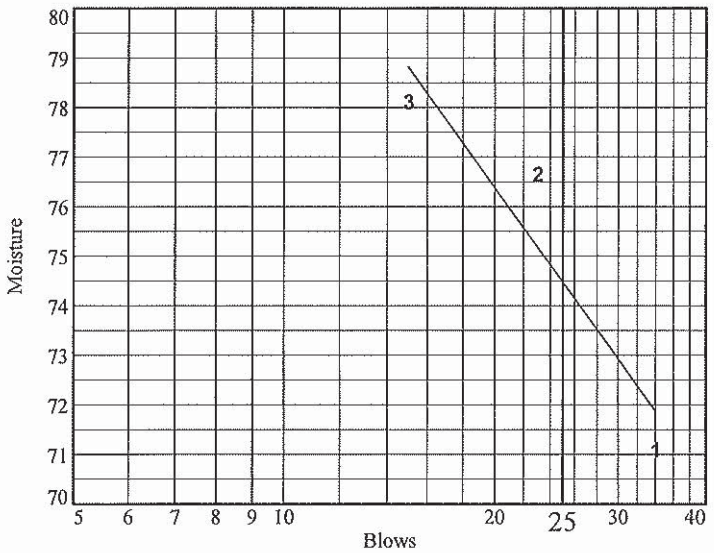
LIQUID AND PLASTIC LIMIT TEST DATA

11/16/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-35
Depth: 175'-176.5'
Sample Number: 8003-41
USCS: CH
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	27.49	27.23	28.51			
Dry+Tare	20.70	20.30	20.94			
Tare	11.15	11.26	11.25			
# Blows	34	23	15			
Moisture	71.1	76.7	78.1			



Liquid Limit= 74
Plastic Limit= 22
Plasticity Index= 52
Natural Moisture= 36.3
Liquidity Index= 0.3

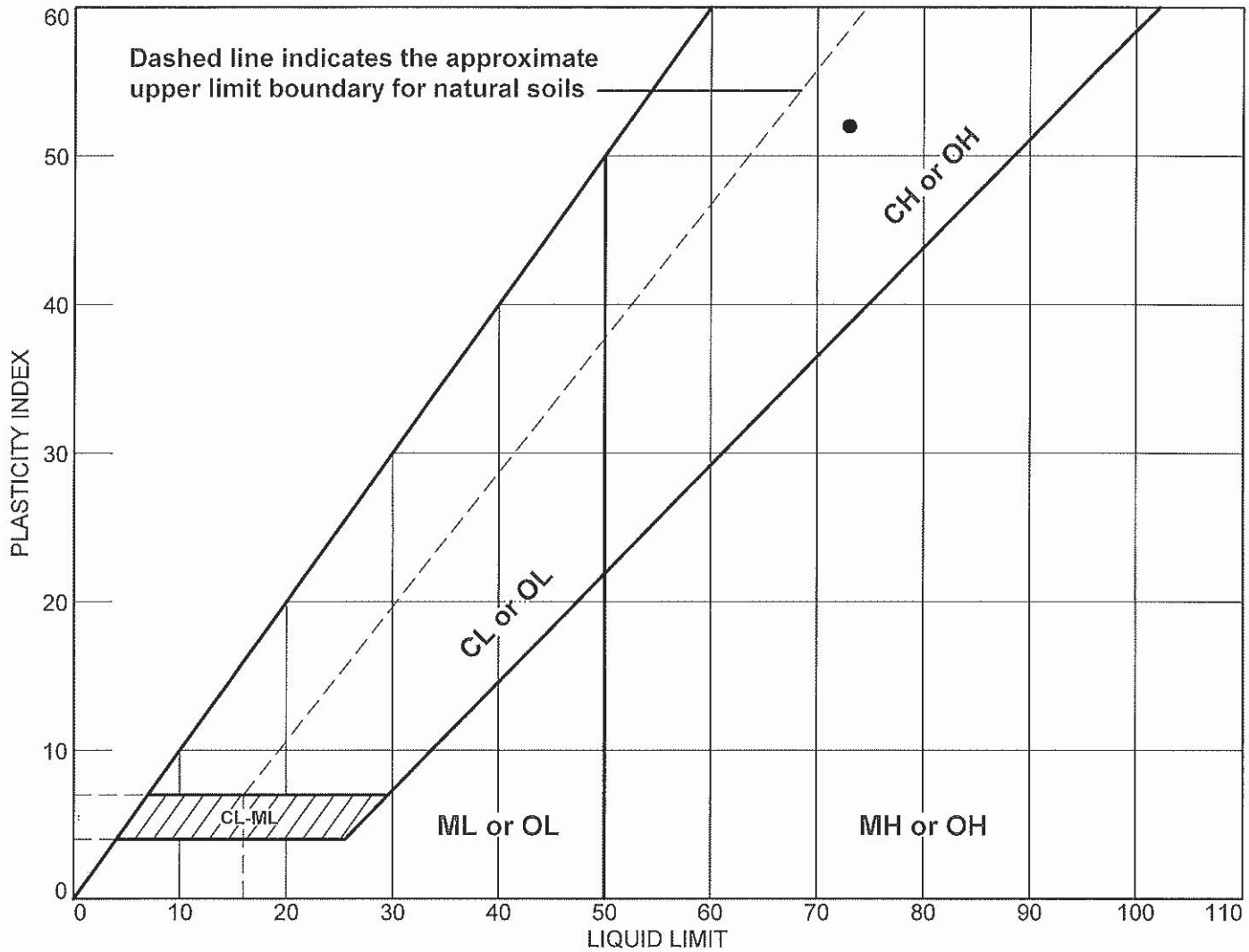
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.12	21.12	21.12		
Dry+Tare	19.76	19.76	19.76		
Tare	13.71	13.71	13.71		
Moisture	22.5	22.5	22.5		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
666.2	532.0	161.9	36.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G018 S-38 190'-191.5'	8003-43	190'-191.5'	30.4	21	73	52	CH

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

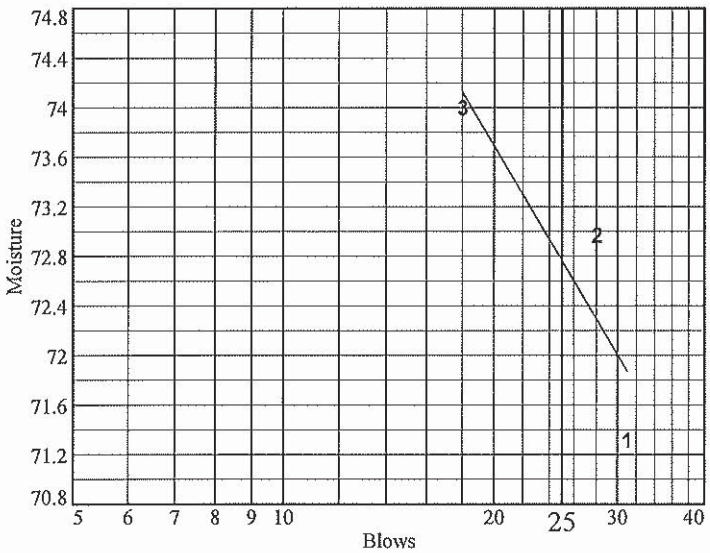
LIQUID AND PLASTIC LIMIT TEST DATA

11/16/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G018 S-38
Depth: 190'-191.5'
Sample Number: 8003-43
USCS: CH
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	26.80	27.27	32.55			
Dry+Tare	20.31	20.52	23.47			
Tare	11.21	11.27	11.20			
# Blows	31	28	18			
Moisture	71.3	73.0	74.0			



Liquid Limit= 73
Plastic Limit= 21
Plasticity Index= 52
Natural Moisture= 30.4
Liquidity Index= 0.2

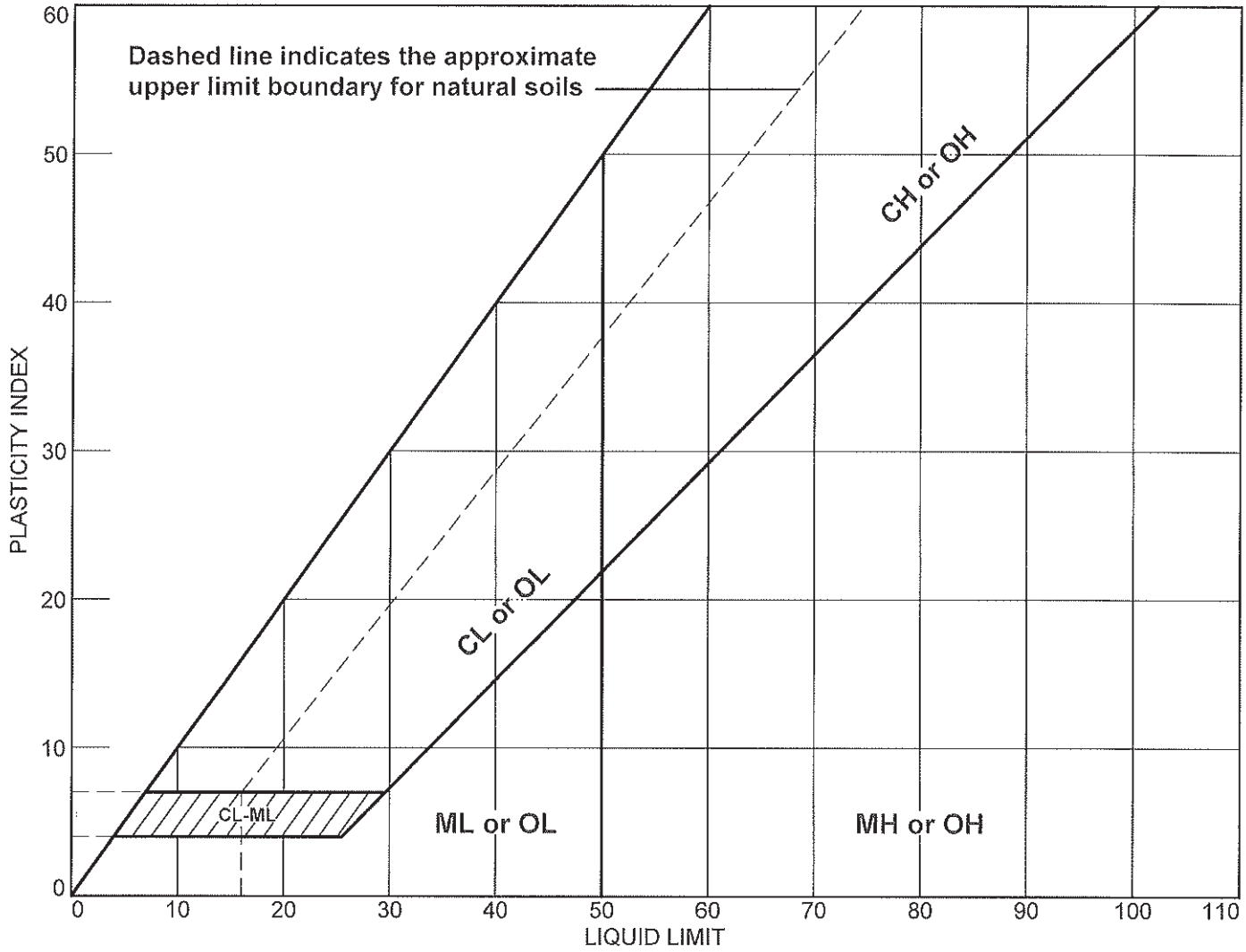
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.48	21.48	21.48		
Dry+Tare	20.13	20.13	20.13		
Tare	13.67	13.67	13.67		
Moisture	20.9	20.9	20.9		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
612.2	507.9	164.9	30.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G019 S-19a 75'-76.5'	7980-1	75'-76.5'	31.3	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

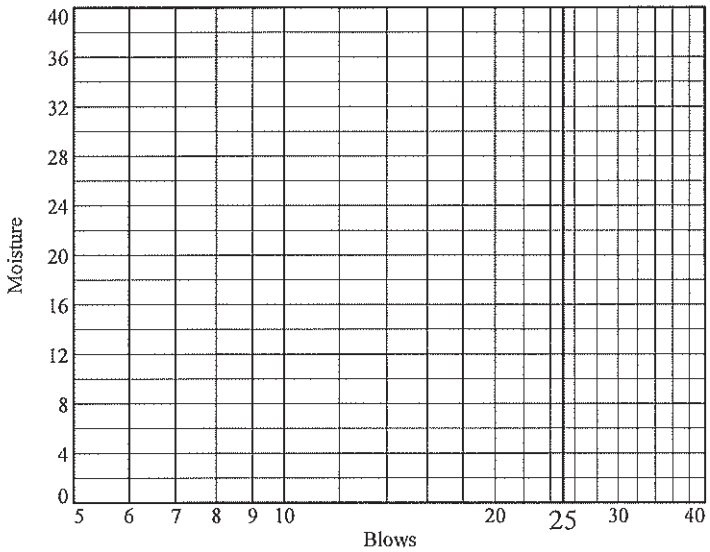
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-19a
Depth: 75'-76.5'
Sample Number: 7980-1
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 31.3

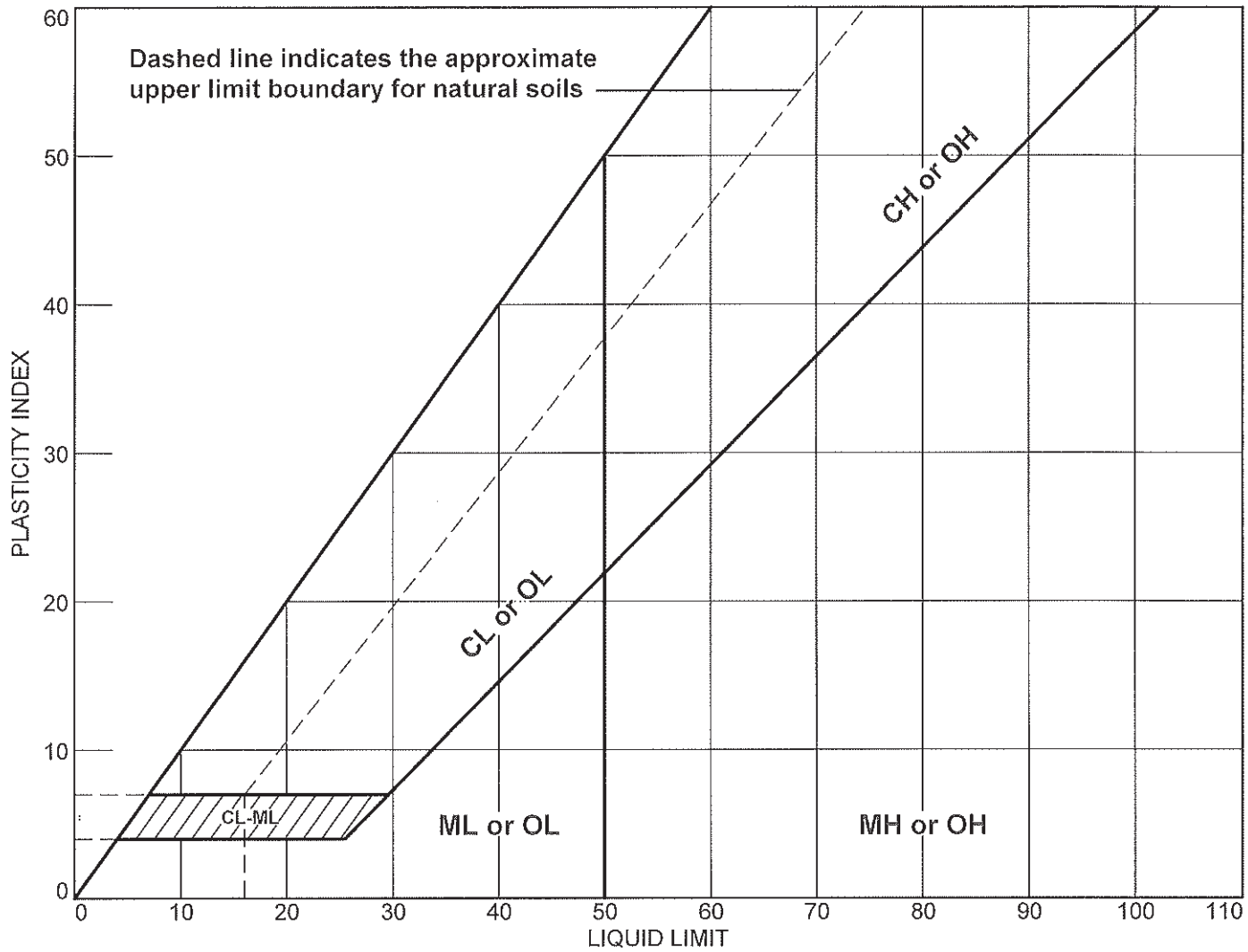
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
356.6	275.5	16.4	31.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G019 S-19b 75'-76'	7980-2	75'-76.5	31.1	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

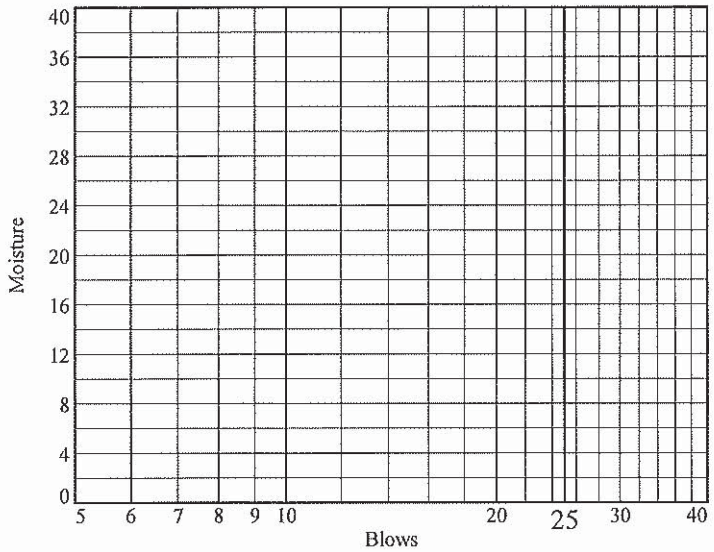
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-19b
Depth: 75'-76.5
Sample Number: 7980-2
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 31.1

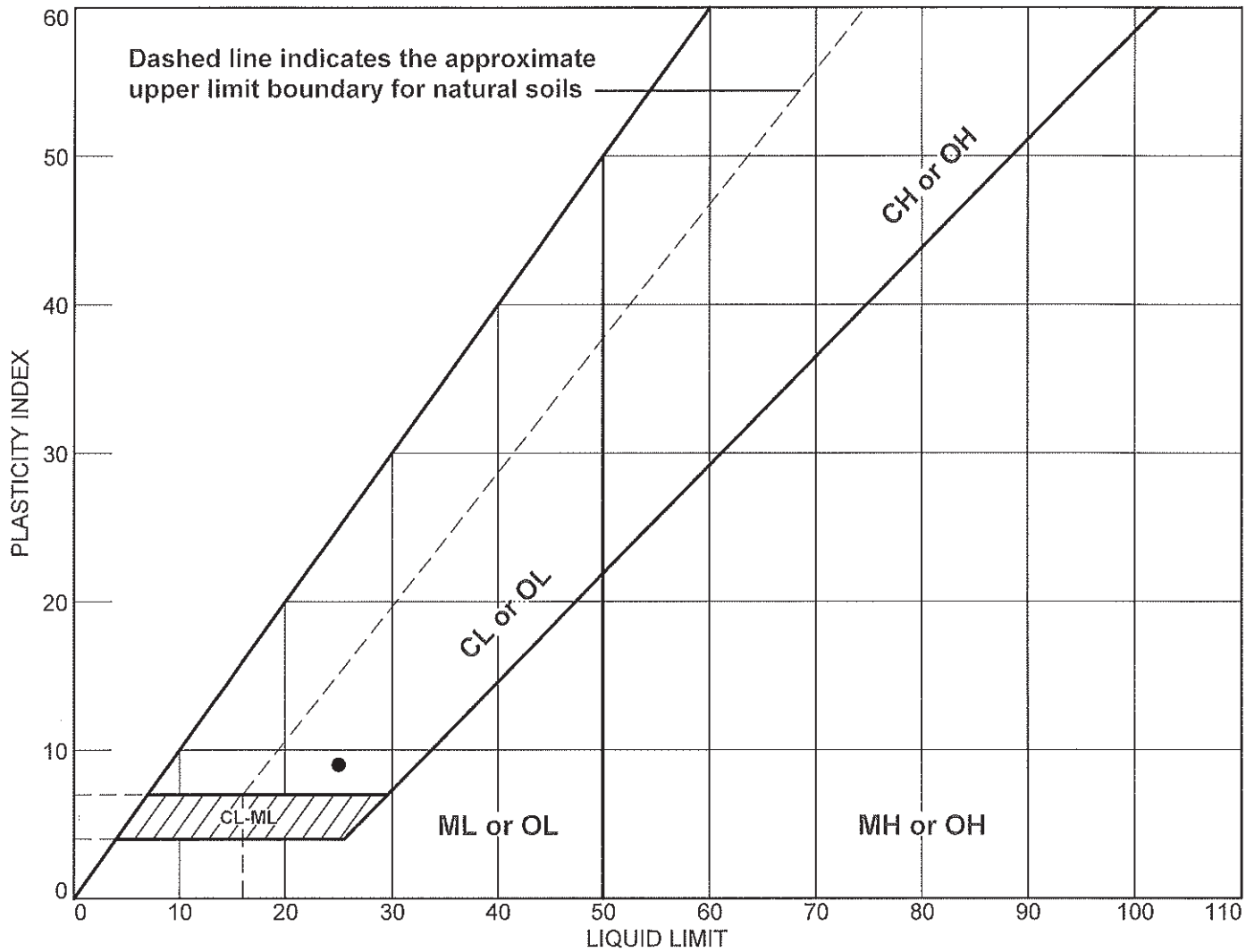
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
371.9	287.5	16.2	31.1

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G019 S-21 85'-86.5'	7980-3	85'-86.5'	34.6	16	25	9	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

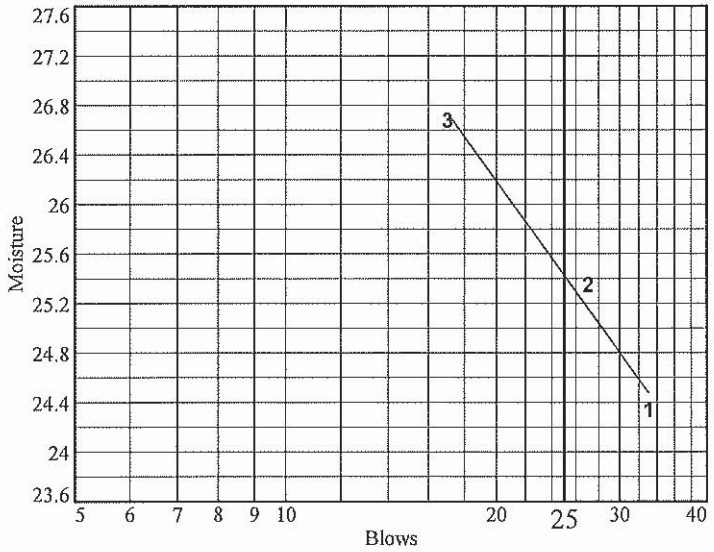
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-21
Depth: 85'-86.5'
Sample Number: 7980-3
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	32.18	29.60	28.44			
Dry+Tare	28.55	26.38	25.31			
Tare	13.64	13.68	13.58			
# Blows	33	27	17			
Moisture	24.3	25.4	26.7			



Liquid Limit= 25
Plastic Limit= 16
Plasticity Index= 9
Natural Moisture= 34.6
Liquidity Index= 2.1

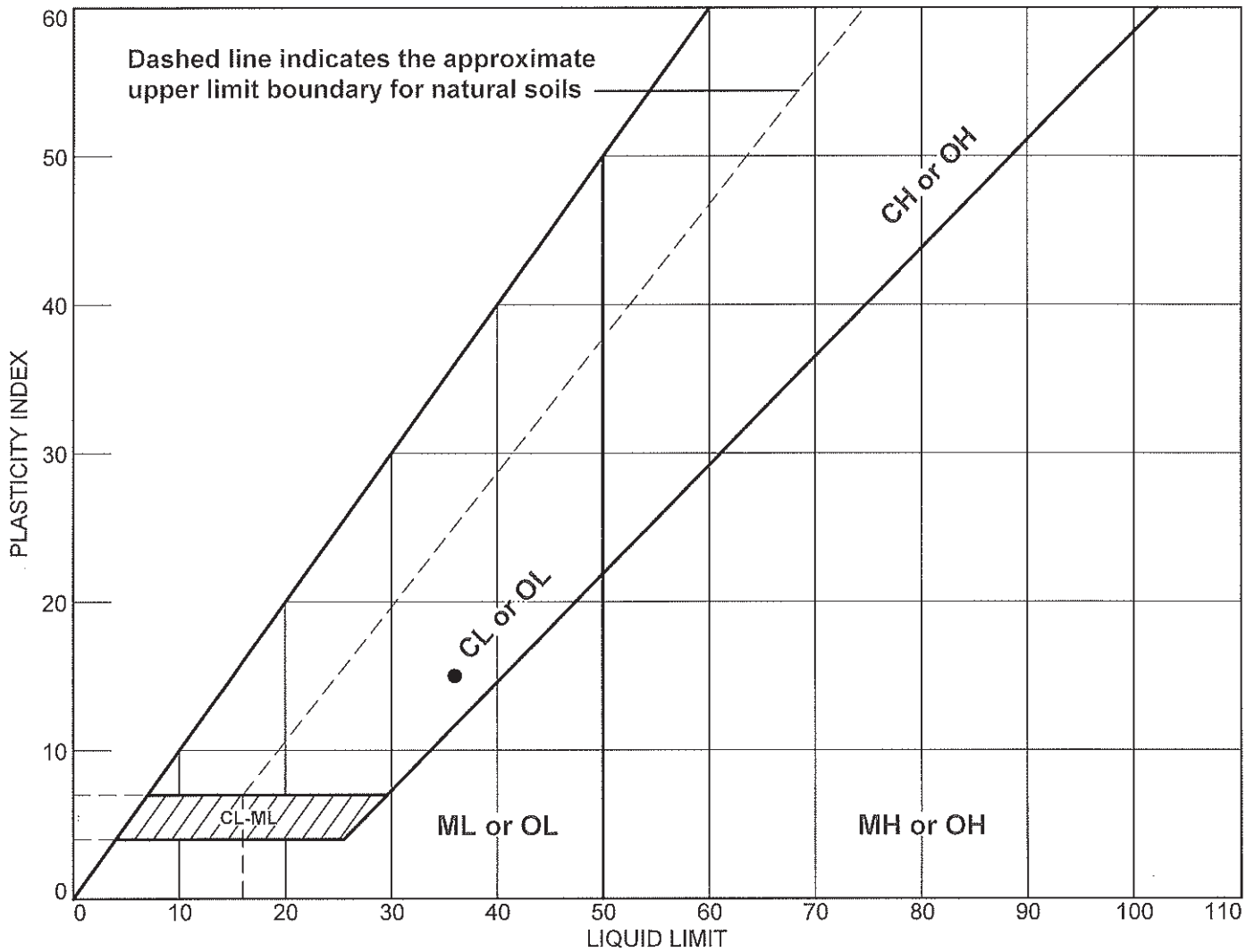
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.55	23.55	23.55		
Dry+Tare	22.14	22.14	22.14		
Tare	13.54	13.54	13.54		
Moisture	16.4	16.4	16.4		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
445.9	335.6	16.6	34.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G019 S-23 95'-96.5'	7980-4	95'-96.5'	37.8	21	36	15	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

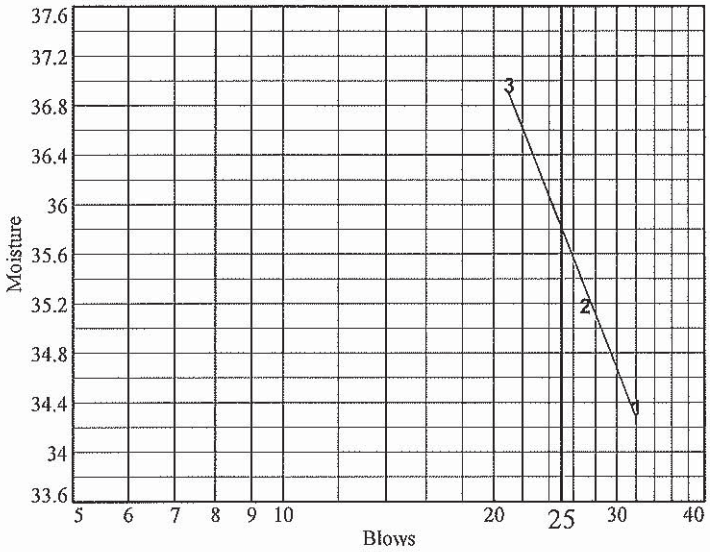
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-23
Depth: 95'-96.5'
Sample Number: 7980-4
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.06	27.76	29.98			
Dry+Tare	24.39	24.08	25.57			
Tare	13.71	13.62	13.64			
# Blows	32	27	21			
Moisture	34.4	35.2	37.0			



Liquid Limit= 36
Plastic Limit= 21
Plasticity Index= 15
Natural Moisture= 37.8
Liquidity Index= 1.1

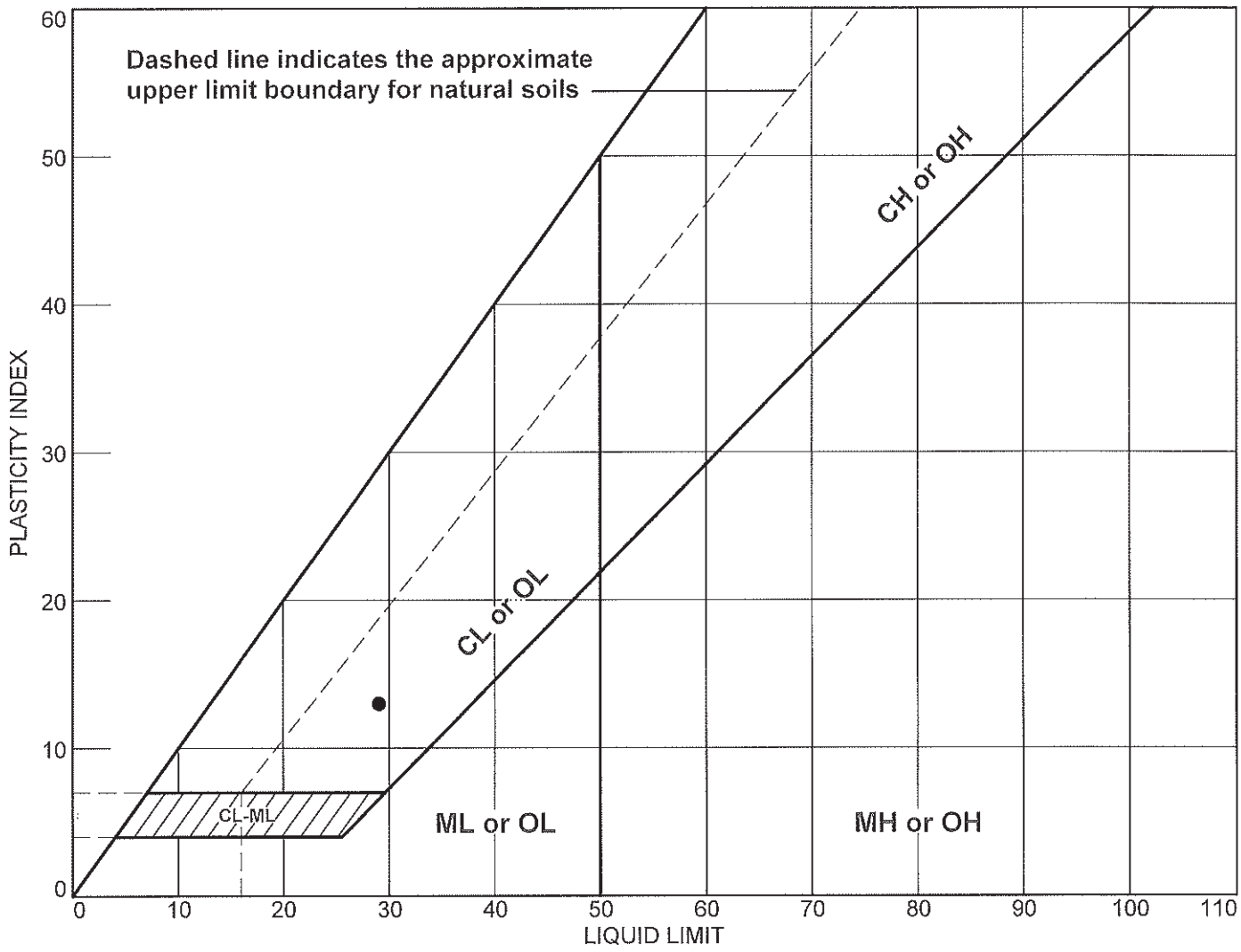
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.80	22.80	22.80		
Dry+Tare	21.22	21.22	21.22		
Tare	13.62	13.62	13.62		
Moisture	20.8	20.8	20.8		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
470.9	346.2	16.0	37.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G-019 S-25 105'-106.5'	7980-5	105'-106.5'	32.6	16	29	13	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

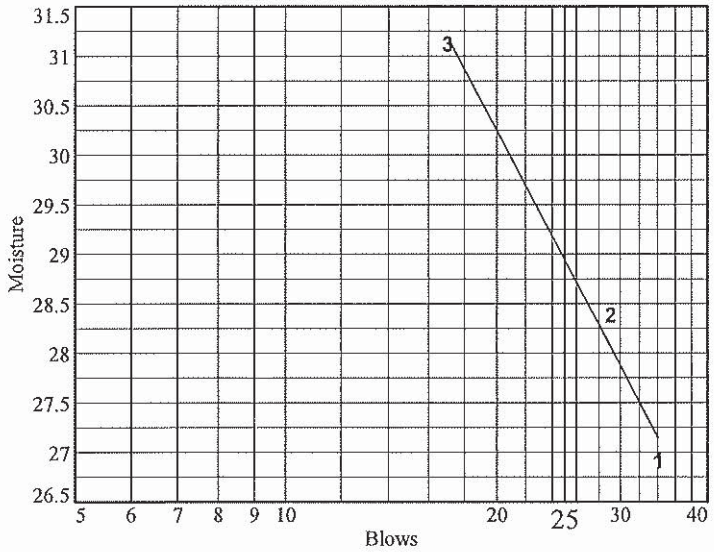
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-25
Depth: 105'-106.5'
Sample Number: 7980-5
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	33.23	31.79	28.79			
Dry+Tare	29.05	27.77	25.22			
Tare	13.52	13.61	13.75			
# Blows	34	29	17			
Moisture	26.9	28.4	31.1			



Liquid Limit= 29
Plastic Limit= 16
Plasticity Index= 13
Natural Moisture= 32.6
Liquidity Index= 1.3

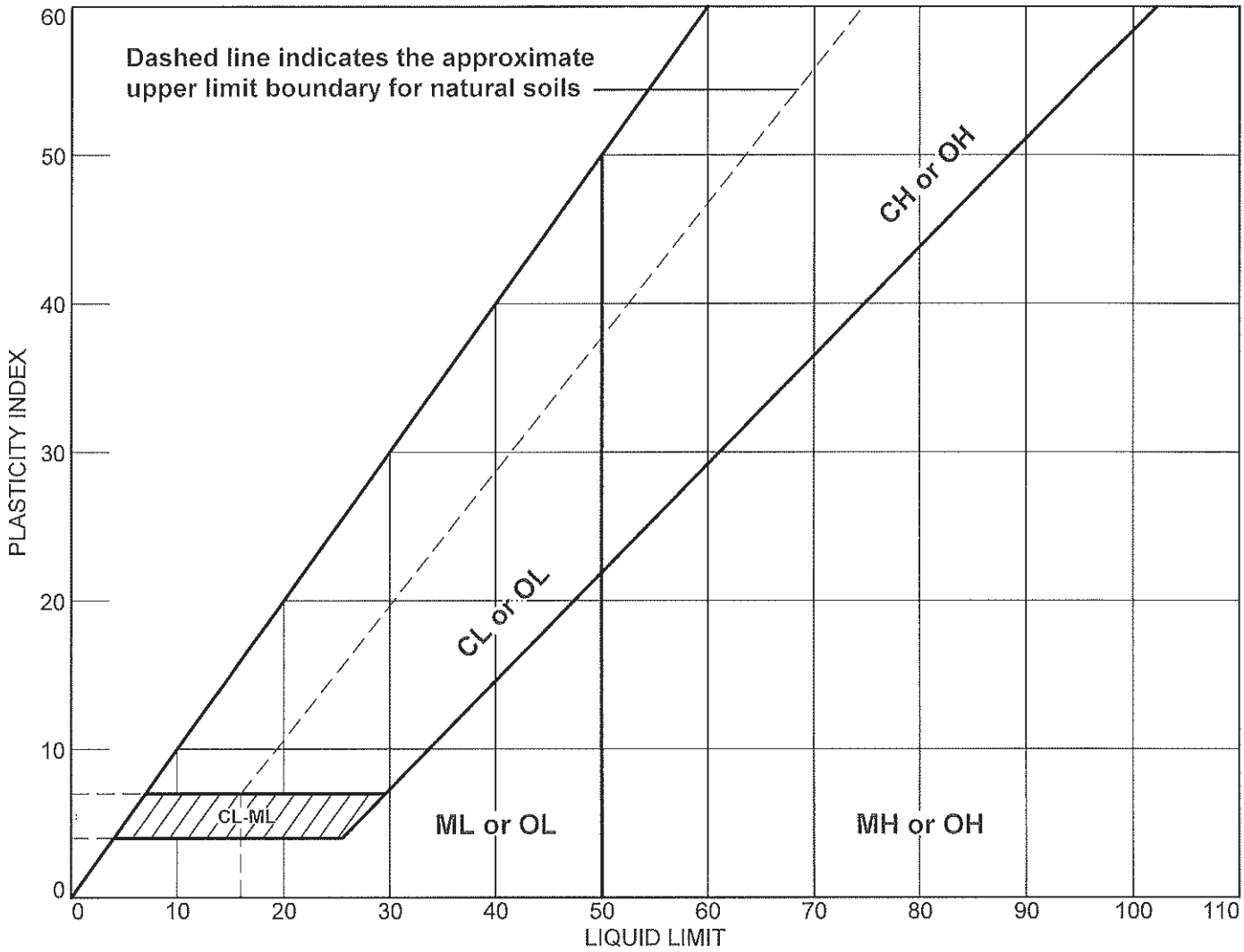
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.78	22.78	22.78		
Dry+Tare	21.50	21.50	21.50		
Tare	13.69	13.69	13.69		
Moisture	16.4	16.4	16.4		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
421.1	321.6	16.1	32.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G019 S-27 115'-116.5'	7980-6	115'-116.5'	25.7	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

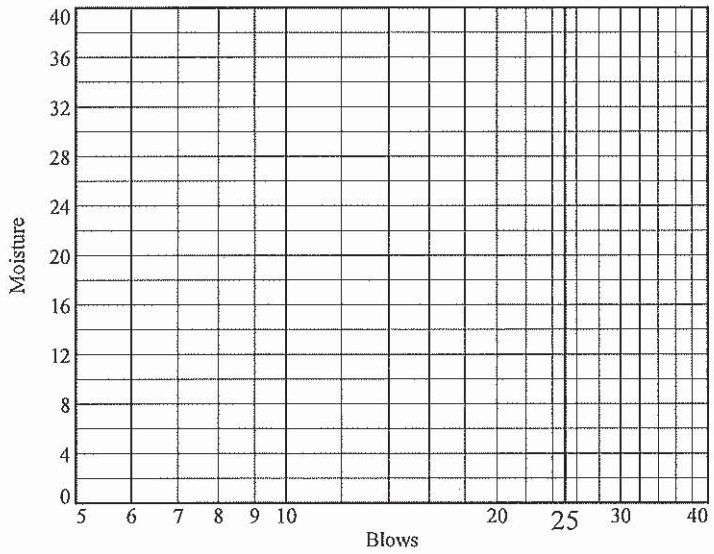
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-27
Depth: 115'-116.5'
Sample Number: 7980-6
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 25.7

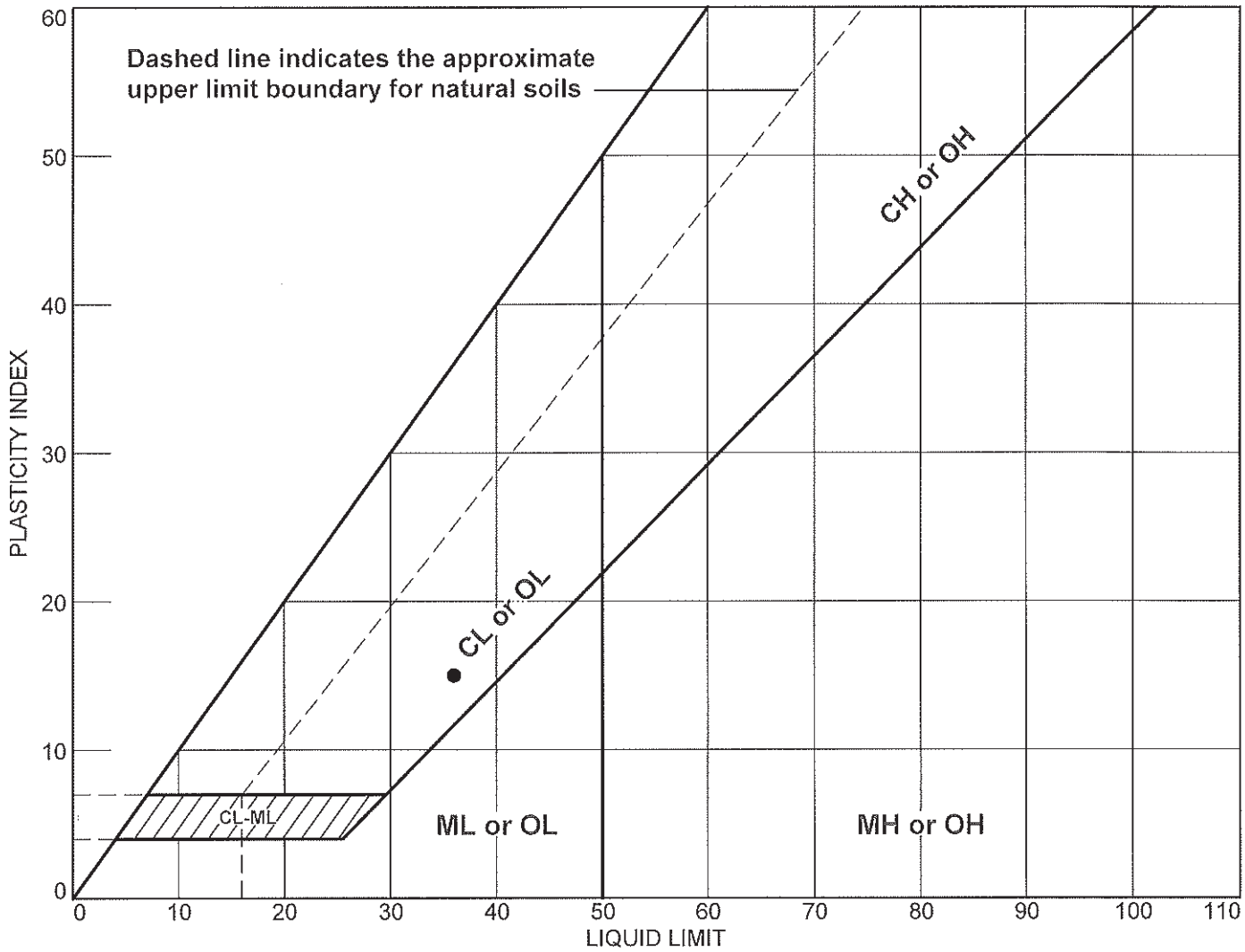
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
461.2	370.3	16.0	25.7

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G019 S-29 125'-126.5'	7980-7	125'-126.5'	31.7	21	36	15	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

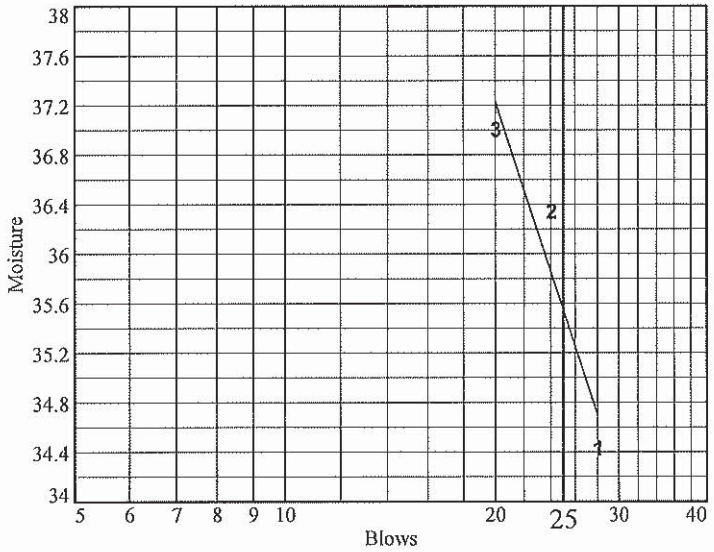
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G019 S-29
Depth: 125'-126.5'
Sample Number: 7980-7
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	32.39	28.94	25.89			
Dry+Tare	27.59	24.88	22.60			
Tare	13.65	13.71	13.71			
# Blows	28	24	20			
Moisture	34.4	36.3	37.0			



Liquid Limit= 36
Plastic Limit= 21
Plasticity Index= 15
Natural Moisture= 31.7
Liquidity Index= 0.7

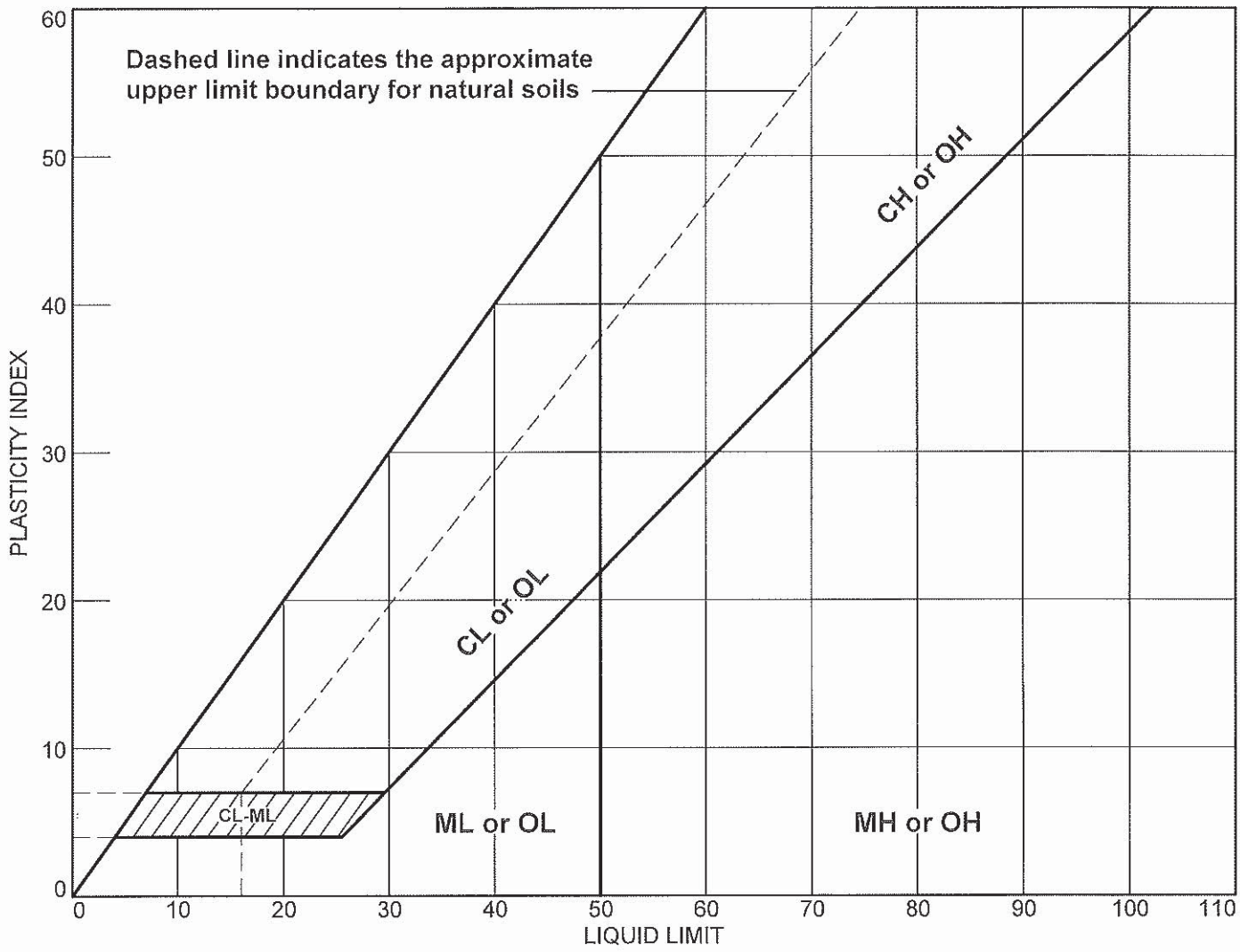
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.30	23.30	23.30		
Dry+Tare	21.62	21.62	21.62		
Tare	13.63	13.63	13.63		
Moisture	21.0	21.0	21.0		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
480.6	368.6	15.8	31.7

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G020 S-20 80'-81.5'	7980-8	80'-81.5'	30.4	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

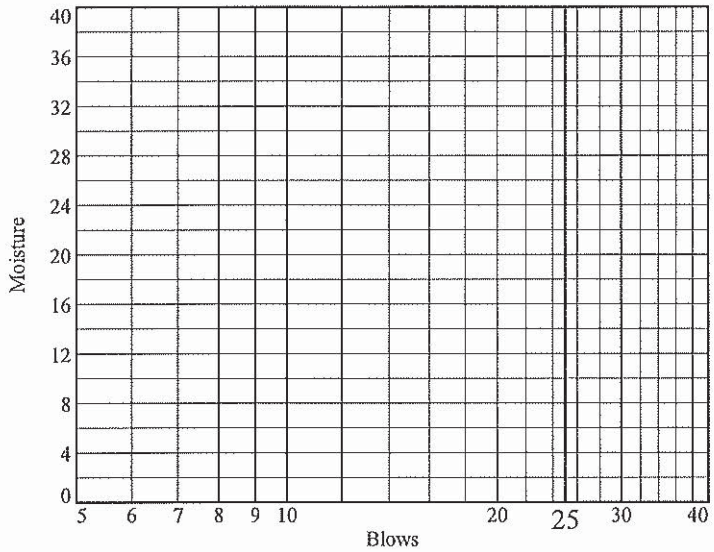
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-20
Depth: 80'-81.5'
Sample Number: 7980-8
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 30.4

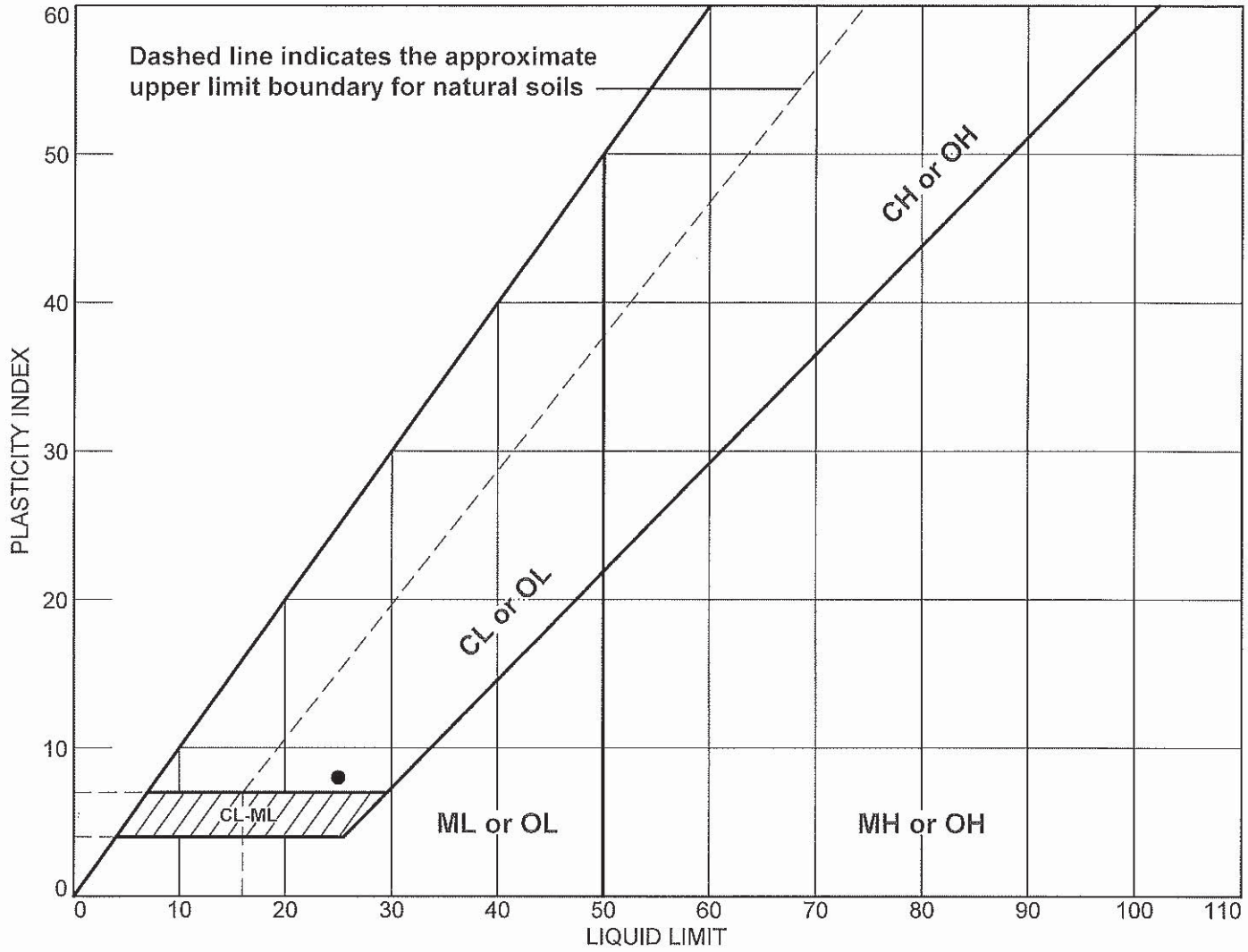
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
488.8	378.6	16.1	30.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G020 S-22 90'-91.5'	7980-9	90'-91.5'	34.3	17	25	8	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

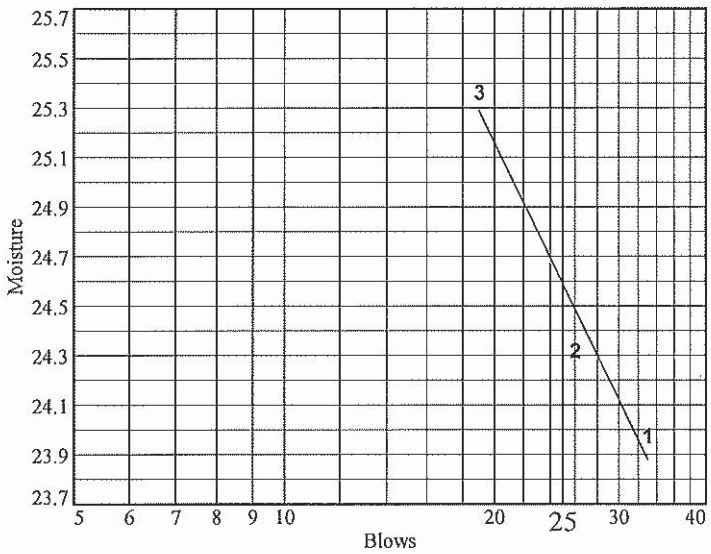
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-22
Depth: 90'-91.5'
Sample Number: 7980-9
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	29.07	30.54	29.09			
Dry+Tare	26.08	27.23	25.96			
Tare	13.61	13.62	13.62			
# Blows	33	26	19			
Moisture	24.0	24.3	25.4			



Liquid Limit= 25
Plastic Limit= 17
Plasticity Index= 8
Natural Moisture= 34.3
Liquidity Index= 2.2

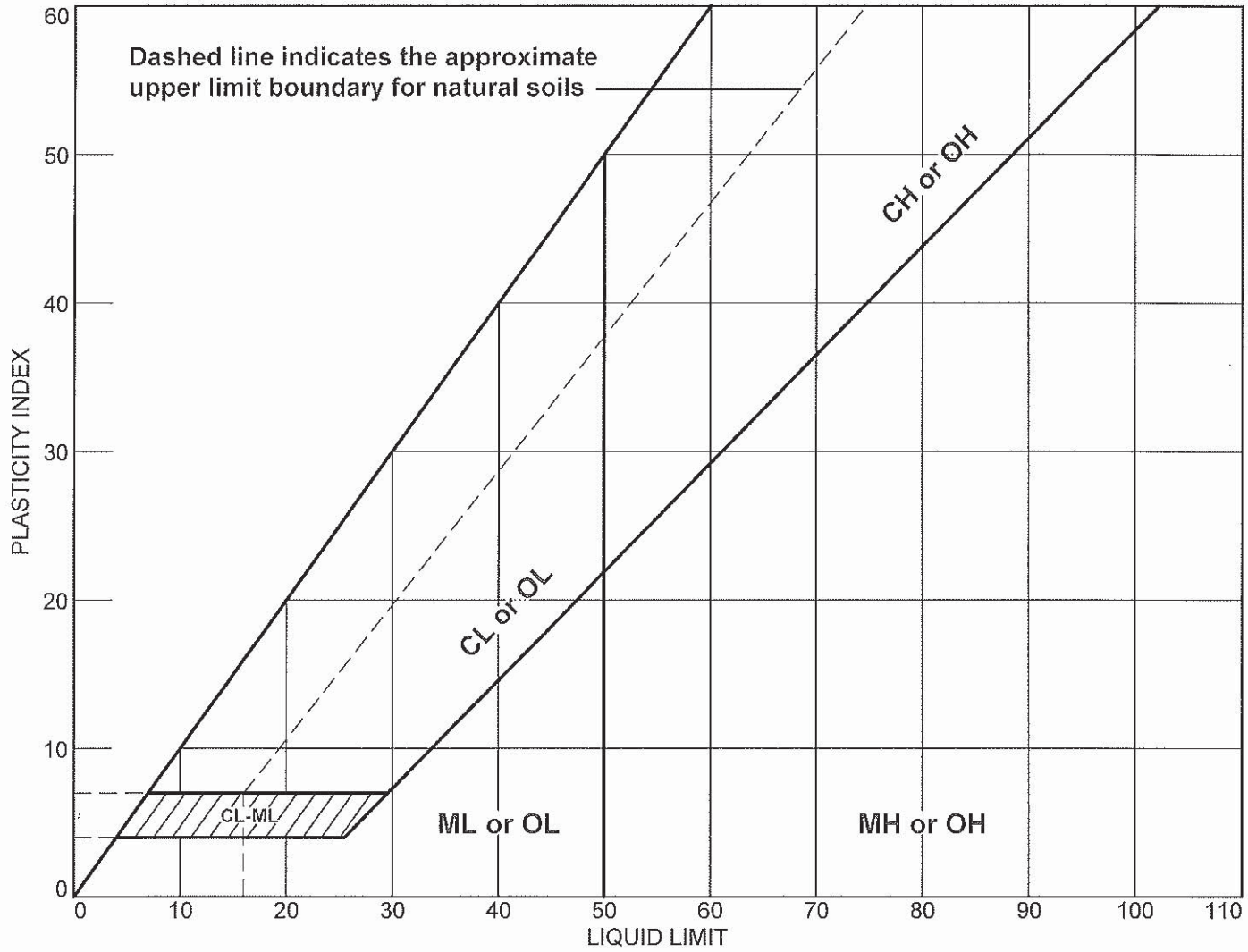
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.84	23.84	23.84		
Dry+Tare	22.39	22.39	22.39		
Tare	13.65	13.65	13.65		
Moisture	16.6	16.6	16.6		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
509.7	383.4	15.7	34.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G020 S-24 100'-101.5'	7980-10	100'-101.5'	30.2	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

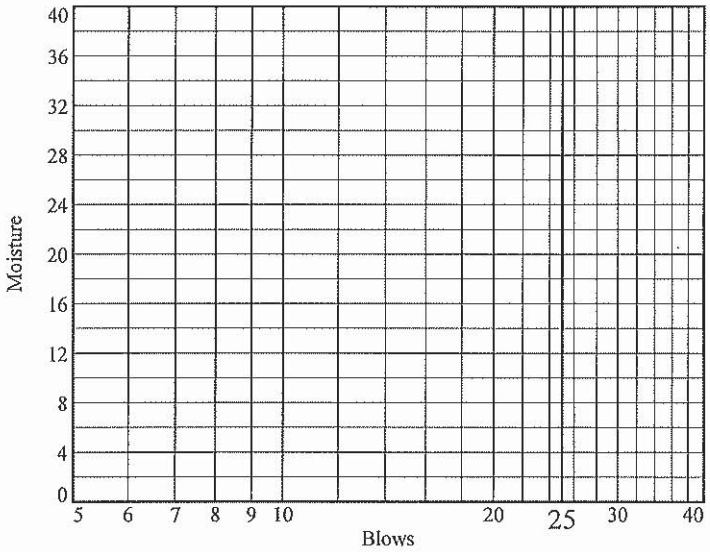
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-24
Depth: 100'-101.5'
Sample Number: 7980-10
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 30.2

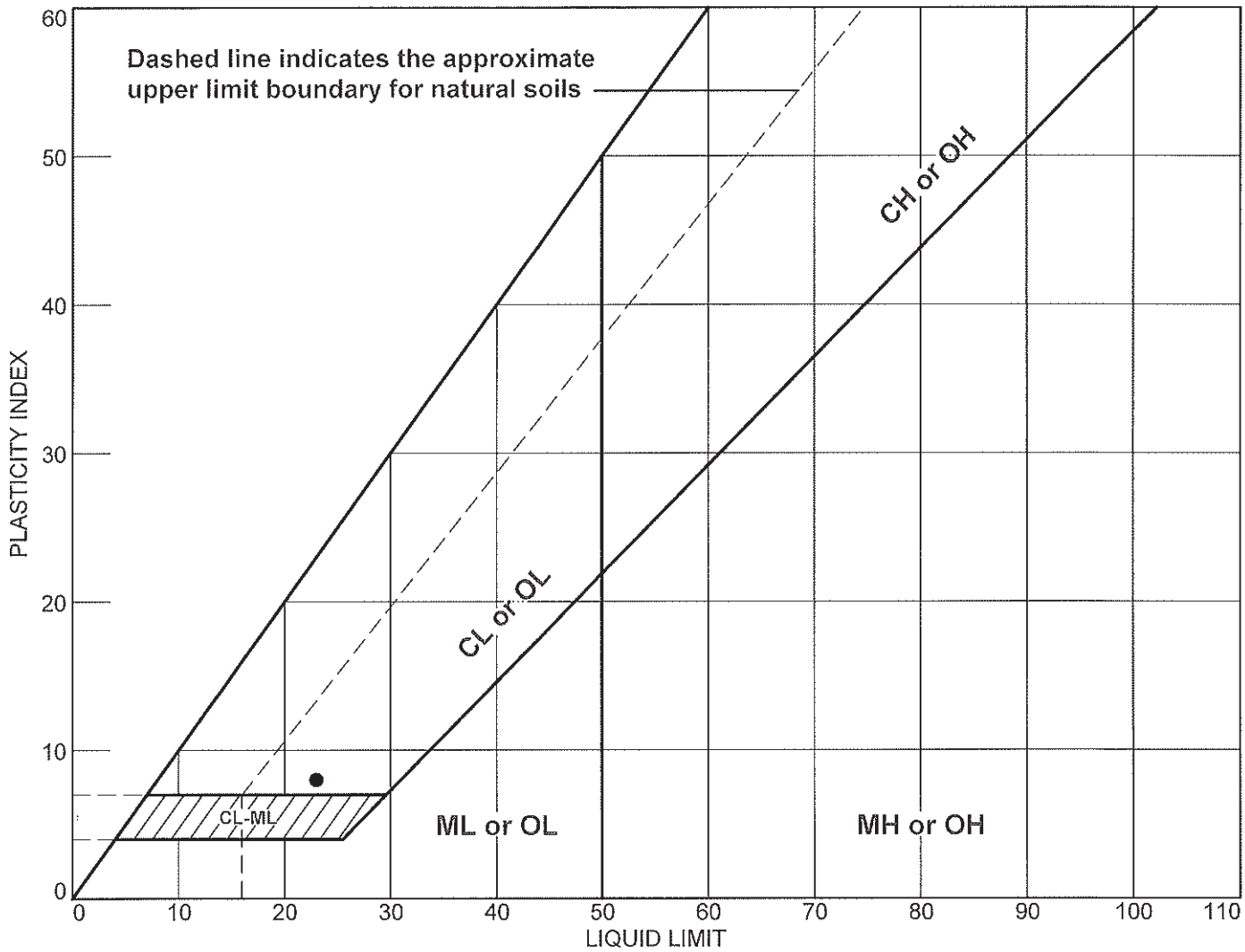
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
545.8	423.0	17.0	30.2

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G020 S-25 105'-106.5'	7920-11		32.4	15	23	8	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

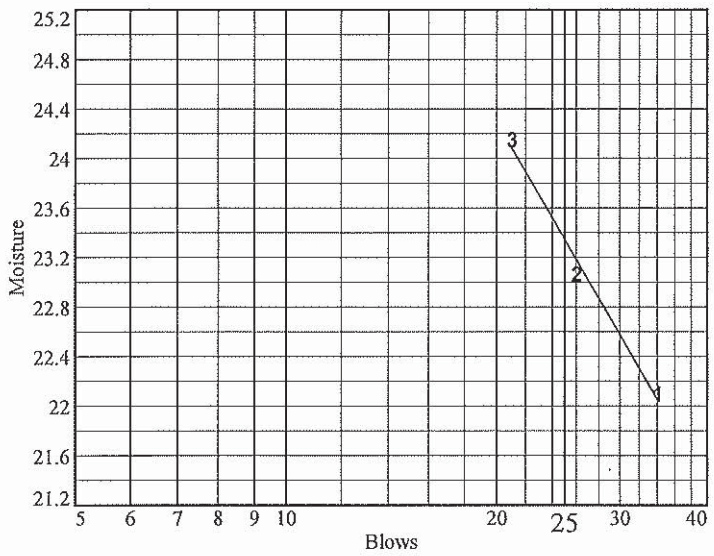
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-25
Sample Number: 7920-11
USCS: CL
Tested by: BH **Checked by:** JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	34.74	26.60	32.06			
Dry+Tare	30.91	24.15	28.49			
Tare	13.58	13.53	13.71			
# Blows	34	26	21			
Moisture	22.1	23.1	24.2			



Liquid Limit= 23
Plastic Limit= 15
Plasticity Index= 8
Natural Moisture= 32.4
Liquidity Index= 2.2

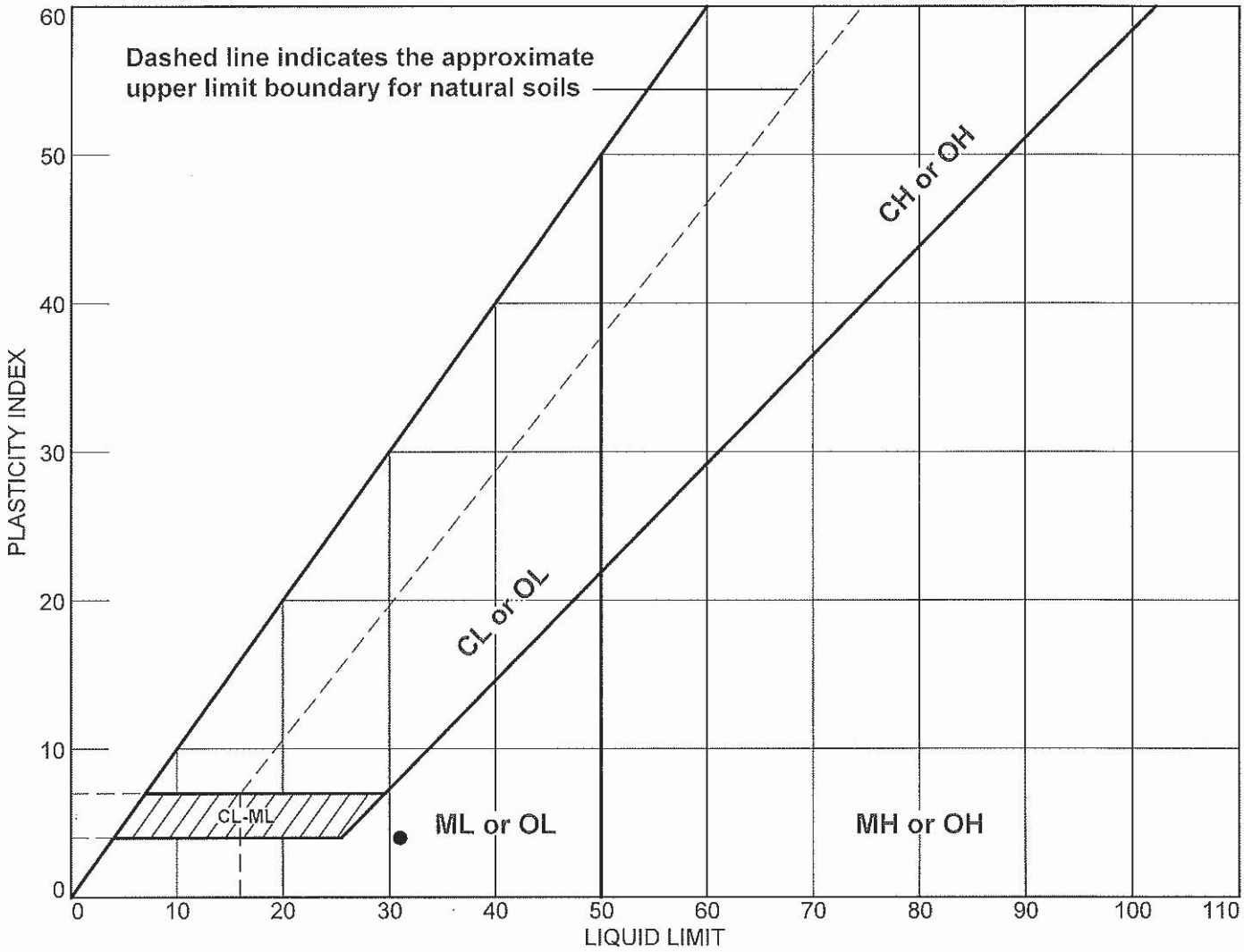
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.54	23.54	23.54		
Dry+Tare	22.25	22.25	22.25		
Tare	13.69	13.69	13.69		
Moisture	15.1	15.1	15.1		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
496.4	378.7	15.8	32.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G020 S-26 110'-111.5'	7980-12	110'-111.5'	33.9	27	31	4	ML

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

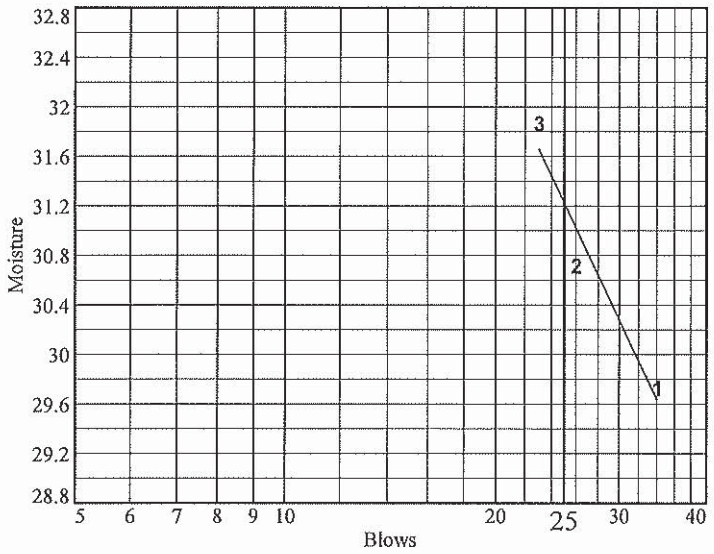
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-26
Depth: 110'-111.5'
Sample Number: 7980-12
USCS: ML
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	30.05	29.24	27.91			
Dry+Tare	26.28	25.60	24.43			
Tare	13.60	13.75	13.51			
# Blows	34	26	23			
Moisture	29.7	30.7	31.9			



Liquid Limit= 31
Plastic Limit= 27
Plasticity Index= 4
Natural Moisture= 33.9
Liquidity Index= 1.7

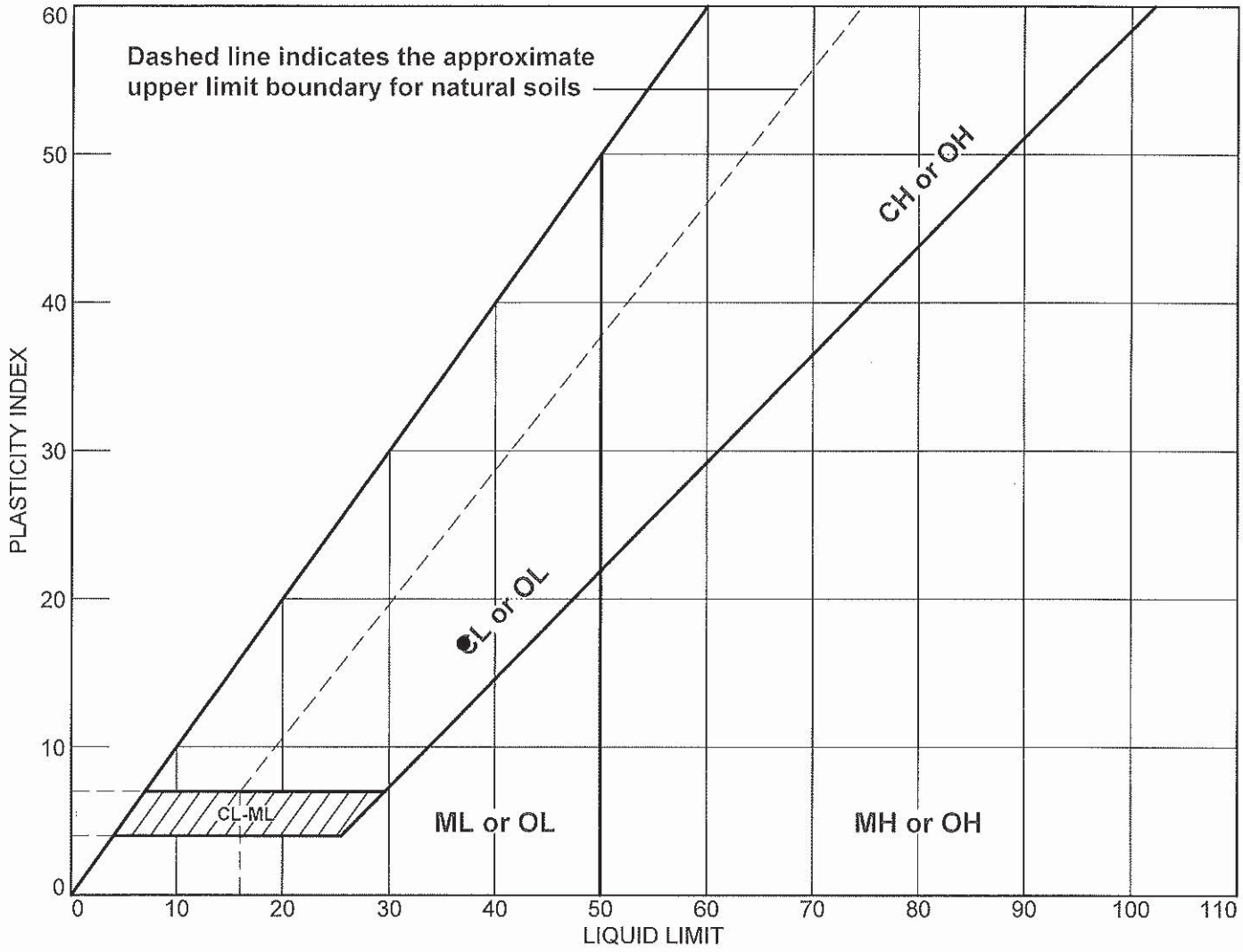
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.10	23.10	23.10		
Dry+Tare	21.07	21.07	21.07		
Tare	13.65	13.65	13.65		
Moisture	27.4	27.4	27.4		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
413.1	312.7	16.1	33.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G020 S-28 120'-121.5'	7980-13	120'-121.5'	34.4	20	37	17	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

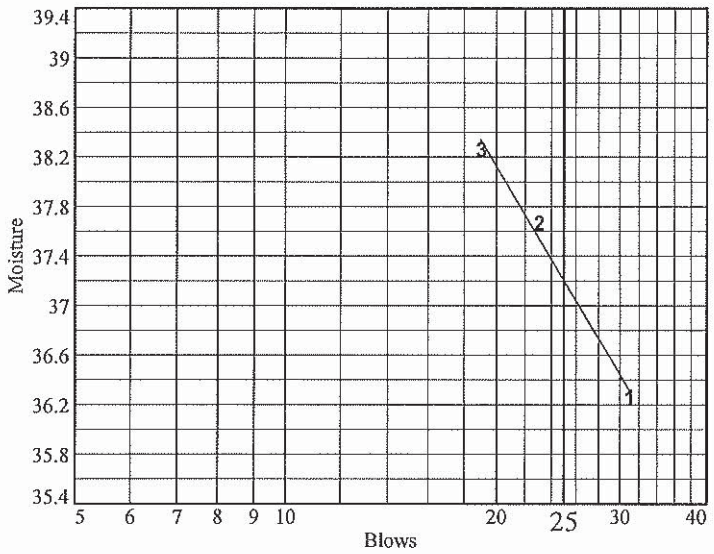
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 G-28
Depth: 120'-121.5'
Sample Number: 7980-13
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	30.90	27.70	29.62			
Dry+Tare	26.32	23.85	25.17			
Tare	13.69	13.63	13.54			
# Blows	31	23	19			
Moisture	36.3	37.7	38.3			



Liquid Limit= 37
Plastic Limit= 20
Plasticity Index= 17
Natural Moisture= 34.4
Liquidity Index= 0.8

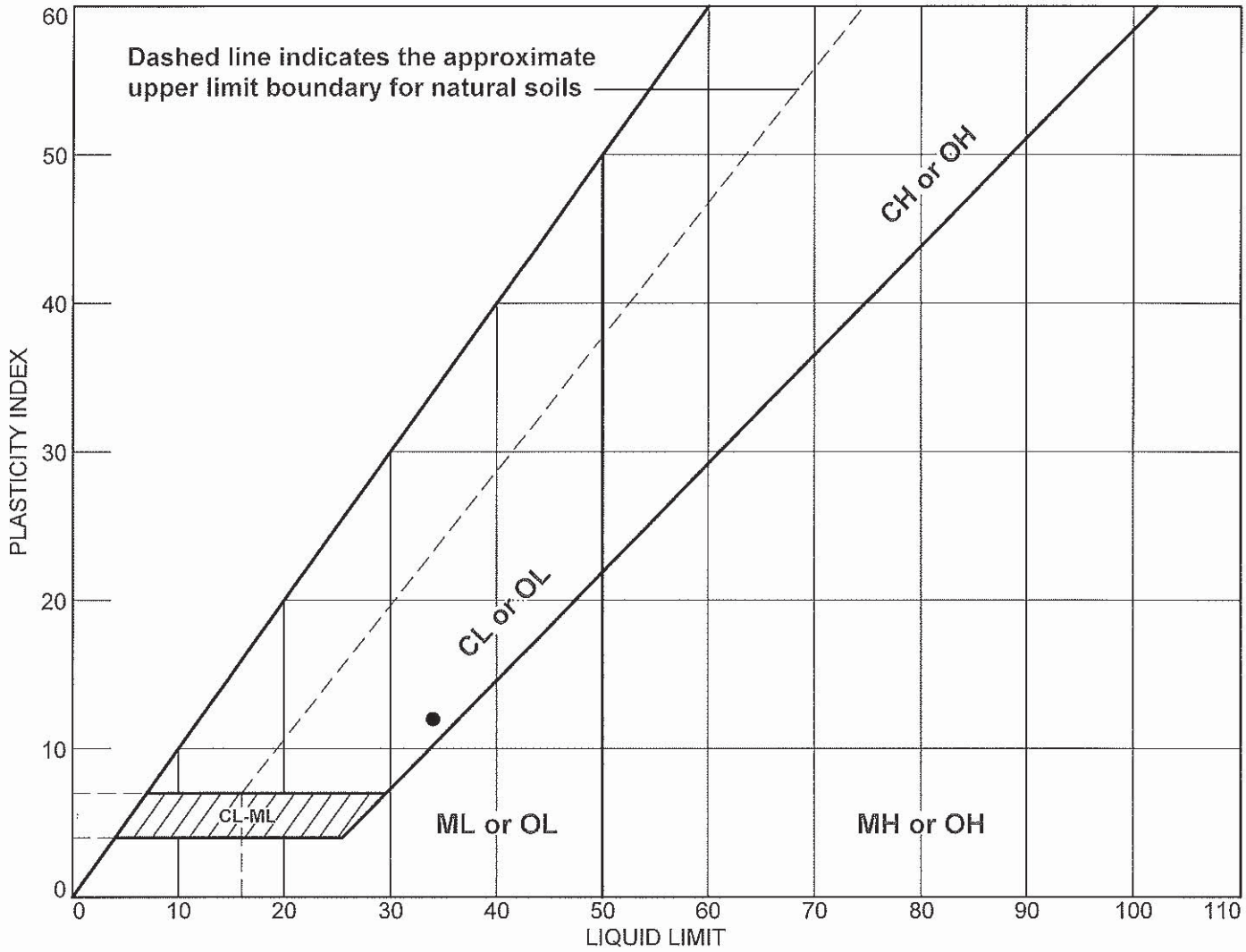
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.10	21.10	21.10		
Dry+Tare	19.83	19.83	19.83		
Tare	13.59	13.59	13.59		
Moisture	20.4	20.4	20.4		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
457.4	344.4	16.0	34.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G020 S-31 135'-136.5'	7980-14	135'-136.5'	31.3	22	34	12	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

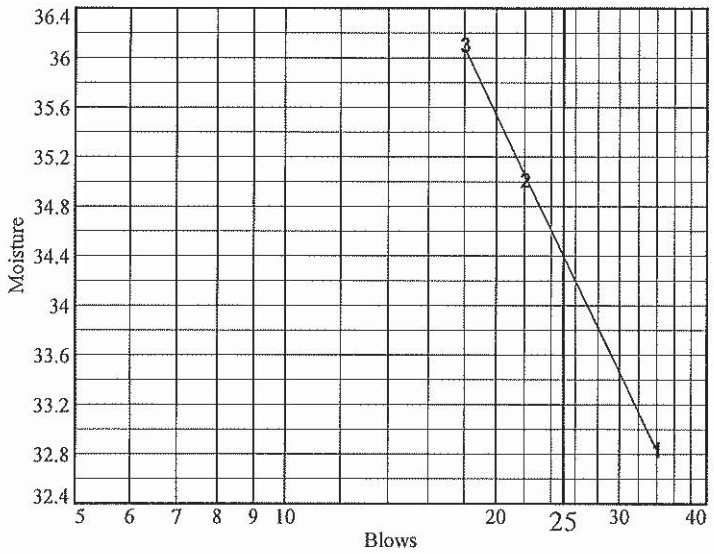
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-31
Depth: 135'-136.5'
Sample Number: 7980-14
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	27.94	31.30	29.96			
Dry+Tare	24.39	26.72	25.62			
Tare	13.58	13.64	13.60			
# Blows	34	22	18			
Moisture	32.8	35.0	36.1			



Liquid Limit= 34
Plastic Limit= 22
Plasticity Index= 12
Natural Moisture= 31.3
Liquidity Index= 0.8

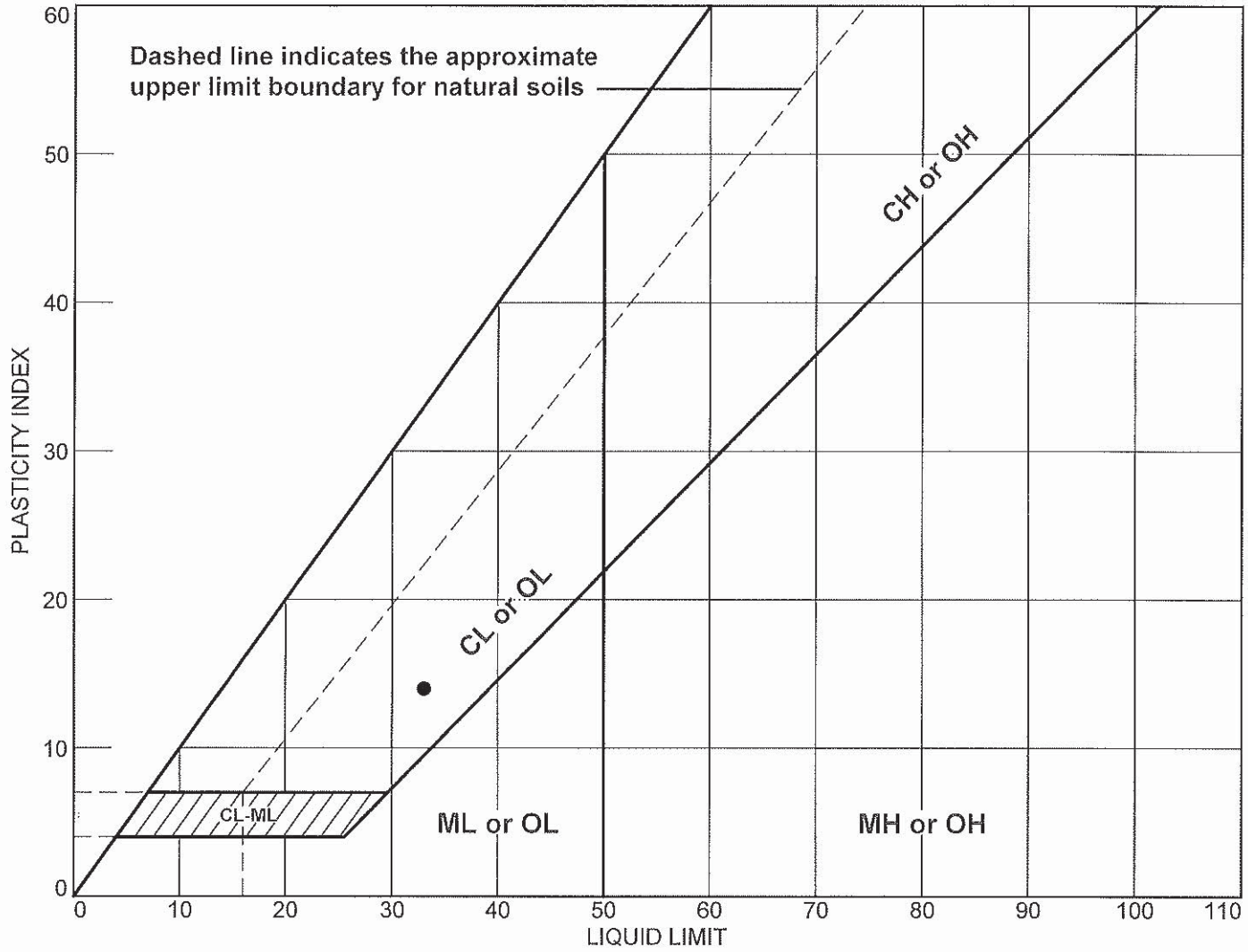
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.02	22.02	22.02		
Dry+Tare	20.52	20.52	20.52		
Tare	13.68	13.68	13.68		
Moisture	21.9	21.9	21.9		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
447.1	344.4	16.6	31.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G020 S-33 145'-146.5'	7980-15	145'-146.5'	28.8	19	33	14	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

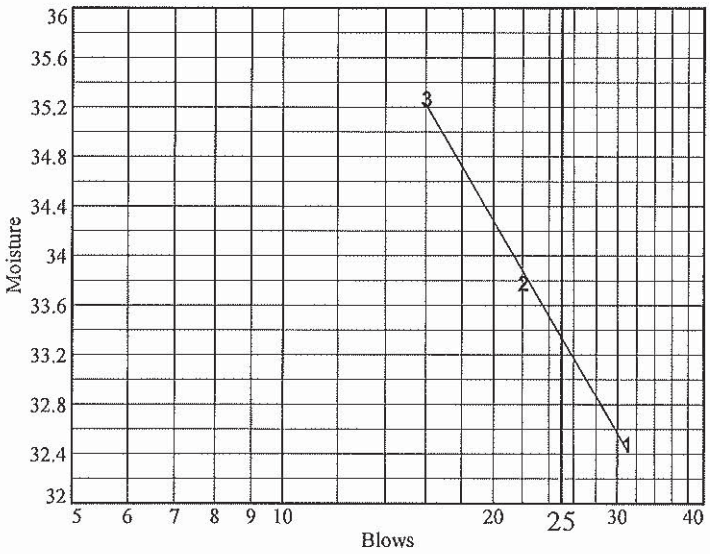
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-33
Depth: 145'-146.5'
Sample Number: 7980-15
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.60	31.51	30.26			
Dry+Tare	24.93	26.99	25.89			
Tare	13.63	13.61	13.5			
# Blows	31	22	16			
Moisture	32.5	33.8	35.3			



Liquid Limit= 33
Plastic Limit= 19
Plasticity Index= 14
Natural Moisture= 28.8
Liquidity Index= 0.7

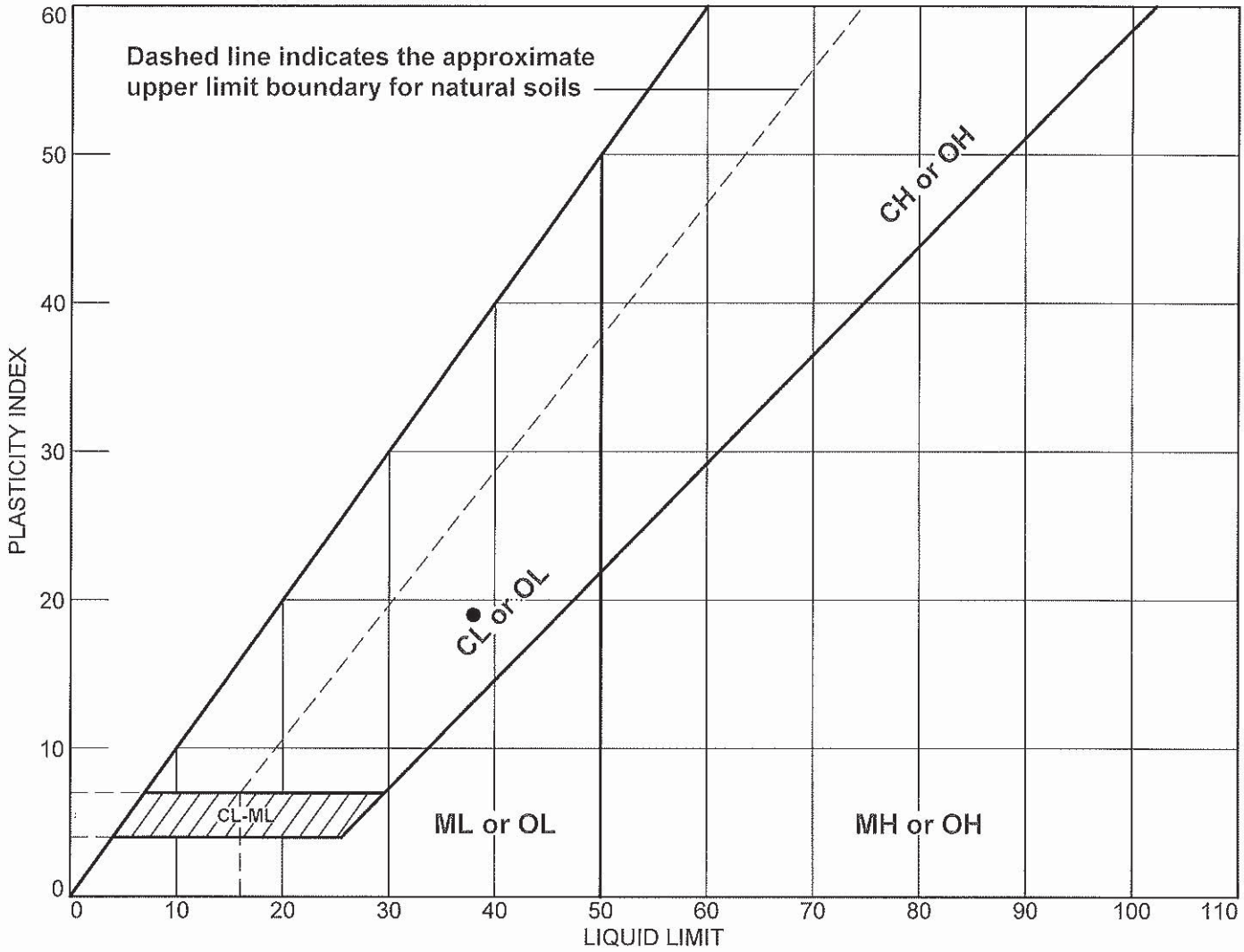
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.49	22.49	22.49		
Dry+Tare	21.08	21.08	21.08		
Tare	13.66	13.66	13.66		
Moisture	19.0	19.0	19.0		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
401.3	315.1	15.8	28.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G020 S-37 165'-166.5'	7980-16	165'-166.5'	31.8	19	38	19	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

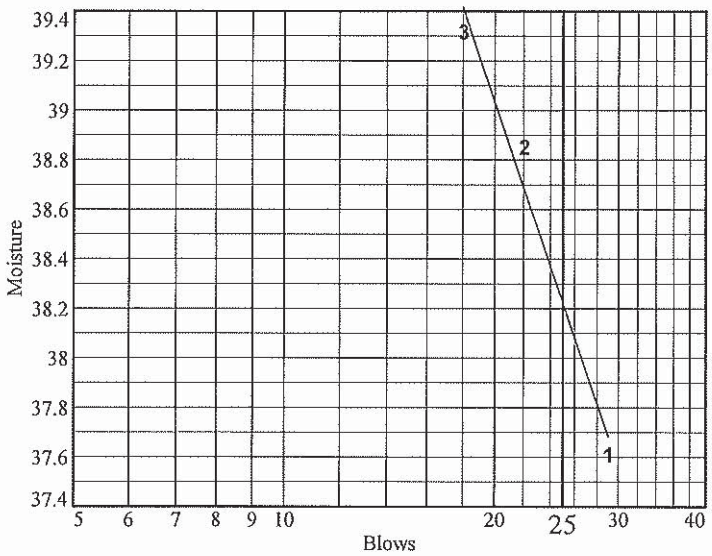
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-37
Depth: 165'-166.5'
Sample Number: 7980-16
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.85	30.96	30.07			
Dry+Tare	24.66	26.08	25.45			
Tare	13.52	13.52	13.70			
# Blows	29	22	18			
Moisture	37.6	38.9	39.3			



Liquid Limit= 38
Plastic Limit= 19
Plasticity Index= 19
Natural Moisture= 31.8
Liquidity Index= 0.7

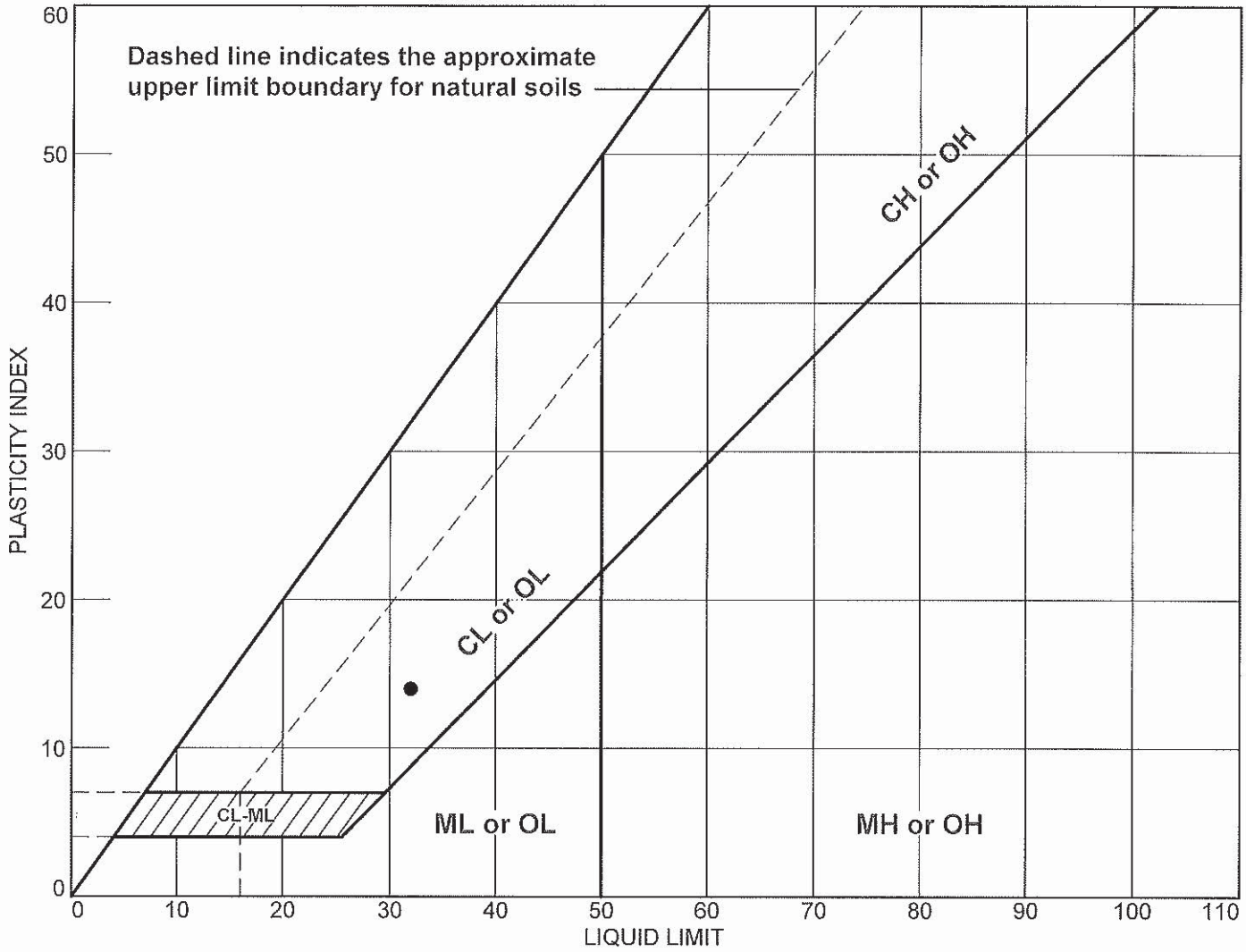
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.50	23.50	23.50		
Dry+Tare	21.90	21.90	21.90		
Tare	13.67	13.67	13.67		
Moisture	19.4	19.4	19.4		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
400.2	307.5	16.1	31.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G020 S-40 180'-181.5'	7980-17	180'-181.5'	26.5	18	32	14	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

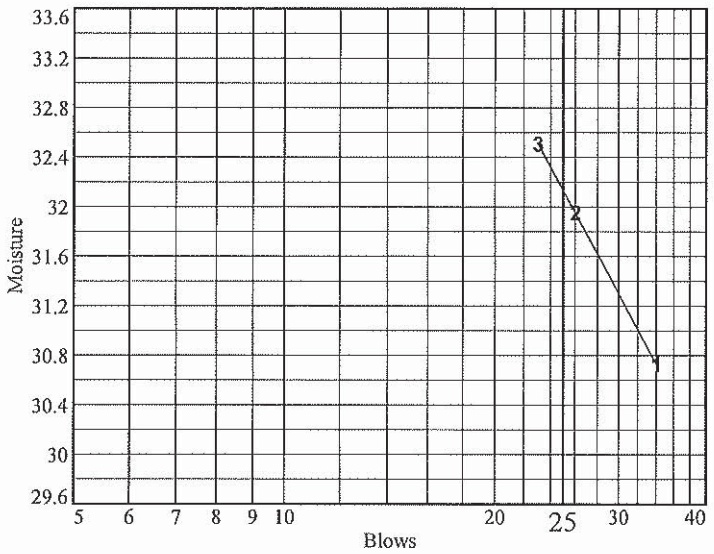
LIQUID AND PLASTIC LIMIT TEST DATA

8/23/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G020 S-40
Depth: 180'-181.5'
Sample Number: 7980-17
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	30.37	31.25	27.65			
Dry+Tare	26.43	27.00	24.22			
Tare	13.61	13.70	13.67			
# Blows	34	26	23			
Moisture	30.7	32.0	32.5			



Liquid Limit= 32
Plastic Limit= 18
Plasticity Index= 14
Natural Moisture= 26.5
Liquidity Index= 0.6

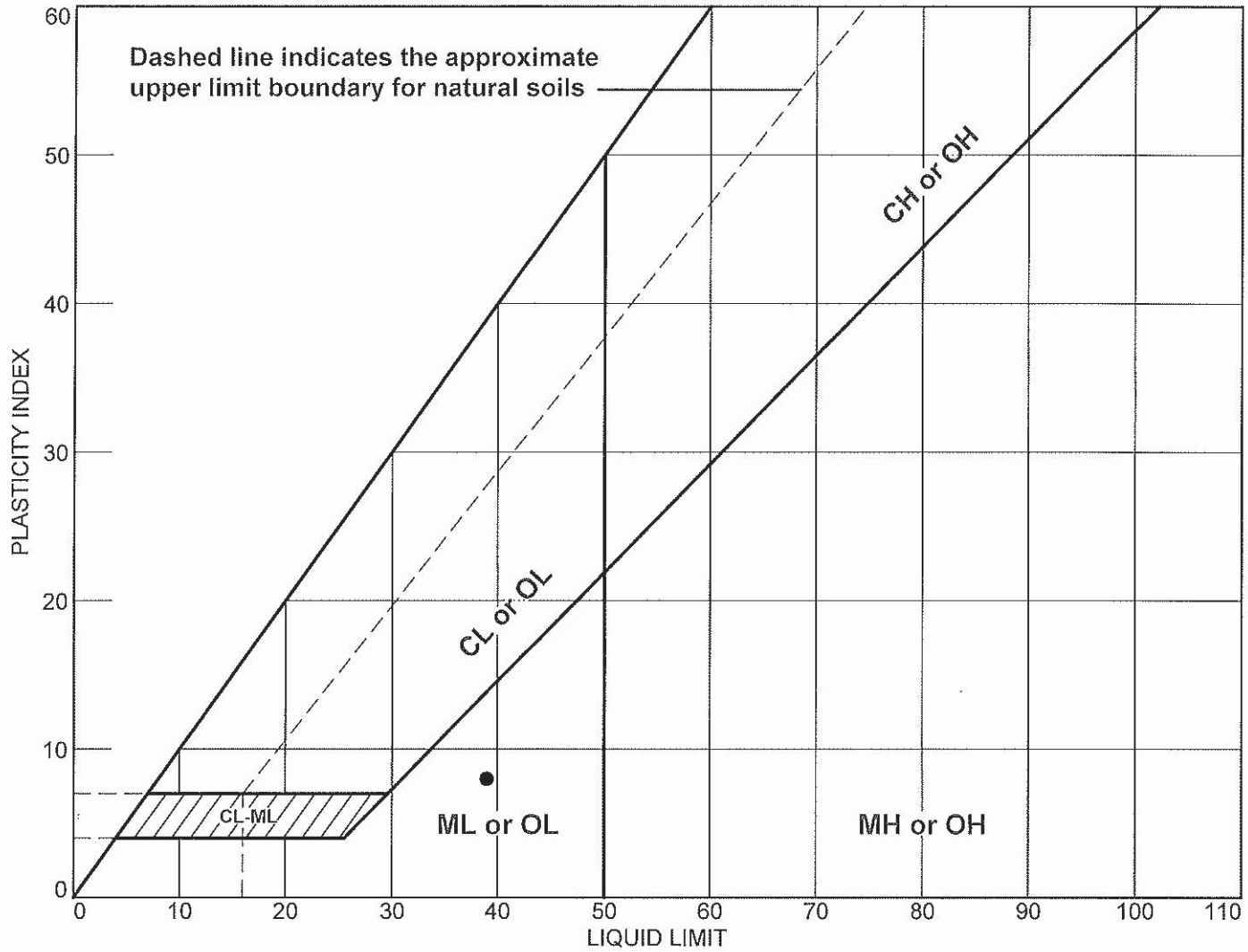
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.23	22.23	22.23		
Dry+Tare	20.95	20.95	20.95		
Tare	13.65	13.65	13.65		
Moisture	17.5	17.5	17.5		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
278.9	223.8	15.7	26.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G021 S-2 2.5'-3.5'	7992-27	2.5'-3.5'	37.5	31	39	8	ML

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

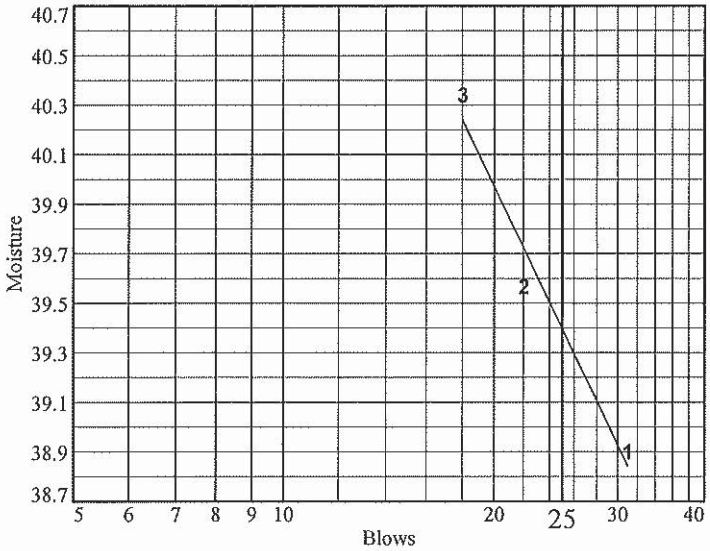
LIQUID AND PLASTIC LIMIT TEST DATA

10/11/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G021 S-2
Depth: 2.5'-3.5'
Sample Number: 7992-27
USCS: ML
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	32.61	36.26	26.79			
Dry+Tare	27.30	29.85	23.03			
Tare	13.65	13.65	13.71			
# Blows	31	22	18			
Moisture	38.9	39.6	40.3			



Liquid Limit= 39
Plastic Limit= 31
Plasticity Index= 8
Natural Moisture= 37.5
Liquidity Index= 0.8

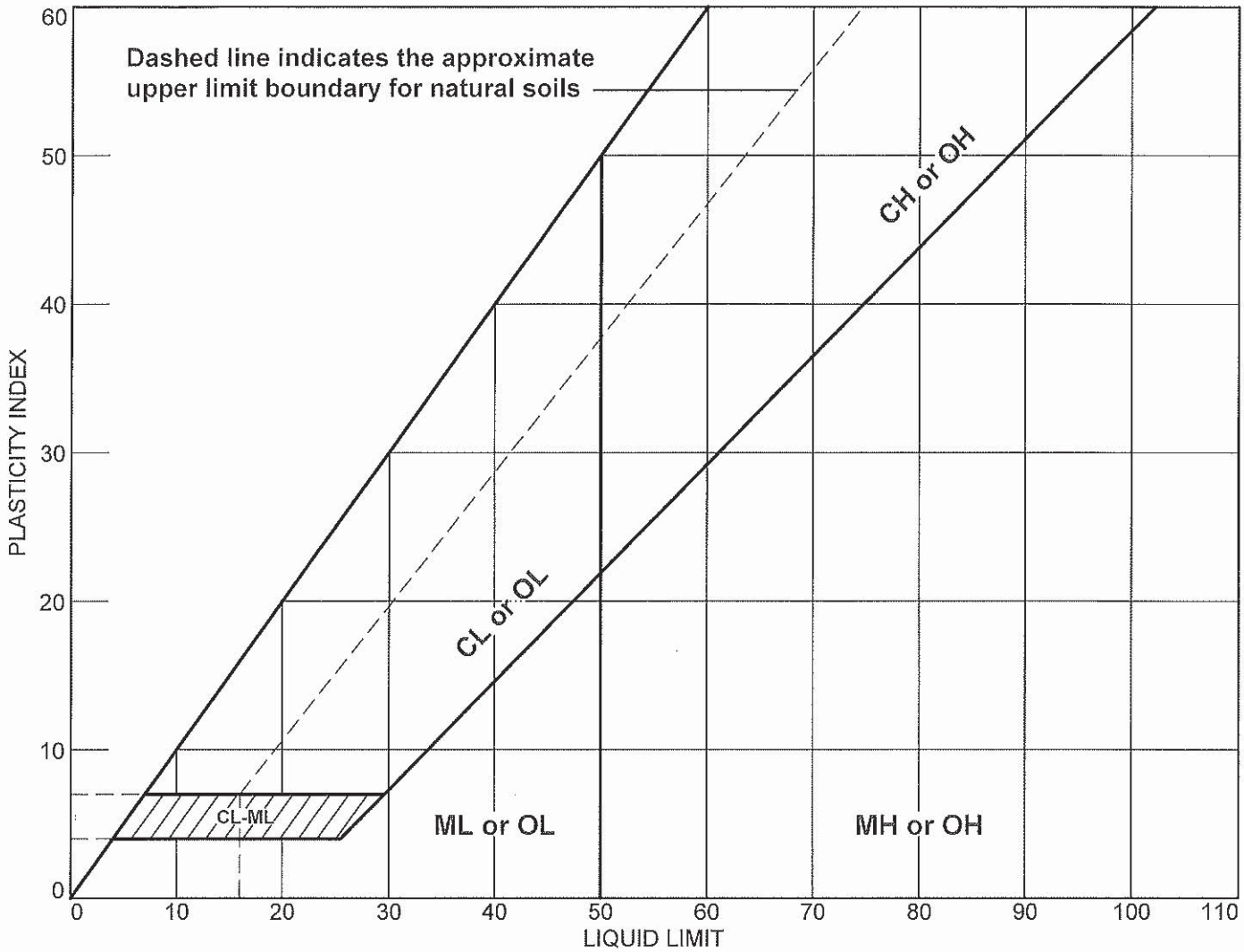
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.08	23.08	23.08		
Dry+Tare	20.83	20.83	20.83		
Tare	13.59	13.59	13.59		
Moisture	31.1	31.1	31.1		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
278.1	206.5	15.8	37.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G023 S-1 3.6'-4.0'	7992-41	3.6'-4.0'	30.7	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

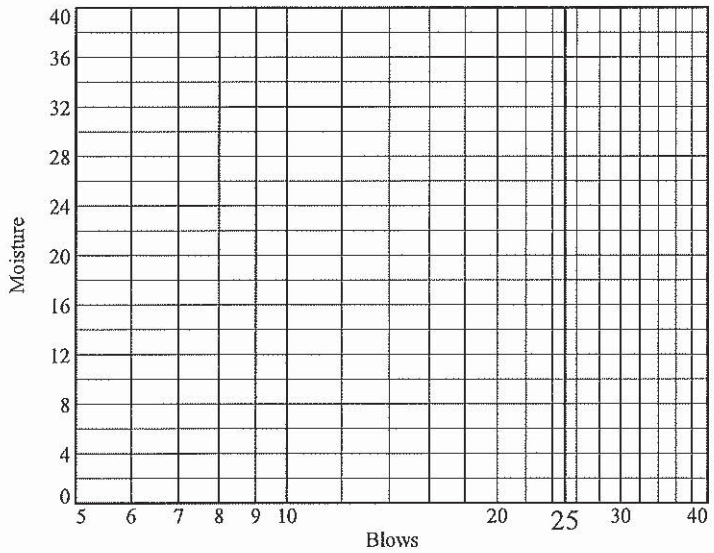
LIQUID AND PLASTIC LIMIT TEST DATA

10/11/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G023 S-1
Depth: 3.6'-4.0'
Sample Number: 7992-41
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 30.7

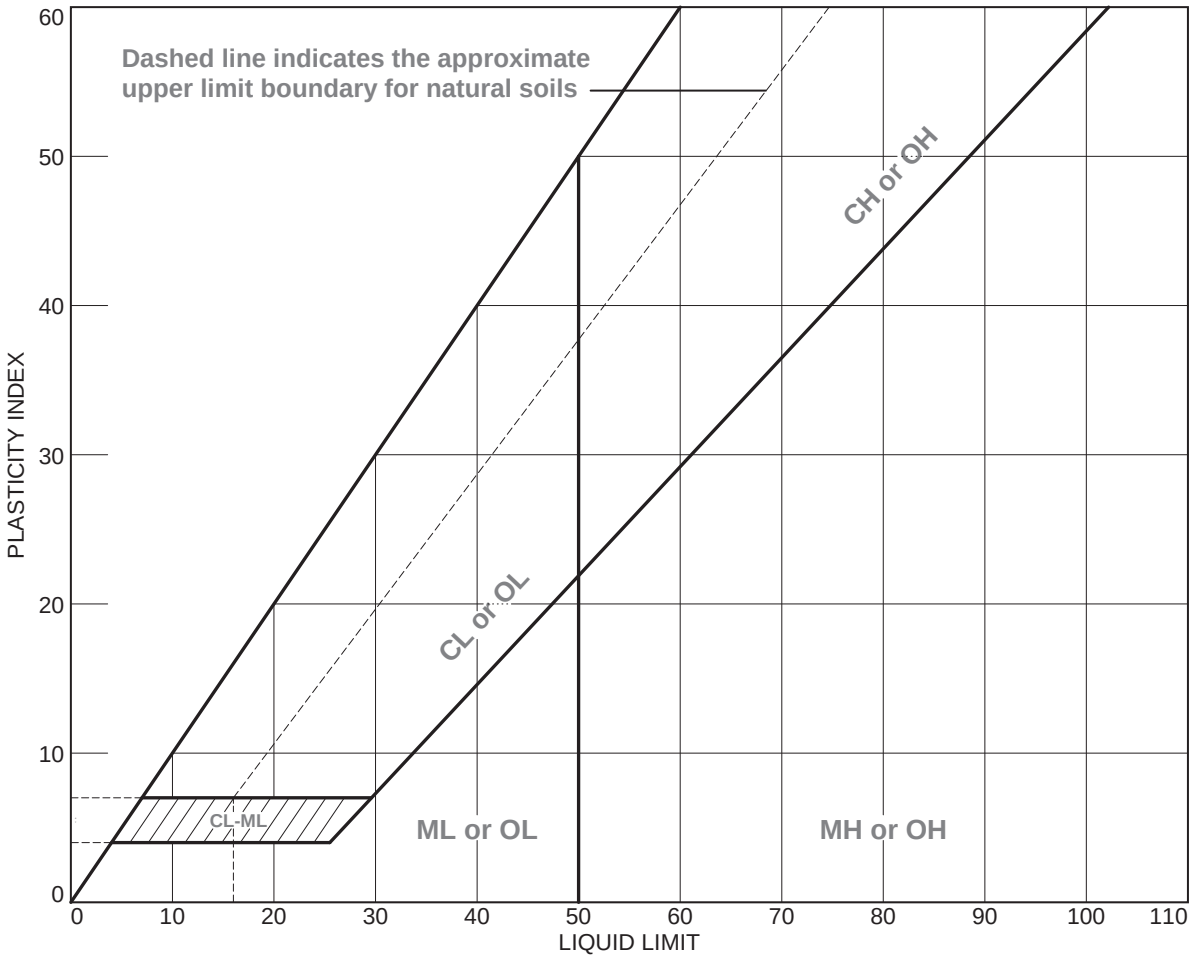
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
232.1	181.3	15.8	30.7

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G023 S-2 5'-6.5'	7992-42	5'-6.5'	151.8		NV		PT

NV = No Value
Note: Indeterminate result due to peat structure preventing reliable test results.

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

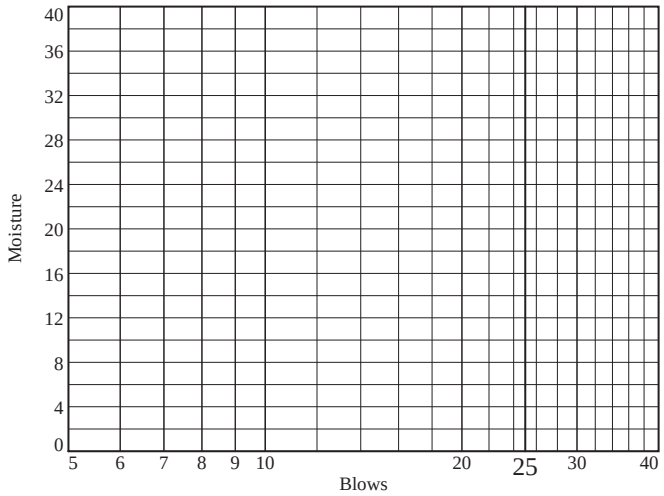
LIQUID AND PLASTIC LIMIT TEST DATA

3/12/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G023 S-2
Depth: 5'-6.5'
Sample Number: 7992-42
Material Description: Peat
USCS: PT
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						

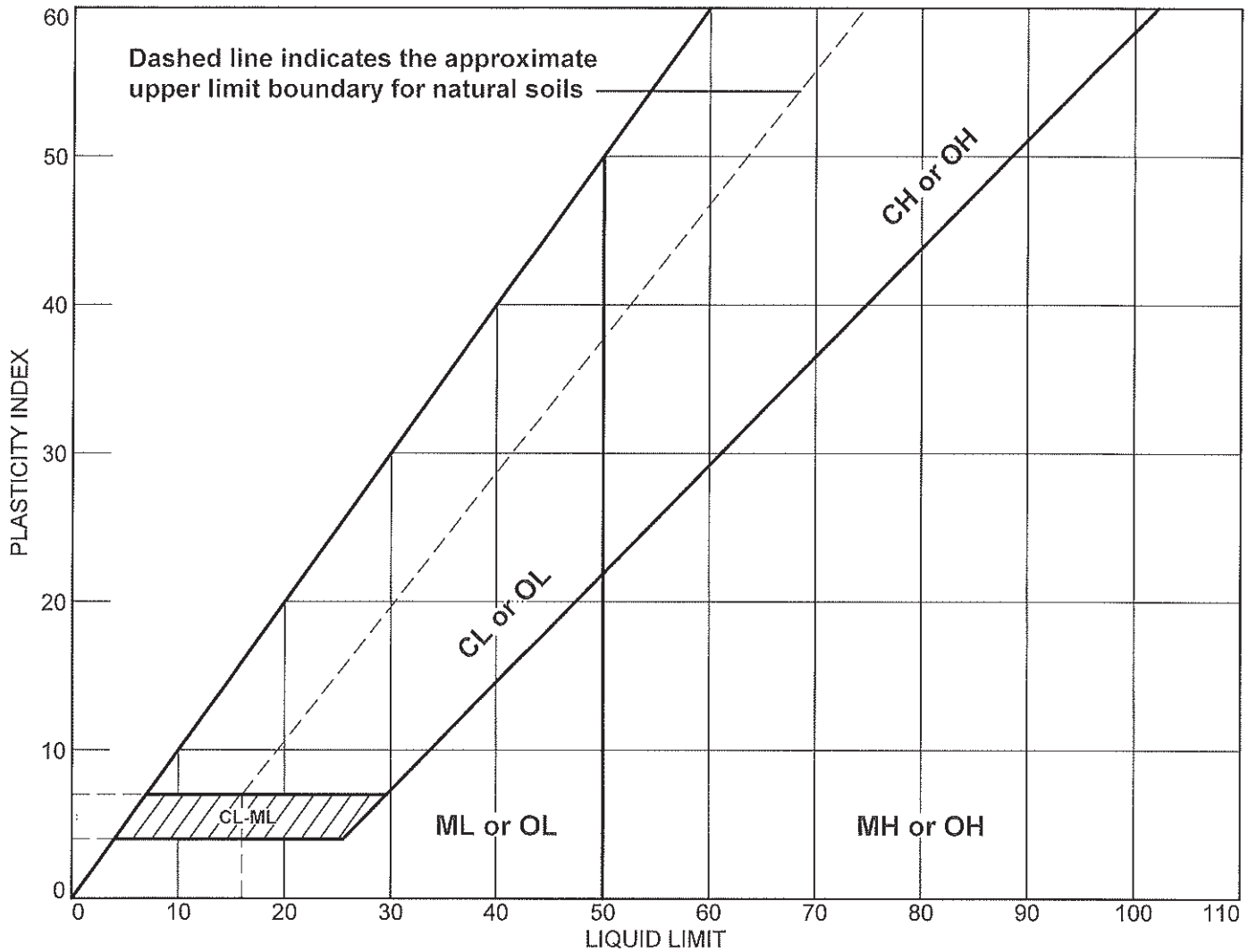


Liquid Limit= NV
Plastic Limit=
Plasticity Index=
Natural Moisture= 151.8

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
329.8	140.5	15.8	151.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G024 S-2 2.5'-4'	7995-3	2.5'-4'	21.8	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

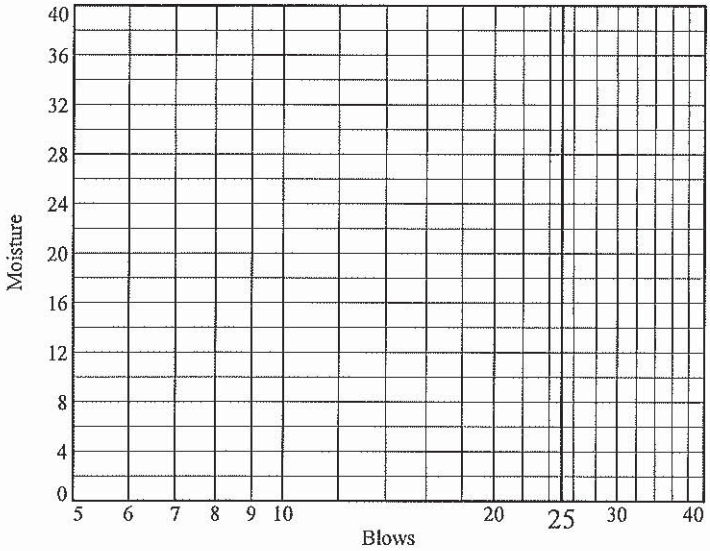
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G024 S-2
Depth: 2.5'-4'
Sample Number: 7995-3
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 21.8

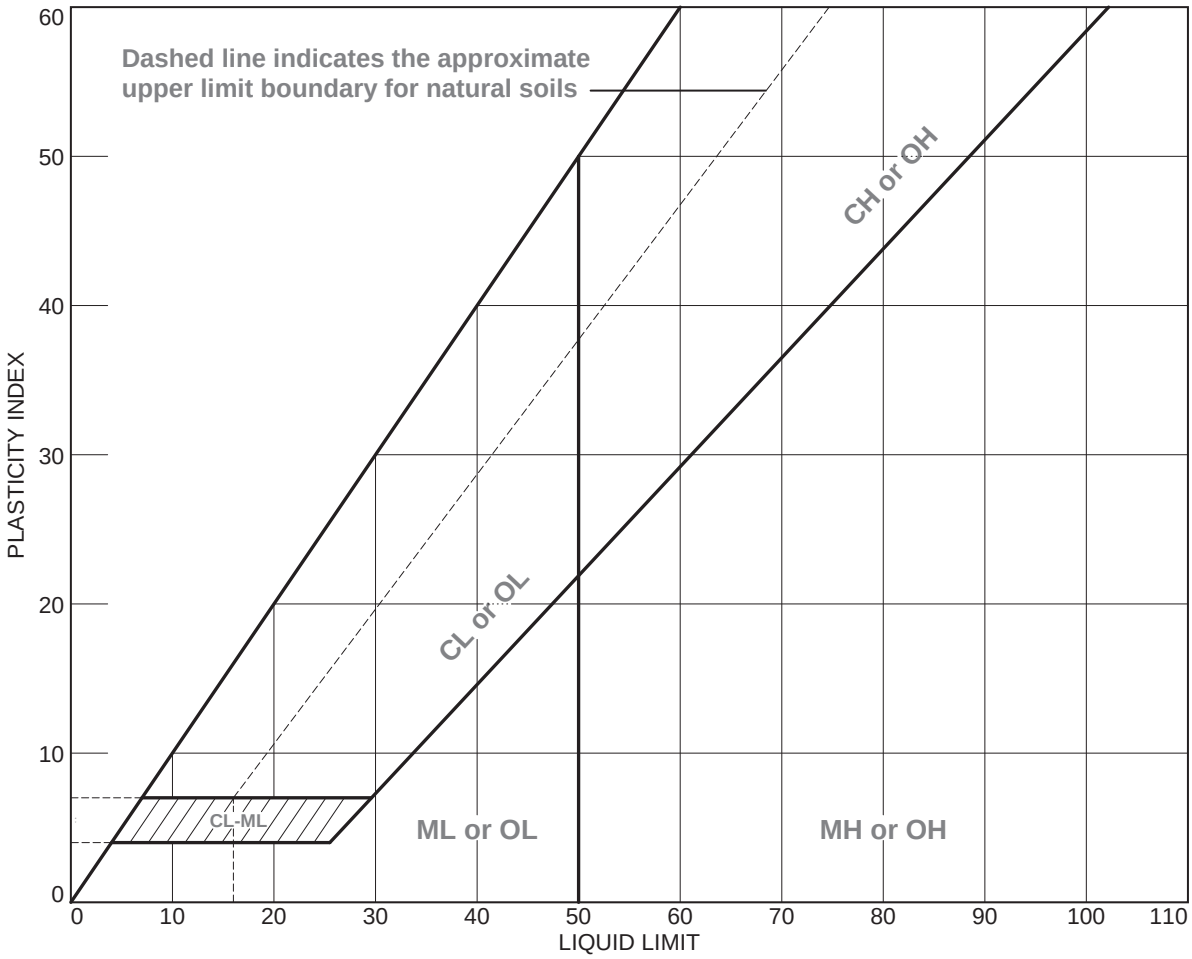
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
293.1	243.4	15.7	21.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G024 S-4 7.5'-9'	7995-5	7.5'-9'	50.0		NV		

NV = No Value
Note: Indeterminate result due to organic structure preventing reliable test results.

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

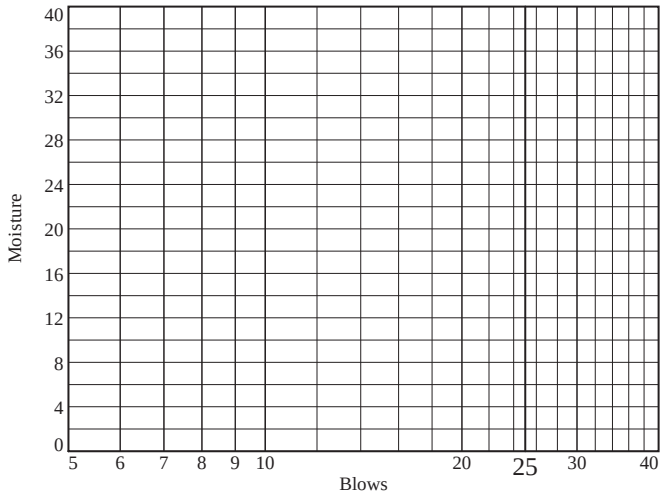
LIQUID AND PLASTIC LIMIT TEST DATA

3/12/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G024 S-4
Depth: 7.5'-9'
Sample Number: 7995-5
Material Description: Silt with organics
USCS: NA
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						

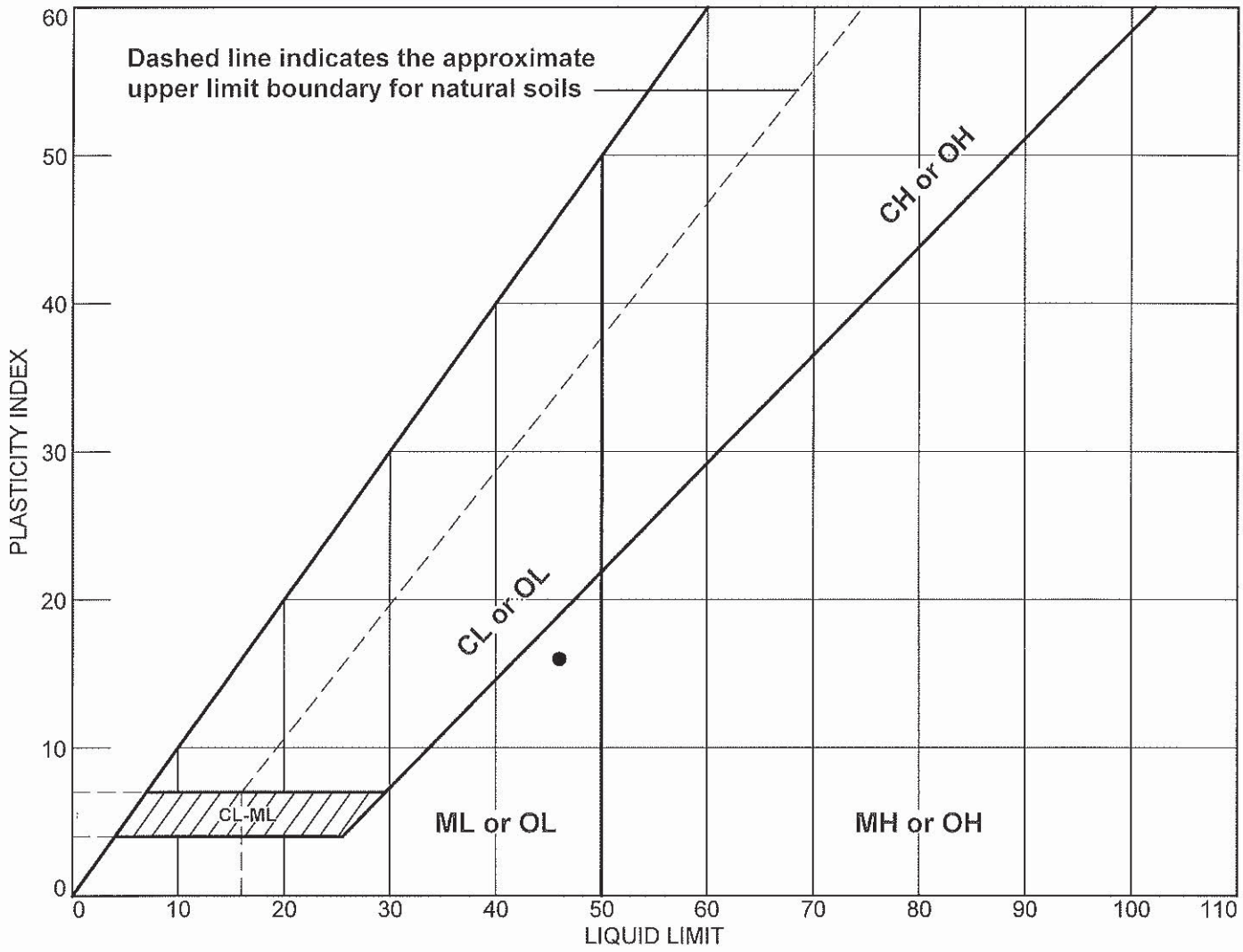


Liquid Limit= NV
Plastic Limit=
Plasticity Index=
Natural Moisture= 50.0

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
332.2	226.8	15.8	50.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G024 S-5A 10'-11.5'	7995-6	10'-11.5'	54.6	30	46	16	OL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

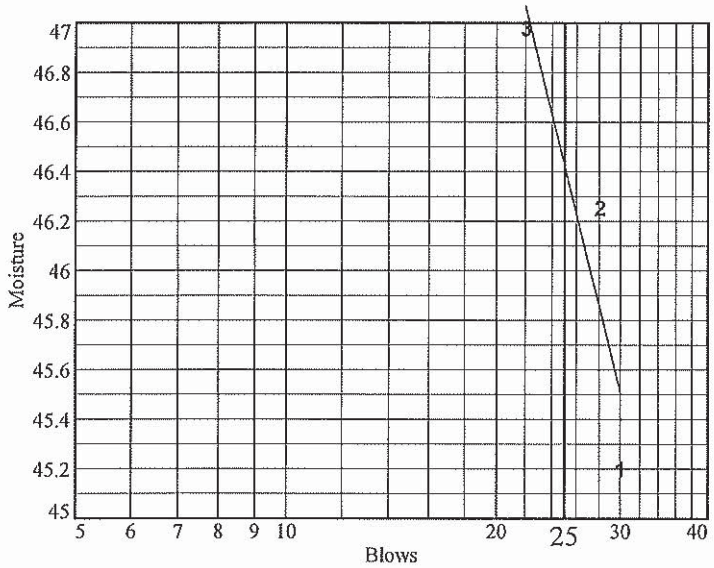
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G024 S-5A
Depth: 10'-11.5'
Sample Number: 7995-6
USCS: OL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	32.83	30.32	29.85			
Dry+Tare	26.85	25.01	24.64			
Tare	13.62	13.53	13.55			
# Blows	30	28	22			
Moisture	45.2	46.3	47.0			



Liquid Limit= 46
Plastic Limit= 30
Plasticity Index= 16
Natural Moisture= 54.6
Liquidity Index= 1.5

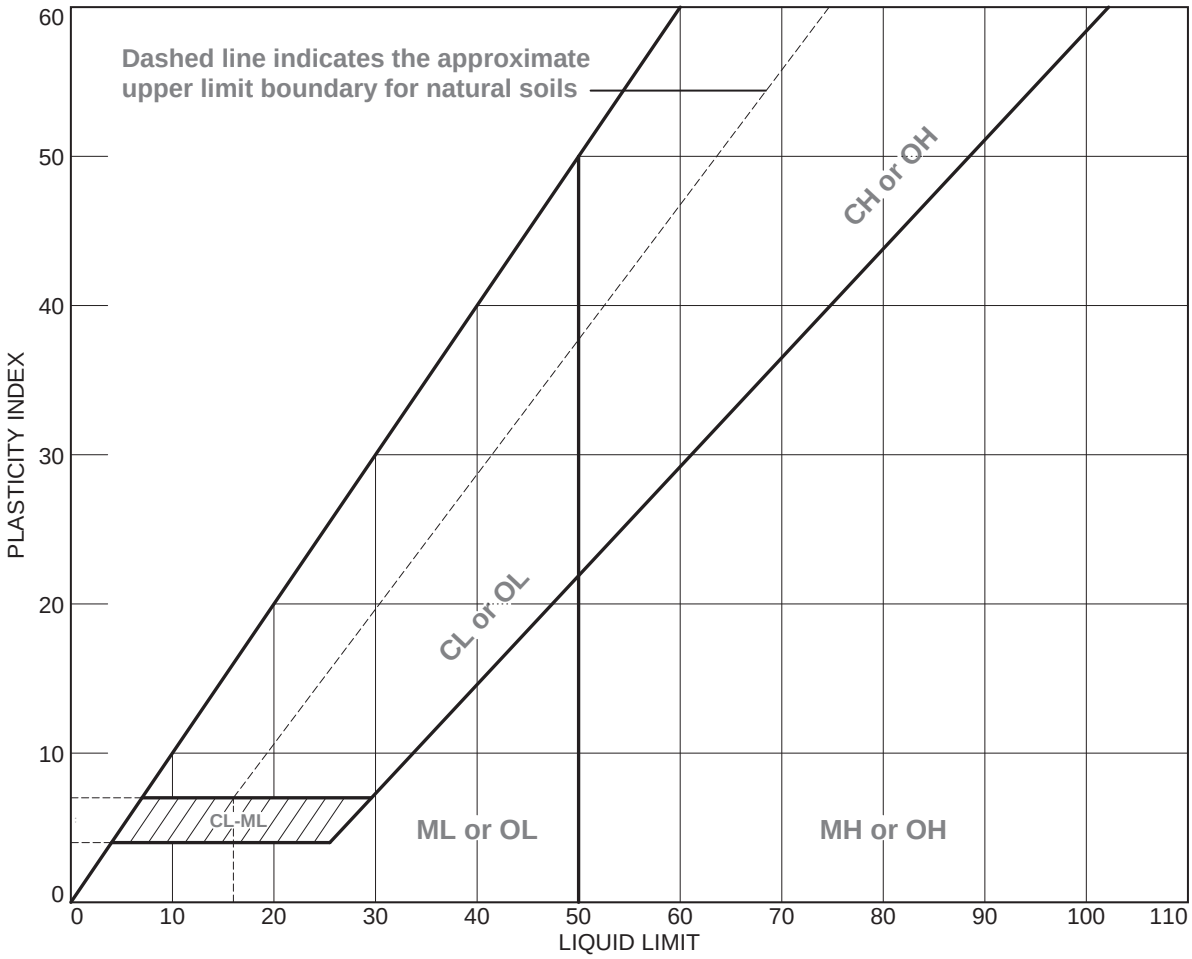
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.44	21.44	21.44		
Dry+Tare	19.67	19.67	19.67		
Tare	13.69	13.69	13.69		
Moisture	29.6	29.6	29.6		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
333.5	221.2	15.7	54.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G024 S5B 10'-11.5'	7995-7	10'-11.5'	161.9		NV		PT

NV = No Value
Note: Indeterminate result due to peat structure preventing reliable test results.

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

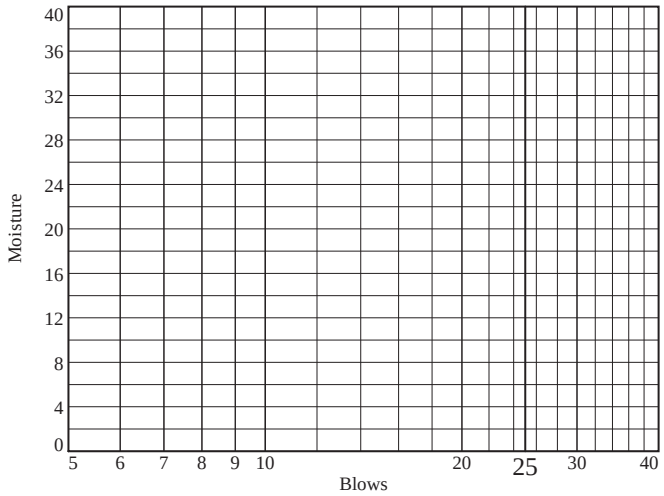
LIQUID AND PLASTIC LIMIT TEST DATA

3/12/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G024 S-5B
Depth: 10'-11.5'
Sample Number: 7995-7
Material Description: Peat
USCS: PT
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						

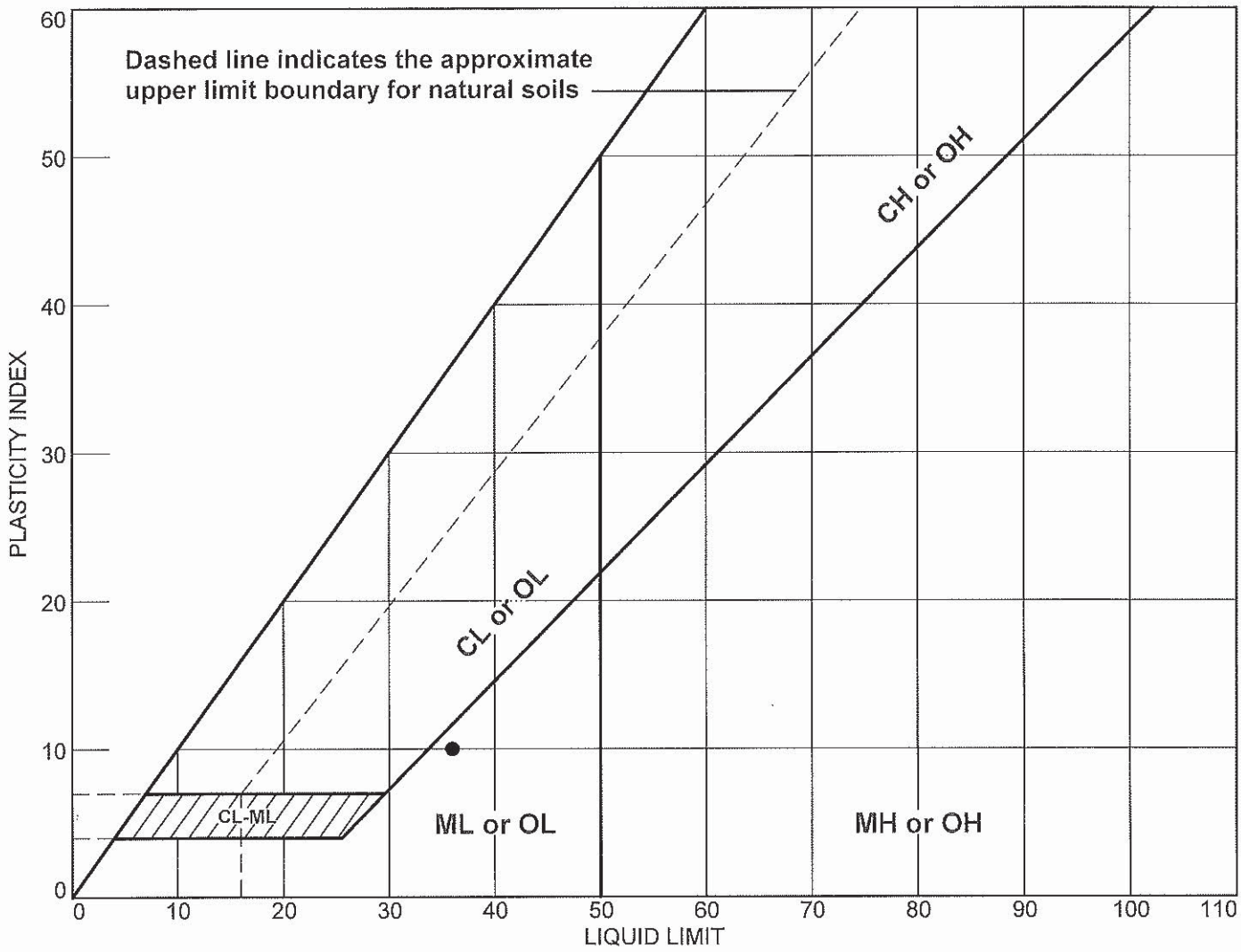


Liquid Limit= NV
Plastic Limit=
Plasticity Index=
Natural Moisture= 161.9

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
198.0	85.3	15.7	161.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G025 S-3 10'-11.5'	7995-11	10'-11.5'	37.7	26	36	10	ML

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

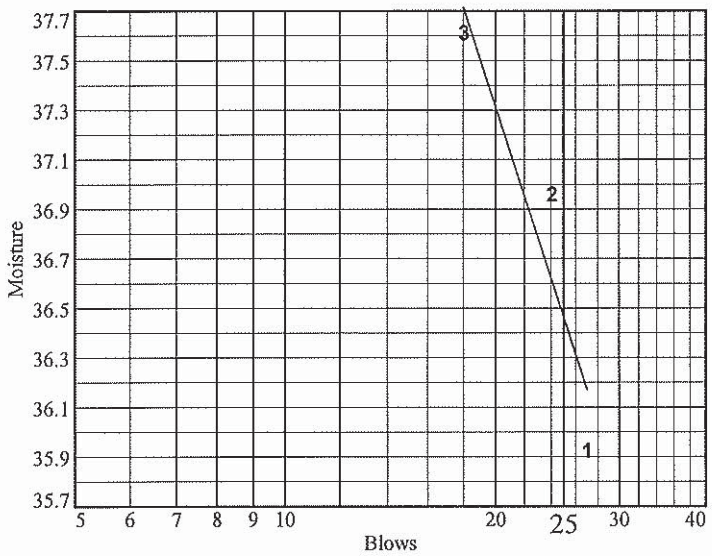
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G025 S-3
Depth: 10'-11.5'
Sample Number: 7995-11
USCS: ML
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	33.62	30.55	31.66			
Dry+Tare	28.31	26.00	26.74			
Tare	13.53	13.69	13.66			
# Blows	27	24	18			
Moisture	35.9	37.0	37.6			



Liquid Limit= 36
Plastic Limit= 26
Plasticity Index= 10
Natural Moisture= 37.7
Liquidity Index= 1.2

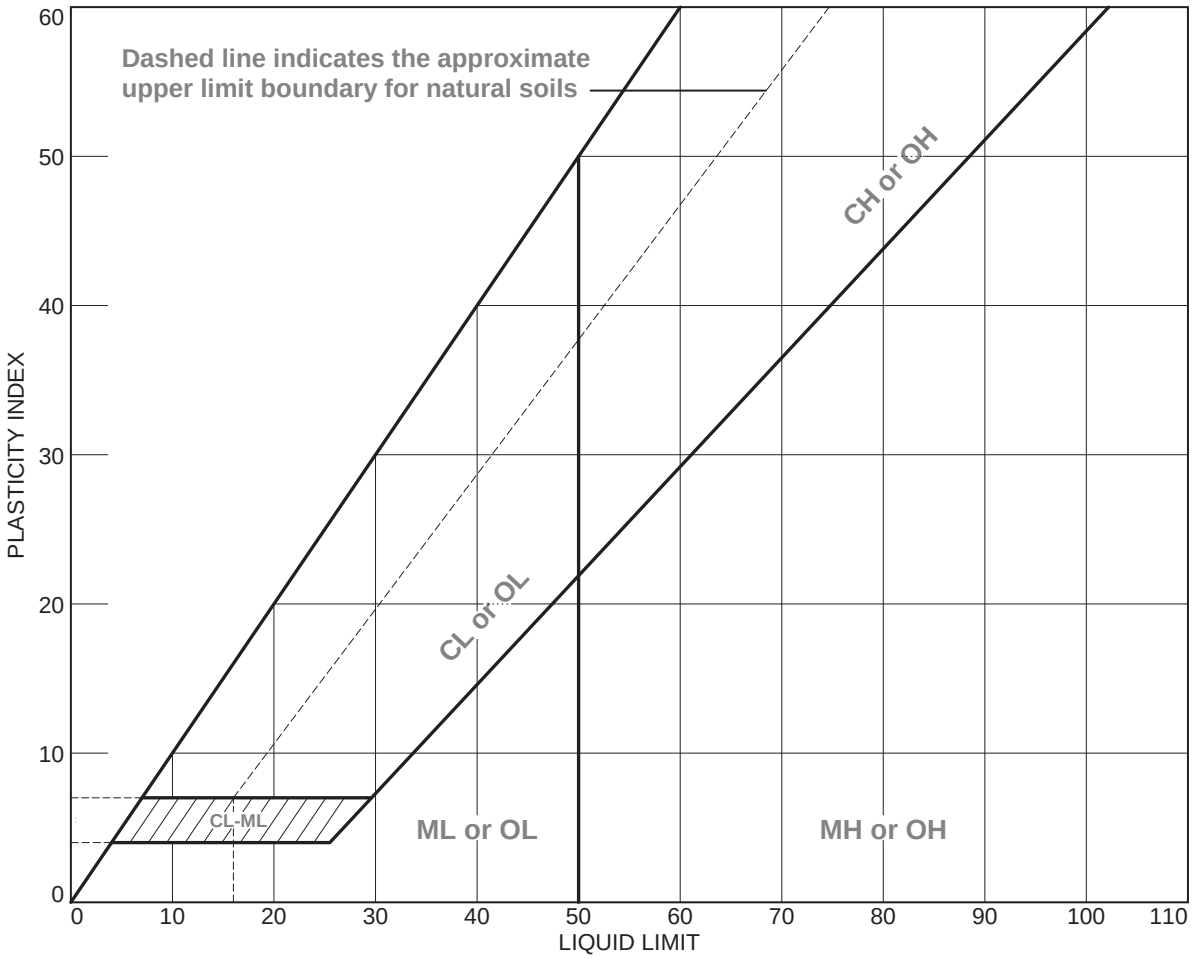
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.92	20.92	20.92		
Dry+Tare	19.42	19.42	19.42		
Tare	13.69	13.69	13.69		
Moisture	26.2	26.2	26.2		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
323.5	239.2	15.6	37.7

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G025 S-4A 15'-16.5'	7995-12	15'-16.5'	215.9		NV		PT

NV = No Value
Note: Indeterminate result due to peat structure preventing reliable test results.

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

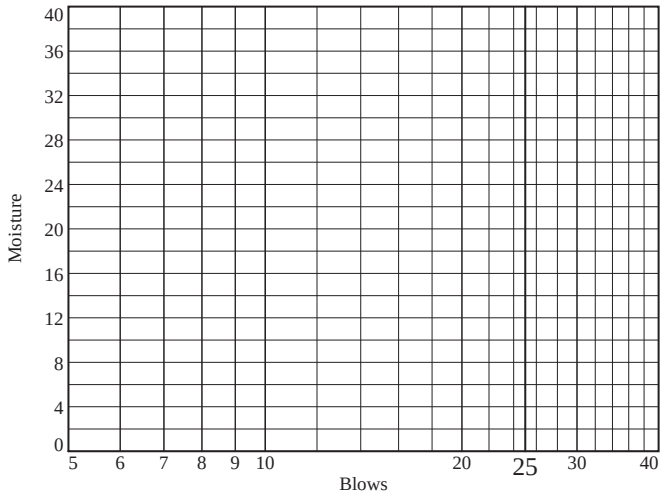
LIQUID AND PLASTIC LIMIT TEST DATA

3/12/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G025 S-4A
Depth: 15'-16.5'
Sample Number: 7995-12
Material Description: Peat
USCS: NA
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						

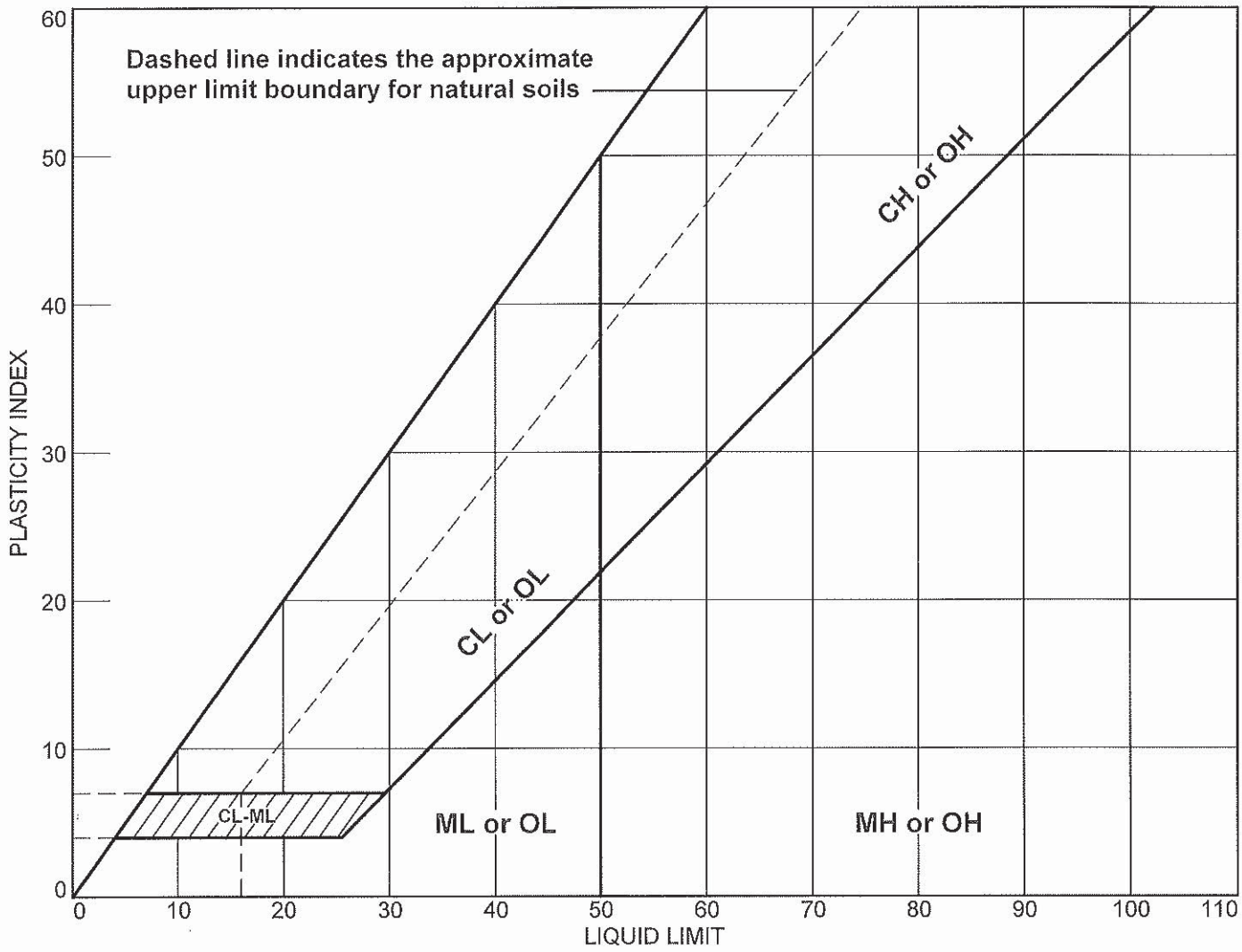


Liquid Limit= NV
Plastic Limit=
Plasticity Index=
Natural Moisture= 215.9

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
260.1	93.0	15.6	215.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G031 S-1 2.5'-4.0'	7995-28	2.5'-4.0'	14.3	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

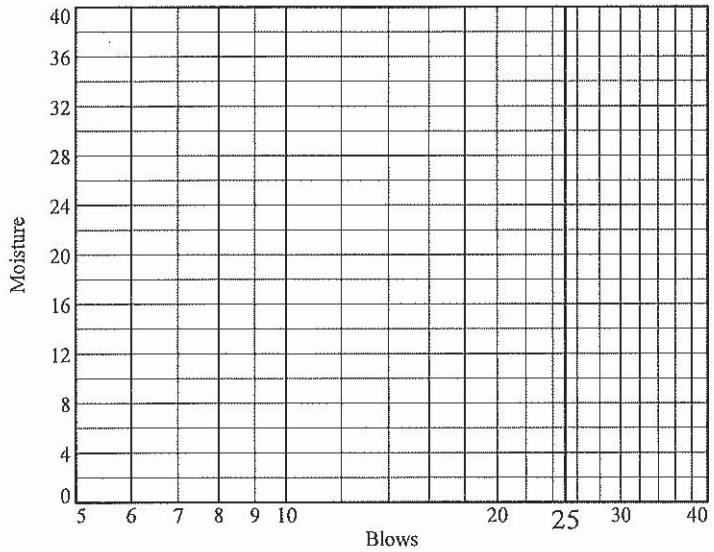
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-1
Depth: 2.5'-4.0'
Sample Number: 7995-28
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 14.3

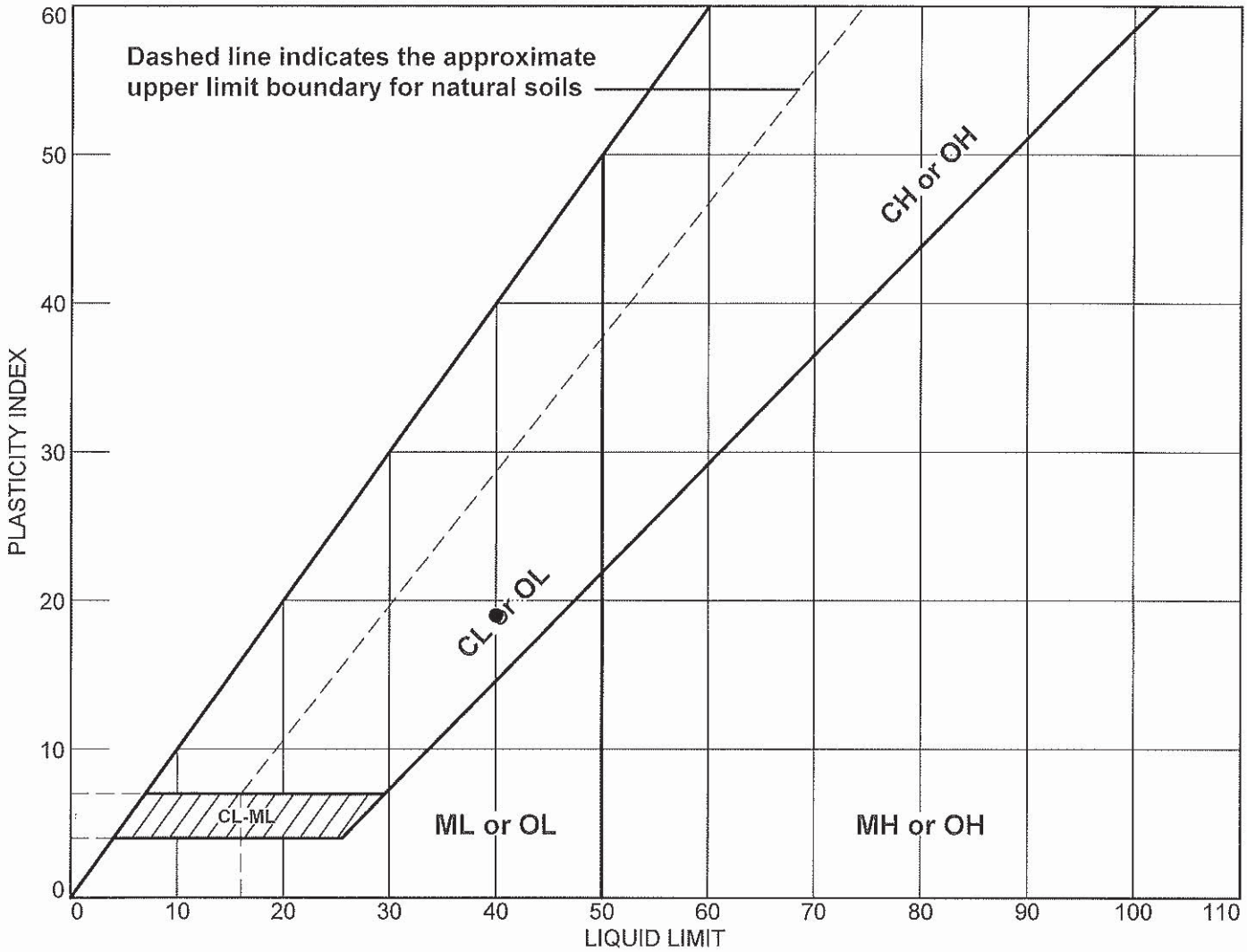
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
133.0	118.3	15.8	14.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G031 S-20 95'-96.5'	7795-34	95'-96.5'	37.8	21	40	19	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

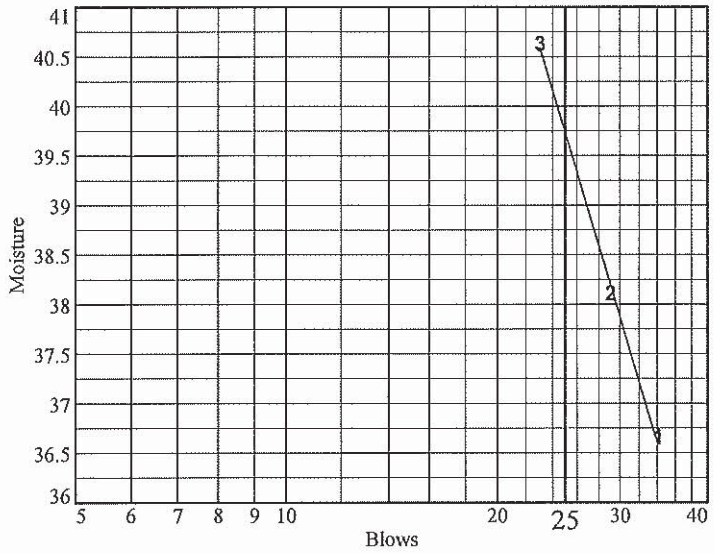
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-20
Depth: 95'-96.5'
Sample Number: 7795-34
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	31.36	30.67	27.69			
Dry+Tare	26.59	25.94	23.61			
Tare	13.58	13.53	13.57			
# Blows	34	29	23			
Moisture	36.7	38.1	40.6			



Liquid Limit= 40
Plastic Limit= 21
Plasticity Index= 19
Natural Moisture= 37.8
Liquidity Index= 0.9

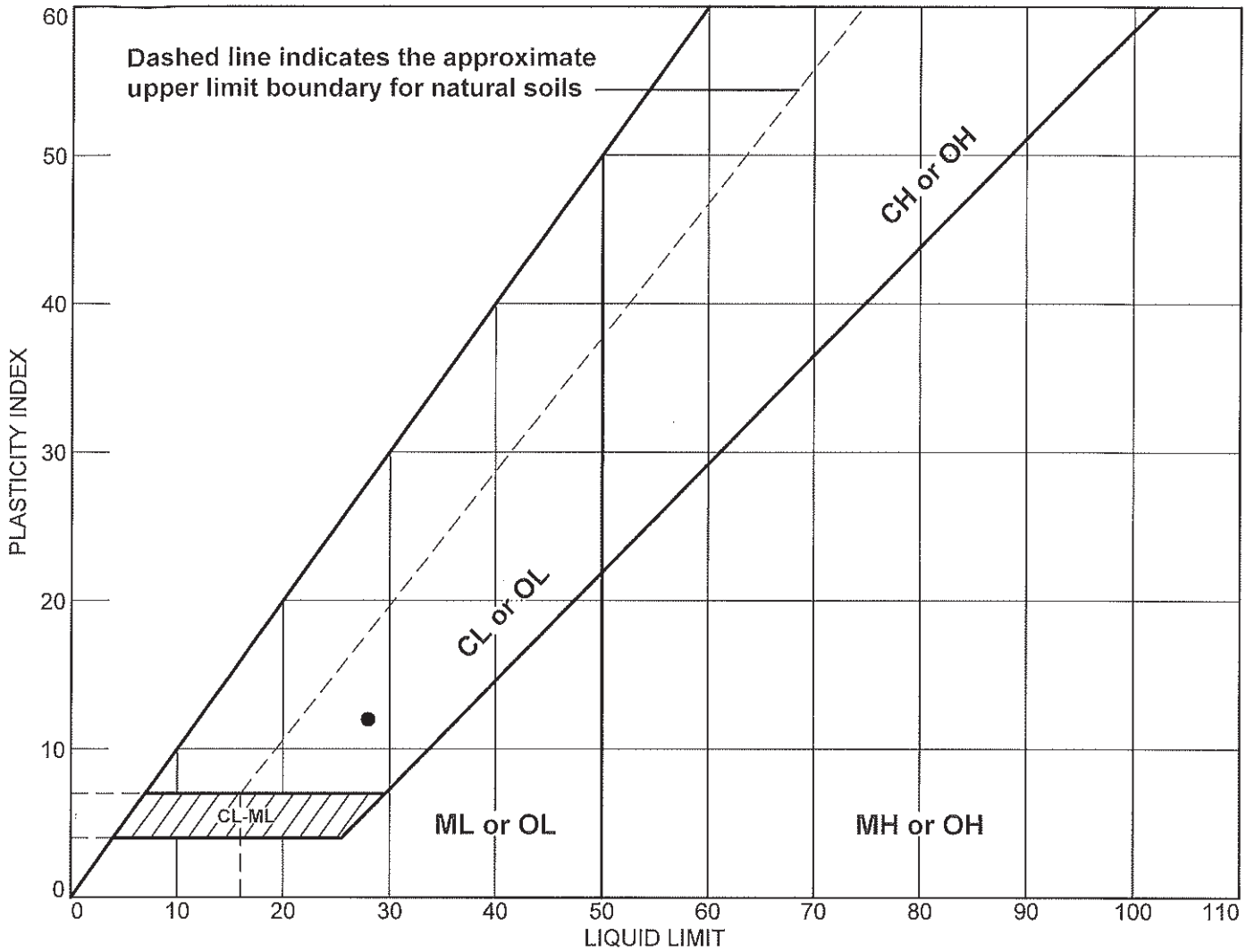
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.76	20.76	20.76		
Dry+Tare	19.50	19.50	19.50		
Tare	13.62	13.62	13.62		
Moisture	21.4	21.4	21.4		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
408.2	300.6	15.8	37.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G031 S-21 110'-111.5'	7995-35	110'-111.5'	30.6	16	28	12	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH/JR **Checked By:** JAM

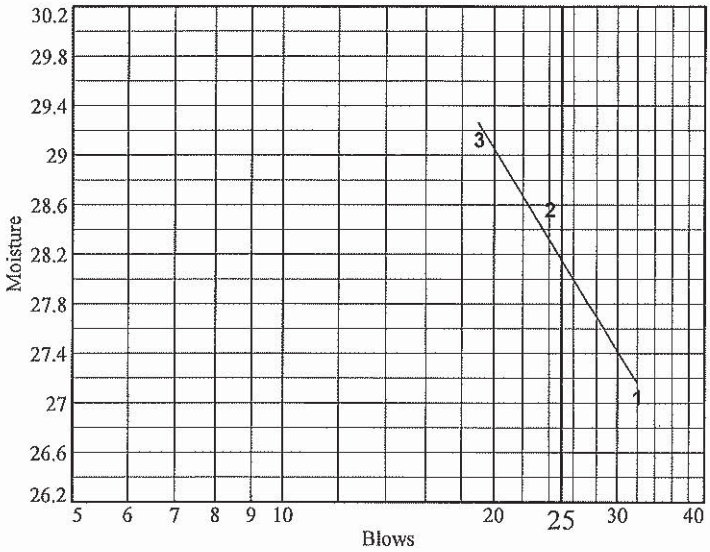
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-21
Depth: 110'-111.5'
Sample Number: 7995-35
USCS: CL
Tested by: BH/JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	37.89	34.08	33.94			
Dry+Tare	32.74	29.53	29.37			
Tare	13.70	13.60	13.68			
# Blows	32	24	19			
Moisture	27.0	28.6	29.1			



Liquid Limit= 28
Plastic Limit= 16
Plasticity Index= 12
Natural Moisture= 30.6
Liquidity Index= 1.2

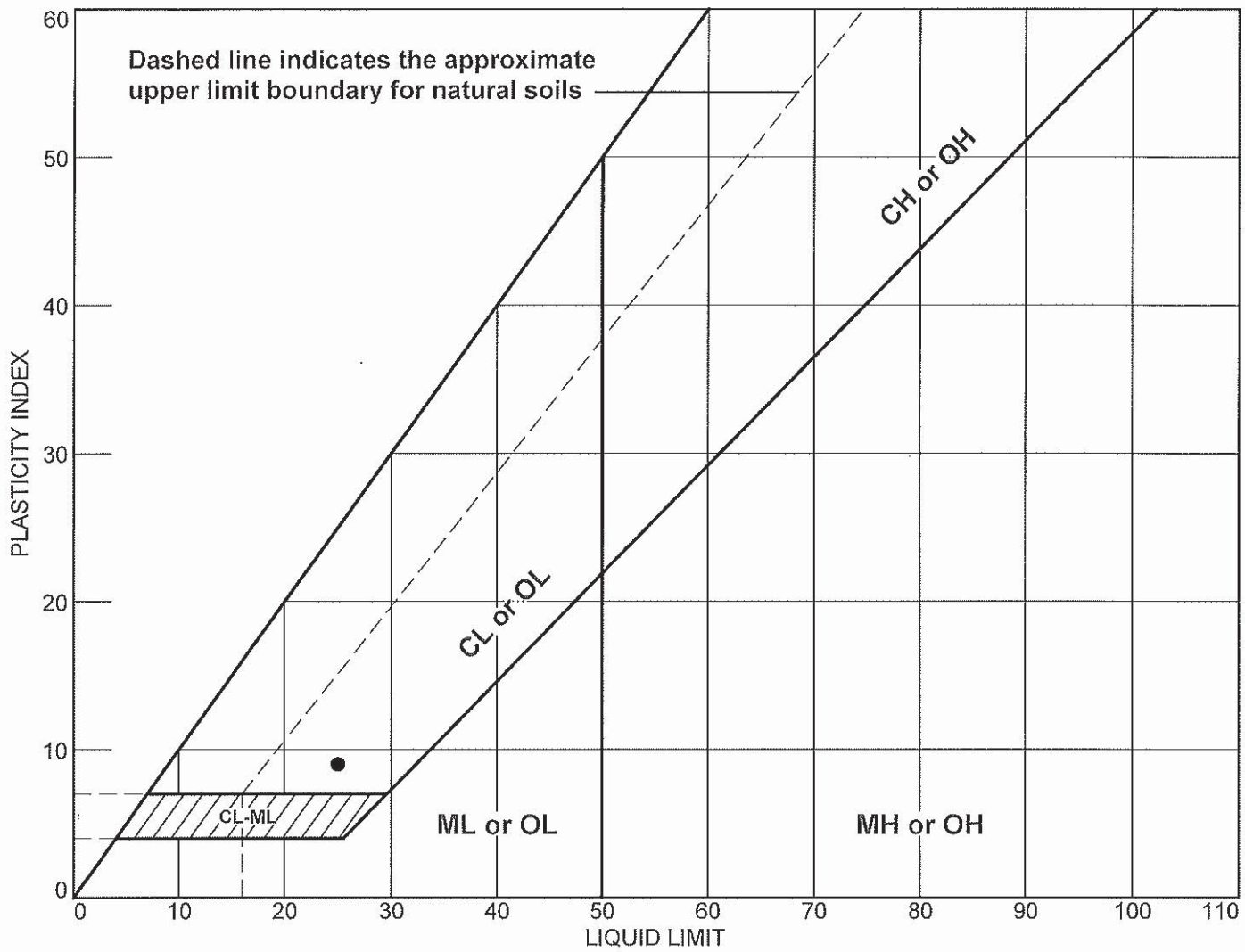
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.37	23.37	23.37		
Dry+Tare	21.99	21.99	21.99		
Tare	13.61	13.61	13.61		
Moisture	16.5	16.5	16.5		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
402.6	312.0	15.8	30.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	GO31 S-24 115'-116.5'	7995-37	115'-116.5'	15.0	16	25	9	

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

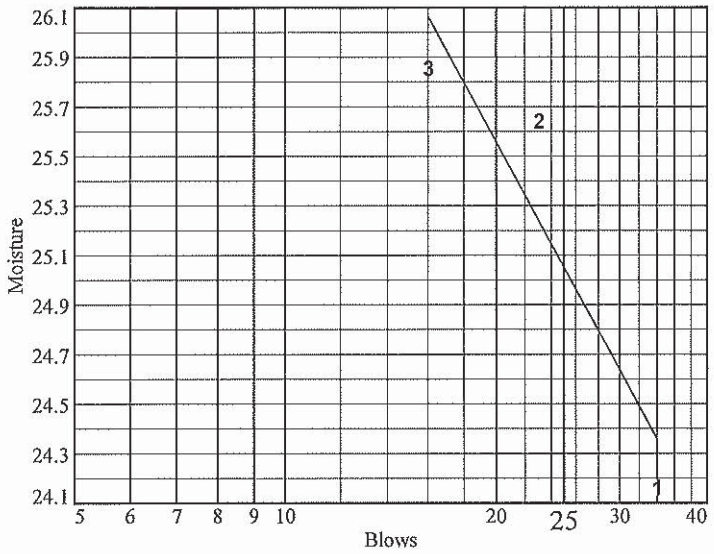
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-24
Depth: 115'-116.5'
Sample Number: 7995-37
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	25.15	27.29	25.78			
Dry+Tare	22.91	24.50	23.29			
Tare	13.64	13.62	13.66			
# Blows	34	23	16			
Moisture	24.2	25.6	25.9			



Liquid Limit= 25
Plastic Limit= 16
Plasticity Index= 9
Natural Moisture= 15.0
Liquidity Index= -0.1

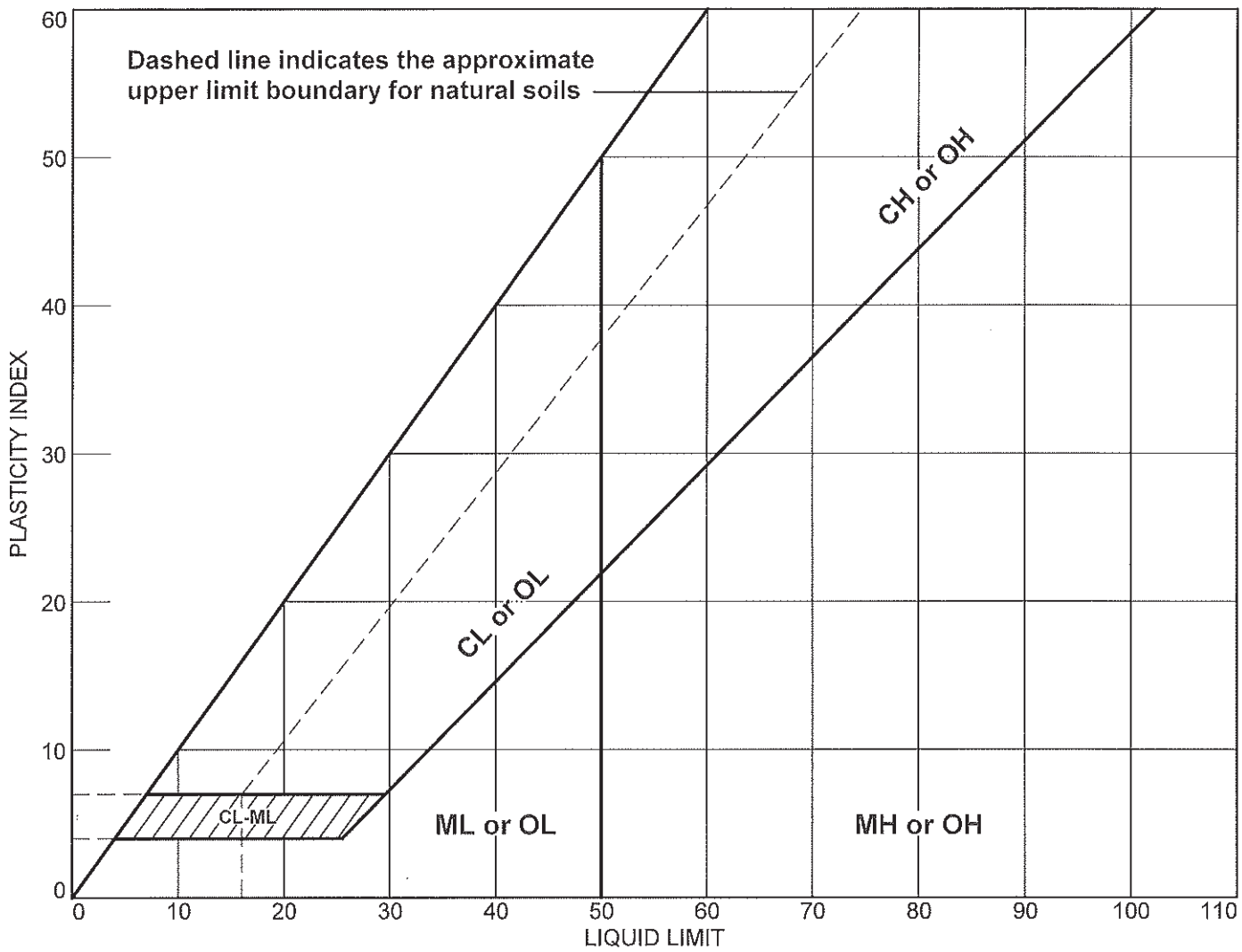
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.77	20.77	20.77		
Dry+Tare	19.82	19.82	19.82		
Tare	13.70	13.70	13.70		
Moisture	15.5	15.5	15.5		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
344.8	301.8	16.0	15.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G031 S-25 120'-121.5'	7995-38	120'-121.5'	25.3	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

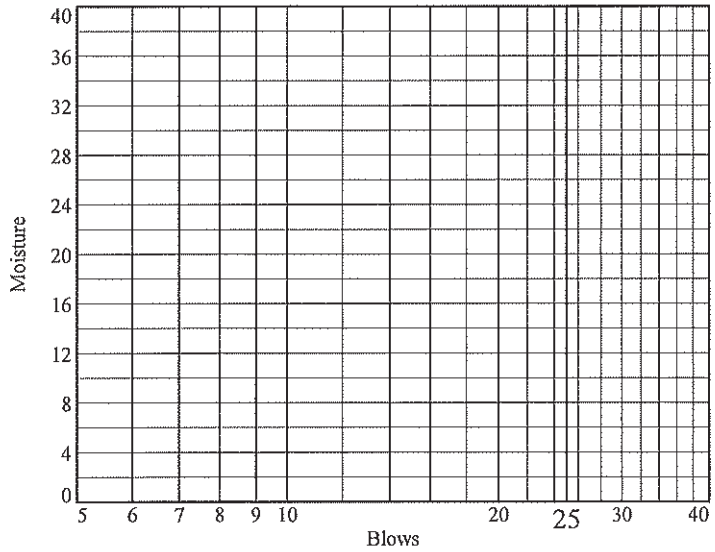
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-25
Depth: 120'-121.5'
Sample Number: 7995-38
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 25.3

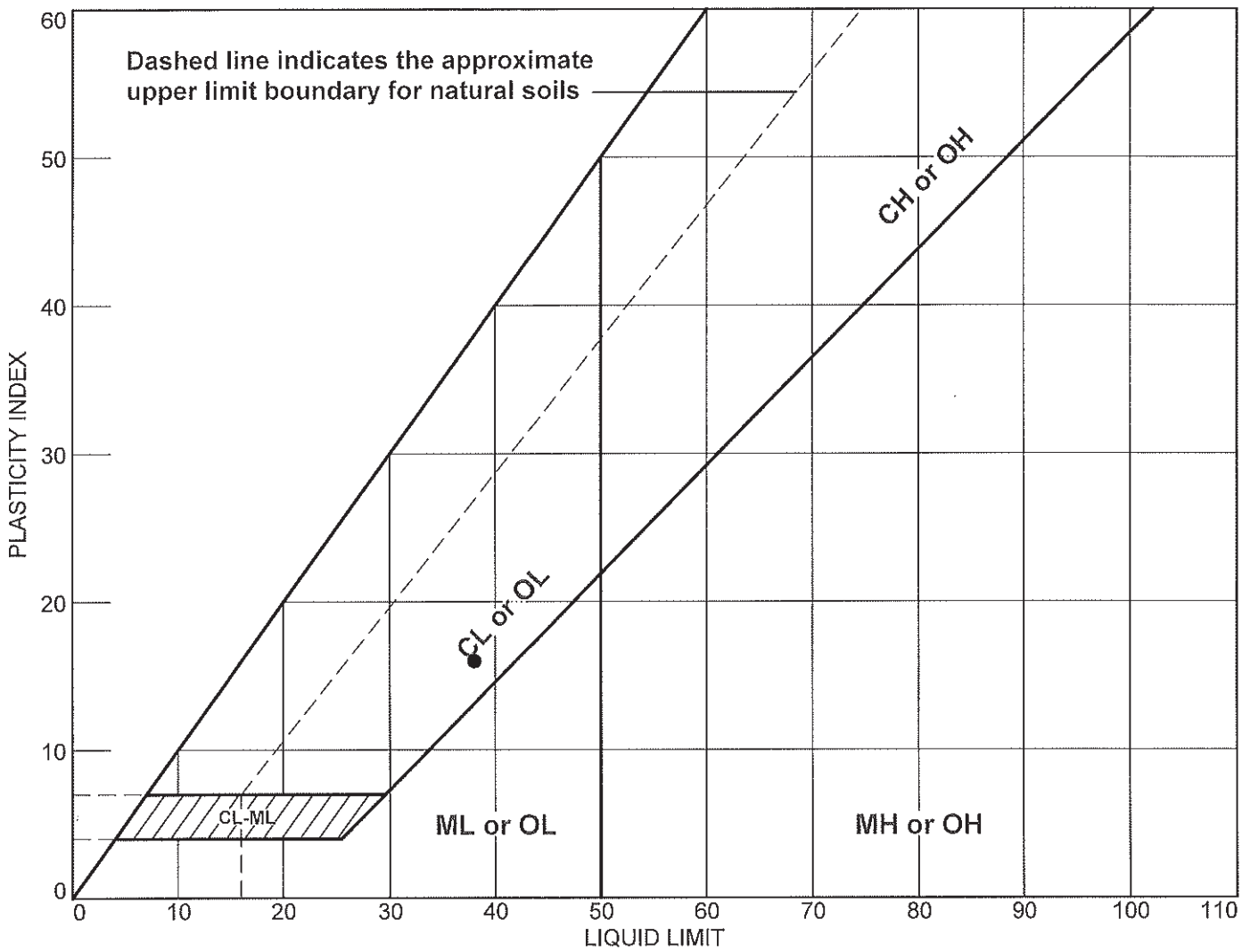
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
227.2	184.6	16.1	25.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	GO31 S-26 125'-126.5'	7995-39	125'-126.5'	35.4	22	38	16	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

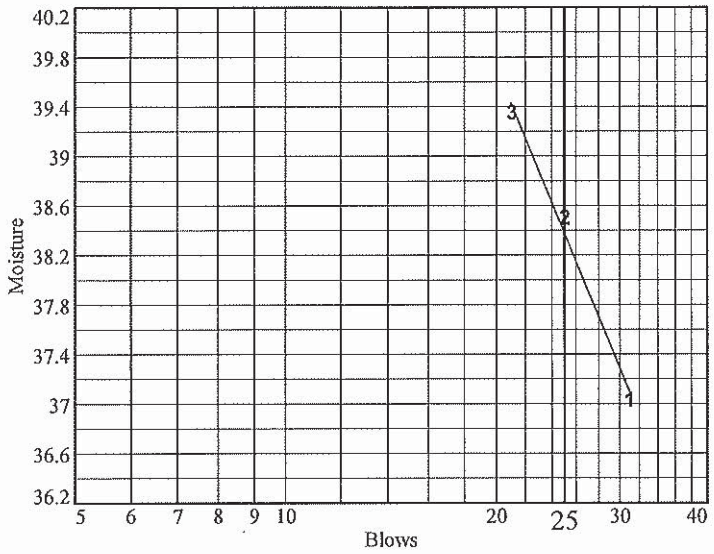
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-26
Depth: 125'-126.5'
Sample Number: 7995-39
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	25.38	24.90	27.50			
Dry+Tare	22.38	21.75	23.58			
Tare	14.28	13.57	13.62			
# Blows	31	25	21			
Moisture	37.0	38.5	39.4			



Liquid Limit= 38
Plastic Limit= 22
Plasticity Index= 16
Natural Moisture= 35.4
Liquidity Index= 0.8

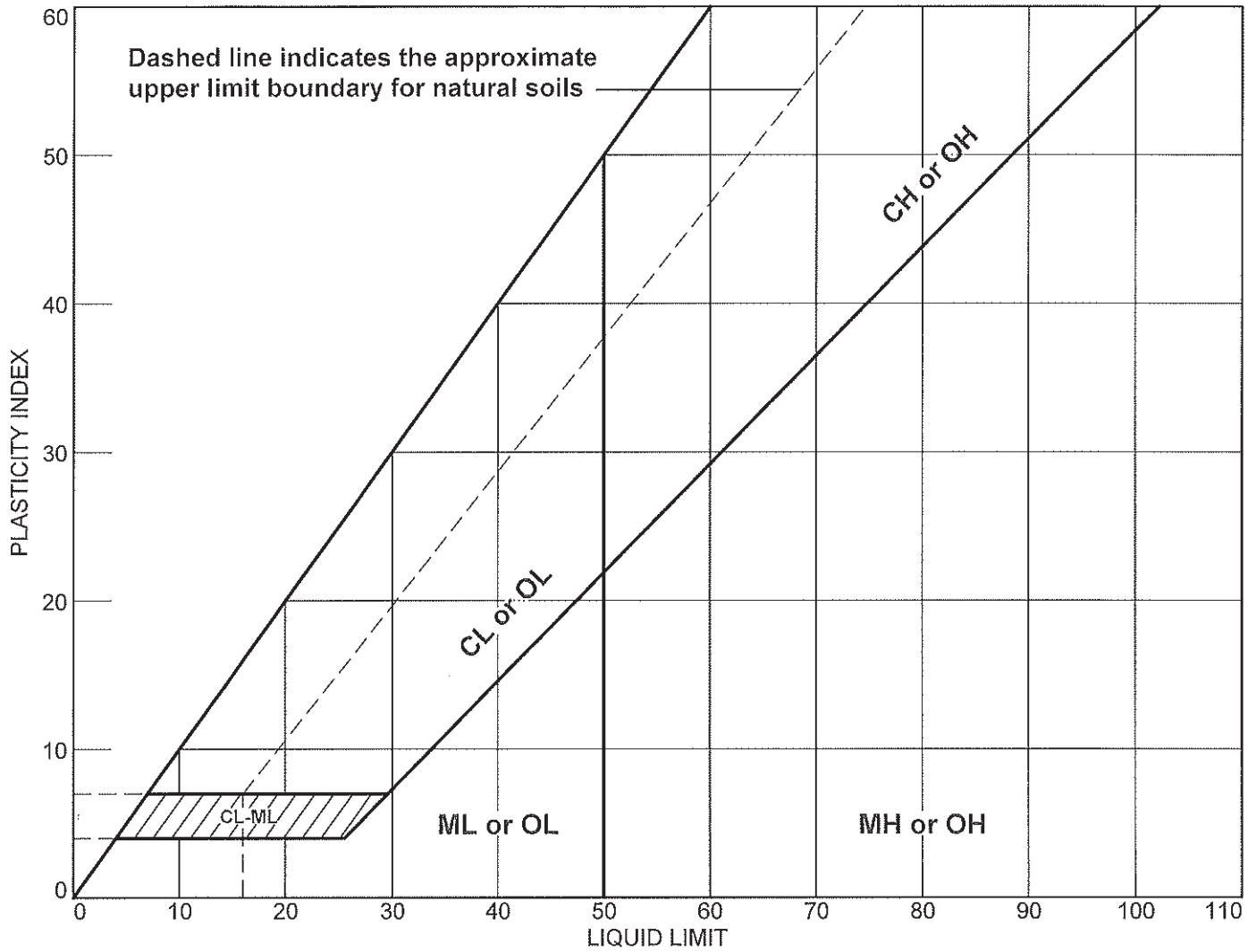
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.78	20.78	20.78		
Dry+Tare	19.51	19.51	19.51		
Tare	13.75	13.75	13.75		
Moisture	22.0	22.0	22.0		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
267.7	201.9	15.8	35.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G031 S-30 145'-146.5'	7995-41	145'-146.5	46.6	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

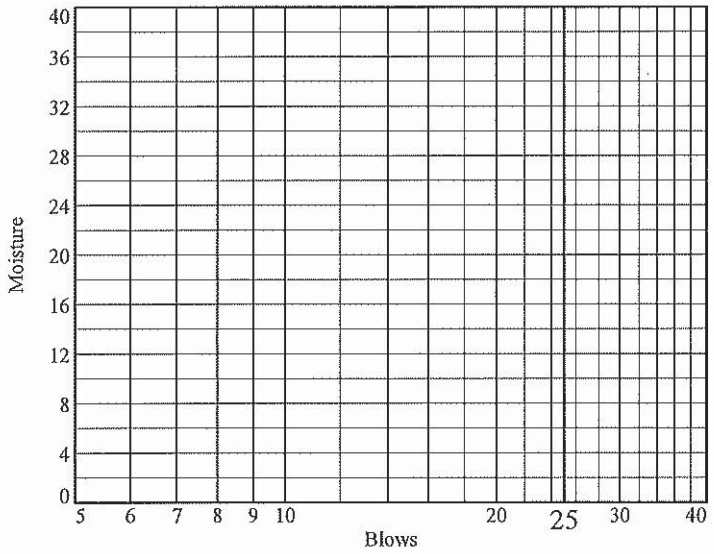
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-30
Depth: 145'-146.5
Sample Number: 7995-41
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 46.6

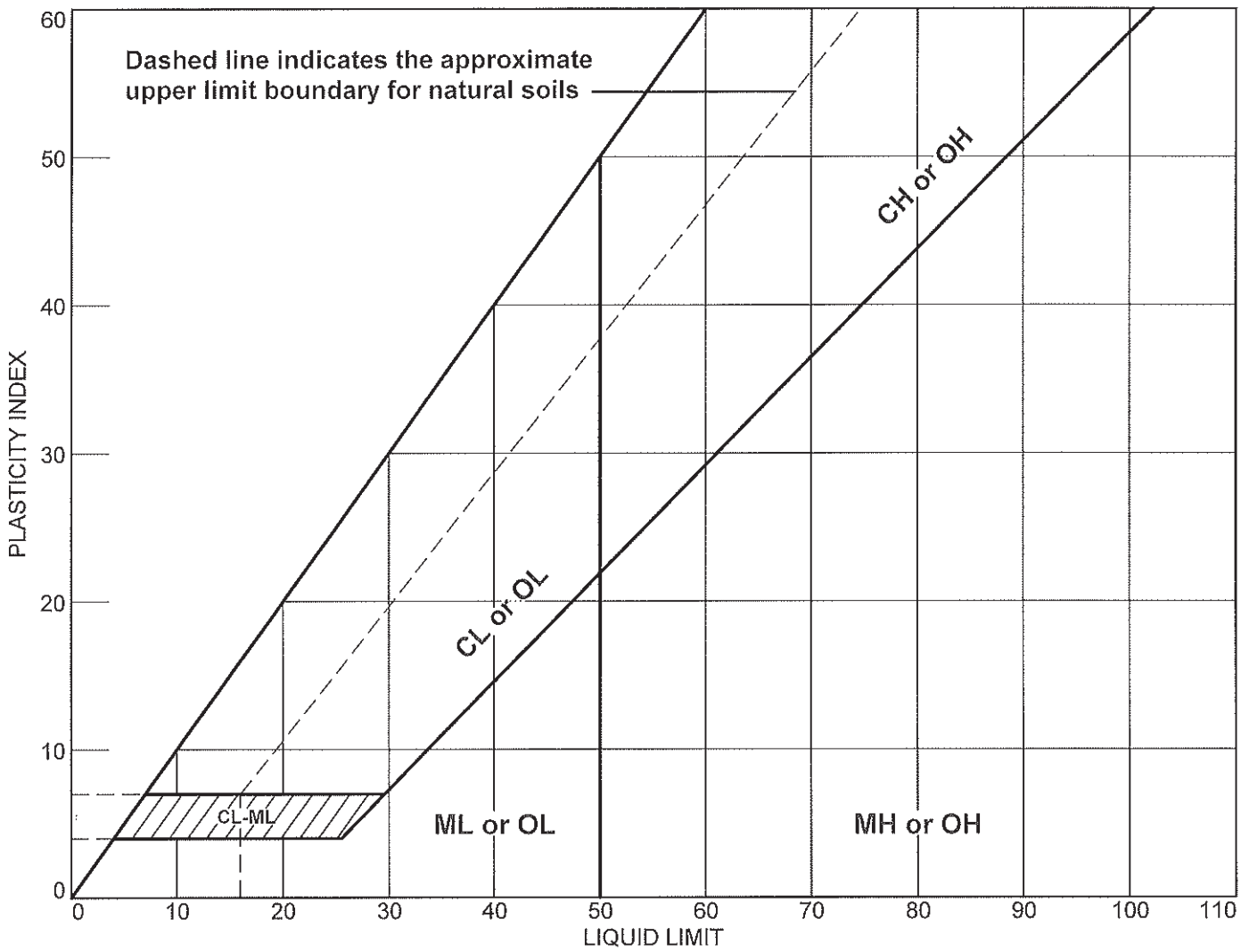
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
548.0	378.8	16.0	46.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G031 S-31 150'-151.5'	7995-42	150'-151.5'	27.8	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

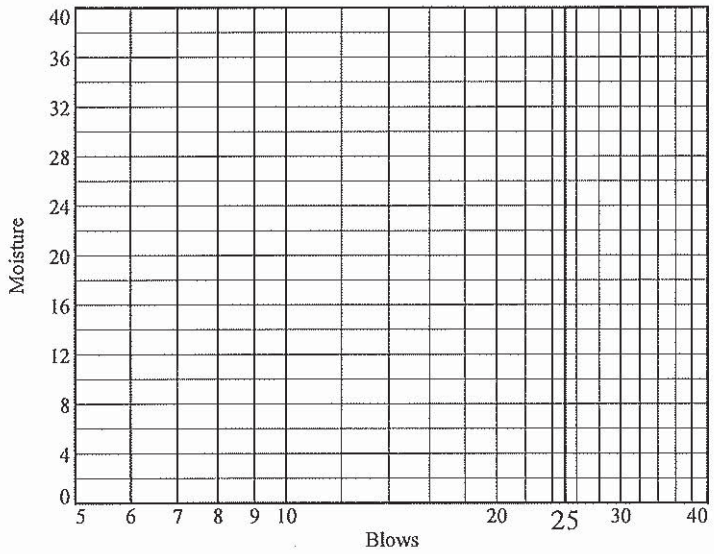
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G031 S-31
Depth: 150'-151.5'
Sample Number: 7995-42
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 27.8

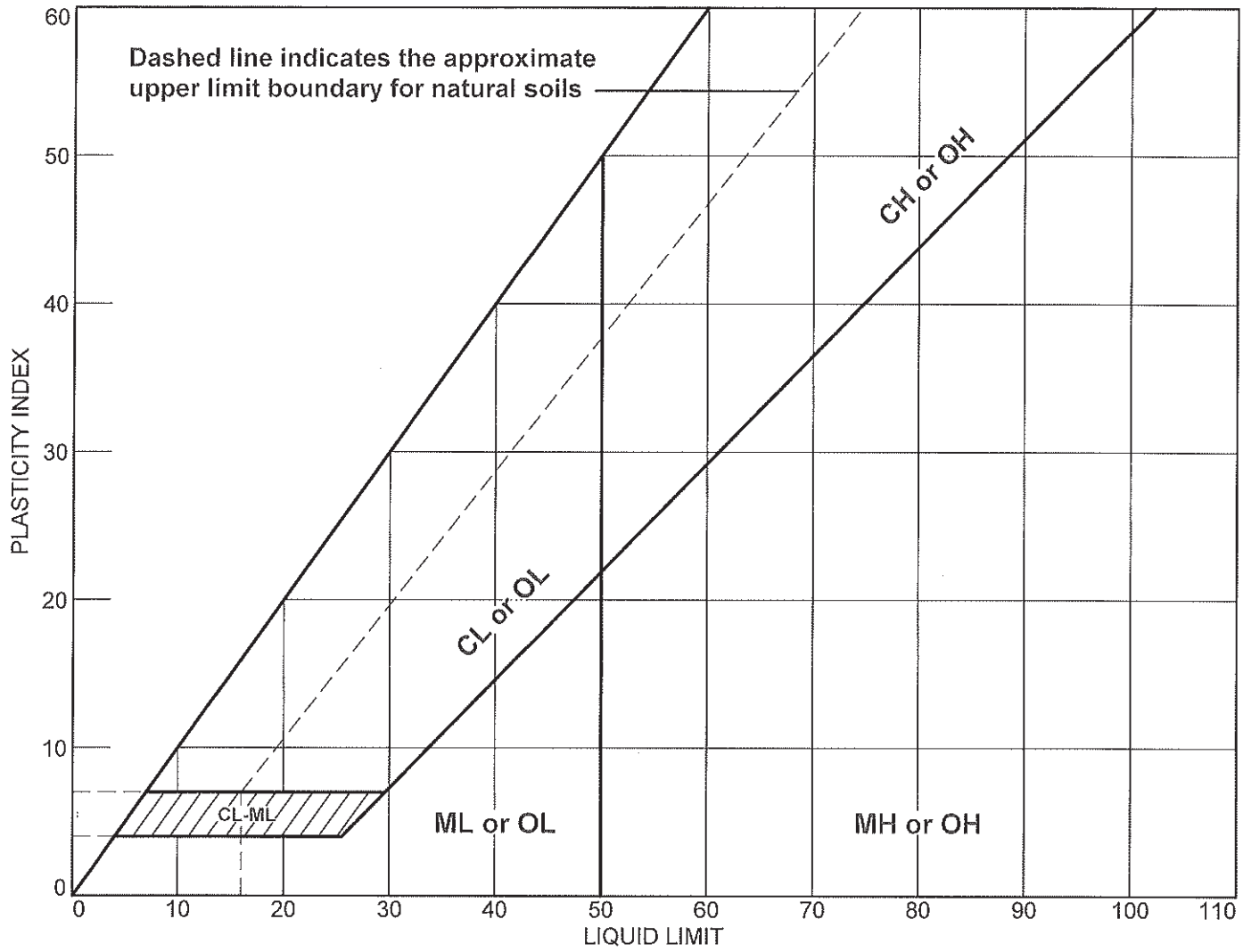
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
563.4	444.3	15.7	27.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G032 S-4A 10'-11.5'	8000-4	10'-11.5'	54.8	NP	NV	NP	N/A

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

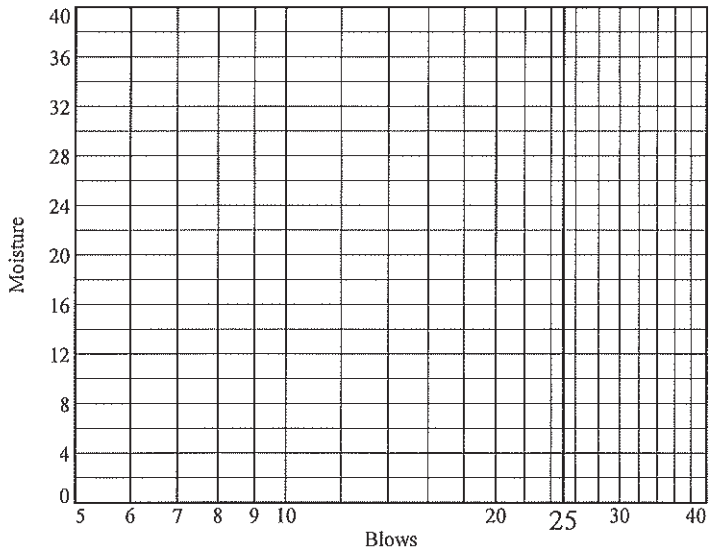
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-4A
Depth: 10'-11.5'
Sample Number: 8000-4
USCS: N/A
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 54.8

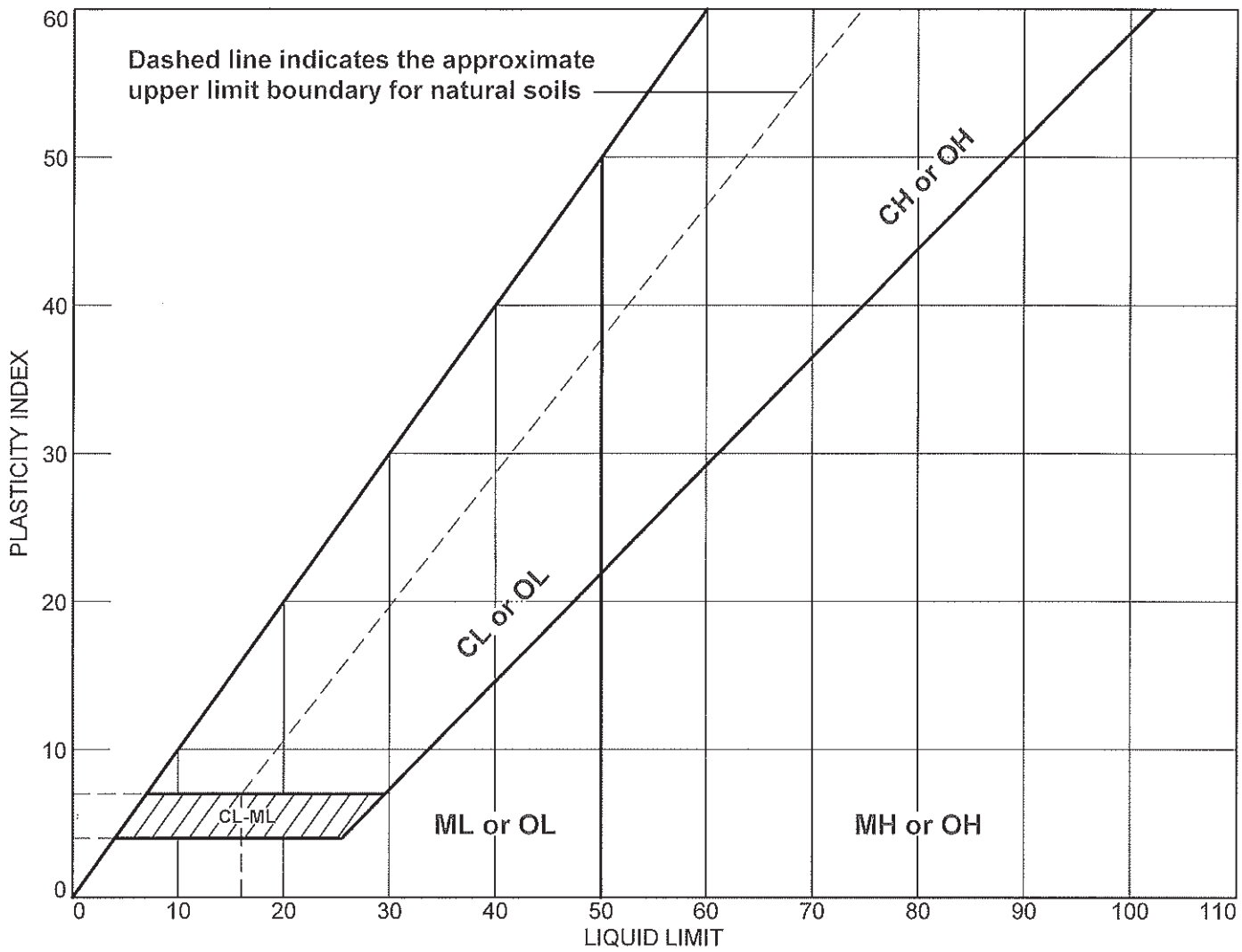
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
280.3	186.7	15.8	54.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G032 S-6A 15'	8000-6	15'	34.4	NP	NV	NP	N/A

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

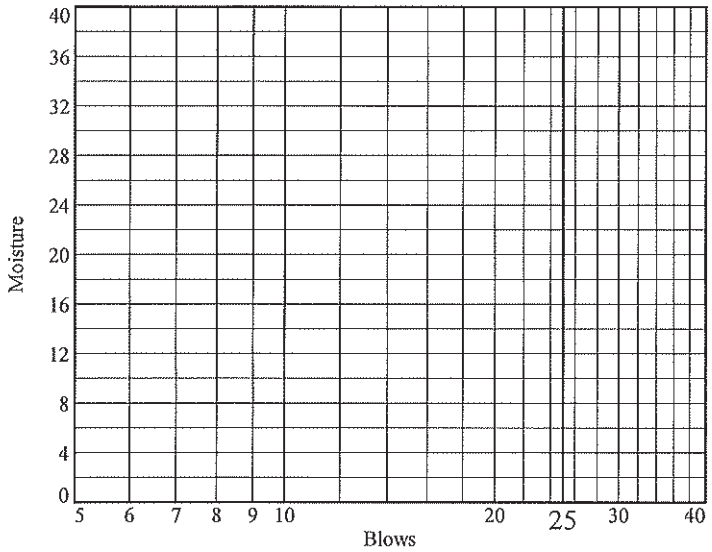
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-6A
Depth: 15'
Sample Number: 8000-6
USCS: N/A
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 34.4

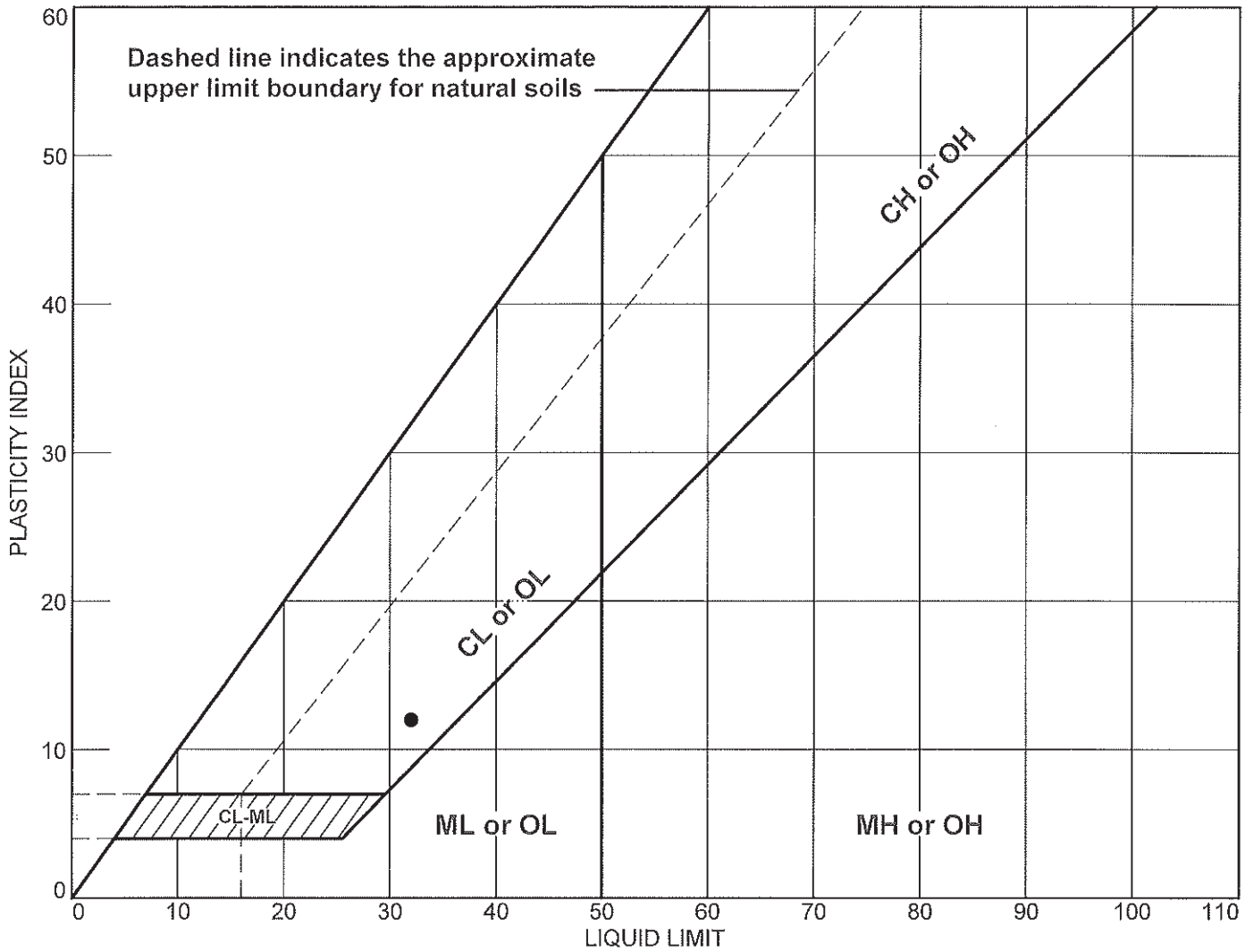
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
304.9	231.0	16.0	34.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G032 S-23A 100'	8000-13	100'	32.8	20	32	12	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

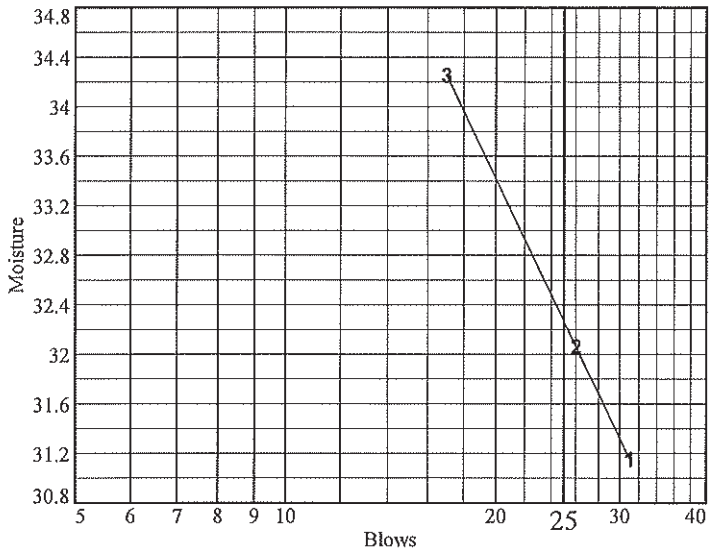
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-23A
Depth: 100'
Sample Number: 8000-13
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	26.89	25.83	28.62			
Dry+Tare	23.74	22.88	24.79			
Tare	13.63	13.68	13.61			
# Blows	31	26	17			
Moisture	31.2	32.1	34.3			



Liquid Limit= 32
Plastic Limit= 20
Plasticity Index= 12
Natural Moisture= 32.8
Liquidity Index= 1.1

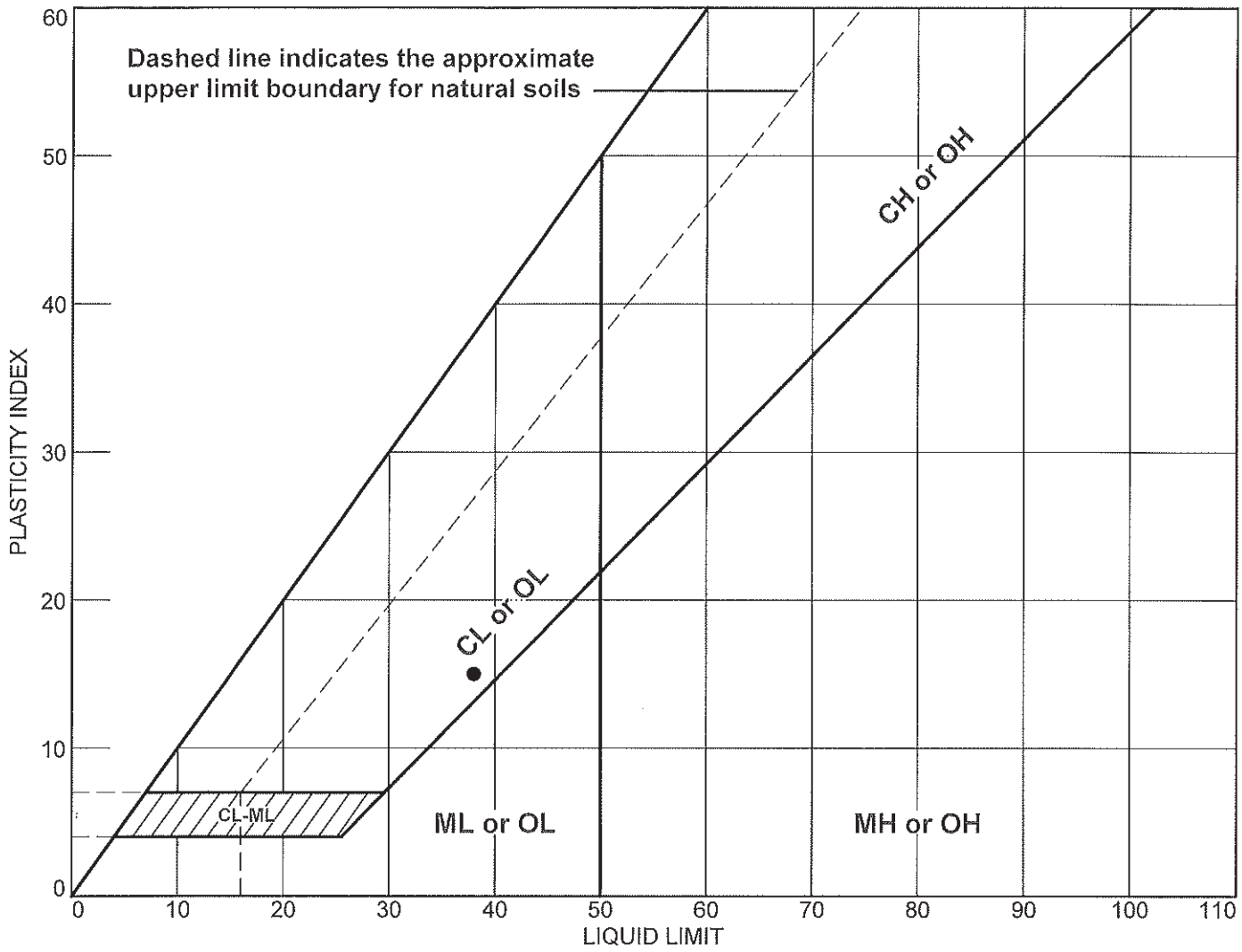
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.76	21.76	21.76		
Dry+Tare	20.40	20.40	20.40		
Tare	13.69	13.69	13.69		
Moisture	20.3	20.3	20.3		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
280.6	215.2	15.7	32.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G032 S-24 105'	8000-14	105'	37.1	23	38	15	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

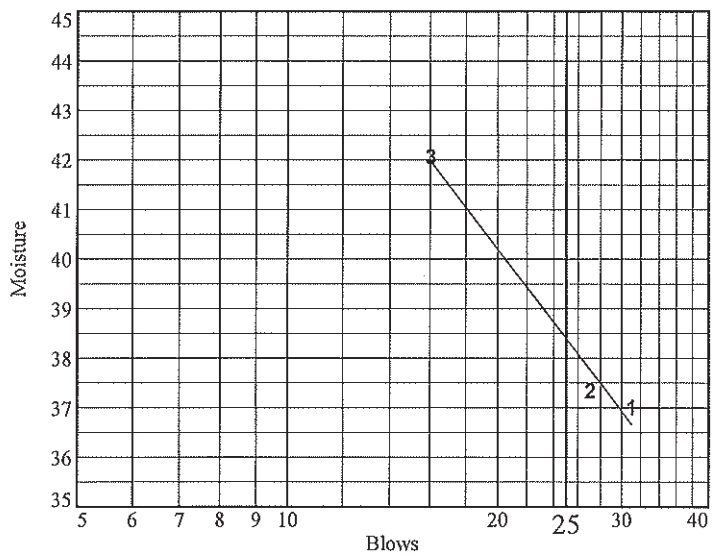
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-24
Depth: 105'
Sample Number: 8000-14
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	29.14	28.76	24.59			
Dry+Tare	24.98	24.70	21.35			
Tare	13.74	13.83	13.65			
# Blows	31	27	16			
Moisture	37.0	37.4	42.1			



Liquid Limit= 38
Plastic Limit= 23
Plasticity Index= 15
Natural Moisture= 37.1
Liquidity Index= 0.9

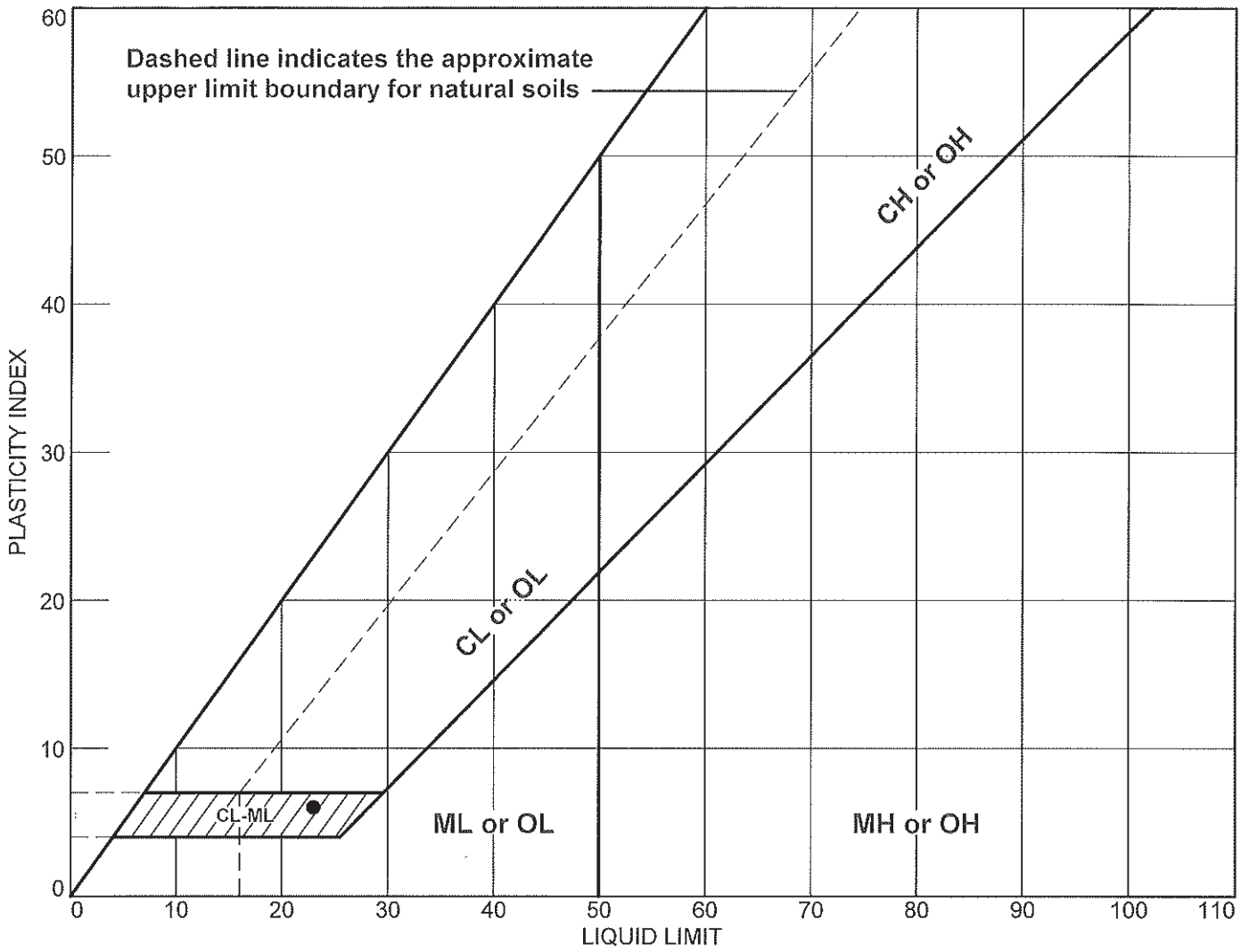
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.39	20.39	20.39		
Dry+Tare	19.14	19.14	19.14		
Tare	13.68	13.68	13.68		
Moisture	22.9	22.9	22.9		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
241.1	180.1	15.8	37.1

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G032 S-26 115'	8000-15	115'	22.6	17	23	6	ML

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

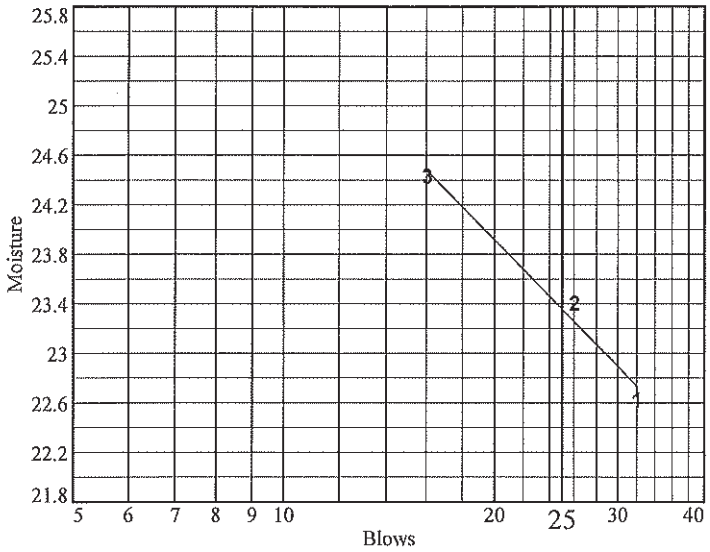
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-26
Depth: 115'
Sample Number: 8000-15
USCS: ML
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	35.54	29.78	31.22			
Dry+Tare	31.51	26.73	27.76			
Tare	13.70	13.70	13.60			
# Blows	32	26	16			
Moisture	22.6	23.4	24.4			



Liquid Limit= 23
Plastic Limit= 17
Plasticity Index= 6
Natural Moisture= 22.6
Liquidity Index= 0.9

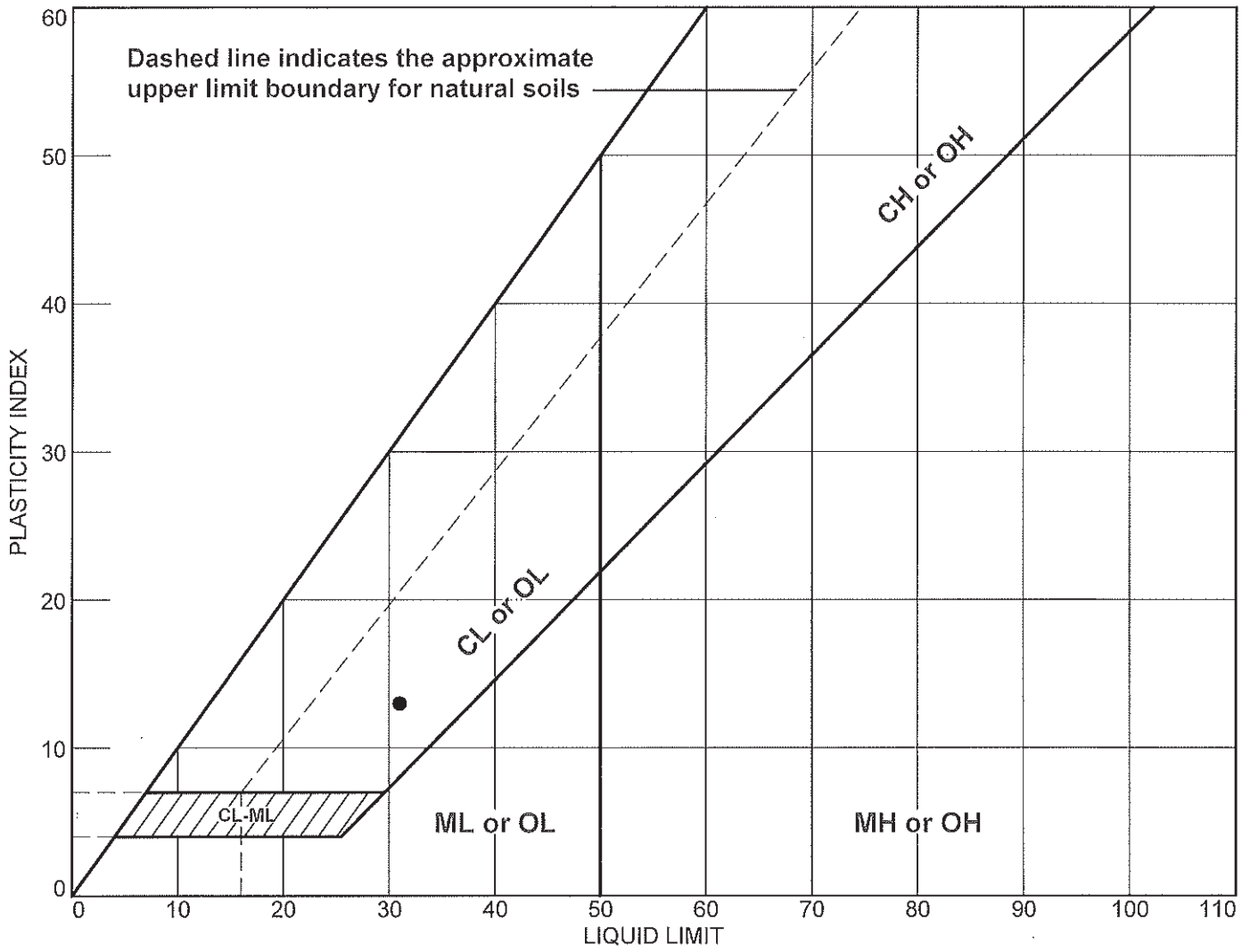
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.45	22.45	22.45		
Dry+Tare	21.21	21.21	21.21		
Tare	14.00	14.00	14.00		
Moisture	17.2	17.2	17.2		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
215.4	178.6	15.7	22.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G032 S-28 125'	8000-16	125'	33.5	18	31	13	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

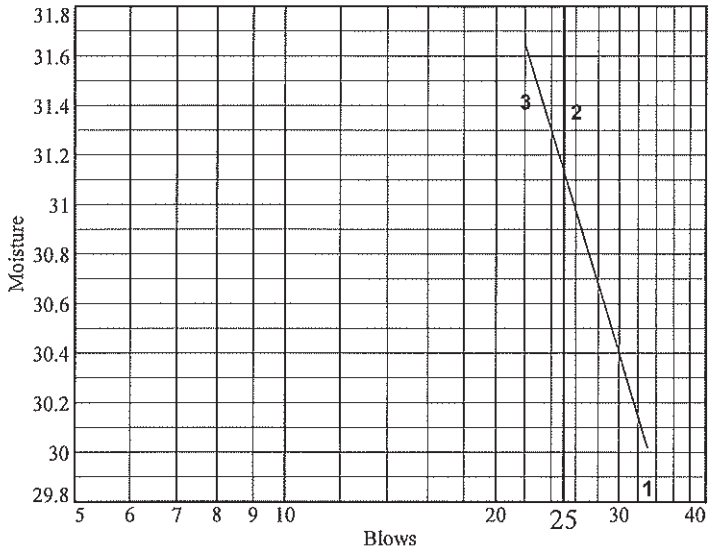
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-28
Depth: 125'
Sample Number: 8000-16
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.96	31.35	25.91			
Dry+Tare	25.44	27.13	22.96			
Tare	13.65	13.68	13.57			
# Blows	33	26	22			
Moisture	29.9	31.4	31.4			



Liquid Limit= 31
Plastic Limit= 18
Plasticity Index= 13
Natural Moisture= 33.5
Liquidity Index= 1.2

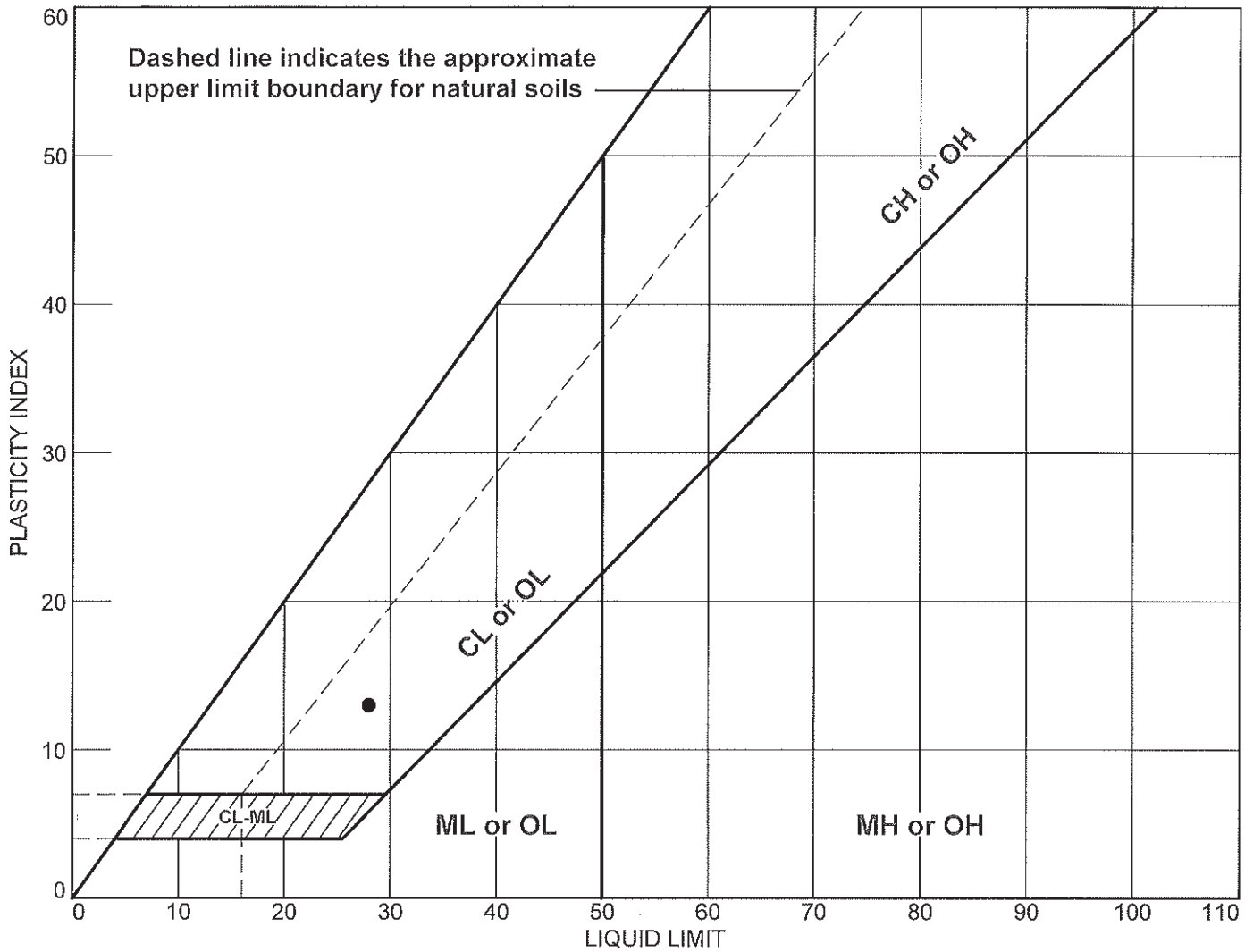
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	19.89	19.89	19.89		
Dry+Tare	18.93	18.93	18.93		
Tare	13.68	13.68	13.68		
Moisture	18.3	18.3	18.3		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
260.2	198.9	16.0	33.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G032 S-31 140'	8000-19	140'	30.4	15	28	13	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

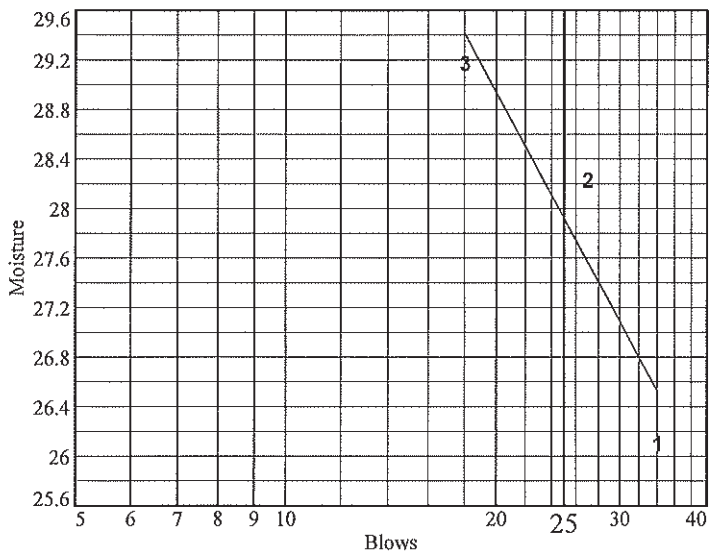
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-31
Depth: 140'
Sample Number: 8000-19
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	27.68	25.04	30.15			
Dry+Tare	24.84	22.53	26.43			
Tare	13.96	13.64	13.68			
# Blows	34	27	18			
Moisture	26.1	28.2	29.2			



Liquid Limit= 28
Plastic Limit= 15
Plasticity Index= 13
Natural Moisture= 30.4
Liquidity Index= 1.2

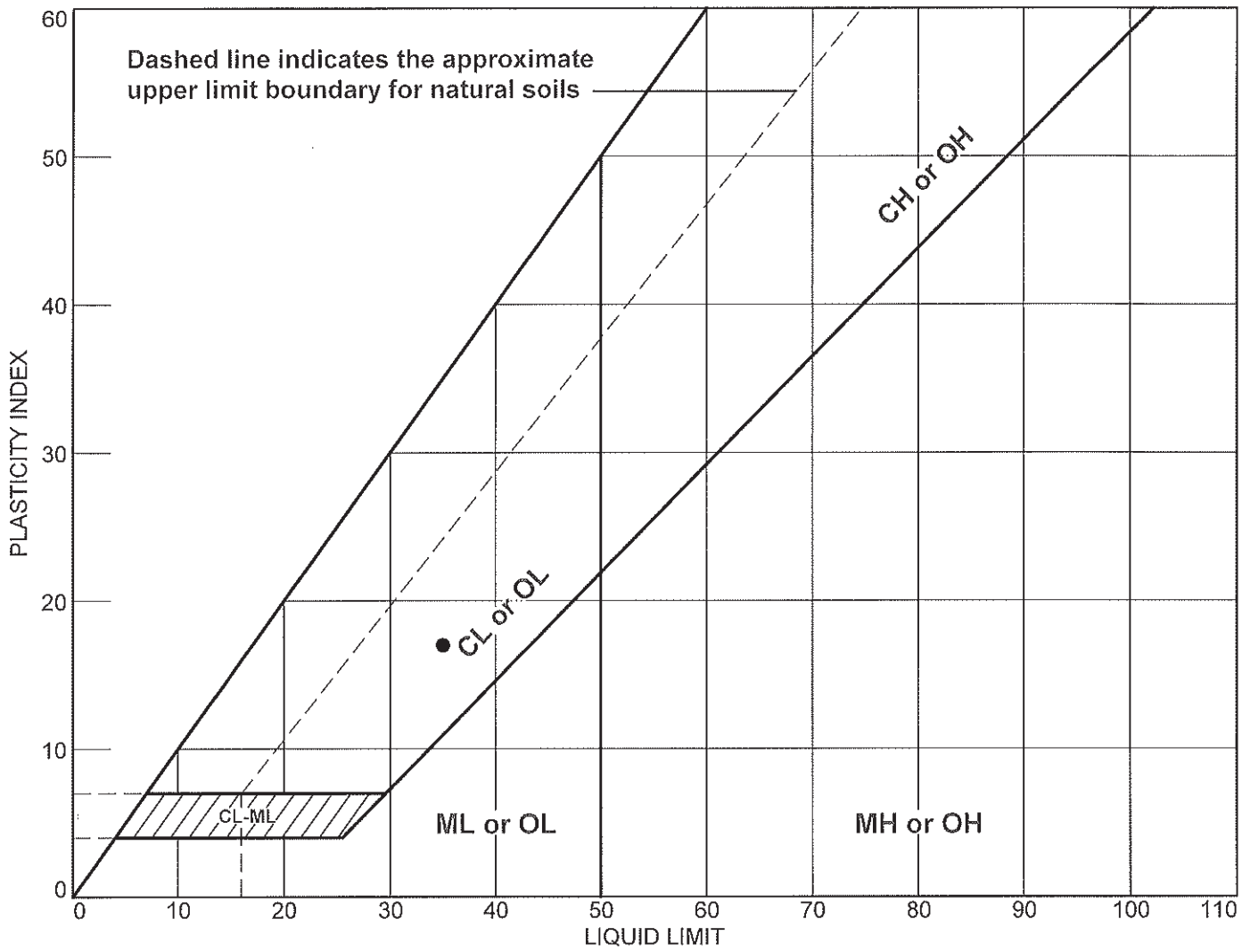
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.45	22.45	22.45		
Dry+Tare	21.32	21.32	21.32		
Tare	13.73	13.73	13.73		
Moisture	14.9	14.9	14.9		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
290.0	226.2	16.0	30.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G032 S-34 155'	8000-22	155'	29.6	18	35	17	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

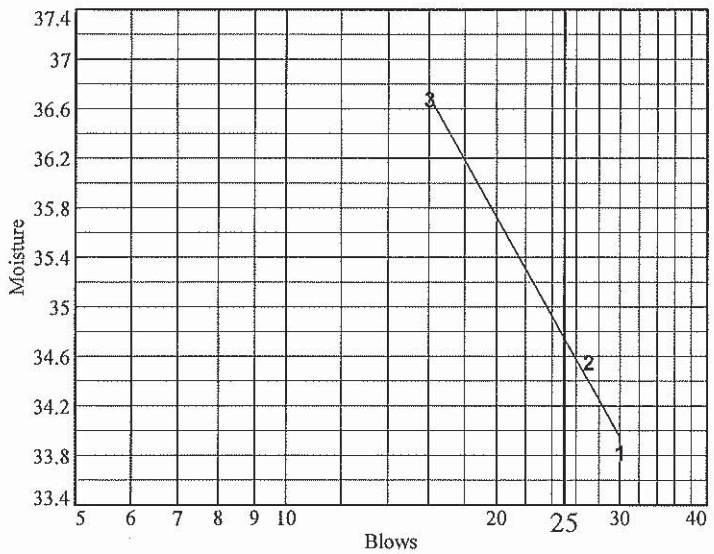
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-34
Depth: 155'
Sample Number: 8000-22
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	29.99	30.64	31.21			
Dry+Tare	25.86	26.29	26.53			
Tare	13.65	13.70	13.77			
# Blows	30	27	16			
Moisture	33.8	34.6	36.7			



Liquid Limit= 35
Plastic Limit= 18
Plasticity Index= 17
Natural Moisture= 29.6
Liquidity Index= 0.7

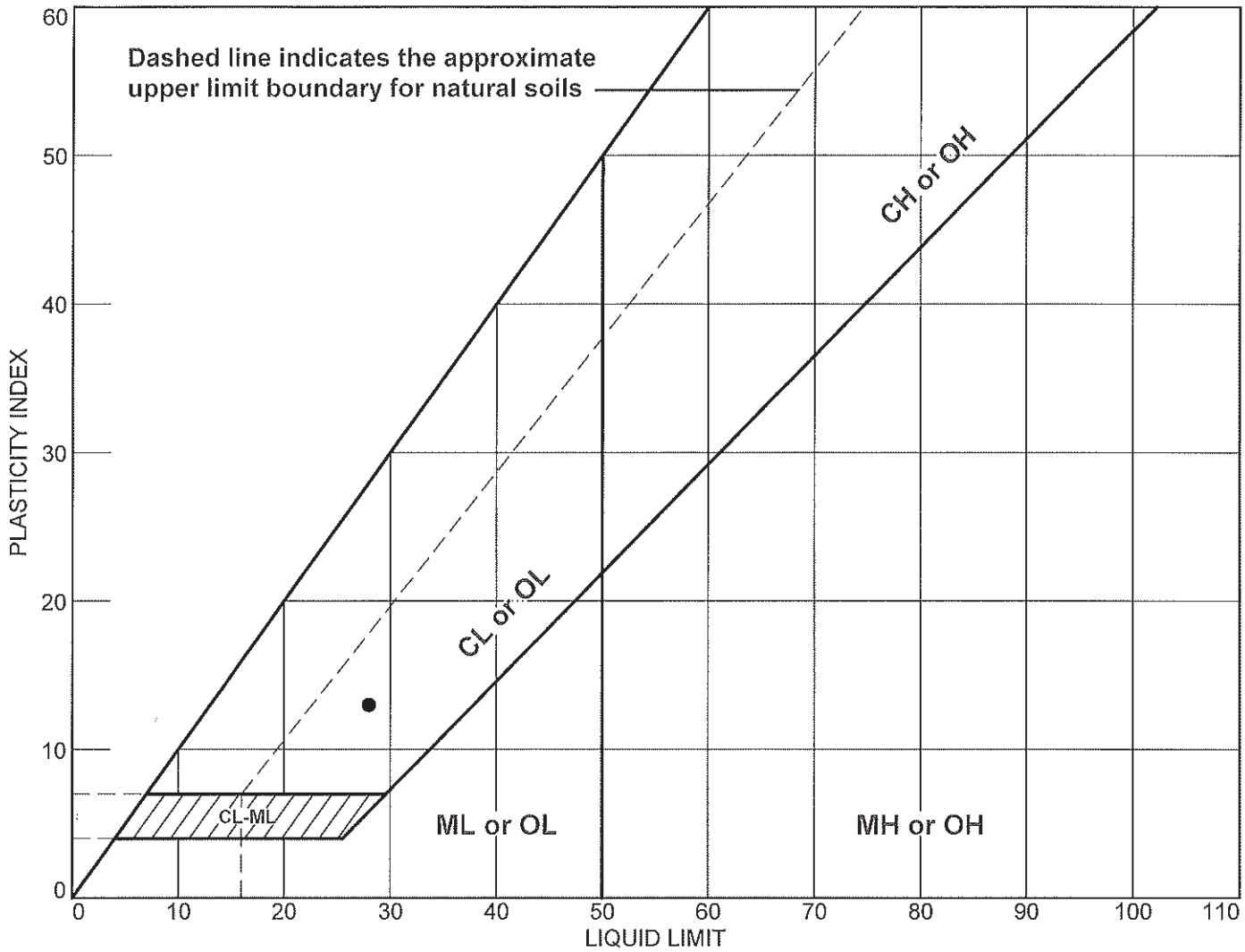
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.44	22.44	22.44		
Dry+Tare	21.10	21.10	21.10		
Tare	13.61	13.61	13.61		
Moisture	17.9	17.9	17.9		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
250.0	196.6	15.9	29.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G032 S-38 167.5'	8000-24	167.5	23.1	15	28	13	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

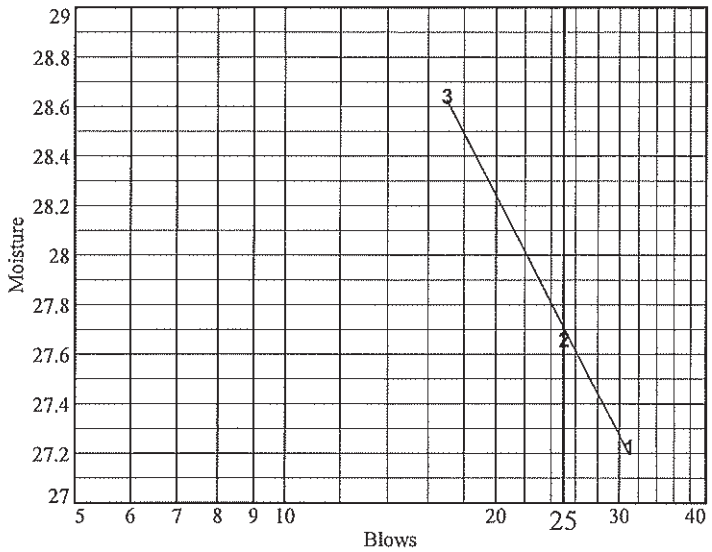
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-38
Depth: 167.5 **Sample Number:** 8000-24
USCS: CL
Tested by: BH **Checked by:** JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.71	26.95	28.79			
Dry+Tare	25.50	24.04	24.88			
Tare	13.71	13.52	11.23			
# Blows	31	25	17			
Moisture	27.2	27.7	28.6			



Liquid Limit= 28
Plastic Limit= 15
Plasticity Index= 13
Natural Moisture= 23.1
Liquidity Index= 0.6

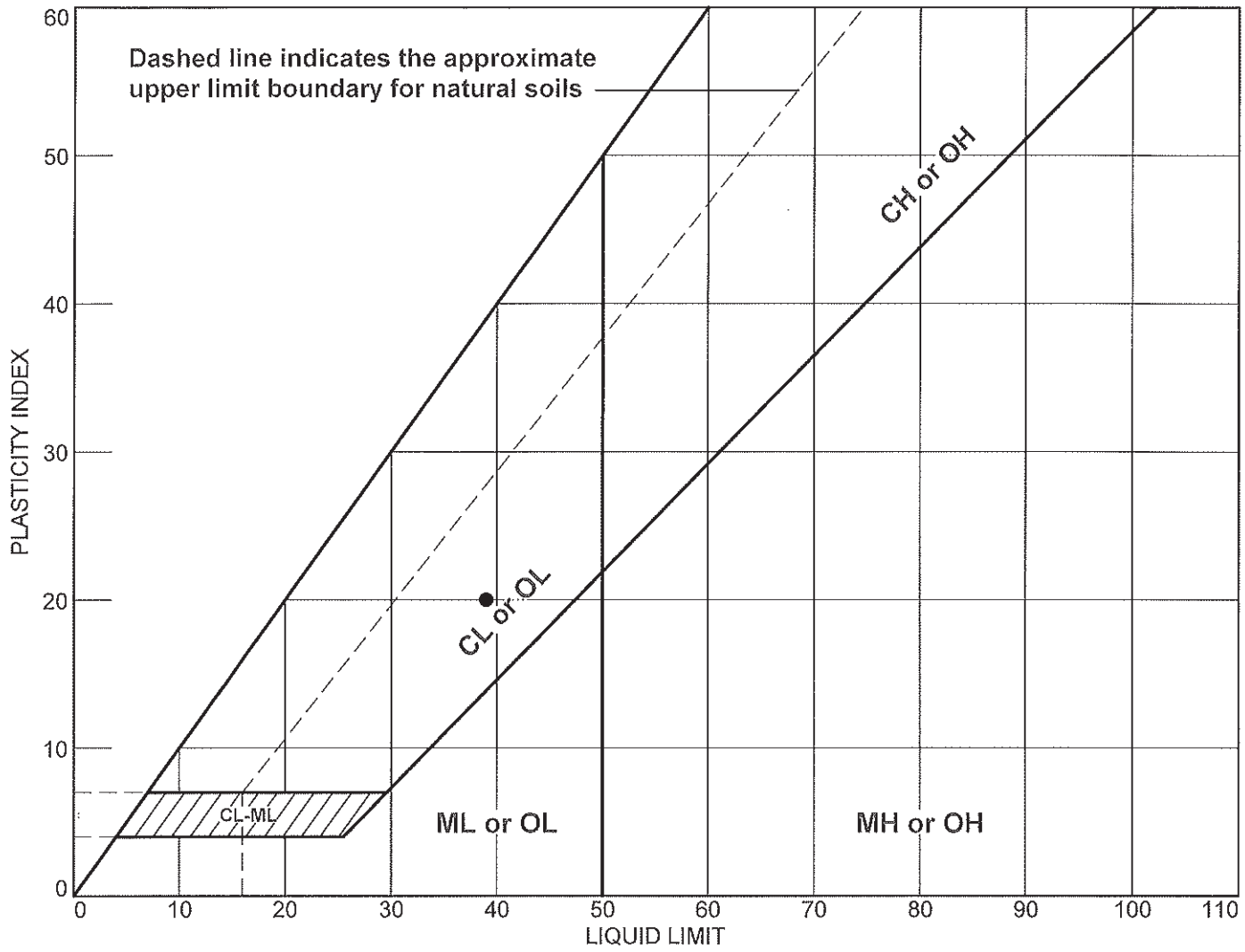
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.29	21.29	21.29		
Dry+Tare	20.30	20.30	20.30		
Tare	13.61	13.61	13.61		
Moisture	14.8	14.8	14.8		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
182.6	151.3	15.9	23.1

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G032 S-44 190'	8000-26	190'	30.4	19	39	20	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

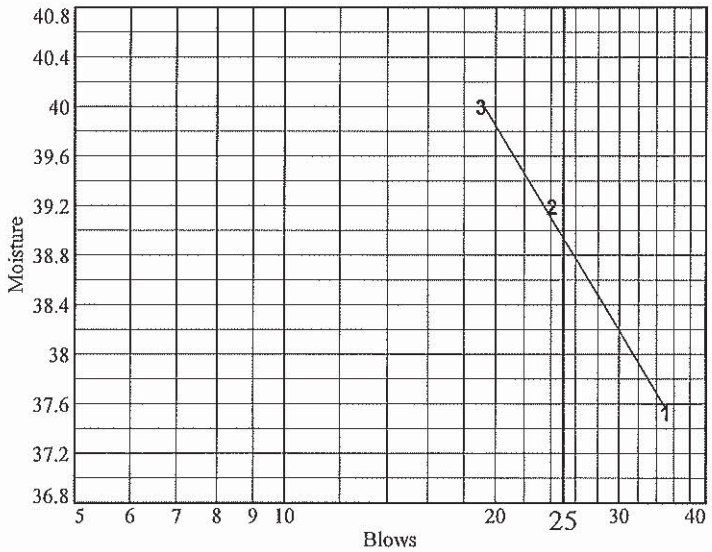
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G032 S-44
Depth: 190'
Sample Number: 8000-26
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.42	26.58	27.15			
Dry+Tare	23.74	22.21	22.59			
Tare	11.27	11.06	11.19			
# Blows	35	24	19			
Moisture	37.5	39.2	40.0			



Liquid Limit= 39
Plastic Limit= 19
Plasticity Index= 20
Natural Moisture= 30.4
Liquidity Index= 0.6

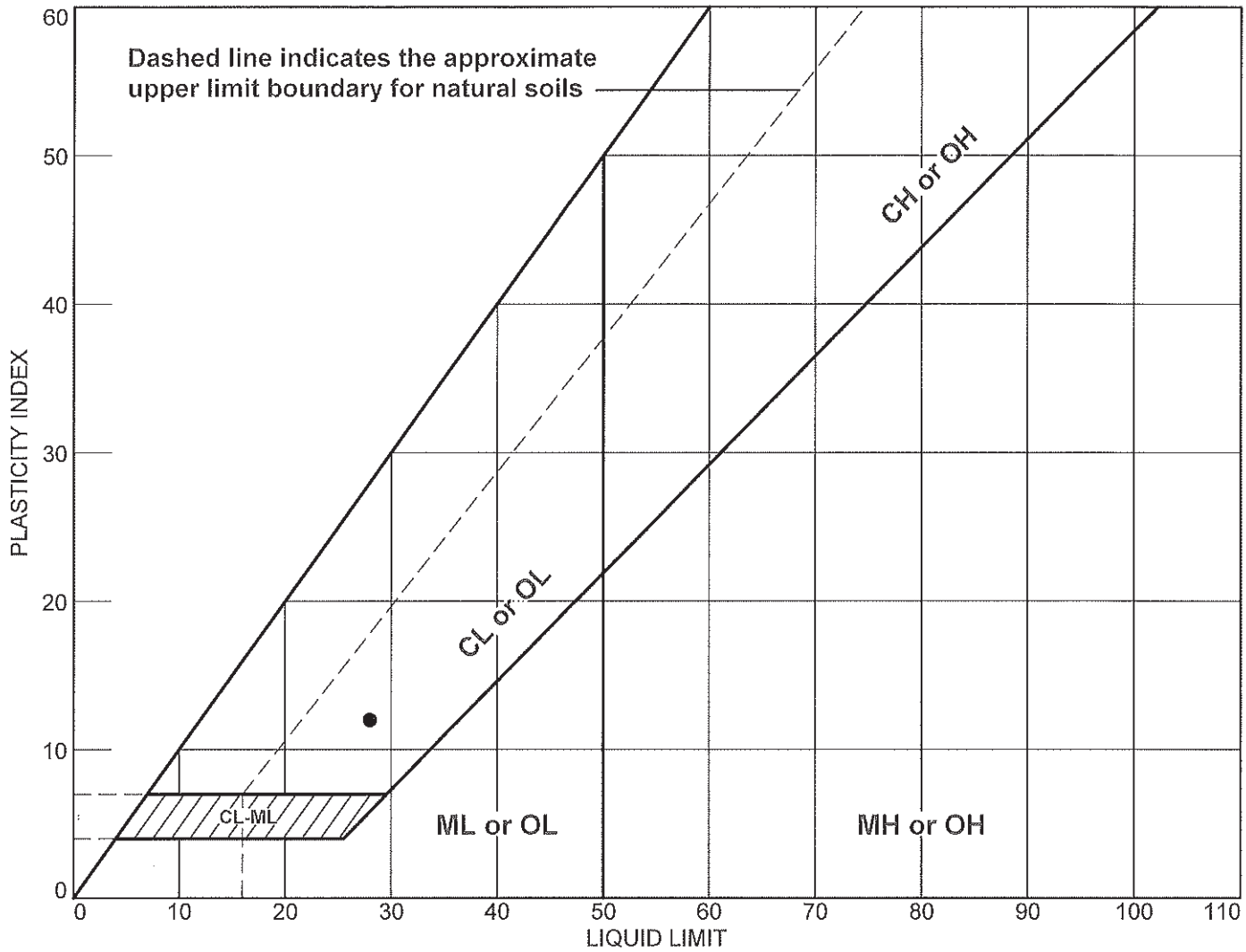
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.59	20.59	20.59		
Dry+Tare	19.44	19.44	19.44		
Tare	13.54	13.54	13.54		
Moisture	19.5	19.5	19.5		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
197.7	155.3	16.0	30.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G33 / S23	054-87	100'	28.5	16	28	12	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

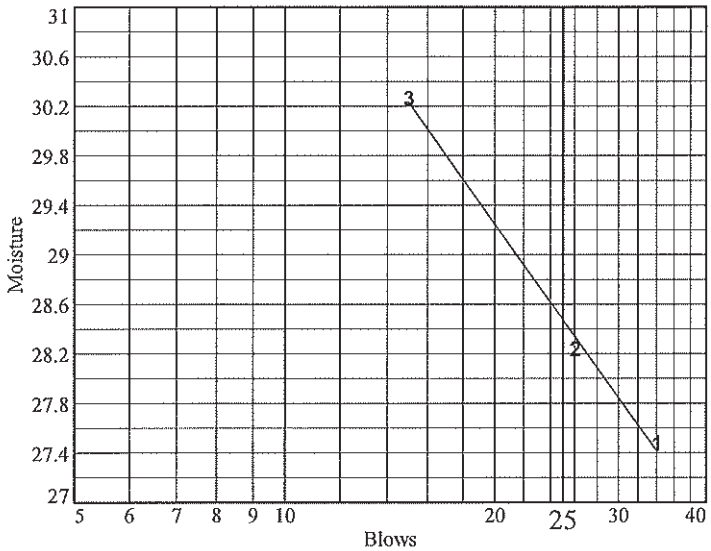
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S23
Depth: 100'
Sample Number: 054-87
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	24.81	23.65	21.44			
Dry+Tare	22.4	20.95	19.07			
Tare	13.63	11.39	11.24			
# Blows	34	26	15			
Moisture	27.5	28.2	30.3			



Liquid Limit= 28
Plastic Limit= 16
Plasticity Index= 12
Natural Moisture= 28.5
Liquidity Index= 1.0

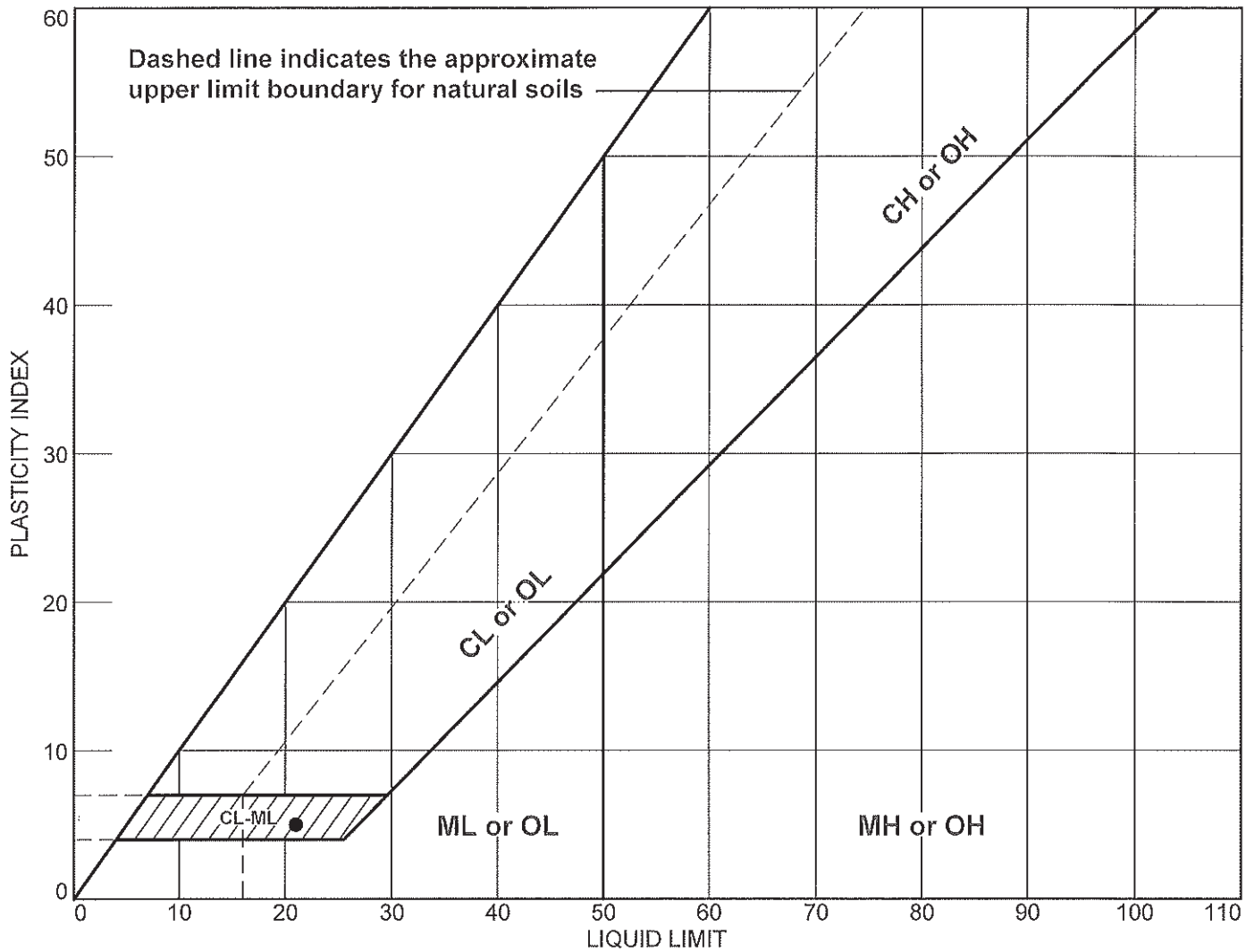
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.62				
Dry+Tare	23.07				
Tare	13.66				
Moisture	16.5				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
121.5	98.1	16	28.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G33 / S29	054-91	120'	23.0	16	21	5	CL-ML

Hayre McElroy & Associates, LLC Redmond, WA	Client: Golder Associates Project: ST-DRLE Project No.: 1657705/17-940 Figure

Tested By: GD Checked By: JAM

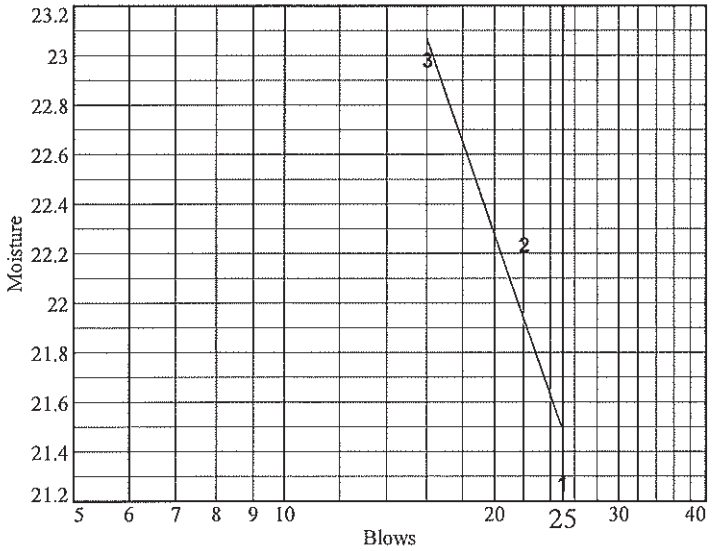
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S29
Depth: 120'
Sample Number: 054-91
USCS: CL-ML
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	23.99	21.87	24.32			
Dry+Tare	21.75	19.94	21.87			
Tare	11.22	11.26	11.21			
# Blows	25	22	16			
Moisture	21.3	22.2	23.0			



Liquid Limit= 21
Plastic Limit= 16
Plasticity Index= 5
Natural Moisture= 23.0
Liquidity Index= 1.4

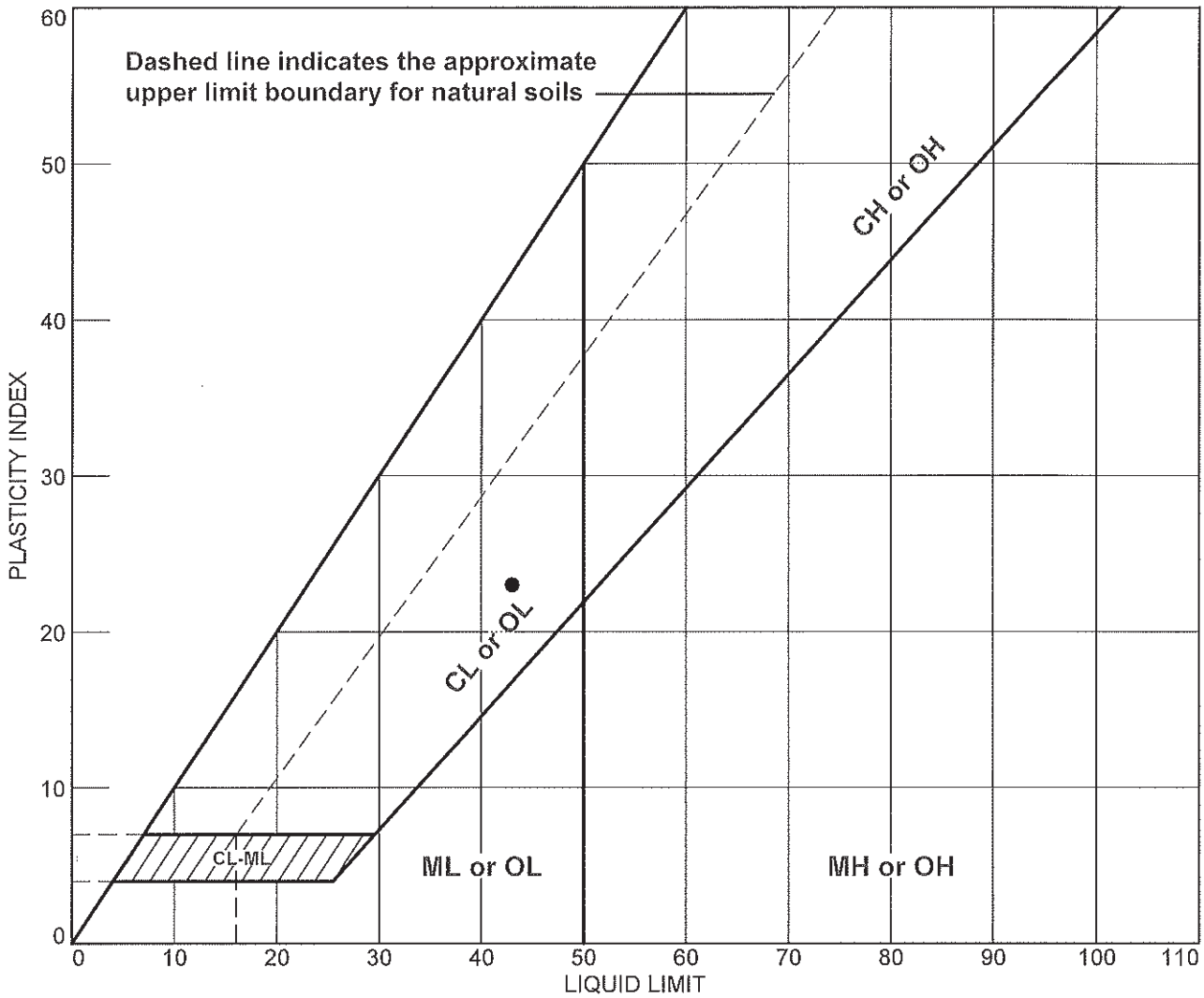
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.39				
Dry+Tare	22.87				
Tare	13.59				
Moisture	16.4				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
210.2	173.9	16.1	23.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G33 / S32	054-94	135'	30.5	20	43	23	CL

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

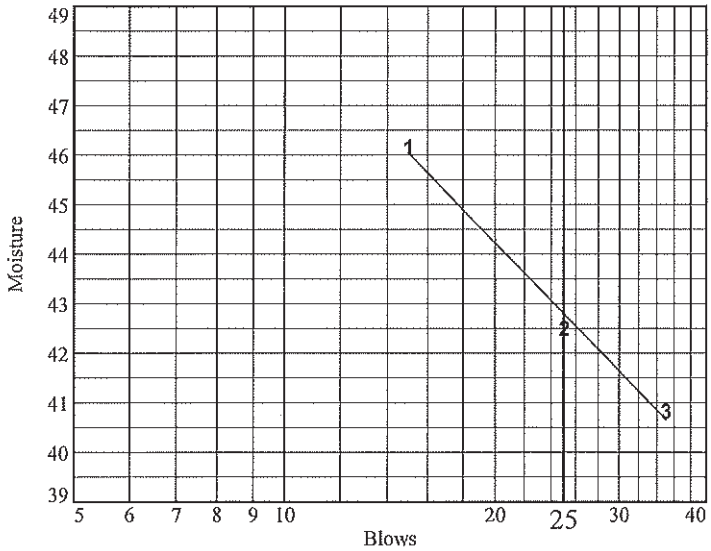
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S32
Depth: 135'
Sample Number: 054-94
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	25.67	20.04	22.35			
Dry+Tare	21.88	18.14	19.81			
Tare	13.67	13.67	13.59			
# Blows	15	25	35			
Moisture	46.2	42.5	40.8			



Liquid Limit= 43
Plastic Limit= 20
Plasticity Index= 23
Natural Moisture= 30.5
Liquidity Index= 0.5

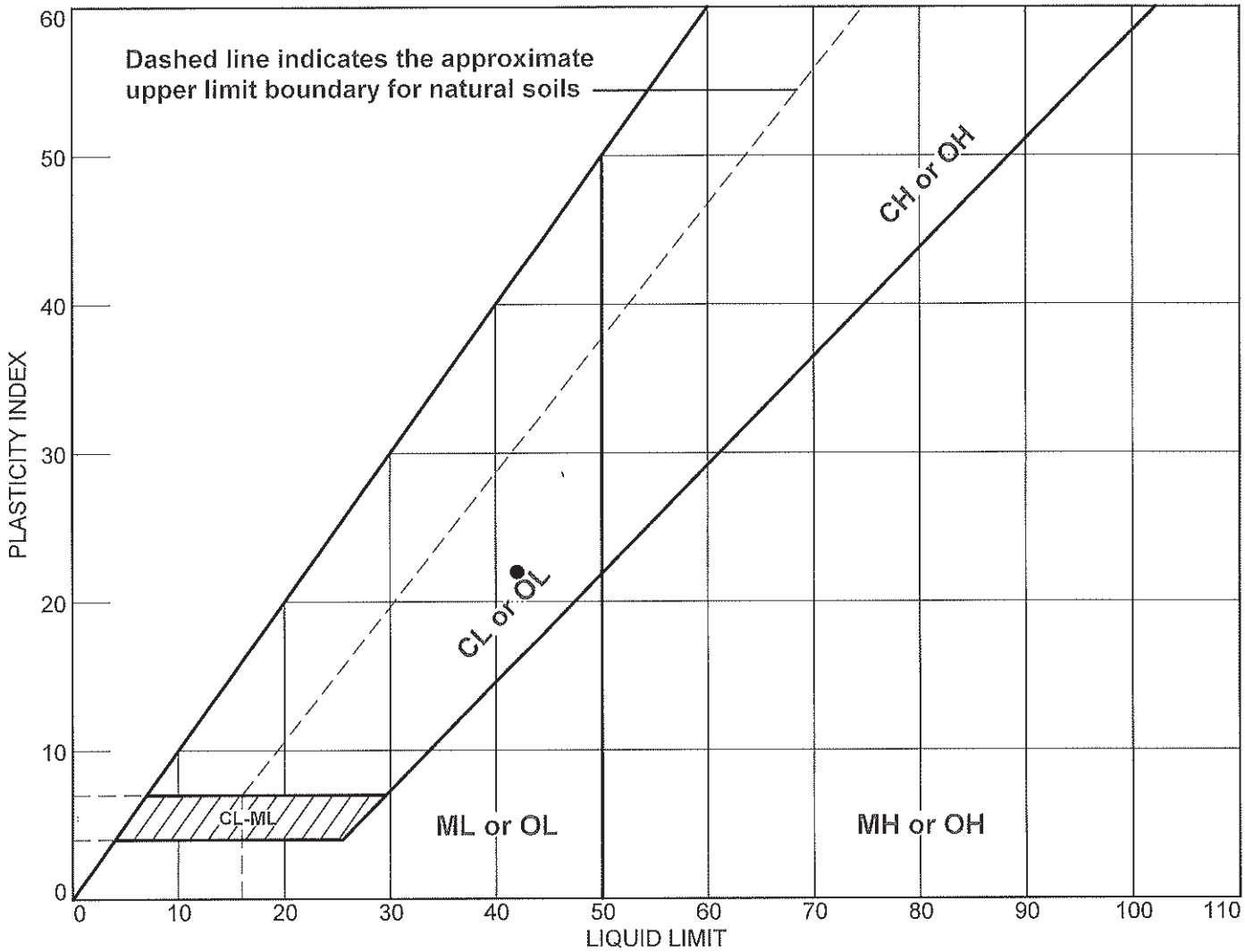
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	29.95				
Dry+Tare	27.2				
Tare	13.59				
Moisture	20.2				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
134.5	106.8	15.9	30.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G33 / S33	054-95	140'	30.2	20	42	22	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

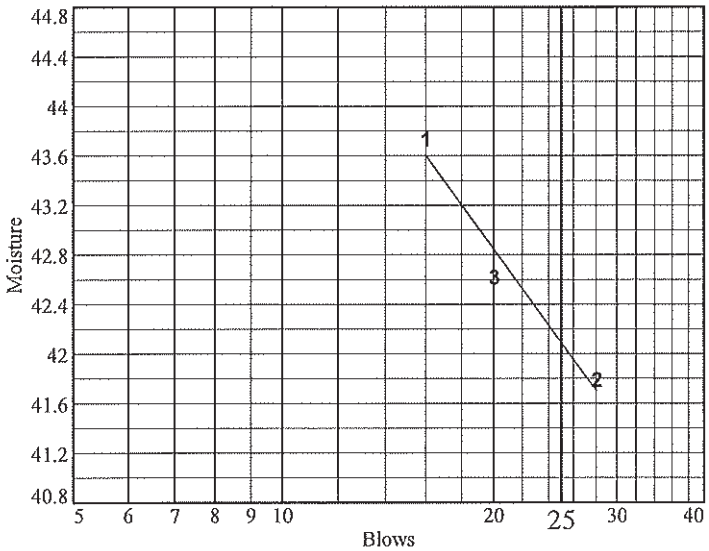
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S33
Depth: 140'
Sample Number: 054-95
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	21.83	22.95	22.29			
Dry+Tare	19.42	20.20	19.69			
Tare	13.91	13.62	13.59			
# Blows	16	28	20			
Moisture	43.7	41.8	42.6			



Liquid Limit= 42
Plastic Limit= 20
Plasticity Index= 22
Natural Moisture= 30.2
Liquidity Index= 0.5

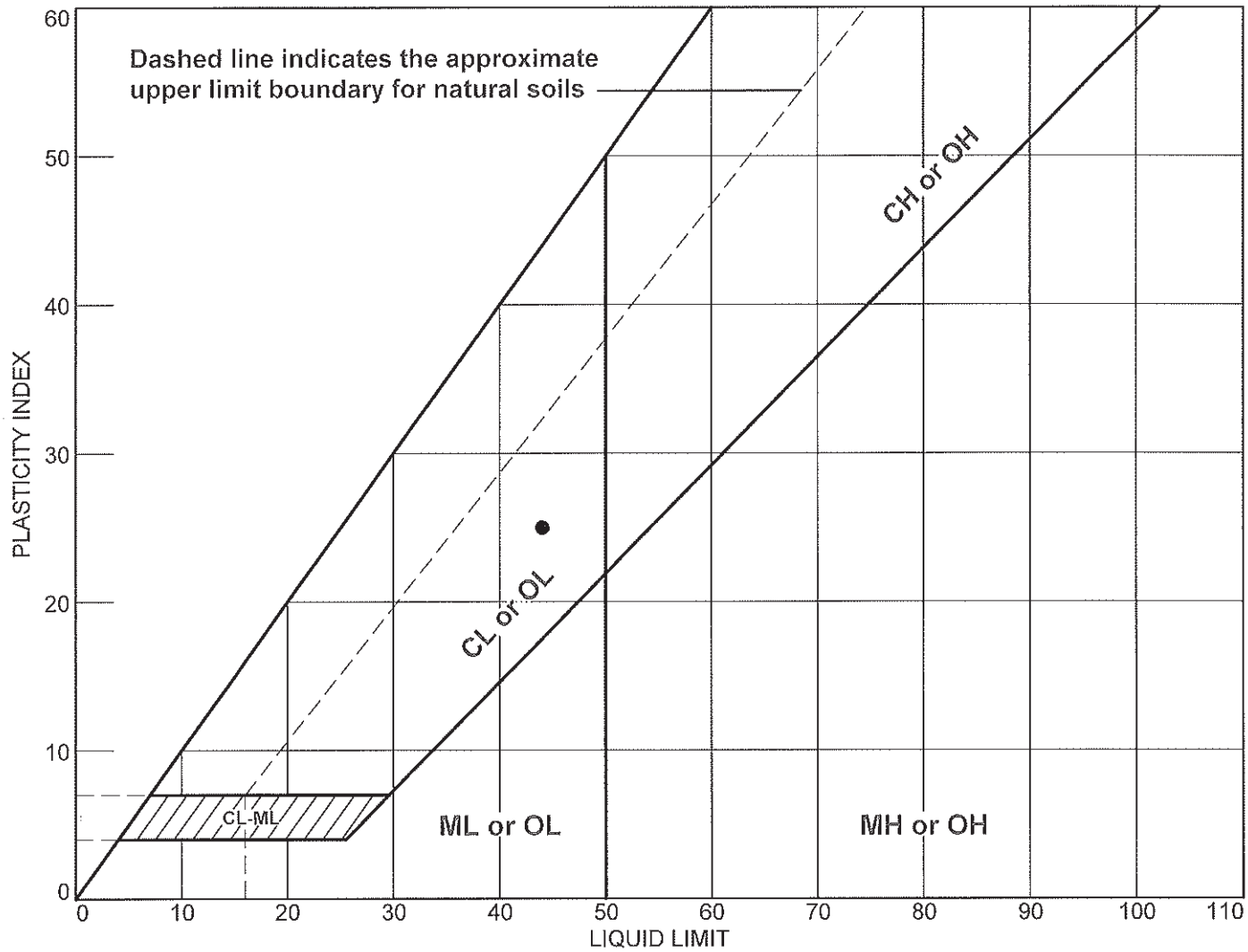
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.83				
Dry+Tare	22.15				
Tare	13.57				
Moisture	19.6				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
121.8	97.2	15.8	30.2

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G33 / S35	054-97	150'	34.3	19	44	25	CL

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

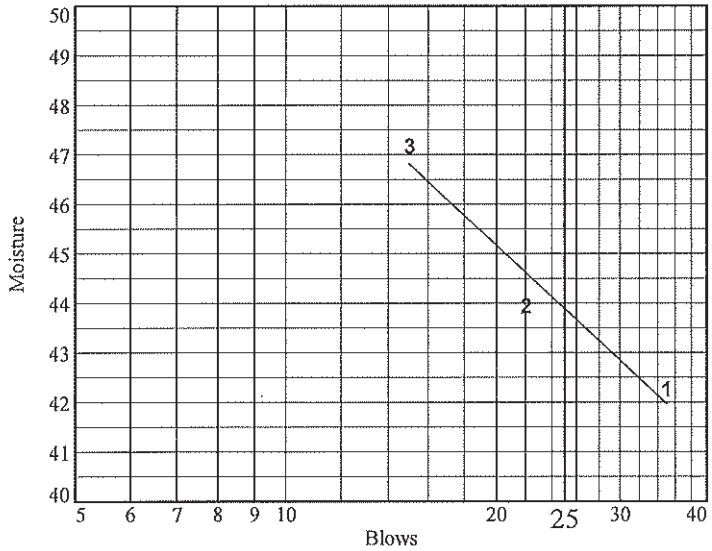
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S35
Depth: 150'
Sample Number: 054-97
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	20.83	19.37	22.29			
Dry+Tare	17.96	16.90	18.69			
Tare	11.17	11.28	11.06			
# Blows	35	22	15			
Moisture	42.3	44.0	47.2			



Liquid Limit= 44
Plastic Limit= 19
Plasticity Index= 25
Natural Moisture= 34.3
Liquidity Index= 0.6

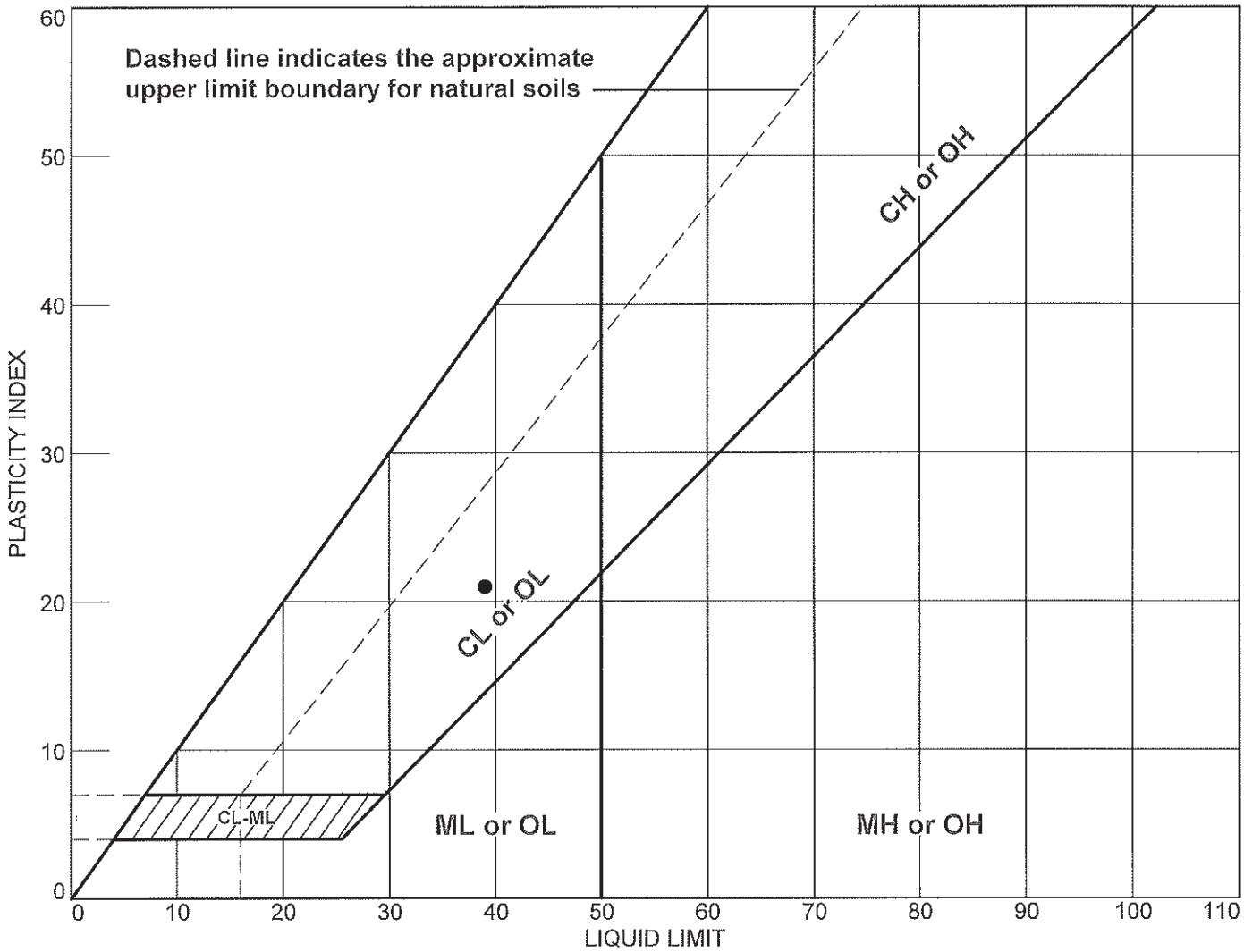
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.43				
Dry+Tare	20.6				
Tare	11.2				
Moisture	19.5				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
130.2	101.1	16.2	34.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G33 / S38	054-99	160'	31.0	18	39	21	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

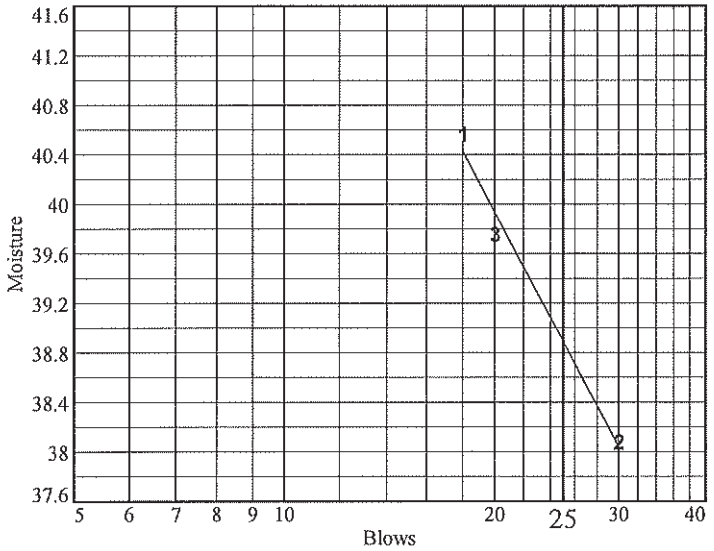
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S38
Depth: 160'
Sample Number: 054-99
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	22.04	21.86	25.22			
Dry+Tare	19.61	19.56	21.94			
Tare	13.62	13.52	13.69			
# Blows	18	30	20			
Moisture	40.6	38.1	39.8			



Liquid Limit= 39
Plastic Limit= 18
Plasticity Index= 21
Natural Moisture= 31.0
Liquidity Index= 0.6

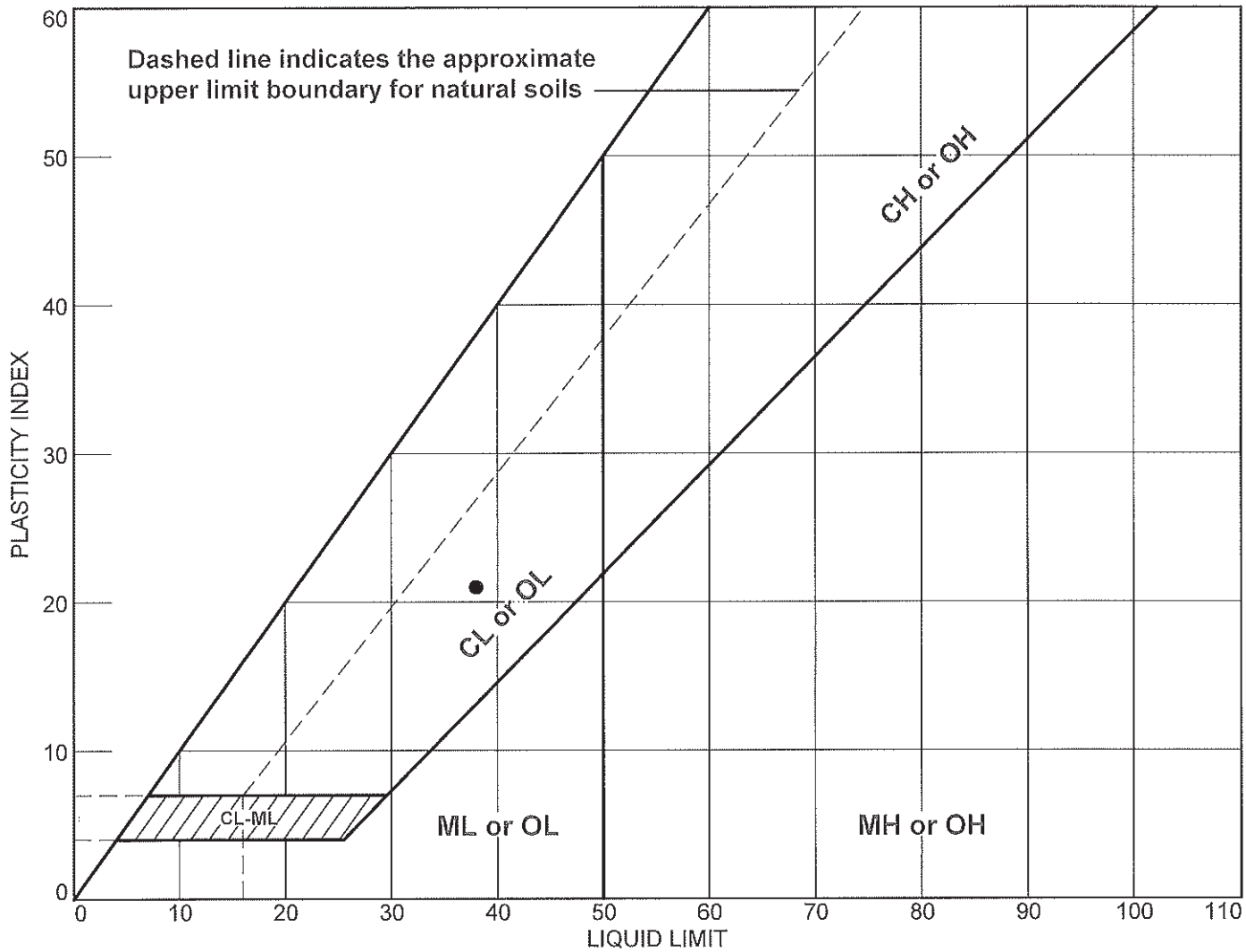
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.17				
Dry+Tare	22.57				
Tare	13.68				
Moisture	18.0				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
119	94.6	15.9	31.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G33 / S42A	054-101	180'	21.1	17	38	21	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

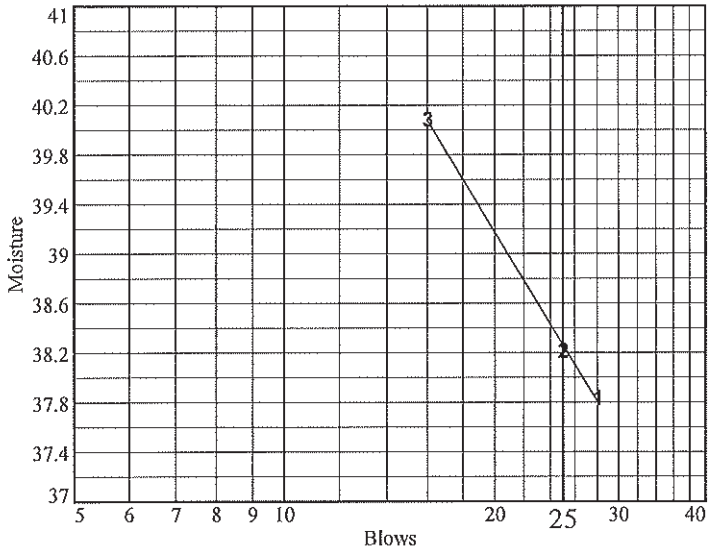
LIQUID AND PLASTIC LIMIT TEST DATA

1/2/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G33 / S42A
Depth: 180'
Sample Number: 054-101
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	21.88	22.55	22.89			
Dry+Tare	19.64	20.10	20.24			
Tare	13.72	13.69	13.63			
# Blows	28	25	16			
Moisture	37.8	38.2	40.1			



Liquid Limit= 38
Plastic Limit= 17
Plasticity Index= 21
Natural Moisture= 21.1
Liquidity Index= 0.2

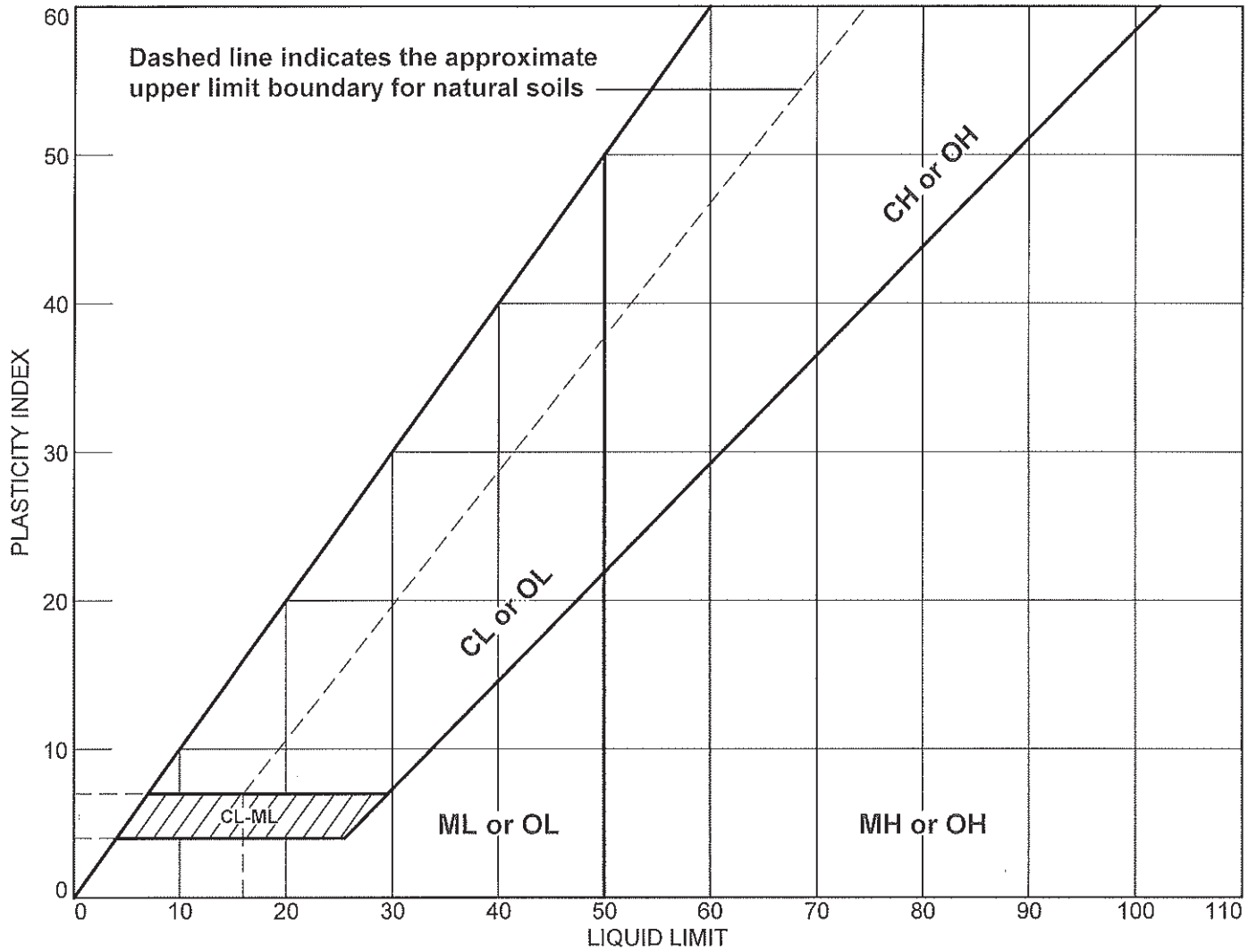
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.59				
Dry+Tare	23.01				
Tare	13.7				
Moisture	17.0				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
124.9	105.9	15.8	21.1

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G034 S-4 7.5'-9'	7995-45	7.5'-9'	35.9	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

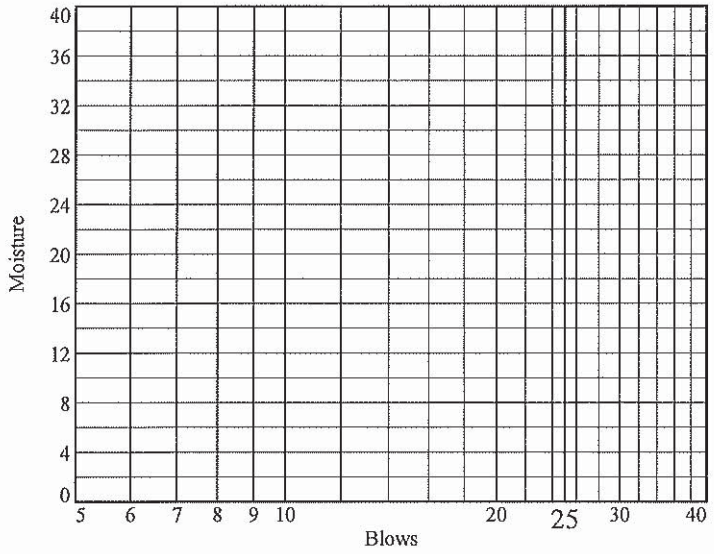
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G034 S-4
Depth: 7.5'-9'
Sample Number: 7995-45
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 35.9

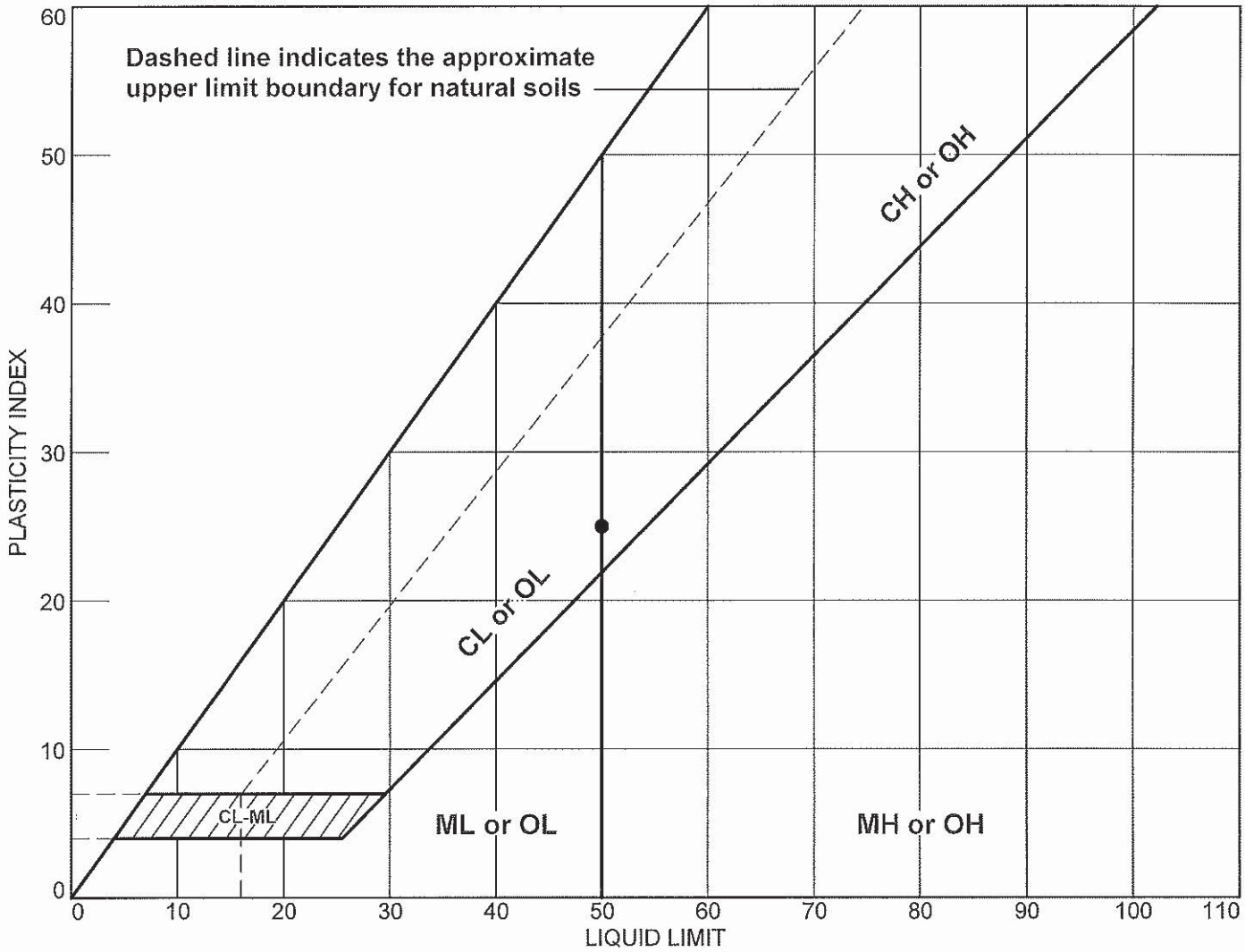
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
336.1	251.5	15.8	35.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G035 S-14 185'-186.5'	7995-71	185'-186.5'	34.9	25	50	25	CH

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

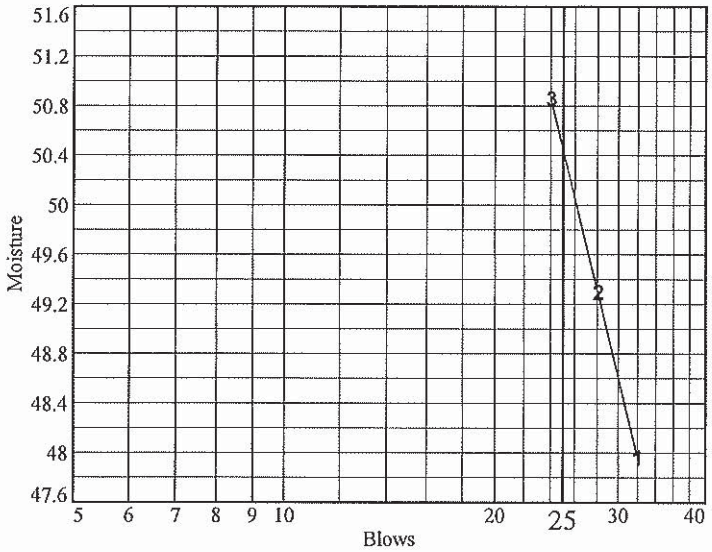
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G035 S-14
Depth: 185'-186.5'
Sample Number: 7995-71
USCS: CH
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	26.32	24.57	25.14			
Dry+Tare	22.20	21.76	21.30			
Tare	13.61	16.06	13.75			
# Blows	32	28	24			
Moisture	48.0	49.3	50.9			



Liquid Limit= 50
Plastic Limit= 25
Plasticity Index= 25
Natural Moisture= 34.9
Liquidity Index= 0.4

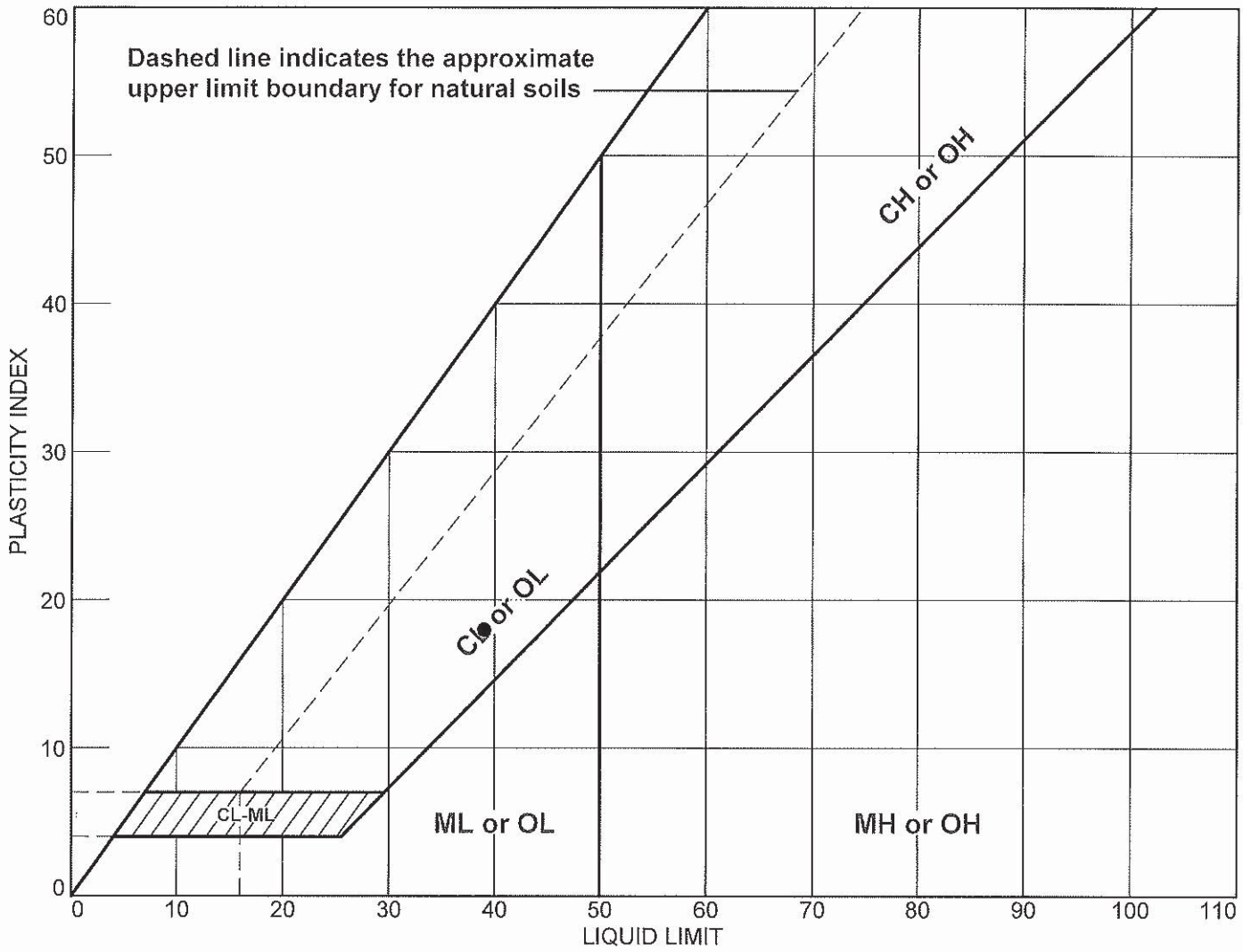
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.52	20.52	20.52		
Dry+Tare	19.14	19.14	19.14		
Tare	13.59	13.59	13.59		
Moisture	24.9	24.9	24.9		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
401.4	301.7	15.8	34.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G035 S-42 190'-191.5'	7995-72	190'-191.5	29.9	21	39	18	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

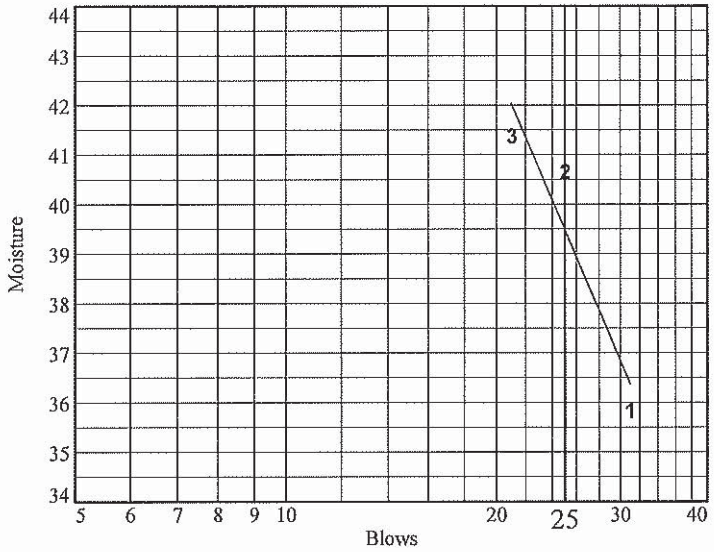
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G035 S-42
Depth: 190'-191.5 **Sample Number:** 7995-72
USCS: CL
Tested by: BH **Checked by:** JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	25.29	24.22	22.87			
Dry+Tare	22.20	21.17	20.18			
Tare	13.58	13.67	13.68			
# Blows	31	25	21			
Moisture	35.8	40.7	41.4			



Liquid Limit= 39
Plastic Limit= 21
Plasticity Index= 18
Natural Moisture= 29.9
Liquidity Index= 0.5

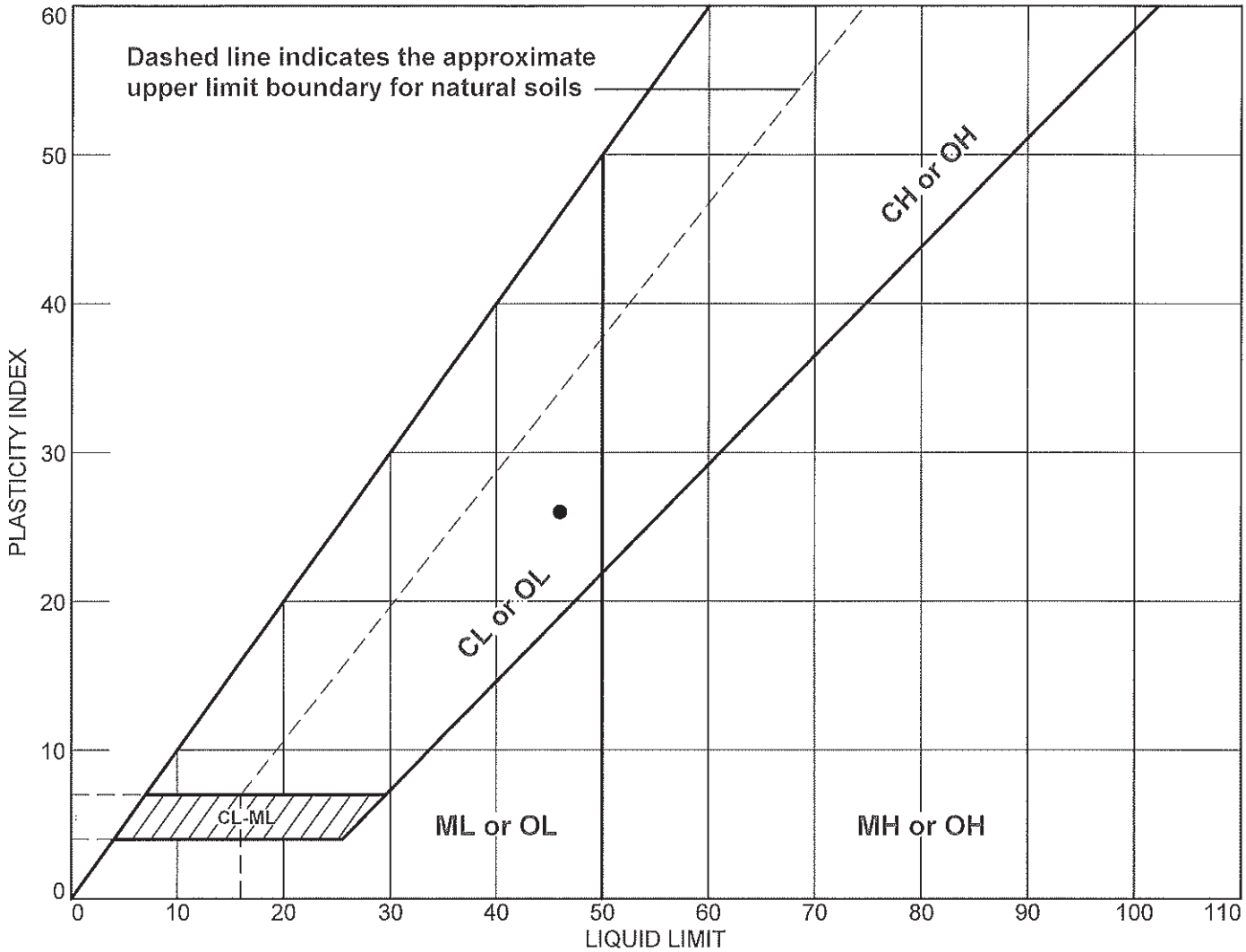
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.48	20.48	20.48		
Dry+Tare	19.30	19.30	19.30		
Tare	13.71	13.71	13.71		
Moisture	21.1	21.1	21.1		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
403.8	314.4	15.8	29.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G036A S-32 210'-211.5'	8000-43	210'-211.5'	30.6	20	46	26	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

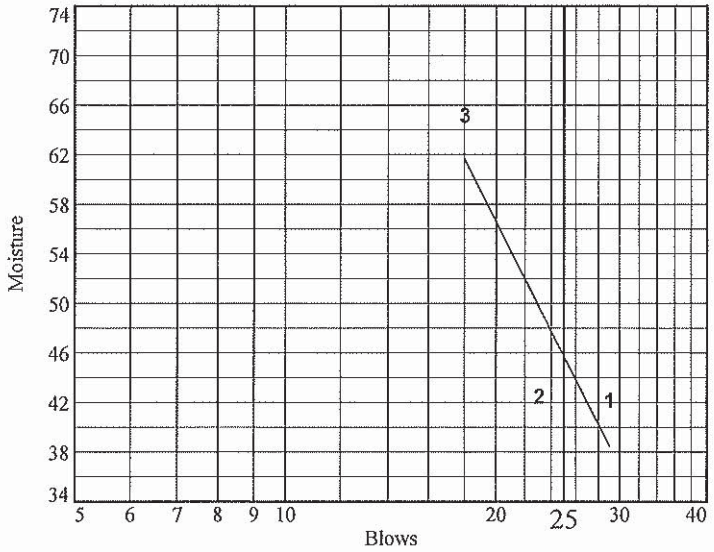
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036A S-32
Depth: 210'-211.5'
Sample Number: 8000-43
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	25.65	26.29	26.85			
Dry+Tare	21.37	21.78	20.68			
Tare	11.23	11.18	11.22			
# Blows	29	23	18			
Moisture	42.2	42.5	65.2			



Liquid Limit= 46
Plastic Limit= 20
Plasticity Index= 26
Natural Moisture= 30.6
Liquidity Index= 0.4

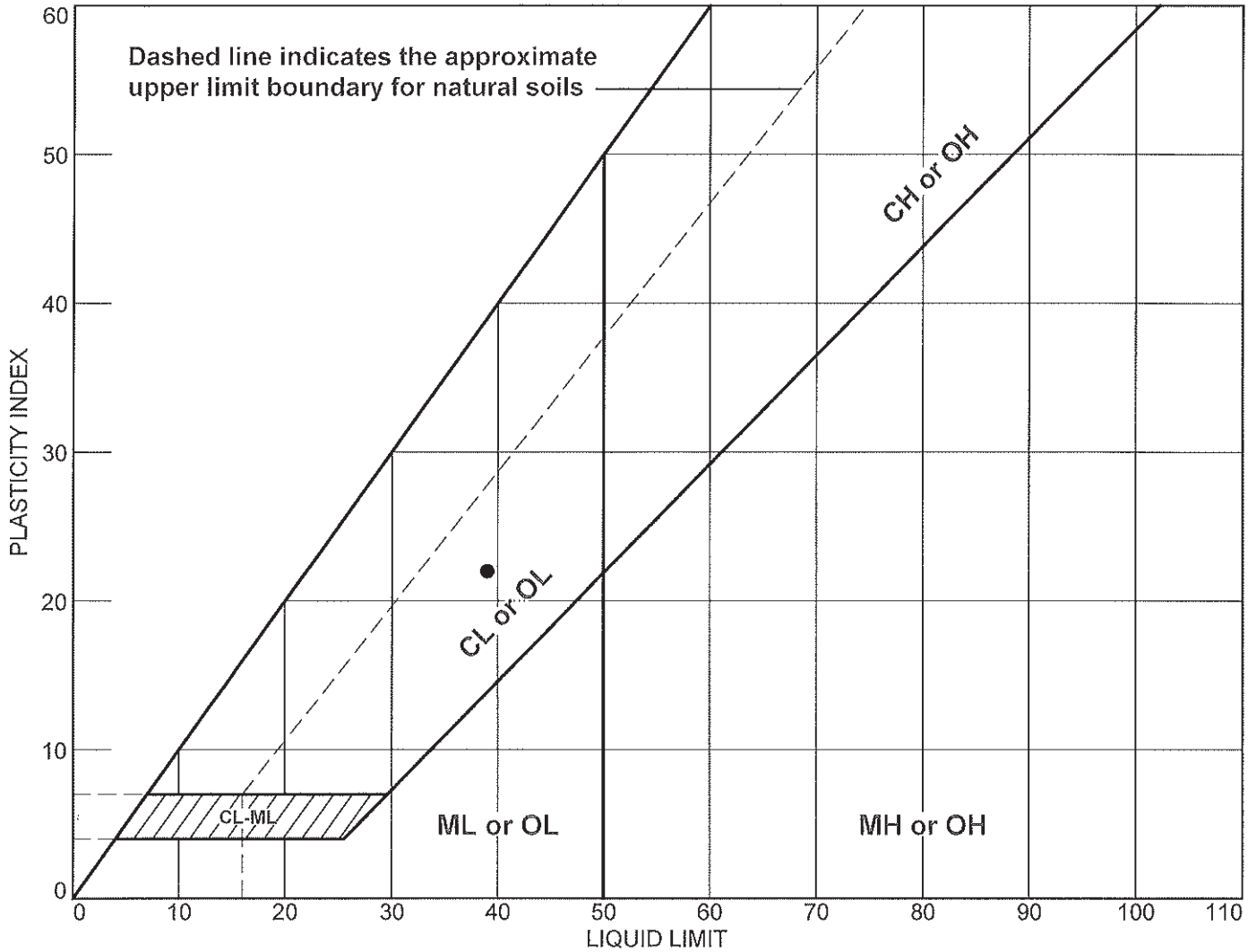
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.10	21.10	21.10		
Dry+Tare	19.82	19.82	19.82		
Tare	13.56	13.56	13.56		
Moisture	20.4	20.4	20.4		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
205.4	161.0	15.7	30.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G036A S-35 215'-216.5'	8000-44	215'-216.5'	42.9	17	39	22	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

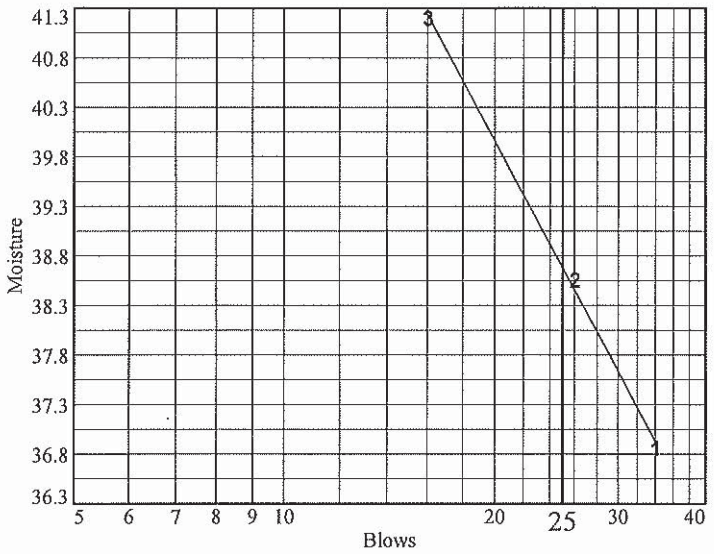
LIQUID AND PLASTIC LIMIT TEST DATA

11/6/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G036A S-35
Depth: 215'-216.5'
Sample Number: 8000-44
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	26.73	25.51	23.83			
Dry+Tare	22.55	21.50	20.13			
Tare	11.21	11.10	11.15			
# Blows	34	26	16			
Moisture	36.9	38.6	41.2			



Liquid Limit= 39
Plastic Limit= 17
Plasticity Index= 22
Natural Moisture= 42.9
Liquidity Index= 1.2

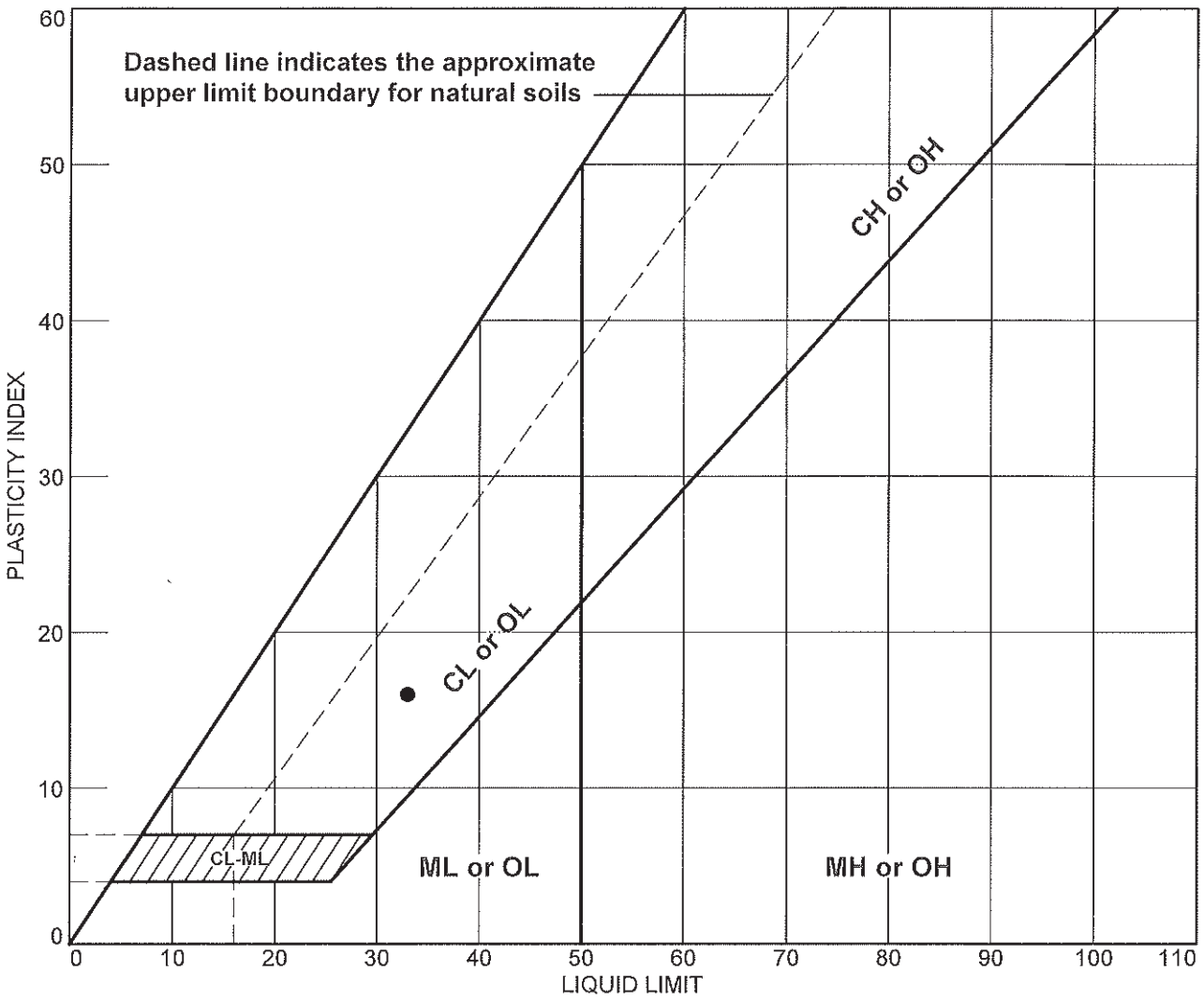
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.91	21.91	21.91		
Dry+Tare	20.67	20.67	20.67		
Tare	13.57	13.57	13.57		
Moisture	17.5	17.5	17.5		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
218.1	157.4	15.8	42.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G37A S22 100'	8023-32	100'	26.0	17	33	16	CL

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

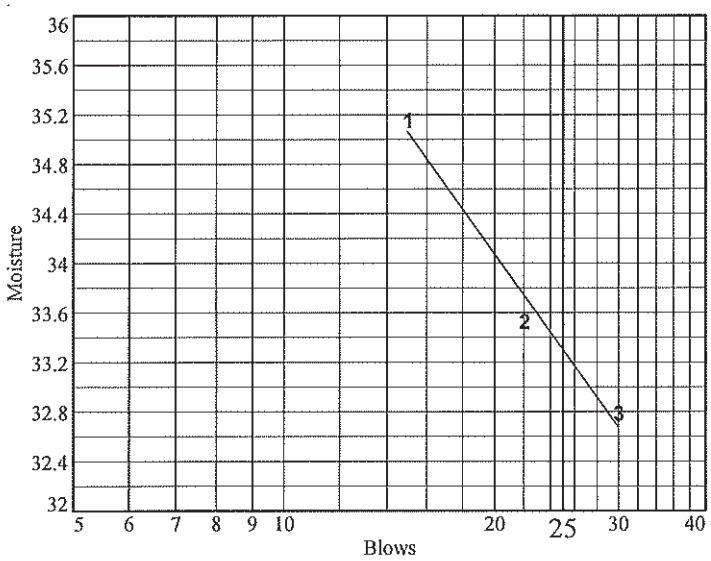
LIQUID AND PLASTIC LIMIT TEST DATA

2/22/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G37A S22
Depth: 100'
Sample Number: 8023-32
Material Description: Lean CLAY
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	22.08	24.85	25.12			
Dry+Tare	19.25	22.02	22.30			
Tare	11.20	13.58	13.70			
# Blows	15	22	30			
Moisture	35.2	33.5	32.8			



Liquid Limit= 33
Plastic Limit= 17
Plasticity Index= 16
Natural Moisture= 26.0
Liquidity Index= 0.6

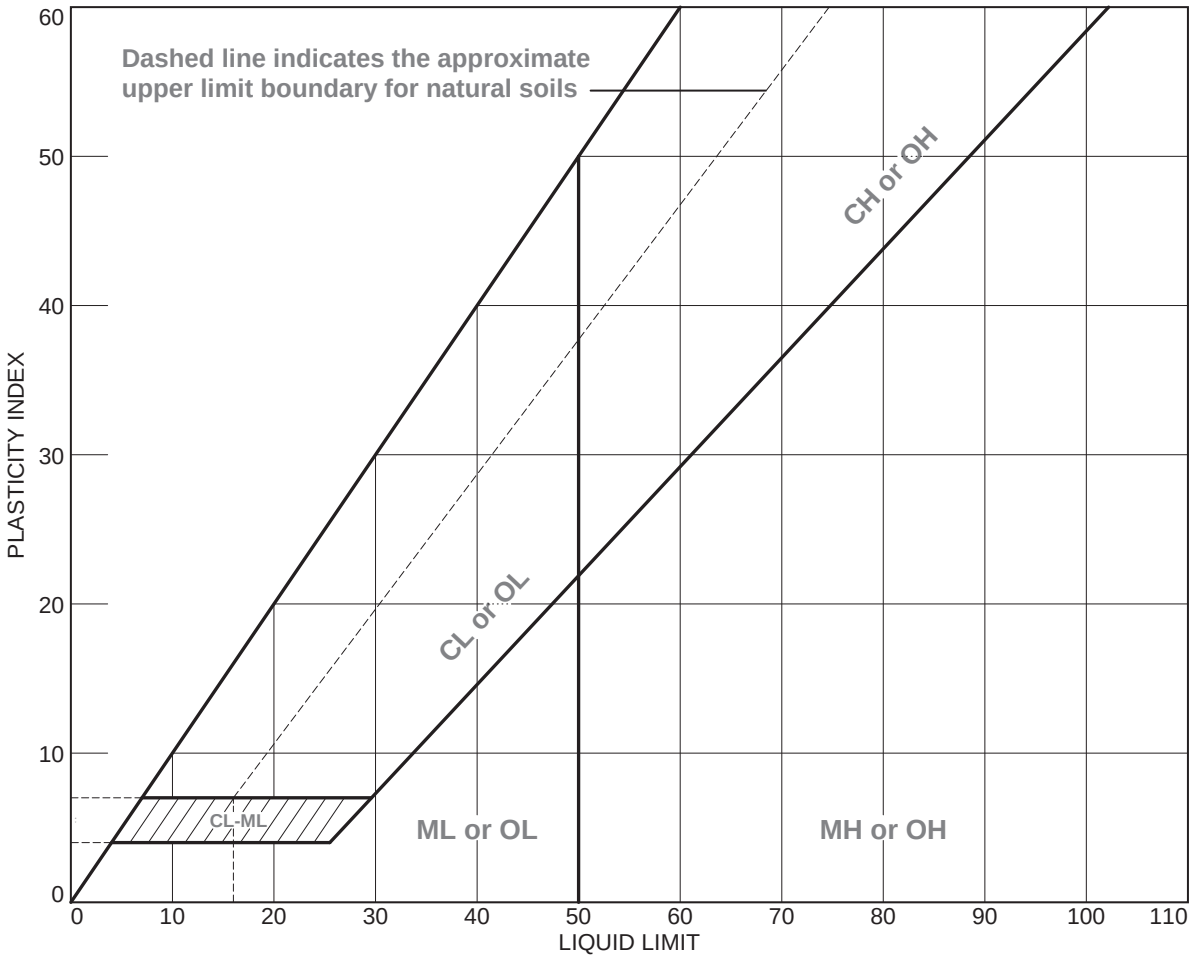
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.97				
Dry+Tare	23.33				
Tare	13.66				
Moisture	17.0				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
109.36	90.11	15.94	26.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G37A S24 108-109.5'	8023-33	108'	21.1	NP	NV	NP	NP

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

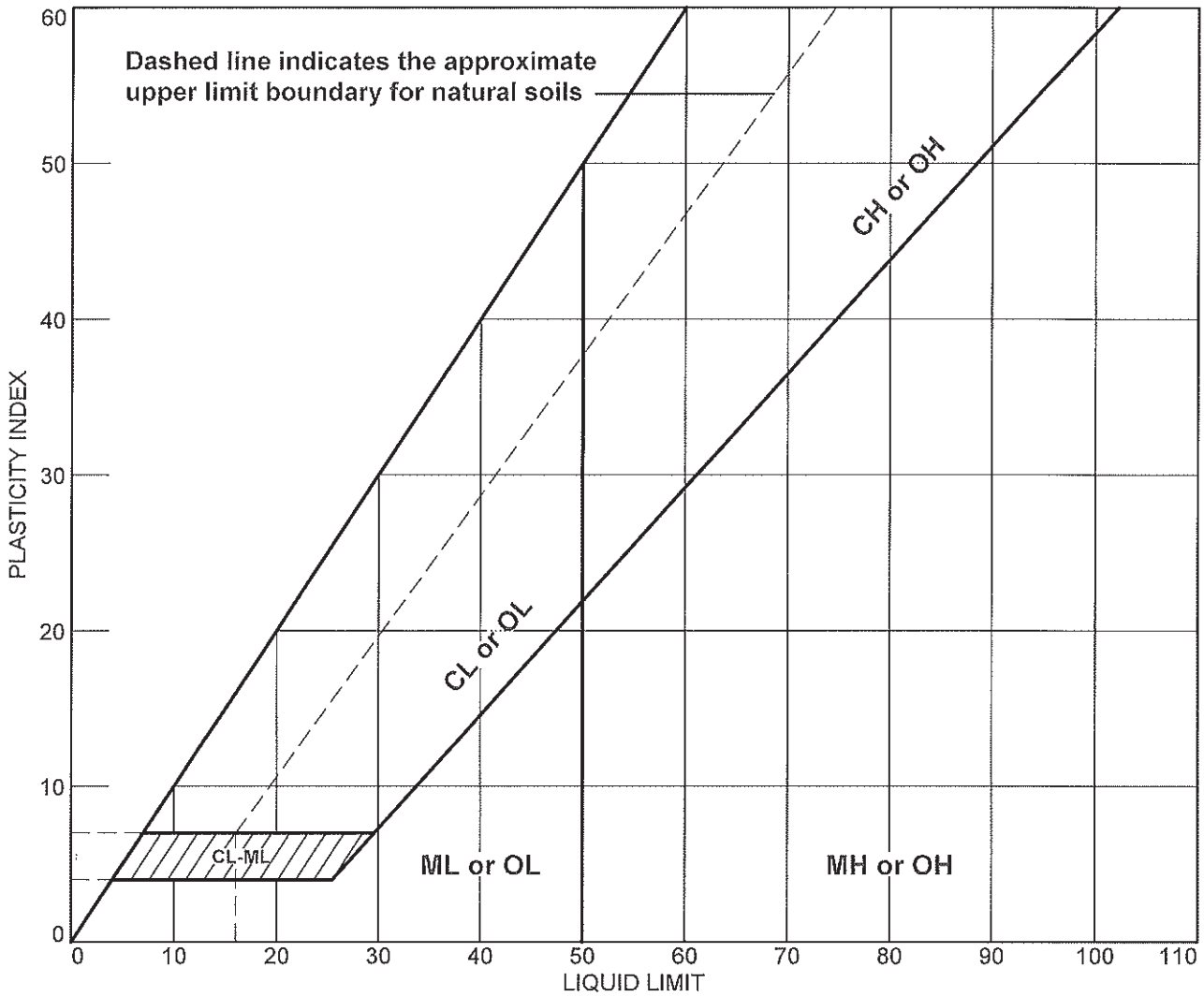
Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G37A S24 108-109.5'	8023-33	108'	21.1	NP	NV	NP	NP

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940
Figure

Tested By: GD **Checked By:** JAM

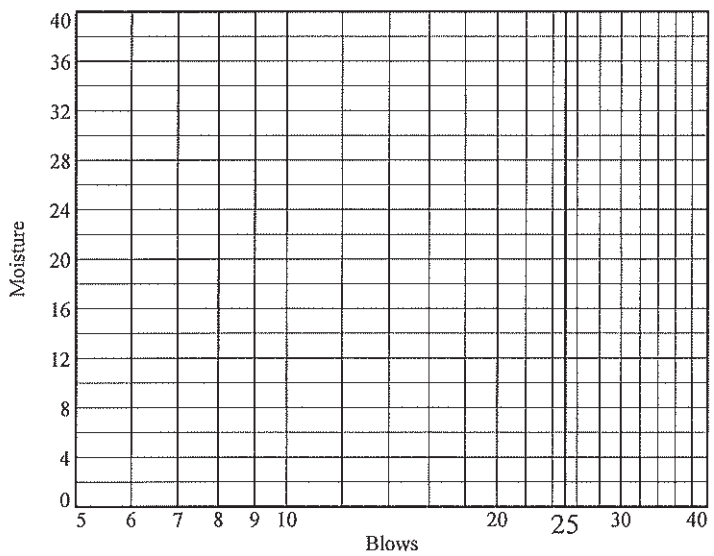
LIQUID AND PLASTIC LIMIT TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G37A S24
Depth: 108'
Sample Number: 8023-33
Material Description: Non Plastic
USCS: NP
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 21.1

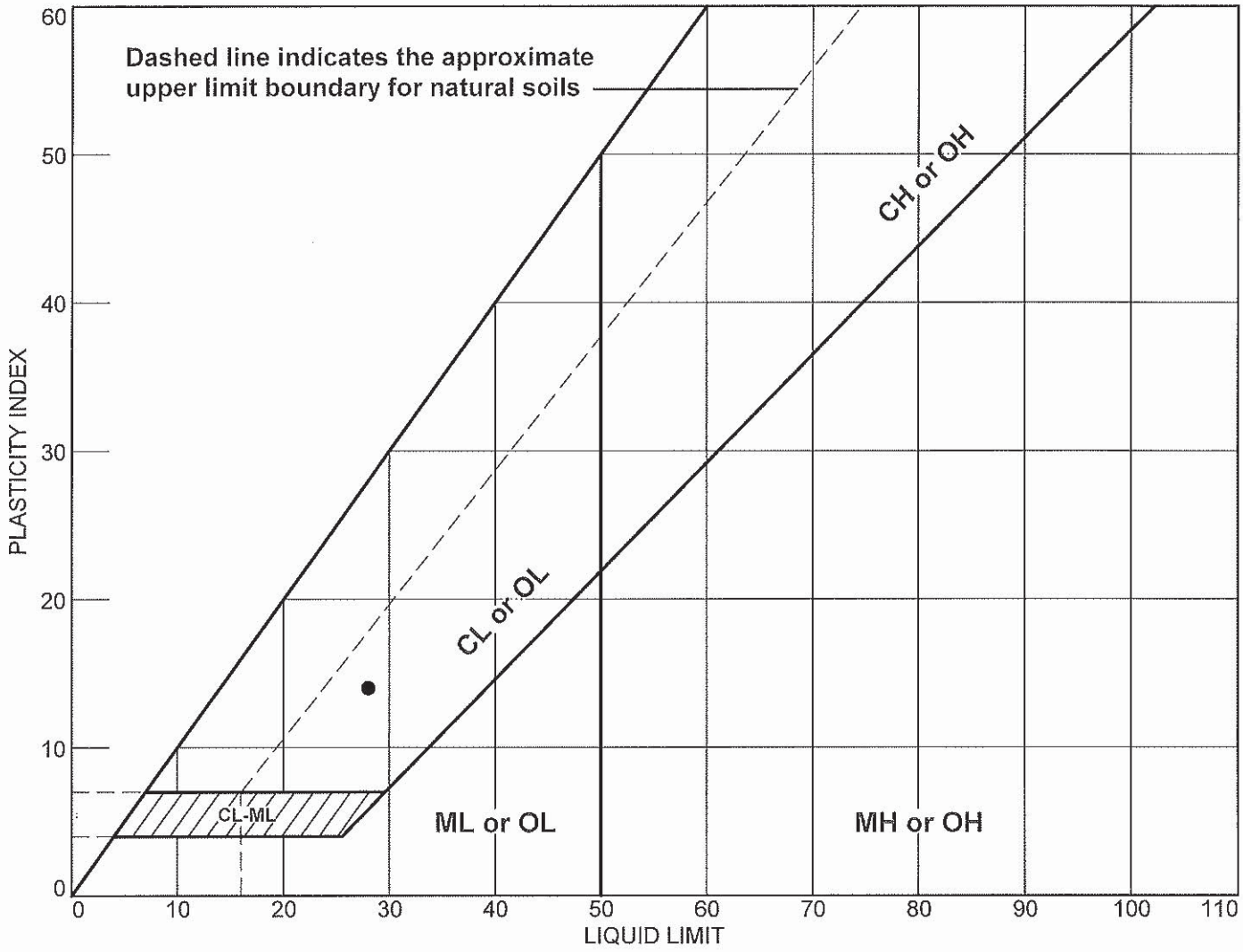
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
93.3	79.8	15.9	21.1

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G037 S-17 90'-91.5'	7995-79	90'-91.5'	25.7	14	28	14	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

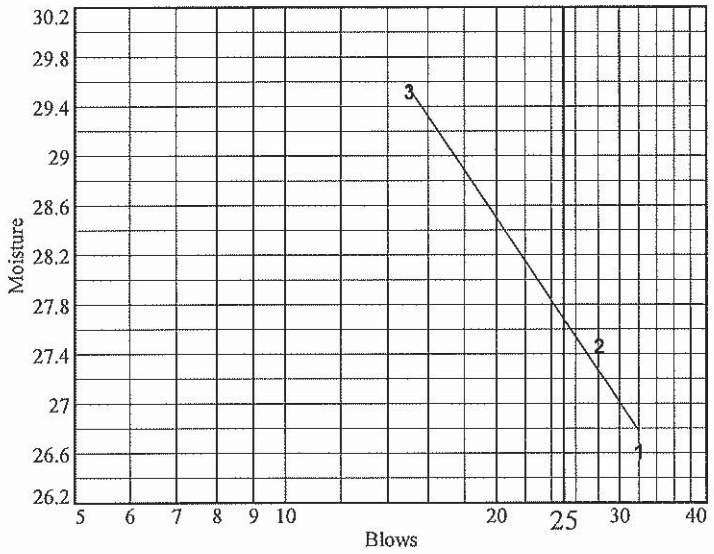
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-17
Depth: 90'-91.5'
Sample Number: 7995-79
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	29.18	27.57	32.23			
Dry+Tare	25.88	24.56	27.97			
Tare	13.48	13.60	13.54			
# Blows	32	28	15			
Moisture	26.6	27.5	29.5			



Liquid Limit= 28
Plastic Limit= 14
Plasticity Index= 14
Natural Moisture= 25.7
Liquidity Index= 0.8

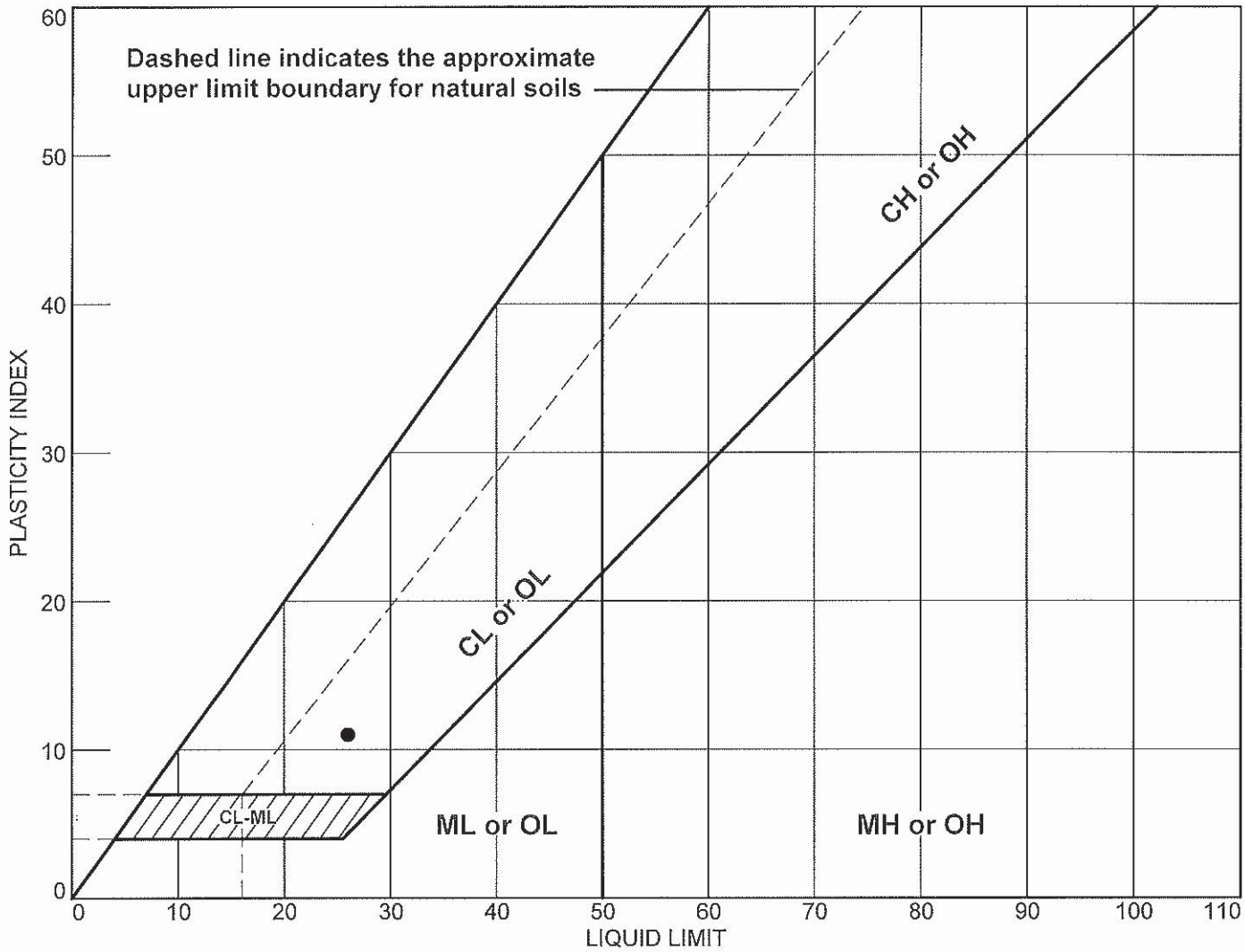
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.81	21.81	21.81		
Dry+Tare	20.81	20.81	20.81		
Tare	13.67	13.67	13.67		
Moisture	14.0	14.0	14.0		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
426.7	342.6	15.8	25.7

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G037 S-18 97.5'-99.5'	7995-80	97.5'-99.5'	18.9	15	26	11	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

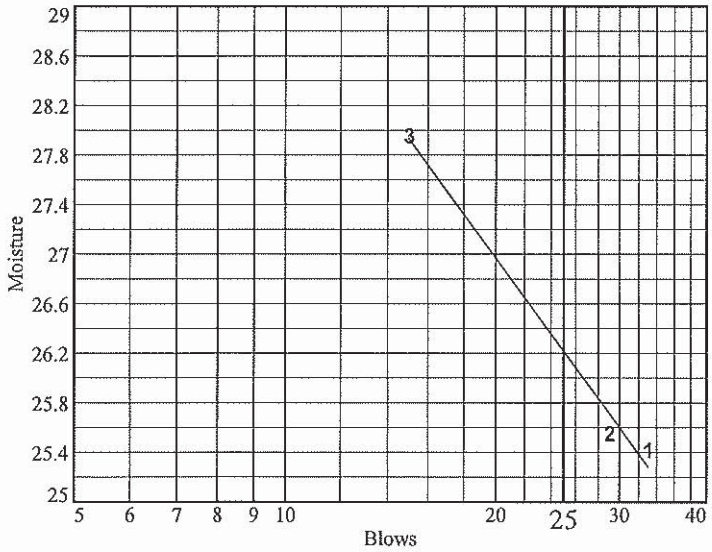
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-18
Depth: 97.5'-99.5'
Sample Number: 7995-80
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	33.67	26.65	30.35			
Dry+Tare	29.60	24.00	26.69			
Tare	13.59	13.63	13.60			
# Blows	33	29	15			
Moisture	25.4	25.6	28.0			



Liquid Limit= 26
Plastic Limit= 15
Plasticity Index= 11
Natural Moisture= 18.9
Liquidity Index= 0.4

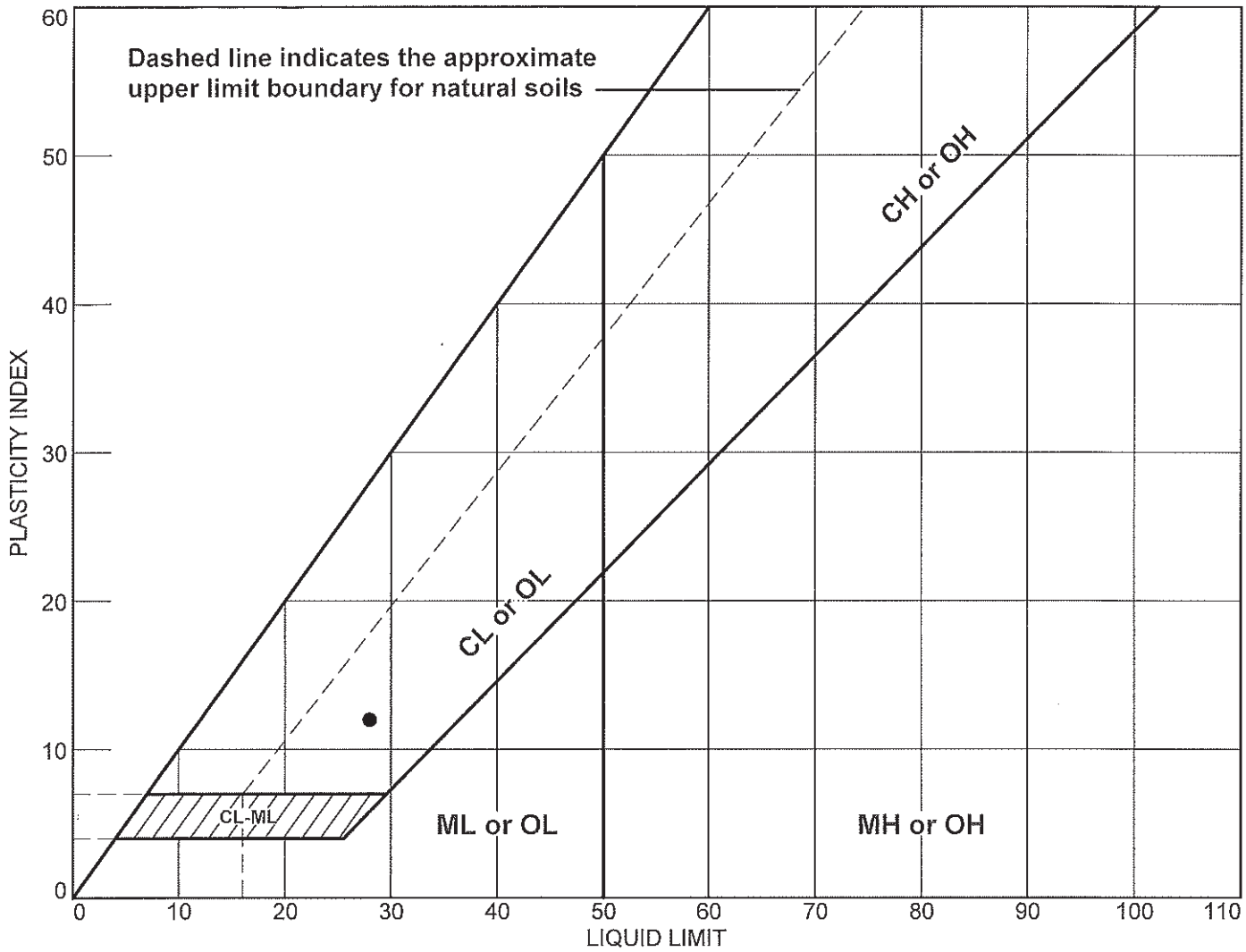
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.97	21.97	21.97		
Dry+Tare	20.85	20.85	20.85		
Tare	13.54	13.54	13.54		
Moisture	15.3	15.3	15.3		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
430.6	364.7	15.8	18.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G037 S-20 105'-106.5'	7995-81	105'-106.5	28.0	16	28	12	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

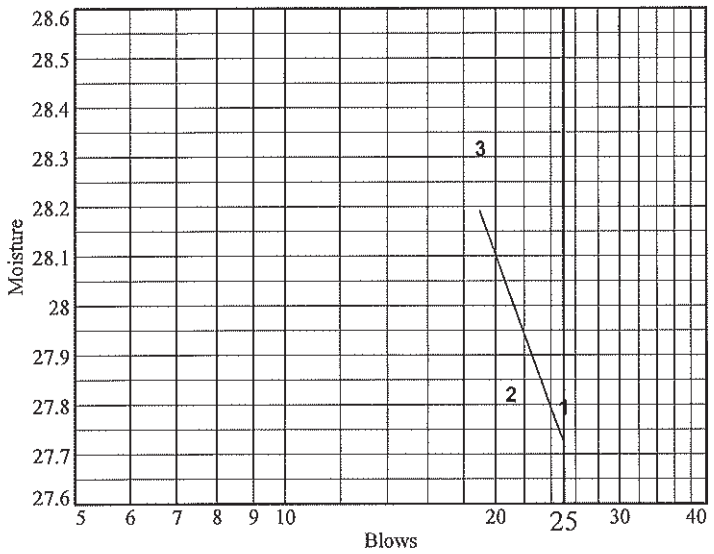
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-20
Depth: 105'-106.5 **Sample Number:** 7995-81
USCS: CL
Tested by: JR **Checked by:** JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	34.08	31.74	26.01			
Dry+Tare	29.63	27.82	23.30			
Tare	13.62	13.73	13.73			
# Blows	25	21	19			
Moisture	27.8	27.8	28.3			



Liquid Limit= 28
Plastic Limit= 16
Plasticity Index= 12
Natural Moisture= 28.0
Liquidity Index= 1.0

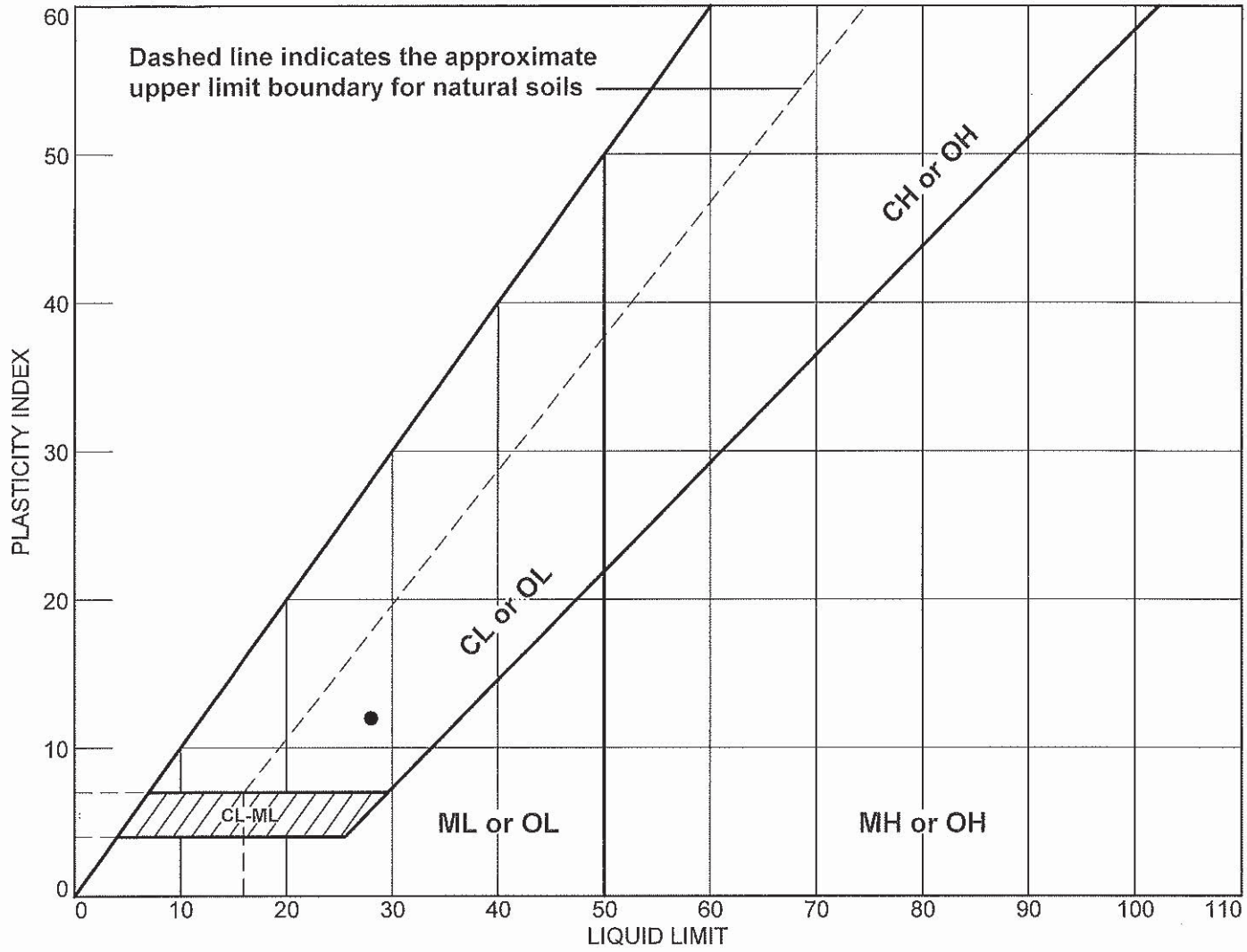
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.66	21.66	21.66		
Dry+Tare	20.55	20.55	20.55		
Tare	13.50	13.50	13.50		
Moisture	15.7	15.7	15.7		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
453.5	357.8	15.8	28.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G037 S-21 115'-116.5'	7995-82	115'-116.5'	24.3	16	28	12	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

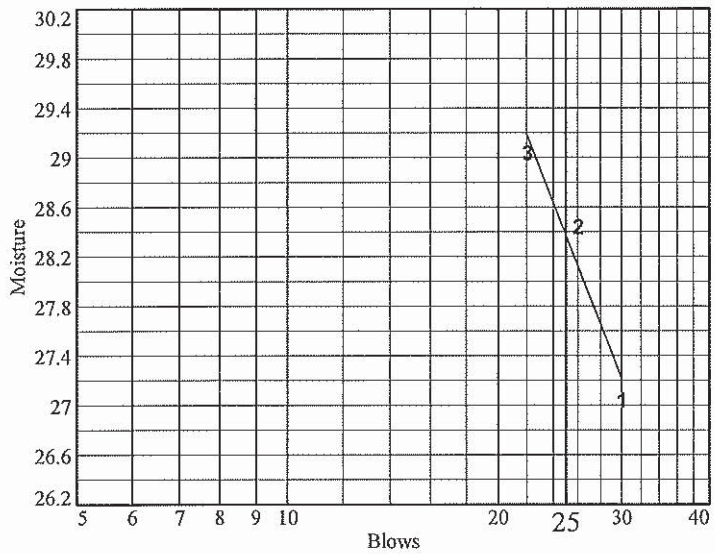
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-21
Depth: 115'-116.5'
Sample Number: 7995-82
USCS: CL
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	30.26	26.73	27.95			
Dry+Tare	26.72	23.84	24.77			
Tare	13.63	13.68	13.82			
# Blows	30	26	22			
Moisture	27.0	28.4	29.0			



Liquid Limit= 28
Plastic Limit= 16
Plasticity Index= 12
Natural Moisture= 24.3
Liquidity Index= 0.7

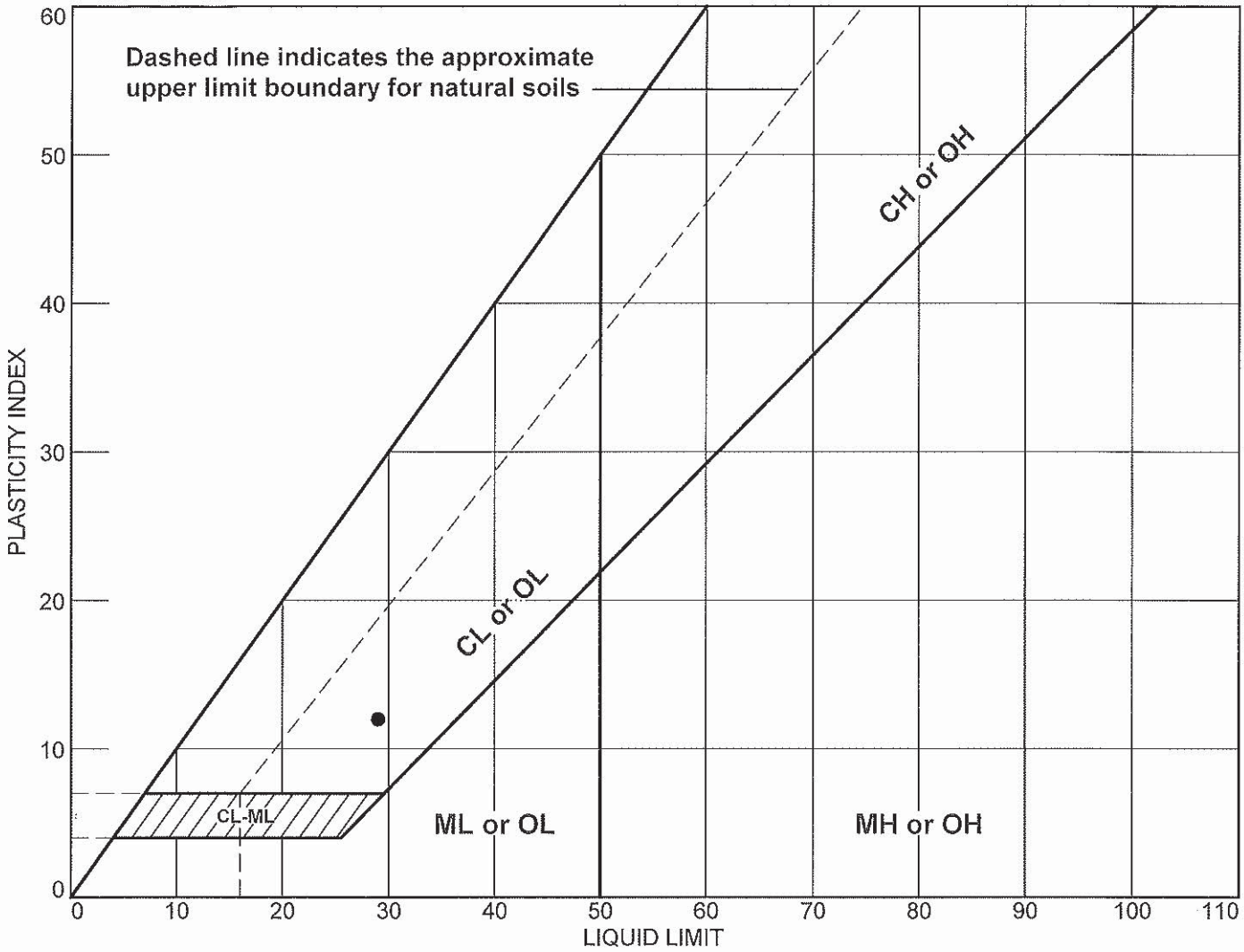
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.72	21.72	21.72		
Dry+Tare	20.58	20.58	20.58		
Tare	13.66	13.66	13.66		
Moisture	16.5	16.5	16.5		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
418.5	339.9	15.8	24.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G037 S-23 125'-126.5'	7995-83	125'-126.5'	23.9	17	29	12	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

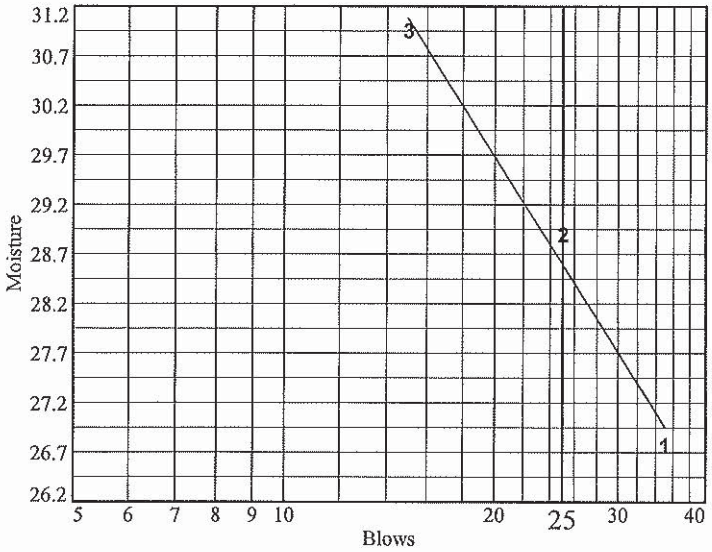
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-23
Depth: 125'-126.5'
Sample Number: 7995-83
USCS: CL
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	27.64	33.75	33.91			
Dry+Tare	24.70	29.25	29.13			
Tare	13.72	13.68	13.69			
# Blows	35	25	15			
Moisture	26.8	28.9	31.0			



Liquid Limit= 29
Plastic Limit= 17
Plasticity Index= 12
Natural Moisture= 23.9
Liquidity Index= 0.6

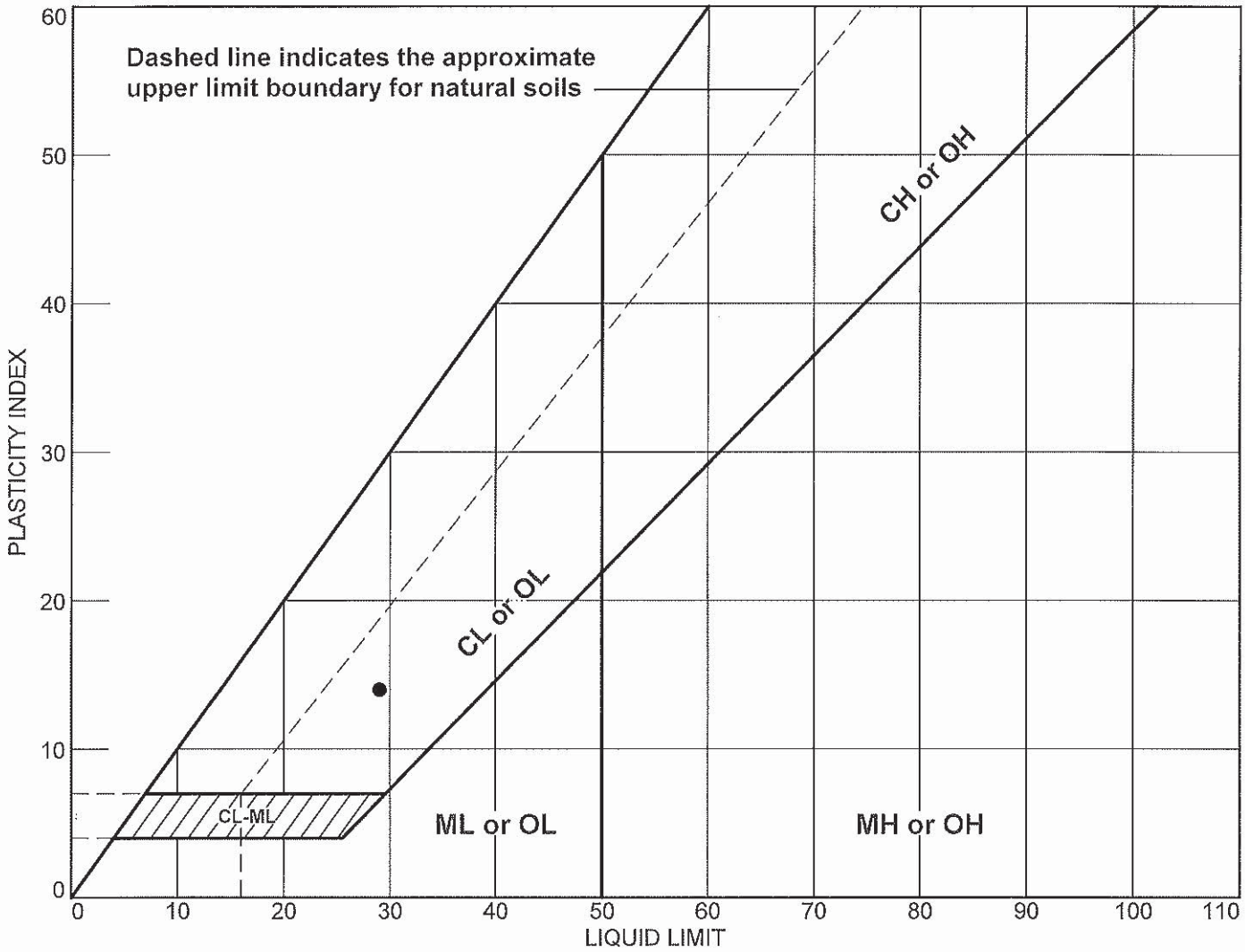
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.41	22.41	22.41		
Dry+Tare	21.11	21.11	21.11		
Tare	13.56	13.56	13.56		
Moisture	17.2	17.2	17.2		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
337.8	275.7	15.8	23.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●		7995-85	145'-146.5'	16.8	15	29	14	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

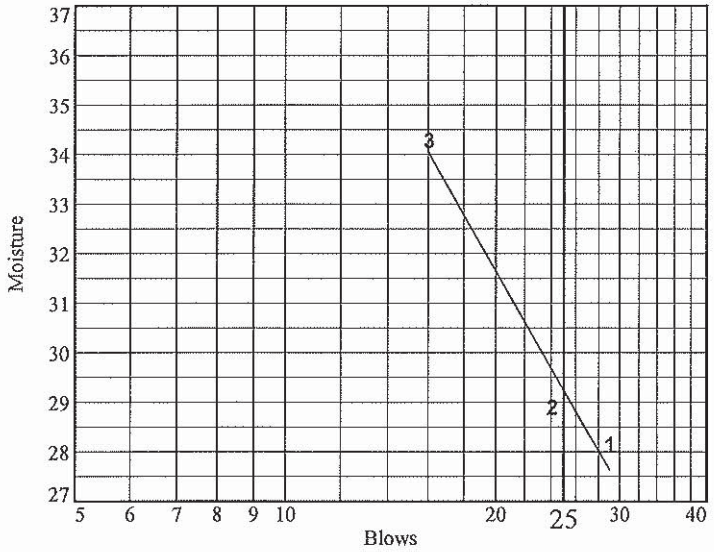
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-27 145'-146.5'
Depth: 145'-146.5' **Sample Number:** 7995-85
USCS: CL
Tested by: BH **Checked by:** JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	24.71	25.09	27.74			
Dry+Tare	22.28	22.52	24.53			
Tare	13.65	13.63	15.17			
# Blows	29	24	16			
Moisture	28.2	28.9	34.3			



Liquid Limit= 29
Plastic Limit= 15
Plasticity Index= 14
Natural Moisture= 16.8
Liquidity Index= 0.1

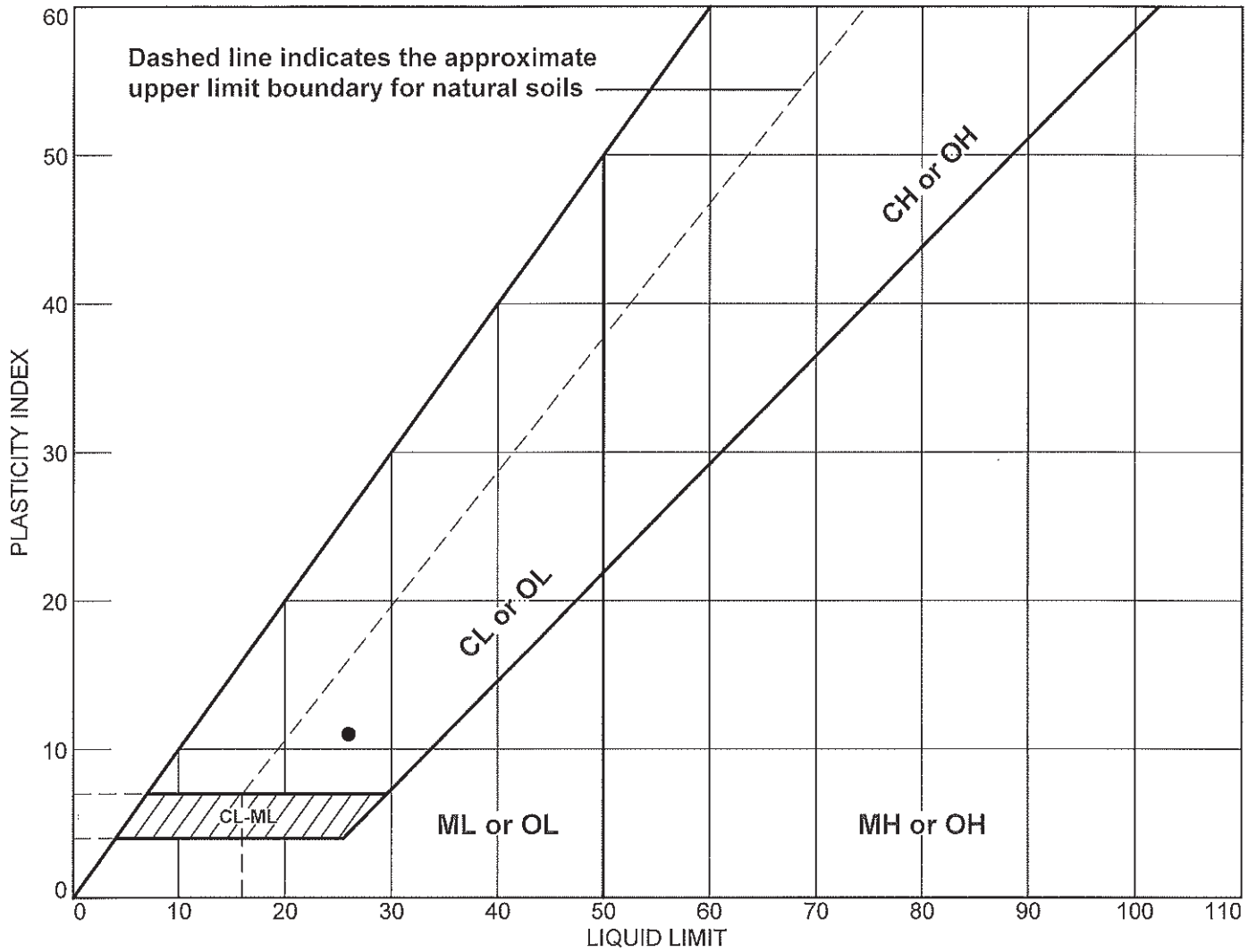
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.81	20.81	20.81		
Dry+Tare	19.84	19.84	19.84		
Tare	13.56	13.56	13.56		
Moisture	15.4	15.4	15.4		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
384.3	331.4	15.8	16.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G037 S-29 155'-156.5'	7995-86	155'-156.5'	21.9	15	26	11	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

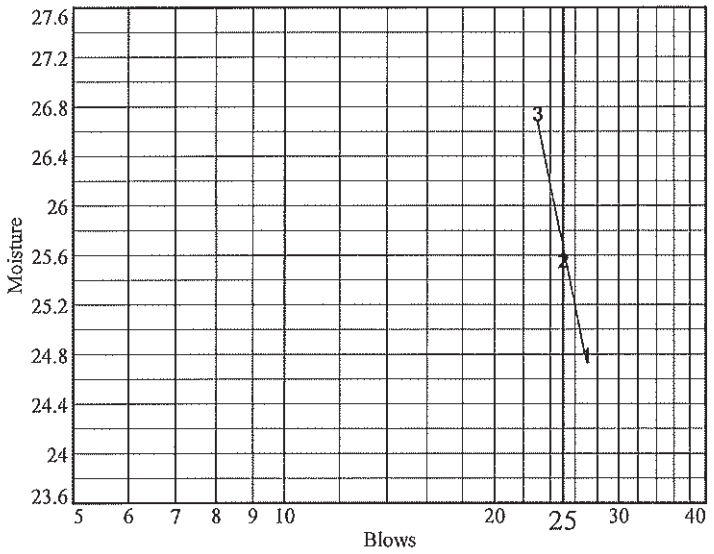
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-29
Depth: 155'-156.5'
Sample Number: 7995-86
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.91	35.55	32.30			
Dry+Tare	25.94	31.08	28.35			
Tare	13.96	13.59	13.58			
# Blows	27	25	23			
Moisture	24.8	25.6	26.7			



Liquid Limit= 26
Plastic Limit= 15
Plasticity Index= 11
Natural Moisture= 21.9
Liquidity Index= 0.6

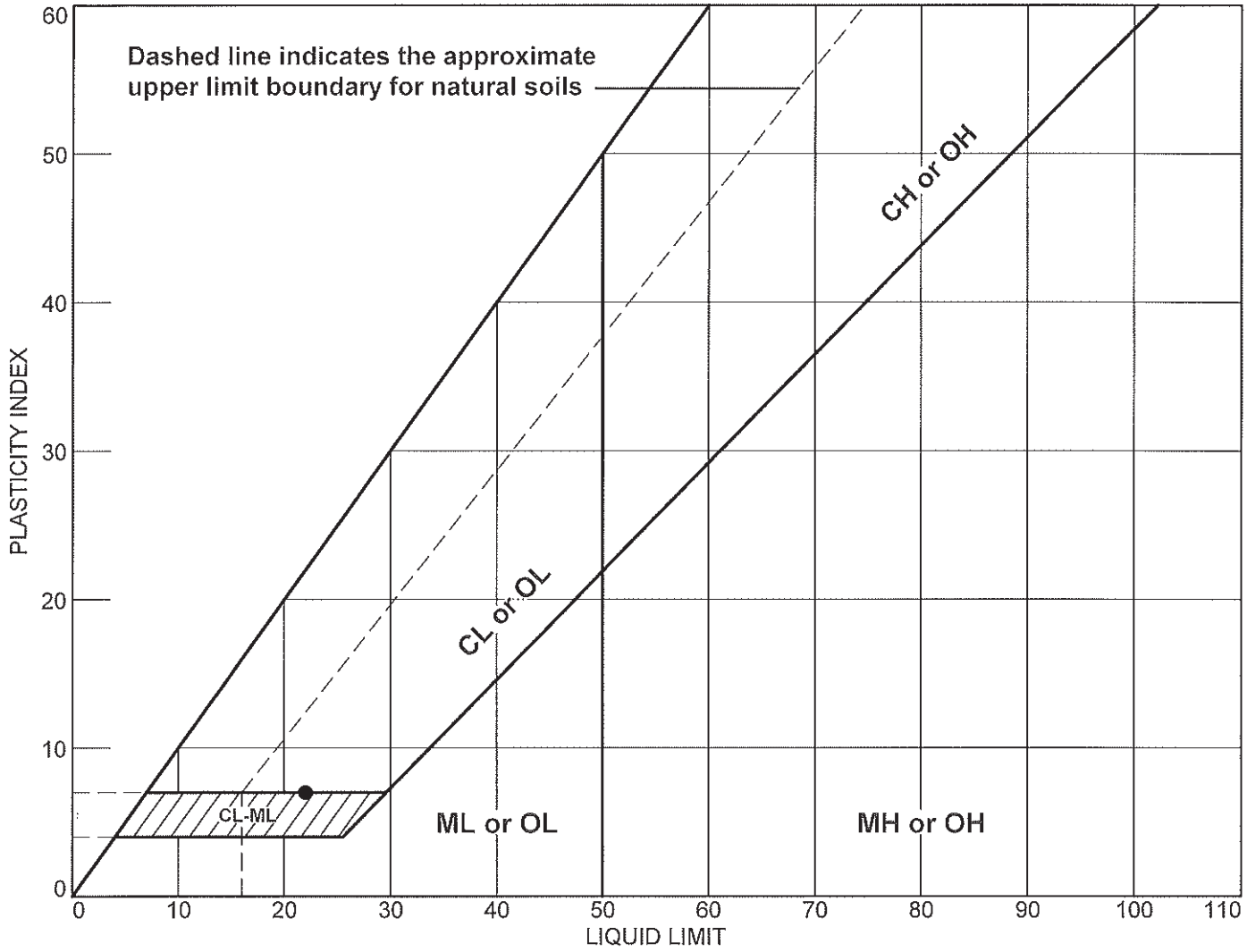
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.78	21.78	21.78		
Dry+Tare	20.70	20.70	20.70		
Tare	13.63	13.63	13.63		
Moisture	15.3	15.3	15.3		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
382.9	317.0	15.8	21.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G037 S-31 170'-171.5'	7995-87	170'-171.5	18.8	15	22	7	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

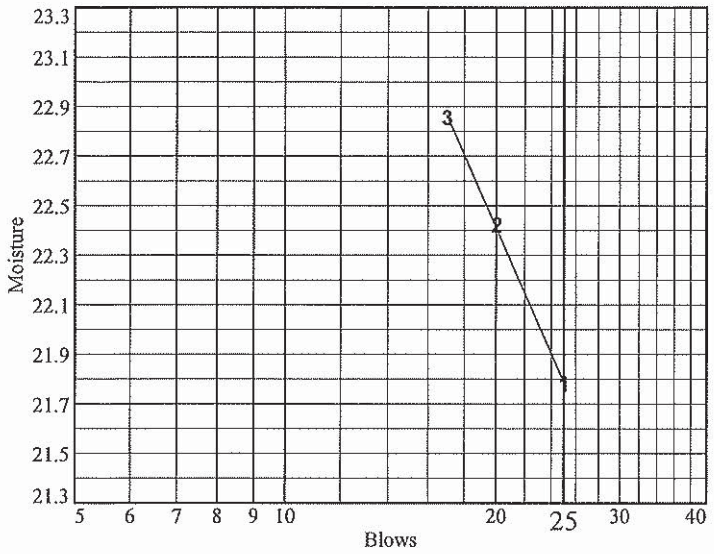
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-31
Depth: 170'-171.5 **Sample Number:** 7995-87
USCS: CL
Tested by: JR **Checked by:** JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	34.57	33.19	26.48			
Dry+Tare	30.83	29.62	24.08			
Tare	13.66	13.70	13.58			
# Blows	25	20	17			
Moisture	21.8	22.4	22.9			



Liquid Limit= 22
Plastic Limit= 15
Plasticity Index= 7
Natural Moisture= 18.8
Liquidity Index= 0.5

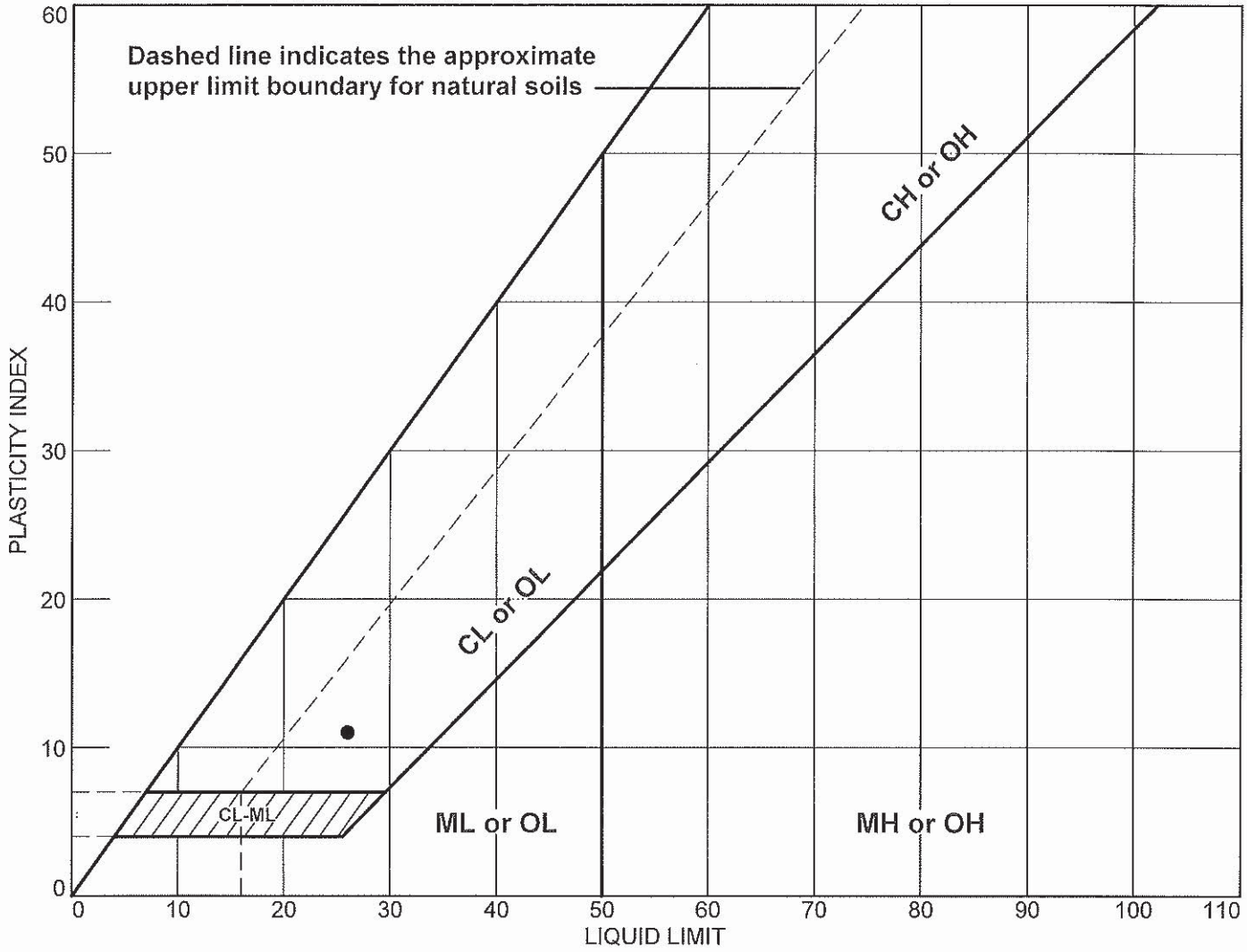
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.53	22.53	22.53		
Dry+Tare	21.38	21.38	21.38		
Tare	13.73	13.73	13.73		
Moisture	15.0	15.0	15.0		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
426.1	361.2	15.8	18.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G037 S-37 200'-201.5'	7995-90	200'-201.5'	28.4	15	26	11	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

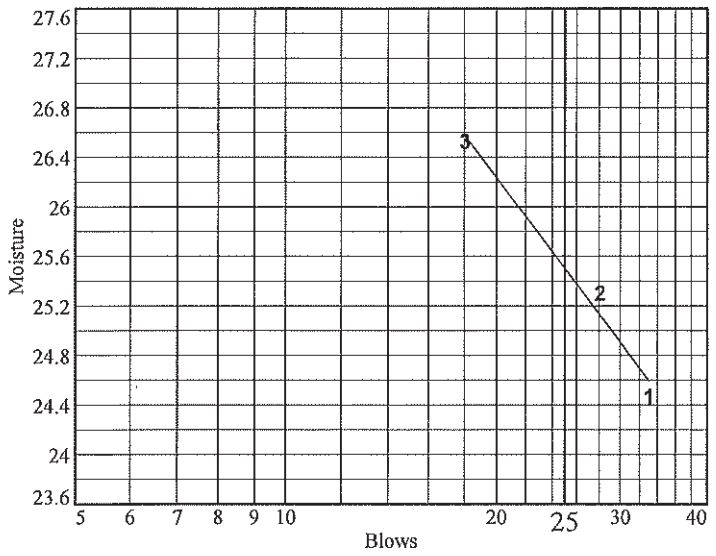
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G037 S-37
Depth: 200'-201.5'
Sample Number: 7995-90
USCS: CL
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	25.30	24.89	26.25			
Dry+Tare	22.99	22.62	23.61			
Tare	13.55	13.65	13.66			
# Blows	33	28	18			
Moisture	24.5	25.3	26.5			



Liquid Limit= 26
Plastic Limit= 15
Plasticity Index= 11
Natural Moisture= 28.4
Liquidity Index= 1.2

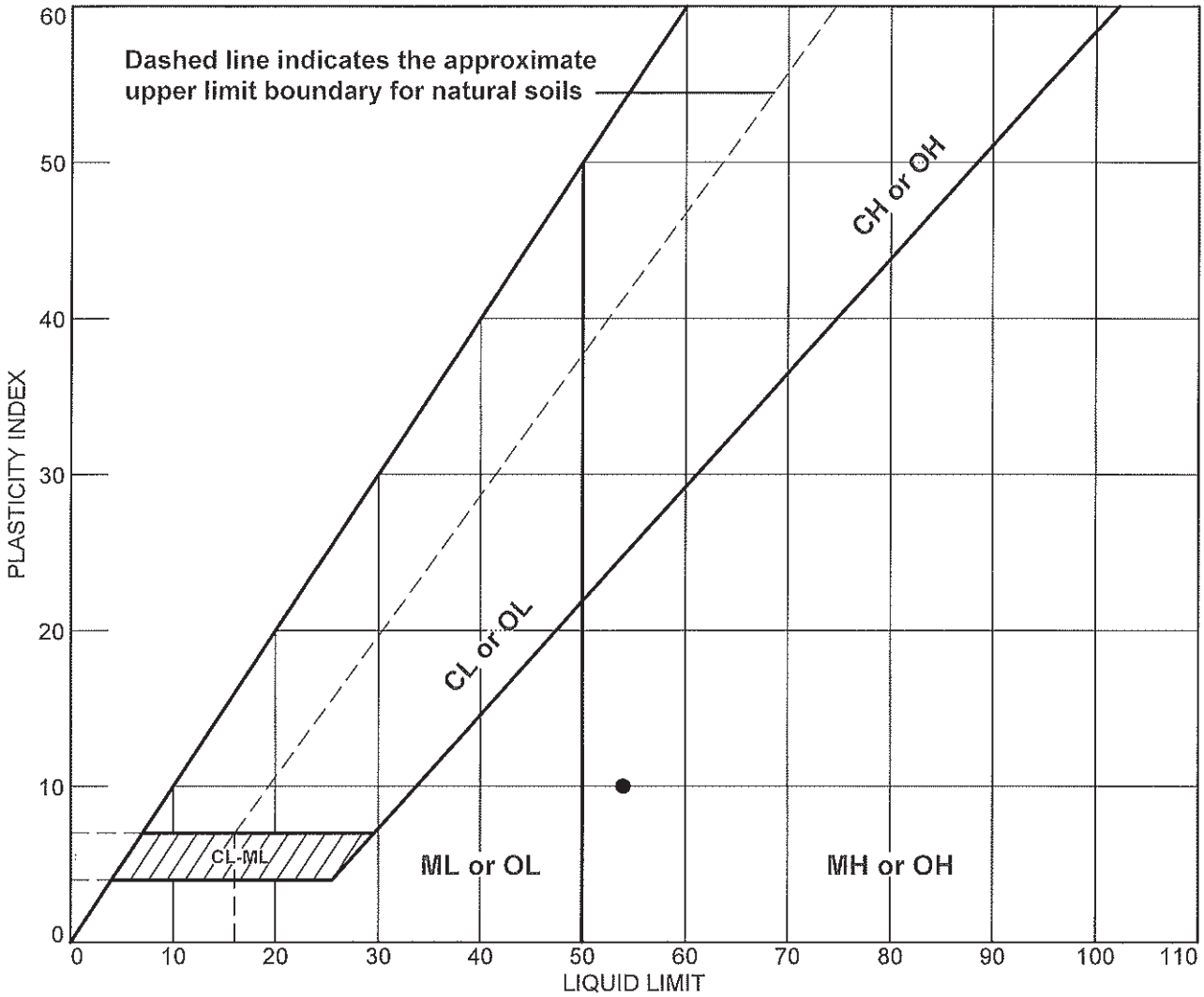
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.17	21.17	21.17		
Dry+Tare	20.21	20.21	20.21		
Tare	13.63	13.63	13.63		
Moisture	14.6	14.6	14.6		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
362.3	285.6	15.8	28.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G38 S4 12.5'	8023-35	12.5'	49.9	44	54	10	MH

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940
Figure

Tested By: GD **Checked By:** JAM

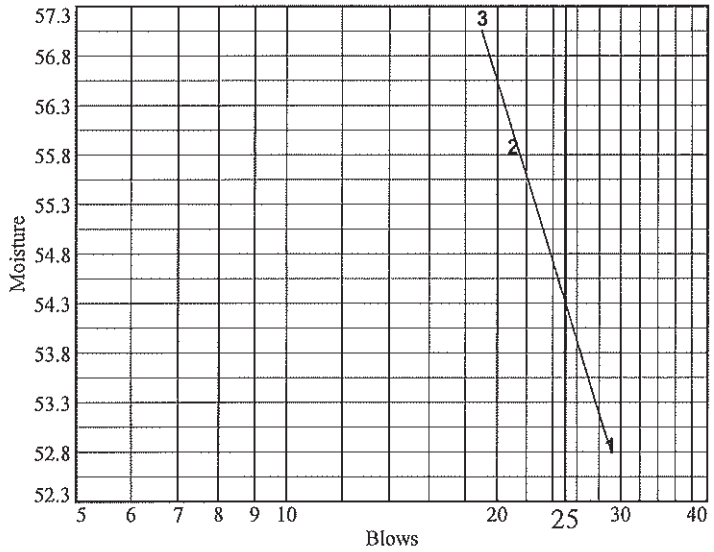
LIQUID AND PLASTIC LIMIT TEST DATA

2/22/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G38 S4
Depth: 12.5'
Sample Number: 8023-35
Material Description: Elastic SILT
USCS: MH
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	29.31	20.61	22.45			
Dry+Tare	23.04	17.24	18.35			
Tare	11.18	11.21	11.18			
# Blows	29	21	19			
Moisture	52.9	55.9	57.2			



Liquid Limit= 54
Plastic Limit= 44
Plasticity Index= 10
Natural Moisture= 49.9
Liquidity Index= 0.6

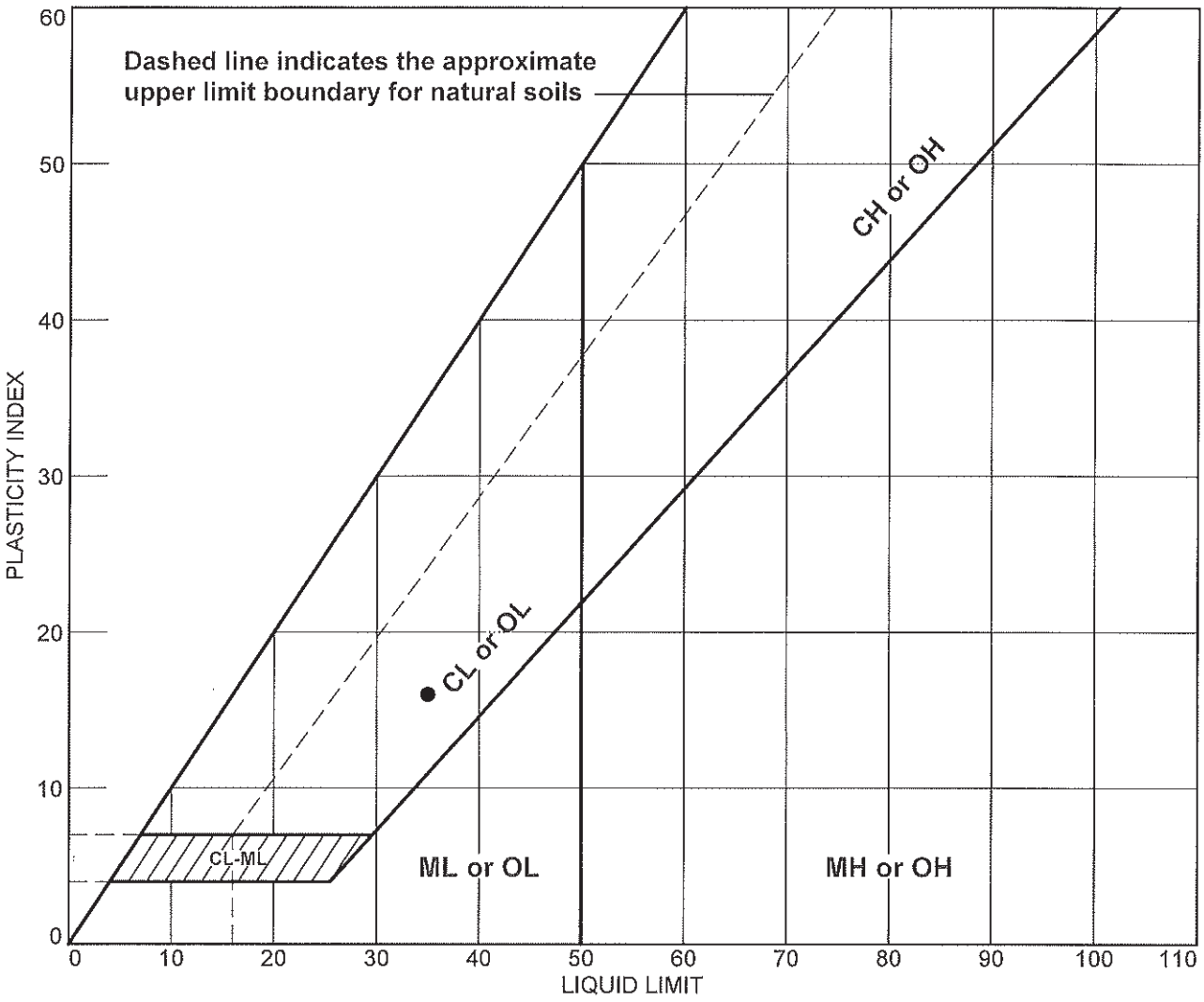
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.81				
Dry+Tare	18.57				
Tare	11.25				
Moisture	44.3				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
74.18	54.76	15.81	49.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G38 S5 15'	2023-36	15'	58.0	19	35	16	CL

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940
Figure

Tested By: GD **Checked By:** JAM

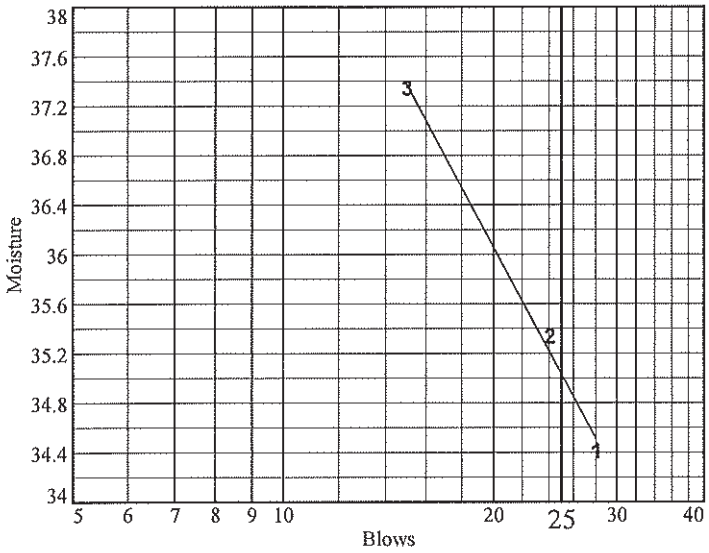
LIQUID AND PLASTIC LIMIT TEST DATA

2/26/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G38 S5
Depth: 15' **Sample Number:** 2023-36
Material Description: Lean CLAY - Sample received with free water in the jar.
USCS: CL
Tested by: GD **Checked by:** JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	24.99	27.21	31.63			
Dry+Tare	22.13	23.69	26.70			
Tare	13.82	13.73	13.50			
# Blows	28	24	15			
Moisture	34.4	35.3	37.3			



Liquid Limit= 35
Plastic Limit= 19
Plasticity Index= 16
Natural Moisture= 58.0
Liquidity Index= 2.4

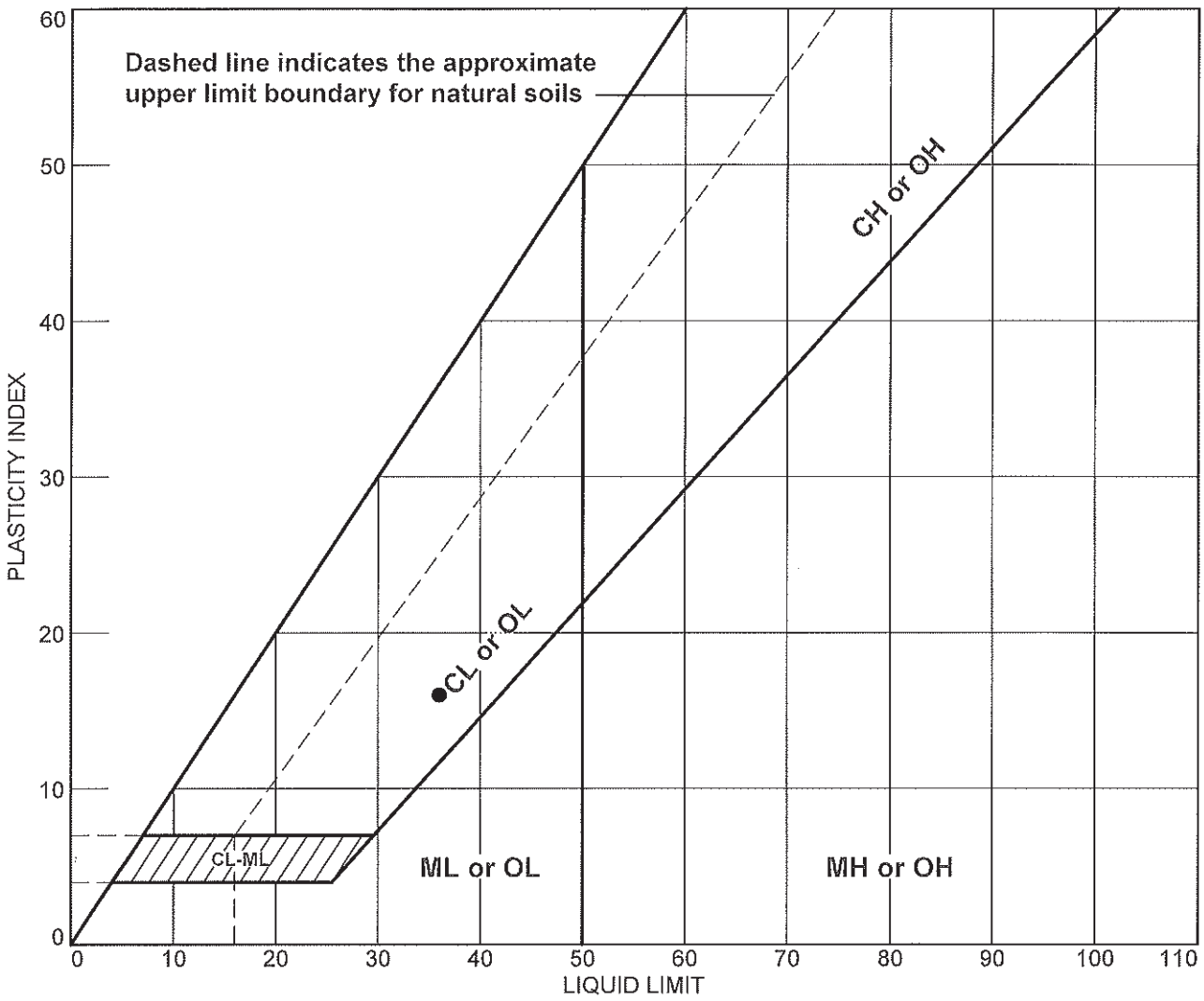
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.42				
Dry+Tare	22.68				
Tare	13.74				
Moisture	19.5				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
126.76	86.06	15.84	58.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G38 S22 100'	8023-44	100'	32.5	20	36	16	CL

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

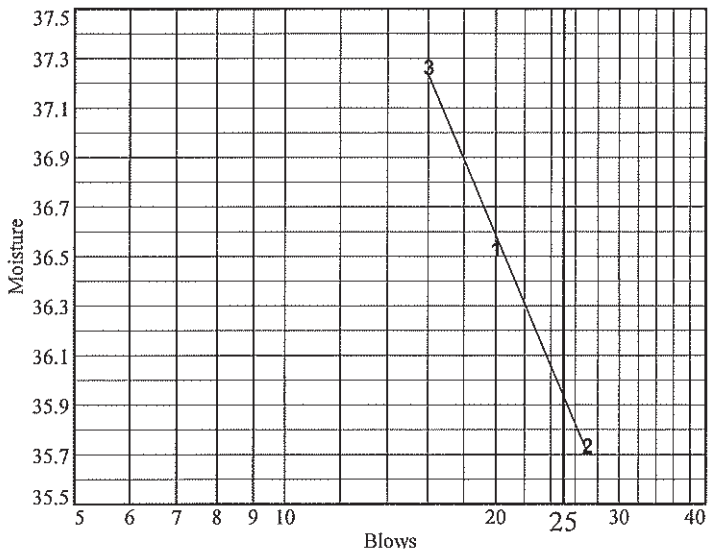
LIQUID AND PLASTIC LIMIT TEST DATA

2/22/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G38 S22
Depth: 100'
Sample Number: 8023-44
Material Description: Lean CLAY
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	26.25	20.45	23.94			
Dry+Tare	22.90	18.02	21.16			
Tare	13.73	11.22	13.70			
# Blows	20	27	16			
Moisture	36.5	35.7	37.3			



Liquid Limit= 36
Plastic Limit= 20
Plasticity Index= 16
Natural Moisture= 32.5
Liquidity Index= 0.8

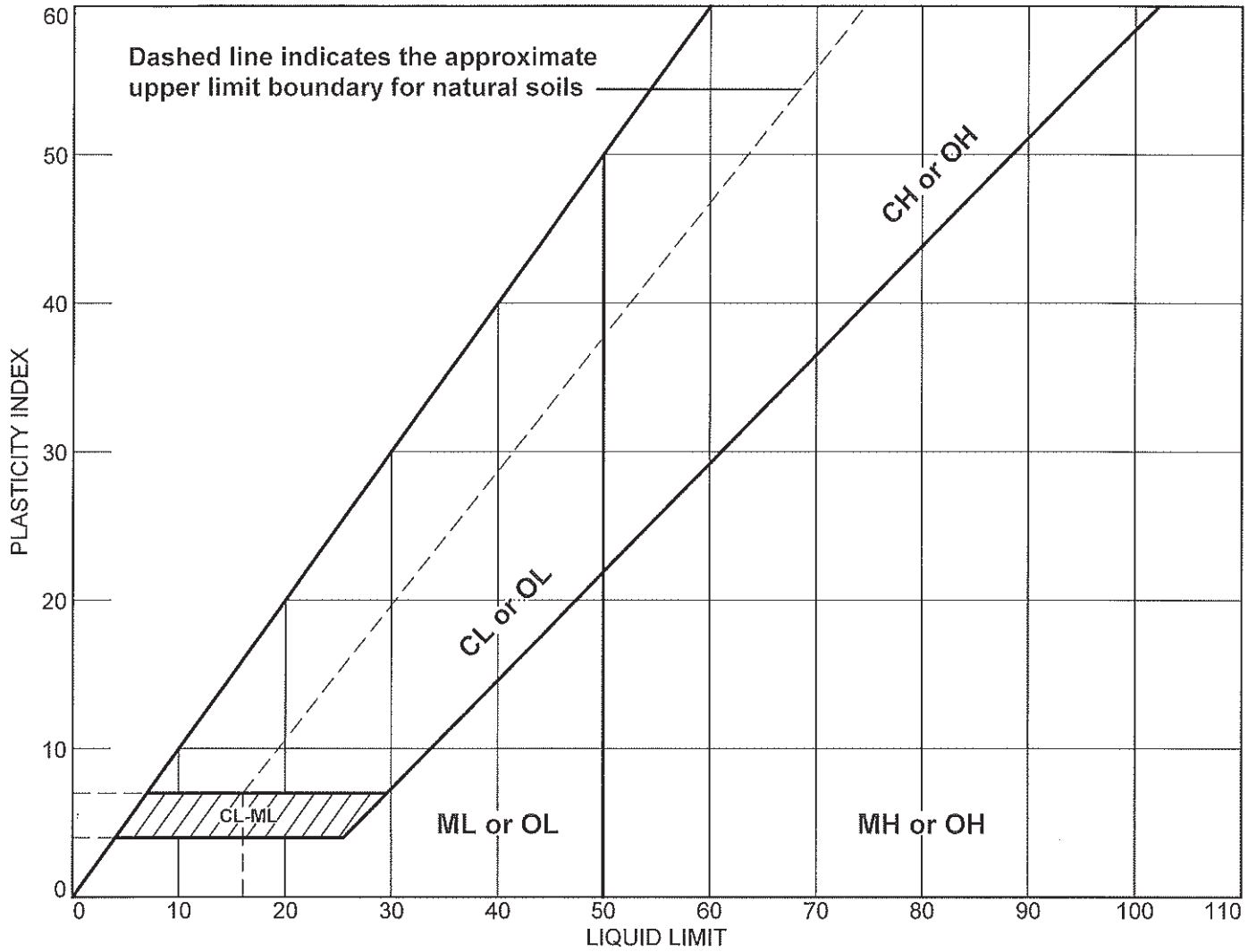
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.29				
Dry+Tare	22.53				
Tare	13.67				
Moisture	19.9				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
117.47	92.55	15.96	32.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G044 S-22 80'-81.5'	7995-104	80'-81.5'	31.1	NP	NV	NP	N/A

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

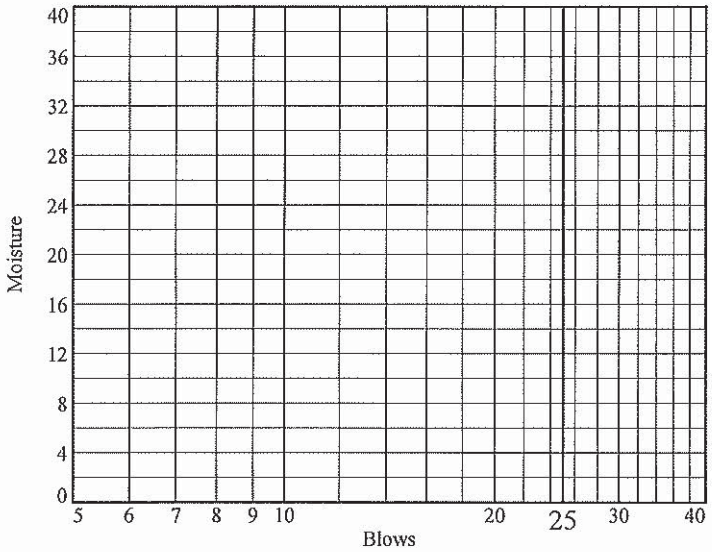
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-22
Depth: 80'-81.5'
Sample Number: 7995-104
USCS: N/A
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 31.1

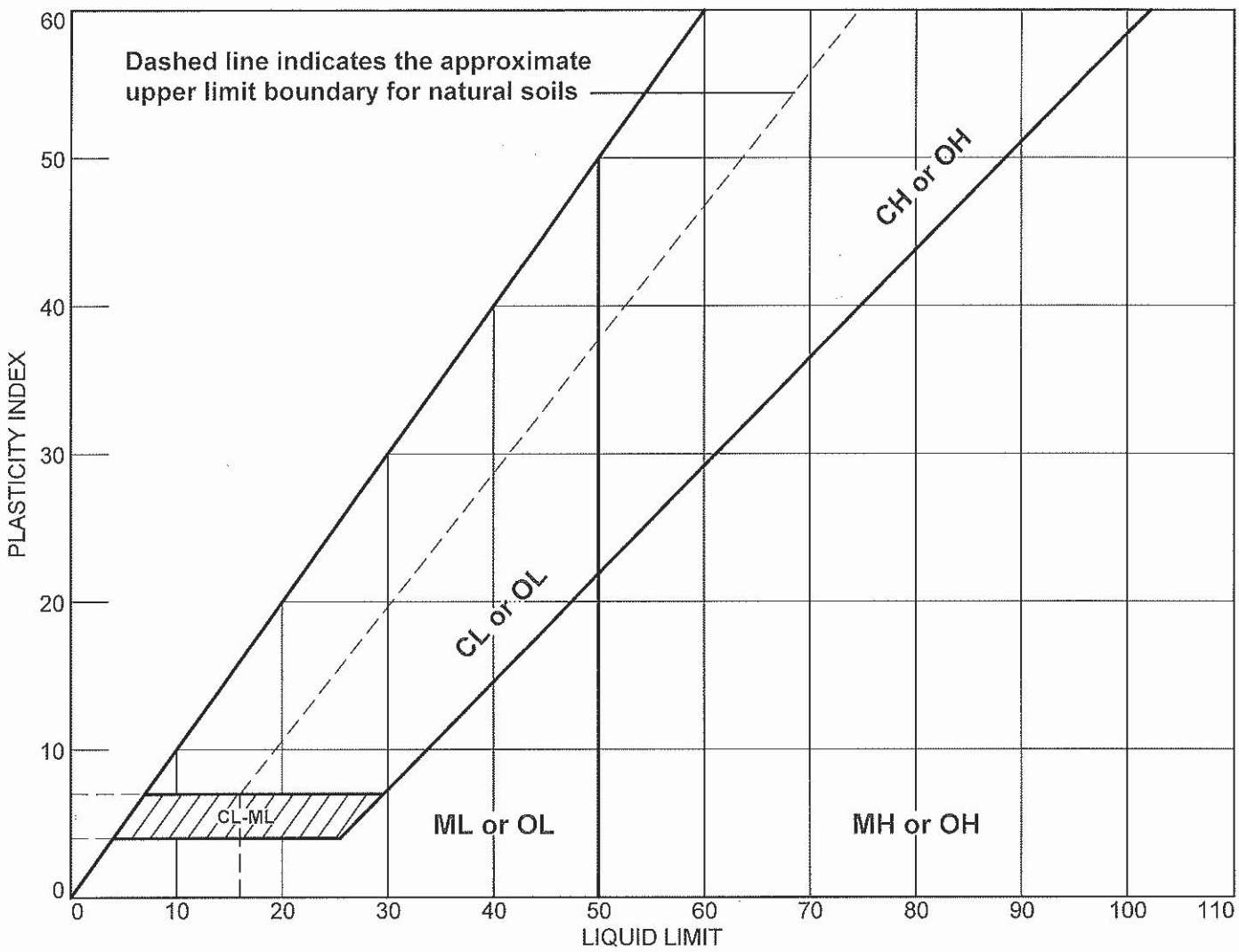
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
496.5	382.6	15.8	31.1

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G044 S-23 85'-86.5'	7995-105	85'-86.5'	29.8	NP	NV	NP	

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

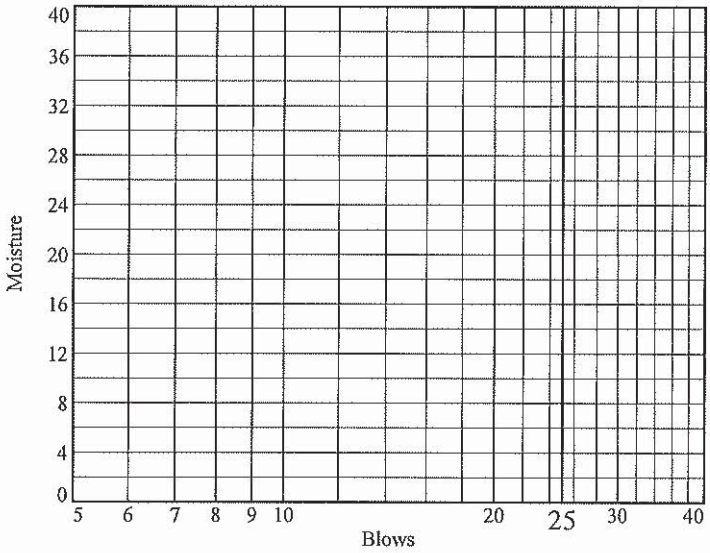
LIQUID AND PLASTIC LIMIT TEST DATA

10/26/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: GO44 S-23
Depth: 85'-86.5'
Sample Number: 7995-105
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 29.8

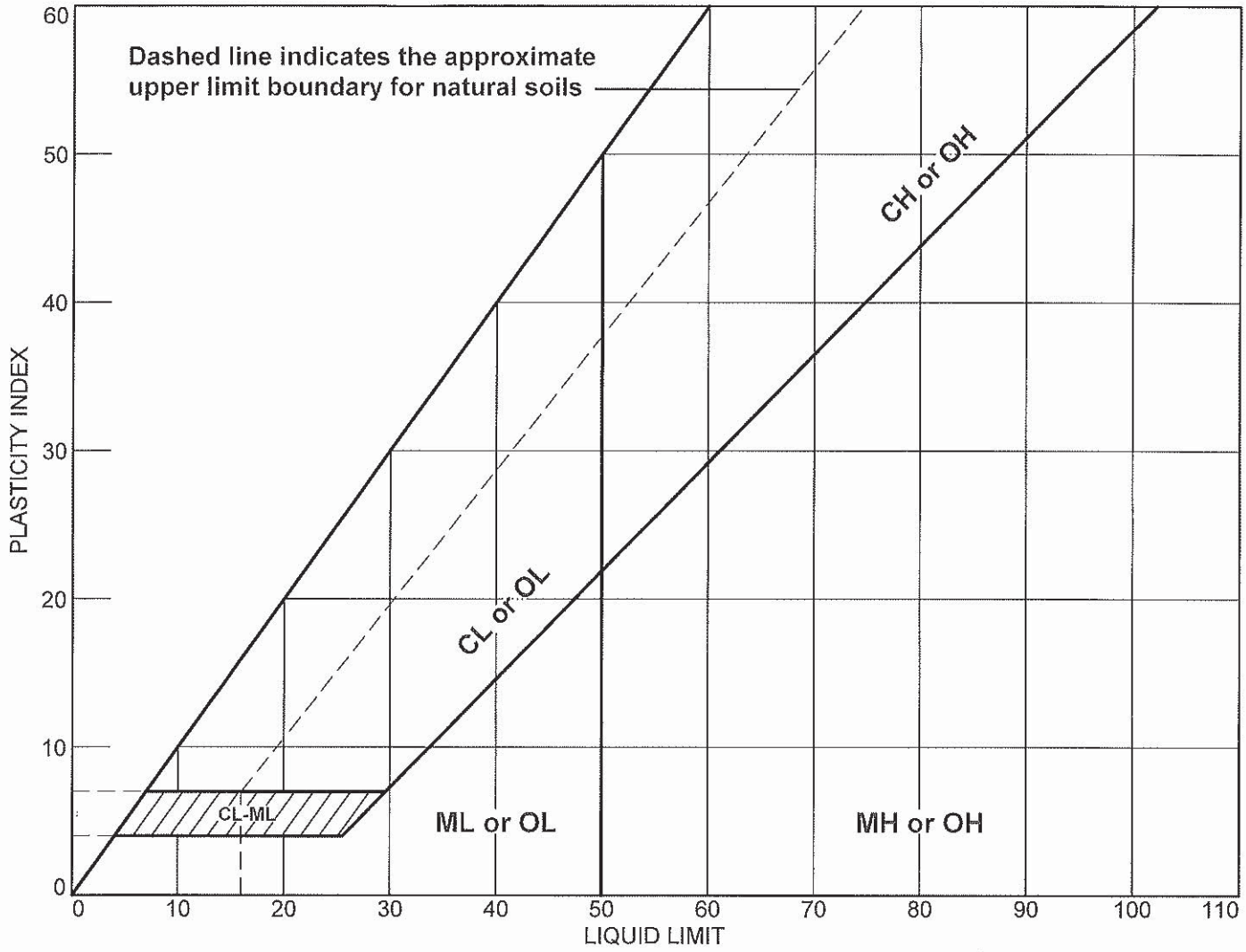
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
506.8	394.2	15.8	29.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G044 S-25 95'-96.5'	7995-106	95'-96.5'	26.4	NP	NV	NP	N/A

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

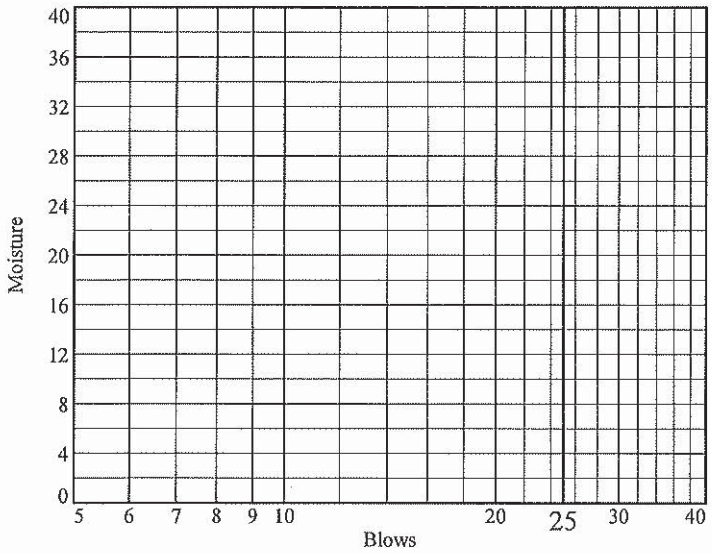
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-25
Depth: 95'-96.5'
Sample Number: 7995-106
USCS: N/A
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 26.4

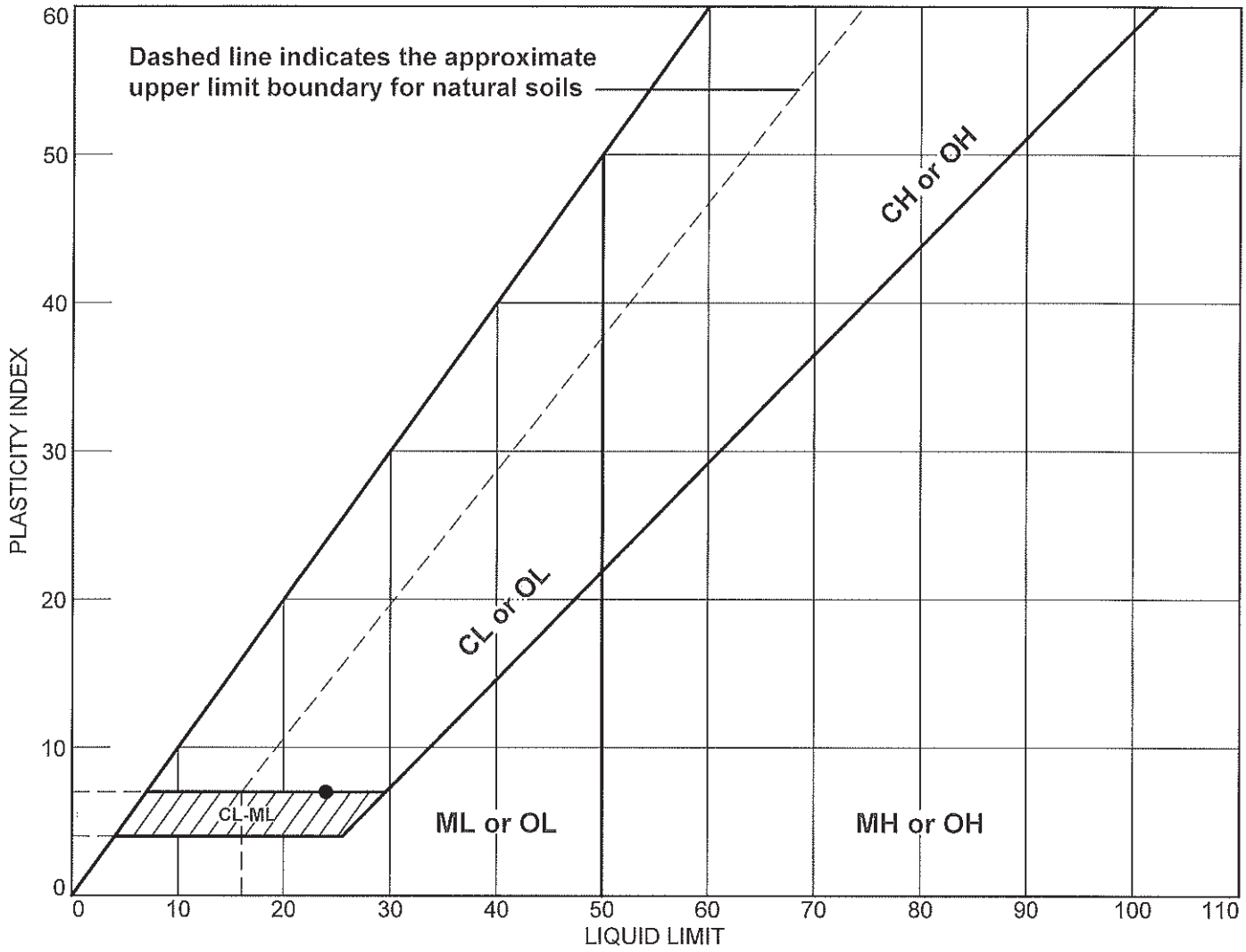
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
487.8	389.3	15.8	26.4

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G044 S-27 110'-111.5'	7995-107	110'-111.5'	29.7	17	24	7	CL-ML

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

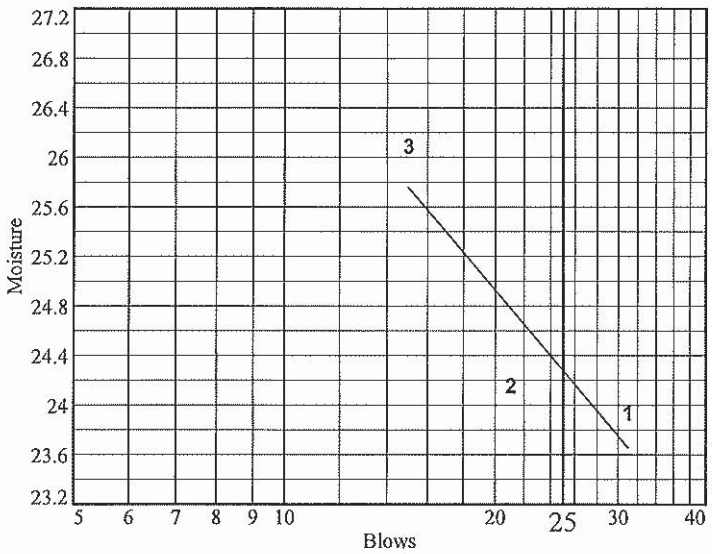
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-27
Depth: 110'-111.5'
Sample Number: 7995-107
USCS: CL-ML
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	31.95	28.85	30.11			
Dry+Tare	28.44	25.90	26.71			
Tare	13.78	13.69	13.68			
# Blows	31	21	15			
Moisture	23.9	24.2	26.1			



Liquid Limit= 24
Plastic Limit= 17
Plasticity Index= 7
Natural Moisture= 29.7
Liquidity Index= 1.8

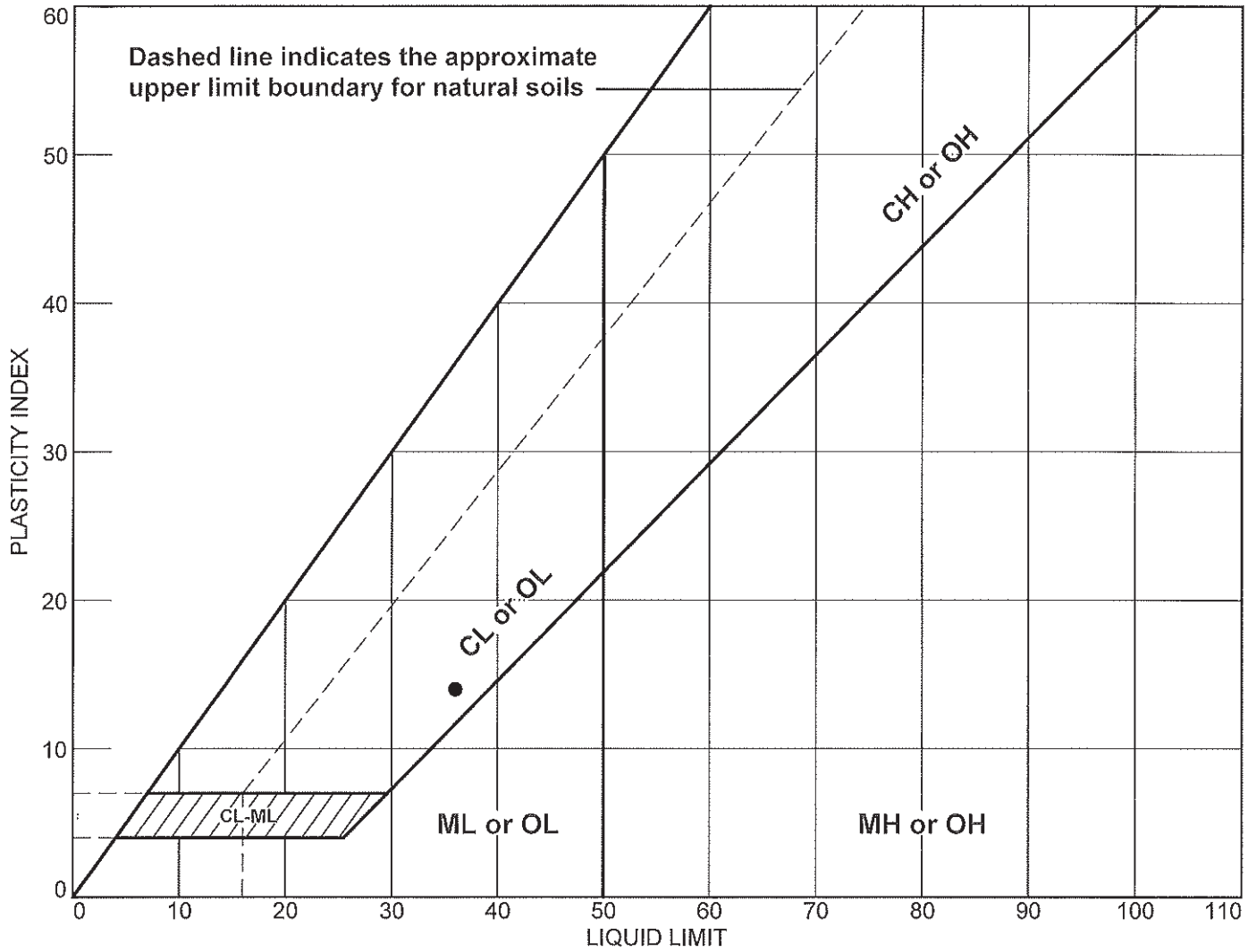
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.73	22.73	22.73		
Dry+Tare	21.41	21.41	21.41		
Tare	13.61	13.61	13.61		
Moisture	16.9	16.9	16.9		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
468.6	364.8	15.8	29.7

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G044 S-29 120'-121.5'	7995-109	120'-121.5'	36.3	22	36	14	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

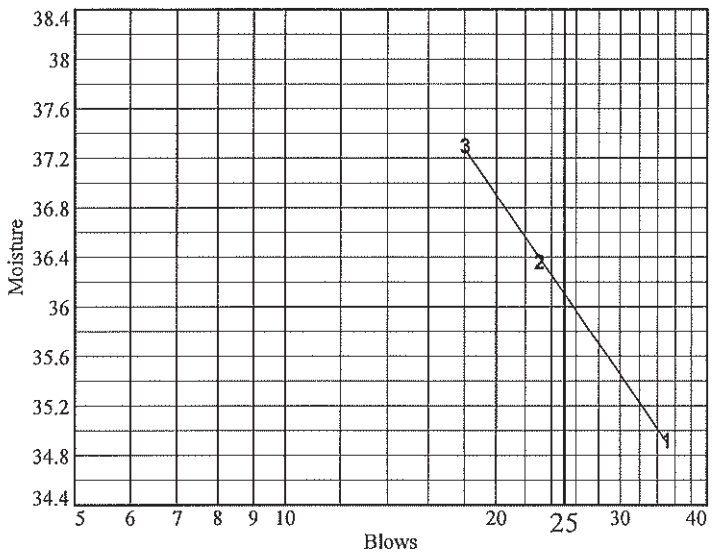
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-29
Depth: 120'-121.5'
Sample Number: 7995-109
USCS: CL
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.14	29.08	29.87			
Dry+Tare	24.40	25.00	25.42			
Tare	13.69	13.78	13.49			
# Blows	35	23	18			
Moisture	34.9	36.4	37.3			



Liquid Limit= 36
Plastic Limit= 22
Plasticity Index= 14
Natural Moisture= 36.3
Liquidity Index= 1.0

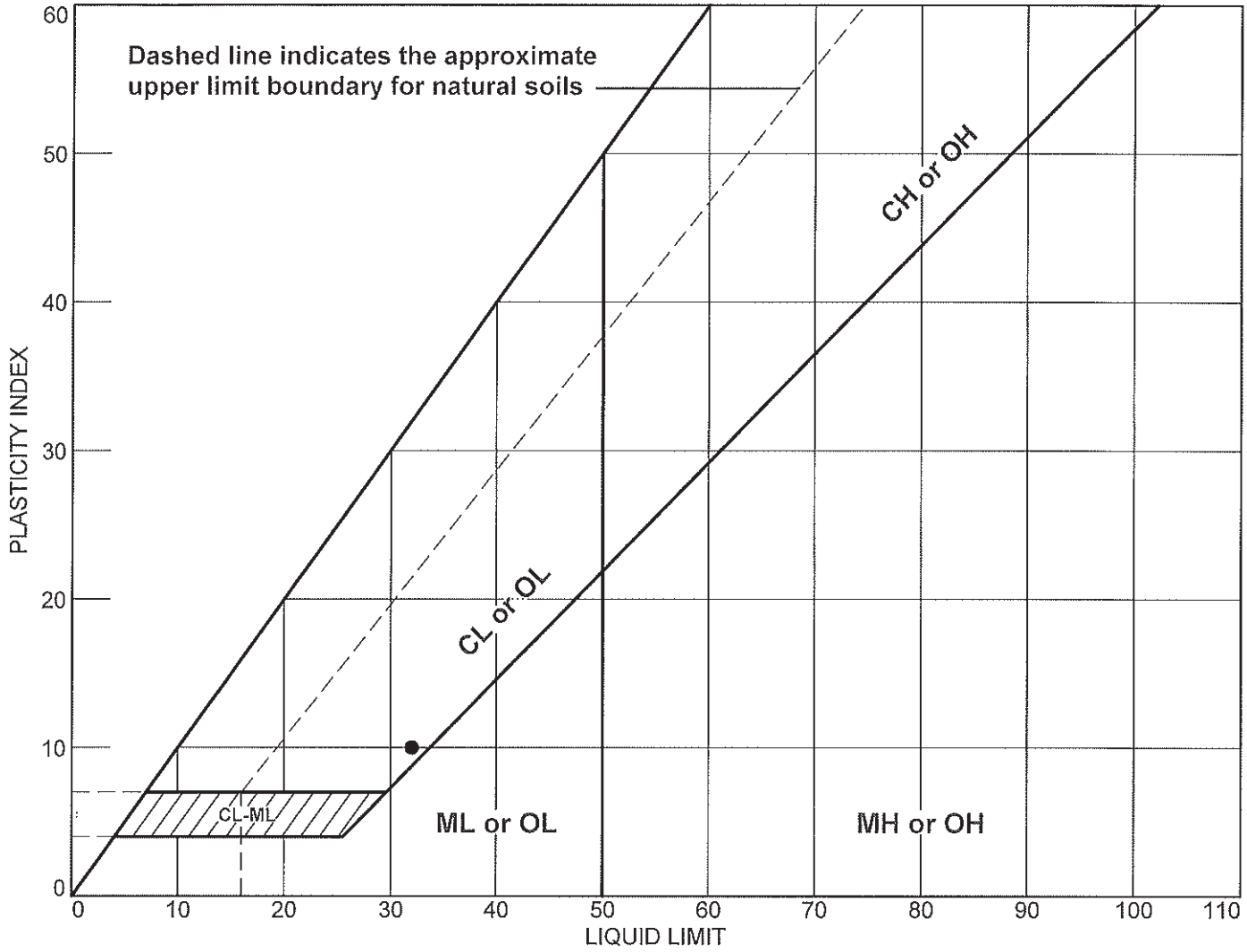
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.26	22.26	22.26		
Dry+Tare	20.73	20.73	20.73		
Tare	13.71	13.71	13.71		
Moisture	21.8	21.8	21.8		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
552.8	409.9	15.8	36.3

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G044 S-31 130'-131.5'	7995-110	130'-131.5'	32.8	22	32	10	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

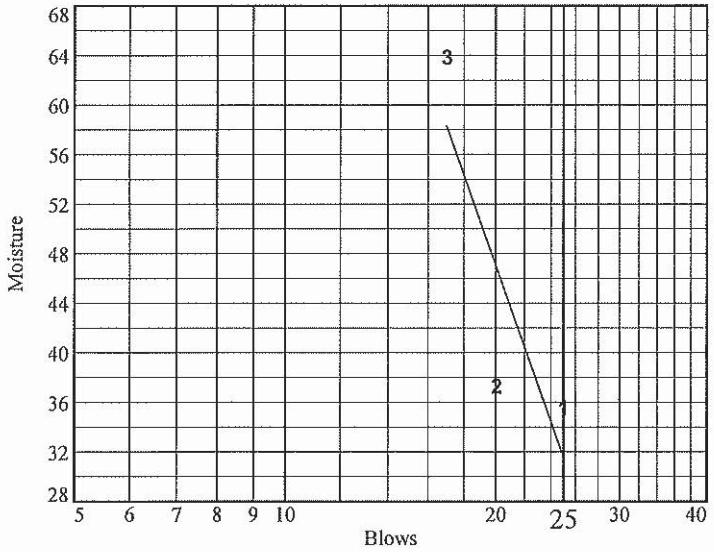
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-31
Depth: 130'-131.5'
Sample Number: 7995-110
USCS: CL
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	36.39	31.33	27.85			
Dry+Tare	30.39	26.53	22.33			
Tare	13.54	13.67	13.69			
# Blows	25	20	17			
Moisture	35.6	37.3	63.9			



Liquid Limit= 32
Plastic Limit= 22
Plasticity Index= 10
Natural Moisture= 32.8
Liquidity Index= 1.1

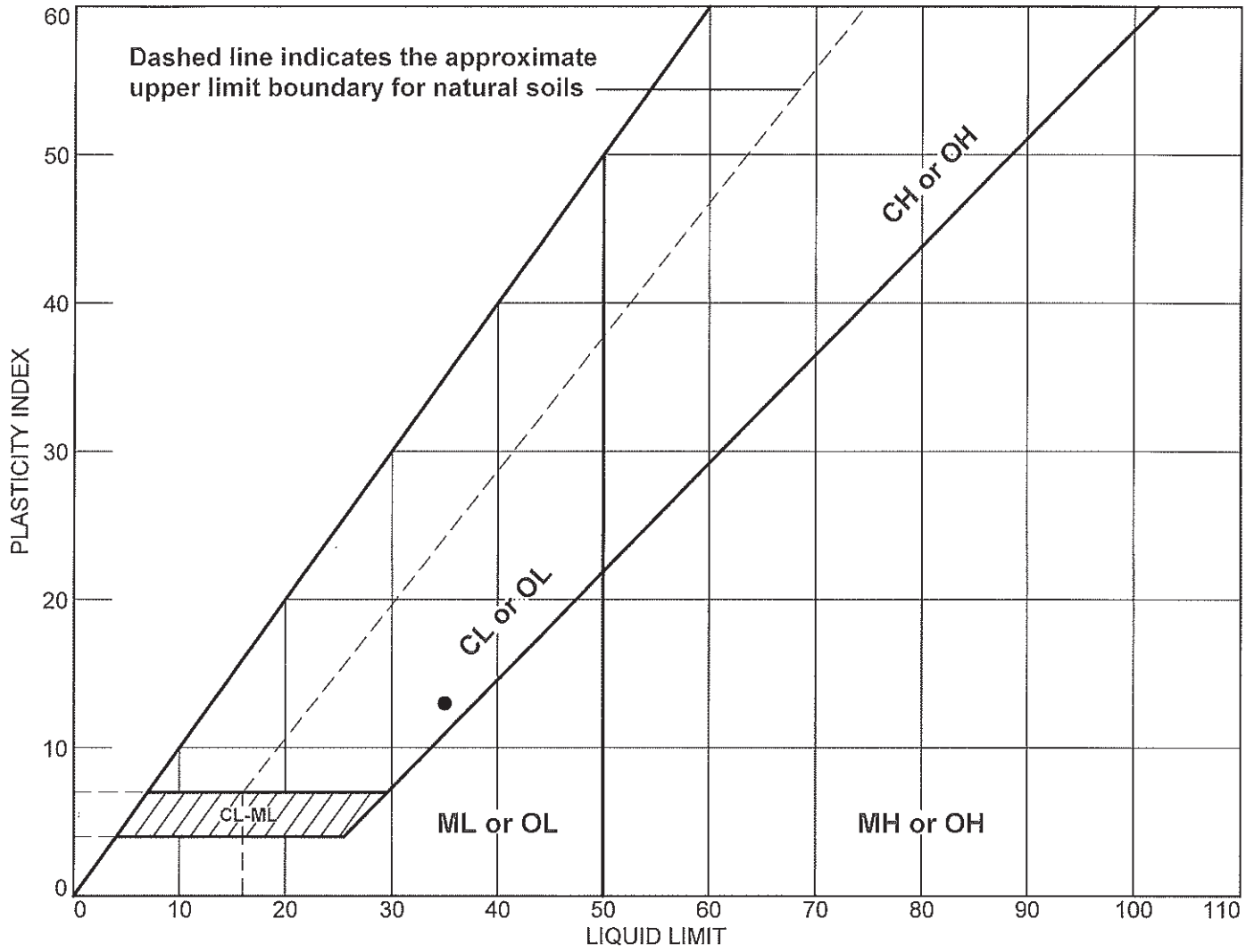
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.00				
Dry+Tare	20.50				
Tare	13.70				
Moisture	22.1				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
433.4	330.2	15.8	32.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G044 S-37 160'-161.5	7995-114	160.5'-161.5'	30.5	22	35	13	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

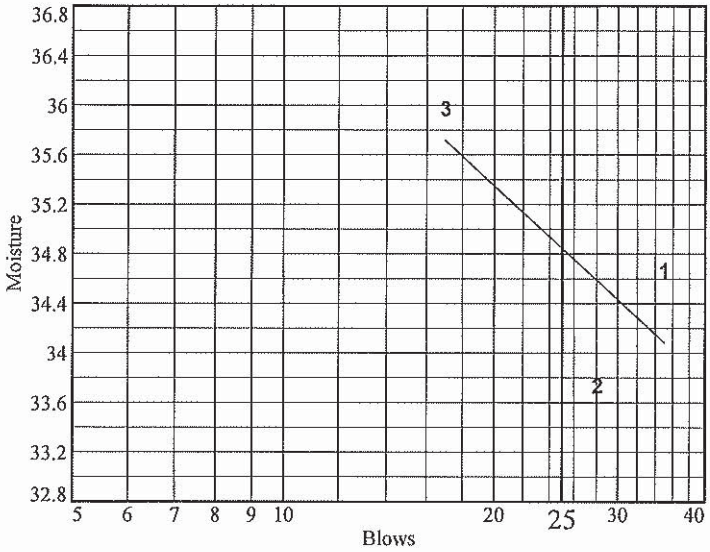
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-37
Depth: 160.5'-161.5'
Sample Number: 7995-114
USCS: CL
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	26.09	25.69	37.25			
Dry+Tare	22.89	22.64	30.99			
Tare	13.66	13.60	13.59			
# Blows	35	28	17			
Moisture	34.7	33.7	36.0			



Liquid Limit= 35
Plastic Limit= 22
Plasticity Index= 13
Natural Moisture= 30.5
Liquidity Index= 0.7

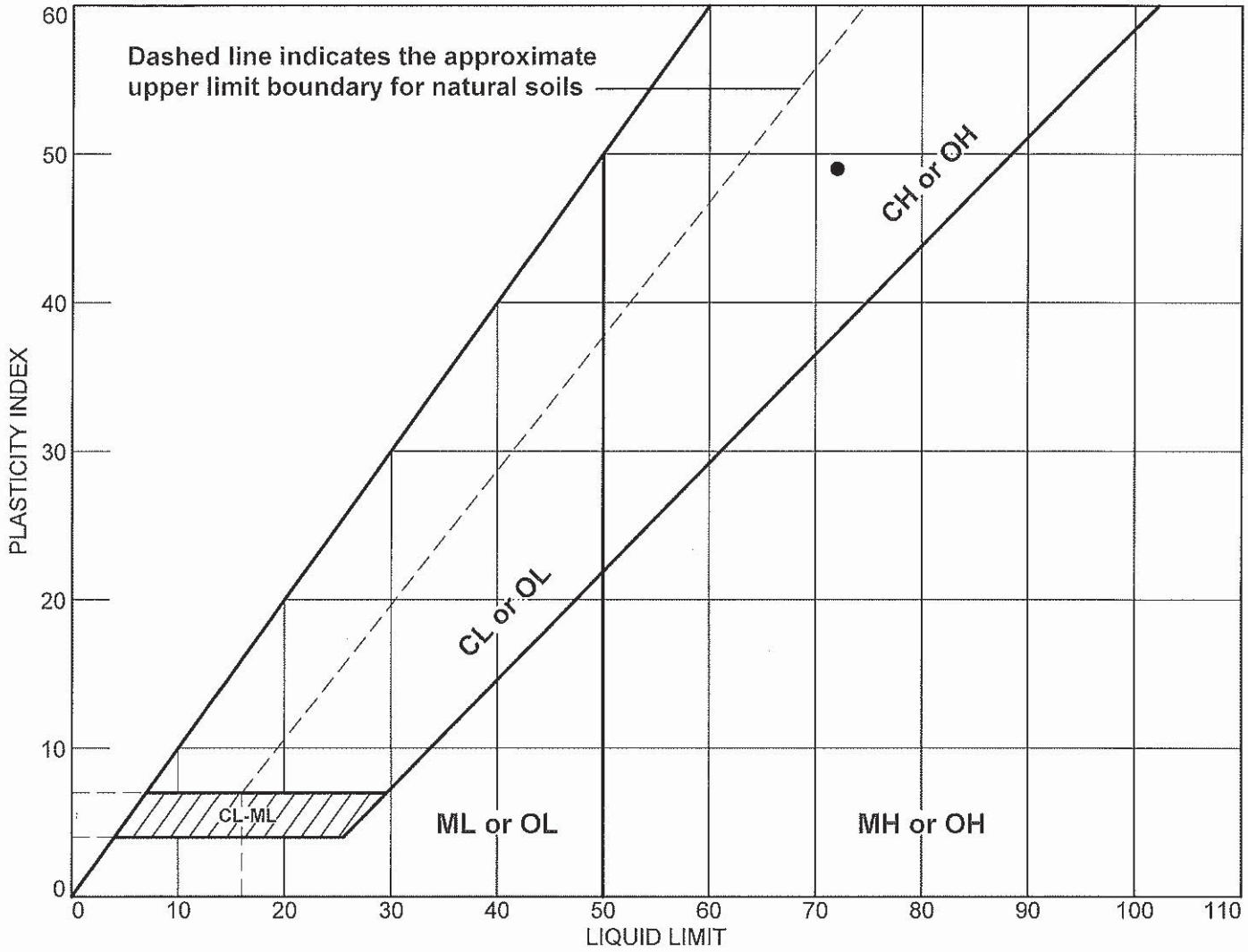
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.89				
Dry+Tare	20.37				
Tare	13.56				
Moisture	22.3				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
373.3	289.7	15.8	30.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G044 S-38 165'-166.5'	7995-115	165'-166.5'	37.6	23	72	49	CH

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH/JR **Checked By:** JAM

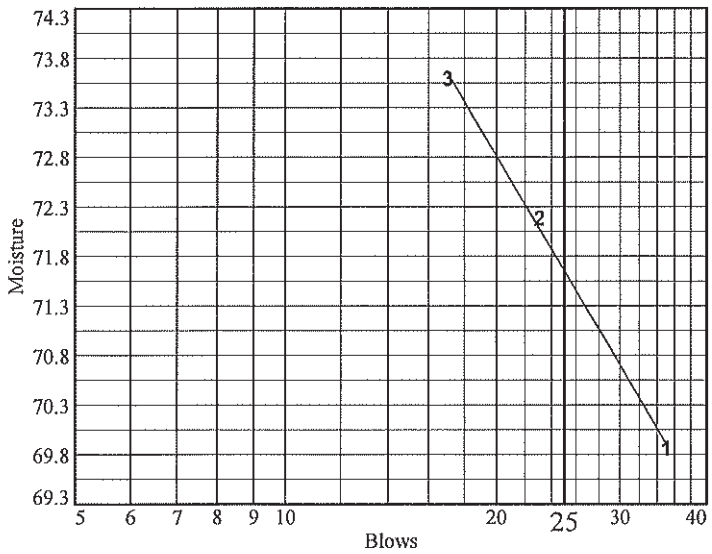
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G044 S-38
Depth: 165'-166.5'
Sample Number: 7995-115
USCS: CH
Tested by: BH/JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	25.05	24.95	25.14			
Dry+Tare	20.39	20.20	20.29			
Tare	13.72	13.62	13.70			
# Blows	35	23	17			
Moisture	69.9	72.2	73.6			



Liquid Limit= 72
Plastic Limit= 23
Plasticity Index= 49
Natural Moisture= 37.6
Liquidity Index= 0.3

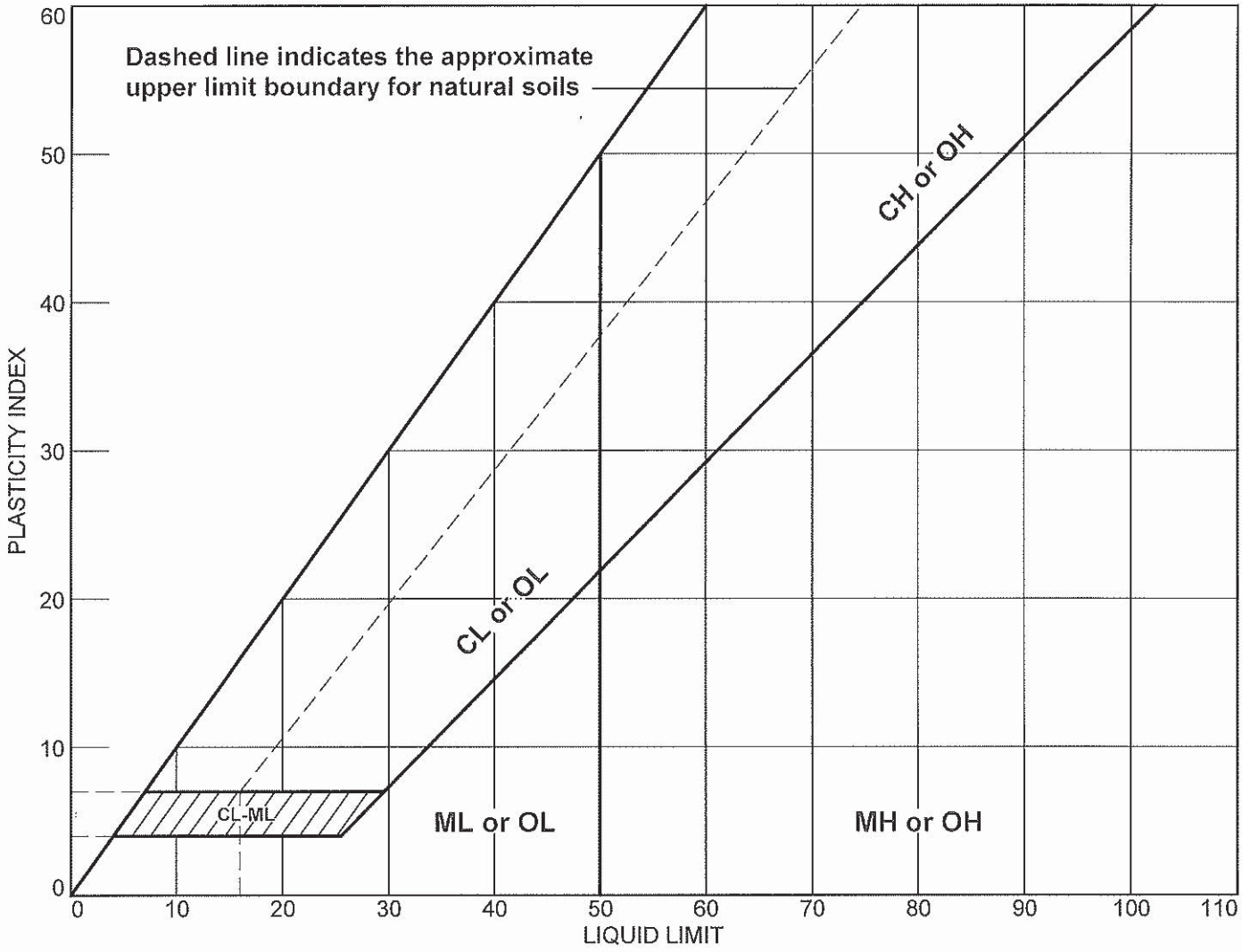
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.52	21.52	21.52		
Dry+Tare	20.05	20.05	20.05		
Tare	13.66	13.66	13.66		
Moisture	23.0	23.0	23.0		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
370.5	273.6	15.8	37.6

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G045 S-1 2.5'-4'	7995-116	2.5'-4'	71.1	NP	NV	NP	N/A

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

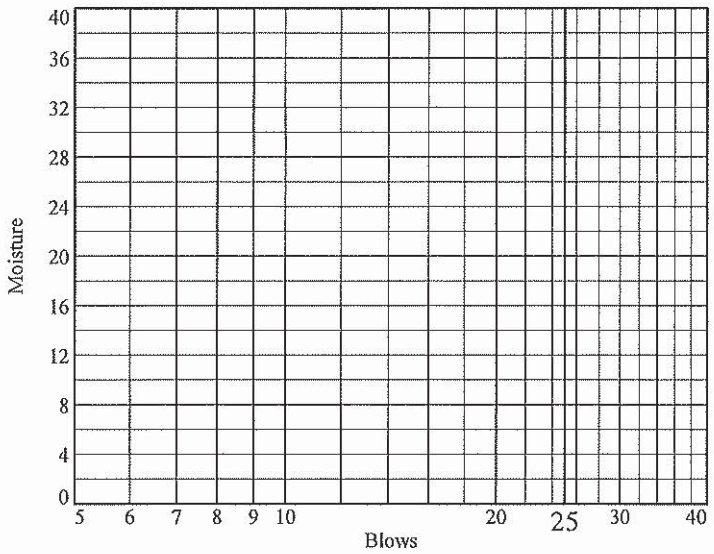
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-1
Depth: 2.5'-4'
Sample Number: 7995-116
USCS: N/A
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 71.1

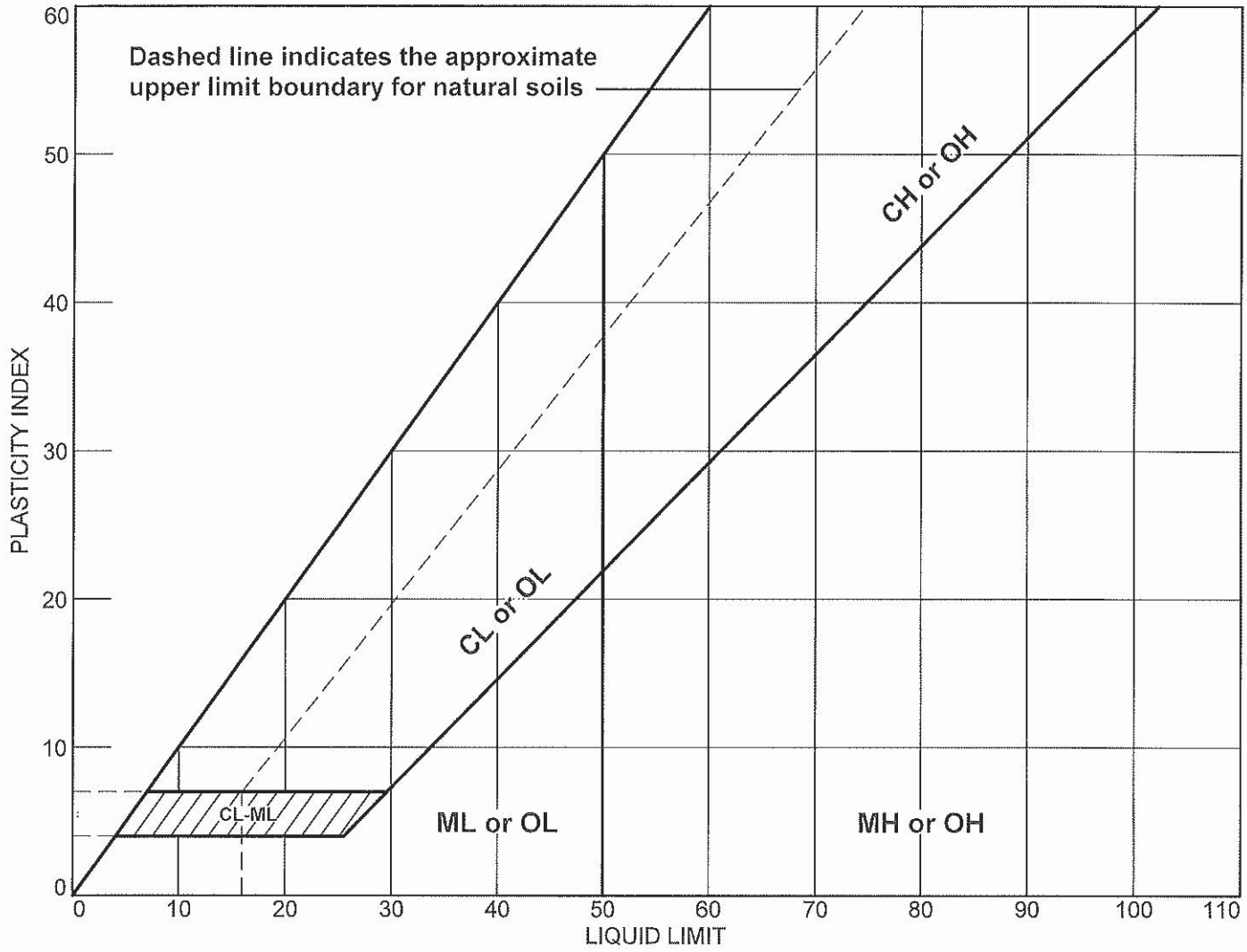
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
183.3	113.7	15.8	71.1

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G045 S-18 77.5'-79'	7995-125	77.5'-79'	28.9	NP	NV	NP	N/A

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

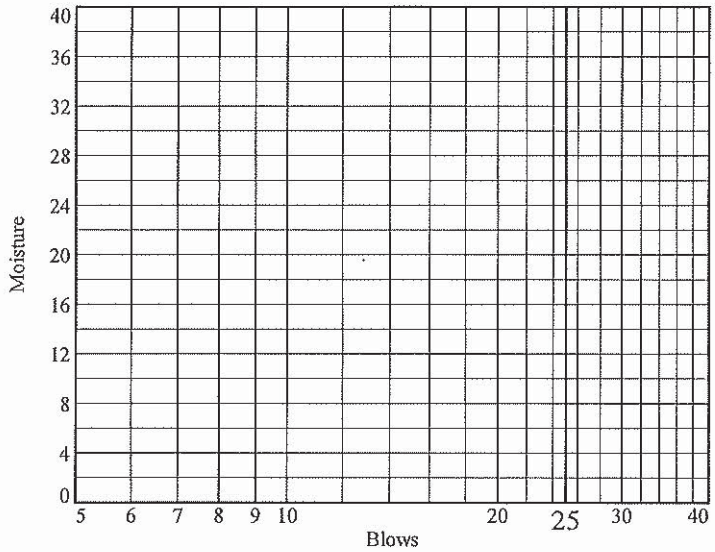
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-18
Depth: 77.5'-79'
Sample Number: 7995-125
USCS: N/A
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 28.9

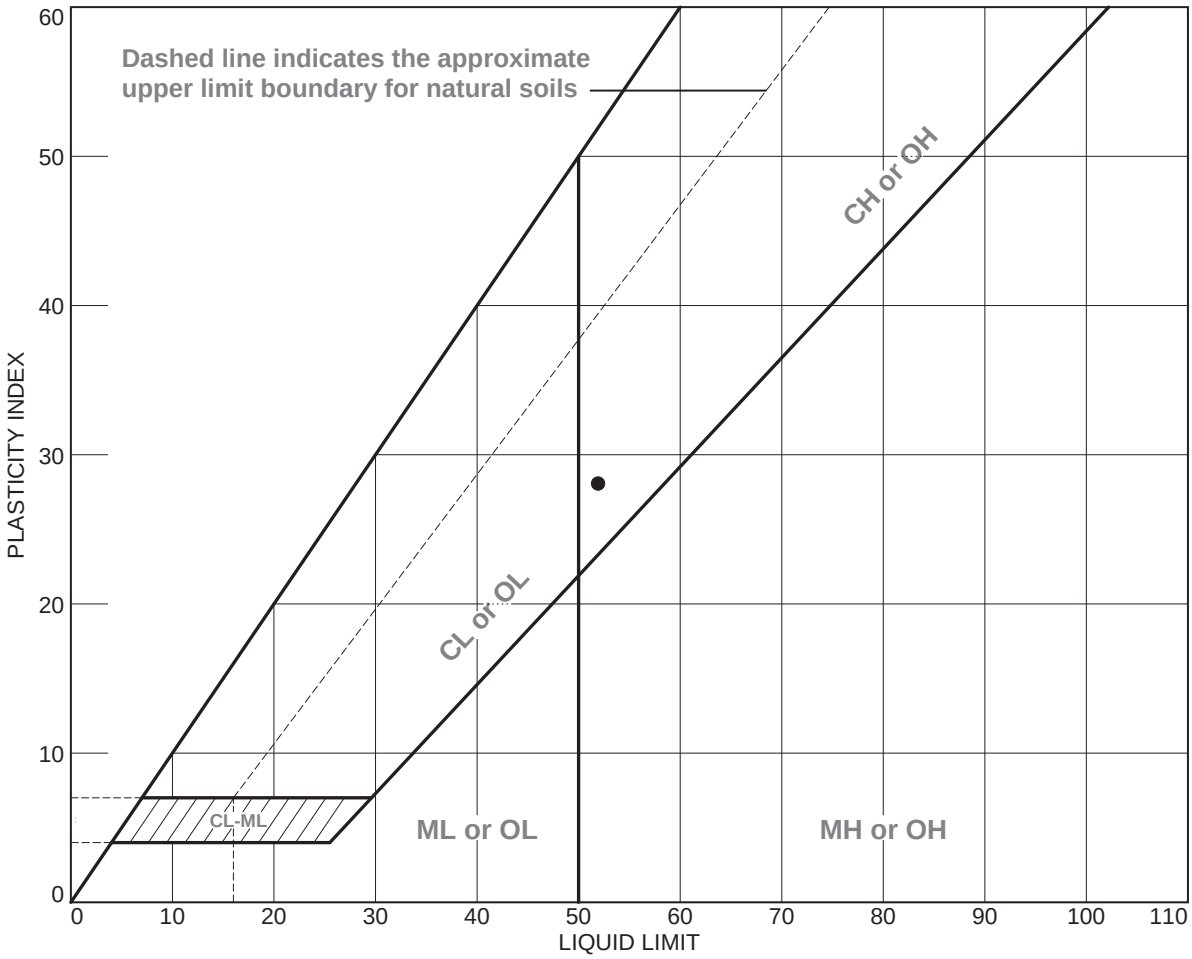
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
274.8	216.7	16.0	28.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G045 S-20 85'-86.5'	7995-127	85'-86.5'	30.1	24	52	28	CH

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Golder Associates
Project: ST-DRLE
Project No.: 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

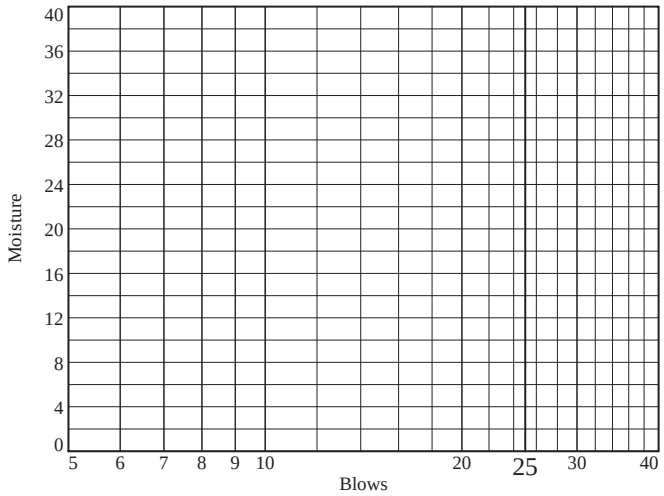
LIQUID AND PLASTIC LIMIT TEST DATA

3/14/2018

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-20
Depth: 85'-86.5'
Sample Number: 7995-127
Material Description: Fat CLAY
USCS: CH
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	20.68					
Dry+Tare	17.40					
Tare	11.10		1			
# Blows	25					
Moisture	52.1					



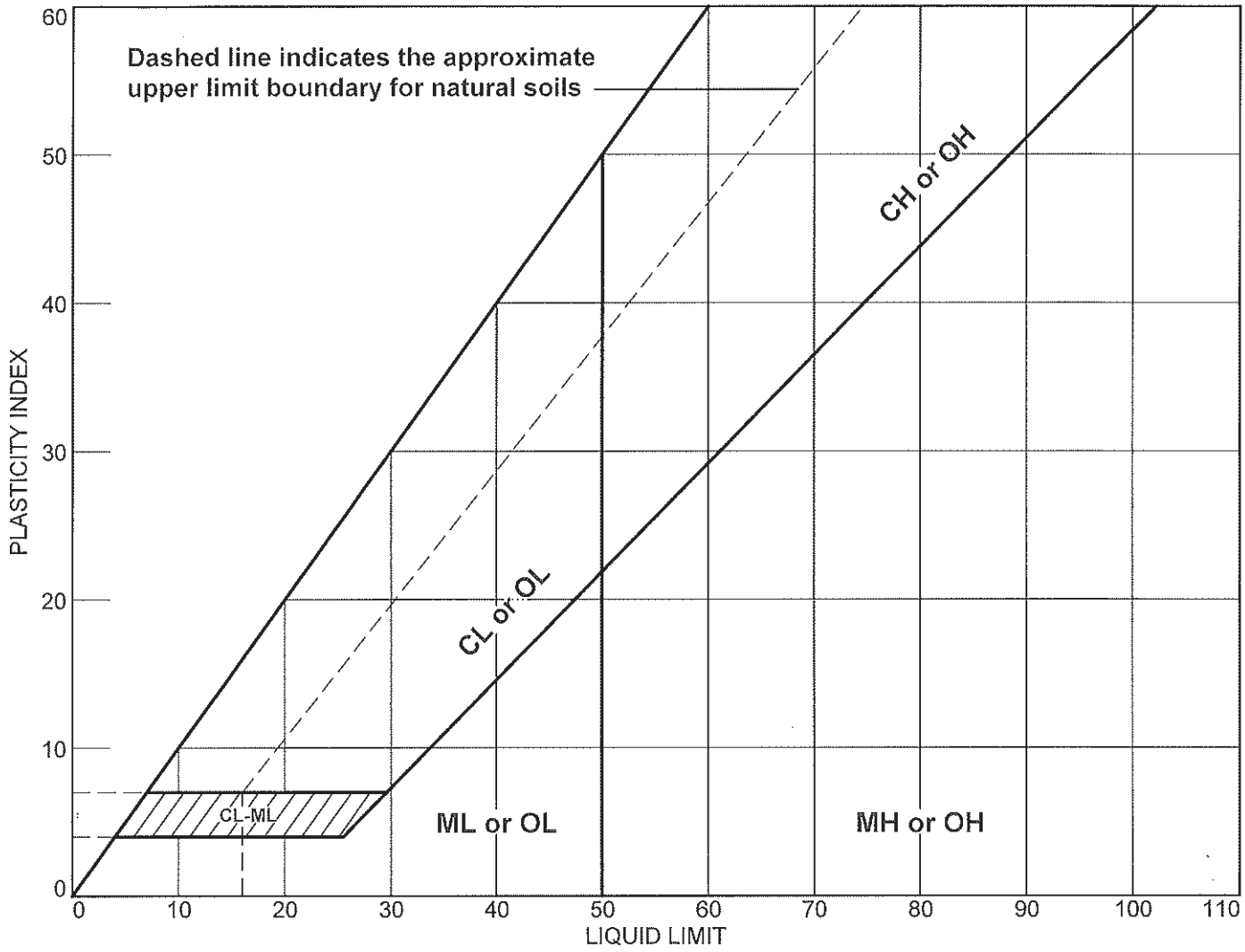
Liquid Limit= 52
Plastic Limit= 24
Plasticity Index= 28
Natural Moisture= 30.1
Liquidity Index= 0.2

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.21				
Dry+Tare	19.24				
Tare	11.06				
Moisture	24.1				

Hayre McElroy & Associates, LLC

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G045 S-21 95'-96.5'	7995-128	95'-96.5'	30.9	NP	NV	NP	N/A

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: BH **Checked By:** JAM

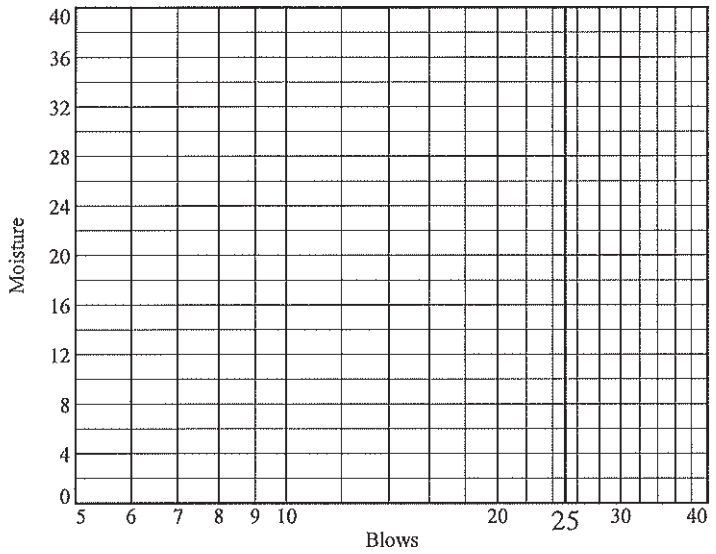
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-21
Depth: 95'-96.5'
Sample Number: 7995-128
USCS: N/A
Tested by: BH
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 30.9

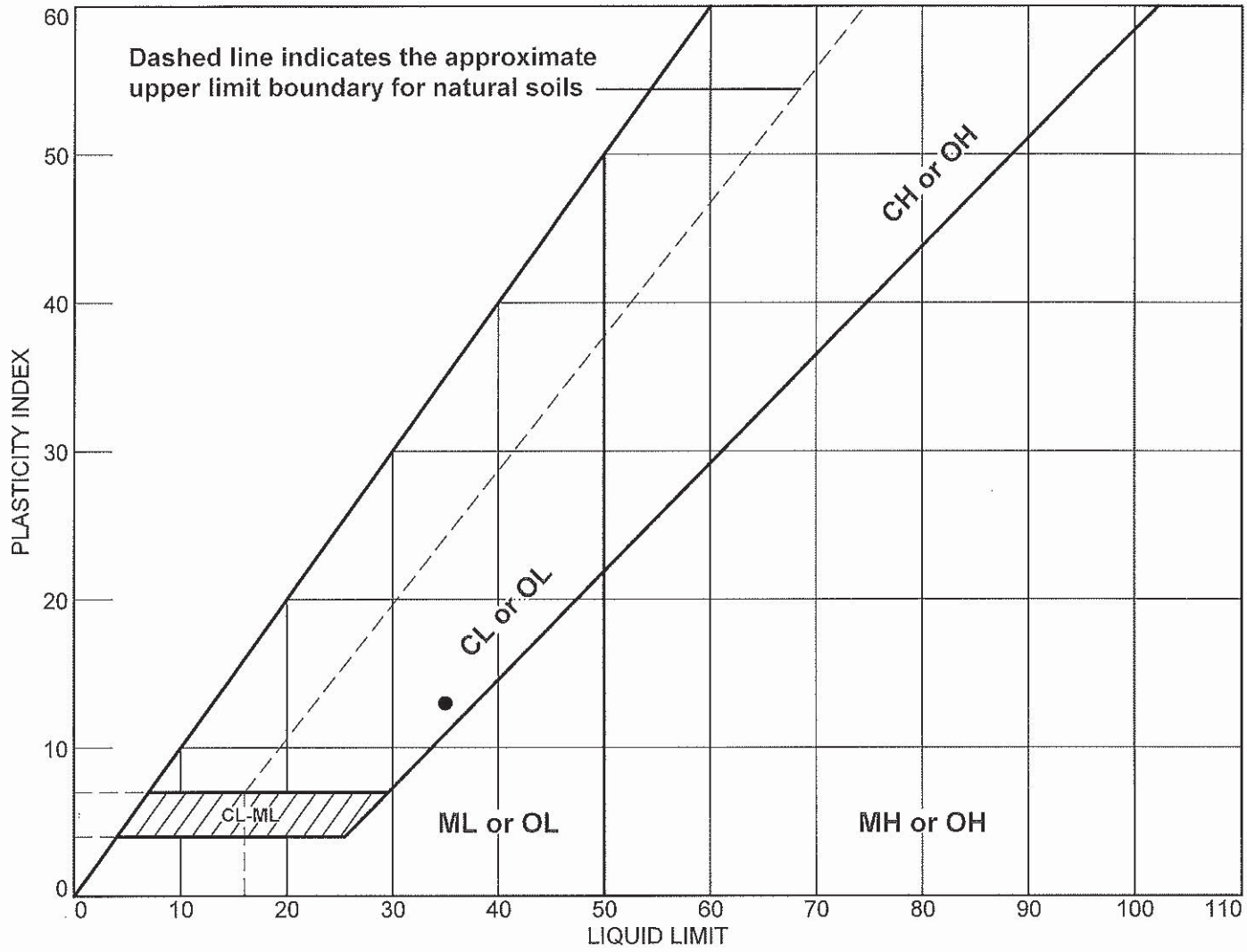
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
458.7	354.2	16.4	30.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G045 S-23 105'-106.5'	7995-130	105'-106.5'	34.8	22	35	13	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

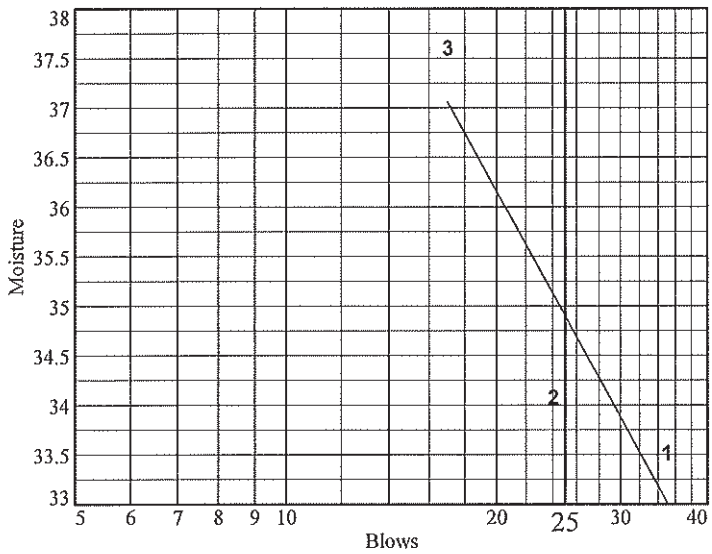
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-23
Depth: 105'-106.5'
Sample Number: 7995-130
USCS: CL
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	25.26	26.88	31.08			
Dry+Tare	22.33	23.54	26.36			
Tare	13.59	13.74	13.81			
# Blows	35	24	17			
Moisture	33.5	34.1	37.6			



Liquid Limit= 35
Plastic Limit= 22
Plasticity Index= 13
Natural Moisture= 34.8
Liquidity Index= 1.0

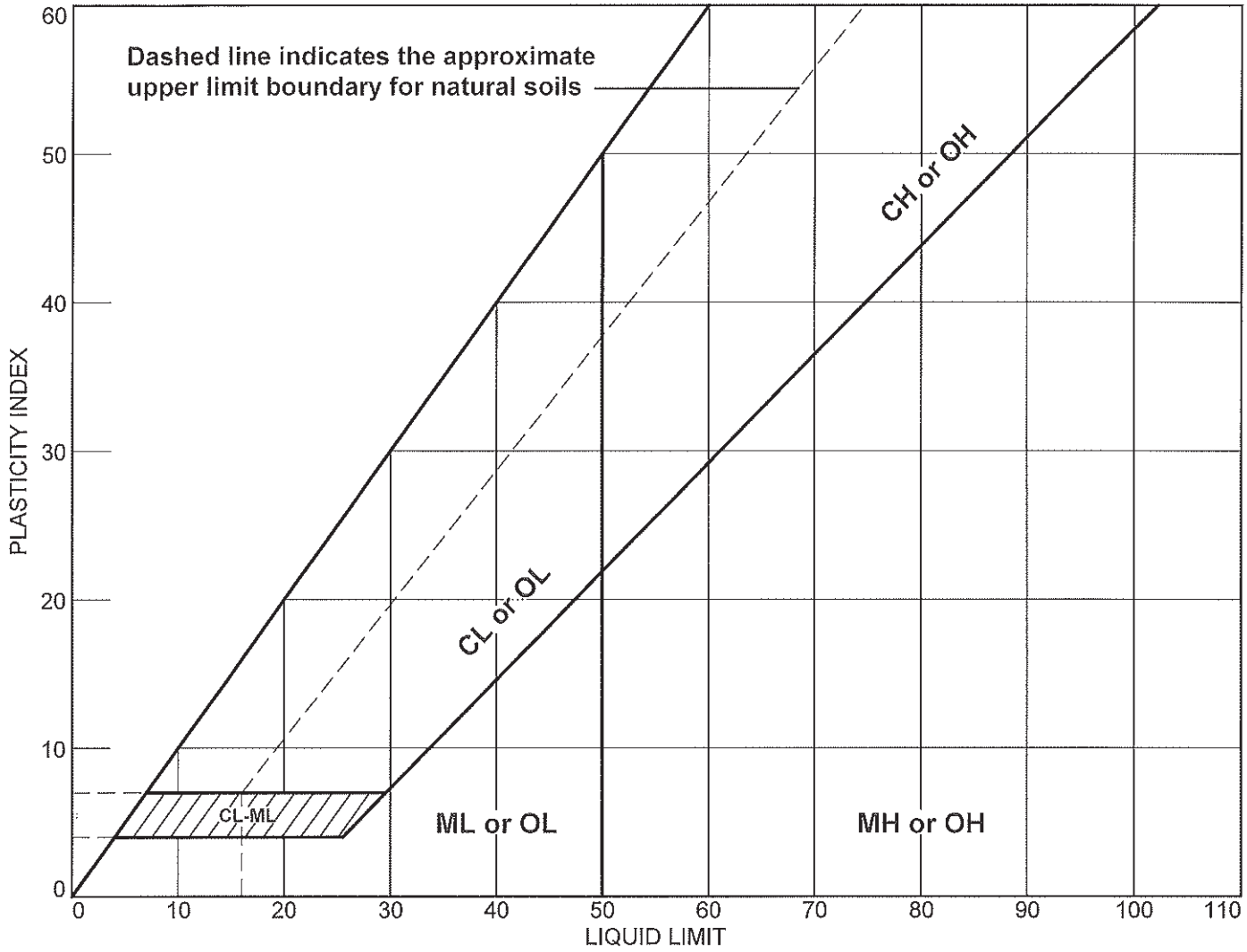
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.11	22.11	22.11		
Dry+Tare	20.59	20.59	20.59		
Tare	13.58	13.58	13.58		
Moisture	21.7	21.7	21.7		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
425.2	319.6	16.1	34.8

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G045 S-25 120'-121.5'	7995-131	120'-121.5'	28.2	NP	NV	NP	N/A

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

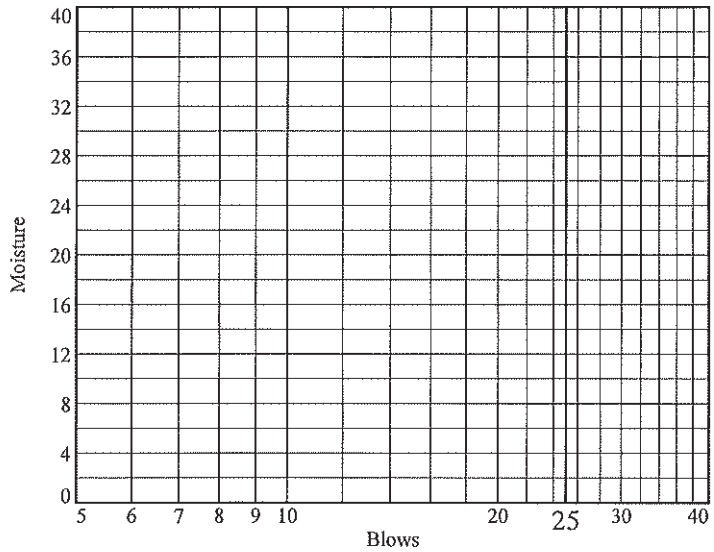
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-25
Depth: 120'-121.5'
Sample Number: 7995-131
USCS: N/A
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 28.2

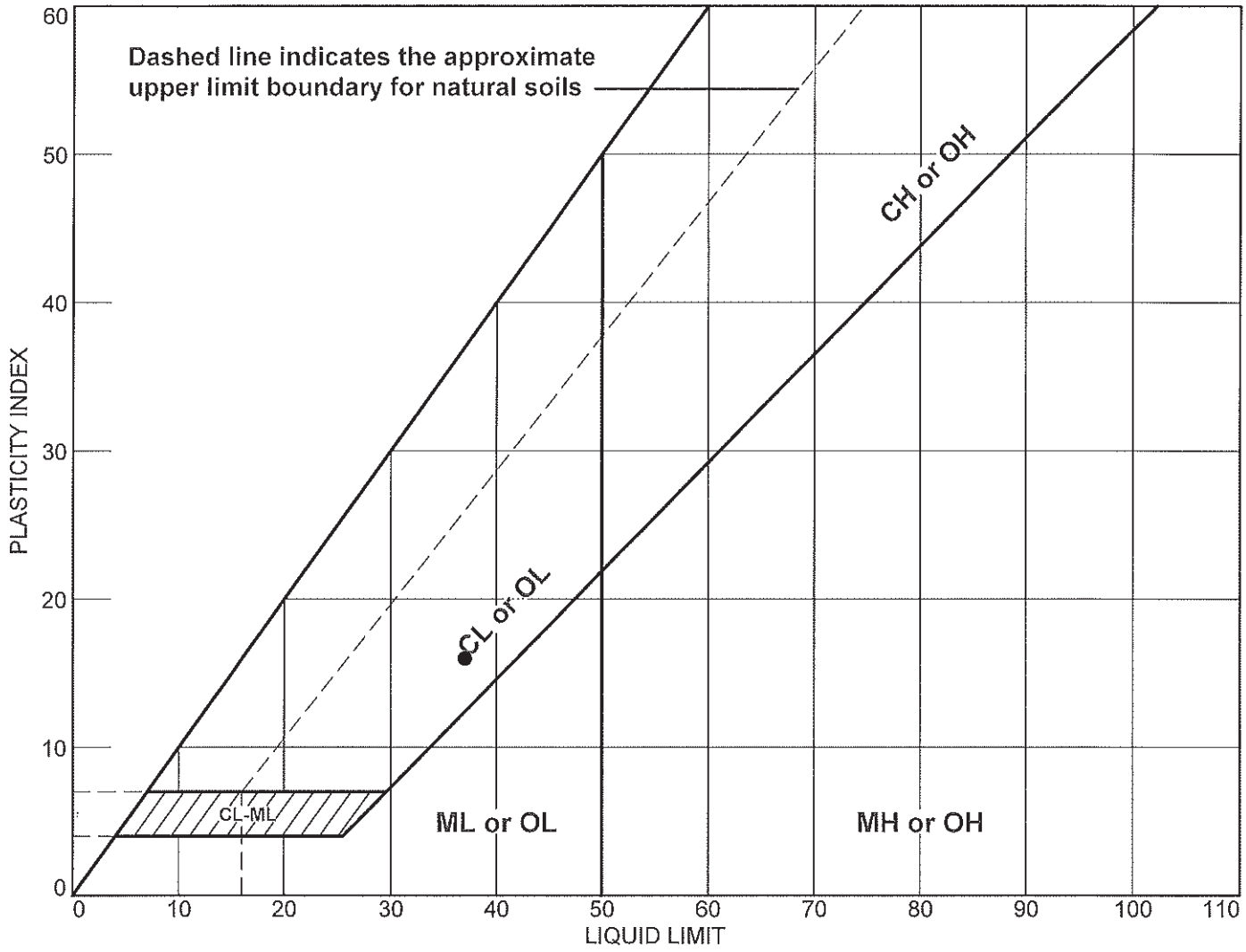
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
205.7	164.1	16.5	28.2

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G045 S-28 135'-136.5'	7995-132	135'-136.5'	34.0	21	37	16	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: JR **Checked By:** JAM

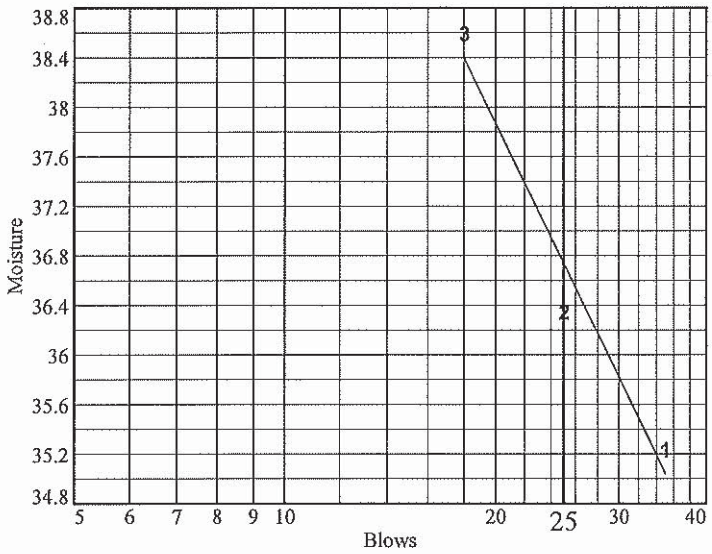
LIQUID AND PLASTIC LIMIT TEST DATA

10/27/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-28
Depth: 135'-136.5'
Sample Number: 7995-132
USCS: CL
Tested by: JR
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	31.29	28.13	26.30			
Dry+Tare	26.72	24.27	22.78			
Tare	13.75	13.65	13.66			
# Blows	35	25	18			
Moisture	35.2	36.3	38.6			



Liquid Limit= 37
Plastic Limit= 21
Plasticity Index= 16
Natural Moisture= 34.0
Liquidity Index= 0.8

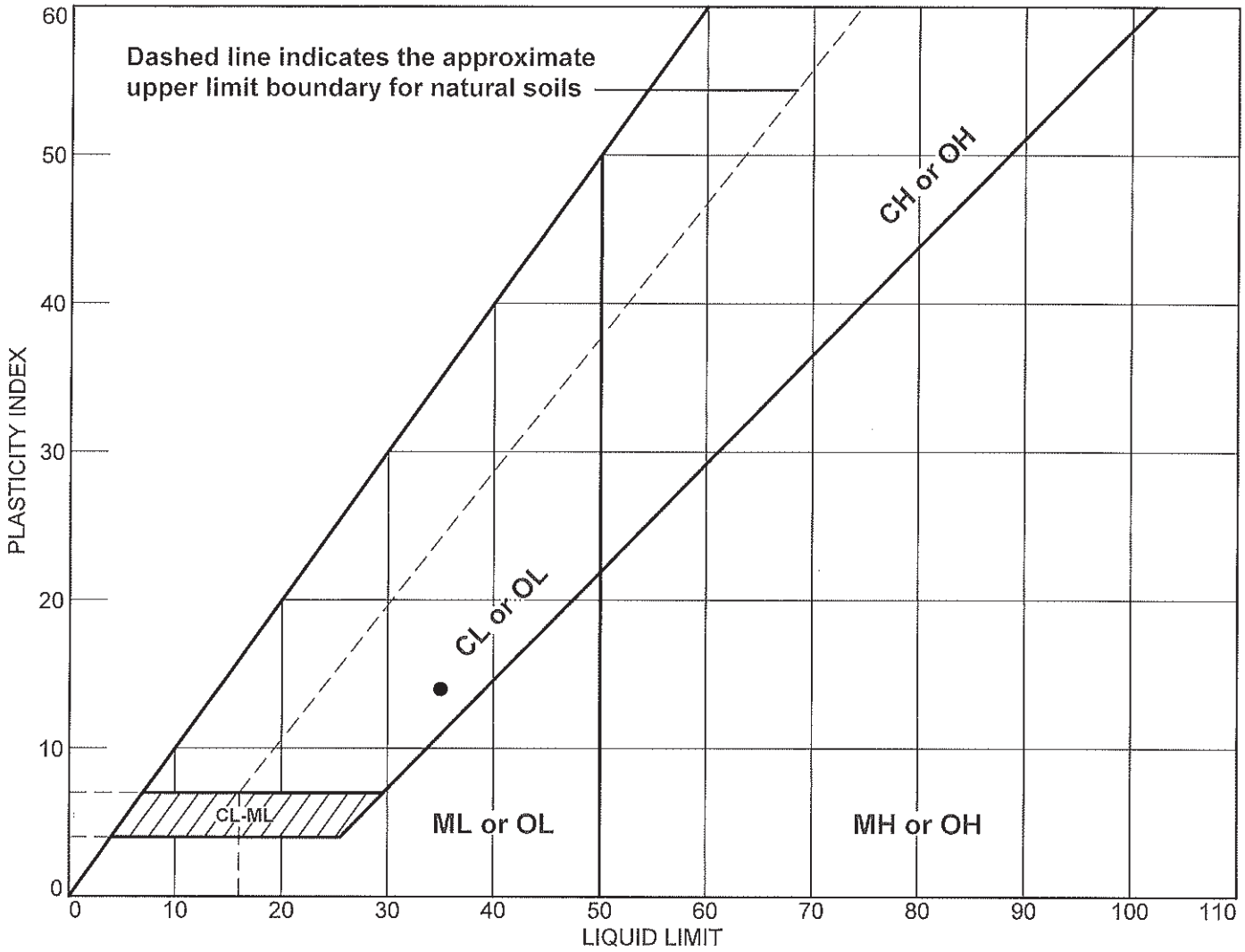
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.76	21.76	21.76		
Dry+Tare	20.36	20.36	20.36		
Tare	13.70	13.70	13.70		
Moisture	21.0	21.0	21.0		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
444.9	336.2	16.1	34.0

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	G045 S-31 150'-151.5'	7995-134	150'-151.5'	36.4	21	35	14	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Golder Associates **Project:** ST-DRLE **Project No.:** 1657705/17-940 **Figure**

Tested By: GD **Checked By:** JAM

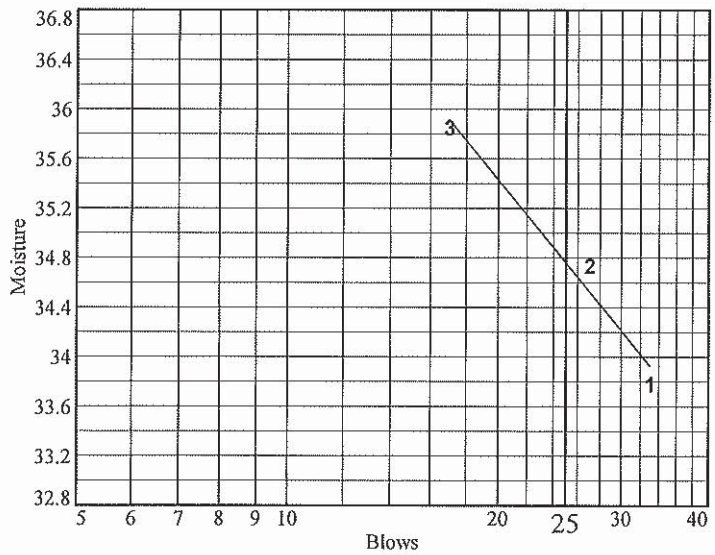
LIQUID AND PLASTIC LIMIT TEST DATA

11/17/2017

Client: Golder Associates
Project: ST-DRLE
Project Number: 1657705/17-940
Location: G045 S-31
Depth: 150'-151.5'
Sample Number: 7995-134
USCS: CL
Tested by: GD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	19.96	18.76	19.57			
Dry+Tare	17.71	16.78	17.34			
Tare	11.05	11.08	11.12			
# Blows	33	27	17			
Moisture	33.8	34.7	35.9			



Liquid Limit= 35
Plastic Limit= 21
Plasticity Index= 14
Natural Moisture= 36.4
Liquidity Index= 1.1

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	25.05	25.05	25.05		
Dry+Tare	23.11	23.11	23.11		
Tare	13.75	13.75	13.75		
Moisture	20.7	20.7	20.7		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
407.5	303.1	16.2	36.4

hayremcelroy & associates, llc

ORGANIC CONTENT

ASTM D 2974

Project Name	ST-DRLE
Project Number	1657705
Date Tested	3/8/2018
HMA Lab #	G023 S2 5-6.5'
Material Description	Peat

Total Wet Wt + Tare	143.5 grams
Total Oven Dried Wt + Tare	128.4 grams
Wt of Tare	117.7 grams
Moisture Loss	15.1 grams
Moisture Content	140.7 %

BURN No.	Tare + Dry Weight
1	124.47
2	124.03
3	124.03
4	
5	

Total Oven Dried Wt + Tare	128.4 grams
Total Ash/Soil Wt + Tare	124.0 grams
Wt of Tare	117.7 grams
Ash Content	4.4 grams
Percentage Ash Content	**68.9 %**

APPENDIX H

LABORATORY TESTS – SOIL TESTING (HWA GEOSCIENCES INC.)

HWA GEOSCIENCES INC.
Geotechnical & Pavement Engineering • Hydrogeology • Geoenvironmental • Inspection & Testing

November 13, 2017
HWA Project No. 2012-095-23 T1200

Golder Associates Inc.
18300 Union Hill Road, Suite 200
Redmond, Washington 98052

Attention: Mr. Birkan Bayrak, Ph.D., P.E.

Subject: **SOIL LABORATORY TESTING REPORT**
Atterberg Limits, Consolidation and Triaxial Strength Testing
Sound Transit Redmond East Link Extension
Golder Project No. 1657705

Dear Mr. Bayrak;

As requested, HWA GeoSciences Inc. (HWA) performed laboratory testing for the above referenced project. Herein we present the results of our laboratory analyses, which are summarized on the attached Figures. The laboratory testing program was performed in general accordance with your instructions and appropriate ASTM Standards as outlined below.

SAMPLE DESCRIPTION: The samples were delivered to our laboratory on October 25, 2017 by Golder Associates personnel. The samples were delivered in Shelby tubes designated with exploration ID, sample number and depth of sampling. The Shelby tubes were extruded and tests were ordered by the client based on photographic information. The samples were classified for engineering purposes in general accordance with ASTM D2487. The sample descriptions appear on the attached report Figures.

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS (ATTERBERG LIMITS): Six selected samples were tested using method ASTM D 4318, multi-point method. The results are reported on the attached Liquid Limit, Plastic Limit, and Plasticity Index report, Figure 1.

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION OF SOILS: The unconsolidated, undrained strength of the selected samples were tested in general accordance with method ASTM D2850 to determine the strength characteristics of the soil. Each sample was extruded from the sample tube and a representative section was cut from the sample. The sample ends were trimmed to obtain a cylindrical test sample with a length to diameter ratio between 2:1 and 2.5:1. The bulk density of the sample was determined by careful weighing and dimensional measurement of the trimmed sample. The confining stresses used are indicated on the test plots. The results are summarized and plotted graphically on the attached Unconsolidated Undrained Triaxial Compression Test for Cohesive Soils reports, Figures 2-7.

21312 30th Drive SE
Suite 110
Bothell, WA 98021-7010
Tel: 425.774.0106
Fax: 425.774.2714
www.hwageo.com

November 13, 2017
HWA Project No. 2012-095-23 Task 1200

ONE DIMENSIONAL CONSOLIDATION PROPERTIES OF SOIL: The consolidation properties of selected soil samples were measured in general accordance with ASTM D2435. Saturation was maintained by inundation of the sample throughout the test. The samples were subjected to increasing increments of total stress, the duration of which was selected to exceed the time required for completion of primary consolidation as defined in the Standard, Method B. Unloading of the sample was carried out incrementally. According to the client's instructions, the samples were also subjected to a reloading cycle after the initial load-unload cycle. The test results are presented on the attached Figures 8-13.

CLOSURE: Experience has shown that laboratory test values for soil and other natural materials vary with each representative sample. As such, HWA has no knowledge as to the extent and quantity of material the tested sample may represent. HWA also makes no warranty as to how representative either the sample tested or the test results obtained are to actual field conditions. It is a well established fact that sampling methods present varying degrees of disturbance or variance that affect sample representativeness.

No copy should be made of this report, except in its entirety.

We appreciate the opportunity to provide laboratory testing services on this project. Should you have any questions or comments, or if we may be of further service, please call.

Sincerely,

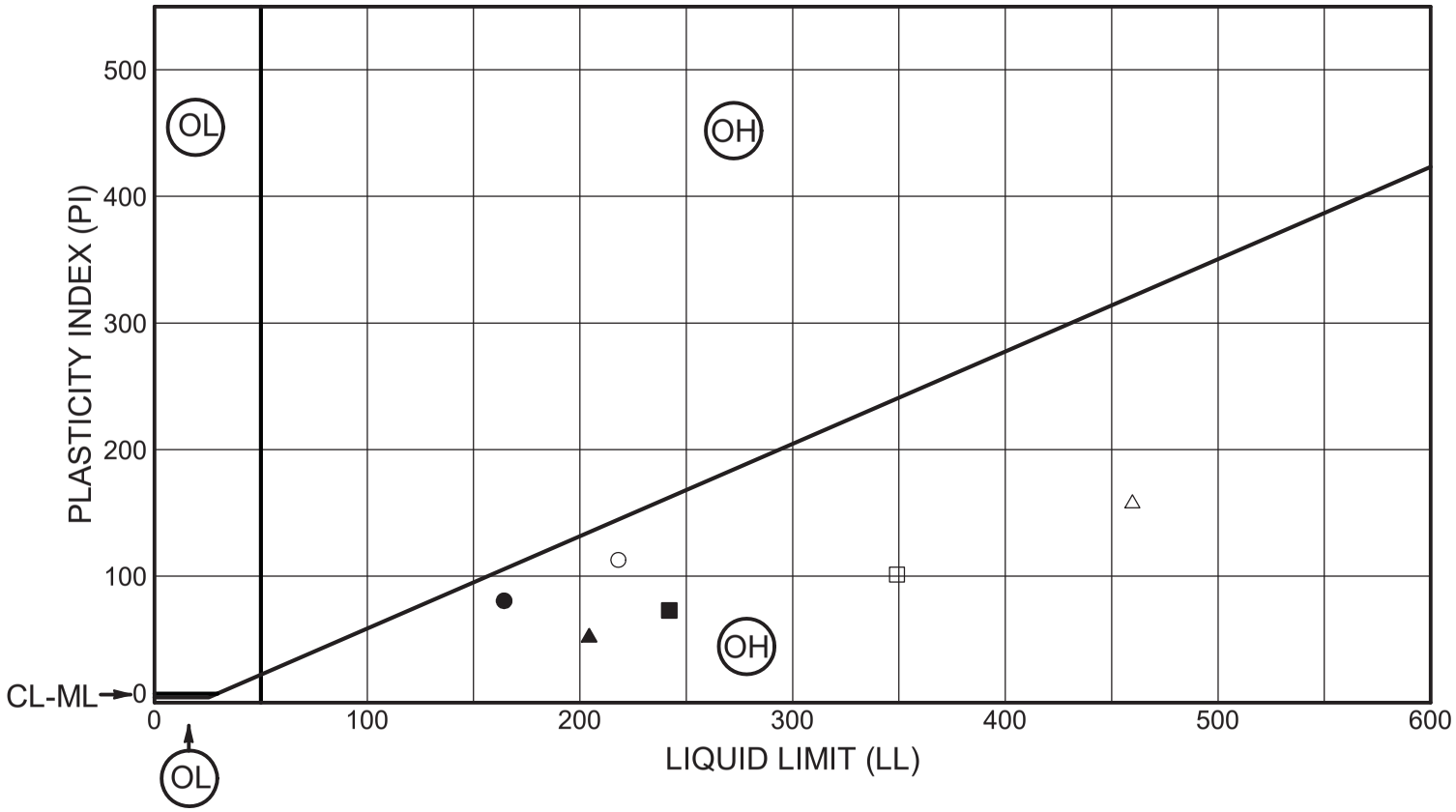
HWA GEOSCIENCES INC.

Daniel Walton
Laboratory Supervisor

Steven E. Greene, L.G., L.E.G.
Principal Engineering Geologist
Vice President

Attachments:

Figure 1	Liquid Limit, Plastic Limit and Plasticity Index of Soils
Figures 2-7	Unconsolidated-Undrained Compression Test for Cohesive Soils
Figures 8-13	One Dimensional Consolidation of Soils



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Fines
●	G023B	UU-TX1	5.0 - 5.5	(OH) Very dark brown, organic SILT	163	164	84	80	
■	G023B	UU-TX2	5.5 - 6.0	(OH) Very dark brown, organic SILT	158	242	169	73	
▲	G024	UU-TX3	12.5 - 13.0	(OH) Dark brown, organic SILT	95	204	151	53	
○	G025	UU-TX4	12.5 - 13.0	(OH) Dark brown, organic SILT	189	218	105	113	
□	G025	UU-TX5	13.0 - 13.5	(OH) Very dark brown, organic SILT	313	349	248	101	
△	G025	UU-TX6	13.5 - 14.0	(OH) Dark brown, organic SILT	258	460	301	159	

HWA GEOSCIENCES INC.

MLT for Golder Associates Inc.
Redmond East Link Extension

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS
METHOD ASTM D4318

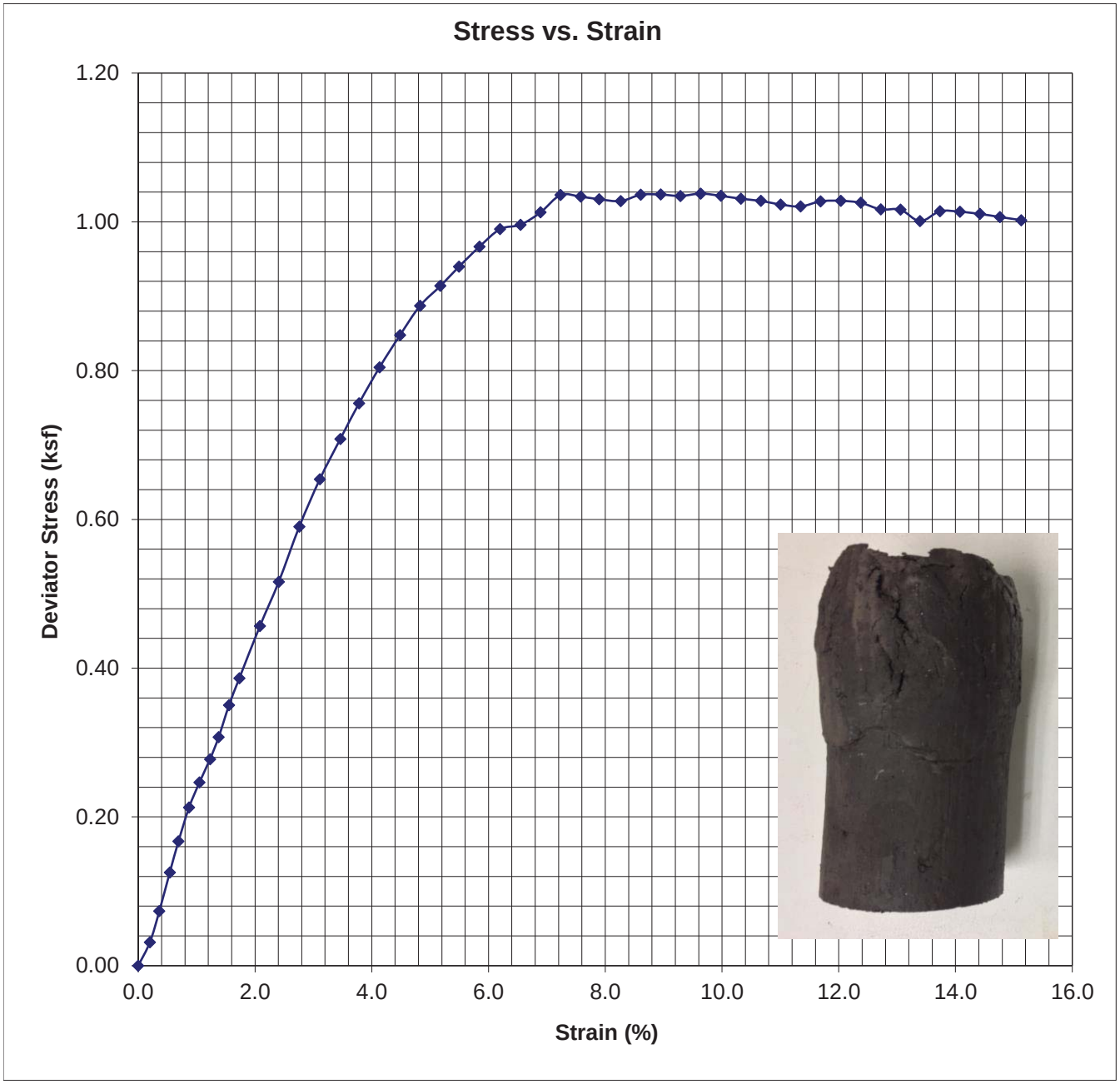
PROJECT NO.: 2012-095 T1200 FIGURE: 1

HWA GEOSCIENCES INC. Materials Testing Laboratory

Unconsolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Client: Golder Associates, Inc. **Project Number:** 2012-095 T1200

Project Name: Redmond East Link Extension



Soil Classification:	Very dark brown, organic SILT (OH)		
Sample Point:	G023B		
Sample Number:	ST-2 (UU-TX1)	Initial Moisture Content (%):	163.1
Sample Depth:	5-5.5 feet	Wet Unit Weight (pcf):	85.7
Confining Stress (ksf):	0.60	Dry Unit Weight (pcf):	32.6
Strain Rate (%\min):	0.85	Total Peak Stress (ksf):	1.038

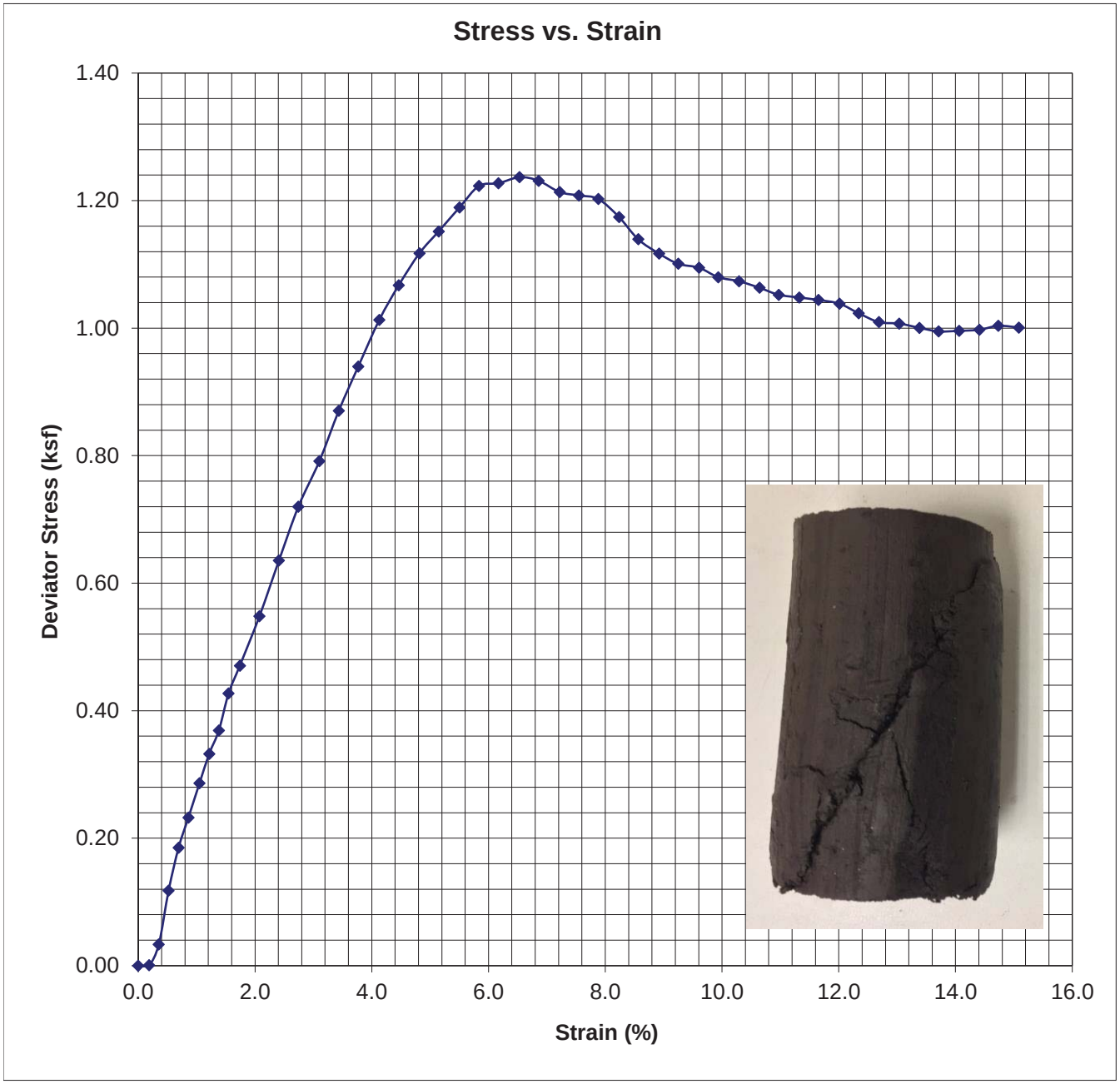
Figure No.: 2

HWA GEOSCIENCES INC. Materials Testing Laboratory

Unconsolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Client: Golder Associates, Inc. **Project Number:** 2012-095 T1200

Project Name: Redmond East Link Extension



Soil Classification:	Very dark brown, organic SILT (OH)		
Sample Point:	G023B		
Sample Number:	ST-2 (UU-TX2)	Initial Moisture Content (%):	157.7
Sample Depth:	5.5-6.0 feet	Wet Unit Weight (pcf):	77.3
Confining Stress (ksf):	0.71	Dry Unit Weight (pcf):	30.0
Strain Rate (%\min):	0.85	Total Peak Stress (ksf):	1.237

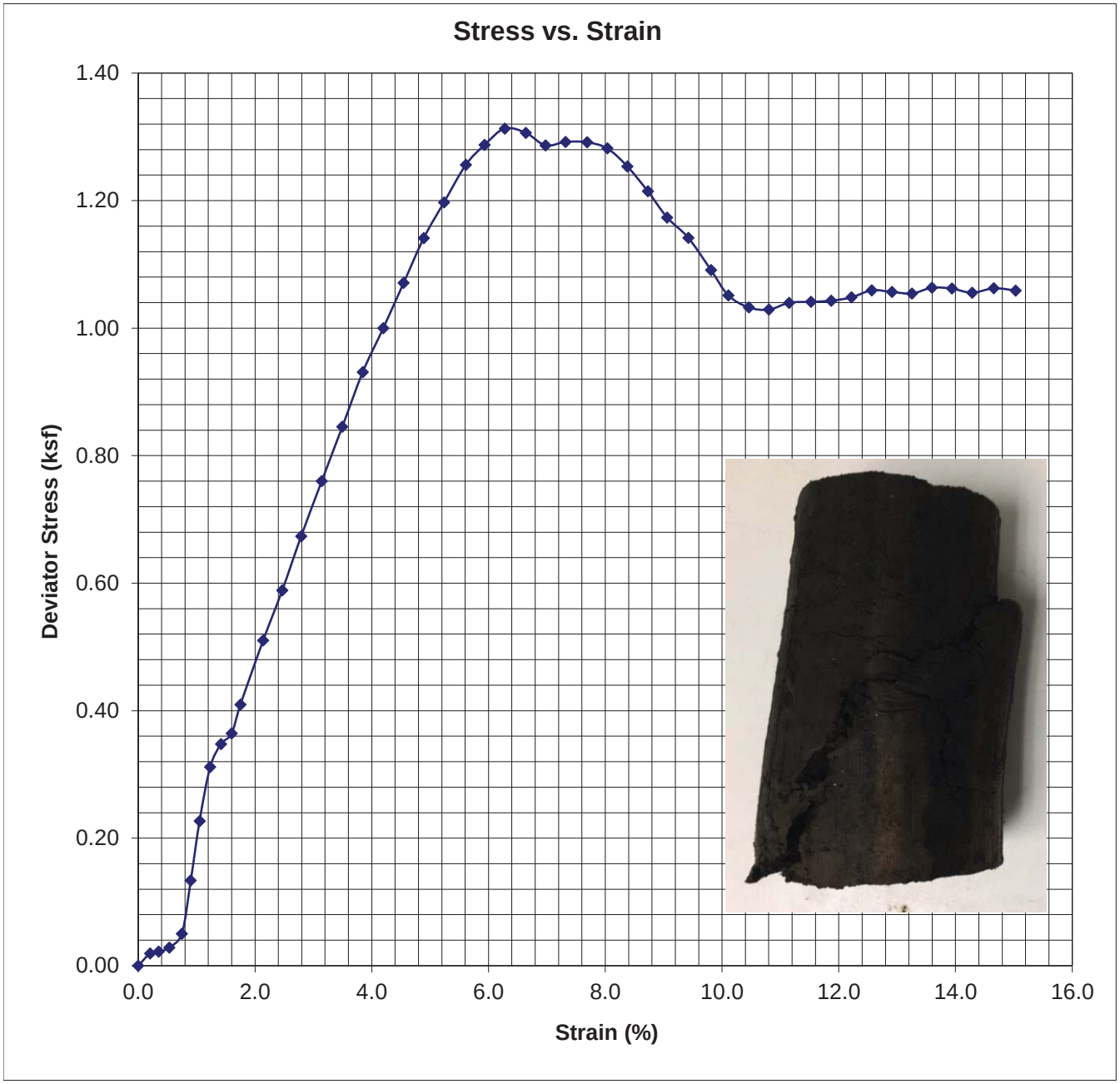
Figure No.: 3

HWA GEOSCIENCES INC. Materials Testing Laboratory

Unconsolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Client: Golder Associates, Inc. **Project Number:** 2012-095 T1200

Project Name: Redmond East Link Extension



Soil Classification:	Dark brown, organic SILT (OH)		
Sample Point:	G024		
Sample Number:	ST-1 (UU-TX3)	Initial Moisture Content (%):	94.6
Sample Depth:	12.5-13.0 feet	Wet Unit Weight (pcf):	79.5
Confining Stress (ksf):	1.50	Dry Unit Weight (pcf):	40.8
Strain Rate (%\min):	0.85	Total Peak Stress (ksf):	1.313

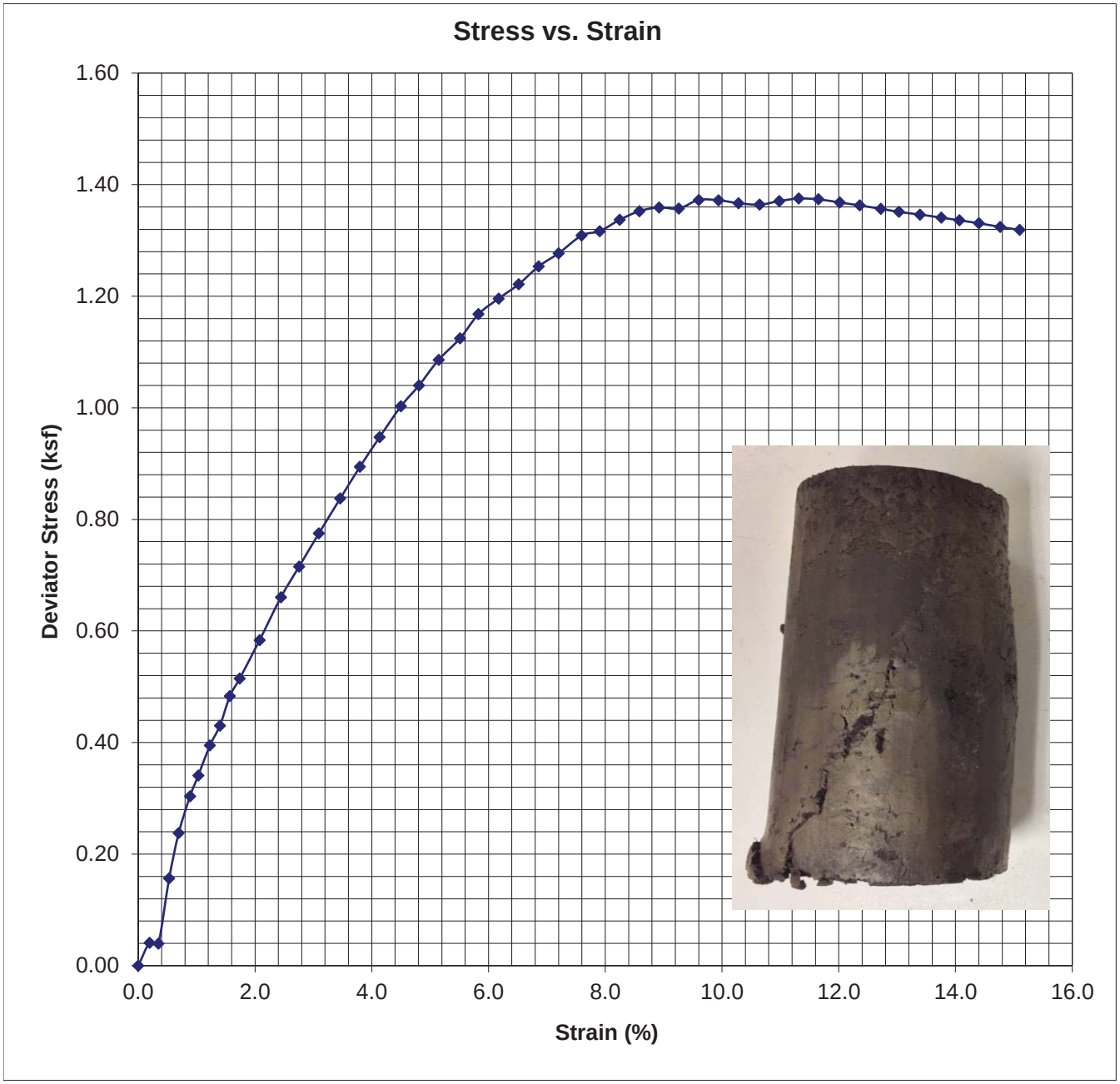
Figure No.: 4

HWA GEOSCIENCES INC. Materials Testing Laboratory

Unconsolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Client: Golder Associates, Inc. **Project Number:** 2012-095 T1200

Project Name: Redmond East Link Extension



Soil Classification:	Dark brown, organic SILT (OH)		
Sample Point:	G025		
Sample Number:	ST-1 (UU-TX4)	Initial Moisture Content (%):	189.4
Sample Depth:	12.5-13.0 feet	Wet Unit Weight (pcf):	79.3
Confining Stress (ksf):	1.50	Dry Unit Weight (pcf):	27.4
Strain Rate (%\min):	0.85	Total Peak Stress (ksf):	1.375

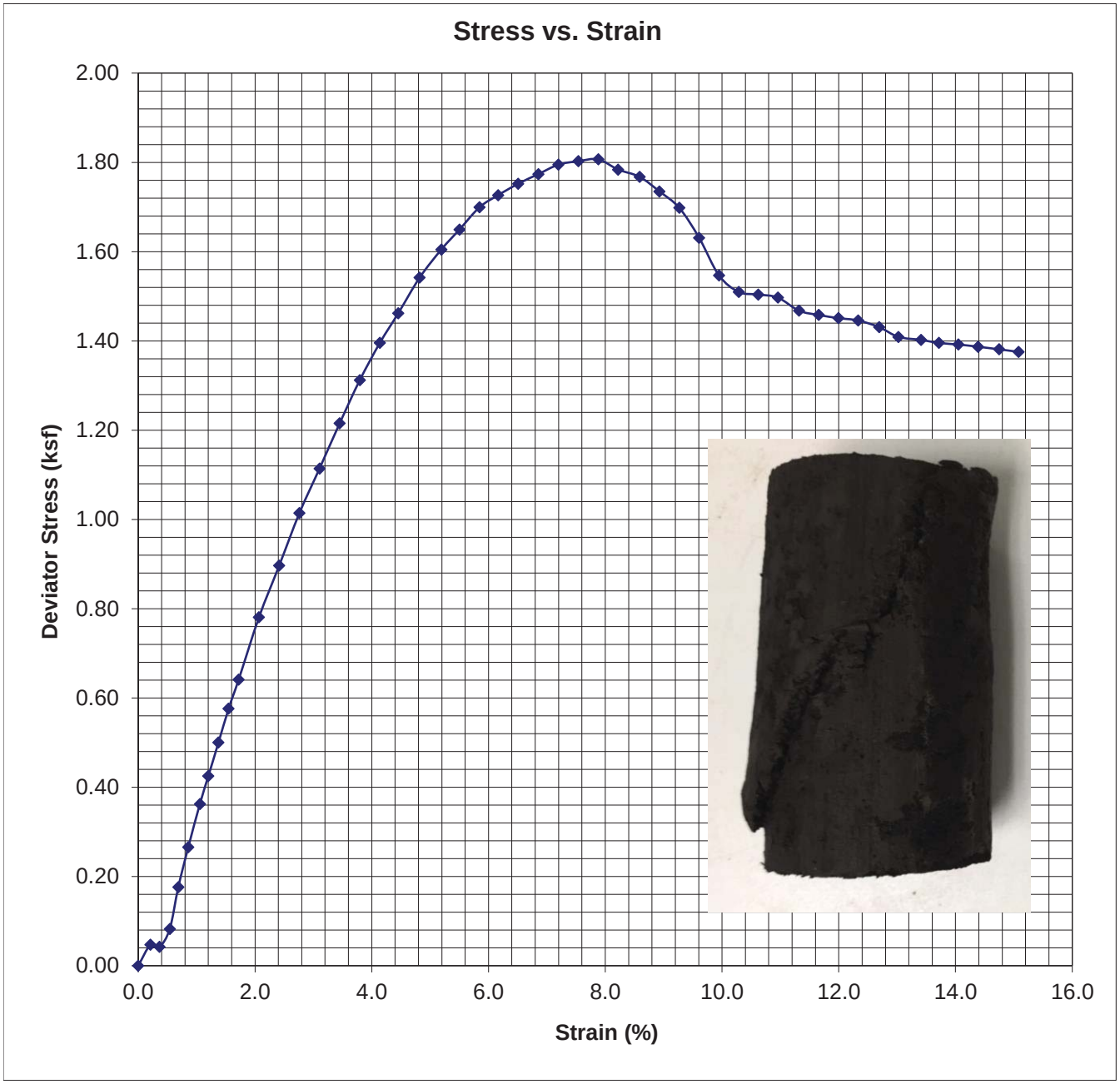
Figure No.: 5

HWA GEOSCIENCES INC. Materials Testing Laboratory

Unconsolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Client: Golder Associates, Inc. **Project Number:** 2012-095 T1200

Project Name: Redmond East Link Extension



Soil Classification:	Very dark brown, organic SILT (OH)		
Sample Point:	G025		
Sample Number:	ST-1 (UU-TX5)	Initial Moisture Content (%):	312.7
Sample Depth:	13.0-13.5 feet	Wet Unit Weight (pcf):	71.0
Confining Stress (ksf):	1.60	Dry Unit Weight (pcf):	17.2
Strain Rate (%\min):	0.85	Total Peak Stress (ksf):	1.807

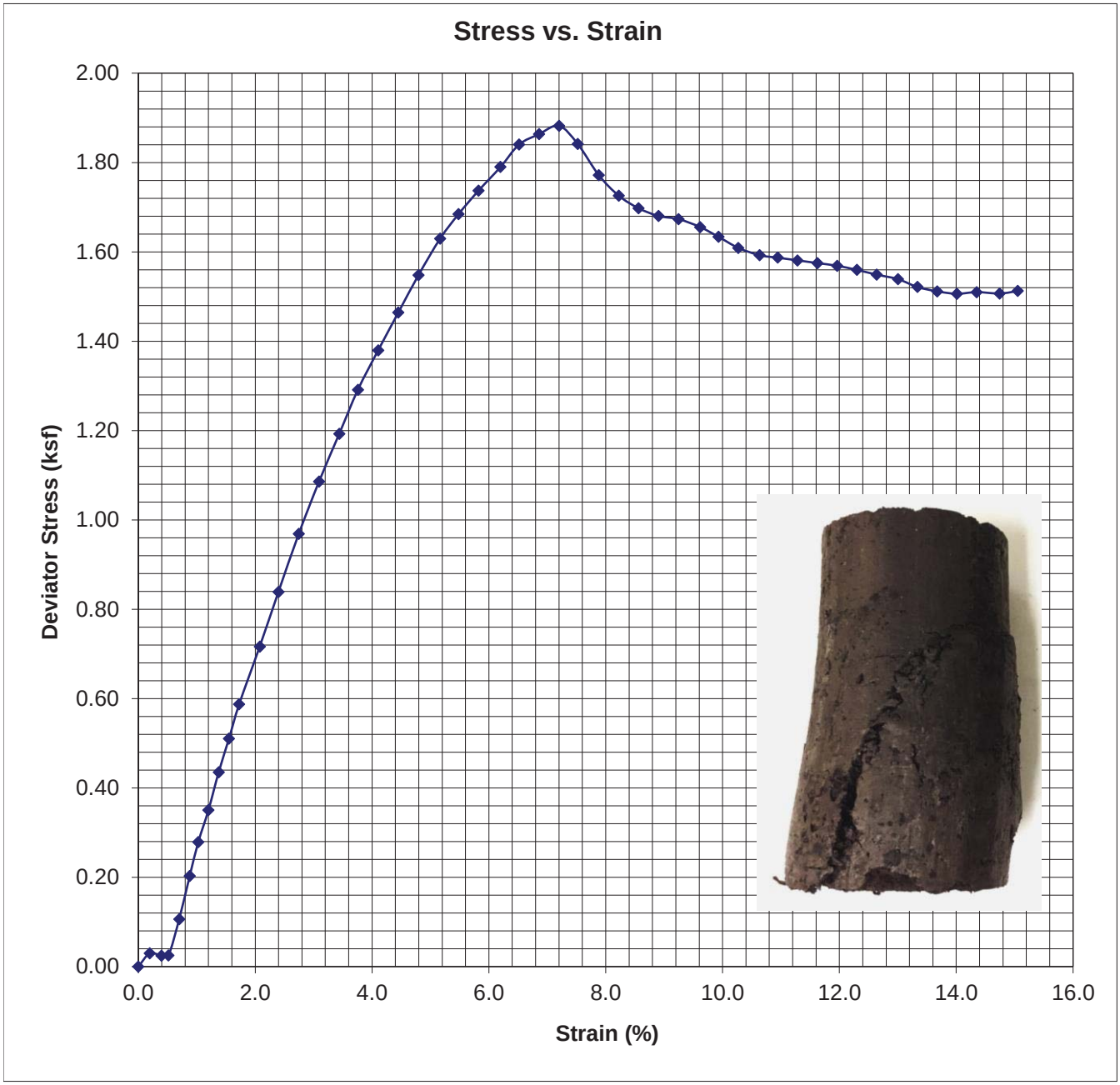
Figure No.: 6

HWA GEOSCIENCES INC. Materials Testing Laboratory

Unconsolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Client: Golder Associates, Inc. **Project Number:** 2012-095 T1200

Project Name: Redmond East Link Extension



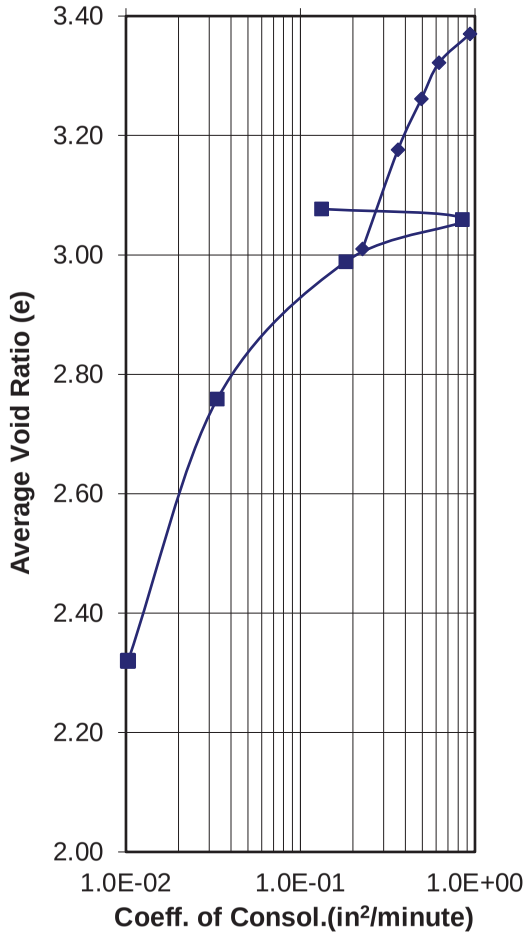
Soil Classification:	Very dark brown, organic SILT (OH)		
Sample Point:	G025		
Sample Number:	ST-1 (UU-TX6)	Initial Moisture Content (%):	257.7
Sample Depth:	13.5-14.0 feet	Wet Unit Weight (pcf):	70.0
Confining Stress (ksf):	1.70	Dry Unit Weight (pcf):	19.6
Strain Rate (%\min):	0.85	Total Peak Stress (ksf):	1.882

Figure No.: 7

HWA GEOSCIENCES INC.

ONE DIMENSIONAL CONSOLIDATION ASTM D 2435

					Start	Finish	
Project Name:	Golder-Redmond E. Link Ext.	Sample Number:	ST-2 (Cons.-1)	Moisture Content	187.6	144.8	%
Project Number:	2012-095 T1200	Sample Depth:	6.0-6.5	Saturation	96.9	100.4	%
Borehole Number:	G023B	Soil Description:	Very dark brown, organic SILT (OH)	Dry Density	24.0	30.8	pcf



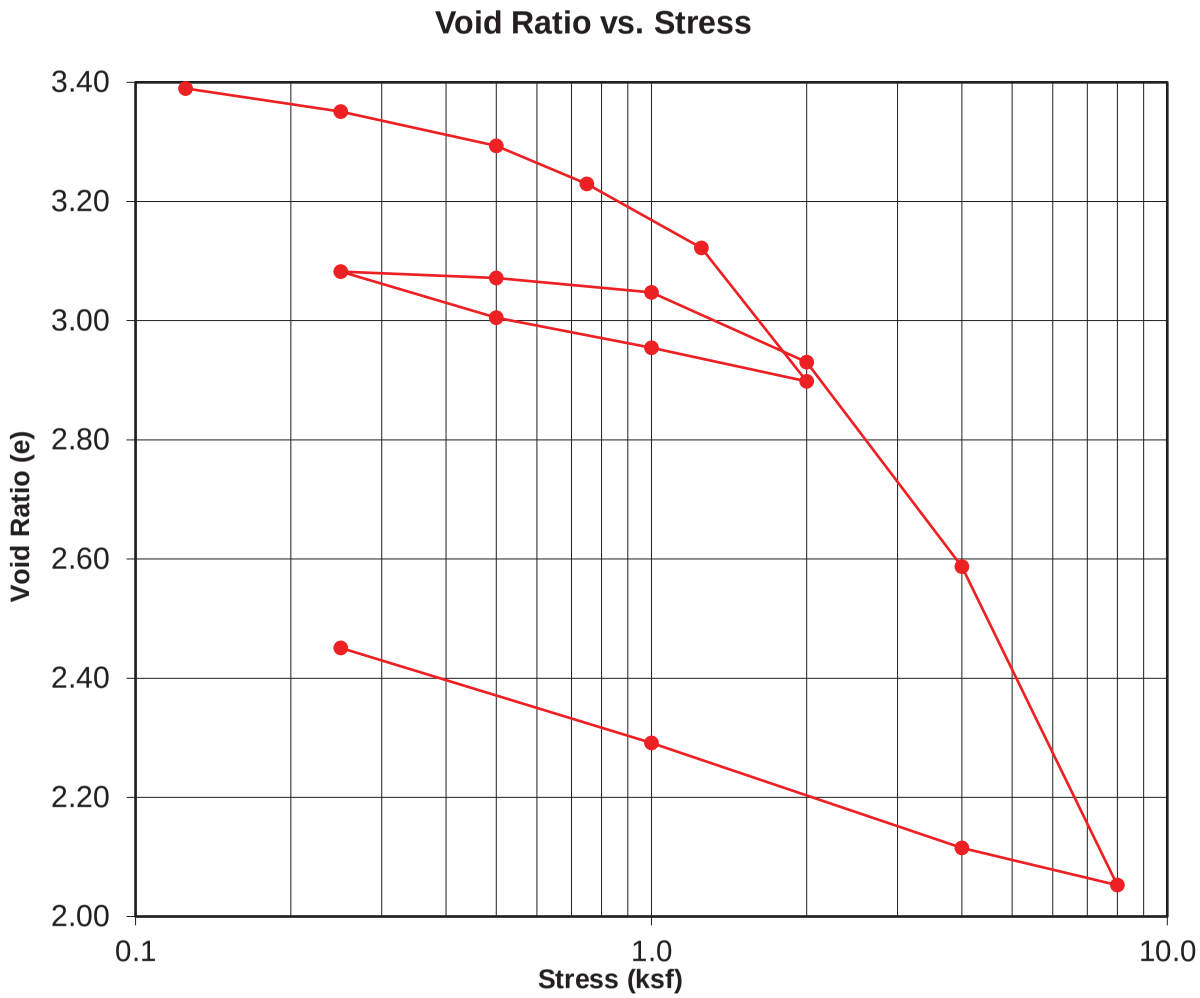
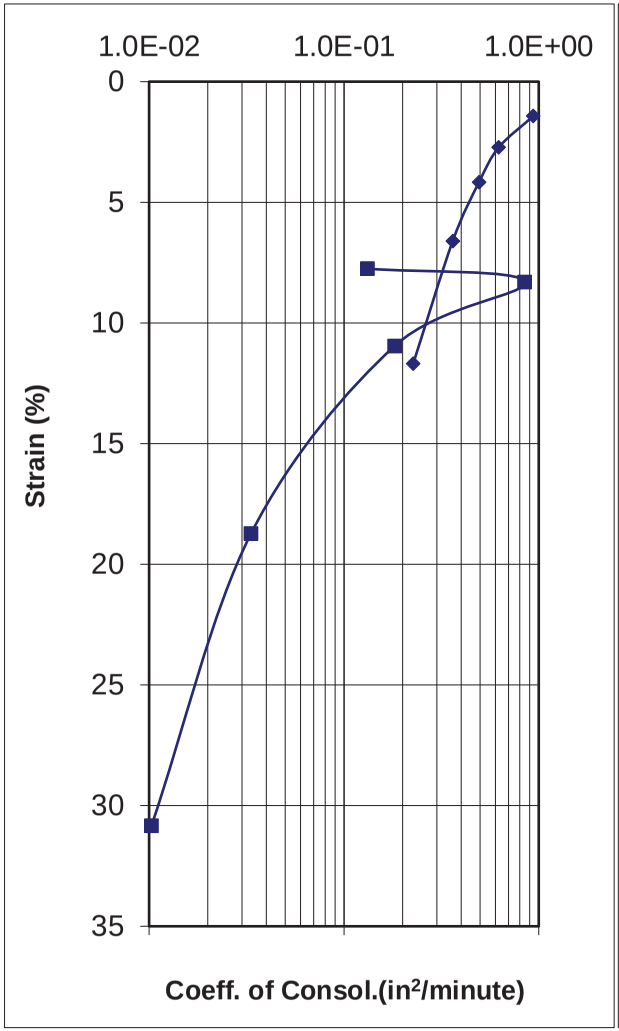


FIGURE 8

HWA GEOSCIENCES INC.

ONE DIMENSIONAL CONSOLIDATION ASTM D 2435

					Start	Finish	
Project Name:	Golder-Redmond E. Link Ext.	Sample Number:	ST-2 (Cons.-1)	Moisture Content	187.6	144.8	%
Project Number:	2012-095 T1200	Sample Depth:	6.0-6.5	Saturation	96.9	100.4	%
Borehole Number:	G023B	Soil Description:	Very dark brown, organic SILT (OH)	Dry Density	24.0	30.8	pcf



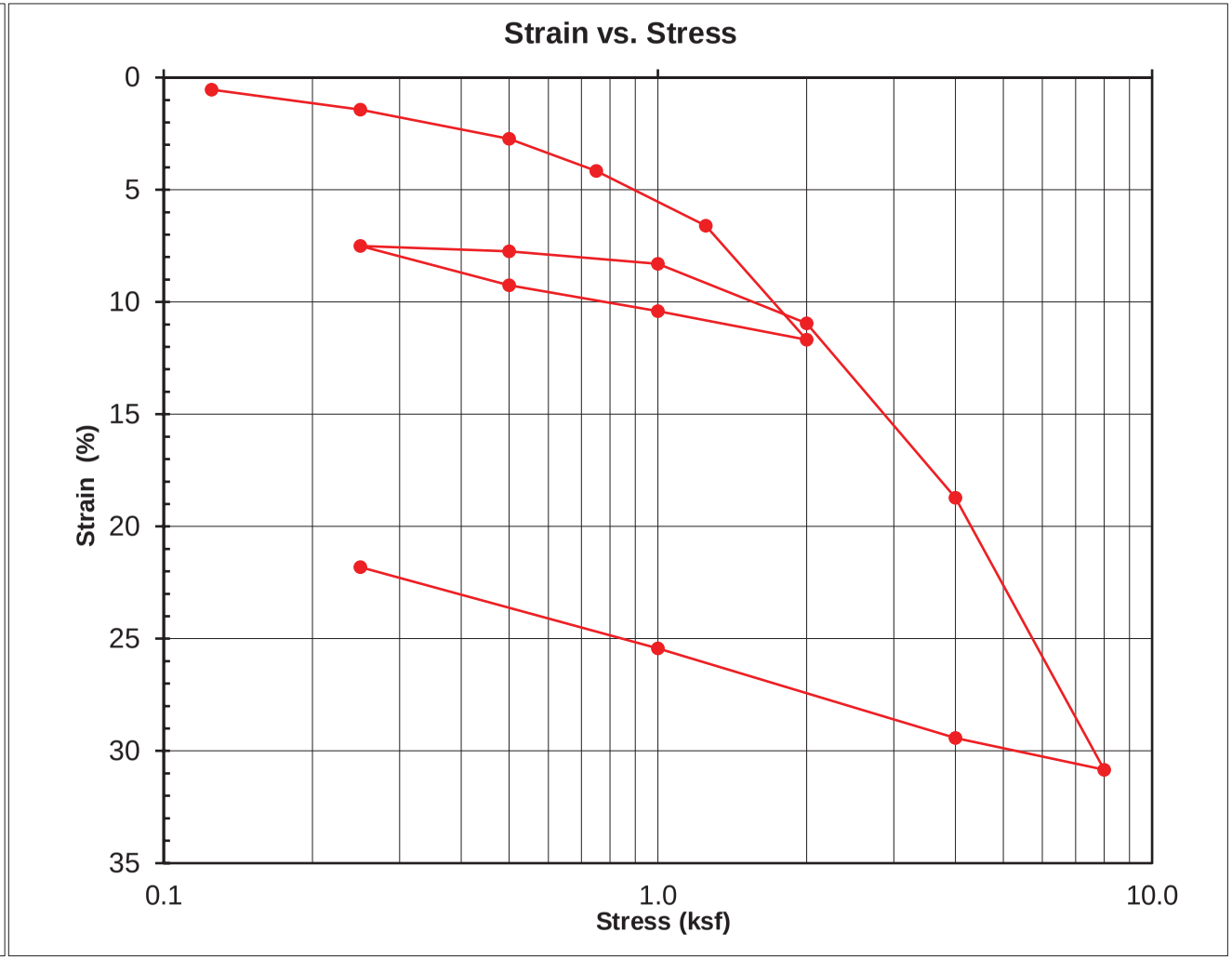
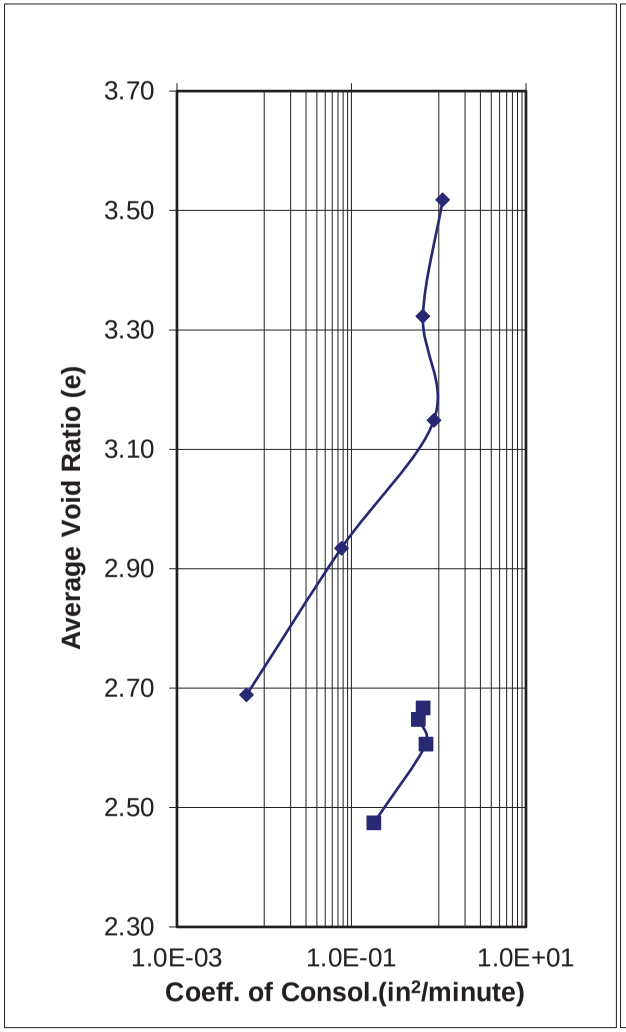


FIGURE 9

HWA GEOSCIENCES INC.

ONE DIMENSIONAL CONSOLIDATION ASTM D 2435

					Start	Finish	
Project Name:	Golder-Redmond E. Link Ext.	Sample Number:	ST-1 (Cons.-2)	Moisture Content	133.8	136.8	%
Project Number:	2012-095 T1200	Sample Depth:	12.5-14.5	Saturation	90.9	100.1	%
Borehole Number:	G024	Soil Description:	Very dark brown, organic SILT (OH)	Dry Density	25.4	33.0	pcf



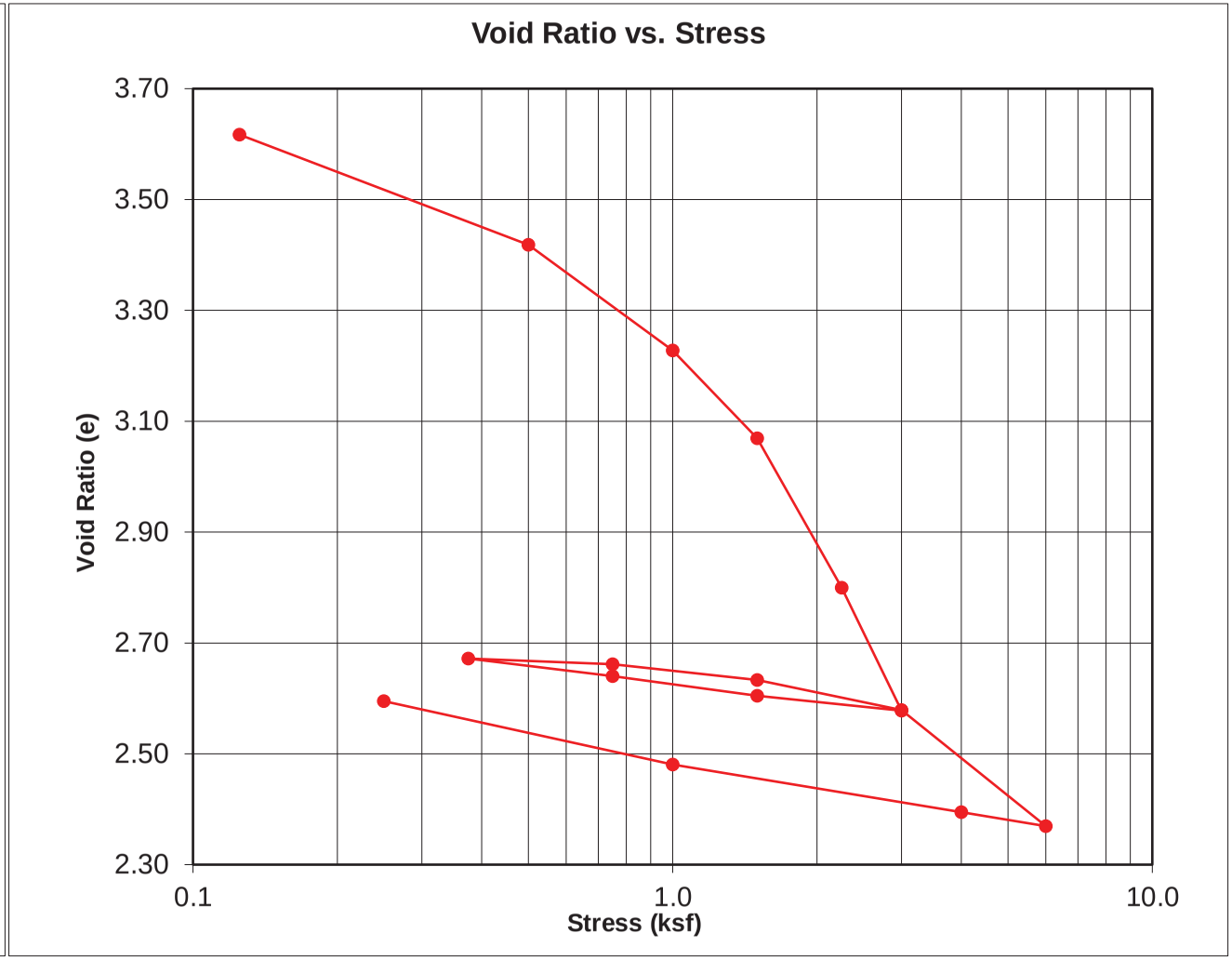
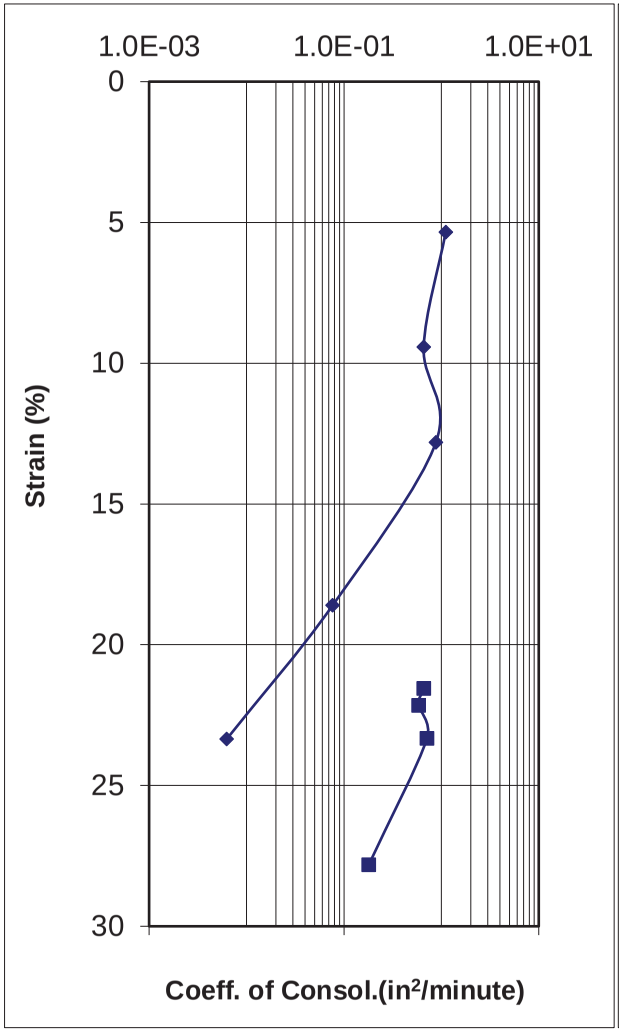


FIGURE 10

HWA GEOSCIENCES INC.

ONE DIMENSIONAL CONSOLIDATION ASTM D 2435

					Start	Finish	
Project Name:	Golder-Redmond E. Link Ext.	Sample Number:	ST-1 (Cons.-2)	Moisture Content	133.8	136.8	%
Project Number:	2012-095 T1200	Sample Depth:	12.5-14.5	Saturation	90.9	100.1	%
Borehole Number:	G024	Soil Description:	Very dark brown, organic SILT (OH)	Dry Density	25.4	33.0	pcf



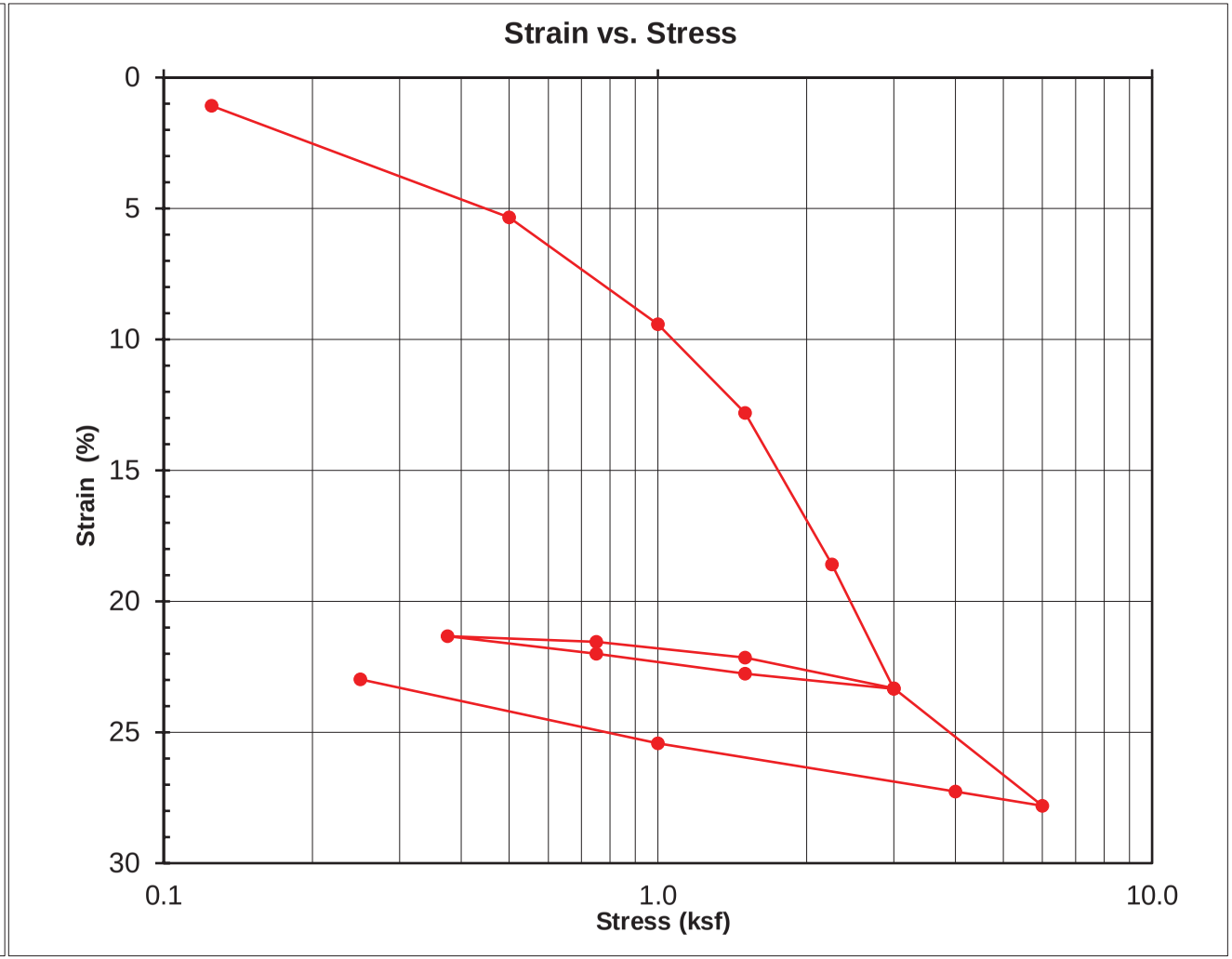
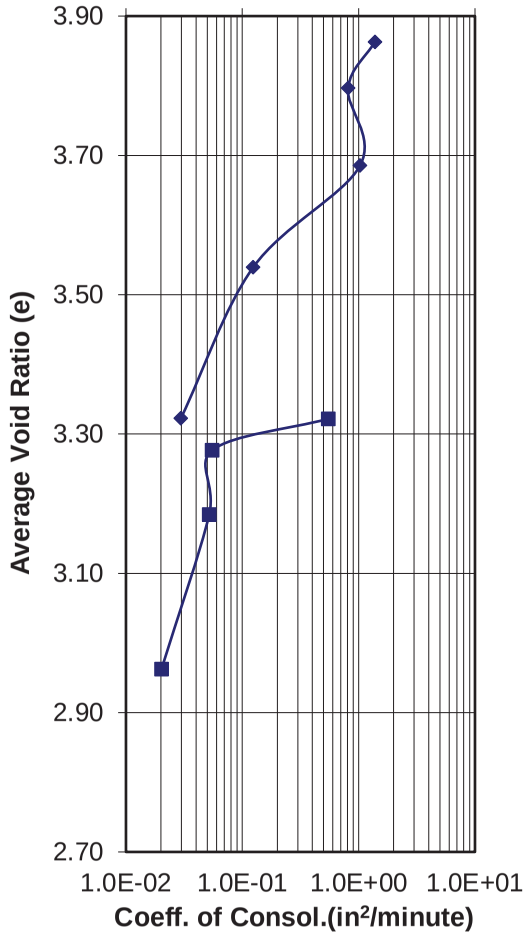


FIGURE 11

HWA GEOSCIENCES INC.

ONE DIMENSIONAL CONSOLIDATION ASTM D 2435

					Start	Finish	
Project Name:	Golder-Redmond E. Link Ext.	Sample Number:	ST-1 (Cons.-3)	Moisture Content	379.1	321.4	%
Project Number:	2012-095 T1200	Sample Depth:	14.0-14.5	Saturation	102.0	98.5	%
Borehole Number:	G025	Soil Description:	Very dark brown, organic SILT (OH)	Dry Density	12.8	14.6	pcf



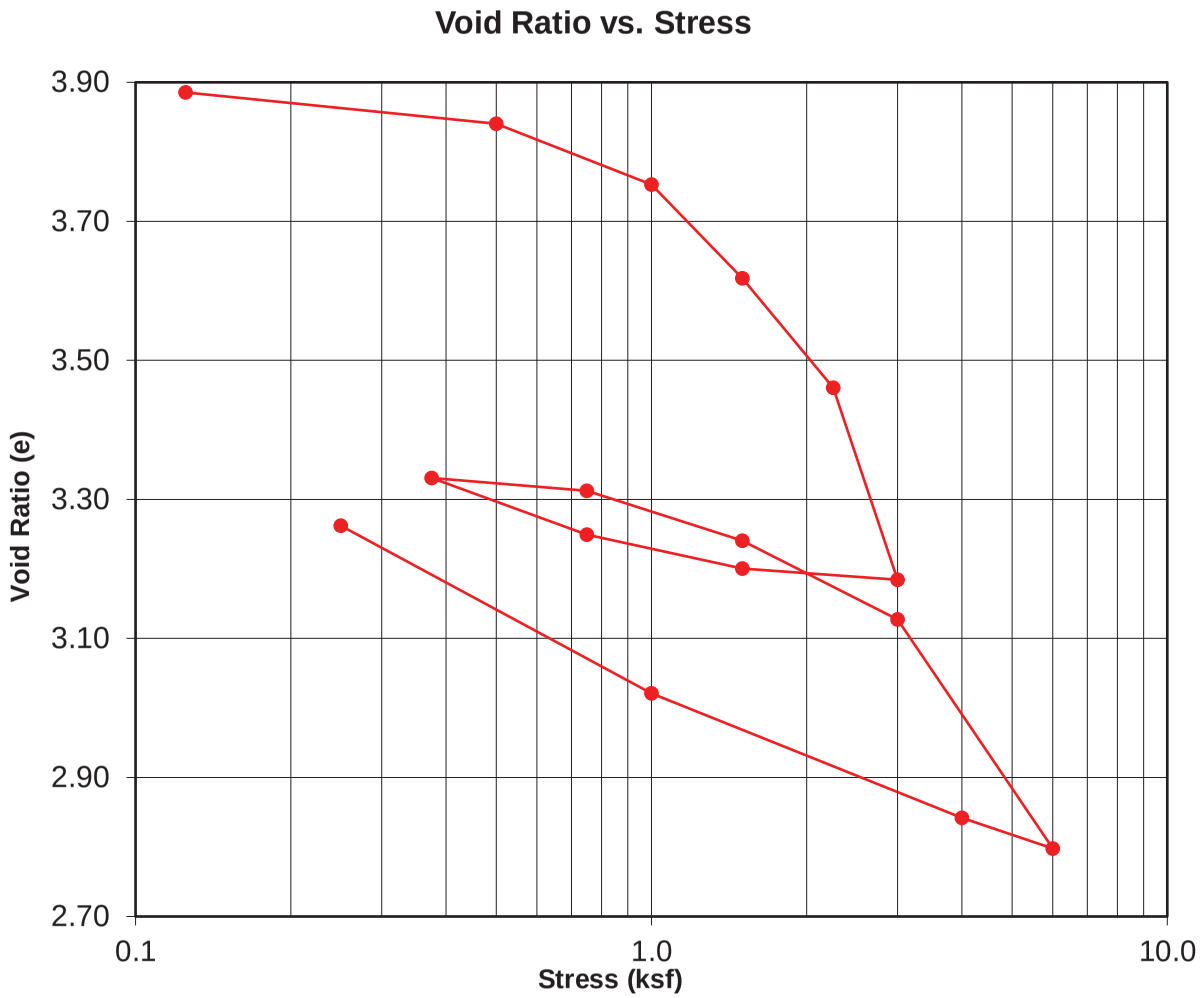
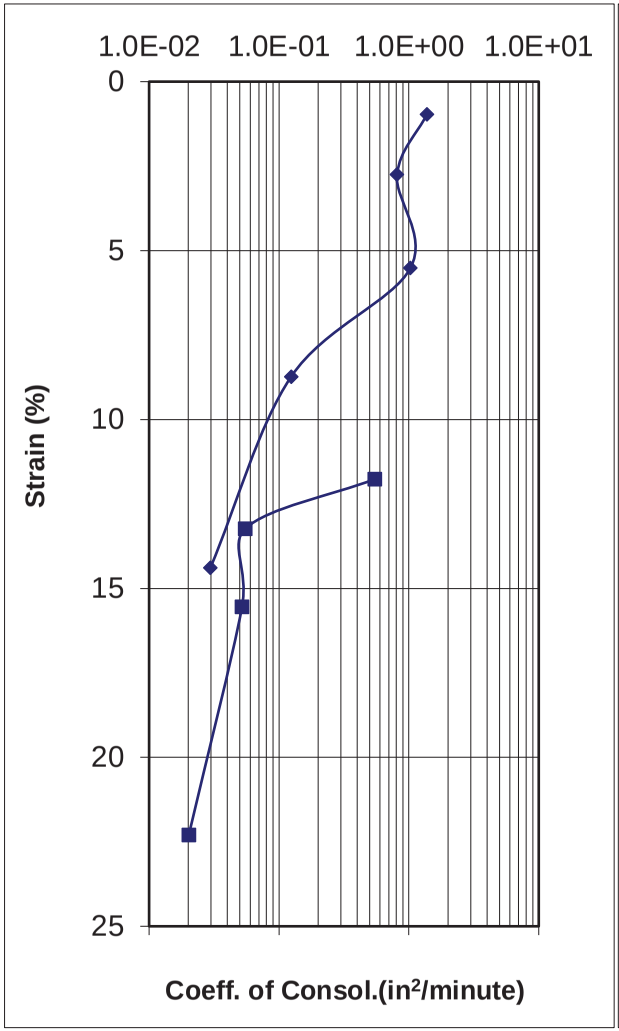


FIGURE 12

HWA GEOSCIENCES INC.

ONE DIMENSIONAL CONSOLIDATION ASTM D 2435

					Start	Finish	
Project Name:	Golder-Redmond E. Link Ext.	Sample Number:	ST-1 (Cons.-3)	Moisture Content	379.1	321.4	%
Project Number:	2012-095 T1200	Sample Depth:	14.0-14.5	Saturation	102.0	98.5	%
Borehole Number:	G025	Soil Description:	Very dark brown, organic SILT (OH)	Dry Density	12.8	14.6	pcf



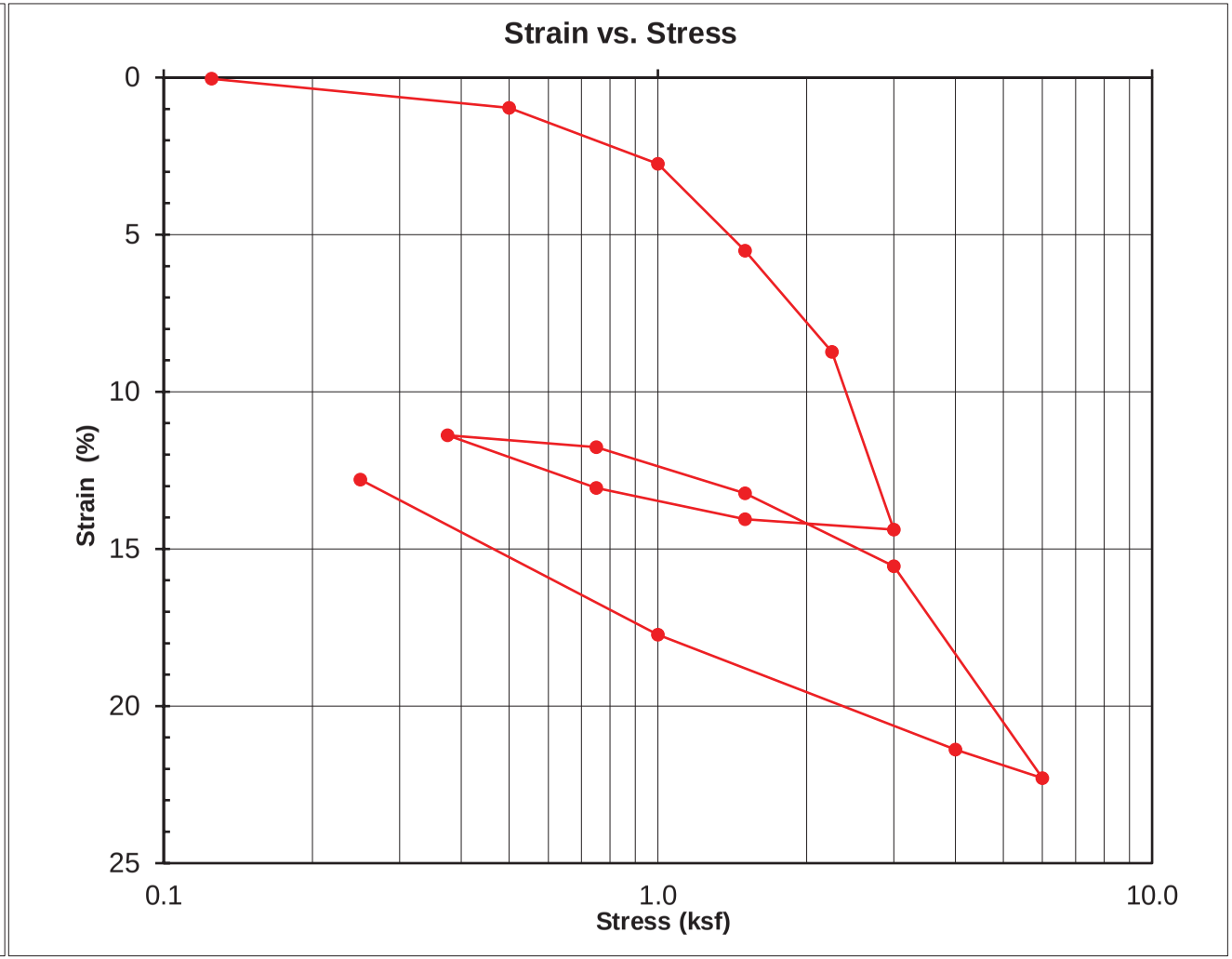


FIGURE 13

HWA GEOSCIENCES INC.
Geotechnical & Pavement Engineering • Hydrogeology • Geoenvironmental • Inspection & Testing

January 18, 2018
HWA Project No. 2012-095-23 T1200

Golder Associates Inc.
18300 Union Hill Road, Suite 200
Redmond, Washington 98052

Attention: Mr. Birkan Bayrak, Ph.D., P.E.

Subject: **SOIL LABORATORY TESTING REPORT**
Atterberg Limits, Consolidation and Triaxial Strength Testing
Sound Transit Redmond East Link Extension
Golder Project No. 1657705

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SAMPLE DESCRIPTION: The samples were delivered to our laboratory on January 11, 2018 by Golder Associates personnel. The samples were delivered in Shelby tubes designated with exploration ID, sample number and depth of sampling. The Shelby tubes were extruded and tests were ordered by the client based on photographic information. The samples were classified for engineering purposes in general accordance with ASTM D2487. The sample descriptions appear on the attached report Figures.

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS (ATTERBERG LIMITS): Two selected samples were tested in general accordance with ASTM D 4318, multi-point method. The results are reported on the attached Liquid Limit, Plastic Limit, and Plasticity Index report, Figure 1.

ONE DIMENSIONAL CONSOLIDATION PROPERTIES OF SOIL: The consolidation properties of selected soil samples were measured in general accordance with ASTM D2435. Saturation was maintained by inundation of the sample throughout the test. The samples were subjected to increasing increments of total stress, the duration of which was selected to exceed the time required for completion of primary consolidation as defined in the Standard, Method B. In accordance with the client's instructions, incremental unloading of the samples was not carried out. The test results are presented on the attached Figures 2-5.

21312 30th Drive SE
Suite 110
Bothell, WA 98021-7010
Tel: 425.774.0106
Fax: 425.774.2714
www.hwageo.com

January 18, 2018
HWA Project No. 2012-095-23 Task 1200

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION OF SOILS: The unconsolidated, undrained strength of the selected samples was tested in general accordance with method ASTM D2850 to determine the strength characteristics of the soil. Each sample was extruded from the sample tube and a representative section was cut from the sample. The sample ends were trimmed to obtain a cylindrical test sample with a length to diameter ratio between 2:1 and 2.5:1. The bulk density of the sample was determined by careful weighing and dimensional measurement of the trimmed sample. The confining stresses used are indicated on the test plots. The results are summarized and plotted graphically on the attached Unconsolidated Undrained Triaxial Compression Test for Cohesive Soils reports, Figures 6-9.

CLOSURE: Experience has shown that laboratory test values for soil and other natural materials vary with each representative sample. As such, HWA has no knowledge as to the extent and quantity of material the tested sample may represent. HWA also makes no warranty as to how representative either the sample tested or the test results obtained are to actual field conditions. It is a well established fact that sampling methods present varying degrees of disturbance or variance that affect sample representativeness.

No copy should be made of this report, except in its entirety.

We appreciate the opportunity to provide laboratory testing services on this project. Should you have any questions or comments, or if we may be of further service, please call.

Sincerely,

HWA GEOSCIENCES INC.

Daniel Walton
Laboratory Supervisor

Steven E. Greene, L.G., L.E.G.
Principal Engineering Geologist
Vice President

Attachments:

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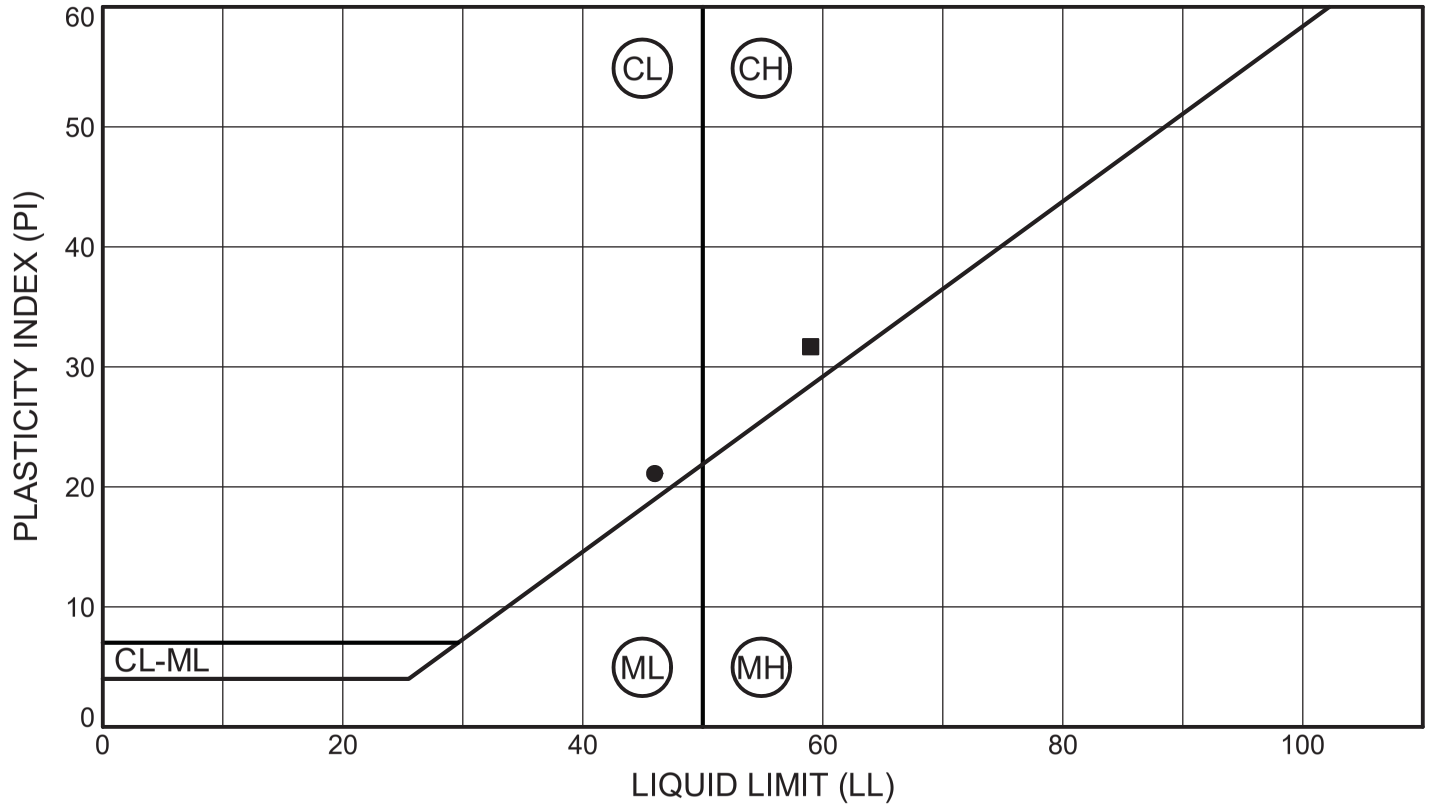
Figures 2-5	One Dimensional Consolidation of Soils
Figures 6-9	Unconsolidated-Undrained Compression Test for Cohesive Soils



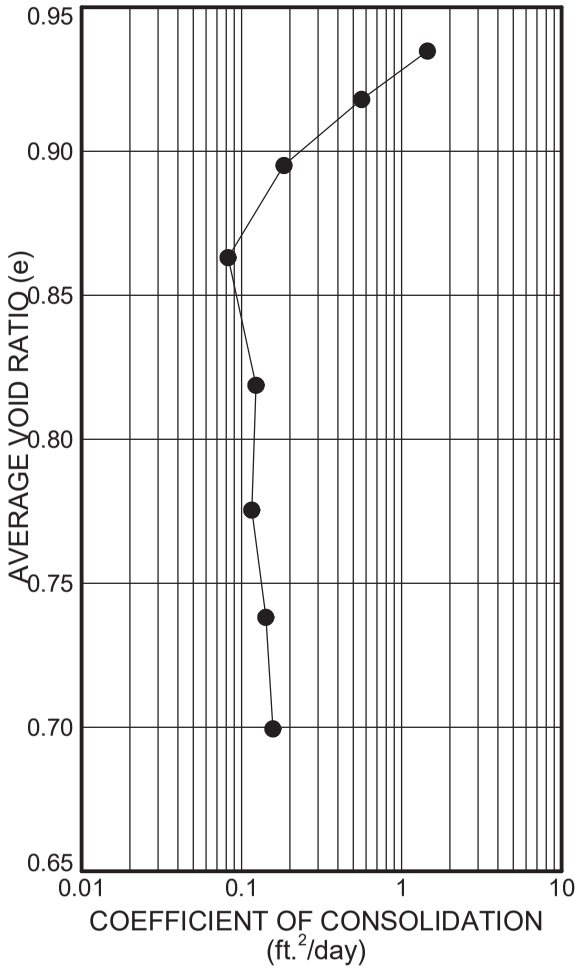
SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Fines
●	G019	ST-2	126.5 - 128.5	(CL) Dark gray, lean CLAY	33	46	25	21	
■	G032	ST-37	165.0 - 167.0	(CH) Gray, fat CLAY	37	59	27	32	

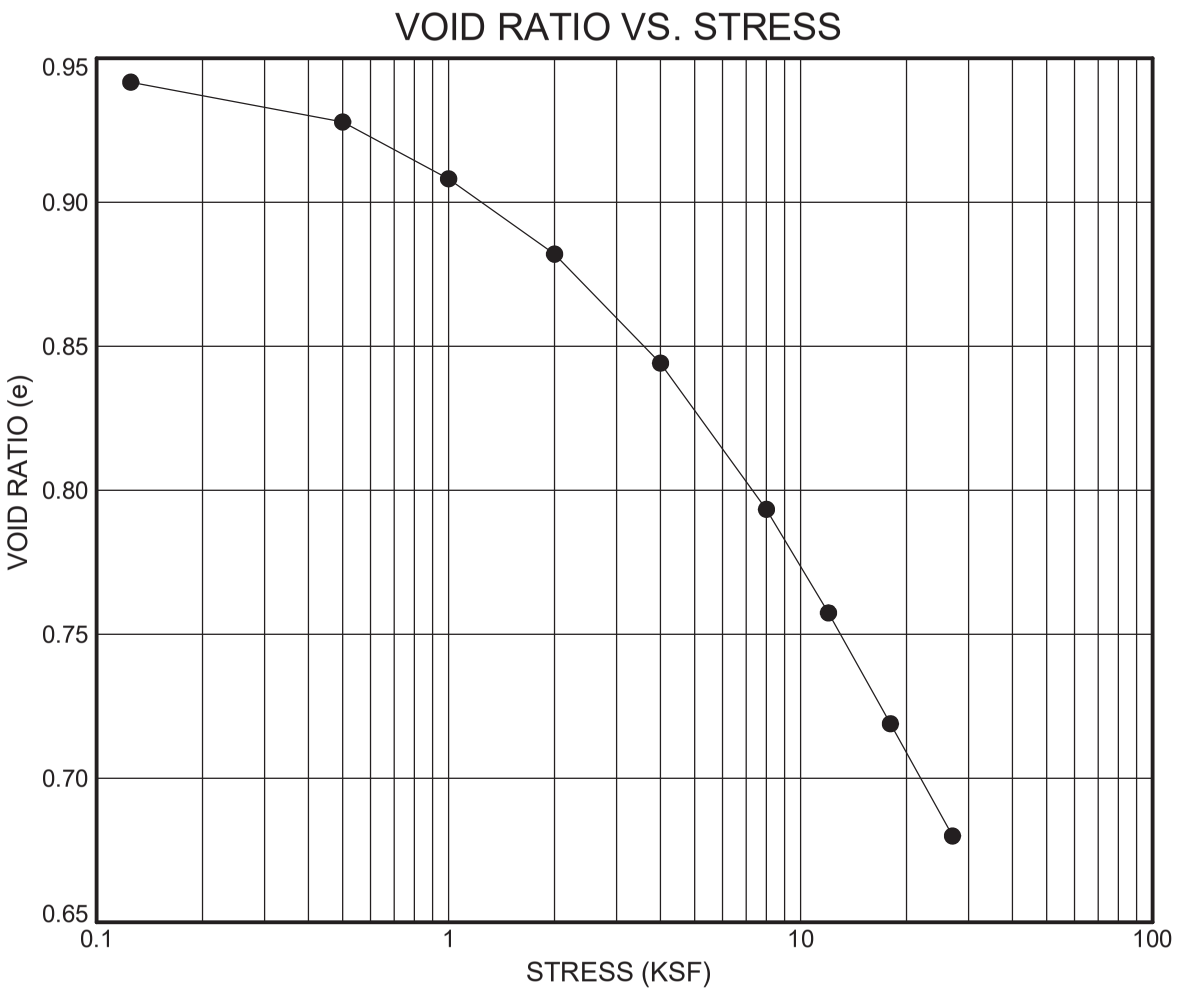
HWA GEOSCIENCES INC.

MLT for Golder Associates Inc.
Redmond East Link Extension

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS
METHOD ASTM D4318

PROJECT NO.: 2012-095 T1200 FIGURE: 1





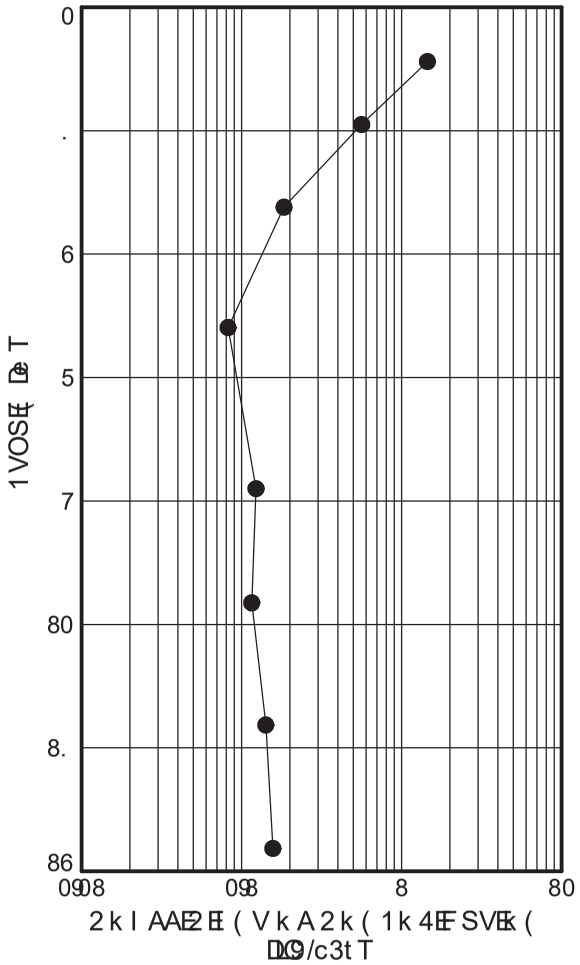
SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487	% MC		% Saturation		Dry Density (pcf)		Void Ratio (e)	
					Initial	Final	Initial	Final	Initial	Final	Initial	Final
●	G019	ST-2	126.5 - 128.5	(CL) Dark gray, lean CLAY	33.0	25.8	99.2	106.4	90.2	104.0	0.945	0.680

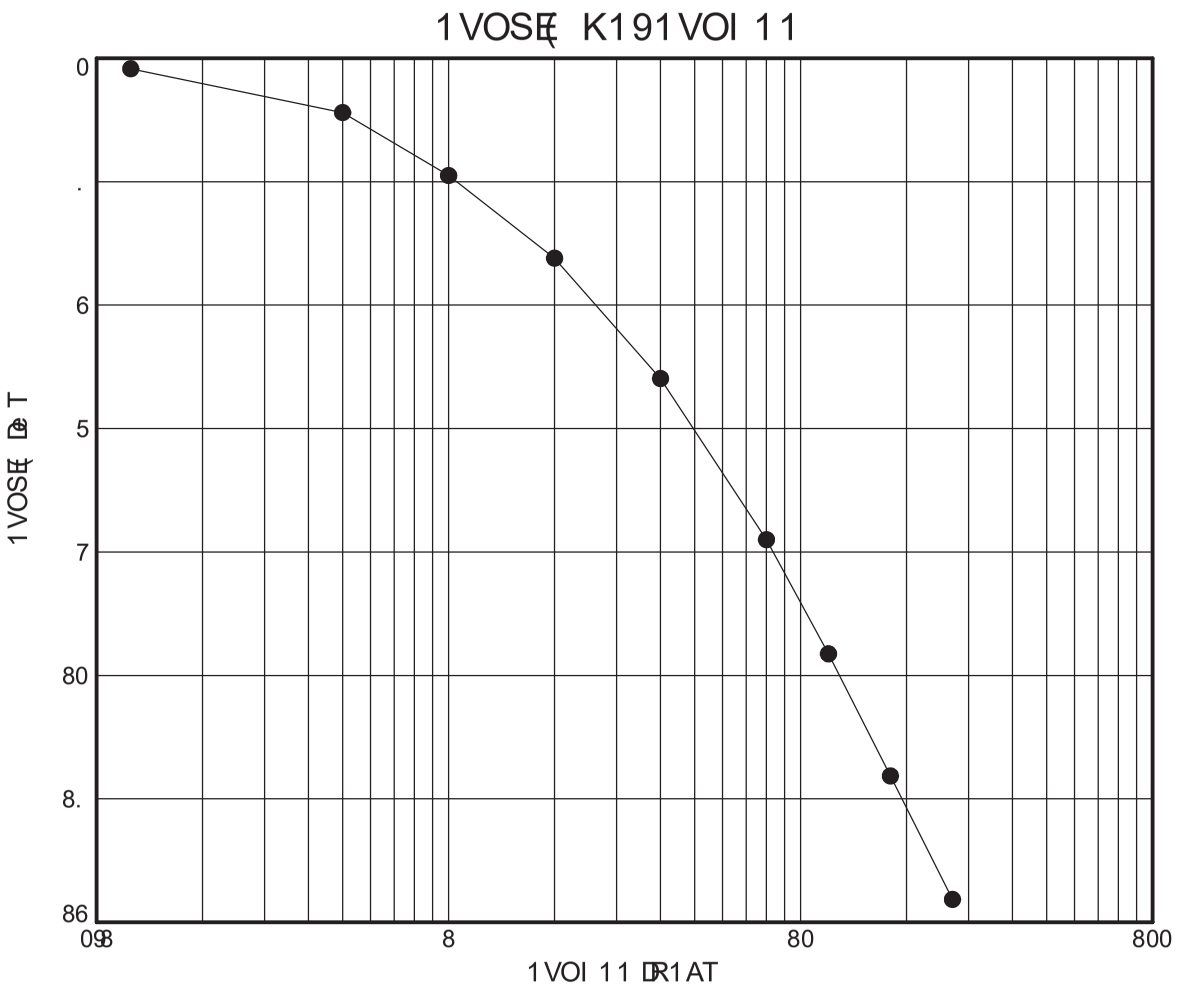
HWA GEOSCIENCES INC.

MLT for Golder Associates Inc.
Redmond East Link Extension

ONE DIMENSIONAL
CONSOLIDATION OF SOILS
ASTM D2435

PROJECT NO.: 2012-095 T1200 FIGURE: 2





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HWA GEOSCIENCES INC.

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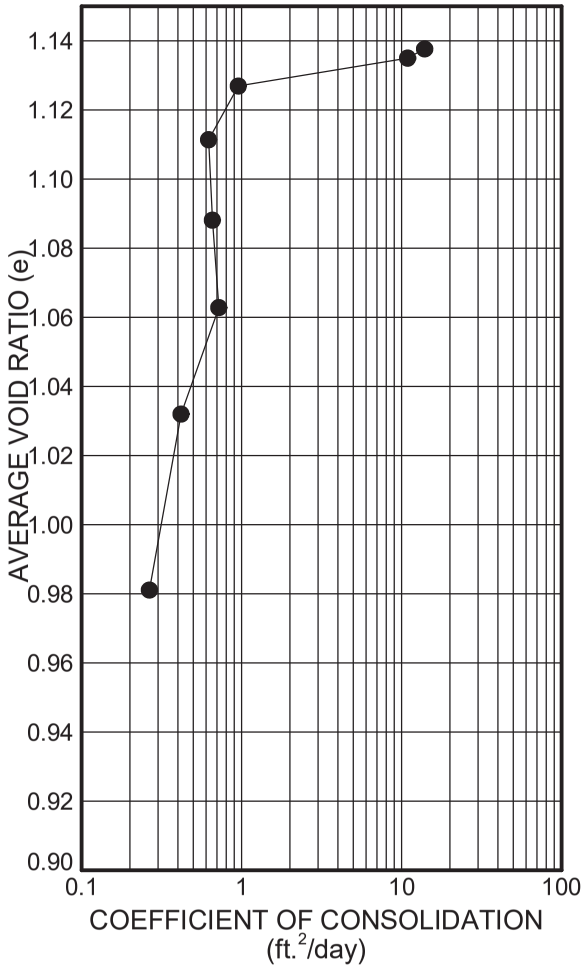
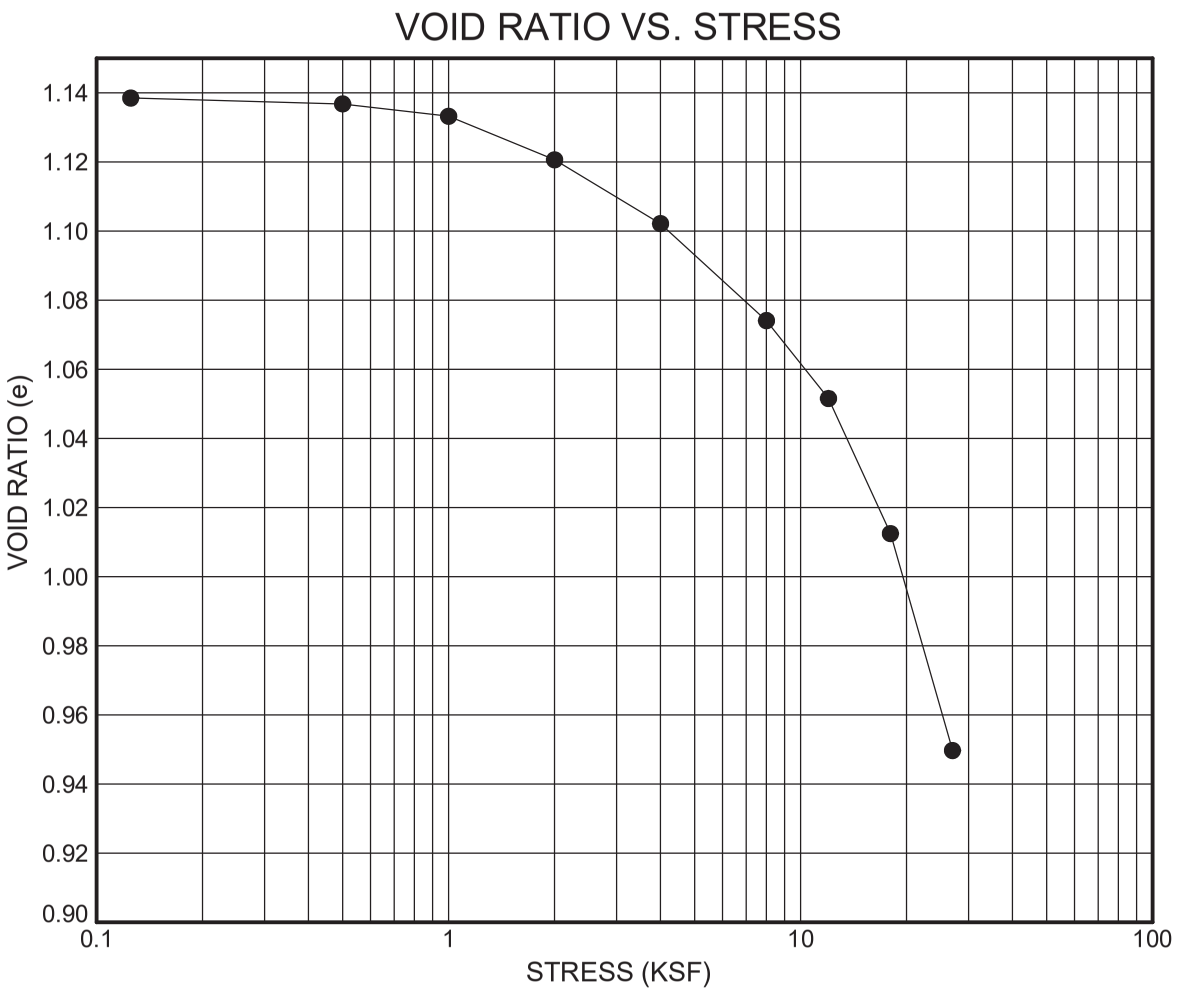




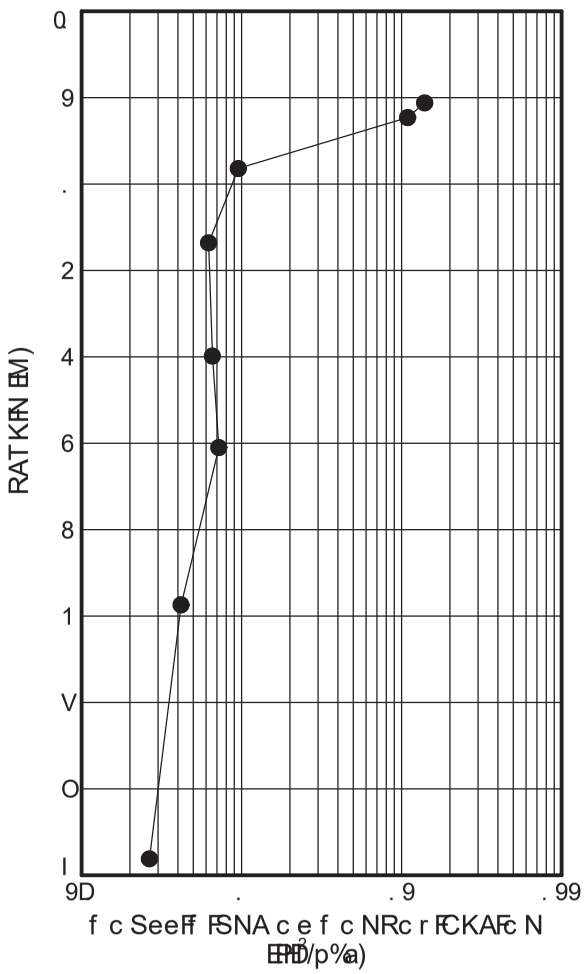
SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487	% MC		% Saturation		Dry Density (pcf)		Void Ratio (e)	
					Initial	Final	Initial	Final	Initial	Final	Initial	Final
●	G032	ST-37	165.0 - 167.0	(CH) Gray, fat CLAY	36.8	35.5	99.4	104.5	81.8	89.7	1.138	0.950

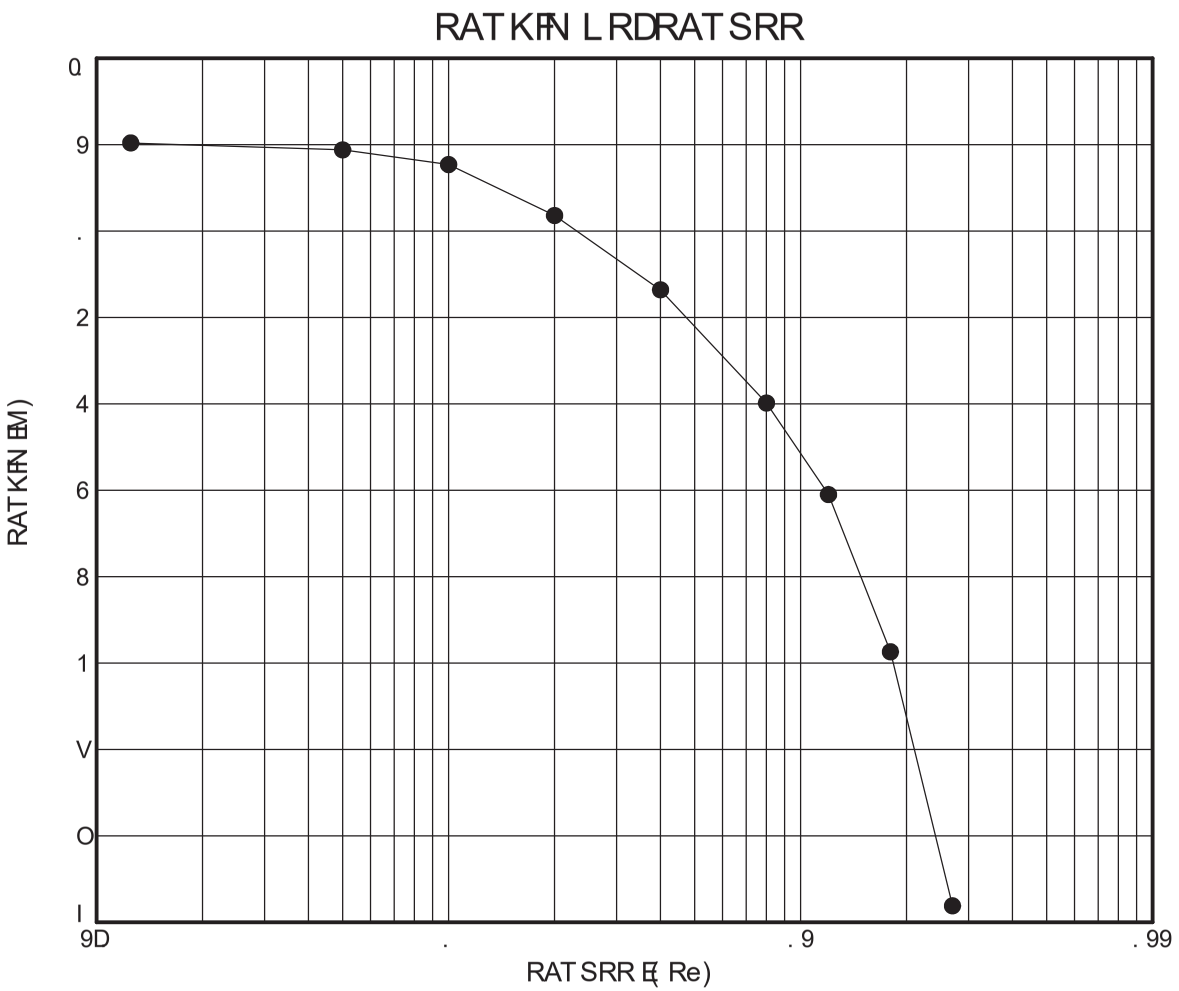
HWA GEOSCIENCES INC.

MLT for Golder Associates Inc.
Redmond East Link Extension

ONE DIMENSIONAL
CONSOLIDATION OF SOILS
ASTM D2435

PROJECT NO.: 2012-095 T1200 FIGURE: 4





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HWA GEOSCIENCES INC.

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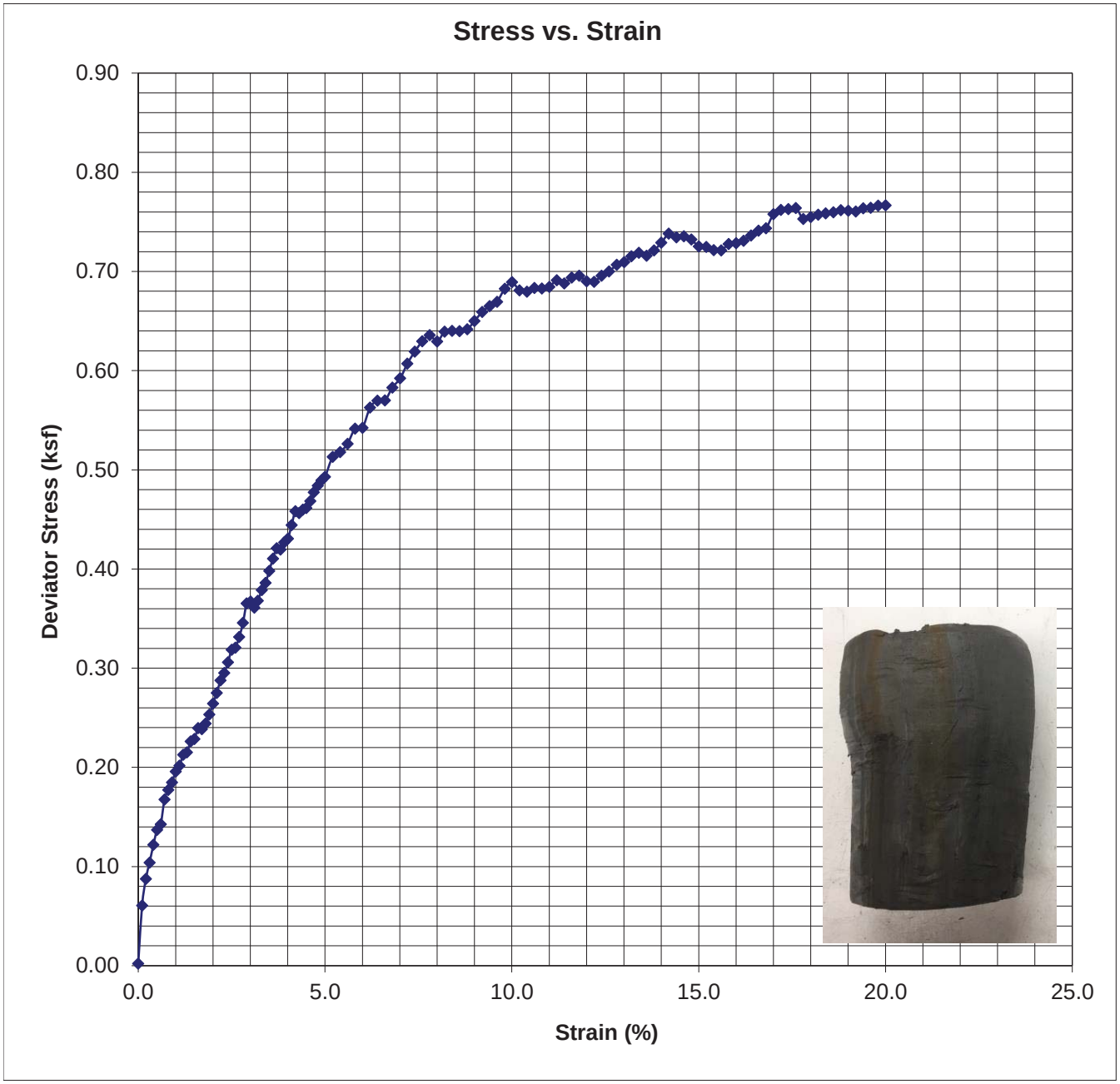
HWA GEOSCIENCES INC. Materials Testing Laboratory

Unconsolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Client: Golder Associates, Inc. **Project Number:** 2012-095 T1200

Project Name: Redmond East Link Extension



Soil Classification:	Dark gray, lean CLAY (CL)		
Sample Point:	G019		
Sample Number:	ST-2 (UU-TX7)	Initial Moisture Content (%):	37.0
Sample Depth:	126.5-128.5 feet	Wet Unit Weight (pcf):	116.3
Confining Stress (ksf):	15.50	Dry Unit Weight (pcf):	84.9
Strain Rate (%\min):	1.00	Total Peak Stress (ksf):	0.767

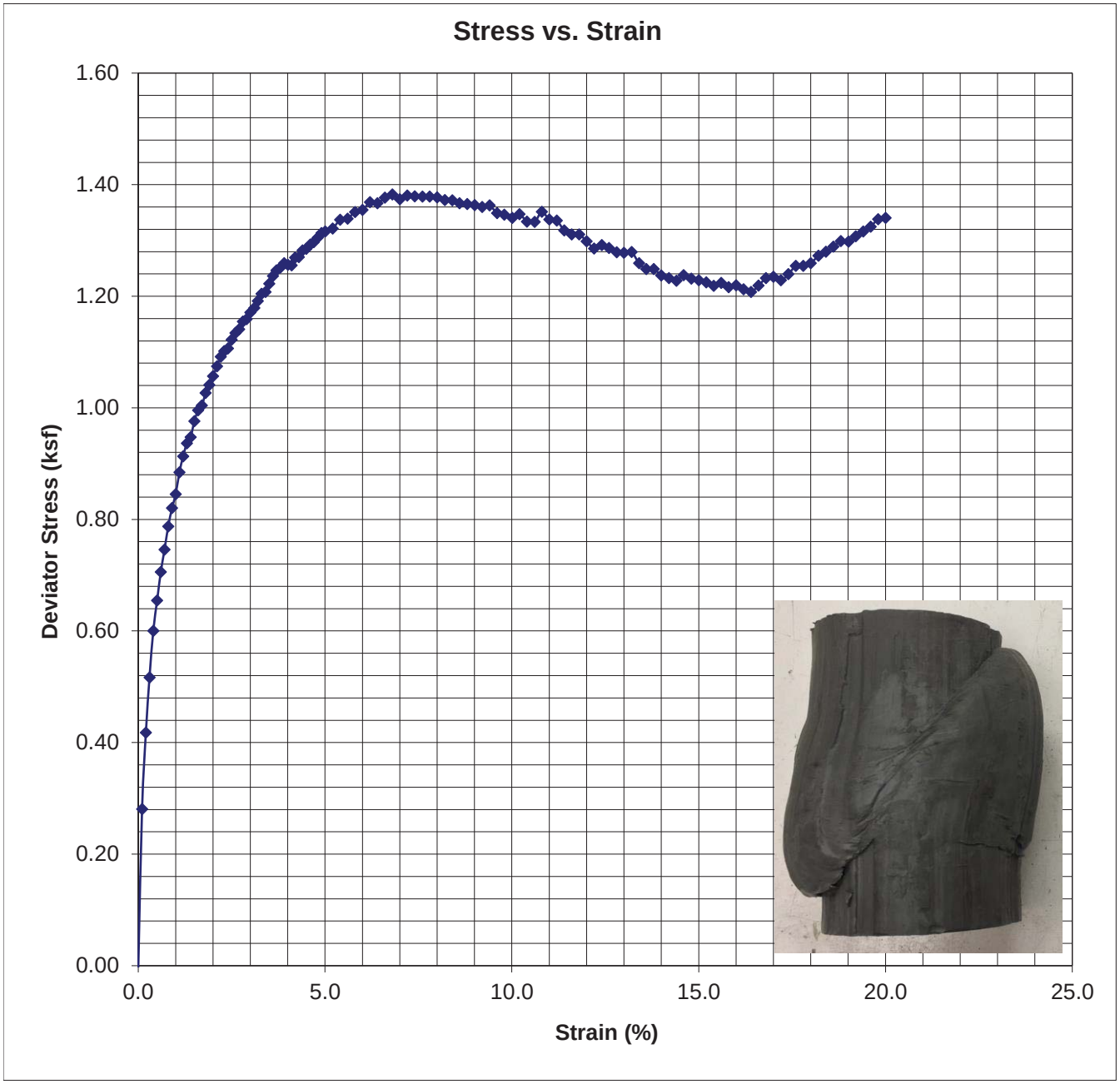
Figure No.: 6

HWA GEOSCIENCES INC. Materials Testing Laboratory

Unconsolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Client: Golder Associates, Inc. **Project Number:** 2012-095 T1200

Project Name: Redmond East Link Extension



Soil Classification:	Gray, lean CLAY (CL)		
Sample Point:	G019		
Sample Number:	ST-2 (UU-TX8)	Initial Moisture Content (%):	39.9
Sample Depth:	126.5-128.5 feet	Wet Unit Weight (pcf):	110.2
Confining Stress (ksf):	15.50	Dry Unit Weight (pcf):	78.8
Strain Rate (%\min):	1.00	Total Peak Stress (ksf):	1.382

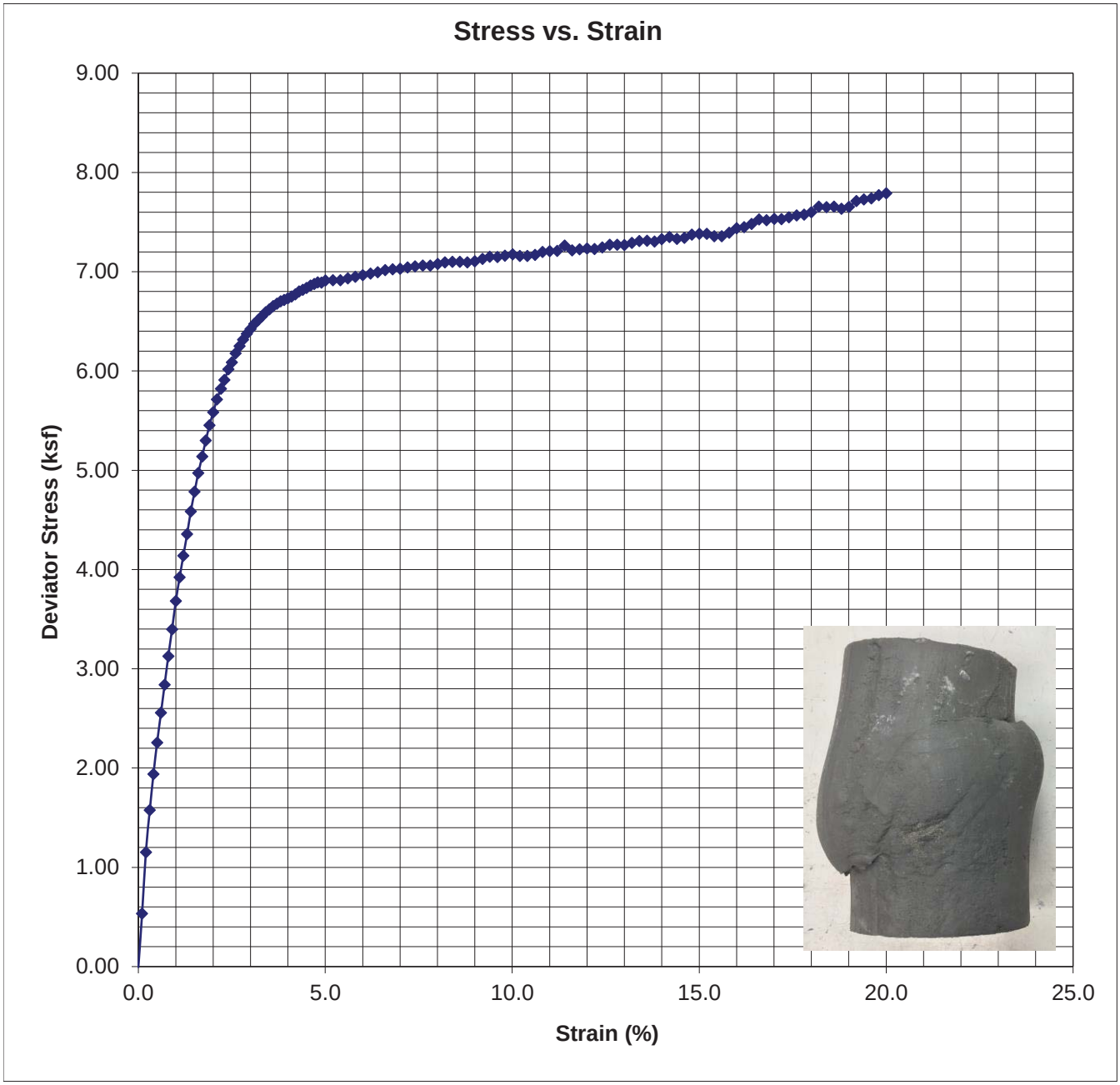
Figure No.: 7

HWA GEOSCIENCES INC. Materials Testing Laboratory

Unconsolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Client: Golder Associates, Inc. **Project Number:** 2012-095 T1200

Project Name: Redmond East Link Extension



Soil Classification:	Gray, fat CLAY (CH) with sand		
Sample Point:	G032		
Sample Number:	ST-37 (UU-TX9)	Initial Moisture Content (%):	28.7
Sample Depth:	165-167 feet	Wet Unit Weight (pcf):	125.8
Confining Stress (ksf):	20.00	Dry Unit Weight (pcf):	97.7
Strain Rate (%\min):	1.00	Total Peak Stress (ksf):	7.789

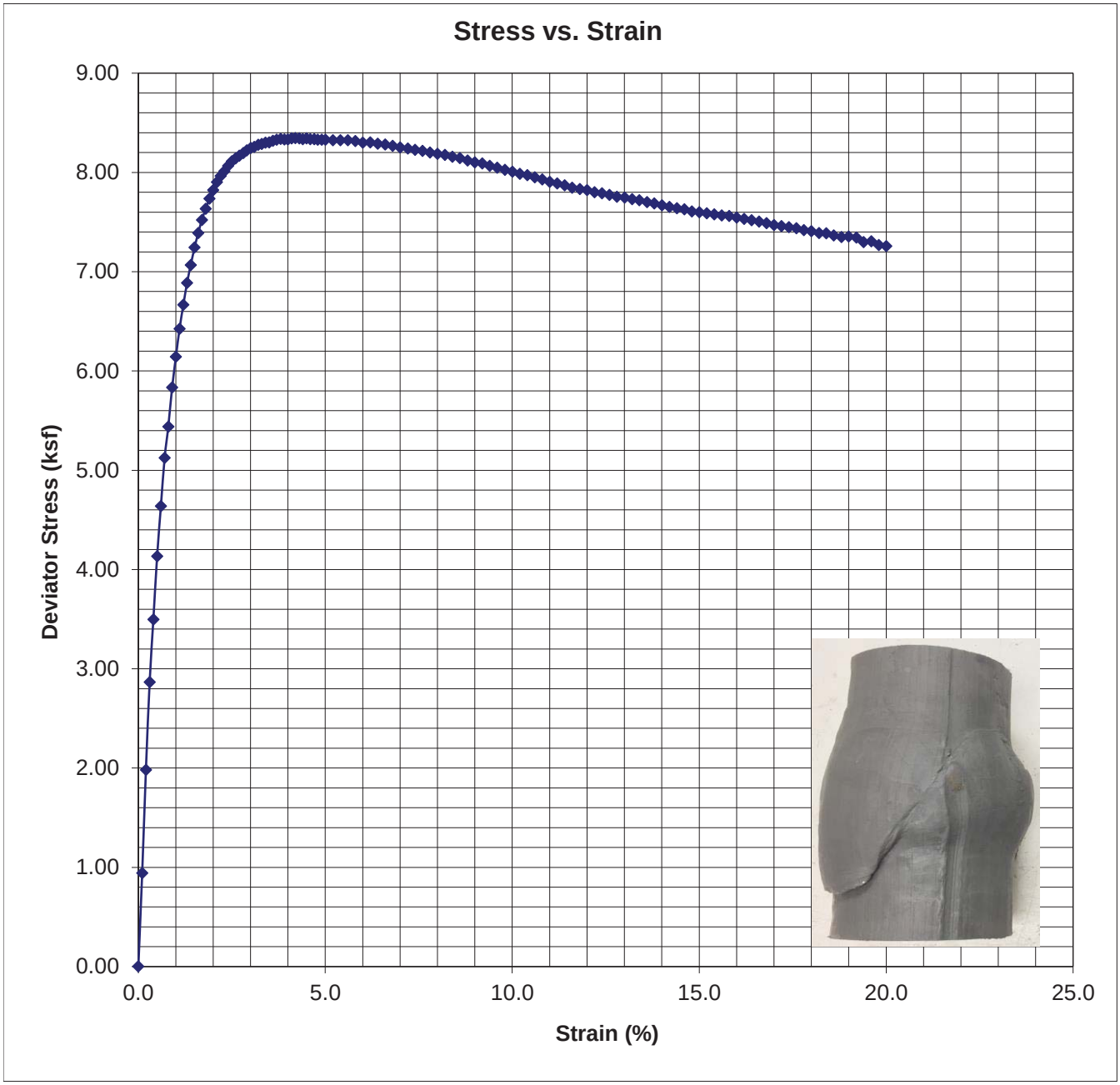
Figure No.: 8

HWA GEOSCIENCES INC. Materials Testing Laboratory

Unconsolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D2850)

Client: Golder Associates, Inc. **Project Number:** 2012-095 T1200

Project Name: Redmond East Link Extension



Soil Classification:	Gray, fat CLAY (CH)		
Sample Point:	G032		
Sample Number:	ST-37 (UU-TX10)	Initial Moisture Content (%):	29.1
Sample Depth:	165-167 feet	Wet Unit Weight (pcf):	117.4
Confining Stress (ksf):	20.00	Dry Unit Weight (pcf):	90.9
Strain Rate (%\min):	1.00	Total Peak Stress (ksf):	8.347

Figure No.: 9

APPENDIX I

LABORATORY TESTS – SOIL TESTING (GOLDER ASSOCIATES LTD)

GOLDER

Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33

General Remarks

~100mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 2

Vertical LVDT	Serial No.:	11897
Vertical Load Cell	Serial No.:	38408
Shear Load Cell	Serial No.:	158877

Sample Properties

Preparation Method	Trim from Undisturbed	Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.	
Height (mm)	23.50			
Diameter (mm)	70.80	Sand Fraction (%)	31.47	Liquid Limit 24
Area (cm^2)	39.37	Fines Fraction (%)	68.53	Plastic Limit 18
Volume (cm^3)	92.52	Shear Strength est. (kPa)		N/A
Specific Gravity (Measured)	2.70	Sensitivity		N/A

Weight Volume Relationships

Initial Wet Mass (g)	189.24	Initial Water Content (%)	24.18
Dry Mass (g)	152.39	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	20.07	Final Water Content (%)	20.87
Initial Dry Unit Weight (kN/m^3)	16.16	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	4.44
Max Applied Vertical Stress (kPa)	400.87	Axial Strain at end of Consol. %	4.44
Vertical Stress at end of Consol (kPa)	400.42	Change in Height ΔH_c (mm)	1.04
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.12
Cycles to 3.75% Shear Strain	3.75% not reached
Initial Vertical Stress (kPa)	400.24
Max Abs. Cyclic Shear Stress (kPa)	48.24
Max. Shear Strain at N= n/a (zero load)	3.75% not reached
Min. Shear Strain at N= n/a (zero load)	3.75% not reached
Max. DU at N= n/a (zero load)	3.75% not reached
Min. DU at N= n/a (zero load)	3.75% not reached

Post Cyclic Monotonic Test Results

Initial Vertical Stress (kPa)	265.23
Initial Shear Stress (kPa)	-1.17
Applied Shear Bias (kPa)	0.00
Rate of Shearing (%/hr)	5.00
Peak Shear Strength (kPa)	130.69
Excess Pore Pressure at Peak (kPa)	169.50
Ratio of Peak / $\sigma'v$	0.33
Maximum Shear Strain γ_{MAX} (%)	20.00
Shear Strength at γ_{MAX} (kPa)	127.26

Comments / Special Instructions

Comments / Special Instructions

The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

G. Patton	February 27, 2018	M. Sanin	March 9, 2018
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd.
300, 3811 North Fraser Way, Burnaby, British Columbia, Canada V5J 5J2
Tel: 604-412-6899 Fax: 604-412-6816 www.golder.com

GOLDER

Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

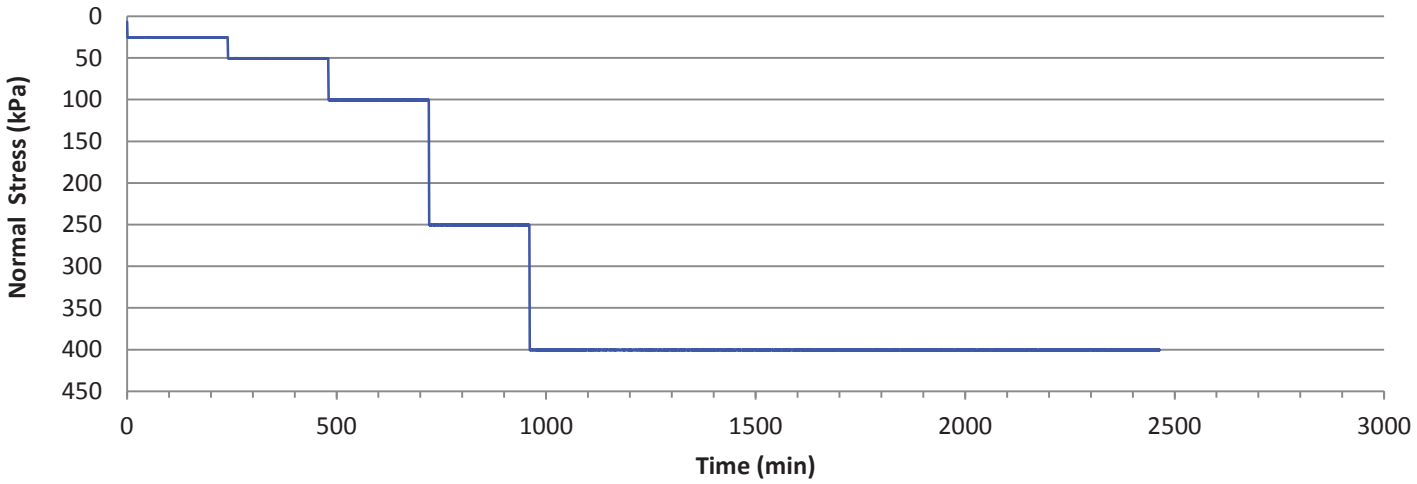
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33

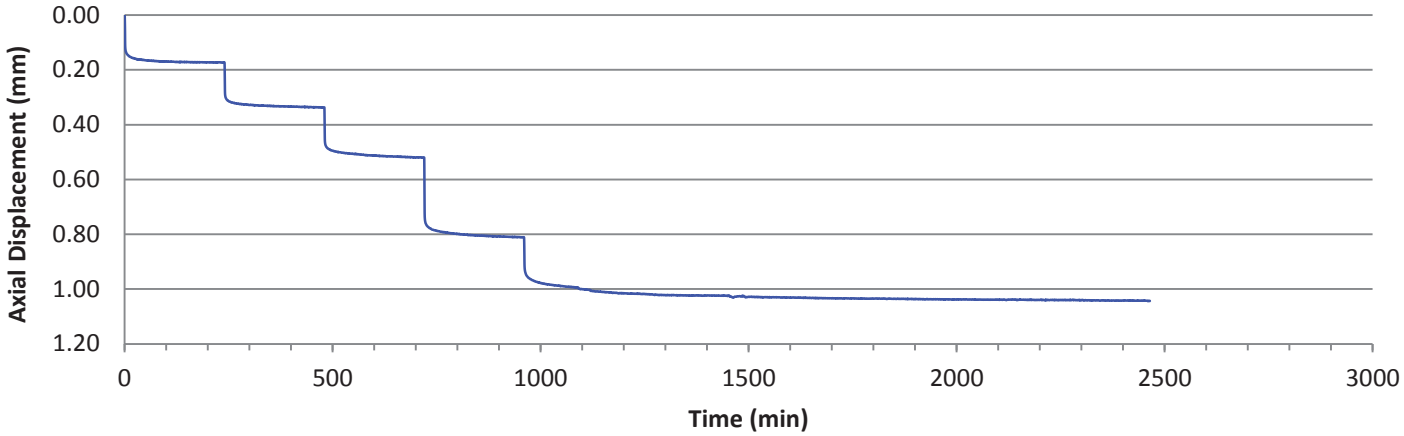
Consolidation Summary

Stress at end of Consolidation (kPa)	400.42
Axial Strain at end of Consolidation (%)	4.44
OCR	N/A
Change in Height ΔH_c (mm)	1.04

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	400		
Load (kN)	0.101	0.1999	0.3969	0.9874	1.5782		
Duration (min)	240	240	240	240	1504		
Axial Strain (%)	0.74	1.43	2.21	3.45	4.44		





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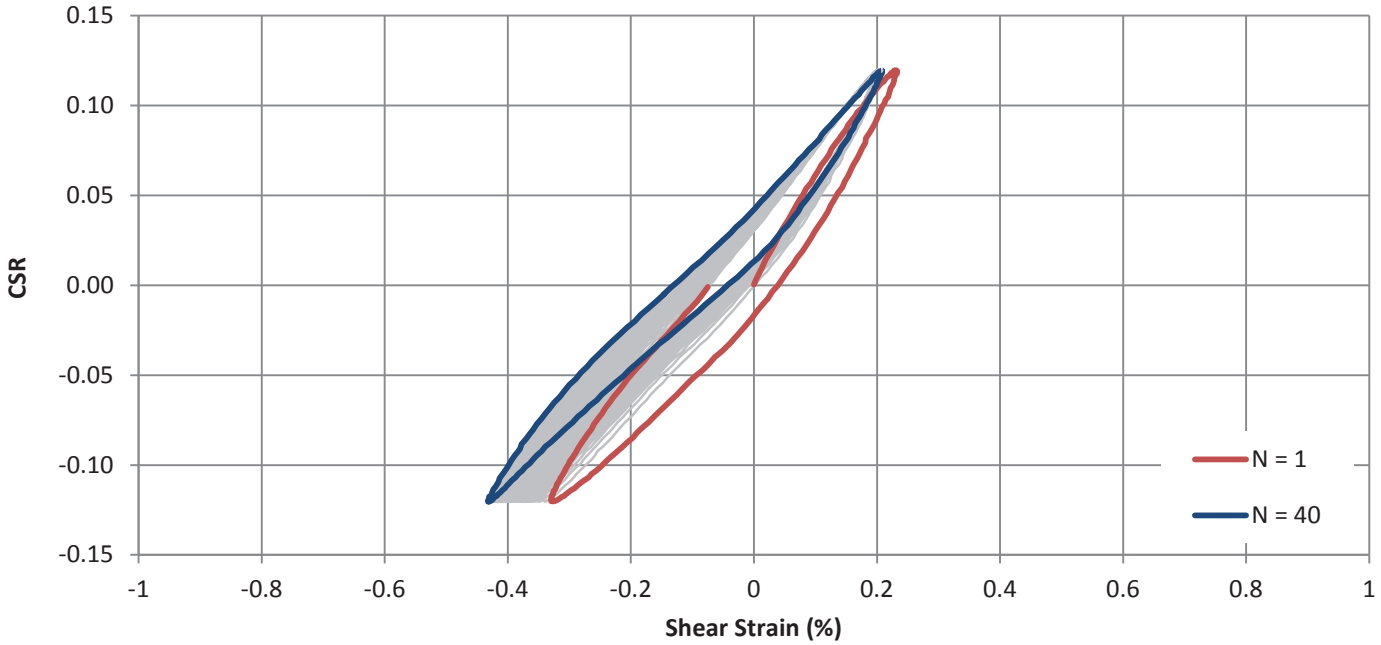
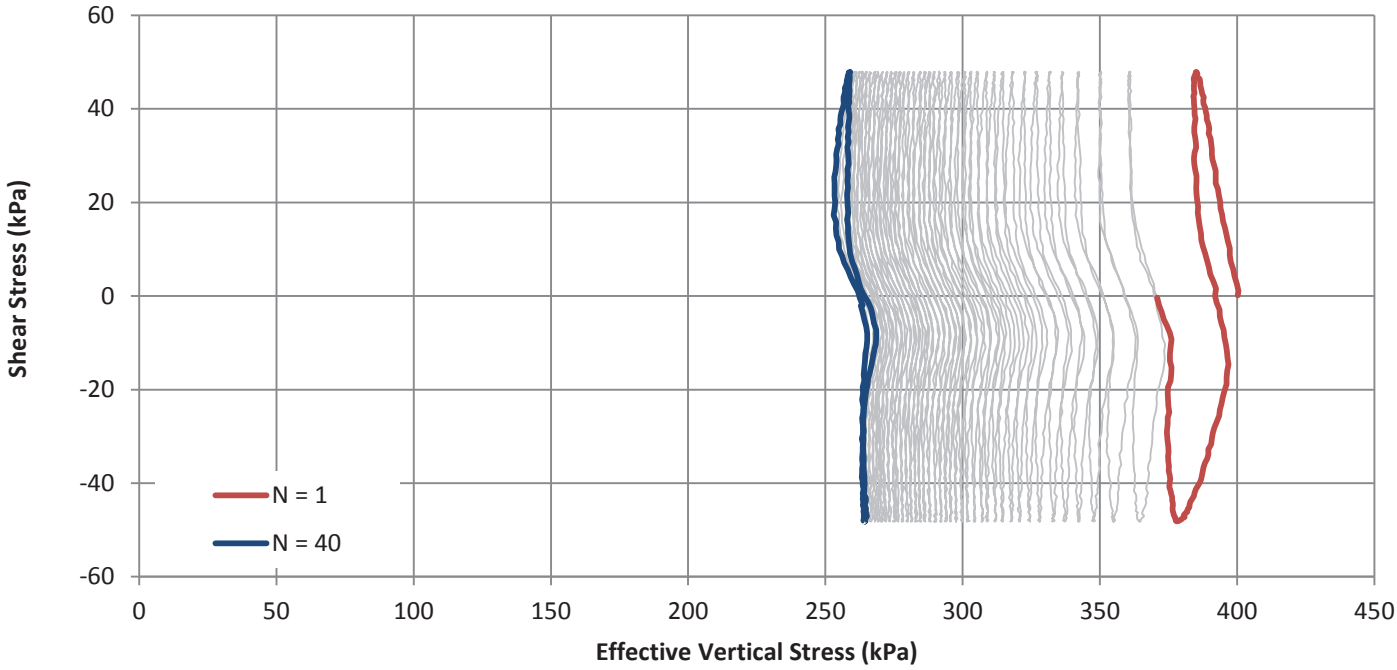
Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33





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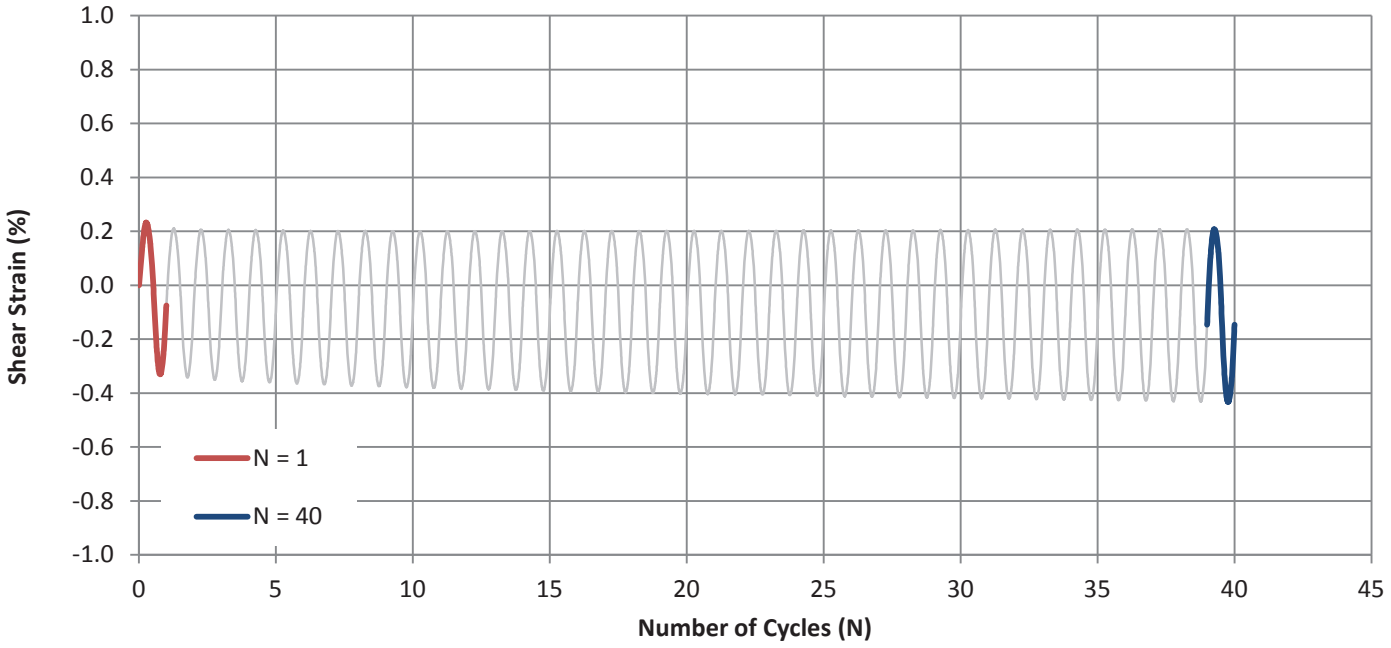
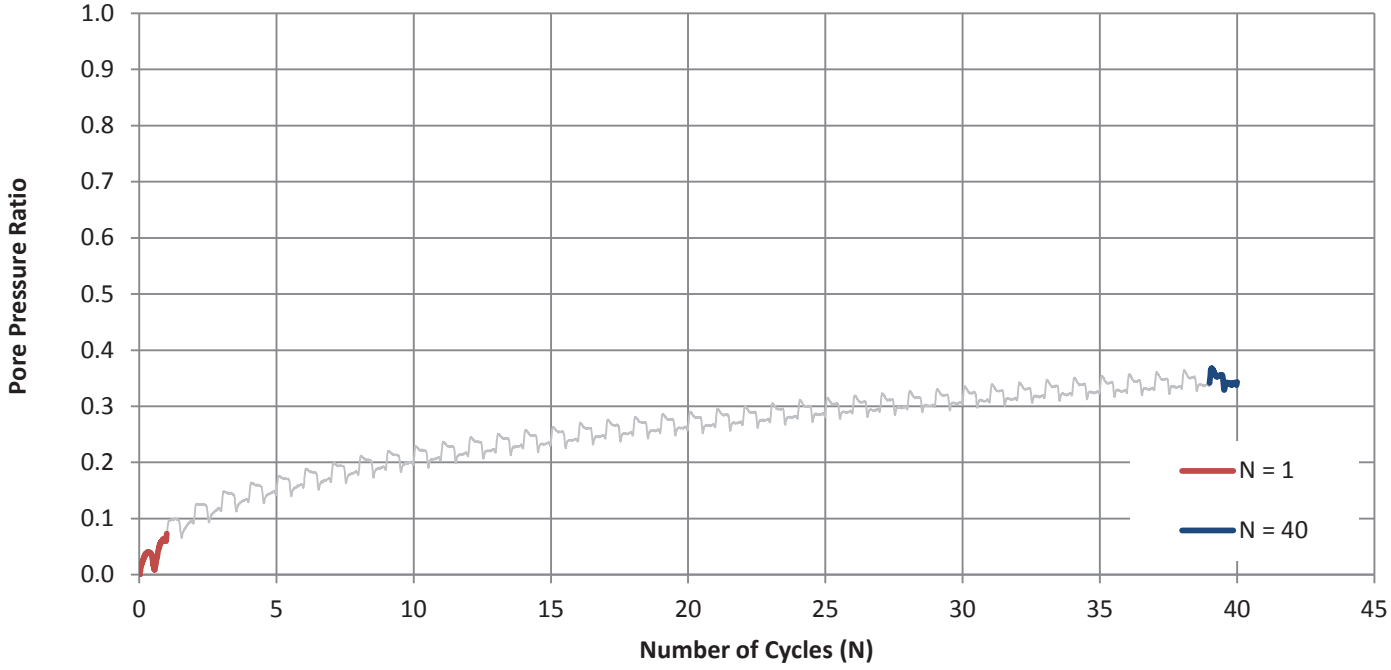
GOLDER

Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33





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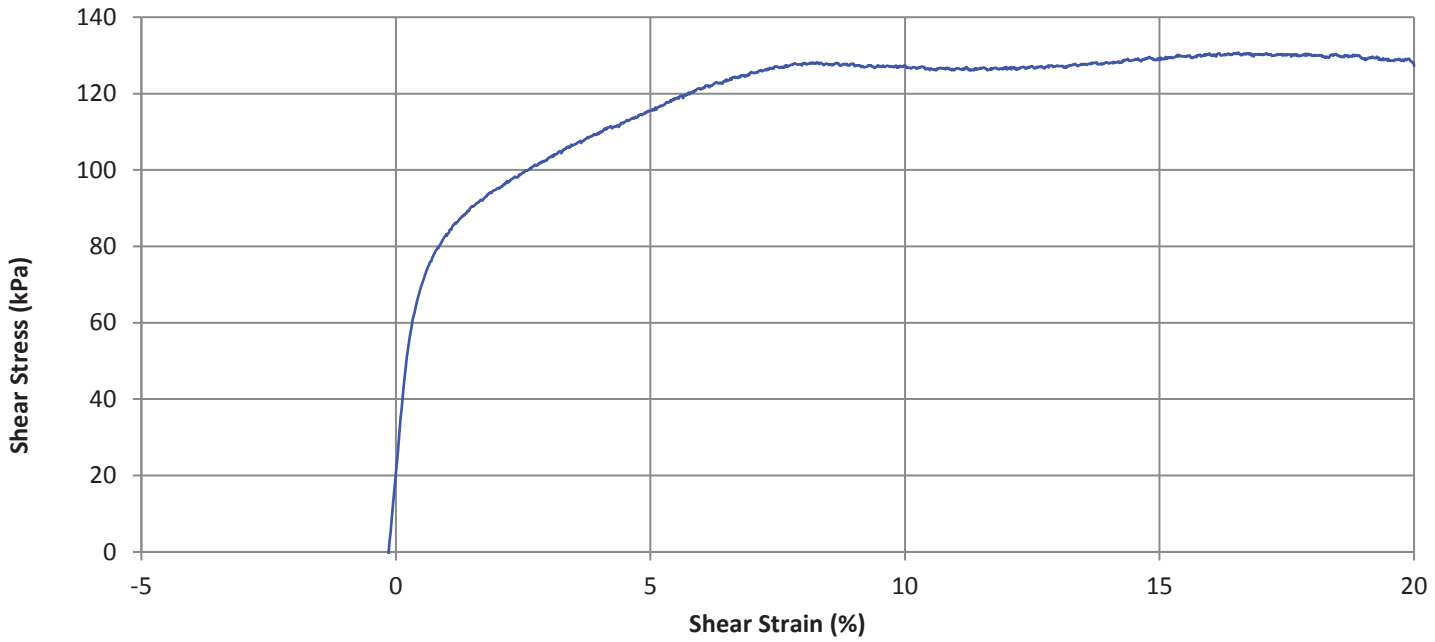
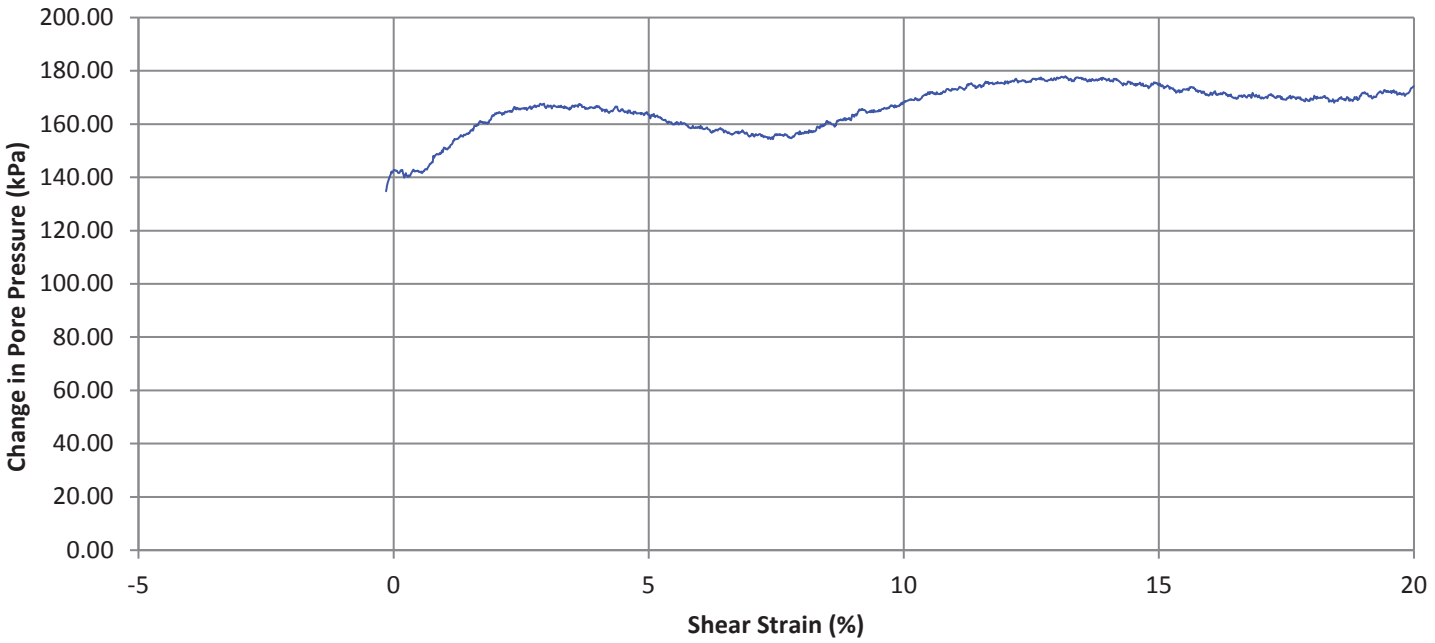
GOLDER

Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33





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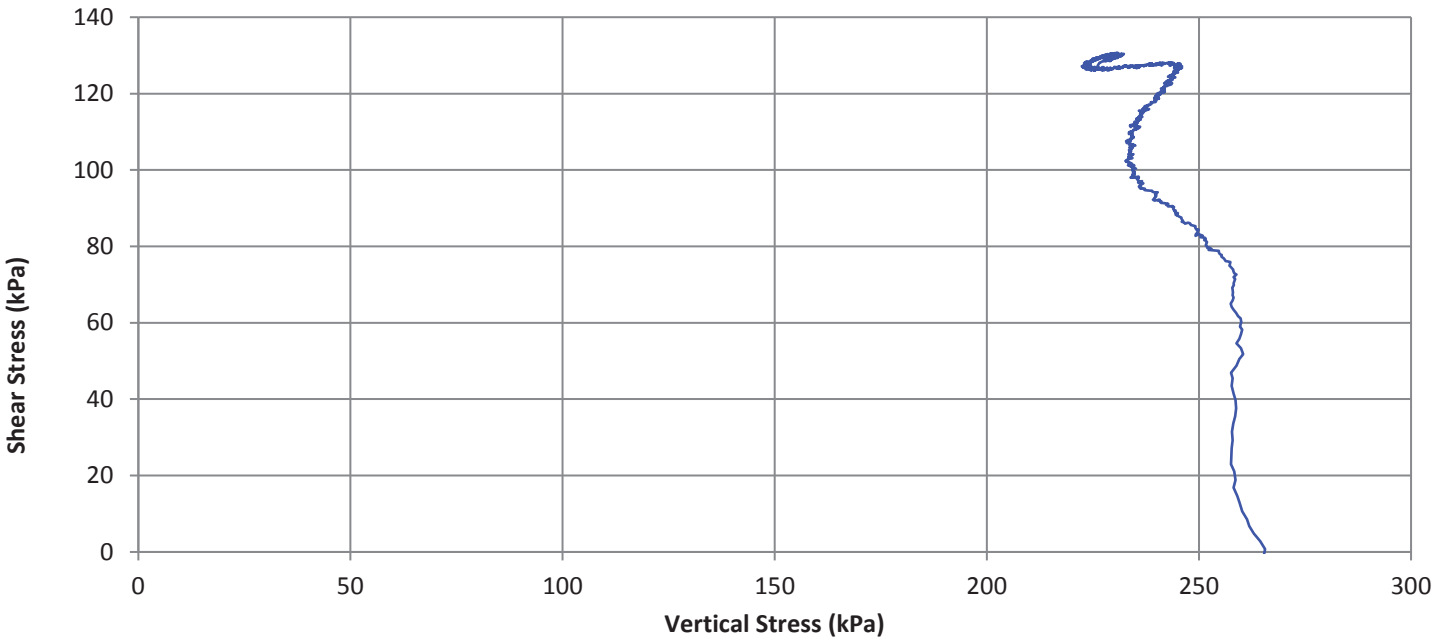
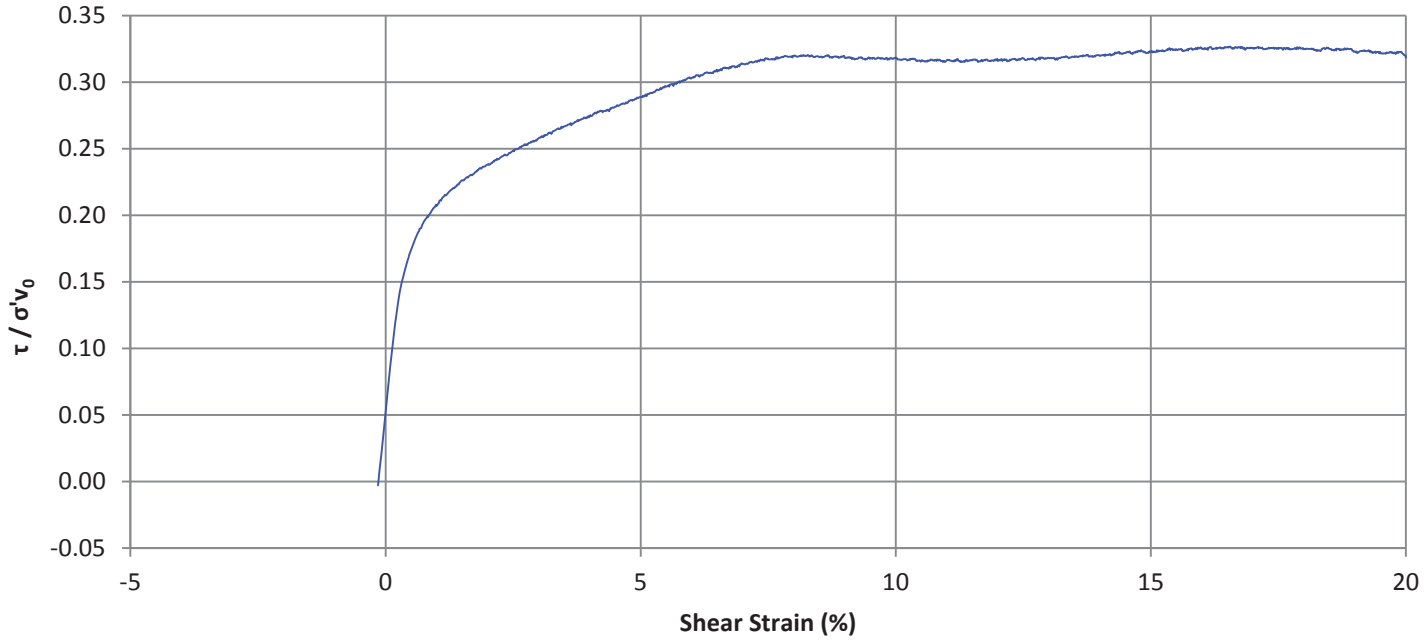
GOLDER

Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33





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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33

The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

G. Patton	February 27, 2018	M. Sanin	March 9, 2018
TESTED BY	DATE	CHECKED BY	DATE

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GOLDER

Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 100mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 2

Vertical LVDT	Serial No.:	11897
Vertical Load Cell	Serial No.:	38408
Shear Load Cell	Serial No.:	158877

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.37
Diameter (mm)	70.91
Area (cm^2)	39.49
Volume (cm^3)	92.29
Specific Gravity (Measured)	2.70

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	31.47	Liquid Limit	24
Fines Fraction (%)	68.53	Plastic Limit	18
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	189.76	Initial Water Content (%)	23.96
Dry Mass (g)	153.08	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	20.17	Final Water Content (%)	20.94
Initial Dry Unit Weight (kN/m^3)	16.27	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	3.65
Max Applied Vertical Stress (kPa)	400.84	Axial Strain at end of Consol. %	3.65
Vertical Stress at end of Consol (kPa)	400.44	Change in Height ΔH_c (mm)	0.85
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.16
Cycles to 3.75% Shear Strain	18
Initial Vertical Stress (kPa)	400.57
Max Abs. Cyclic Shear Stress (kPa)	64.14
Max. Shear Strain at N=18 (zero load)	3.04
Min. Shear Strain at N=18 (zero load)	-2.40
Max. DU at N=18 (zero load)	360.74
Min. DU at N=18 (zero load)	358.70

Post Cyclic Reconsolidation Test Results [1]

Initial Vertical Stress (kPa)	14.21
Max. Applied Vertical Stress (kPa)	400.34
Initial Shear Stress (kPa)	-5.47
Height at beginning of Reconsol (mm)	22.51
Change in Height ΔH_c (mm)	0.46
Axial Strain at end of Reconsol. %	2.06

[1] *Reconsolidation data calculated from the sample height at end of initial consolidation*

Comments / Special Instructions

Comments / Special Instructions

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G. Patton	March 6, 2018	M. Sanin	March 9, 2018
TESTED BY	DATE	CHECKED BY	DATE

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GOLDER

Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

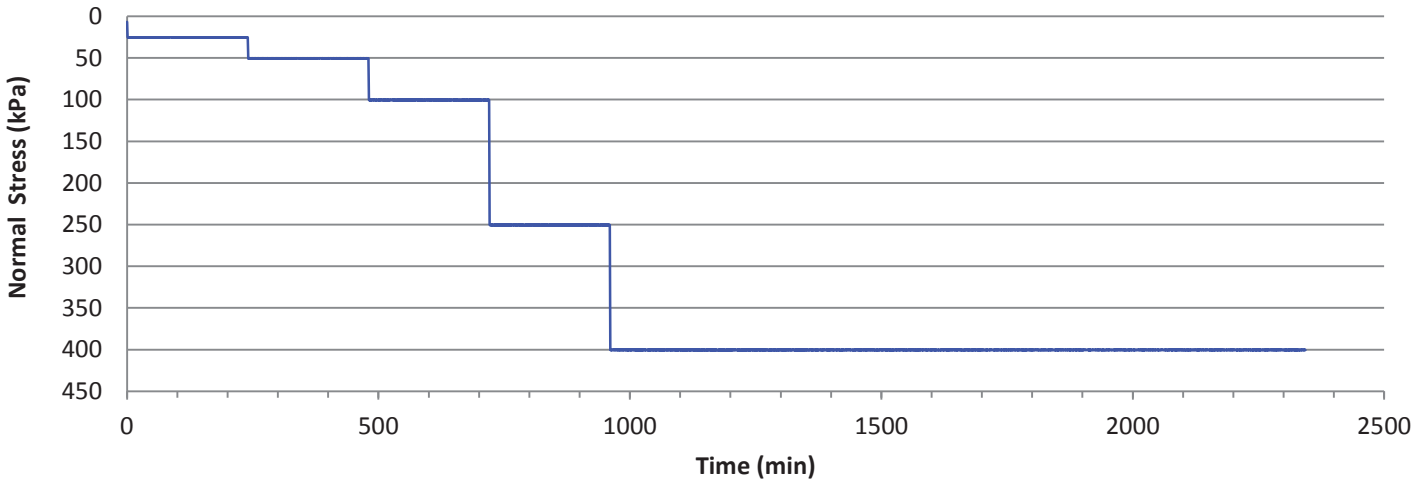
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33

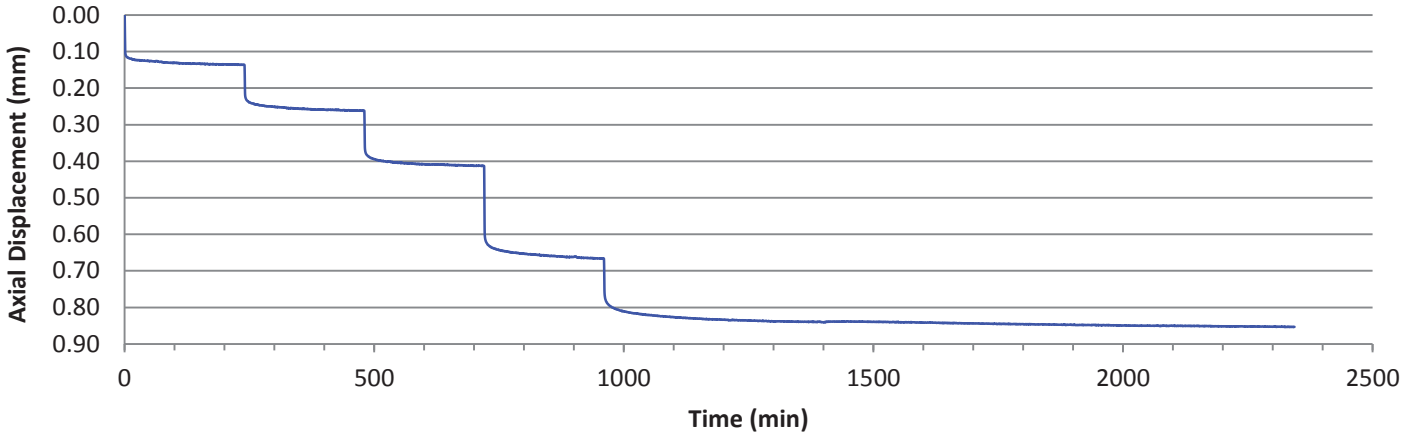
Consolidation Summary

Stress at end of Consolidation (kPa)	400.44
Axial Strain at end of Consolidation (%)	3.65
OCR	N/A
Change in Height ΔH_c (mm)	0.85

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	400		
Load (kN)	0.1012	0.2002	0.3985	0.9911	1.583		
Duration (min)	240	240	240	240	1383		
Axial Strain (%)	0.58	1.12	1.77	2.85	3.65		





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NORSOK G-001

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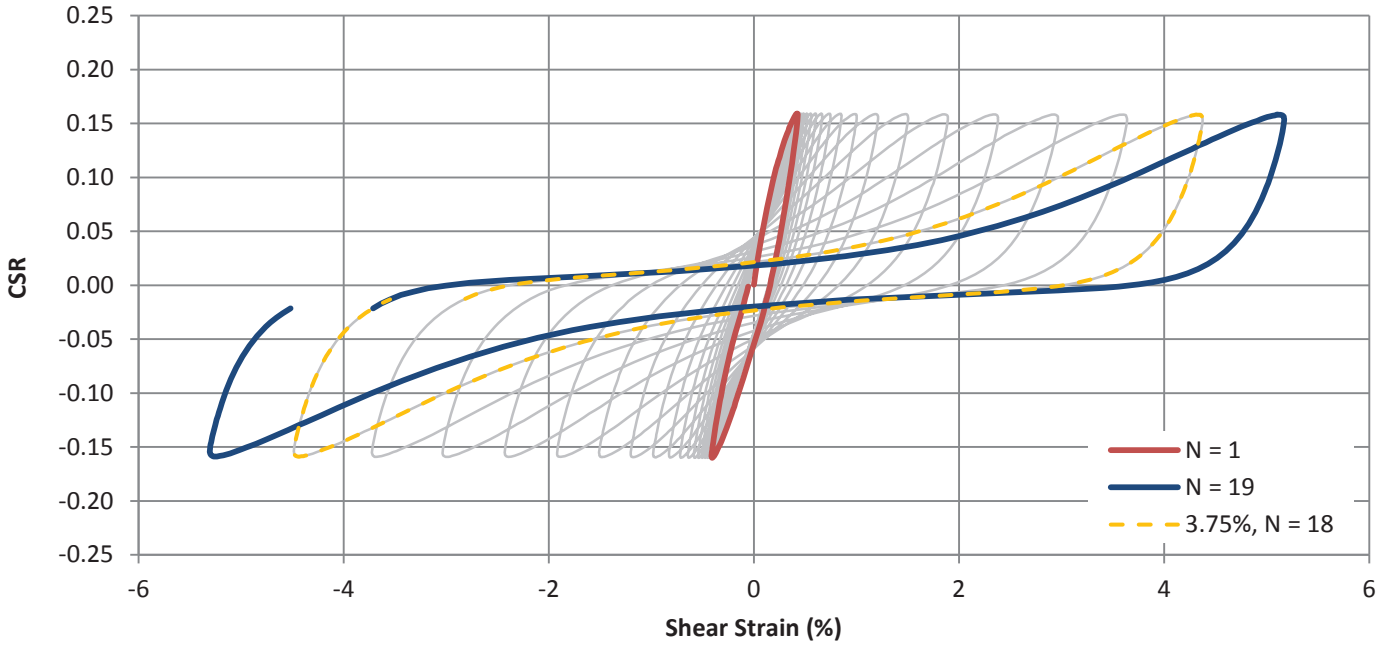
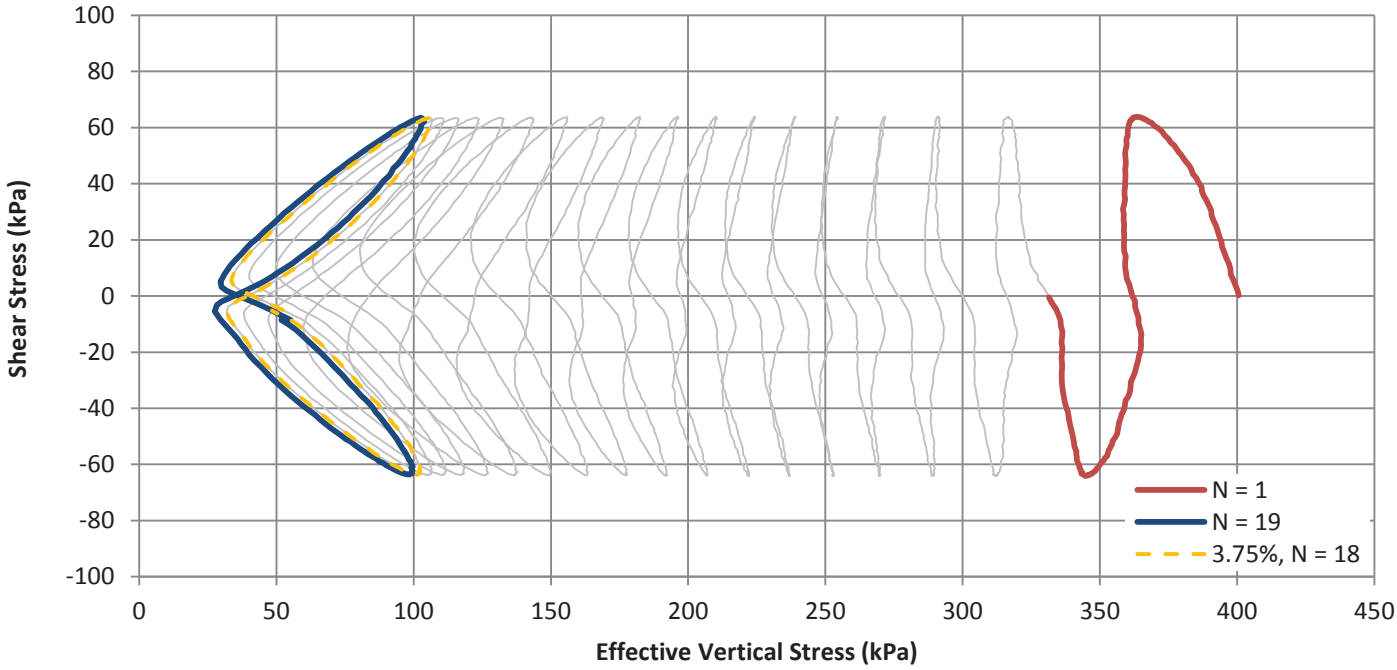
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33





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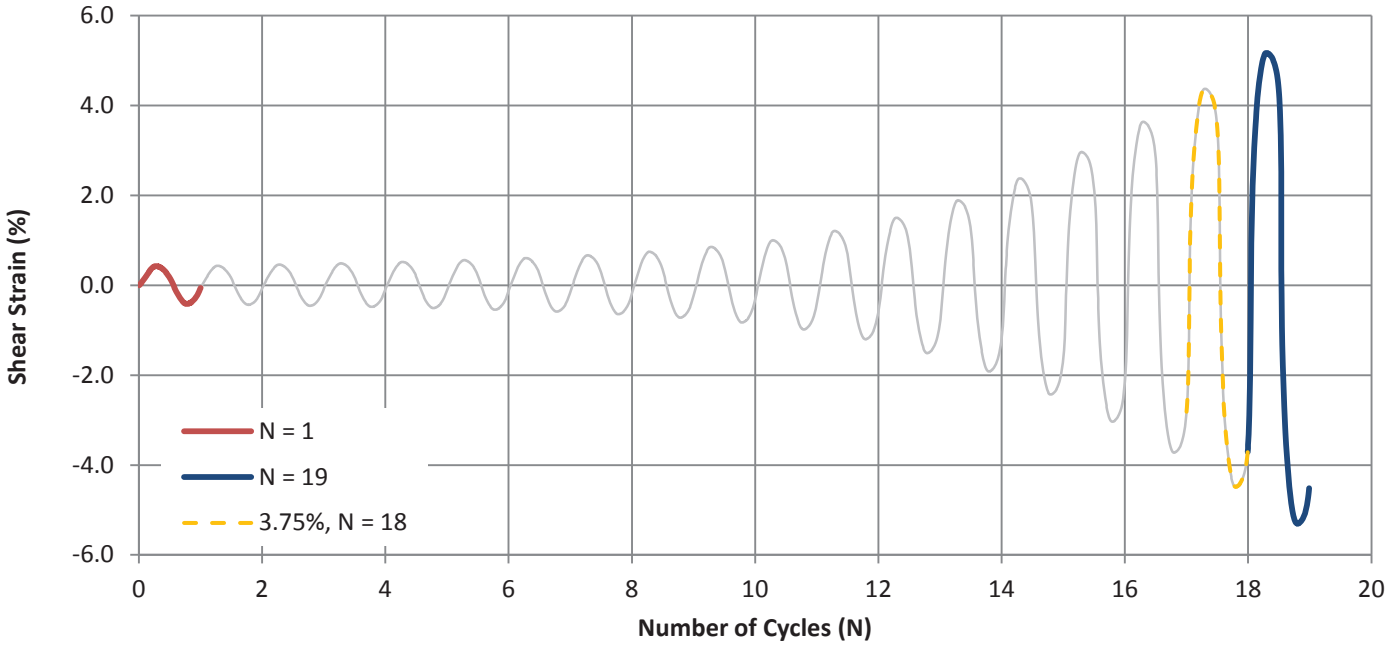
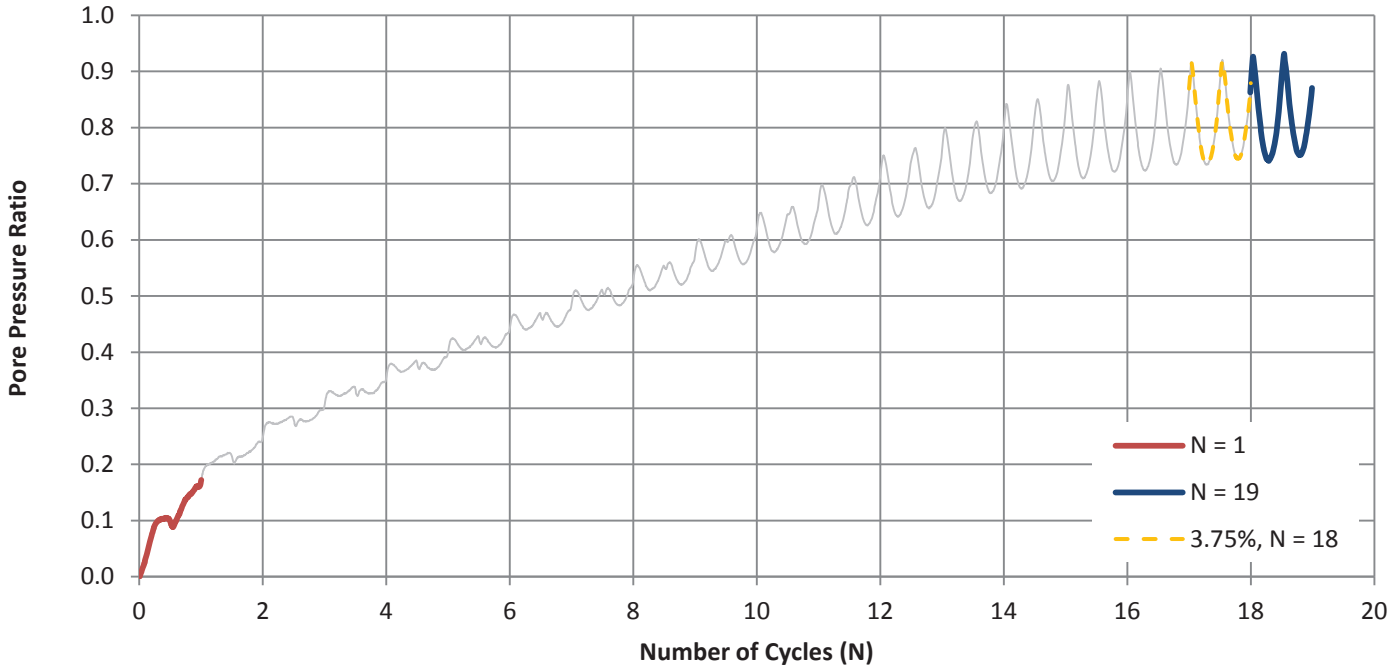
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33





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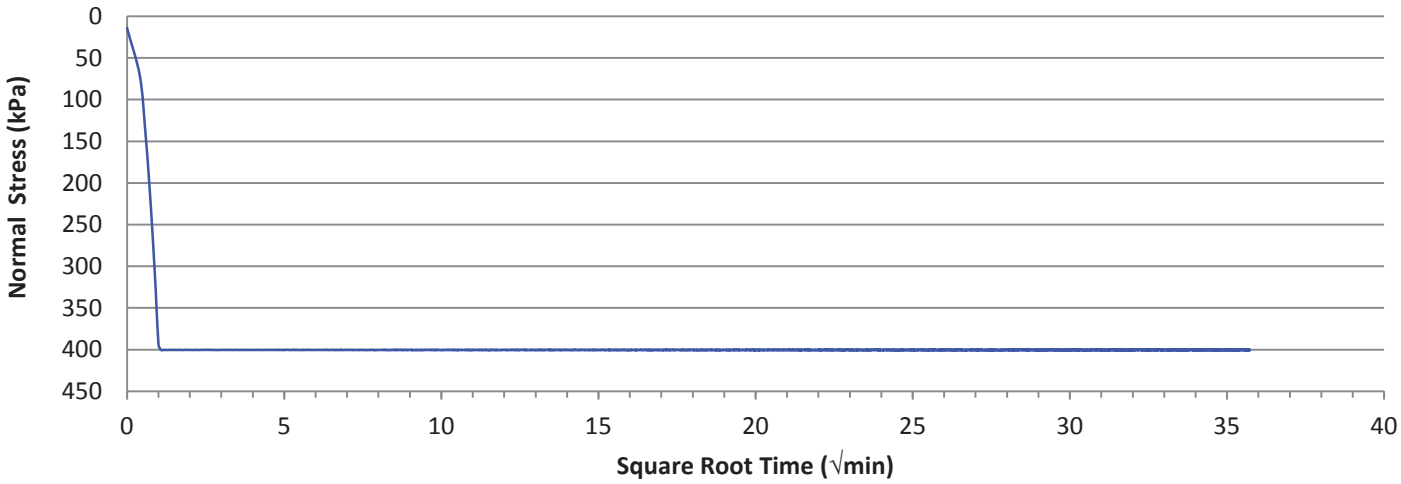
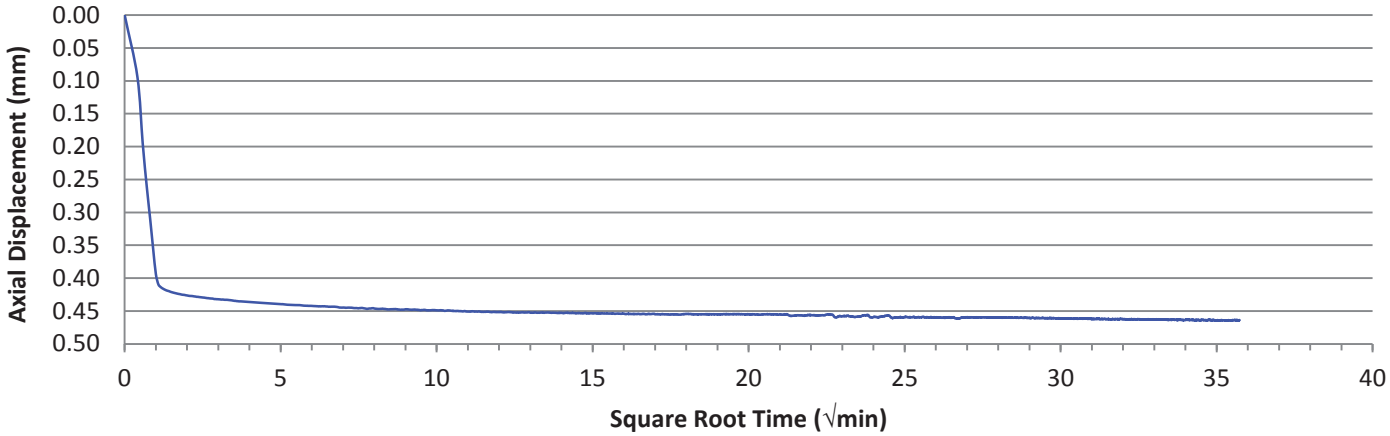
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Ext	**Test ID:**	400kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33

Stress at Start of Reconsolidation (kPa)	14.21
Stress at end of Reconsolidation (kPa)	400.34
Axial Strain at end of Reconsolidation (%)	2.06
Change in Height ΔH_c (mm)	0.46

Comments
Reconsolidation data calculated from the sample height at end of initial consolidation

Increment (kPa)	400						
Load (kN)	1.583						
Duration (min)	1277						
Axial Strain (%)	2.06						





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Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33

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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.18CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 300mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 2

Vertical LVDT	Serial No.:	11897
Vertical Load Cell	Serial No.:	38408
Shear Load Cell	Serial No.:	158877

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.52
Diameter (mm)	70.72
Area (cm^2)	39.28
Volume (cm^3)	92.39
Specific Gravity (Measured)	2.70

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	31.47	Liquid Limit	24
Fines Fraction (%)	68.53	Plastic Limit	18
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	190.29	Initial Water Content (%)	23.81
Dry Mass (g)	153.69	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	20.21	Final Water Content (%)	20.74
Initial Dry Unit Weight (kN/m^3)	16.32	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	3.71
Max Applied Vertical Stress (kPa)	400.51	Axial Strain at end of Consol. %	3.71
Vertical Stress at end of Consol (kPa)	400.10	Change in Height ΔH_c (mm)	0.87
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.18
Cycles to 3.75% Shear Strain	11
Initial Vertical Stress (kPa)	400.05
Max Abs. Cyclic Shear Stress (kPa)	72.22
Max. Shear Strain at N=11 (zero load)	2.15
Min. Shear Strain at N=11 (zero load)	-1.96
Max. DU at N=11 (zero load)	337.88
Min. DU at N=11 (zero load)	335.64

Post Cyclic Reconsolidation Test Results [1]

Initial Vertical Stress (kPa)	
Max. Applied Vertical Stress (kPa)	
Initial Shear Stress (kPa)	
Height at beginning of Reconsol (mm)	
Change in Height ΔH_c (mm)	
Axial Strain at end of Reconsol. %	

[1] *Reconsolidation data calculated from the sample height at end of initial consolidation*

Comments / Special Instructions

Comments / Special Instructions

Stage control error; no post cyclic data availiable.

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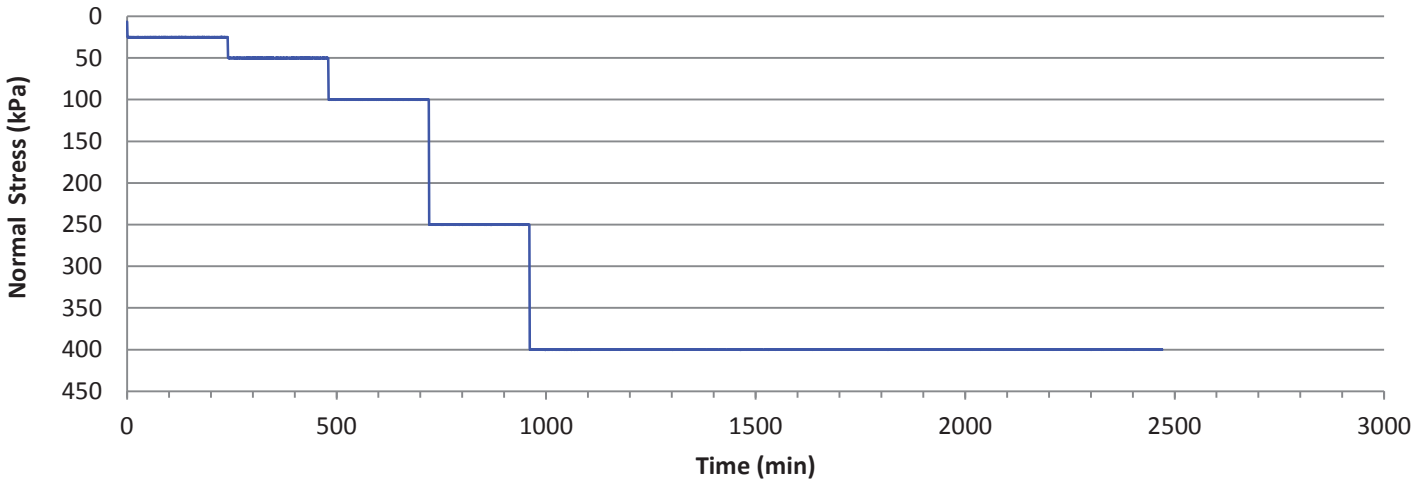
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G018 ST-2
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.18CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33

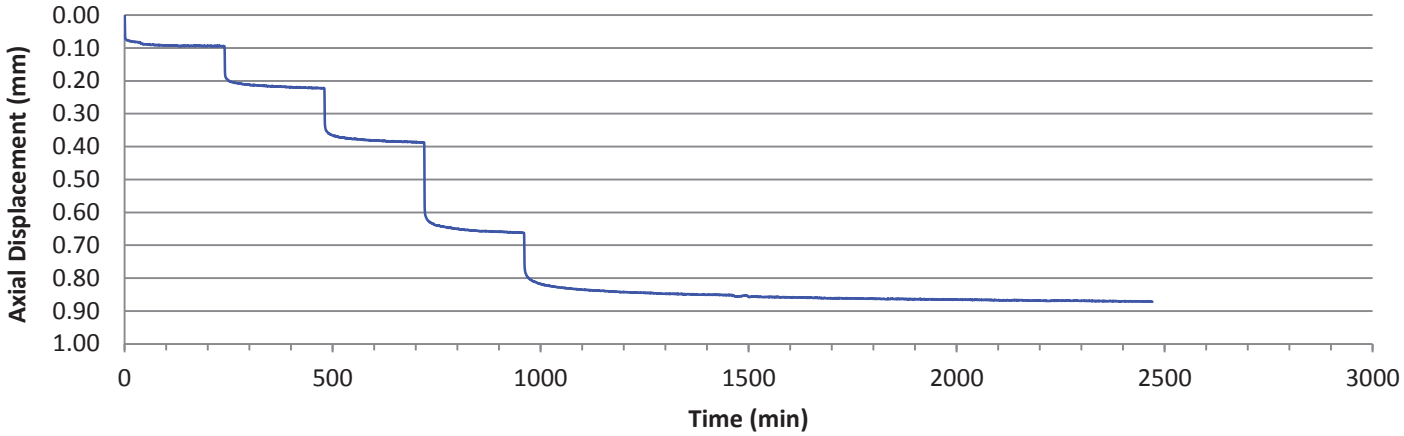
Consolidation Summary

Stress at end of Consolidation (kPa)	400.10
Axial Strain at end of Consolidation (%)	3.71
OCR	N/A
Change in Height ΔH_c (mm)	0.87

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	400		
Load (kN)	0.0996	0.1976	0.3941	0.9836	1.5732		
Duration (min)	240	240	240	240	1510		
Axial Strain (%)	0.40	0.95	1.65	2.82	3.71		





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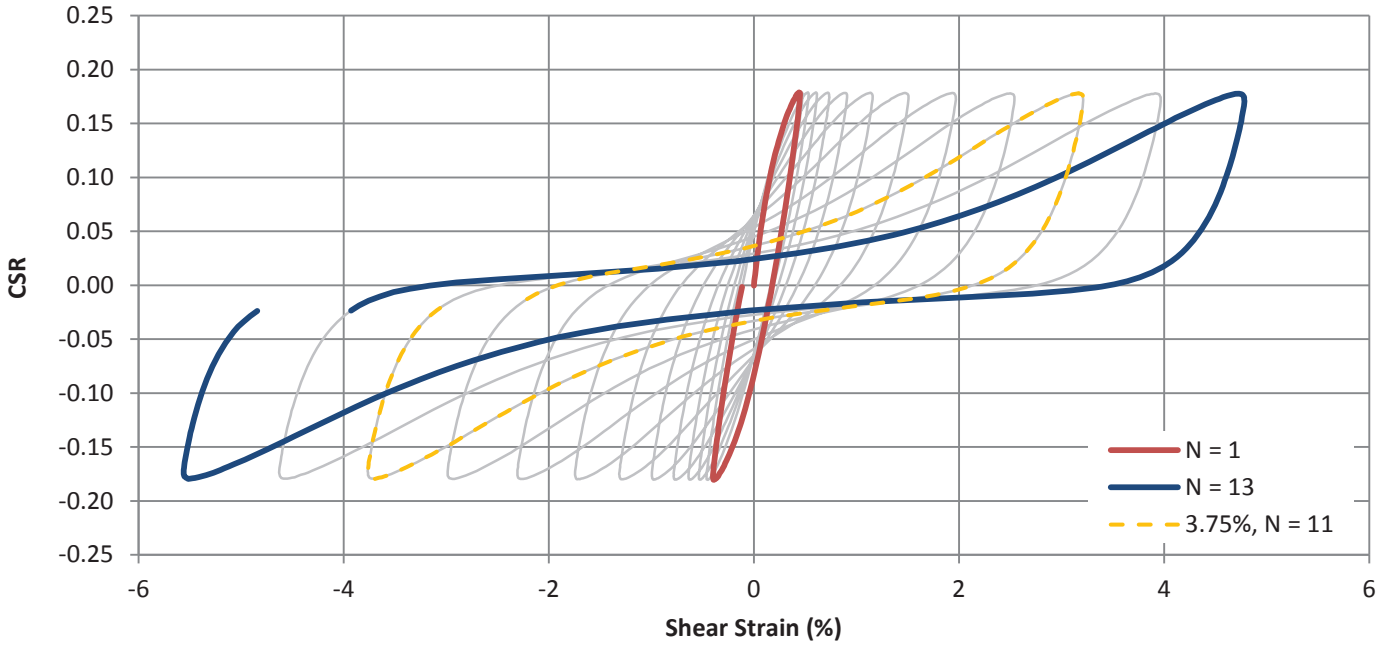
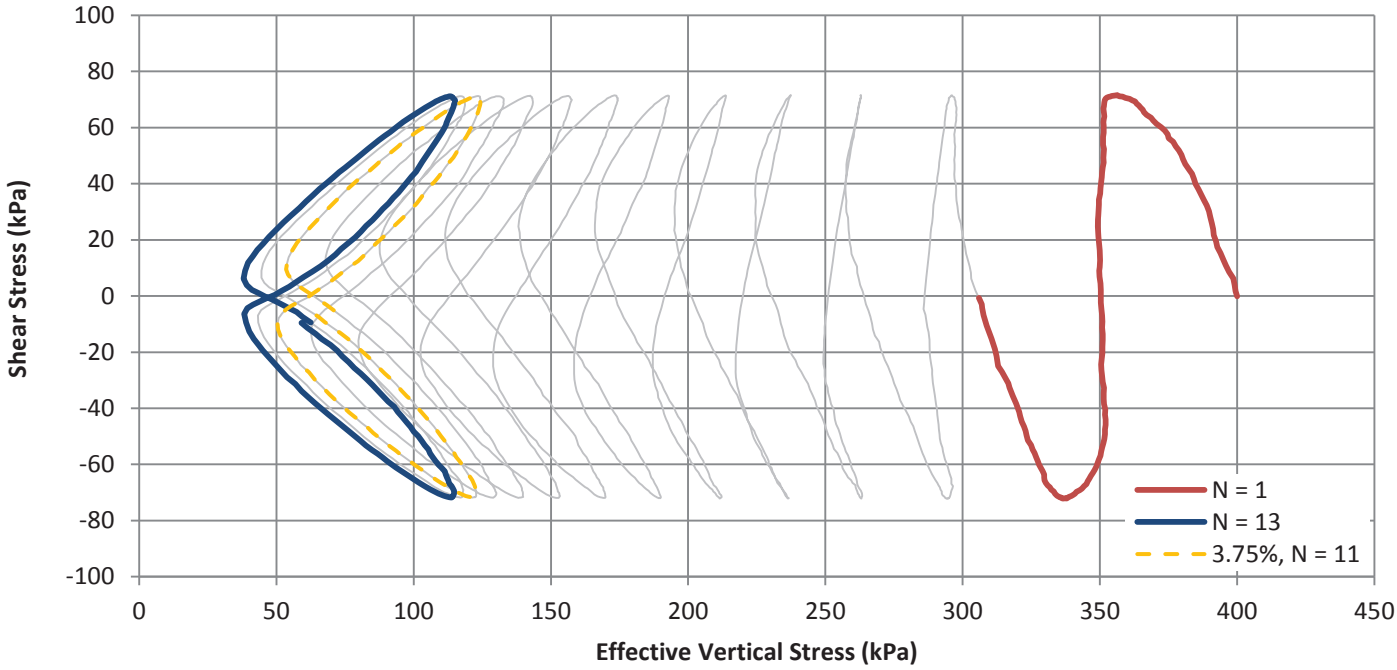
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.18CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33





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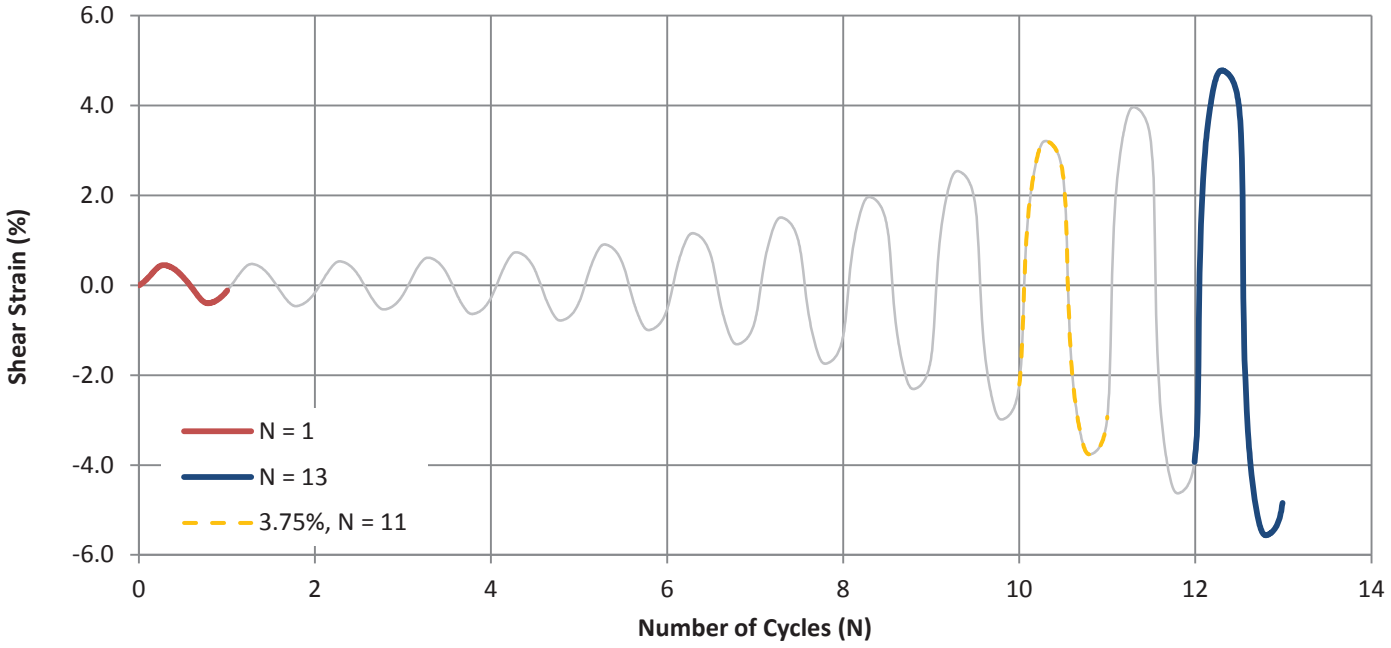
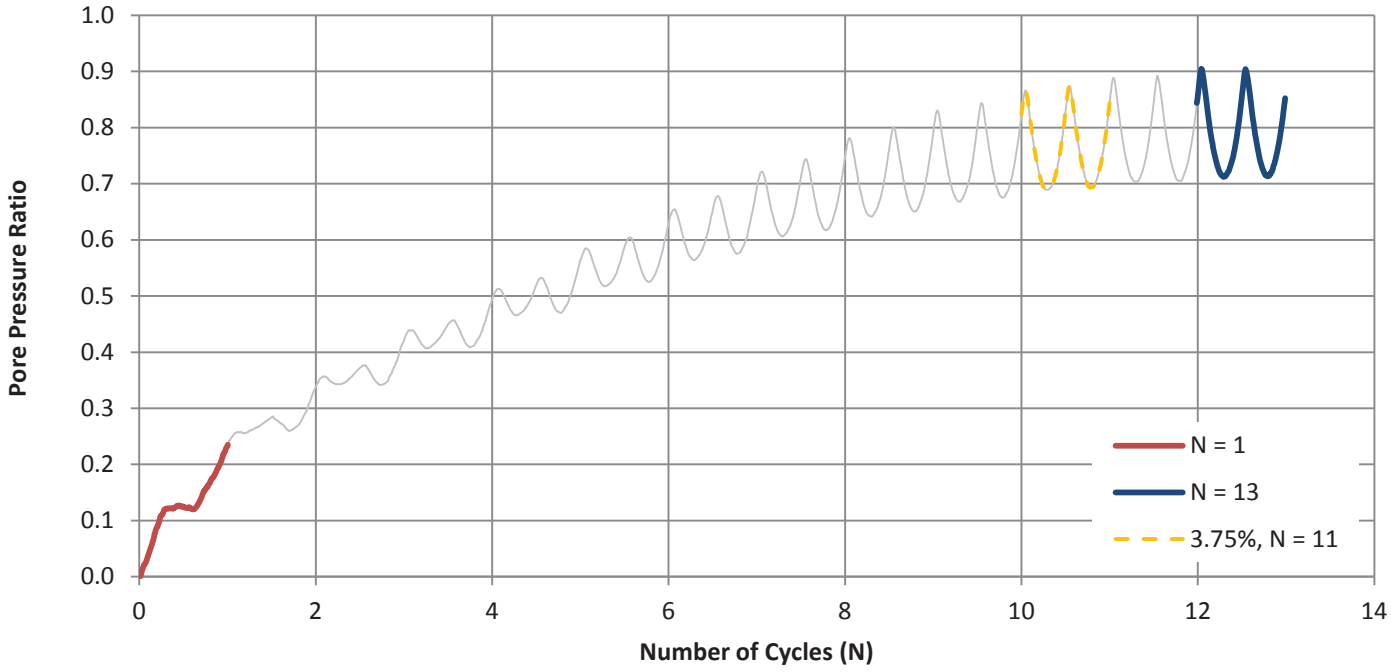
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33





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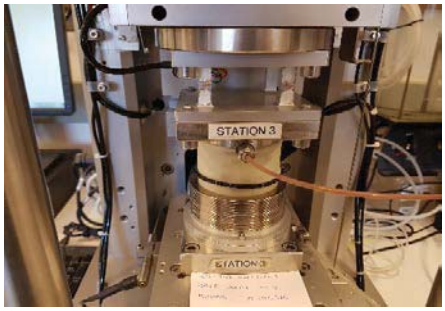
Project:	Sound Transit Redmond Link Extension	**Test ID:**	400kPa, 0.18CSR
Location:	Redmond, WA	**Depth (m):**	34.59-34.63
Client:	GAI	**Lab ID No:**	33



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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.10CSR
Location:	Redmond, WA	**Depth (m):**	35.80-35.84
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 100mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 3

Vertical LVDT	Serial No.:	11894
Vertical Load Cell	Serial No.:	38407
Shear Load Cell	Serial No.:	158879

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.63
Diameter (mm)	70.82
Area (cm^2)	39.39
Volume (cm^3)	93.08
Specific Gravity (Measured)	2.69

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	26.9	Liquid Limit	24
Fines Fraction (%)	73.1	Plastic Limit	16
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	190.56	Initial Water Content (%)	22.97
Dry Mass (g)	154.96	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	20.08	Final Water Content (%)	21.08
Initial Dry Unit Weight (kN/m^3)	16.33	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	2.65
Max Applied Vertical Stress (kPa)	380.29	Axial Strain at end of Consol. %	2.65
Vertical Stress at end of Consol (kPa)	379.98	Change in Height ΔH_c (mm)	0.63
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.10
Cycles to 3.75% Shear Strain	3.75% not reached
Initial Vertical Stress (kPa)	379.17
Max Abs. Cyclic Shear Stress (kPa)	38.46
Max. Shear Strain at N= n/a (zero load)	3.75% not reached
Min. Shear Strain at N= n/a (zero load)	3.75% not reached
Max. DU at N= n/a (zero load)	3.75% not reached
Min. DU at N= n/a (zero load)	3.75% not reached

Post Cyclic Reconsolidation Test Results [1]

Initial Vertical Stress (kPa)	252.39
Max. Applied Vertical Stress (kPa)	380.03
Initial Shear Stress (kPa)	-17.11
Height at beginning of Reconsol (mm)	23.00
Change in Height ΔH_c (mm)	0.05
Axial Strain at end of Reconsol. %	0.20

[1] *Reconsolidation data calculated from the sample height at end of initial consolidation*

Comments / Special Instructions

Comments / Special Instructions

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NORSOK G-001

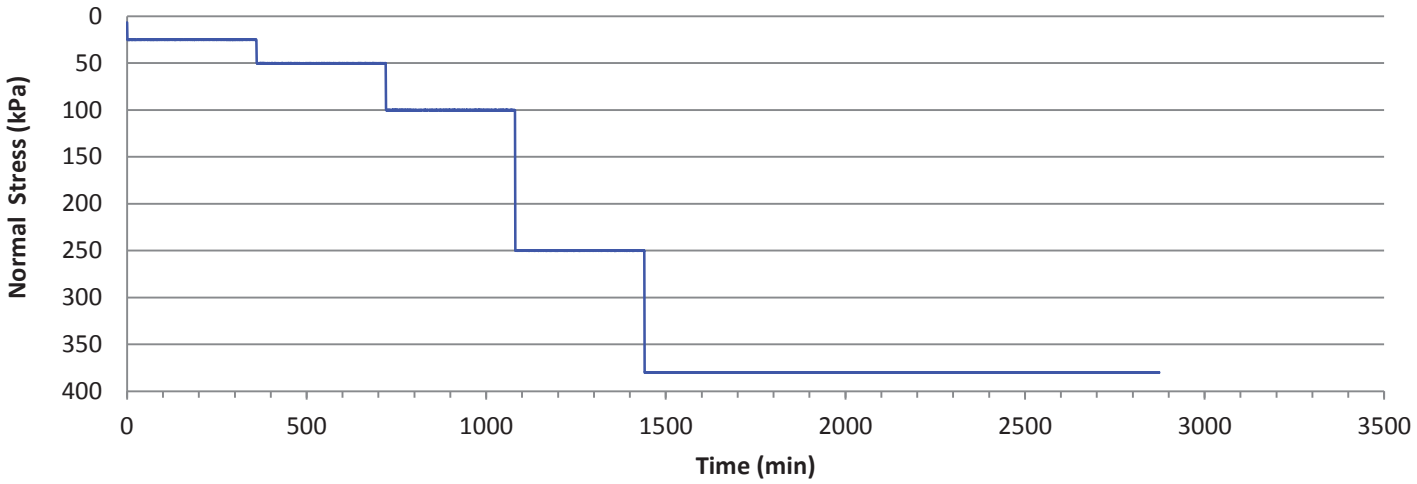
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.10CSR
Location:	Redmond, WA	**Depth (m):**	35.80-35.84
Client:	GAI	**Lab ID No:**	33

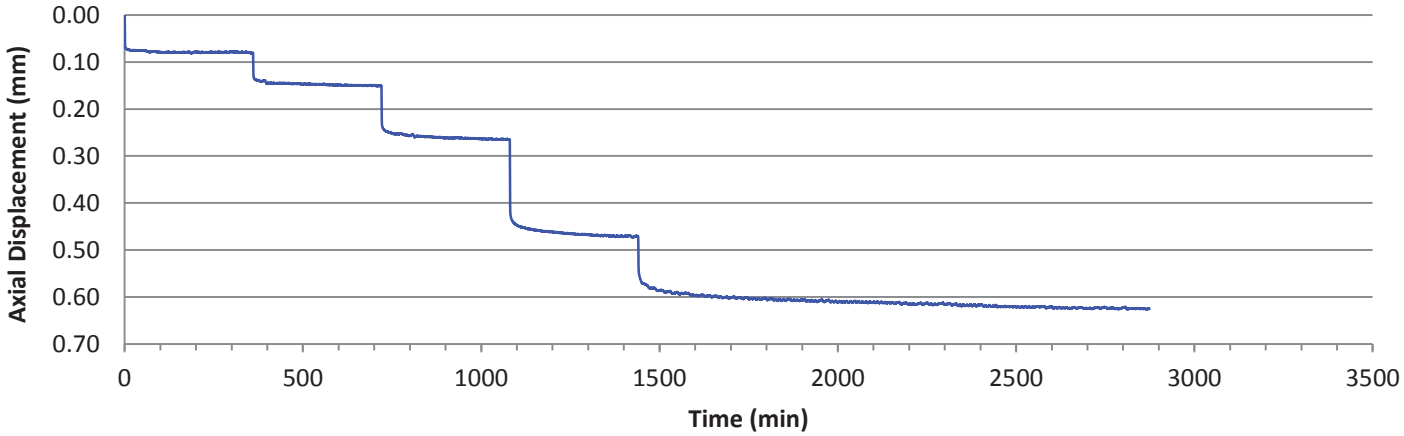
Consolidation Summary

Stress at end of Consolidation (kPa)	379.98
Axial Strain at end of Consolidation (%)	2.65
OCR	N/A
Change in Height ΔH_c (mm)	0.63

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	380		
Load (kN)	0.0994	0.1983	0.3948	0.9862	1.498		
Duration (min)	360	360	360	360	1434		
Axial Strain (%)	0.34	0.64	1.12	2.00	2.65		





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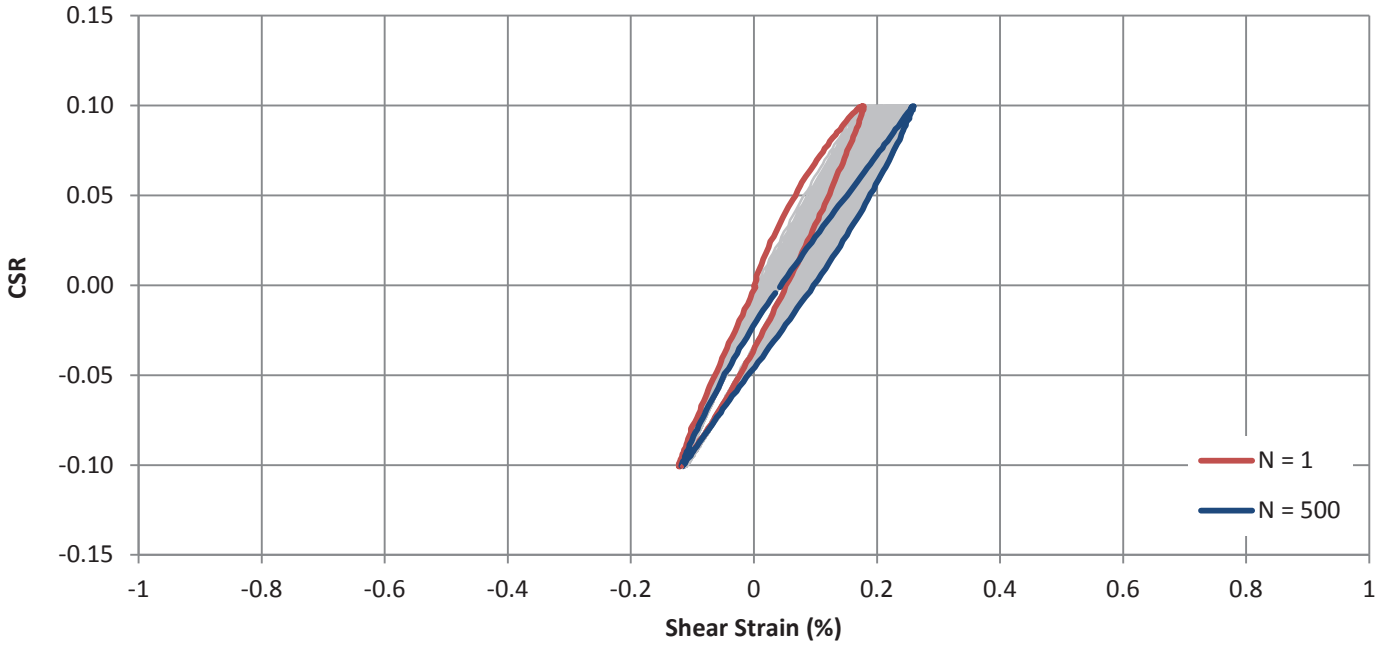
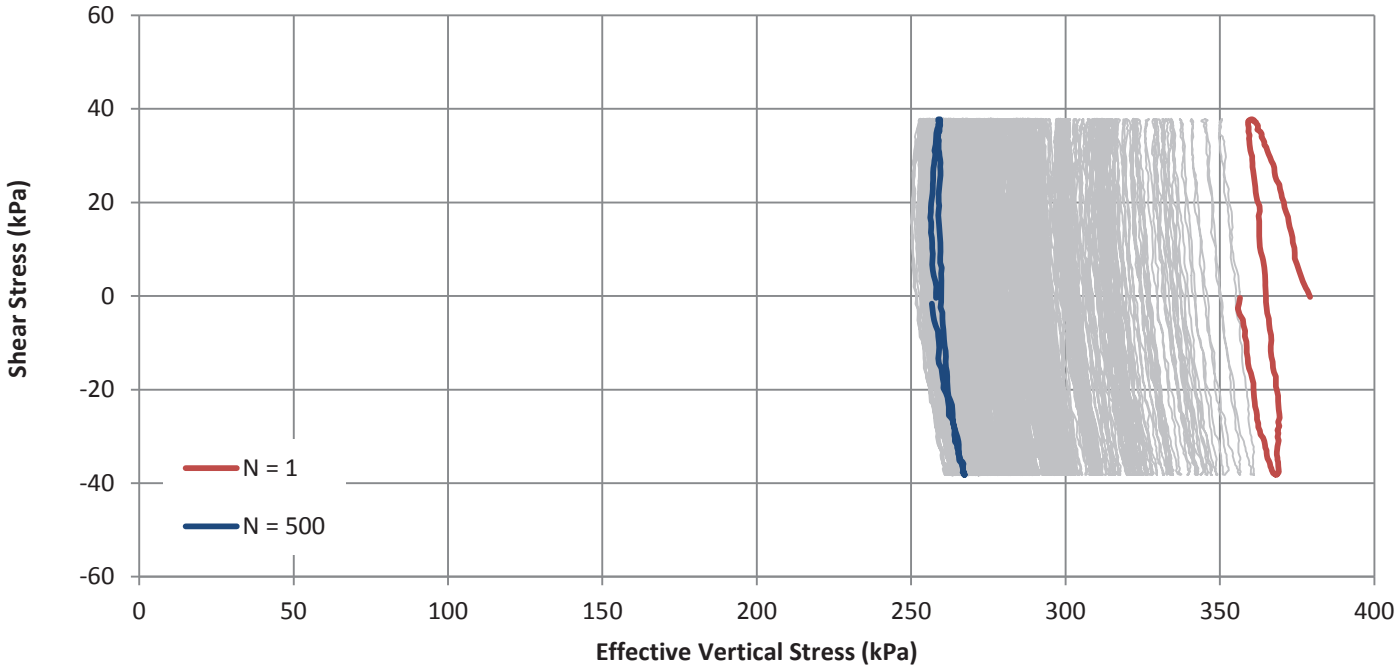
Location:	Redmond, WA	**Depth (m):**	35.80-35.84
Client:	GAI	**Lab ID No:**	33





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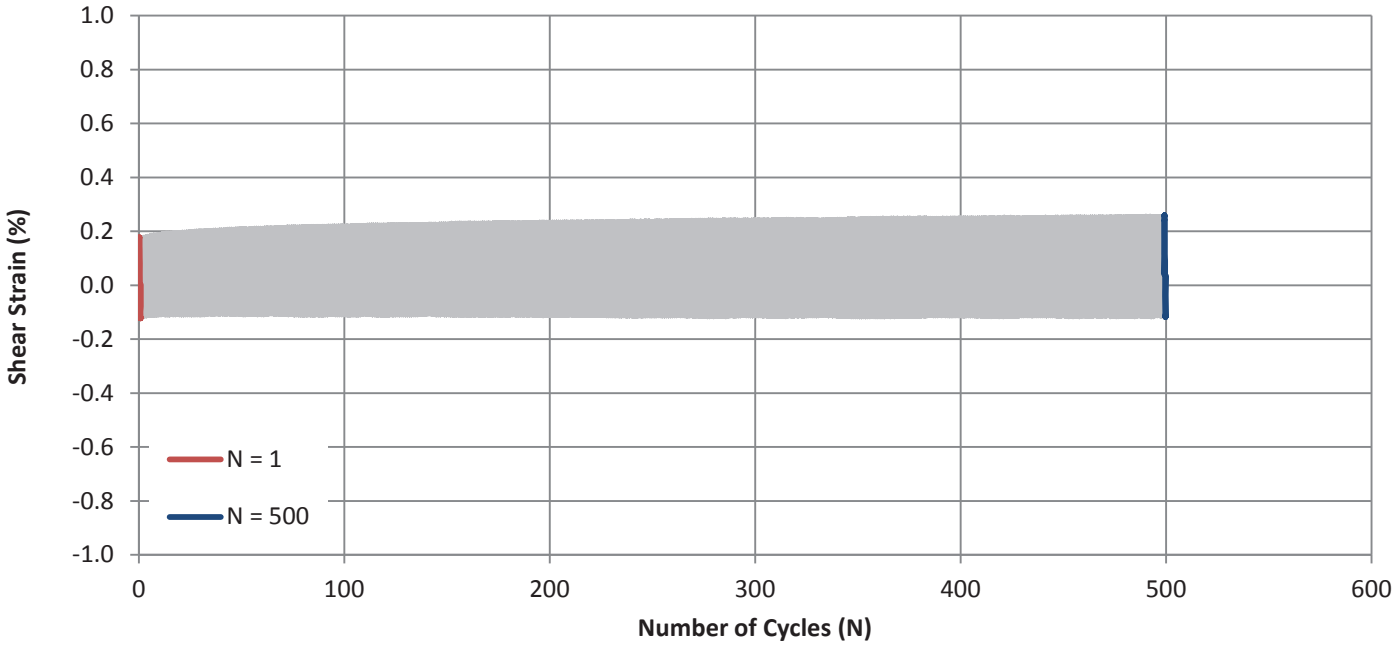
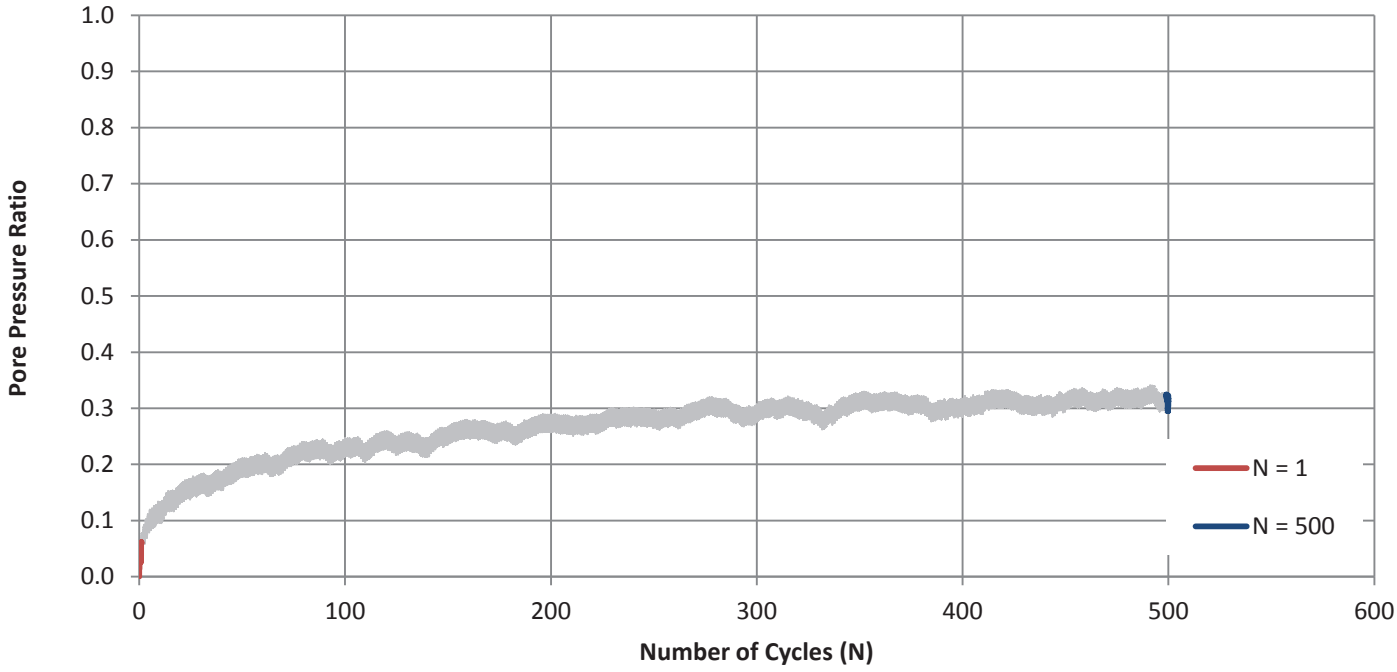
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.10CSR
Location:	Redmond, WA	**Depth (m):**	35.80-35.84
Client:	GAI	**Lab ID No:**	33





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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

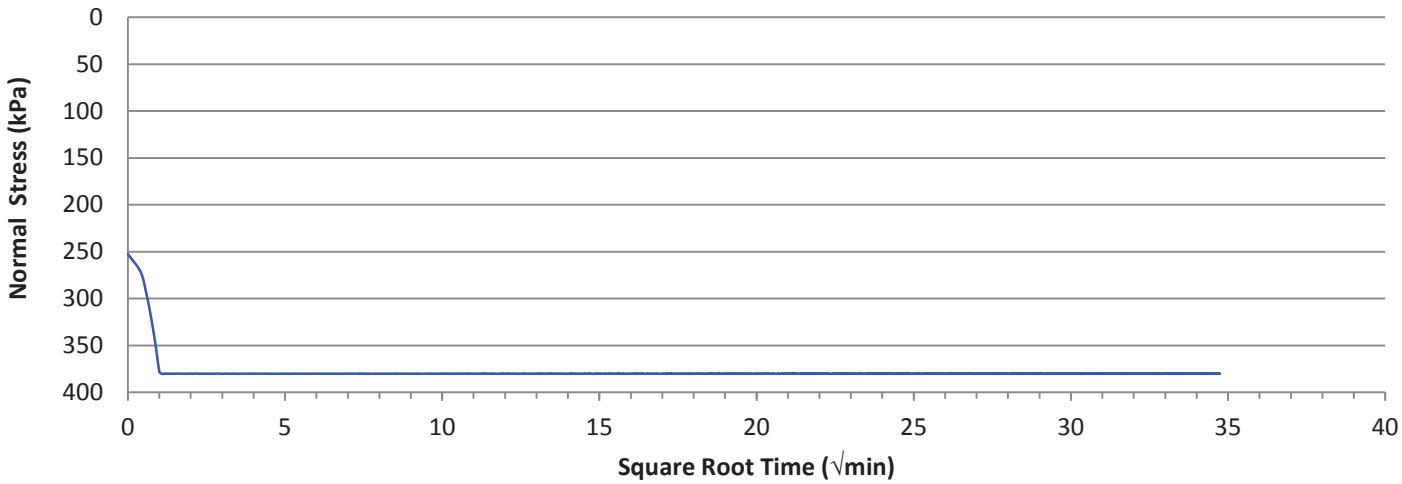
NORSOK G-001

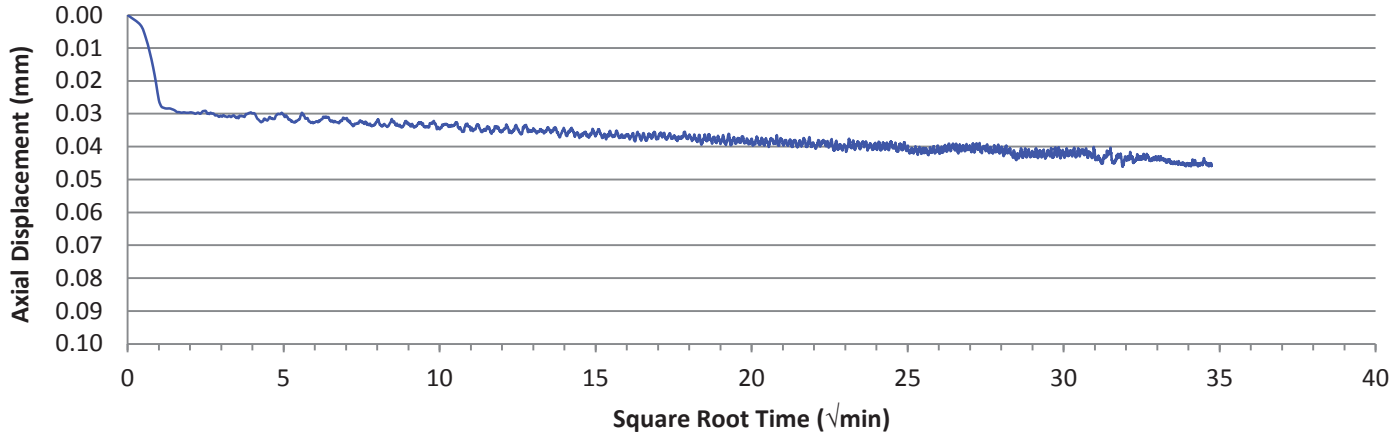
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.10CSR
Location:	Redmond, WA	**Depth (m):**	35.80-35.84
Client:	GAI	**Lab ID No:**	33

Stress at Start of Reconsolidation (kPa)	252.39
Stress at end of Reconsolidation (kPa)	380.03
Axial Strain at end of Reconsolidation (%)	0.20
Change in Height ΔH_c (mm)	0.05

Comments
Reconsolidation data calculated from the sample height at end of initial consolidation

Increment (kPa)	380						
Load (kN)	1.4982						
Duration (min)	1207						
Axial Strain (%)	0.20						





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Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
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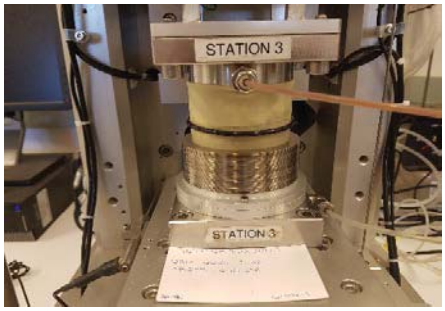
Location:	Redmond, WA	**Depth (m):**	35.80-35.84
Client:	GAI	**Lab ID No:**	33



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Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.13CSR
Location:	Redmond, WA	**Depth (m):**	35.76-35.80
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 100mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 2

Vertical LVDT	Serial No.:	11897
Vertical Load Cell	Serial No.:	38408
Shear Load Cell	Serial No.:	158877

Sample Properties

Preparation Method	Trim from Undisturbed	Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.	
Height (mm)	23.60			
Diameter (mm)	70.89	Sand Fraction (%)	26.9	Liquid Limit 24
Area (cm^2)	39.47	Fines Fraction (%)	73.1	Plastic Limit 16
Volume (cm^3)	93.15	Shear Strength est. (kPa)		N/A
Specific Gravity (Measured)	2.69	Sensitivity		N/A

Weight Volume Relationships

Initial Wet Mass (g)	190.31	Initial Water Content (%)	22.40
Dry Mass (g)	155.48	Initial Saturation (%)	99.00
Initial Wet Unit Weight (kN/m^3)	20.04	Final Water Content (%)	20.32
Initial Dry Unit Weight (kN/m^3)	16.37	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	3.15
Max Applied Vertical Stress (kPa)	381.01	Axial Strain at end of Consol. %	3.14
Vertical Stress at end of Consol (kPa)	380.47	Change in Height ΔH_c (mm)	0.74
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.13
Cycles to 3.75% Shear Strain	3.75% not reached
Initial Vertical Stress (kPa)	381.18
Max Abs. Cyclic Shear Stress (kPa)	49.61
Max. Shear Strain at N= n/a (zero load)	3.75% not reached
Min. Shear Strain at N= n/a (zero load)	3.75% not reached
Max. DU at N= n/a (zero load)	3.75% not reached
Min. DU at N= n/a (zero load)	3.75% not reached

Post Cyclic Reconsolidation Test Results [1]

Initial Vertical Stress (kPa)	89.23
Max. Applied Vertical Stress (kPa)	380.60
Initial Shear Stress (kPa)	8.69
Height at beginning of Reconsol (mm)	22.86
Change in Height ΔH_c (mm)	0.17
Axial Strain at end of Reconsol. %	0.74

[1] *Reconsolidation data calculated from the sample height at end of initial consolidation*

Comments / Special Instructions

Comments / Special Instructions

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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

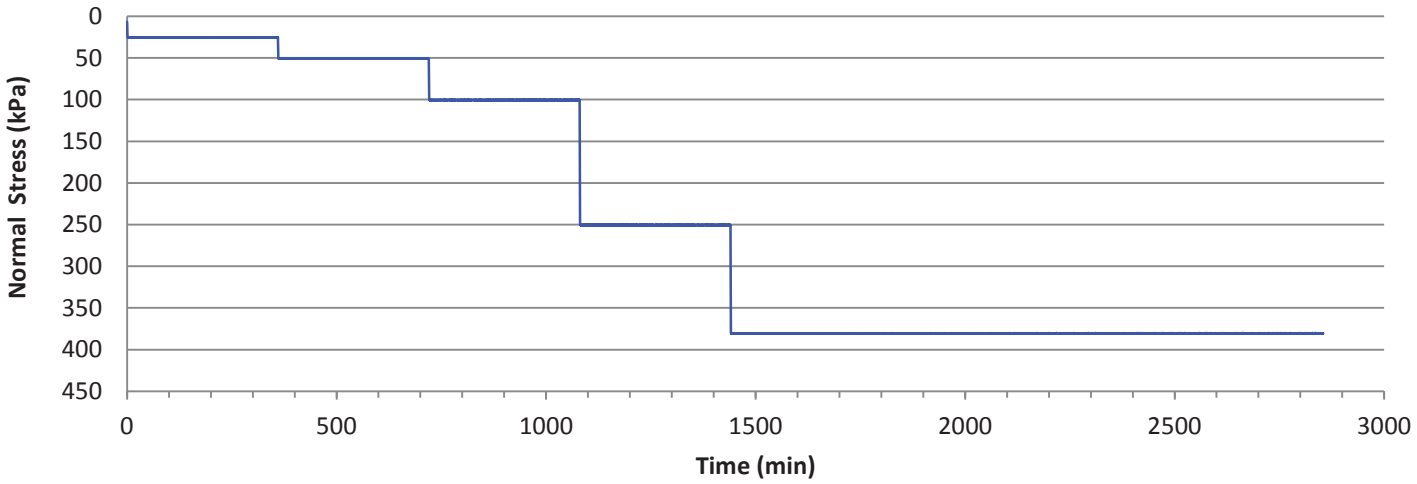
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.13CSR
Location:	Redmond, WA	**Depth (m):**	35.76-35.80
Client:	GAI	**Lab ID No:**	33

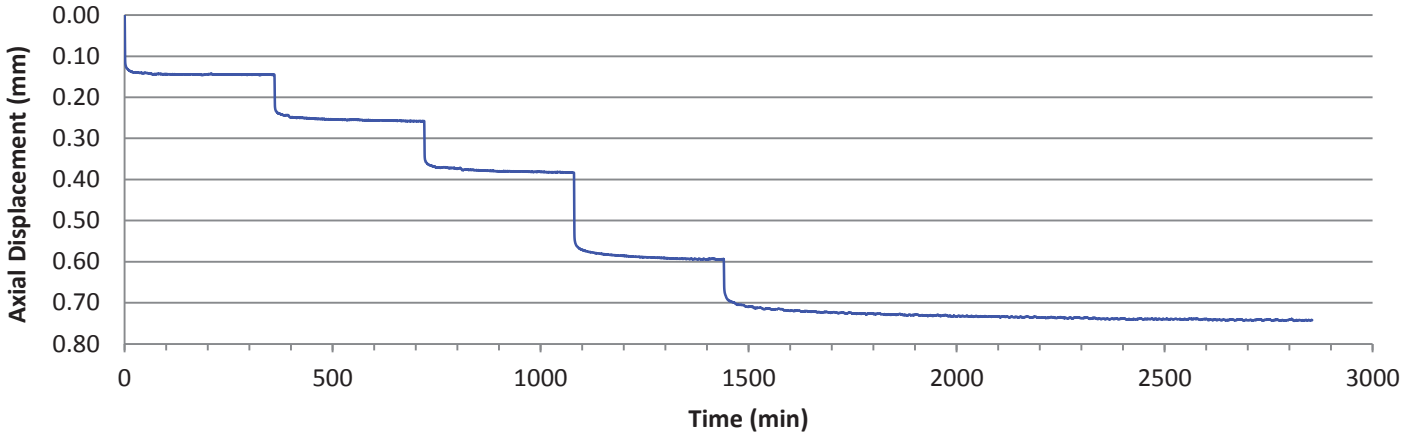
Consolidation Summary

Stress at end of Consolidation (kPa)	380.47
Axial Strain at end of Consolidation (%)	3.14
OCR	N/A
Change in Height ΔH_c (mm)	0.74

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	380		
Load (kN)	0.1023	0.2004	0.3977	0.9904	1.5038		
Duration (min)	360	360	360	360	1415		
Axial Strain (%)	0.62	1.09	1.63	2.52	3.15		





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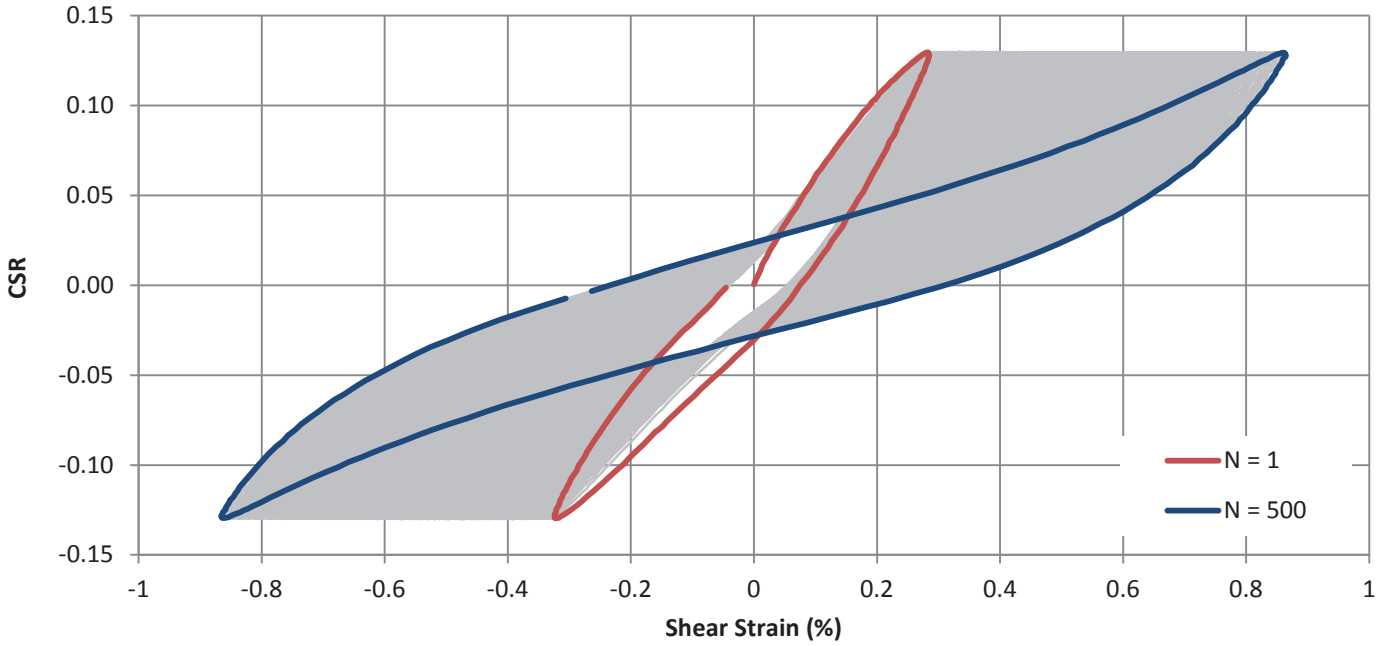
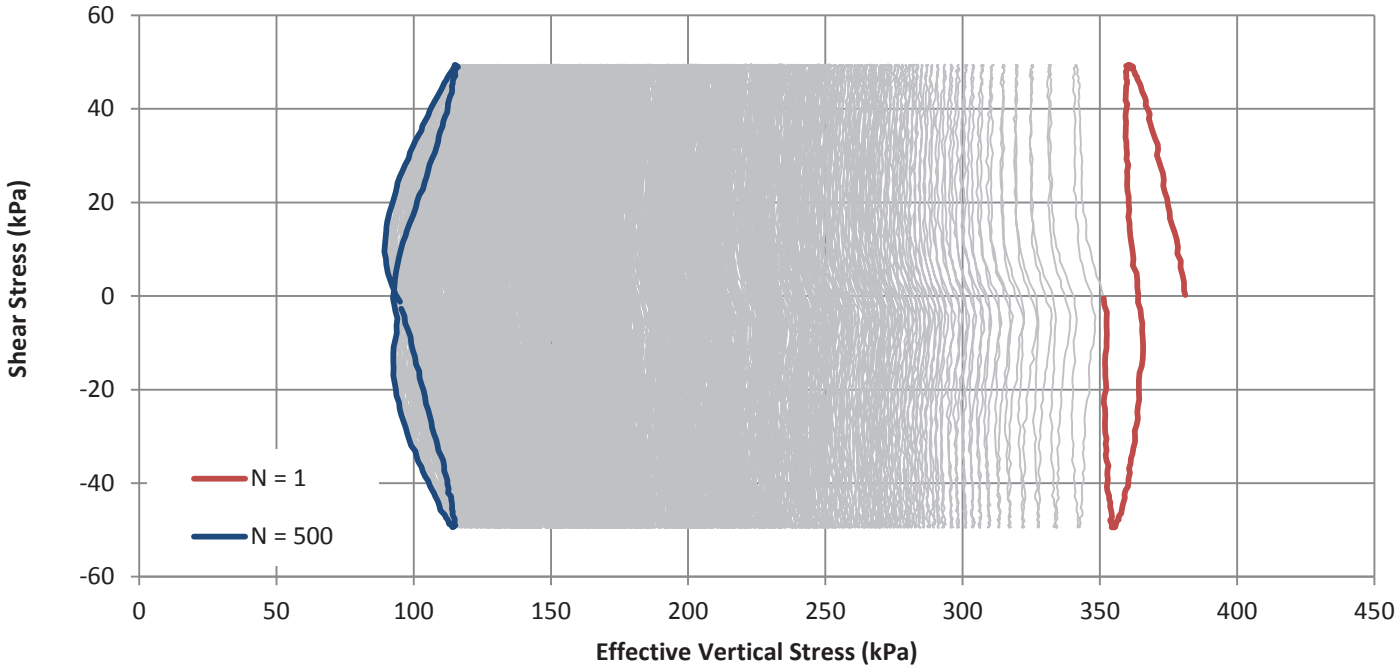
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.13CSR
Location:	Redmond, WA	**Depth (m):**	35.76-35.80
Client:	GAI	**Lab ID No:**	33





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Location:	Redmond, WA	**Depth (m):**	35.76-35.80
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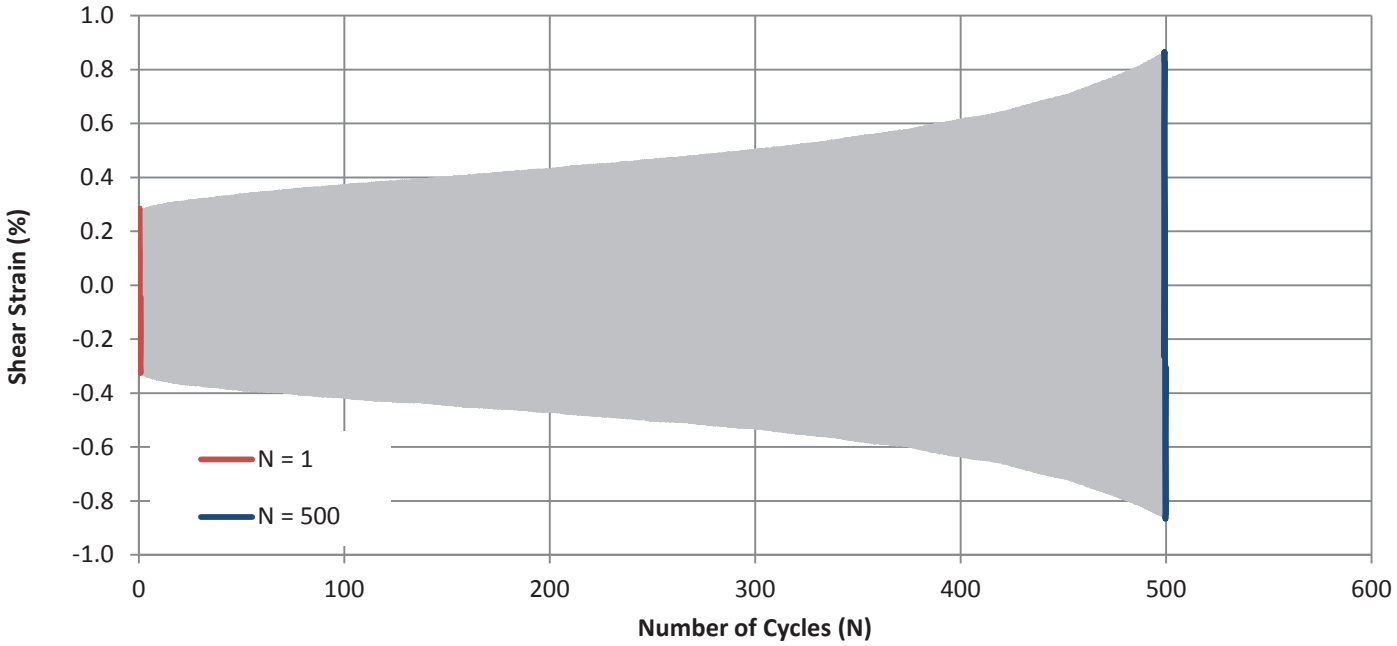

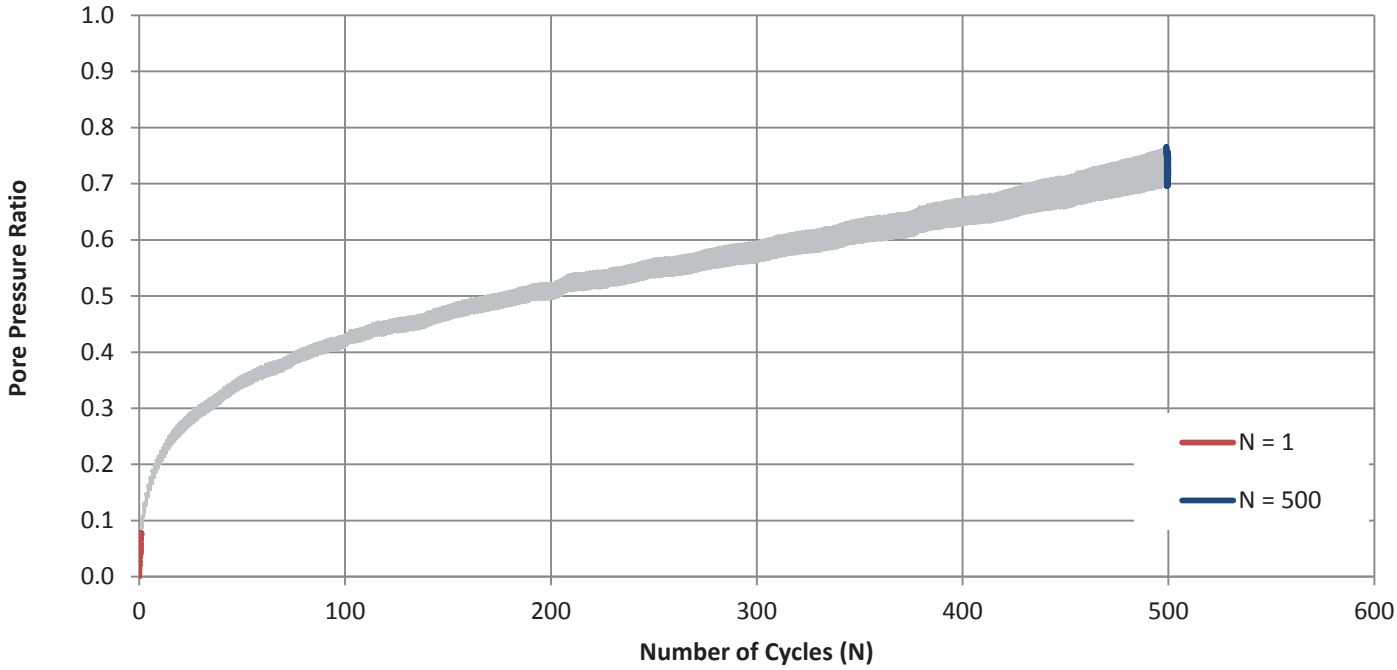

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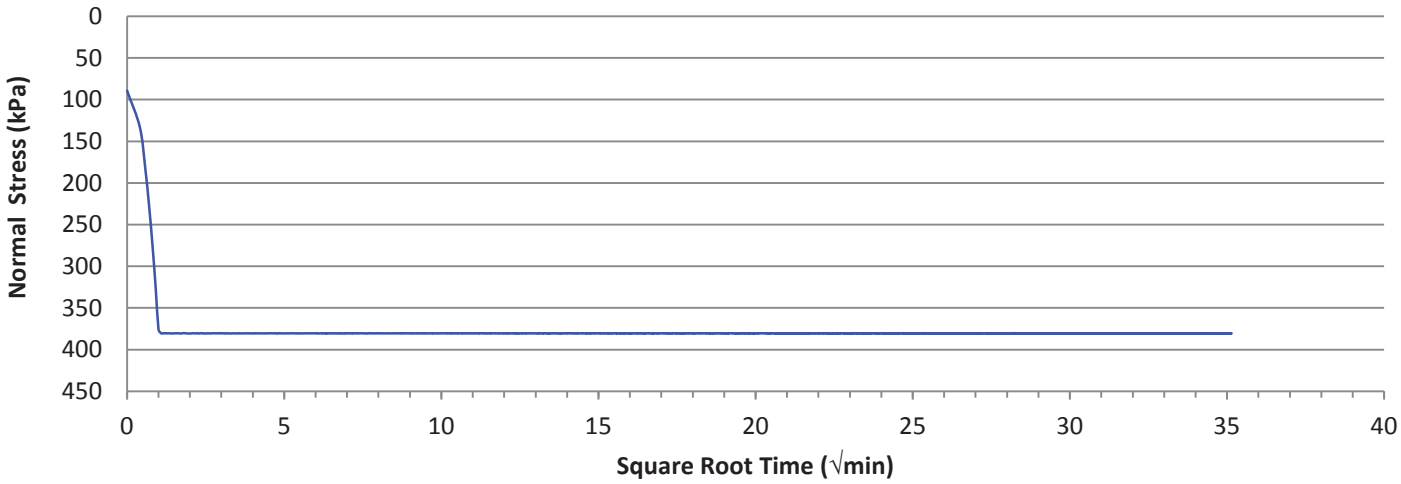
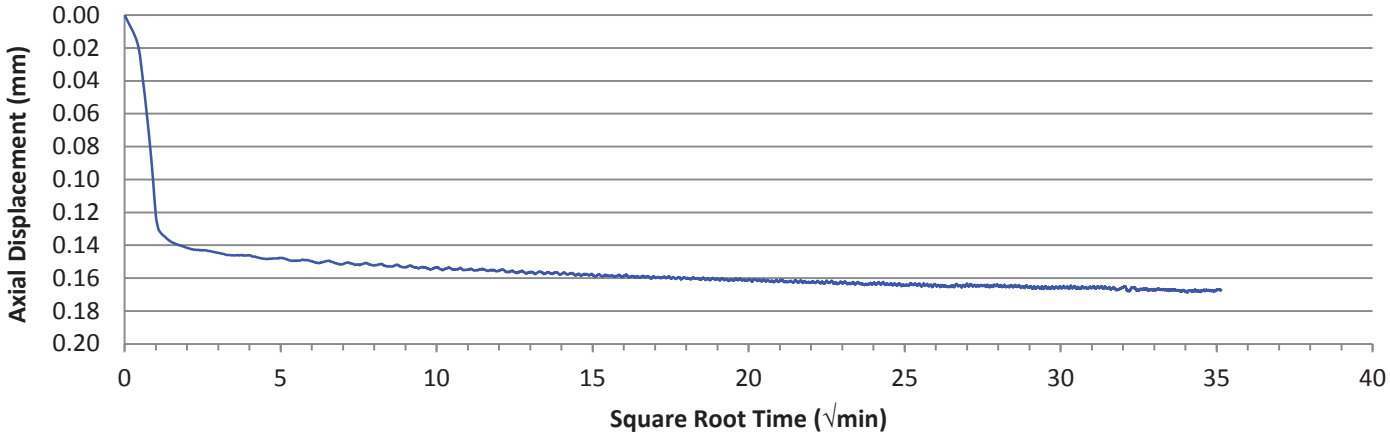
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.13CSR
Location:	Redmond, WA	**Depth (m):**	35.76-35.80
Client:	GAI	**Lab ID No:**	33

Stress at Start of Reconsolidation (kPa)	89.23
Stress at end of Reconsolidation (kPa)	380.60
Axial Strain at end of Reconsolidation (%)	0.74
Change in Height ΔH_c (mm)	0.17

Comments
Reconsolidation data calculated from the sample height at end of initial consolidation

Increment (kPa)	380						
Load (kN)	1.5031						
Duration (min)	1235						
Axial Strain (%)	0.74						





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Location:	Redmond, WA	**Depth (m):**	35.76-35.80
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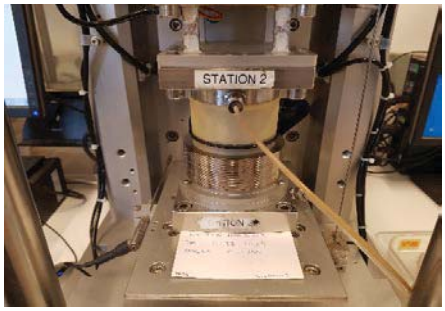

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NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	35.72-35.76
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 100mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 2

Vertical LVDT	Serial No.:	11897
Vertical Load Cell	Serial No.:	38408
Shear Load Cell	Serial No.:	158877

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.32
Diameter (mm)	70.72
Area (cm^2)	39.28
Volume (cm^3)	91.60
Specific Gravity (Measured)	2.69

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	26.9	Liquid Limit	24
Fines Fraction (%)	73.1	Plastic Limit	16
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	188.68	Initial Water Content (%)	22.66
Dry Mass (g)	153.82	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	20.21	Final Water Content (%)	19.35
Initial Dry Unit Weight (kN/m^3)	16.47	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	2.83
Max Applied Vertical Stress (kPa)	381.03	Axial Strain at end of Consol. %	2.83
Vertical Stress at end of Consol (kPa)	380.90	Change in Height ΔH_c (mm)	0.66
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.16
Cycles to 3.75% Shear Strain	197
Initial Vertical Stress (kPa)	380.39
Max Abs. Cyclic Shear Stress (kPa)	61.10
Max. Shear Strain at N=197 (zero load)	2.16
Min. Shear Strain at N=197 (zero load)	-1.84
Max. DU at N=197 (zero load)	342.40
Min. DU at N=197 (zero load)	340.76

Post Cyclic Reconsolidation Test Results [1]

Initial Vertical Stress (kPa)	20.62
Max. Applied Vertical Stress (kPa)	380.55
Initial Shear Stress (kPa)	7.26
Height at beginning of Reconsol (mm)	22.66
Change in Height ΔH_c (mm)	0.48
Axial Strain at end of Reconsol. %	2.15

[1] *Reconsolidation data calculated from the sample height at end of initial consolidation*

Comments / Special Instructions

Comments / Special Instructions

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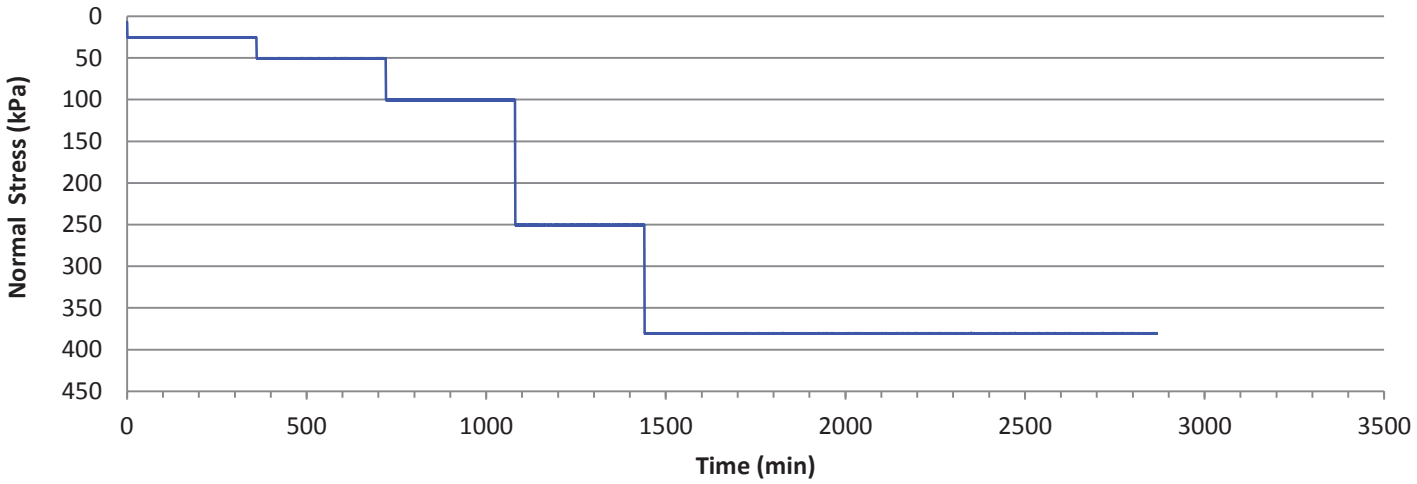
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	35.72-35.76
Client:	GAI	**Lab ID No:**	33

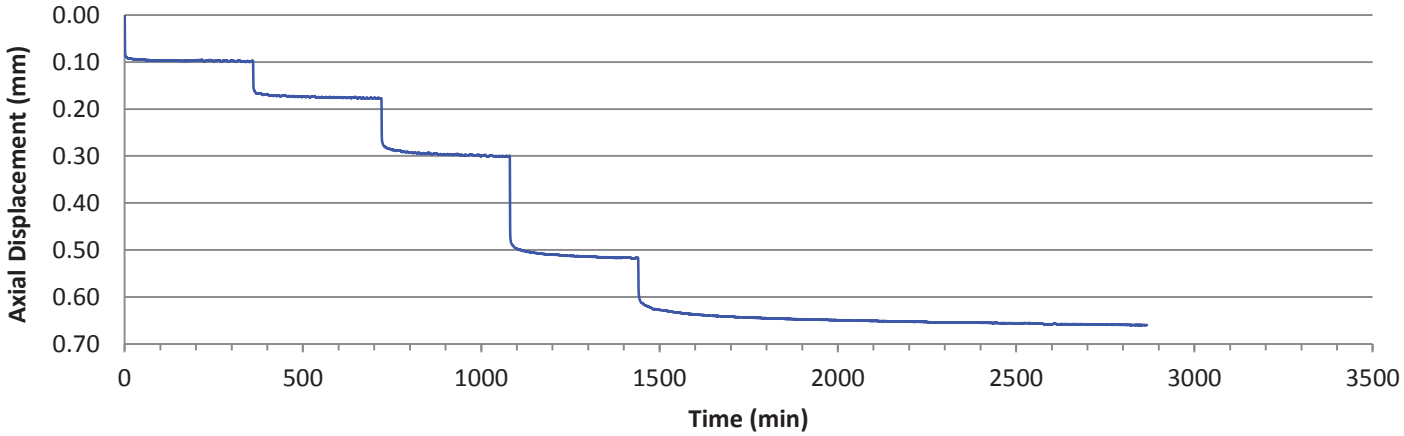
Consolidation Summary

Stress at end of Consolidation (kPa)	380.90
Axial Strain at end of Consolidation (%)	2.83
OCR	N/A
Change in Height ΔH_c (mm)	0.66

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	380		
Load (kN)	0.101	0.1997	0.3964	0.9856	1.4967		
Duration (min)	360	360	360	360	1427		
Axial Strain (%)	0.43	0.76	1.29	2.22	2.83		





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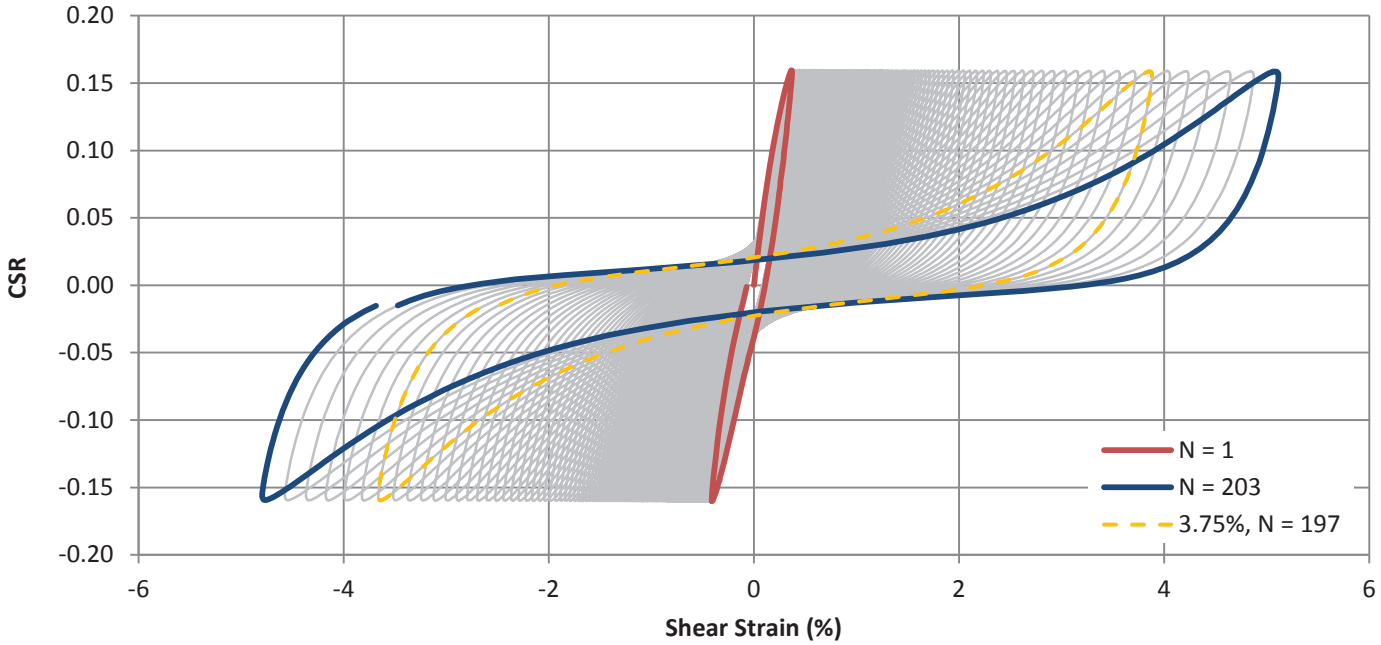
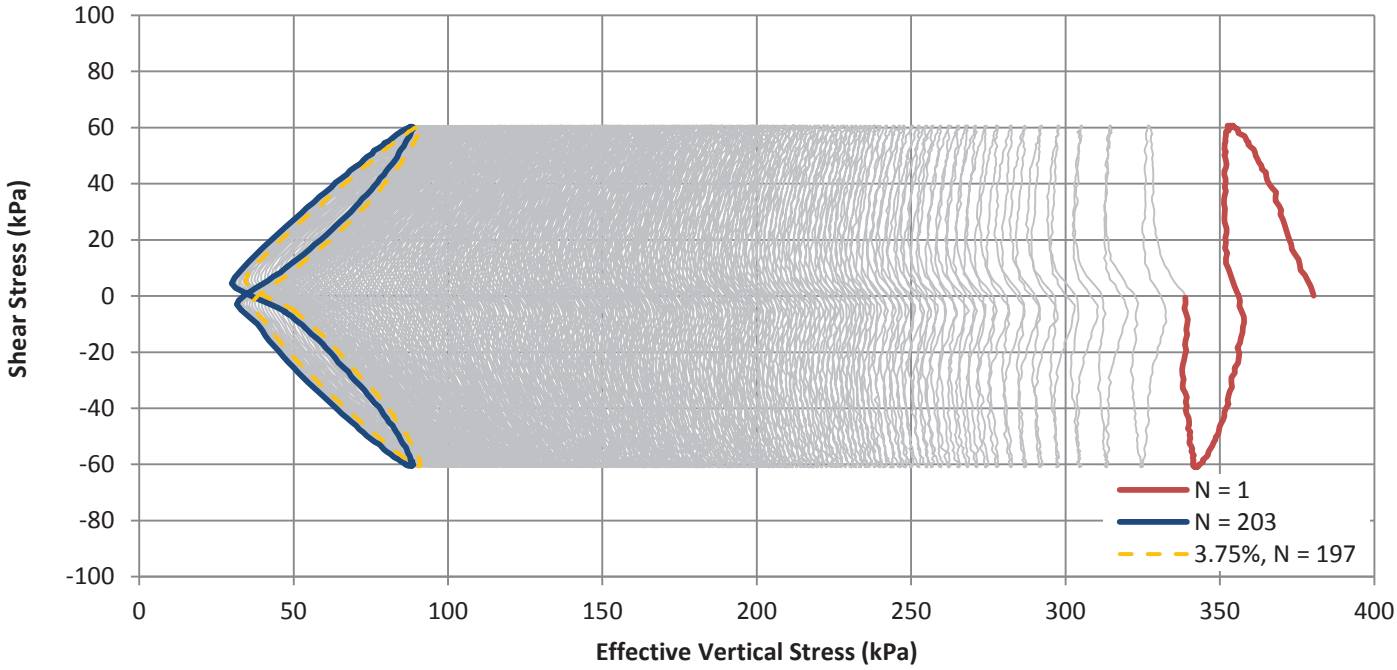
Location:	Redmond, WA	**Depth (m):**	35.72-35.76
Client:	GAI	**Lab ID No:**	33





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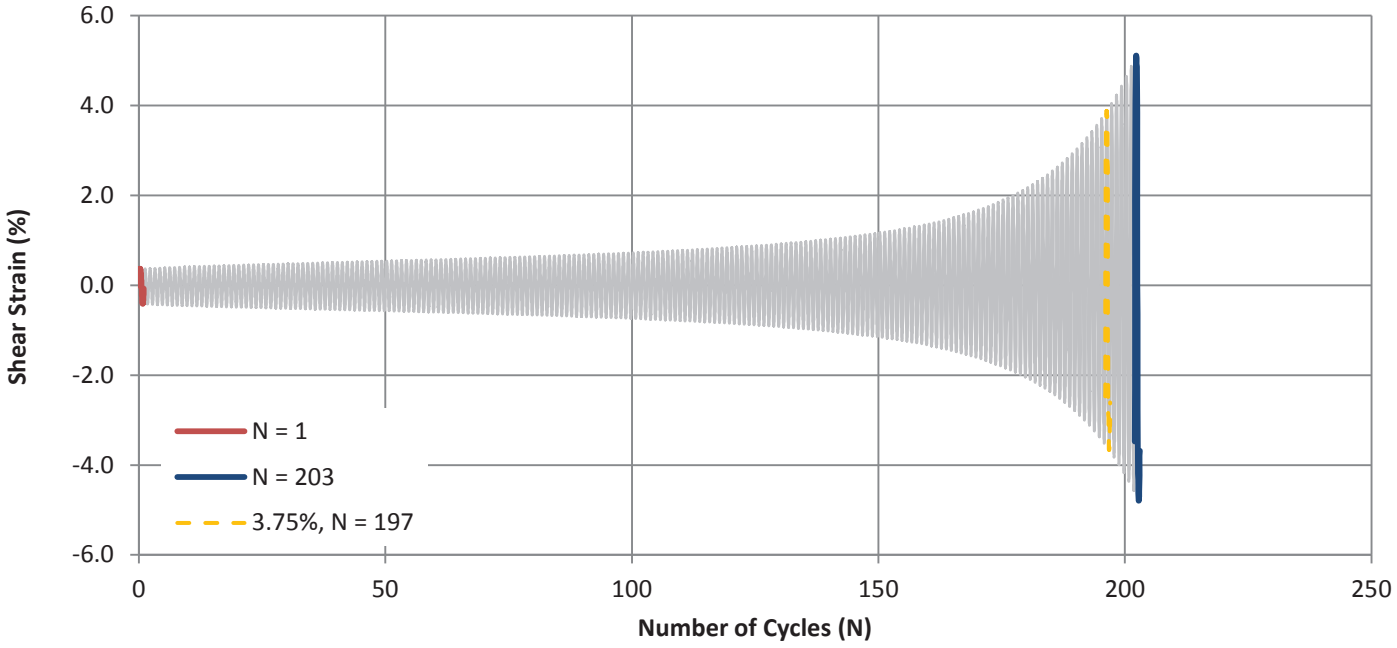
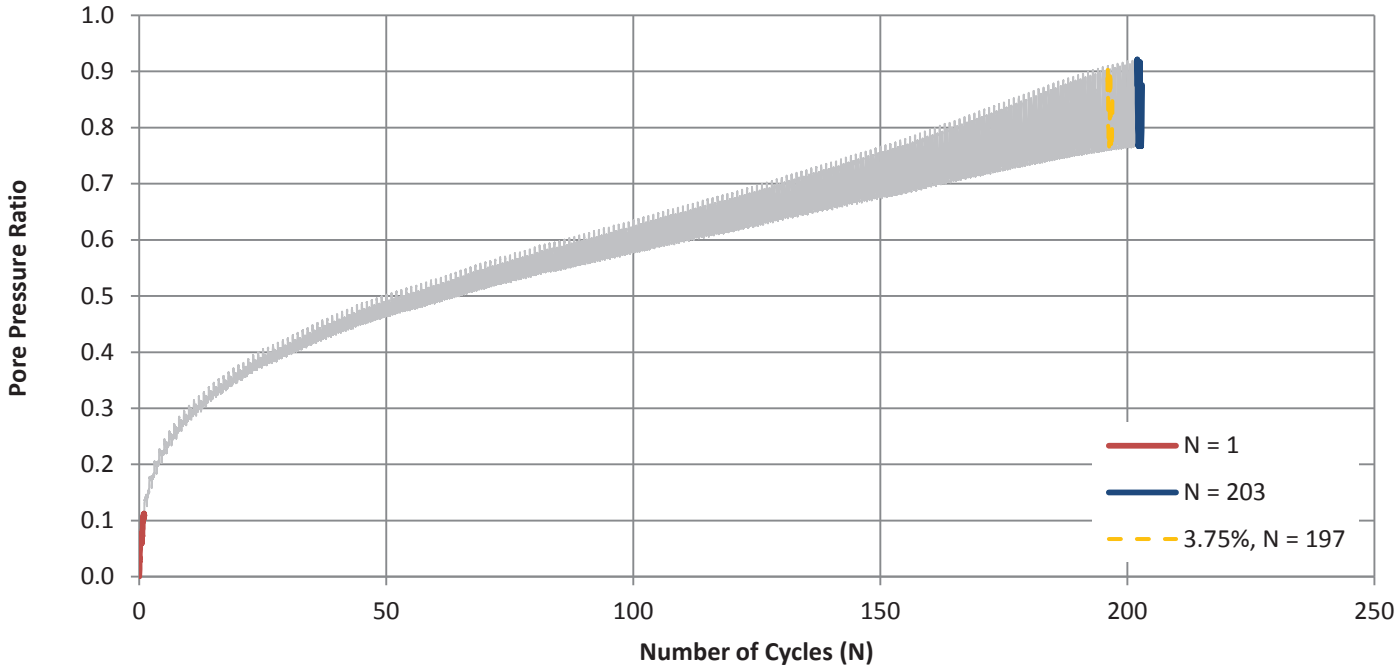
Location:	Redmond, WA	**Depth (m):**	35.72-35.76
Client:	GAI	**Lab ID No:**	33





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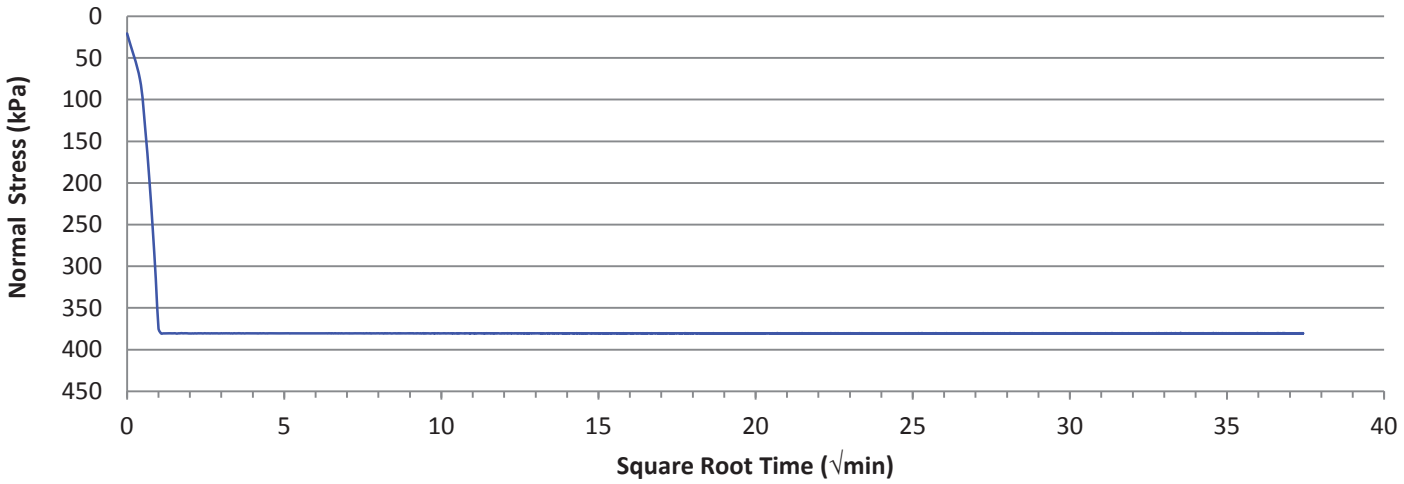
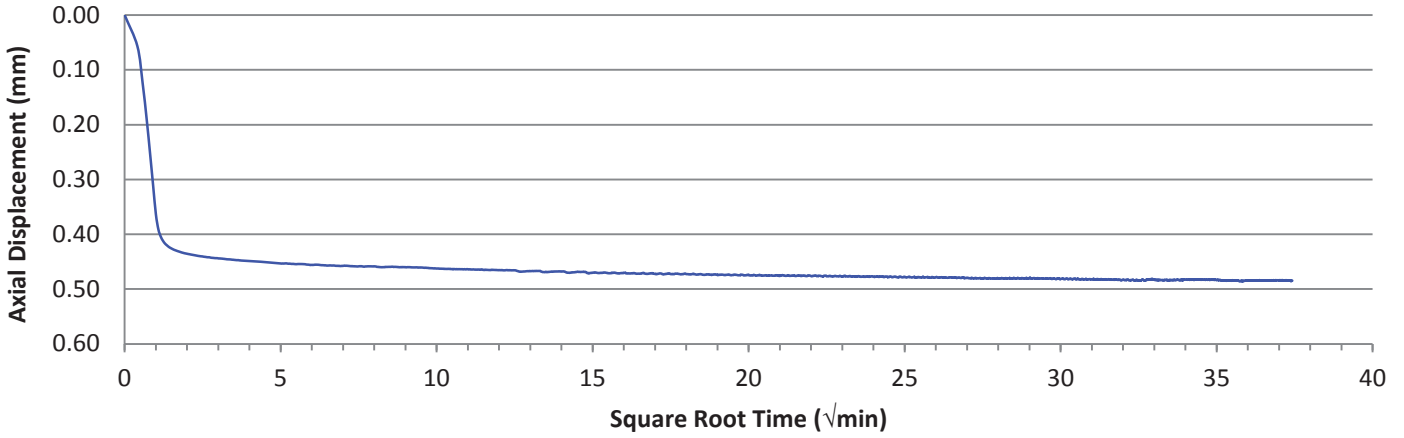
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	35.72-35.76
Client:	GAI	**Lab ID No:**	33

Stress at Start of Reconsolidation (kPa)	20.62
Stress at end of Reconsolidation (kPa)	380.55
Axial Strain at end of Reconsolidation (%)	2.15
Change in Height ΔH_c (mm)	0.48

Comments
Reconsolidation data calculated from the sample height at end of initial consolidation

Increment (kPa)	380						
Load (kN)	1.4964						
Duration (min)	1400						
Axial Strain (%)	2.15						





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G. Patton	February 6, 2018	M. Sanin	March 1, 2018
TESTED BY	DATE	CHECKED BY	DATE

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Tel: 604-412-6899 Fax: 604-412-6816 www.golder.com

Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	35.72-35.76
Client:	GAI	**Lab ID No:**	33

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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.19CSR
Location:	Redmond, WA	**Depth (m):**	35.84-35.88
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 100mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 2

Vertical LVDT	Serial No.:	11897
Vertical Load Cell	Serial No.:	38408
Shear Load Cell	Serial No.:	158877

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.44
Diameter (mm)	70.84
Area (cm^2)	39.41
Volume (cm^3)	92.39
Specific Gravity (Measured)	2.69

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	26.9	Liquid Limit	24
Fines Fraction (%)	73.1	Plastic Limit	16
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	188.41	Initial Water Content (%)	23.06
Dry Mass (g)	153.11	Initial Saturation (%)	99.99
Initial Wet Unit Weight (kN/m^3)	20.01	Final Water Content (%)	19.91
Initial Dry Unit Weight (kN/m^3)	16.26	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	3.12
Max Applied Vertical Stress (kPa)	380.96	Axial Strain at end of Consol. %	3.11
Vertical Stress at end of Consol (kPa)	380.43	Change in Height ΔH_c (mm)	0.73
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.19
Cycles to 3.75% Shear Strain	29
Initial Vertical Stress (kPa)	381.54
Max Abs. Cyclic Shear Stress (kPa)	72.61
Max. Shear Strain at N=29 (zero load)	2.37
Min. Shear Strain at N=29 (zero load)	-2.13
Max. DU at N=29 (zero load)	331.21
Min. DU at N=29 (zero load)	328.38

Post Cyclic Reconsolidation Test Results [1]

Initial Vertical Stress (kPa)	26.26
Max. Applied Vertical Stress (kPa)	380.55
Initial Shear Stress (kPa)	9.54
Height at beginning of Reconsol (mm)	22.71
Change in Height ΔH_c (mm)	0.49
Axial Strain at end of Reconsol. %	2.17

[1] *Reconsolidation data calculated from the sample height at end of initial consolidation*

Comments / Special Instructions

Comments / Special Instructions

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NORSOK G-001

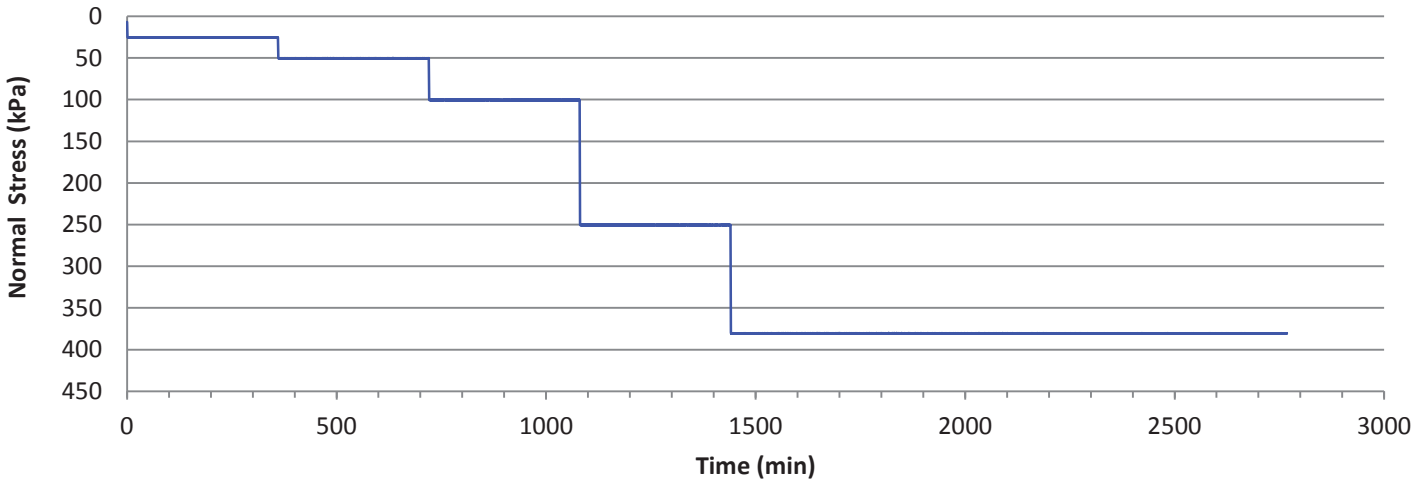
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.19CSR
Location:	Redmond, WA	**Depth (m):**	35.84-35.88
Client:	GAI	**Lab ID No:**	33

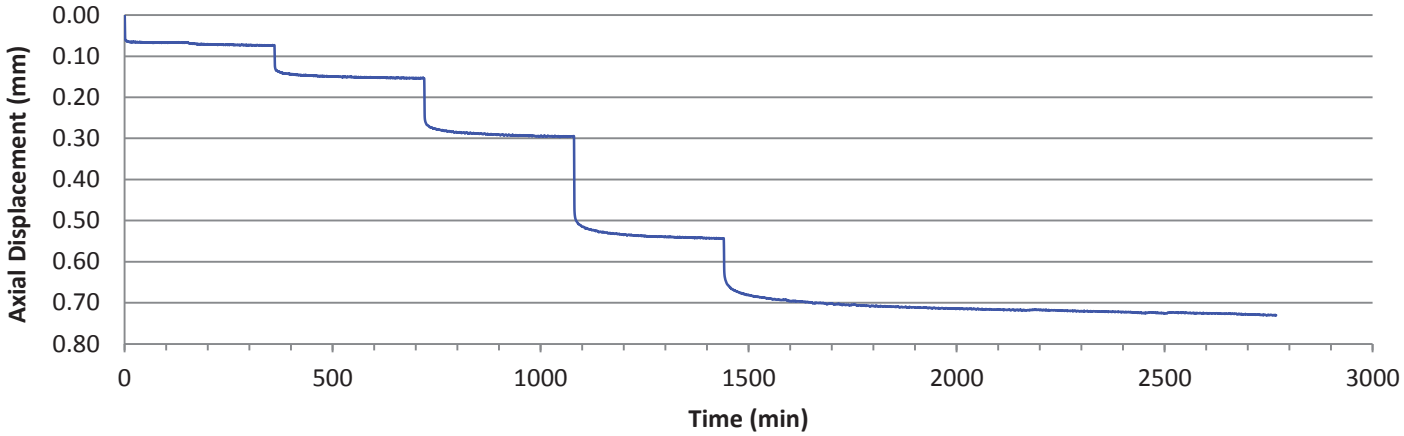
Consolidation Summary

Stress at end of Consolidation (kPa)	380.43
Axial Strain at end of Consolidation (%)	3.11
OCR	N/A
Change in Height ΔH_c (mm)	0.73

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	380		
Load (kN)	0.1012	0.2004	0.3975	0.9885	1.5015		
Duration (min)	360	360	360	360	1328		
Axial Strain (%)	0.32	0.66	1.27	2.32	3.12		





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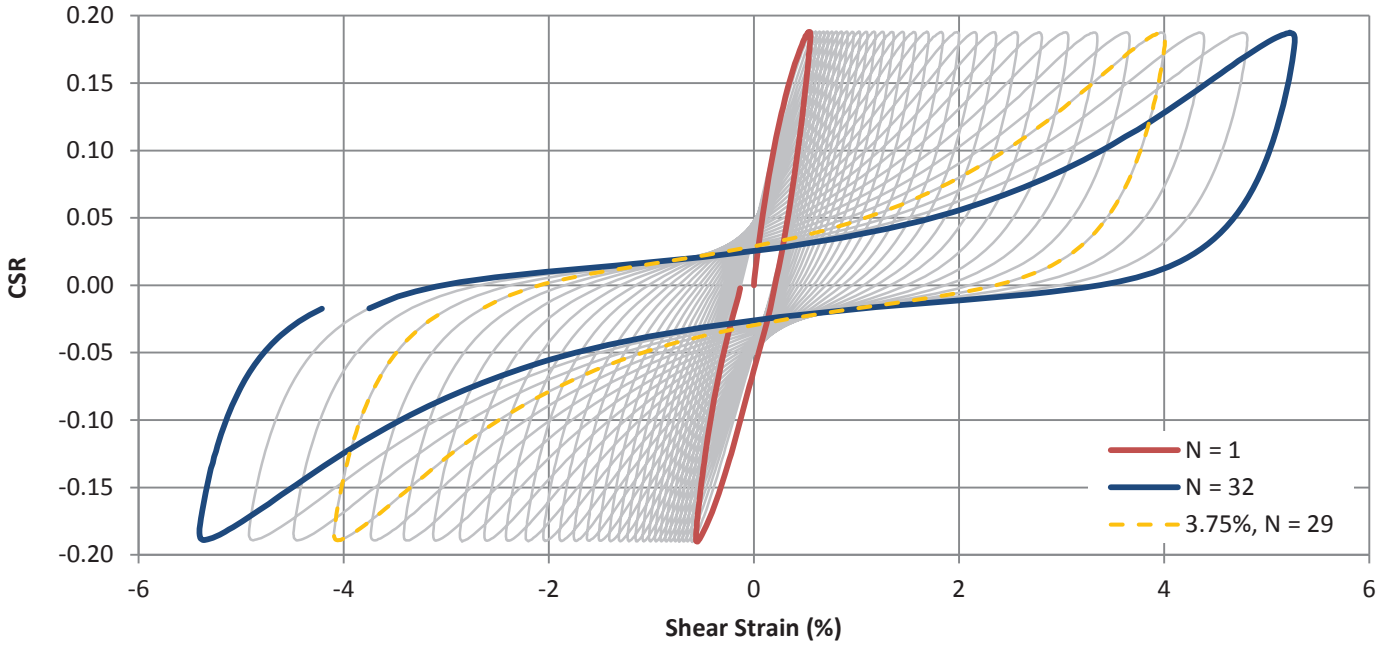
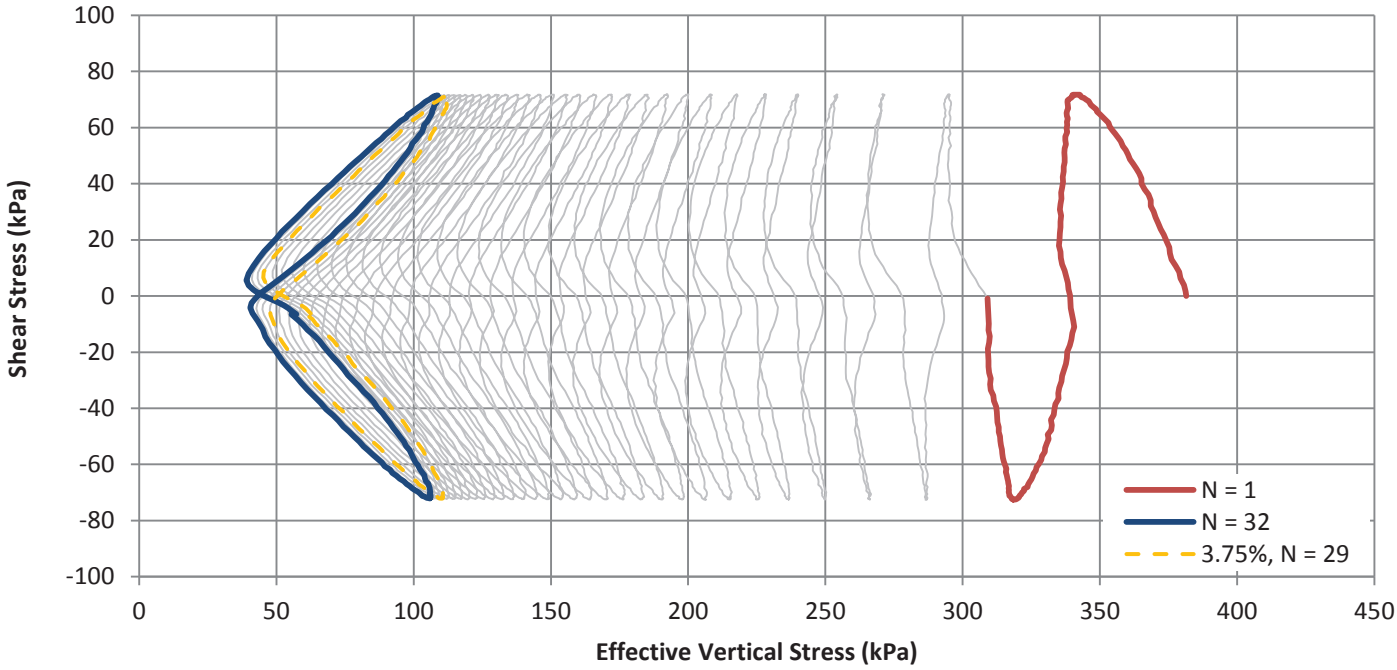
NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.19CSR
Location:	Redmond, WA	**Depth (m):**	35.84-35.88
Client:	GAI	**Lab ID No:**	33





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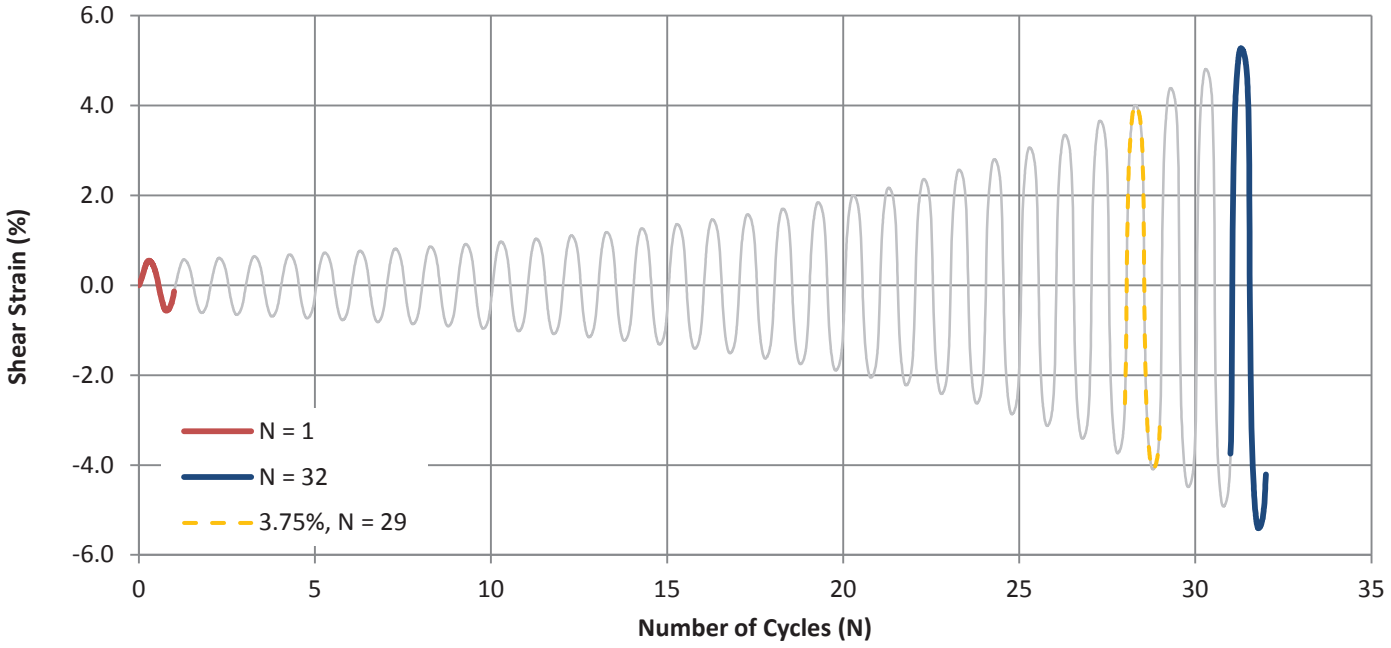
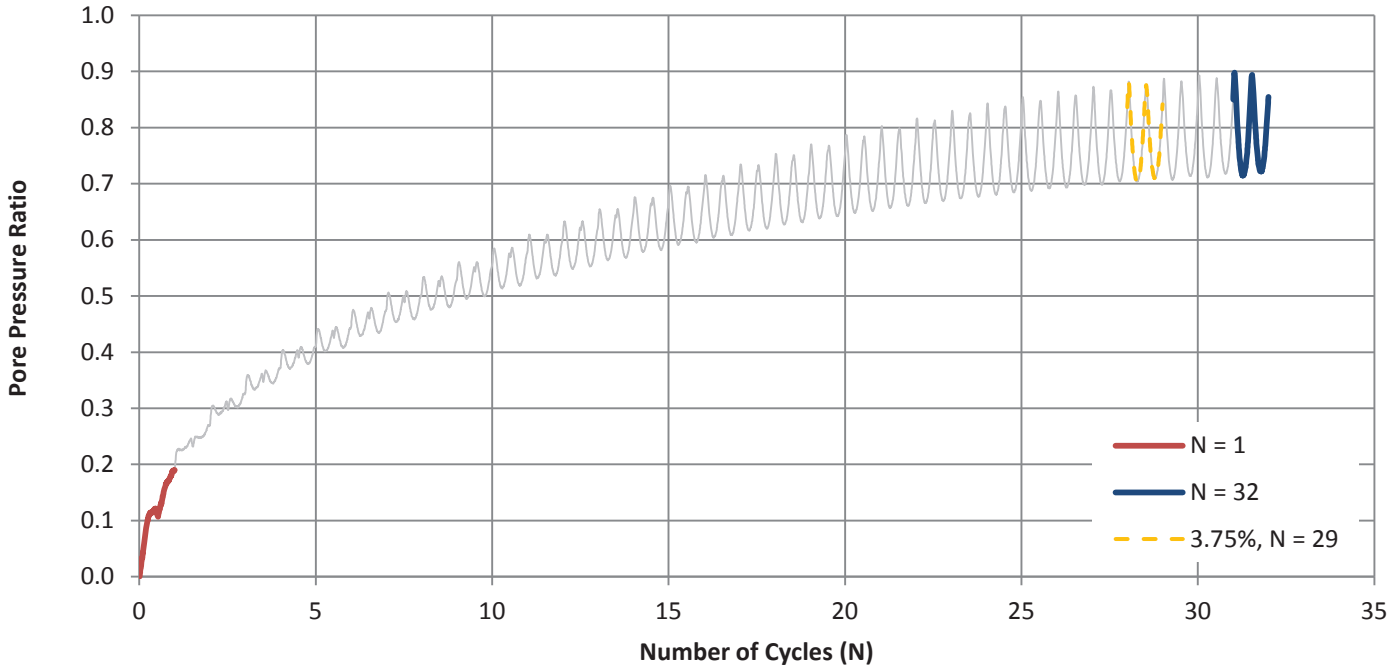
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.19CSR
Location:	Redmond, WA	**Depth (m):**	35.84-35.88
Client:	GAI	**Lab ID No:**	33





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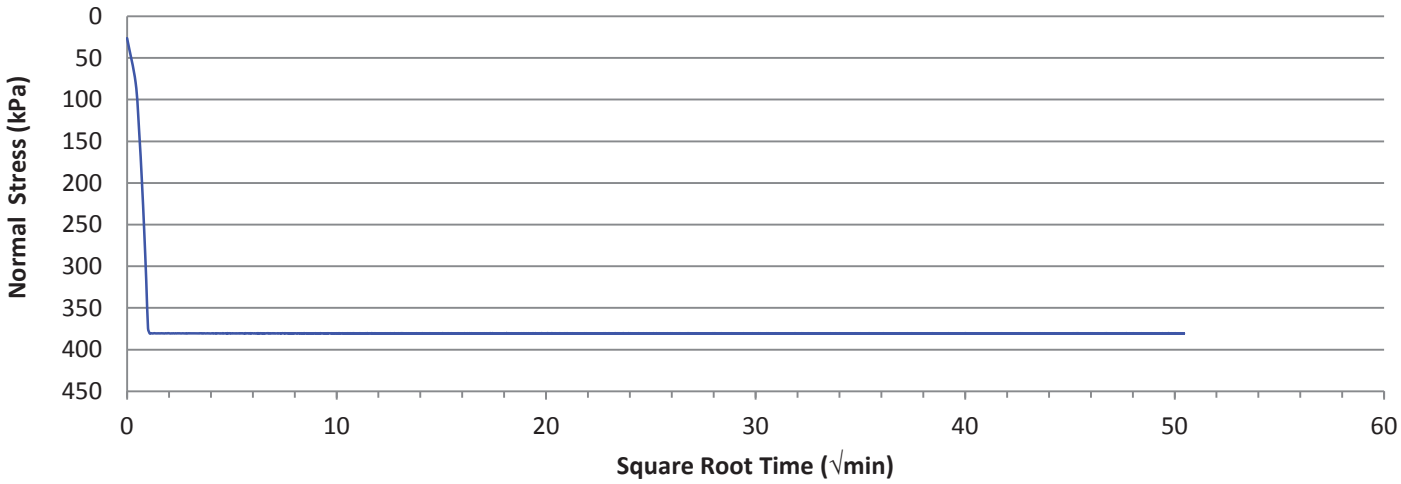
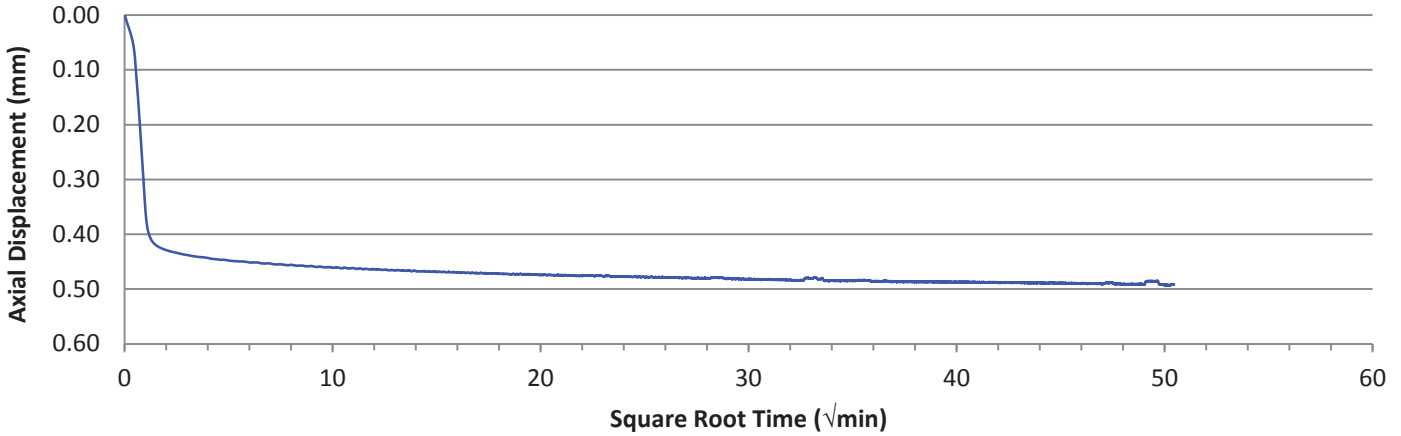
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.19CSR
Location:	Redmond, WA	**Depth (m):**	35.84-35.88
Client:	GAI	**Lab ID No:**	33

Stress at Start of Reconsolidation (kPa)	26.26
Stress at end of Reconsolidation (kPa)	380.55
Axial Strain at end of Reconsolidation (%)	2.17
Change in Height ΔH_c (mm)	0.49

Comments
Reconsolidation data calculated from the sample height at end of initial consolidation

Increment (kPa)	380						
Load (kN)	1.5015						
Duration (min)	2545						
Axial Strain (%)	2.17						





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Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.19CSR
Location:	Redmond, WA	**Depth (m):**	35.84-35.88
Client:	GAI	**Lab ID No:**	33

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NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.22CSR
Location:	Redmond, WA	**Depth (m):**	35.88-35.92
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 200mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 3

Vertical LVDT	Serial No.:	11894
Vertical Load Cell	Serial No.:	38407
Shear Load Cell	Serial No.:	158879

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.30
Diameter (mm)	70.85
Area (cm^2)	39.42
Volume (cm^3)	91.86
Specific Gravity (Measured)	2.69

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	26.9	Liquid Limit	24
Fines Fraction (%)	73.1	Plastic Limit	16
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	188.47	Initial Water Content (%)	23.53
Dry Mass (g)	152.57	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	20.13	Final Water Content (%)	20.00
Initial Dry Unit Weight (kN/m^3)	16.29	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	2.92
Max Applied Vertical Stress (kPa)	380.37	Axial Strain at end of Consol. %	2.91
Vertical Stress at end of Consol (kPa)	380.01	Change in Height ΔH_c (mm)	0.68
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.22
Cycles to 3.75% Shear Strain	15
Initial Vertical Stress (kPa)	380.07
Max Abs. Cyclic Shear Stress (kPa)	83.70
Max. Shear Strain at N=15 (zero load)	2.13
Min. Shear Strain at N=15 (zero load)	-2.02
Max. DU at N=15 (zero load)	314.98
Min. DU at N=15 (zero load)	314.75

Post Cyclic Reconsolidation Test Results [1]

Initial Vertical Stress (kPa)	30.46
Max. Applied Vertical Stress (kPa)	380.07
Initial Shear Stress (kPa)	12.00
Height at beginning of Reconsol (mm)	22.62
Change in Height ΔH_c (mm)	0.45
Axial Strain at end of Reconsol. %	2.02

[1] *Reconsolidation data calculated from the sample height at end of initial consolidation*

Comments / Special Instructions

Comments / Special Instructions

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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

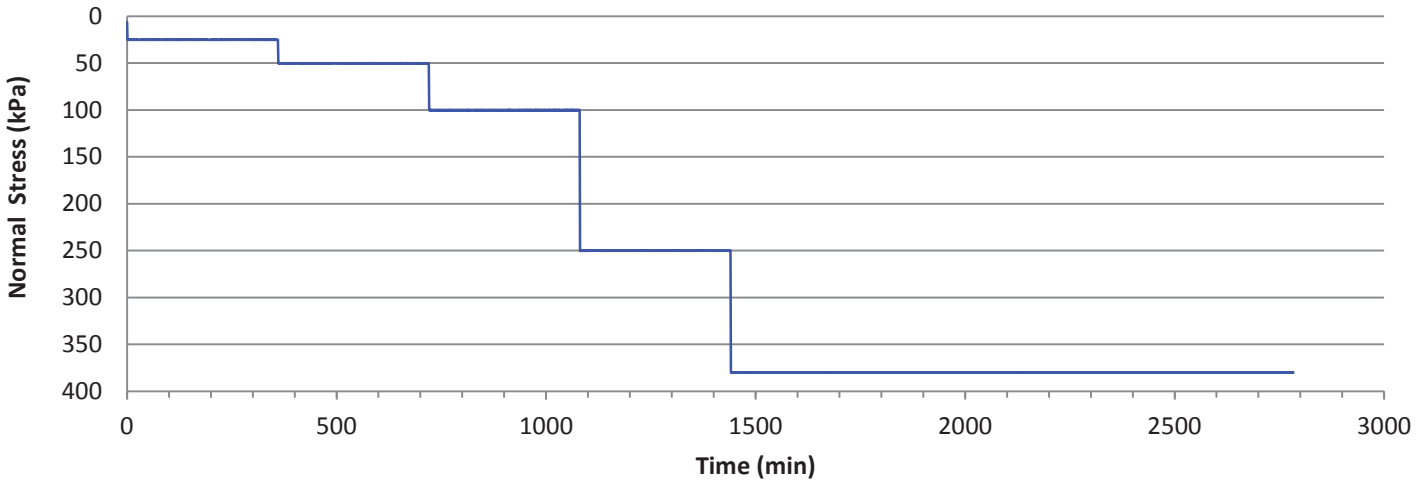
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.22CSR
Location:	Redmond, WA	**Depth (m):**	35.88-35.92
Client:	GAI	**Lab ID No:**	33

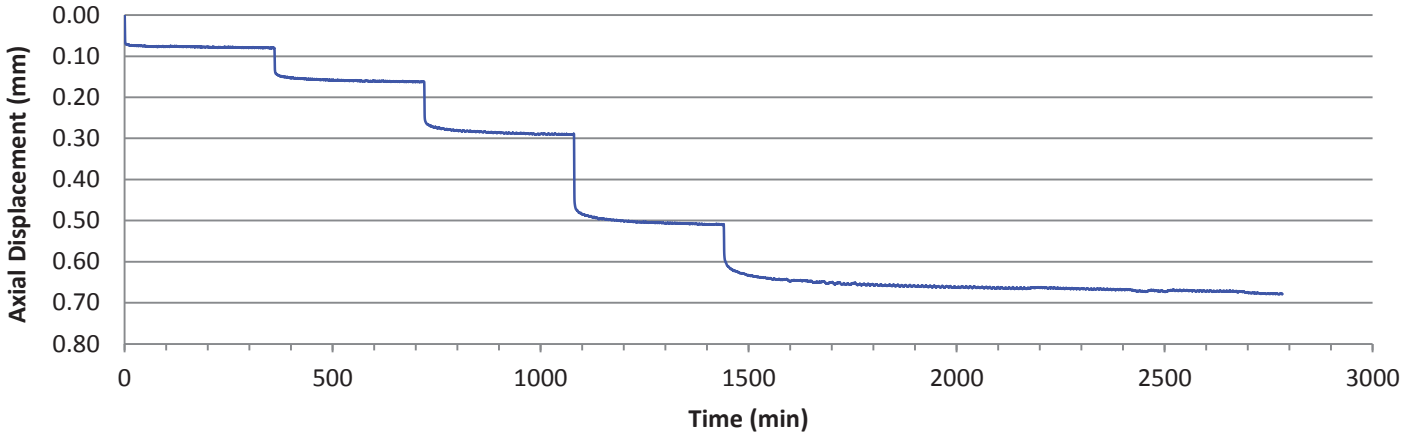
Consolidation Summary

Stress at end of Consolidation (kPa)	380.01
Axial Strain at end of Consolidation (%)	2.91
OCR	N/A
Change in Height ΔH_c (mm)	0.68

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	380		
Load (kN)	0.0992	0.1983	0.3957	0.9871	1.4996		
Duration (min)	360	360	360	360	1343		
Axial Strain (%)	0.35	0.70	1.25	2.19	2.92		





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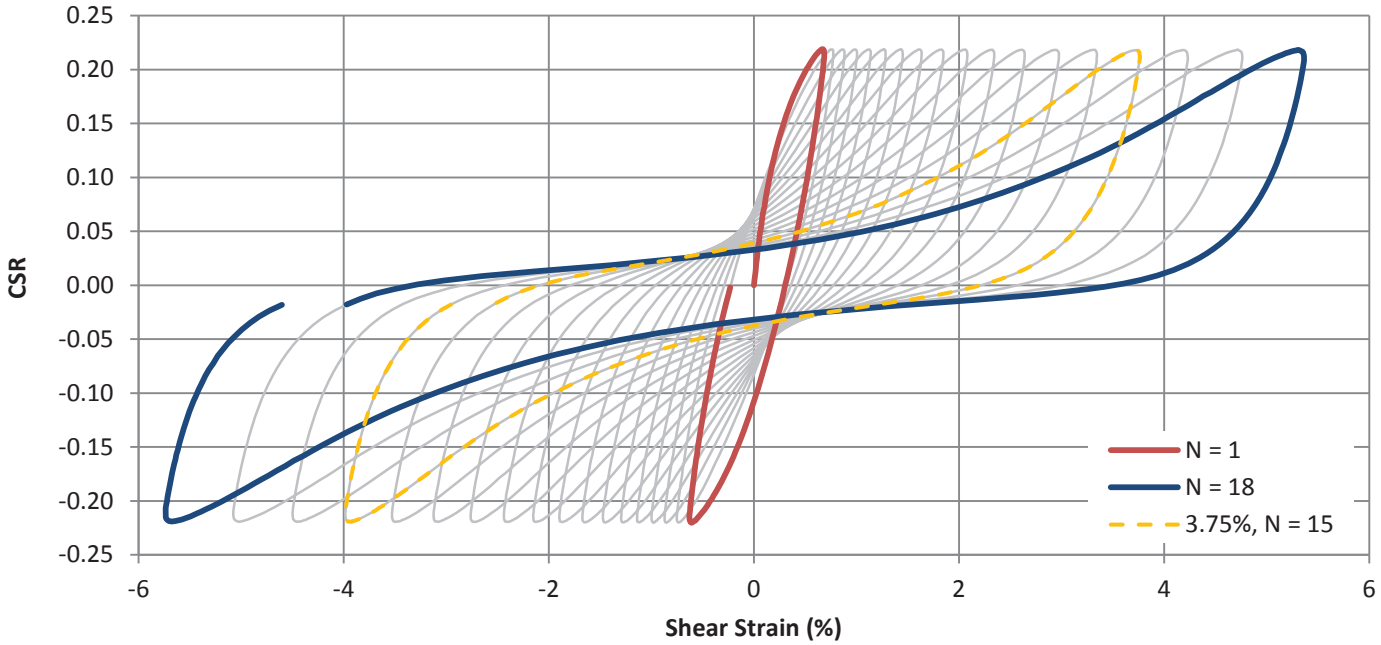
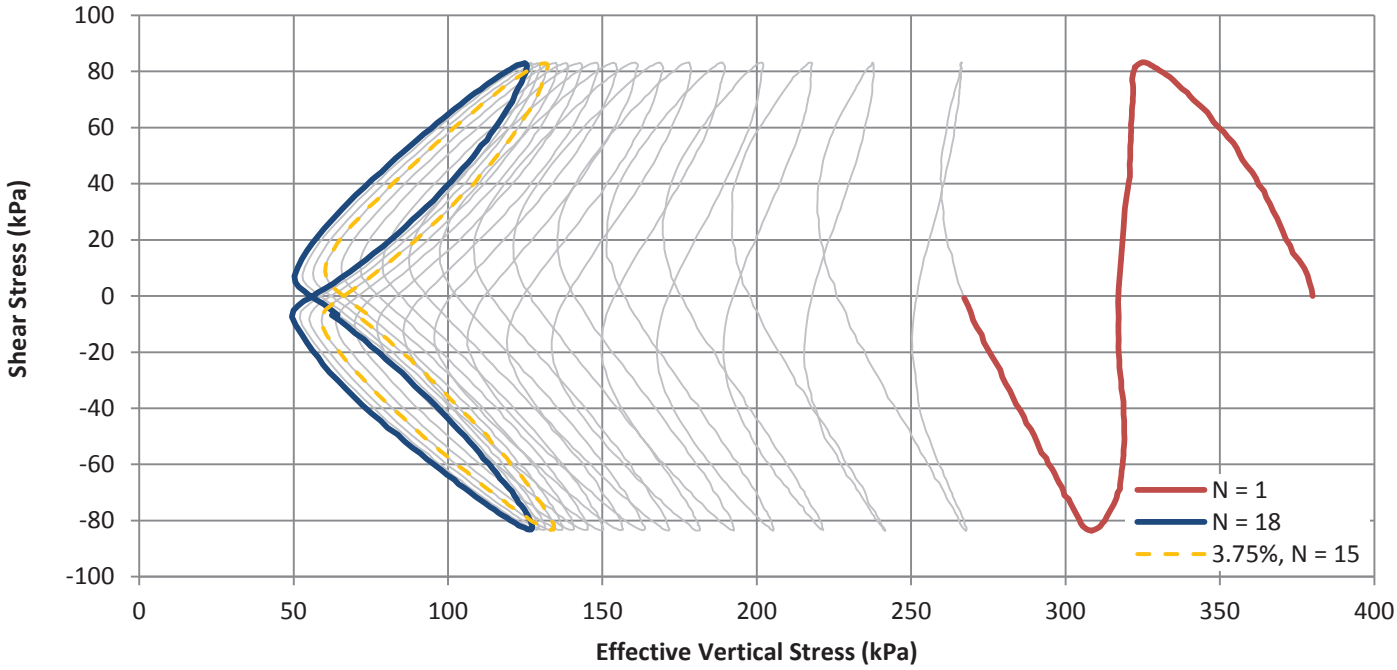
NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.22CSR
Location:	Redmond, WA	**Depth (m):**	35.88-35.92
Client:	GAI	**Lab ID No:**	33





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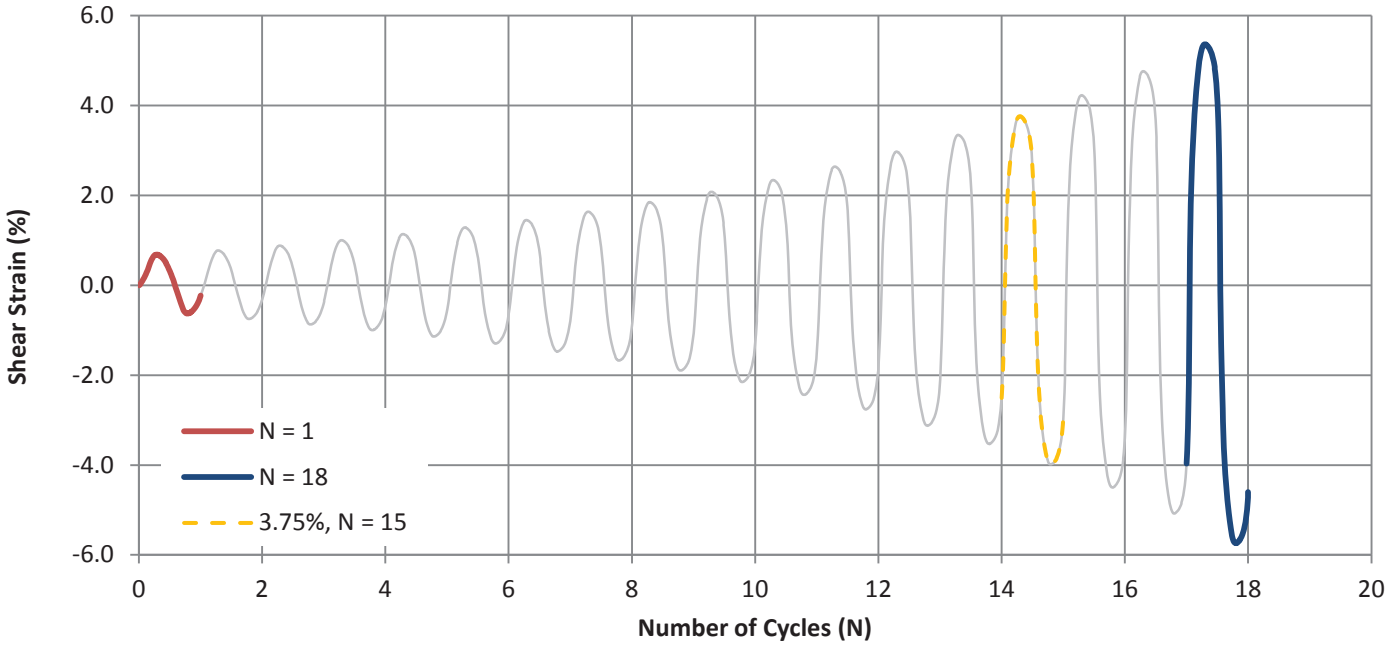
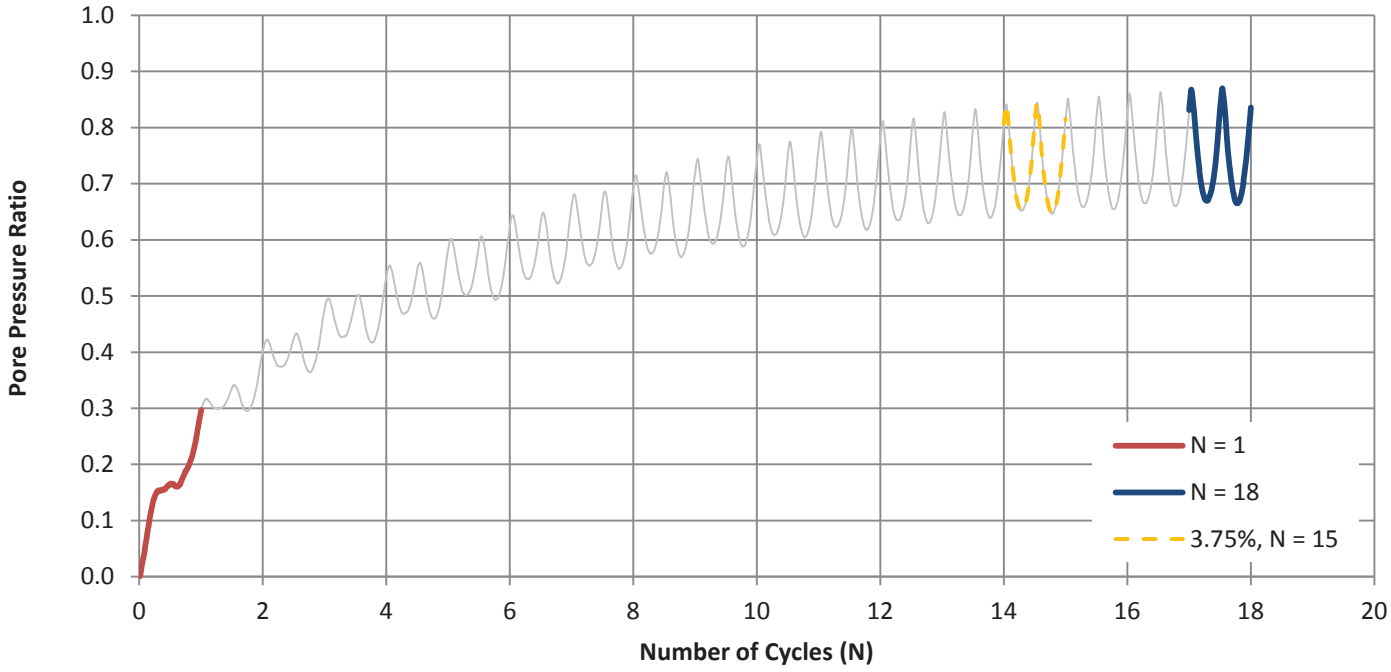
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.22CSR
Location:	Redmond, WA	**Depth (m):**	35.88-35.92
Client:	GAI	**Lab ID No:**	33





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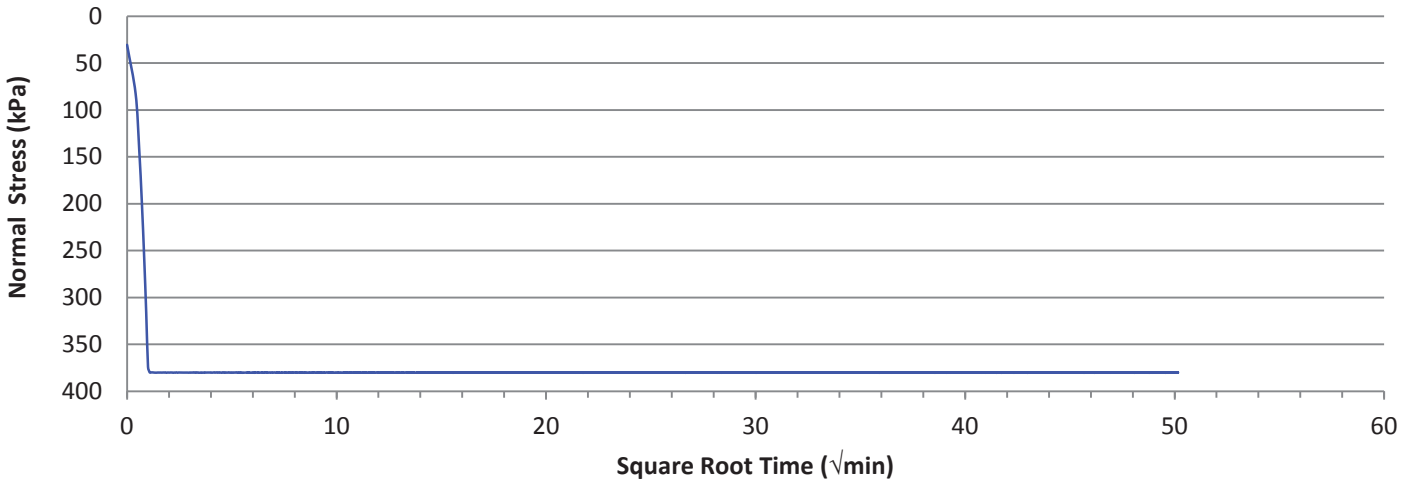
NORSOK G-001

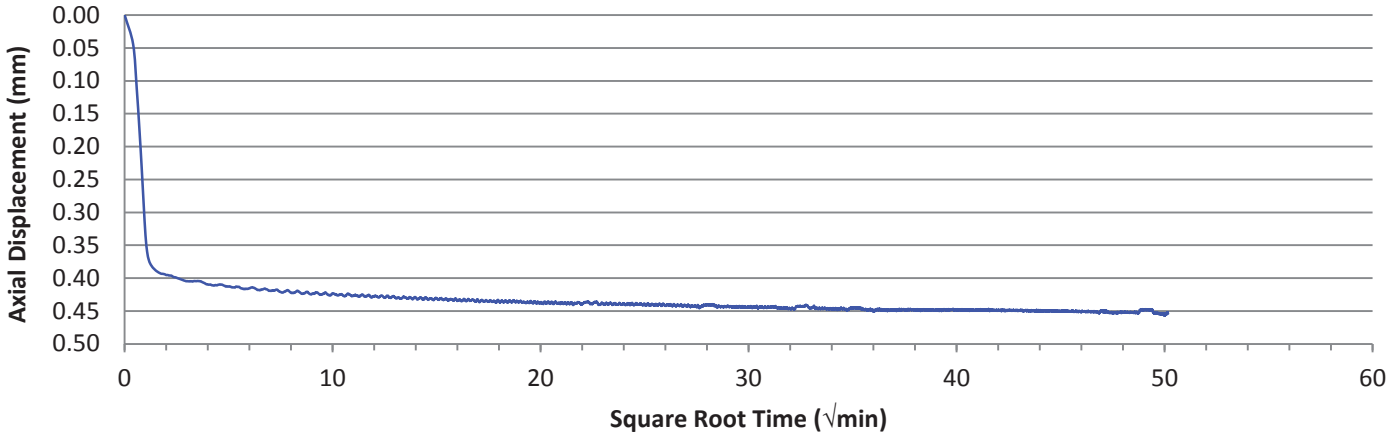
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.22CSR
Location:	Redmond, WA	**Depth (m):**	35.88-35.92
Client:	GAI	**Lab ID No:**	33

Stress at Start of Reconsolidation (kPa)	30.46
Stress at end of Reconsolidation (kPa)	380.07
Axial Strain at end of Reconsolidation (%)	2.02
Change in Height ΔH_c (mm)	0.45

Comments
Reconsolidation data calculated from the sample height at end of initial consolidation

Increment (kPa)	380						
Load (kN)	1.4996						
Duration (min)	2516						
Axial Strain (%)	2.02						





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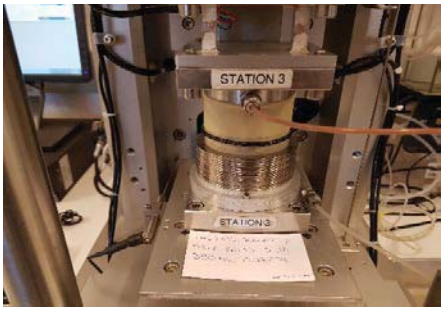
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, 0.22CSR
Location:	Redmond, WA	**Depth (m):**	35.88-35.92
Client:	GAI	**Lab ID No:**	33



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Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, Monotonic
Location:	Redmond, WA	**Depth (m):**	35.80-35.84
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 25mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 3

Vertical LVDT	Serial No.:	11894
Vertical Load Cell	Serial No.:	38407
Shear Load Cell	Serial No.:	158879

Sample Properties

Preparation Method	Trim from Undisturbed	Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.	
Height (mm)	23.36			
Diameter (mm)	70.93	Sand Fraction (%)	26.9	Liquid Limit 24
Area (cm^2)	39.51	Fines Fraction (%)	73.1	Plastic Limit 16
Volume (cm^3)	92.30	Shear Strength est. (kPa)		N/A
Specific Gravity (Measured)	2.69	Sensitivity		N/A

Weight Volume Relationships

Initial Wet Mass (g)	180.64	Initial Water Content (%)	15.62
Dry Mass (g)	156.24	Initial Saturation (%)	71.64
Initial γ_{wet} (kN/m^3)	19.20	Final Water Content (%)	19.72
Initial γ_{dry} (kN/m^3)	16.60	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	3.52
Max Applied Vertical Stress (kPa)	380.88	Axial Strain at end of Consol. %	3.52
Vertical Stress at end of Consol (kPa)	380.47	Change in Height ΔH_c (mm)	0.82
Laboratory OCR	N/A		

Direct Simple Shear Test Results

Initial Vertical Stress (kPa)	380.52	Peak Shear Strength (kPa)	134.43
Initial Shear Stress (kPa)	0.05	Excess Pore Pressure at Peak (kPa)	153.77
Applied Shear Bias (kPa)	0.00	Ratio of Peak / $\sigma'v$	0.35
Rate of Shearing (%/hr)	5.00	Maximum Shear Strain γ_{MAX} (%)	19.98
Test Condition	Undrained	Shear Strength at γ_{MAX} (kPa)	127.65

Comments / Special Instructions

The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

G. Patton	February 22, 2018	M. Sanin	March 9, 2018
TESTED BY	DATE	CHECKED BY	DATE

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GOLDER

Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

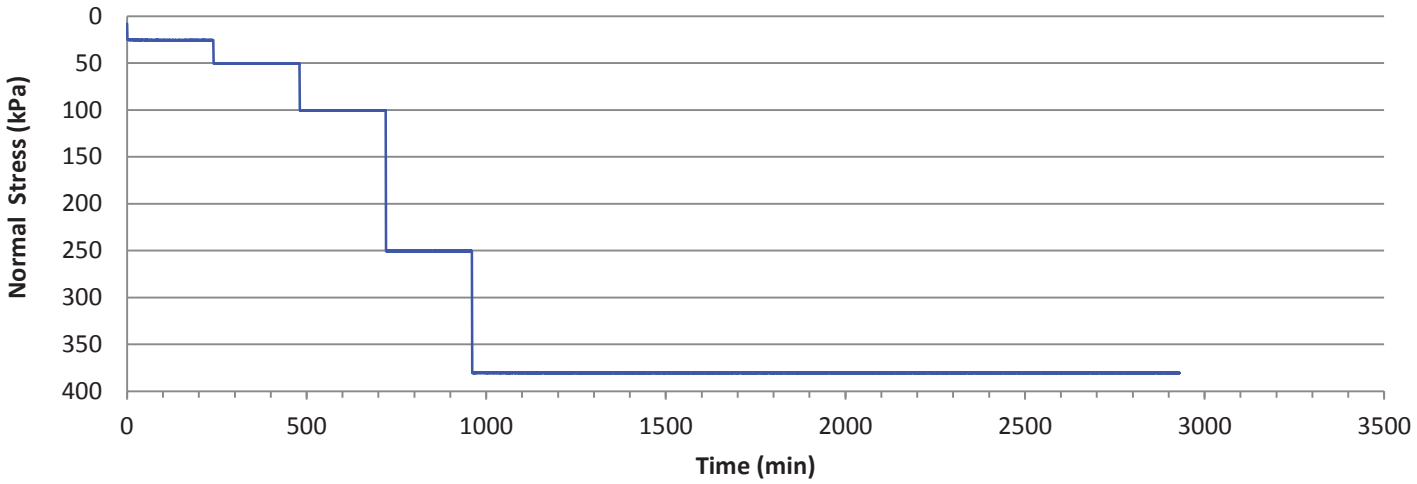
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, Monotonic
Location:	Redmond, WA	**Depth (m):**	35.80-35.84
Client:	GAI	**Lab ID No:**	33

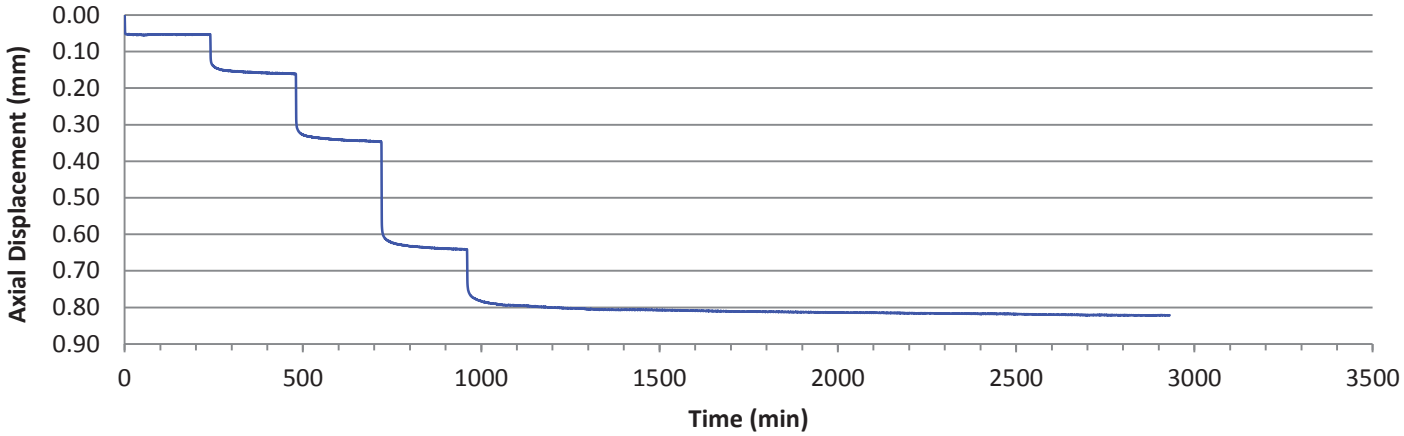
Consolidation Summary

Stress at end of Consolidation (kPa)	380.47
Axial Strain at end of Consolidation (%)	3.52
OCR	N/A
Change in Height ΔH_c (mm)	0.82

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	380		
Load (kN)	0.101	0.2004	0.3982	0.9913	1.505		
Duration (min)	240	240	240	240	1971		
Axial Strain (%)	0.24	0.69	1.49	2.75	3.52		





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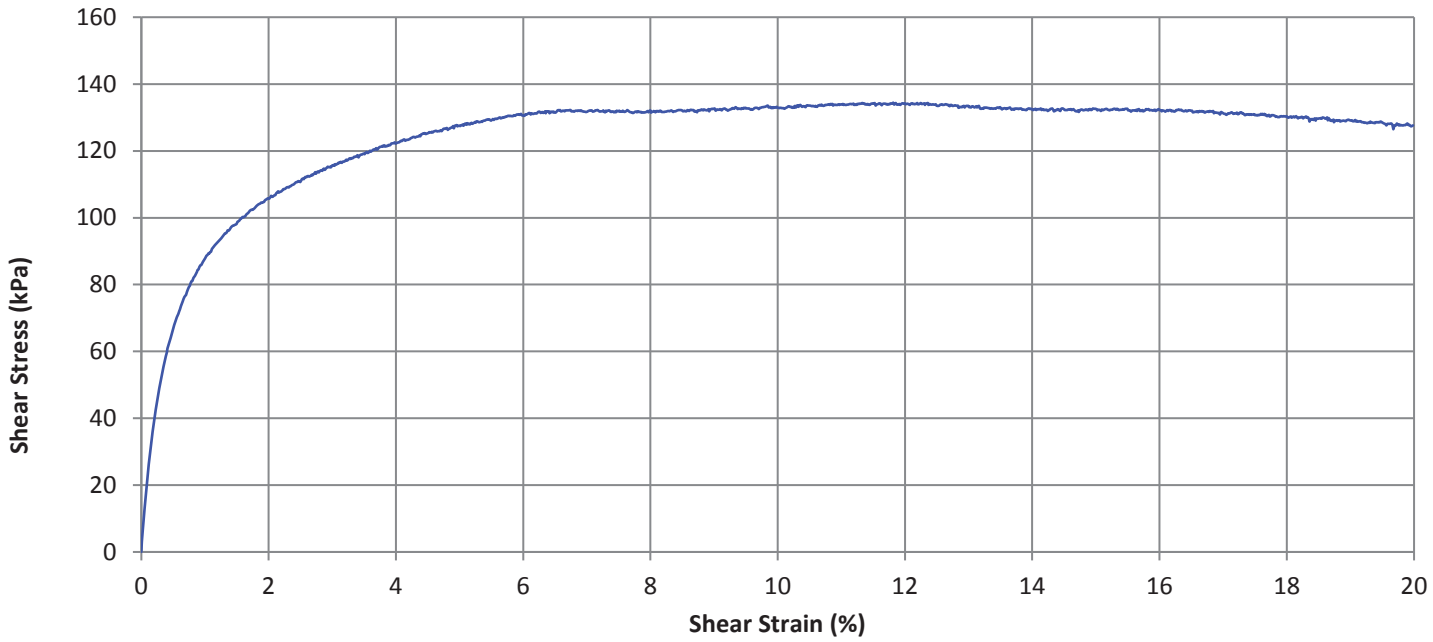
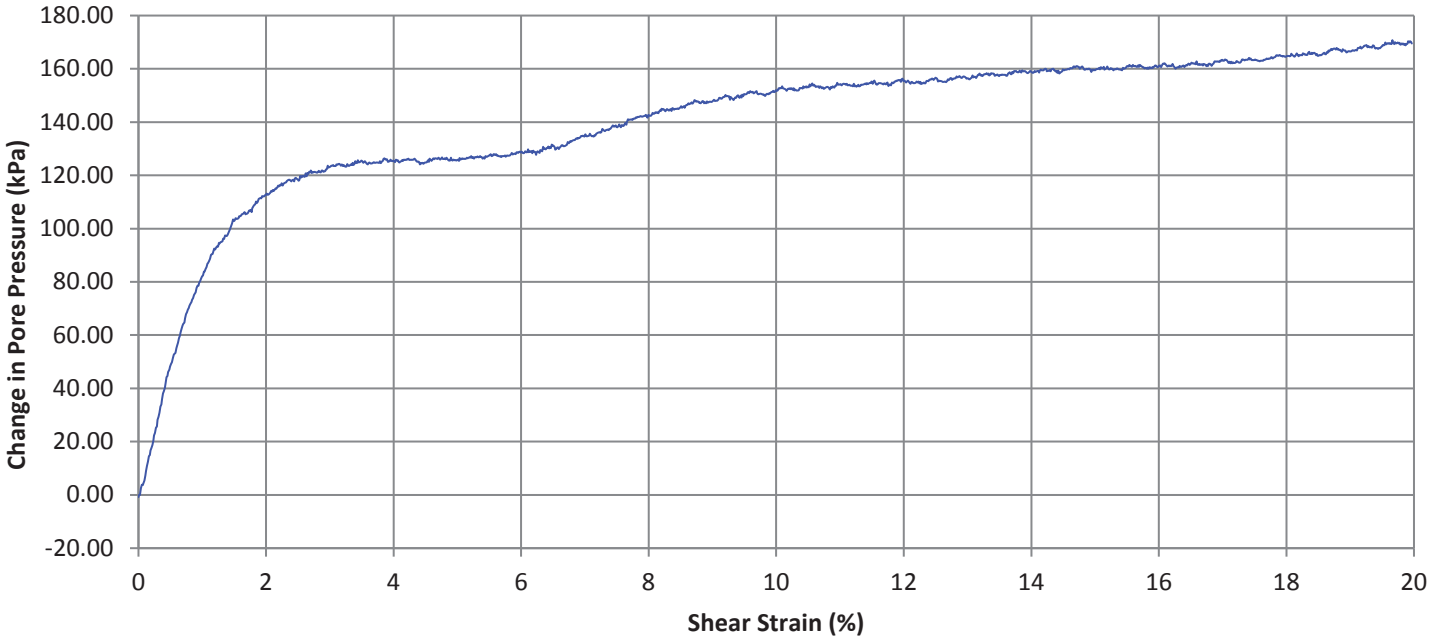
Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G033 S-28
Project:	Sound Transit Redmond Link Extension	**Test ID:**	380kPa, Monotonic
Location:	Redmond, WA	**Depth (m):**	35.80-35.84
Client:	GAI	**Lab ID No:**	33





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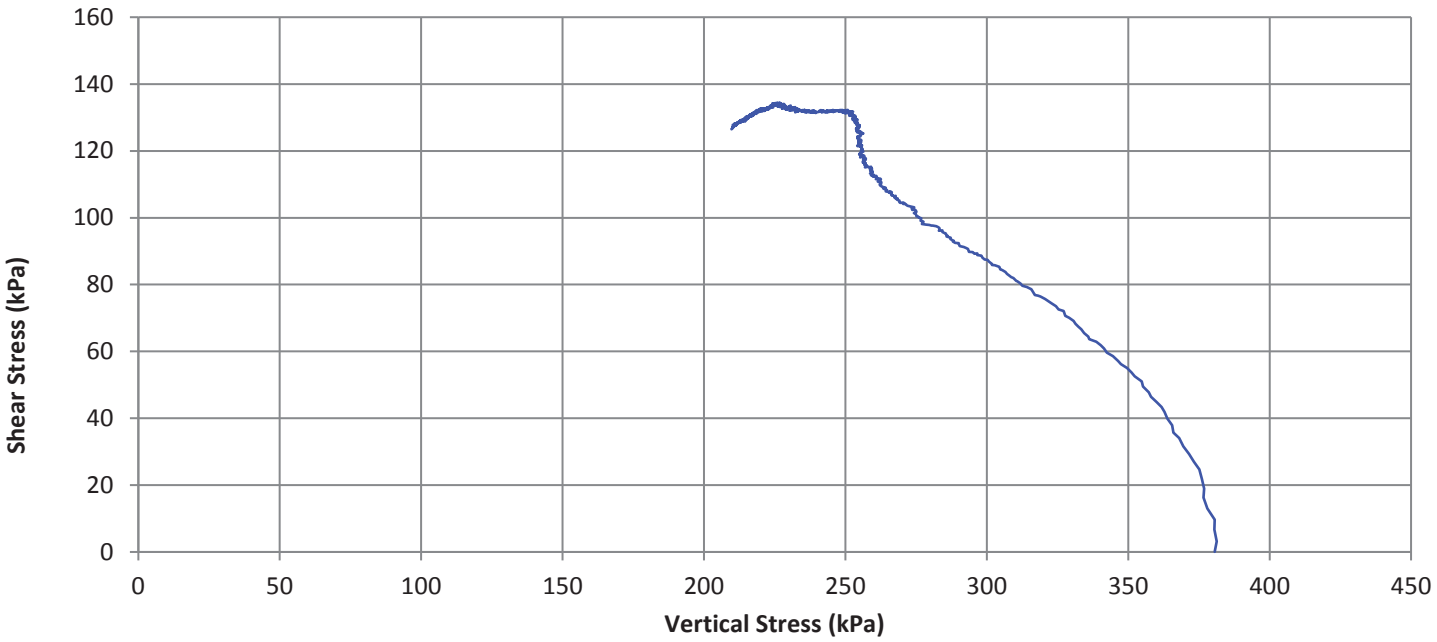

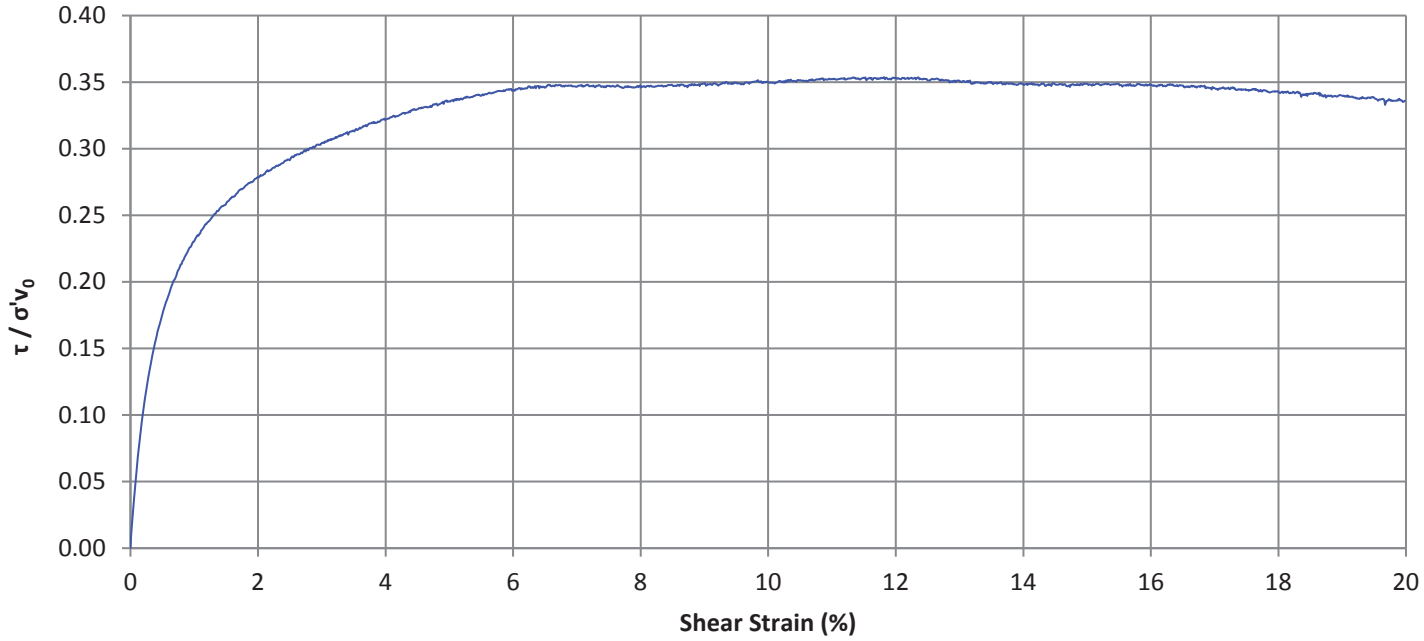

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GOLDER

Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	36.19-36.23
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 50mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 2

Vertical LVDT	Serial No.:	11897
Vertical Load Cell	Serial No.:	38408
Shear Load Cell	Serial No.:	158877

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.52
Diameter (mm)	70.91
Area (cm^2)	39.49
Volume (cm^3)	92.88
Specific Gravity (Measured)	2.73

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	18.09	Liquid Limit	30
Fines Fraction (%)	81.91	Plastic Limit	15
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	191.1	Initial Water Content (%)	23.26
Dry Mass (g)	155.04	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	20.18	Final Water Content (%)	21.04
Initial Dry Unit Weight (kN/m^3)	16.37	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	3.56
Max Applied Vertical Stress (kPa)	320.90	Axial Strain at end of Consol. %	3.56
Vertical Stress at end of Consol (kPa)	320.50	Change in Height ΔH_c (mm)	0.84
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.12
Cycles to 3.75% Shear Strain	3.75% not reached
Initial Vertical Stress (kPa)	321.99
Max Abs. Cyclic Shear Stress (kPa)	38.64
Max. Shear Strain at N= n/a (zero load)	3.75% not reached
Min. Shear Strain at N= n/a (zero load)	3.75% not reached
Max. DU at N= n/a (zero load)	3.75% not reached
Min. DU at N= n/a (zero load)	3.75% not reached

Post Cyclic Monotonic Test Results

Initial Vertical Stress (kPa)	246.15
Initial Shear Stress (kPa)	-1.85
Applied Shear Bias (kPa)	0.00
Rate of Shearing (%/hr)	4.96
Peak Shear Strength (kPa)	97.26
Excess Pore Pressure at Peak (kPa)	143.57
Ratio of Peak / $\sigma'v$	0.30
Maximum Shear Strain γ_{MAX} (%)	19.99
Shear Strength at γ_{MAX} (kPa)	96.12

Comments / Special Instructions

Comments / Special Instructions

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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

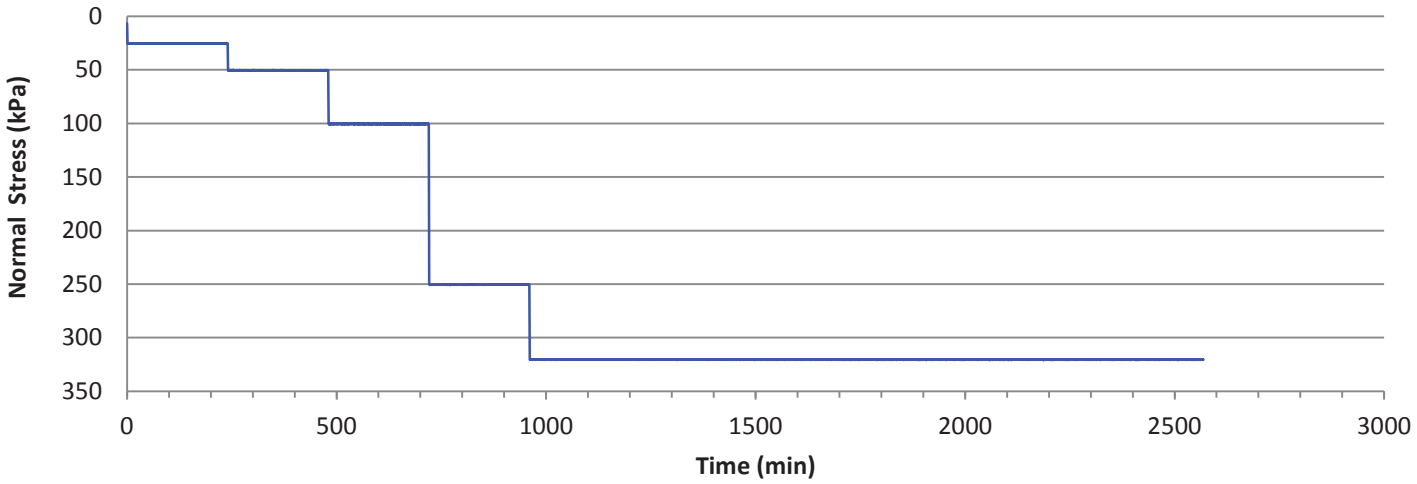
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	36.19-36.23
Client:	GAI	**Lab ID No:**	33

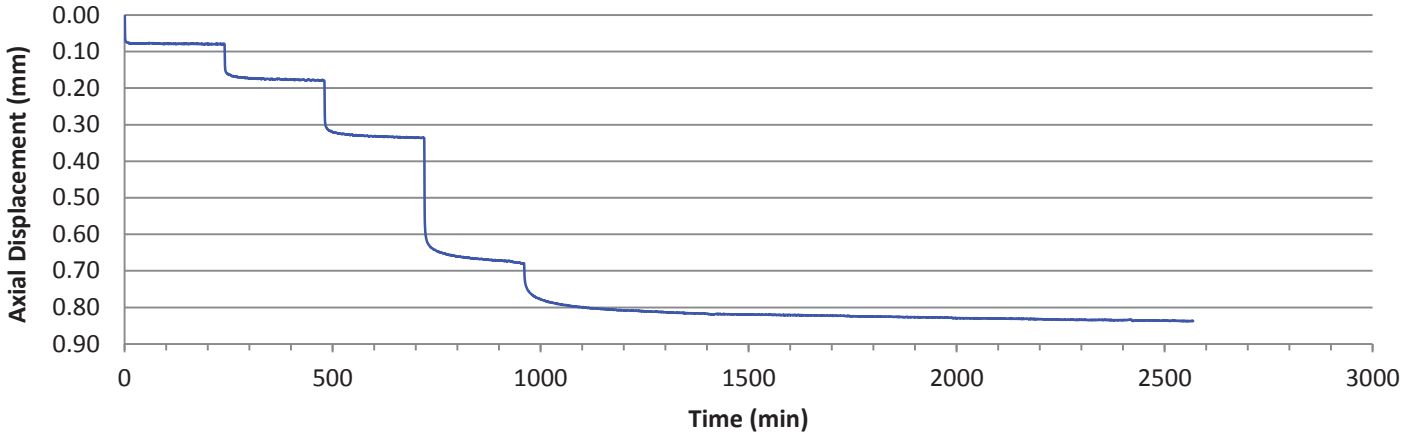
Consolidation Summary

Stress at end of Consolidation (kPa)	320.50
Axial Strain at end of Consolidation (%)	3.56
OCR	N/A
Change in Height ΔH_c (mm)	0.84

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	320		
Load (kN)	0.1012	0.2006	0.398	0.9904	1.2673		
Duration (min)	240	240	240	240	1608		
Axial Strain (%)	0.34	0.76	1.43	2.89	3.56		





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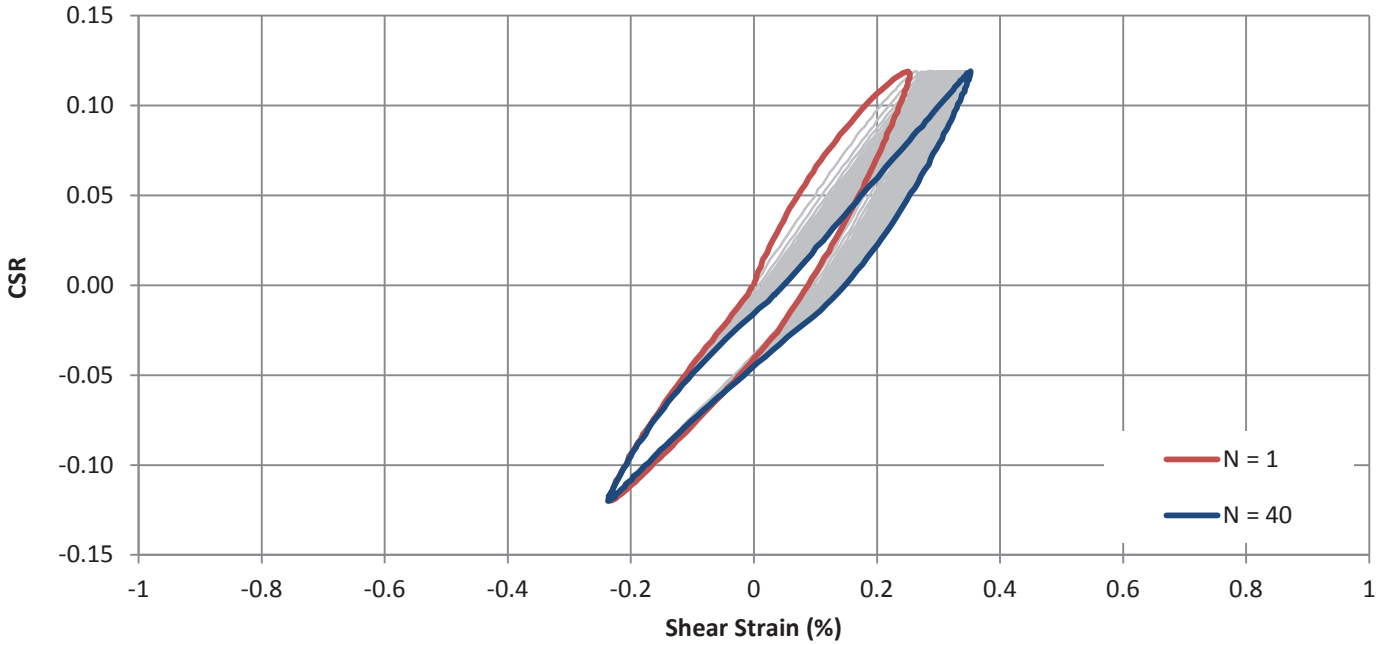
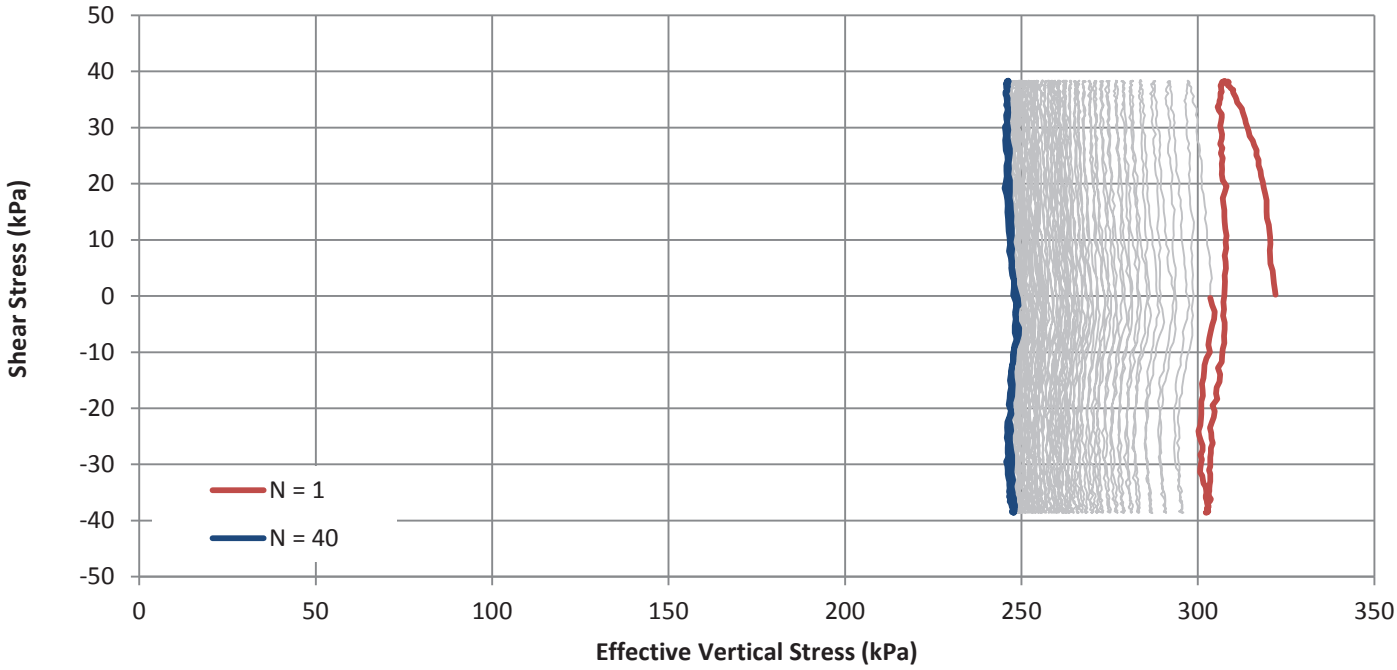
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	36.19-36.23
Client:	GAI	**Lab ID No:**	33





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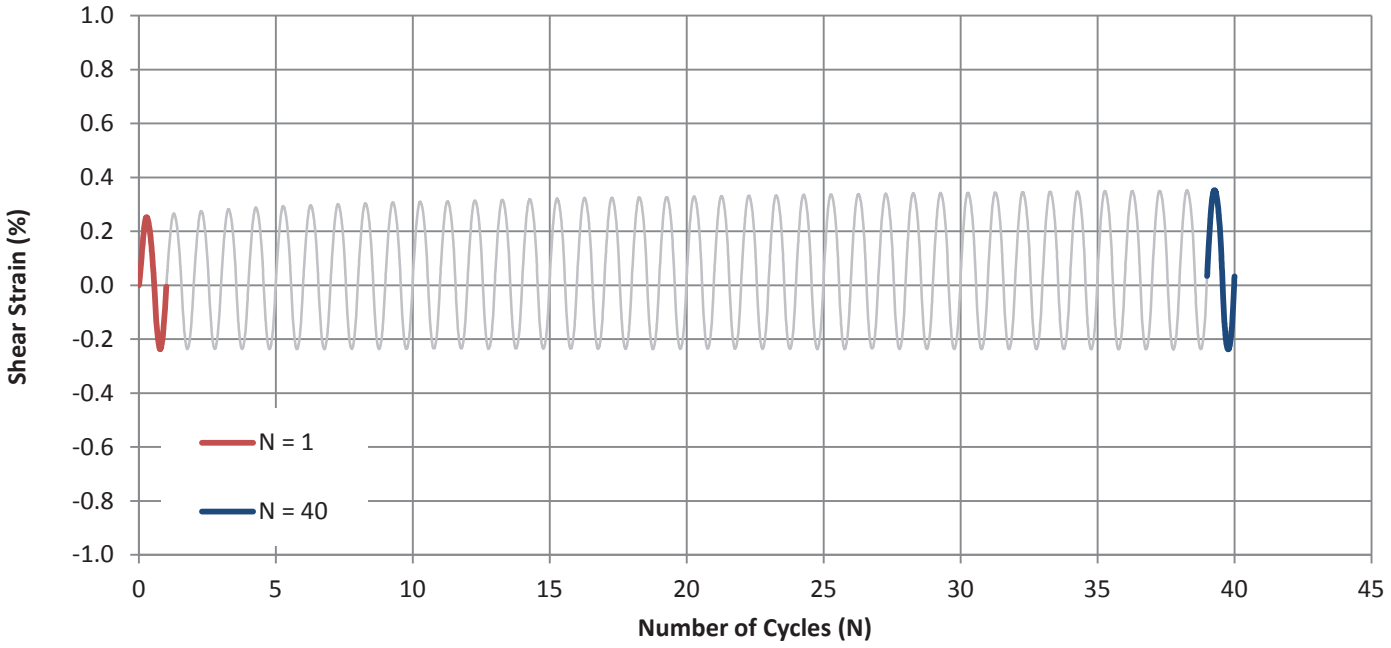
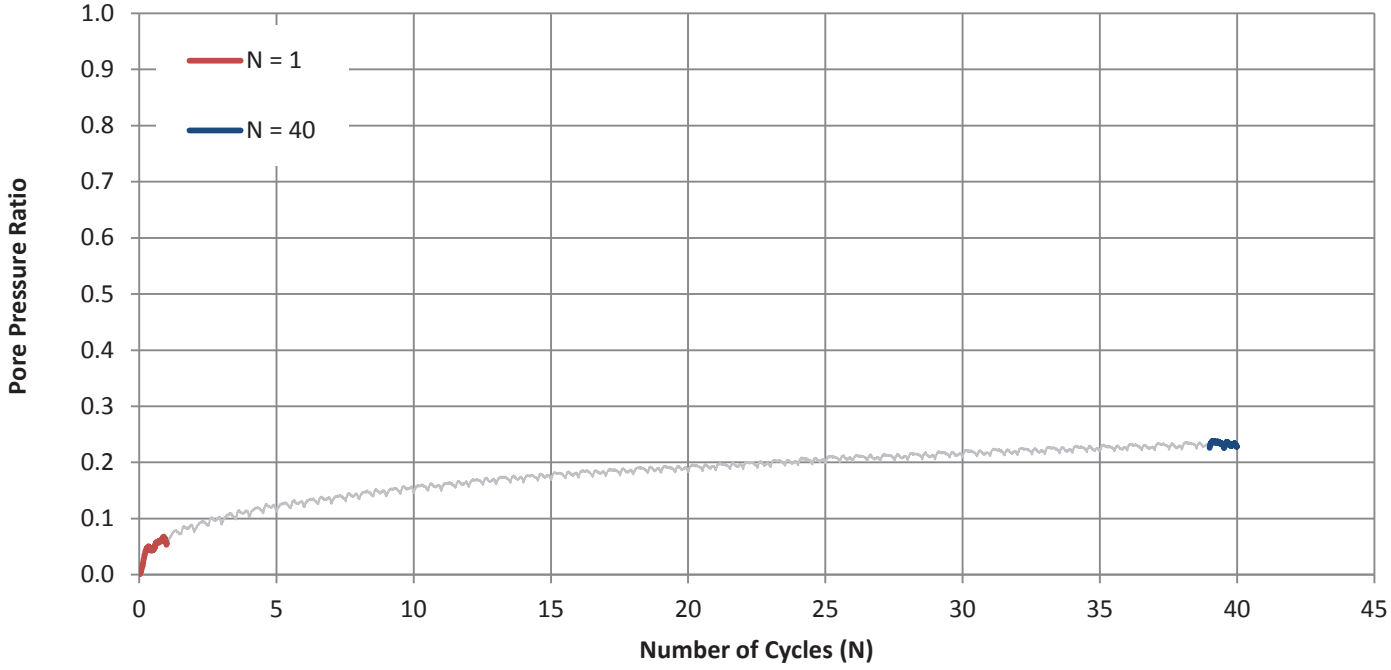
Location:	Redmond, WA	**Depth (m):**	36.19-36.23
Client:	GAI	**Lab ID No:**	33





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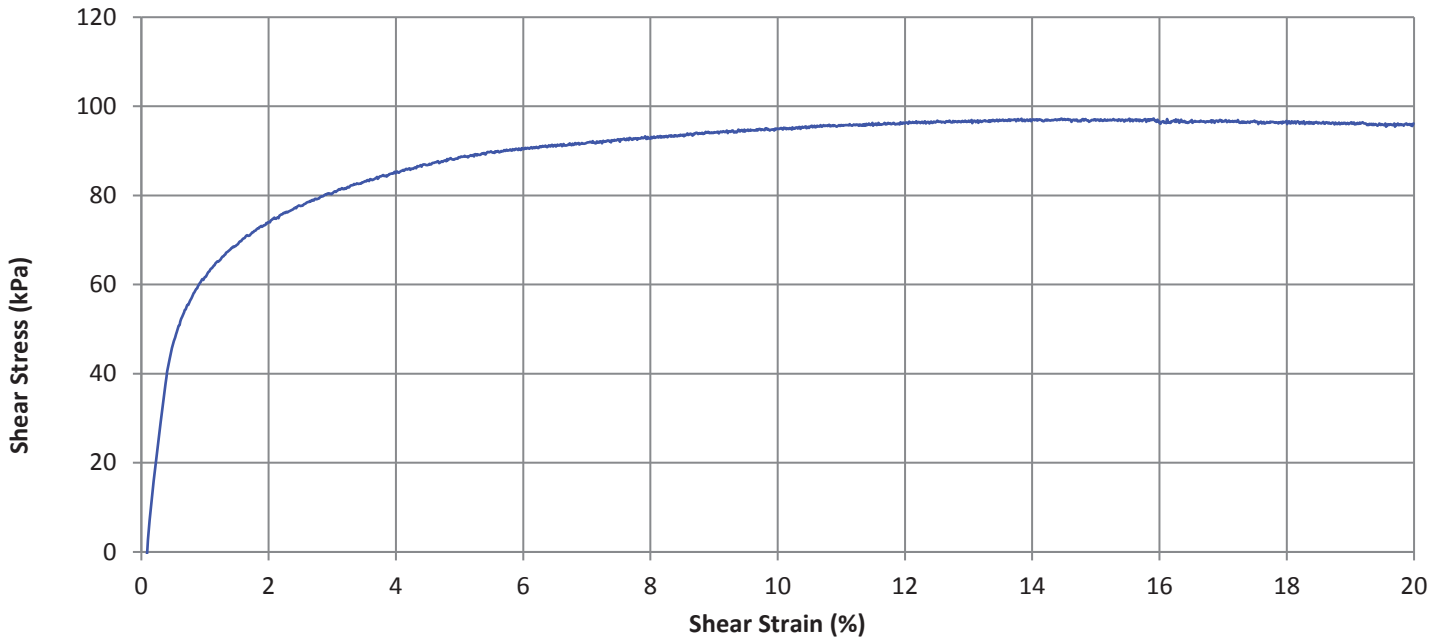
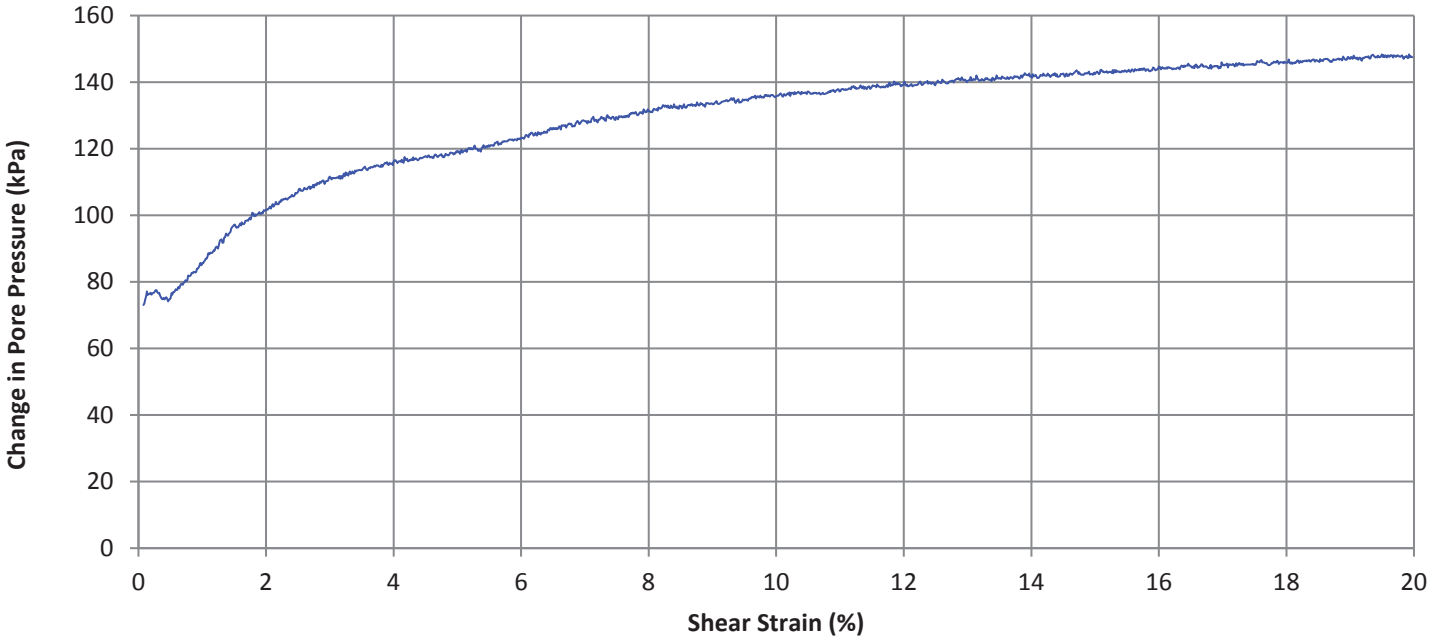
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	36.19-36.23
Client:	GAI	**Lab ID No:**	33





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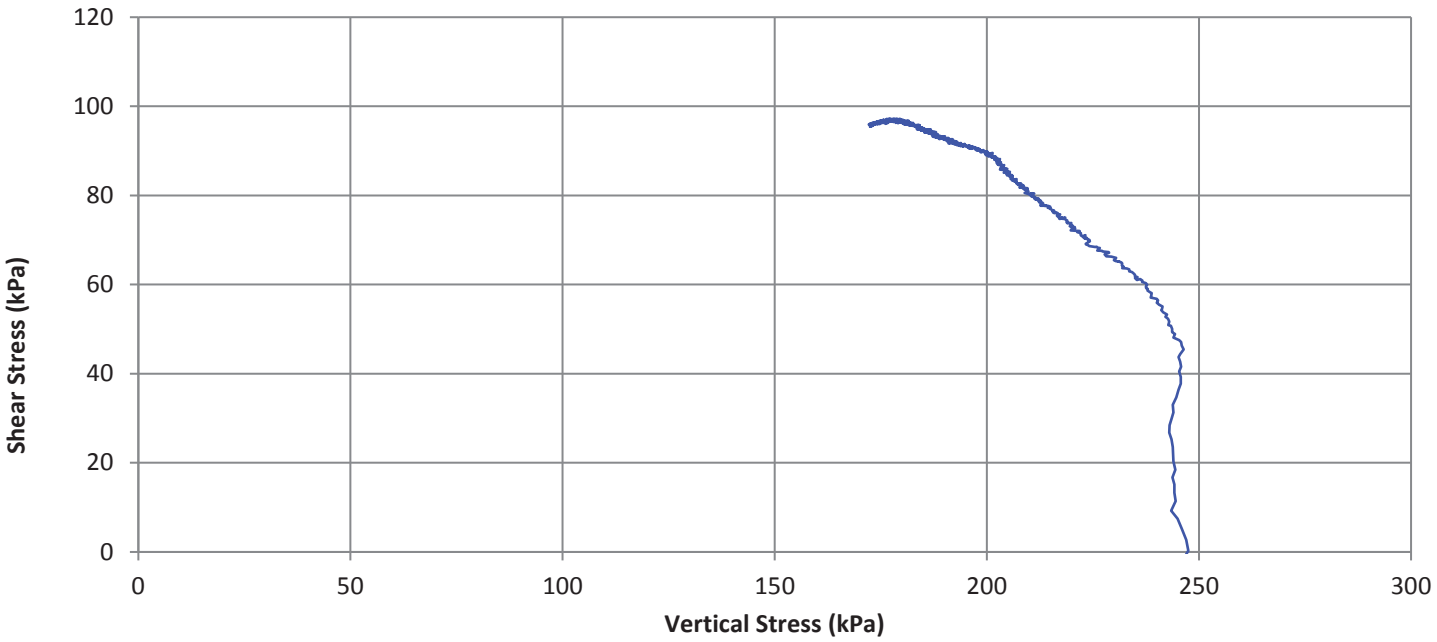
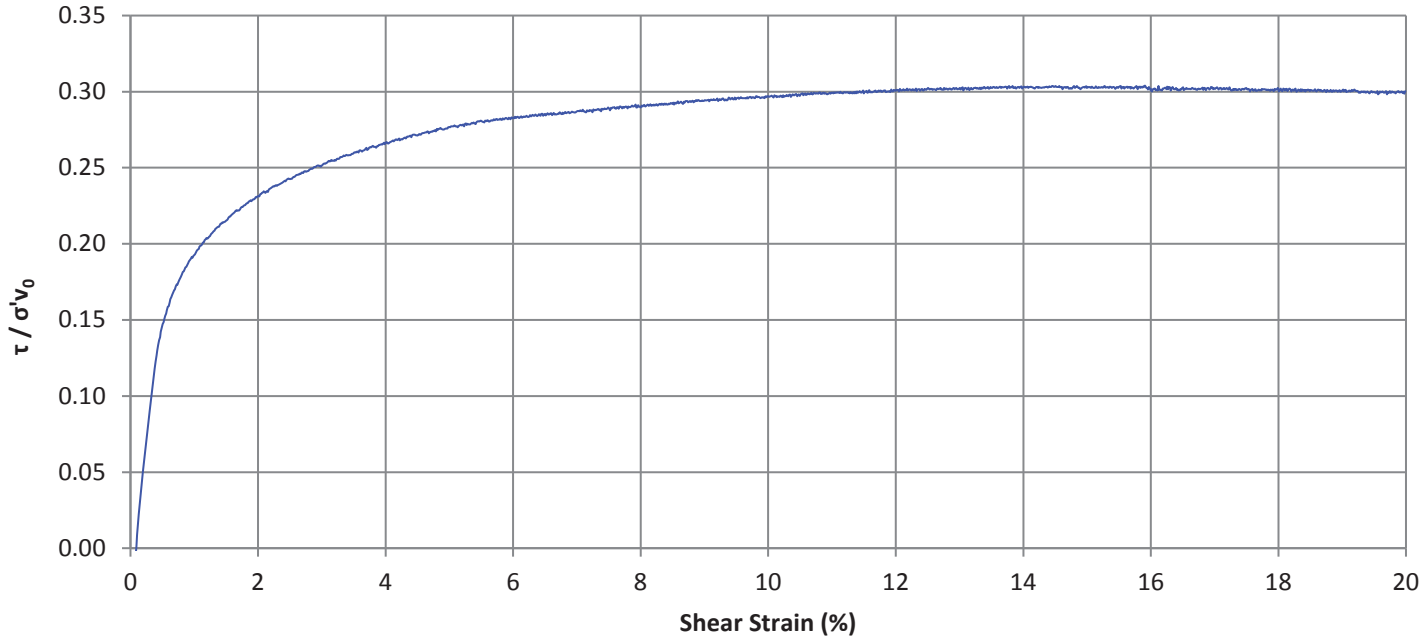
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	36.19-36.23
Client:	GAI	**Lab ID No:**	33





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NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.12CSR
Location:	Redmond, WA	**Depth (m):**	36.19-36.23
Client:	GAI	**Lab ID No:**	33

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NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	36.23-36.27
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 50mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 3

Vertical LVDT	Serial No.:	11894
Vertical Load Cell	Serial No.:	38407
Shear Load Cell	Serial No.:	158879

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.47
Diameter (mm)	70.91
Area (cm^2)	39.49
Volume (cm^3)	92.69
Specific Gravity (Measured)	2.73

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	18.09	Liquid Limit	30
Fines Fraction (%)	81.91	Plastic Limit	15
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	189.5	Initial Water Content (%)	24.10
Dry Mass (g)	152.7	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	20.06	Final Water Content (%)	22.19
Initial Dry Unit Weight (kN/m^3)	16.16	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	2.92
Max Applied Vertical Stress (kPa)	320.50	Axial Strain at end of Consol. %	2.92
Vertical Stress at end of Consol (kPa)	319.97	Change in Height ΔH_c (mm)	0.69
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.16
Cycles to 3.75% Shear Strain	3.75% not reached
Initial Vertical Stress (kPa)	320.02
Max Abs. Cyclic Shear Stress (kPa)	51.25
Max. Shear Strain at N= n/a (zero load)	3.75% not reached
Min. Shear Strain at N= n/a (zero load)	3.75% not reached
Max. DU at N= n/a (zero load)	3.75% not reached
Min. DU at N= n/a (zero load)	3.75% not reached

Post Cyclic Monotonic Test Results

Initial Vertical Stress (kPa)	212.98
Initial Shear Stress (kPa)	-3.34
Applied Shear Bias (kPa)	0.00
Rate of Shearing (%/hr)	5.00
Peak Shear Strength (kPa)	115.82
Excess Pore Pressure at Peak (kPa)	111.42
Ratio of Peak / $\sigma'v$	0.36
Maximum Shear Strain γ_{MAX} (%)	20.00
Shear Strength at γ_{MAX} (kPa)	112.18

Comments / Special Instructions

Comments / Special Instructions

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NORSOK G-001

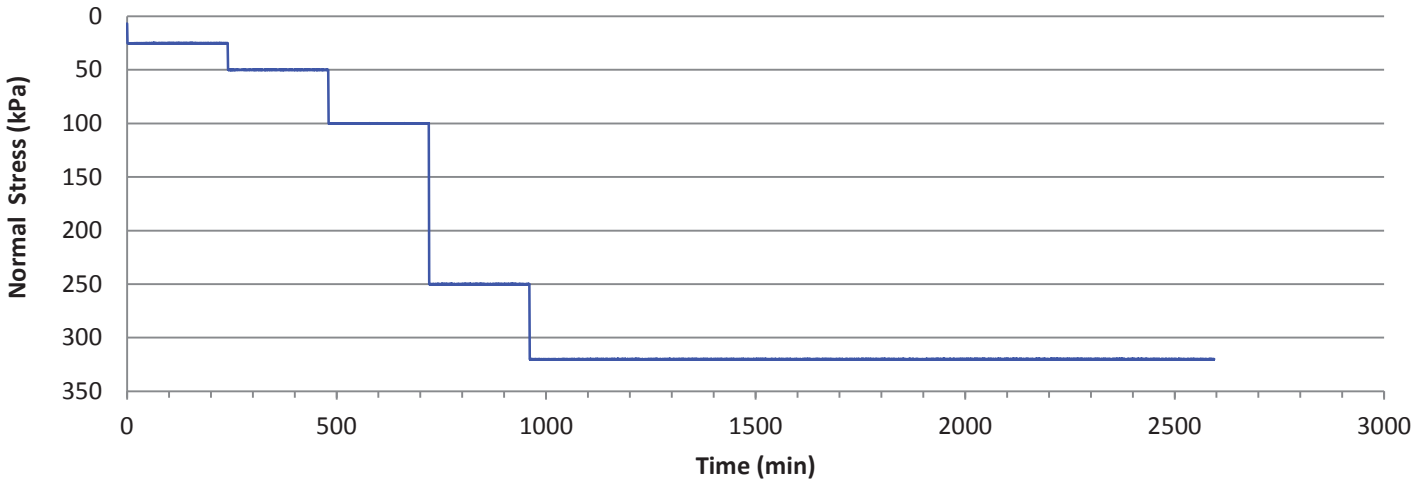
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	36.23-36.27
Client:	GAI	**Lab ID No:**	33

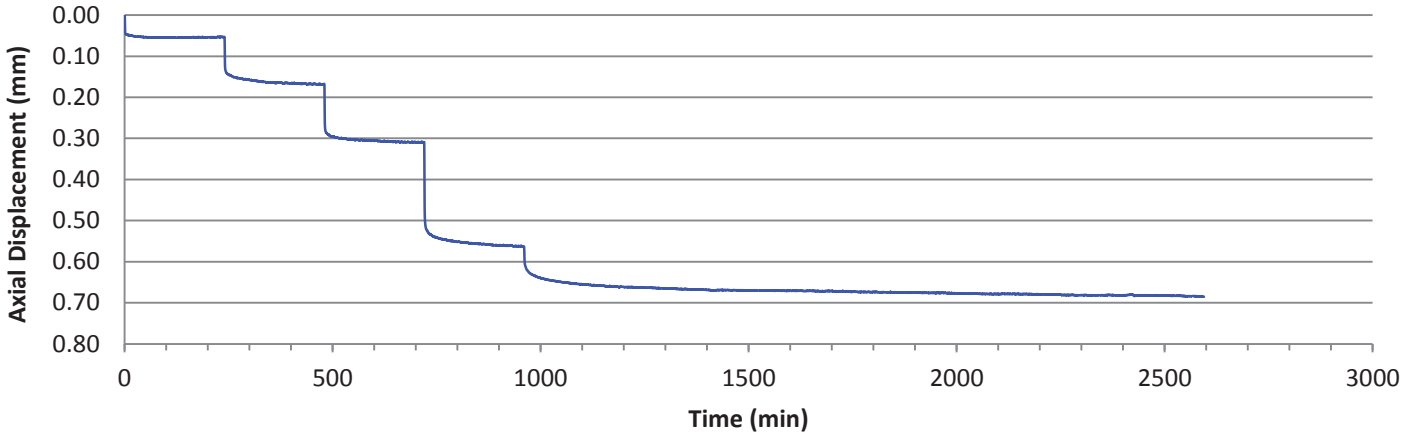
Consolidation Summary

Stress at end of Consolidation (kPa)	319.97
Axial Strain at end of Consolidation (%)	2.92
OCR	N/A
Change in Height ΔH_c (mm)	0.69

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	320		
Load (kN)	0.1001	0.1983	0.3964	0.9889	1.2657		
Duration (min)	240	240	240	240	1634		
Axial Strain (%)	0.23	0.72	1.32	2.40	2.92		





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NORSOK G-001

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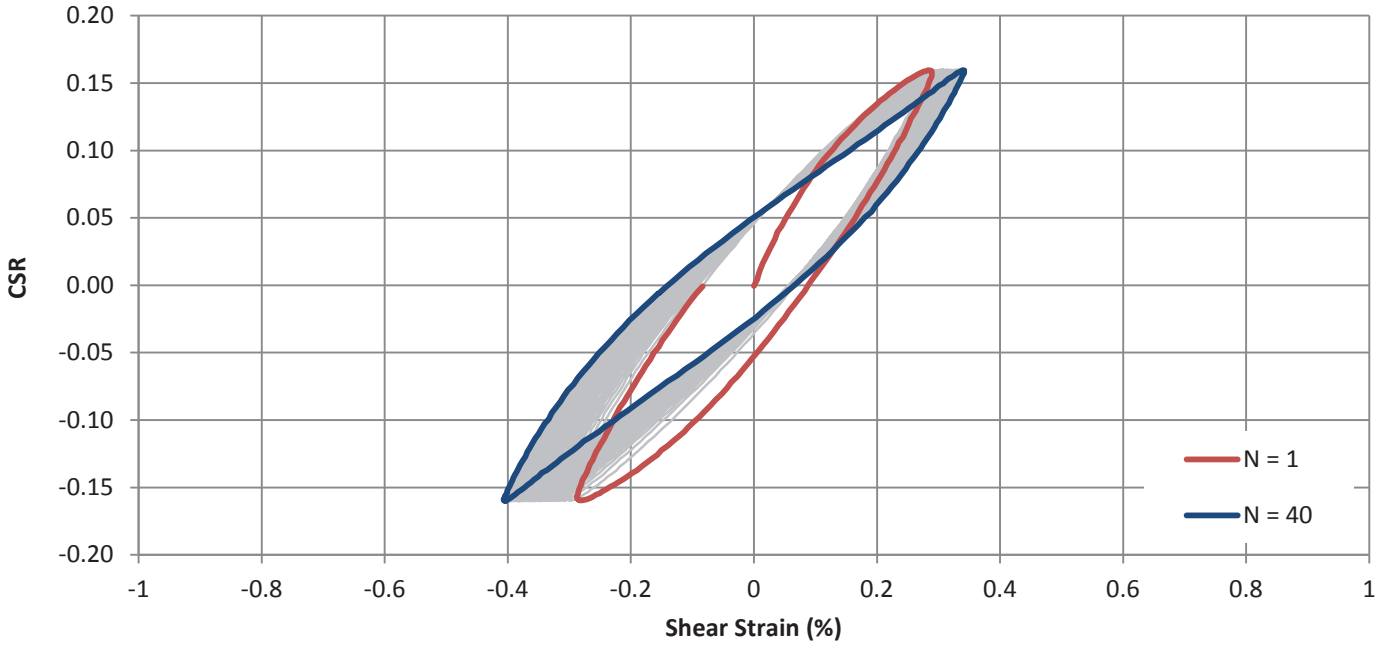
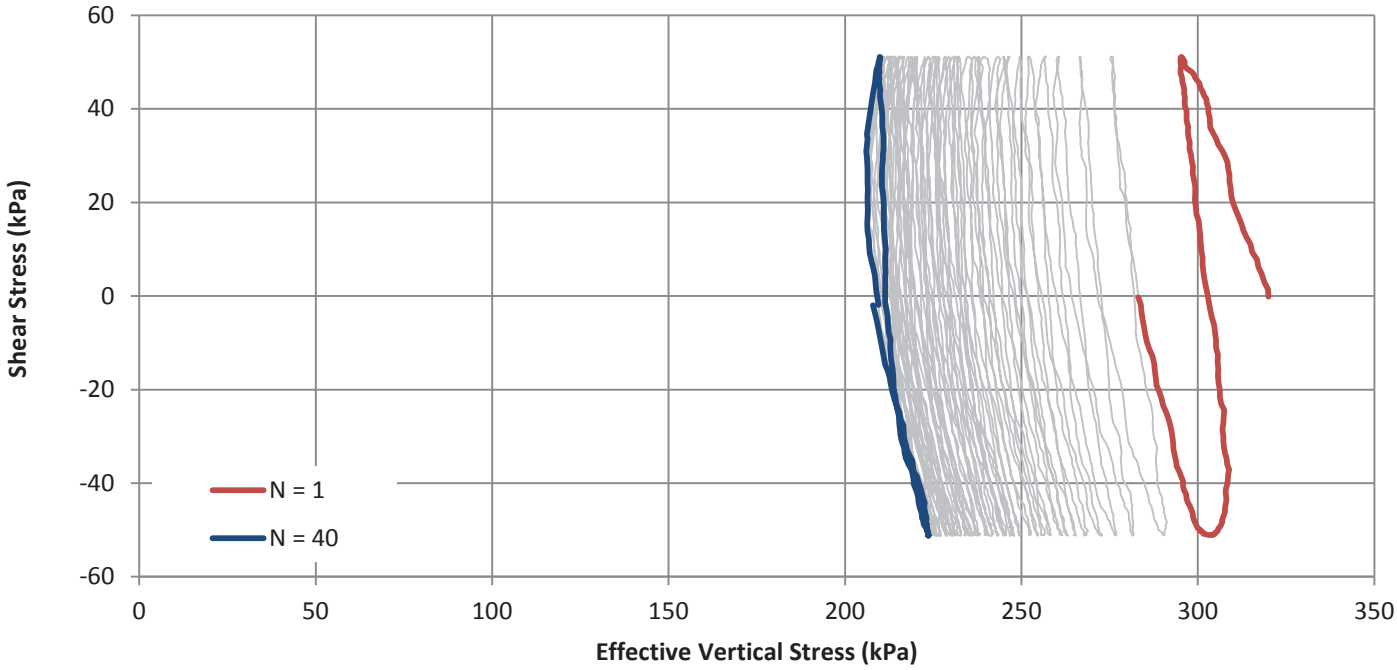
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	36.23-36.27
Client:	GAI	**Lab ID No:**	33





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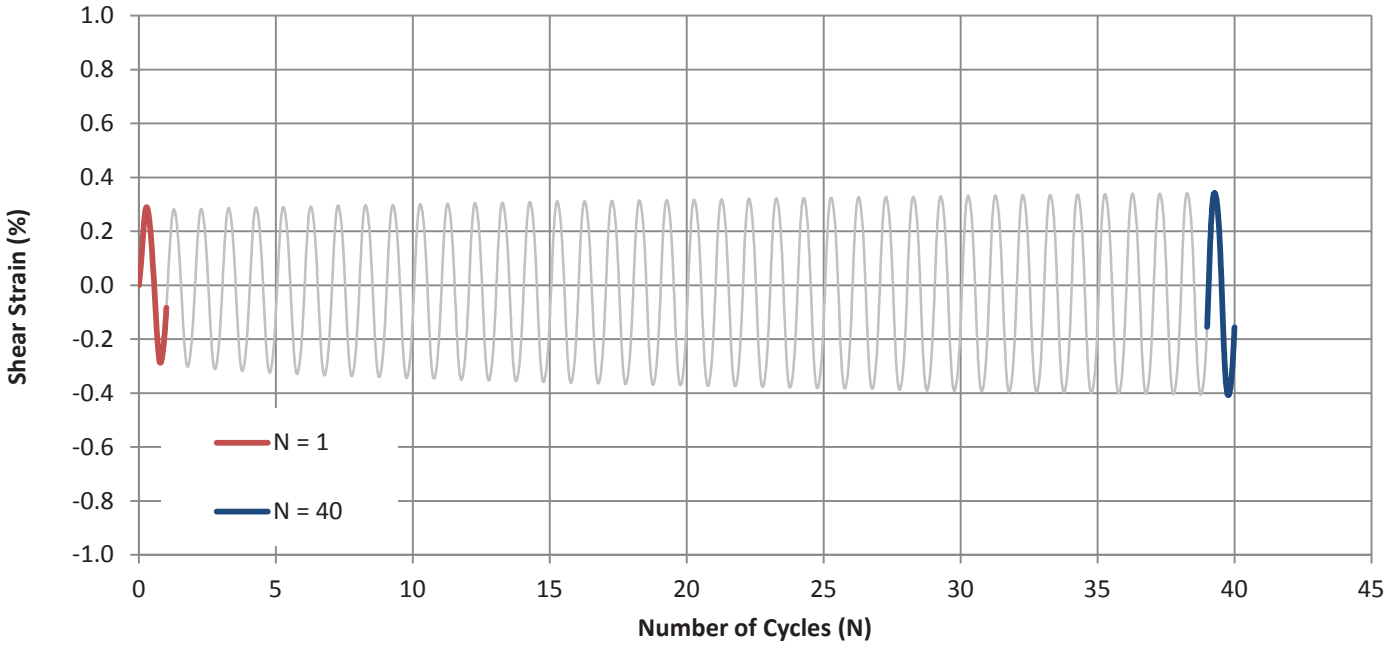
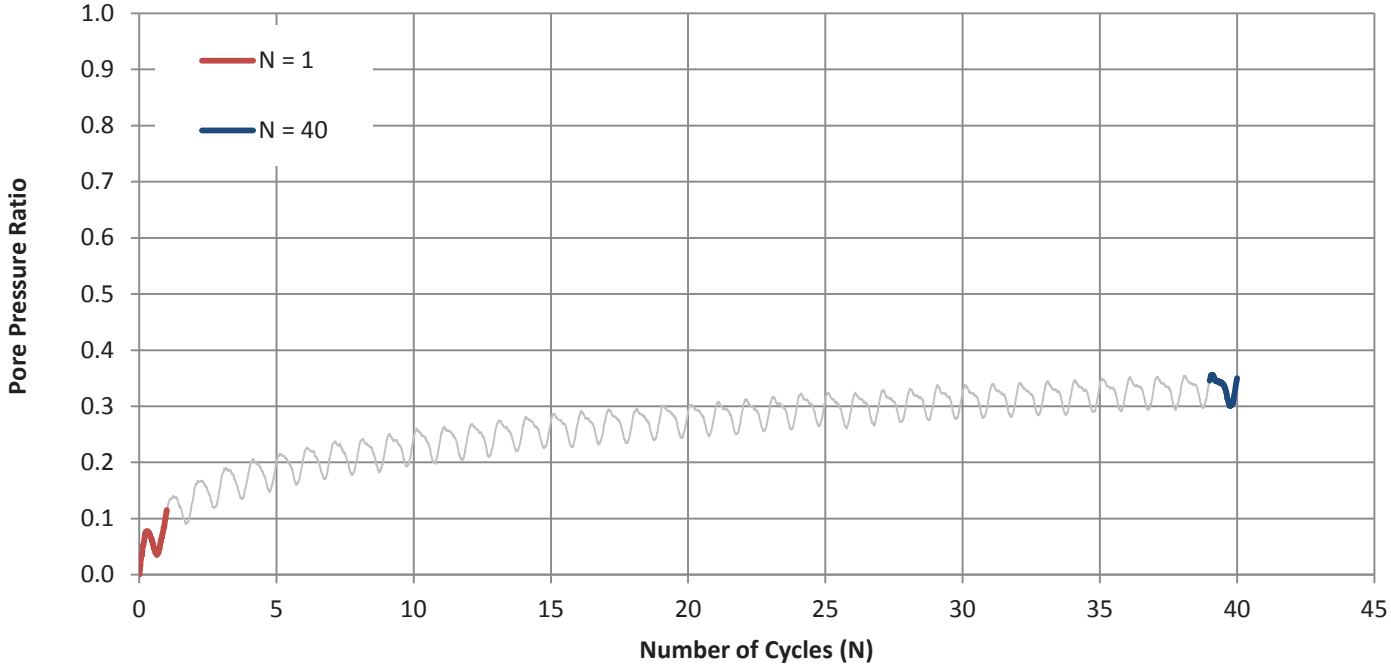
GOLDER

Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.16CSR
Location:	Redmond, WA	**Depth (m):**	36.23-36.27
Client:	GAI	**Lab ID No:**	33





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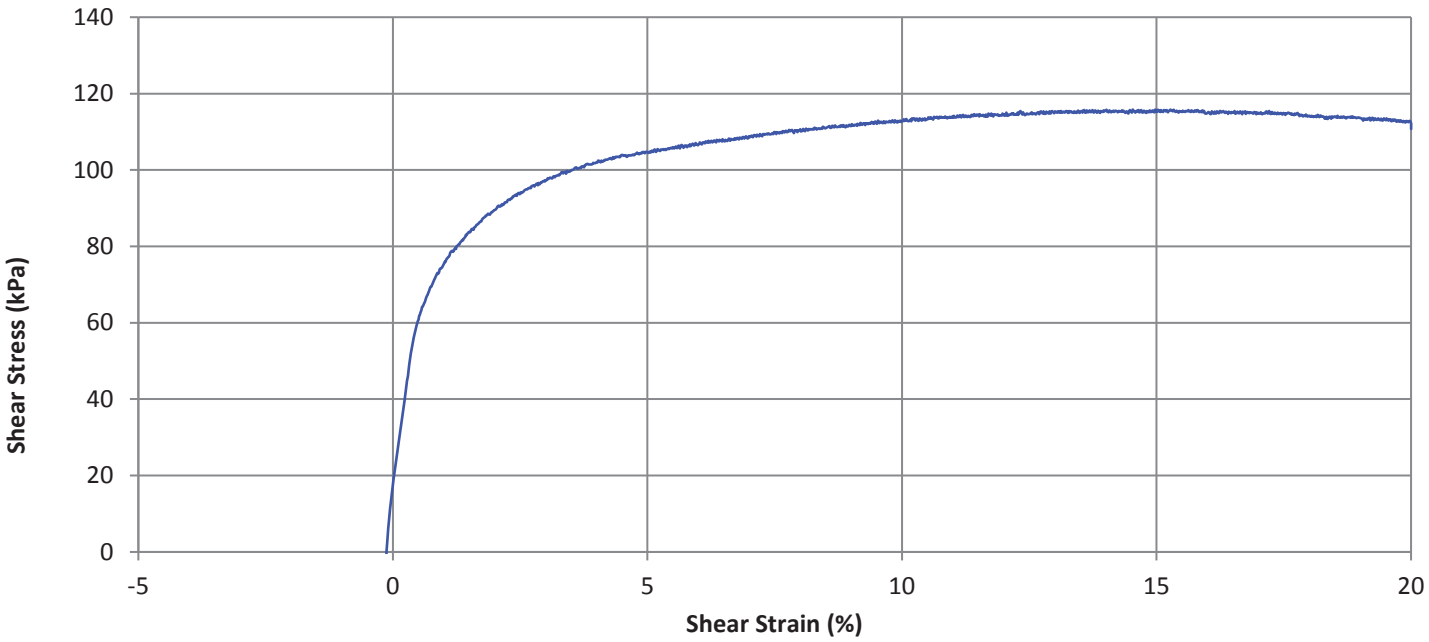

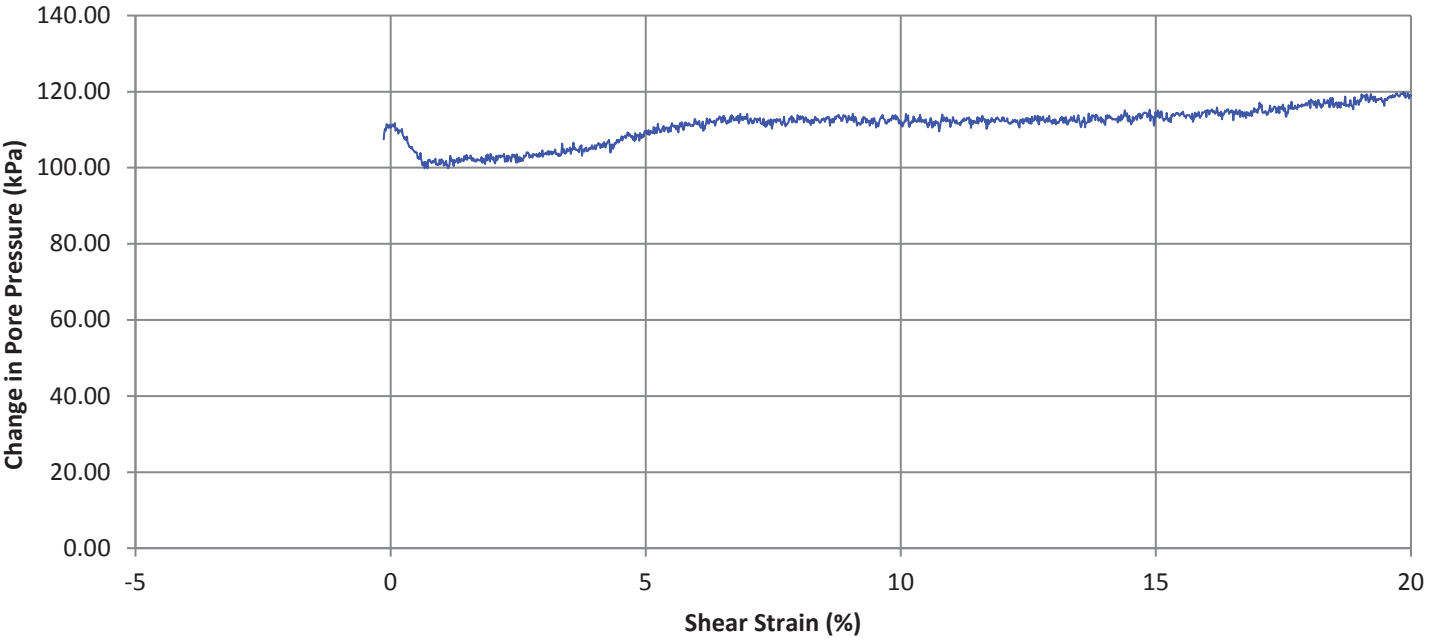

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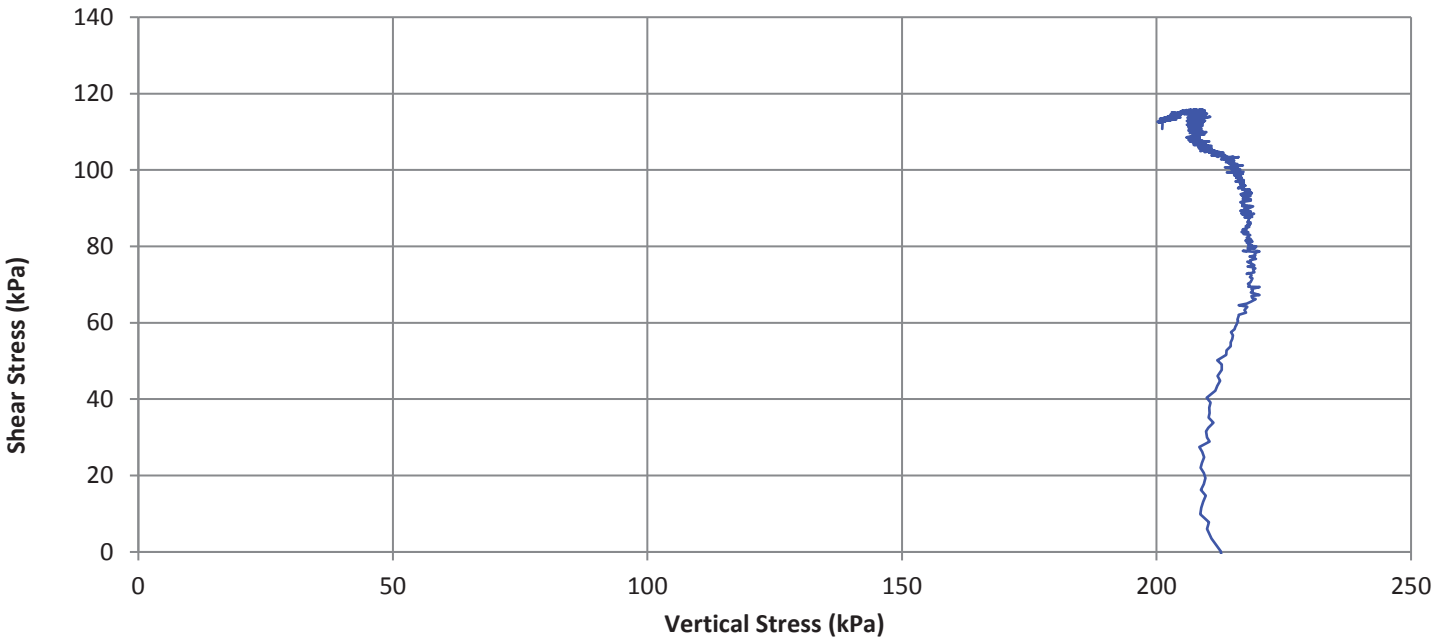

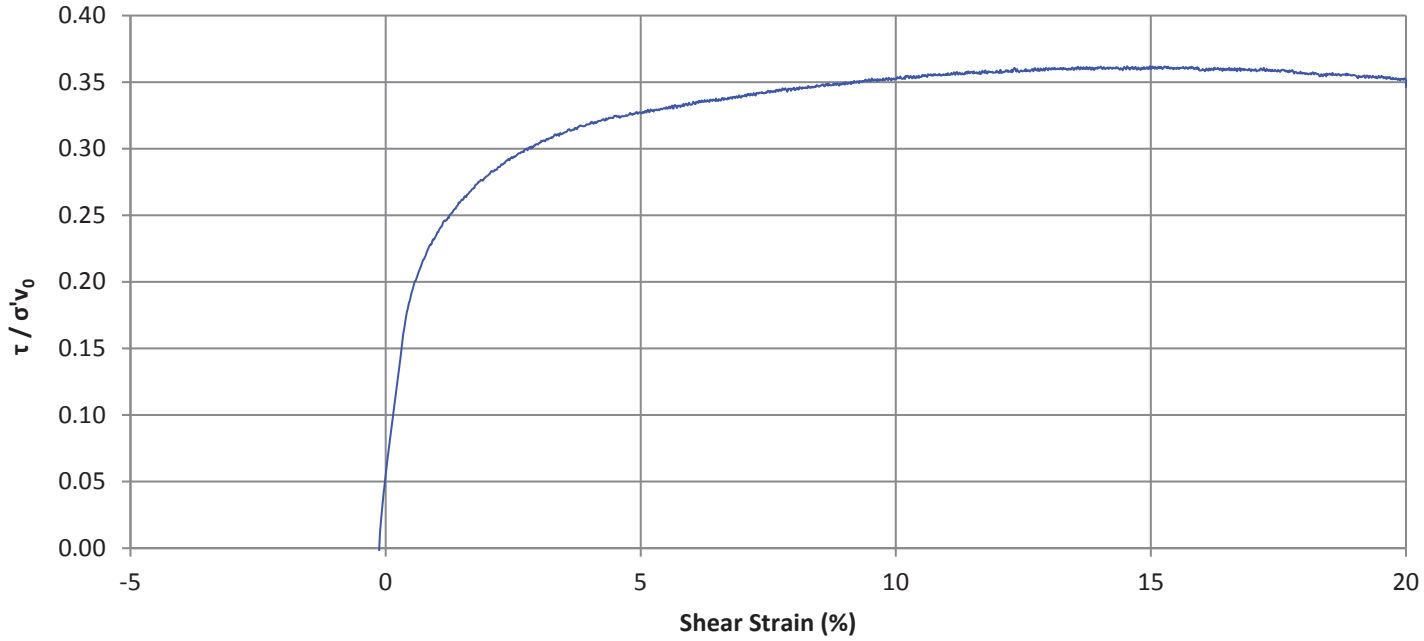

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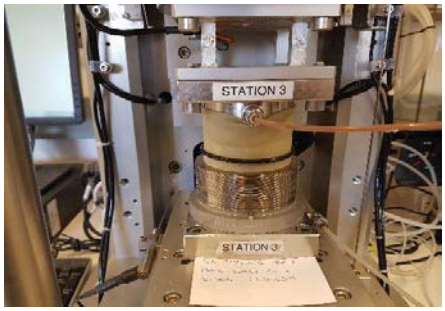

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Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.20CSR
Location:	Redmond, WA	**Depth (m):**	36.15-36.19
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 50mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 3

Vertical LVDT	Serial No.:	11894
Vertical Load Cell	Serial No.:	38407
Shear Load Cell	Serial No.:	158879

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.35
Diameter (mm)	70.85
Area (cm^2)	39.42
Volume (cm^3)	92.06
Specific Gravity (Measured)	2.73

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	18.09	Liquid Limit	30
Fines Fraction (%)	81.91	Plastic Limit	15
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	182.5	Initial Water Content (%)	29.00
Dry Mass (g)	141.47	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	19.45	Final Water Content (%)	25.75
Initial Dry Unit Weight (kN/m^3)	15.08	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	3.96
Max Applied Vertical Stress (kPa)	320.79	Axial Strain at end of Consol. %	3.96
Vertical Stress at end of Consol (kPa)	320.38	Change in Height ΔH_c (mm)	0.93
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.20
Cycles to 3.75% Shear Strain	3.75% not reached
Initial Vertical Stress (kPa)	320.69
Max Abs. Cyclic Shear Stress (kPa)	64.20
Max. Shear Strain at N= n/a (zero load)	3.75% not reached
Min. Shear Strain at N= n/a (zero load)	3.75% not reached
Max. DU at N= n/a (zero load)	3.75% not reached
Min. DU at N= n/a (zero load)	3.75% not reached

Post Cyclic Monotonic Test Results

Initial Vertical Stress (kPa)	163.98
Initial Shear Stress (kPa)	-4.67
Applied Shear Bias (kPa)	0.00
Rate of Shearing (%/hr)	5.00
Peak Shear Strength (kPa)	91.64
Excess Pore Pressure at Peak (kPa)	145.49
Ratio of Peak / $\sigma'v$	0.29
Maximum Shear Strain γ_{MAX} (%)	19.99
Shear Strength at γ_{MAX} (kPa)	85.86

Comments / Special Instructions

Comments / Special Instructions

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NORSOK G-001

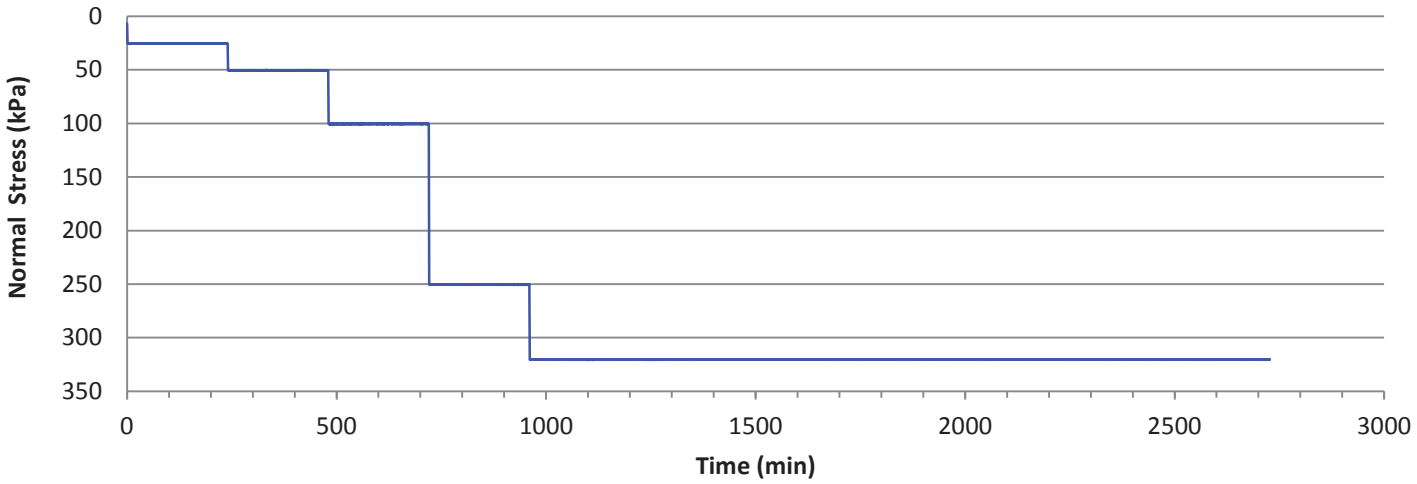
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.20CSR
Location:	Redmond, WA	**Depth (m):**	36.15-36.19
Client:	GAI	**Lab ID No:**	33

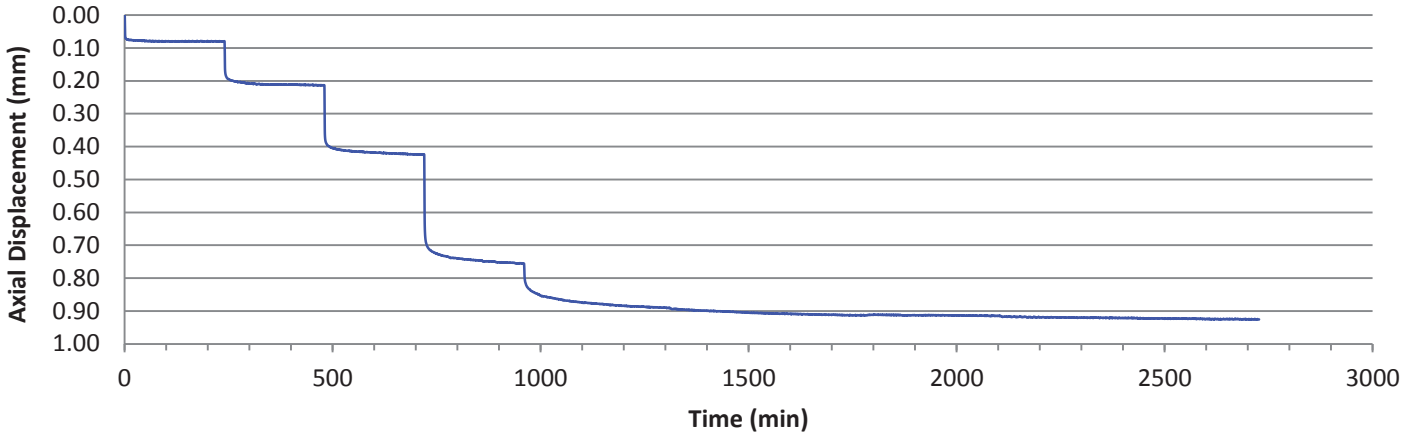
Consolidation Summary

Stress at end of Consolidation (kPa)	320.38
Axial Strain at end of Consolidation (%)	3.96
OCR	N/A
Change in Height ΔH_c (mm)	0.93

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	320		
Load (kN)	0.1015	0.2004	0.3976	0.9888	1.2647		
Duration (min)	240	240	240	240	1767		
Axial Strain (%)	0.35	0.91	1.82	3.24	3.96		





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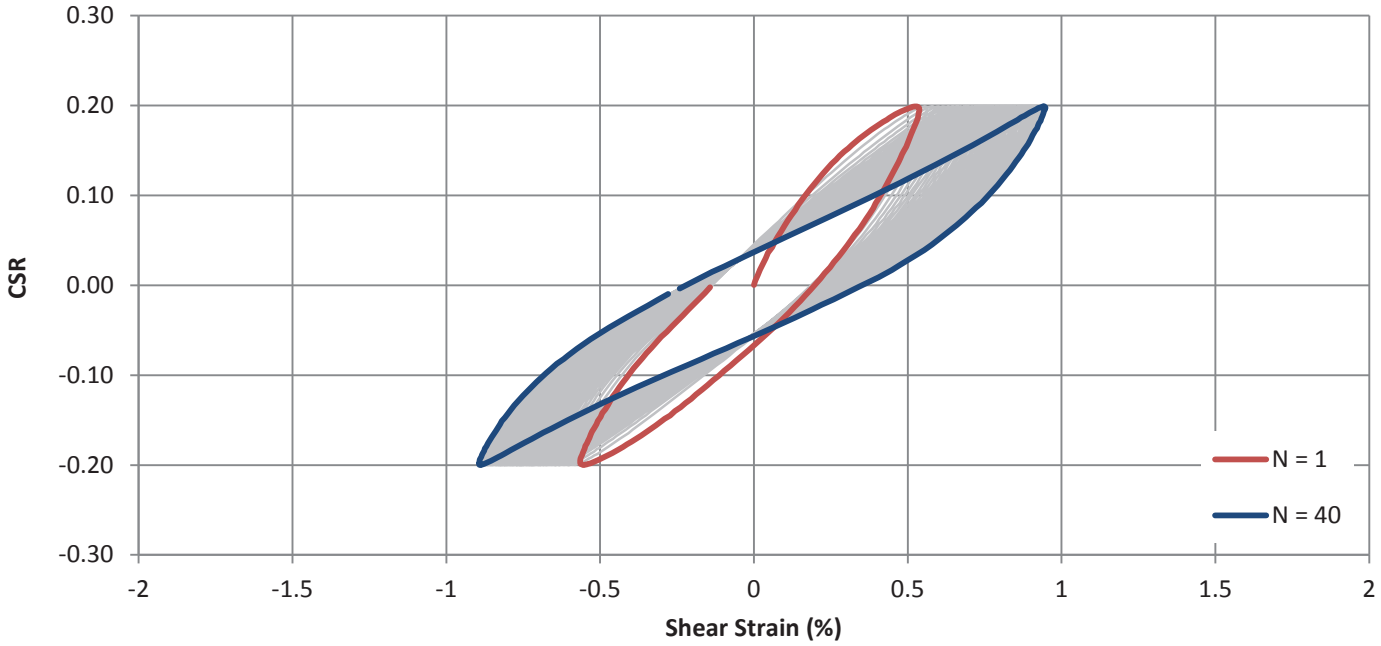

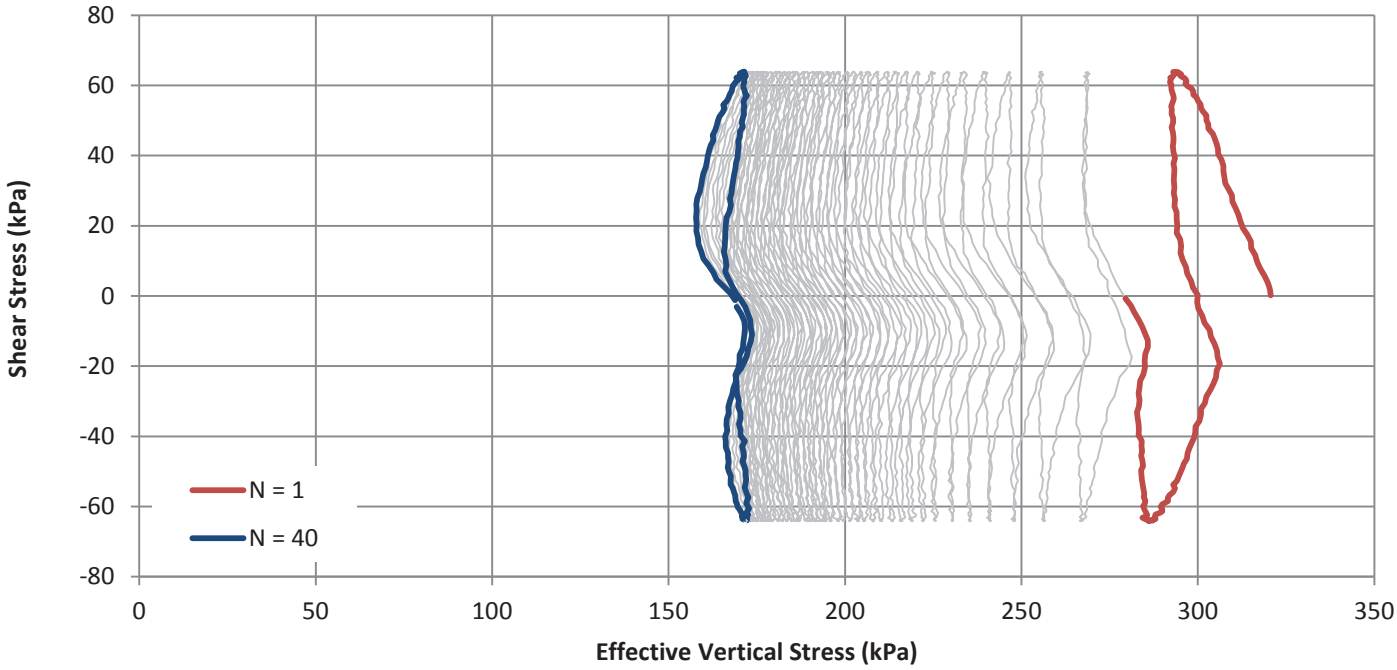

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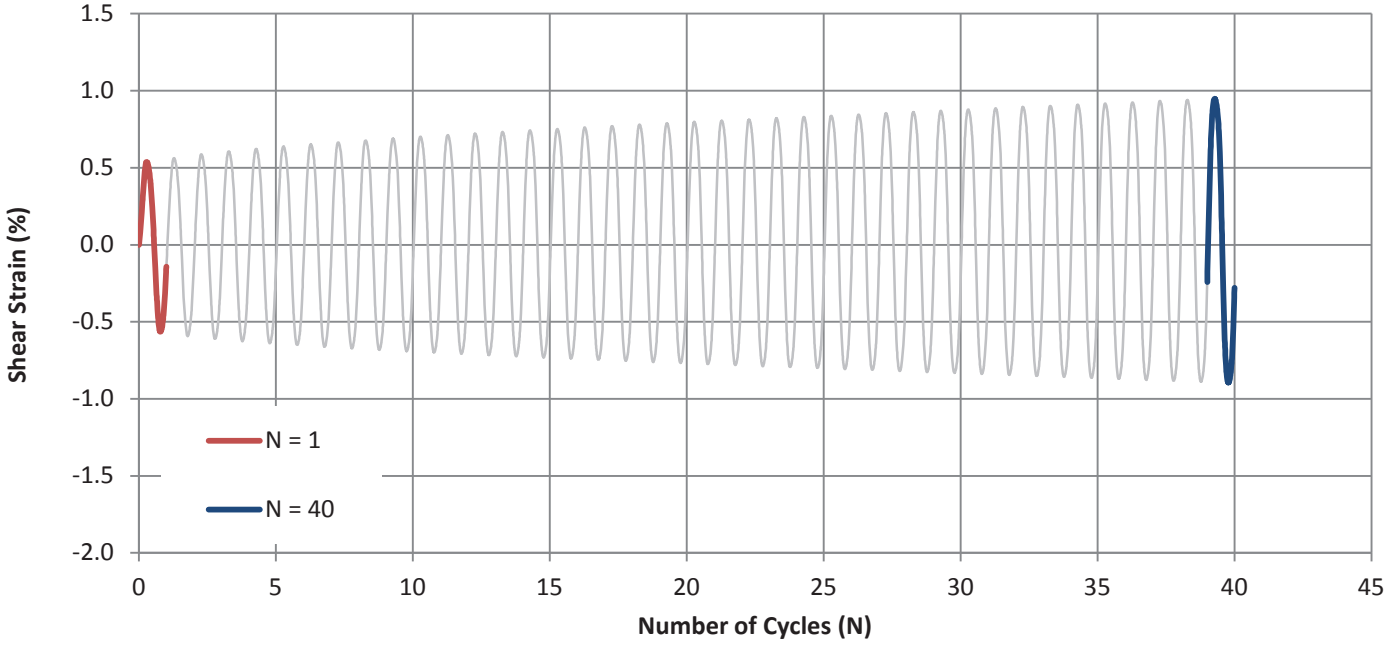

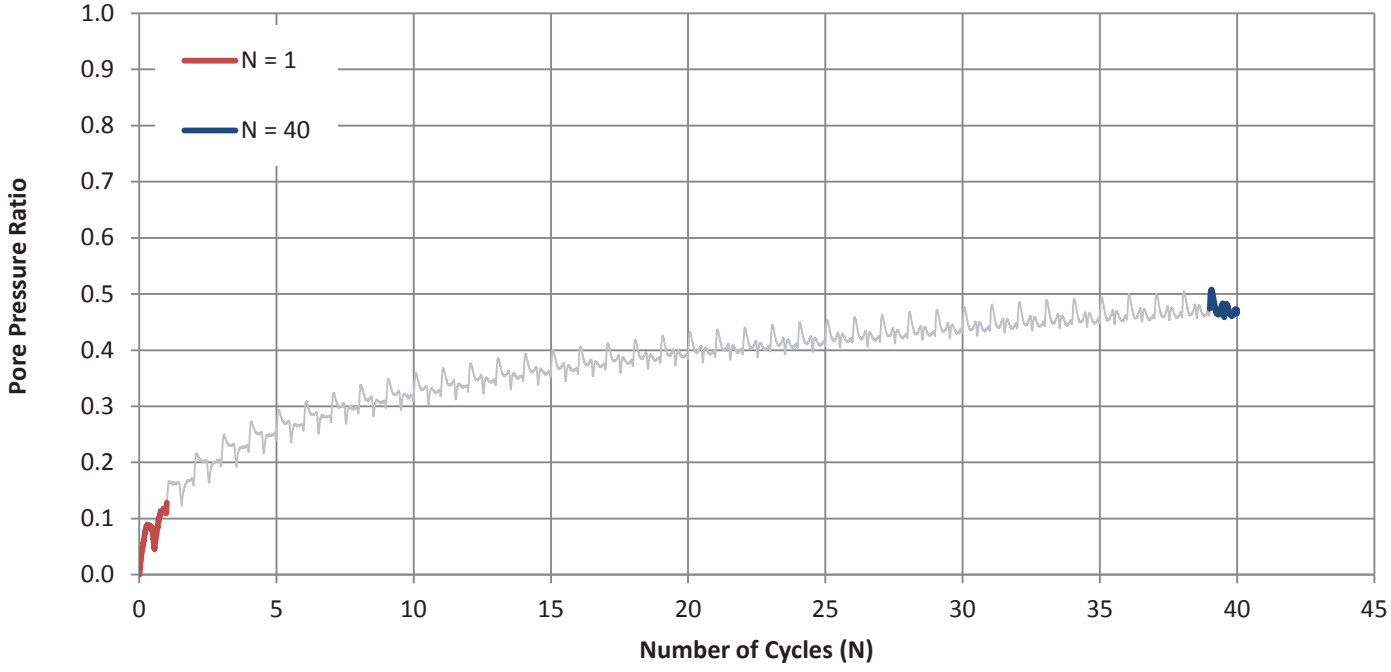

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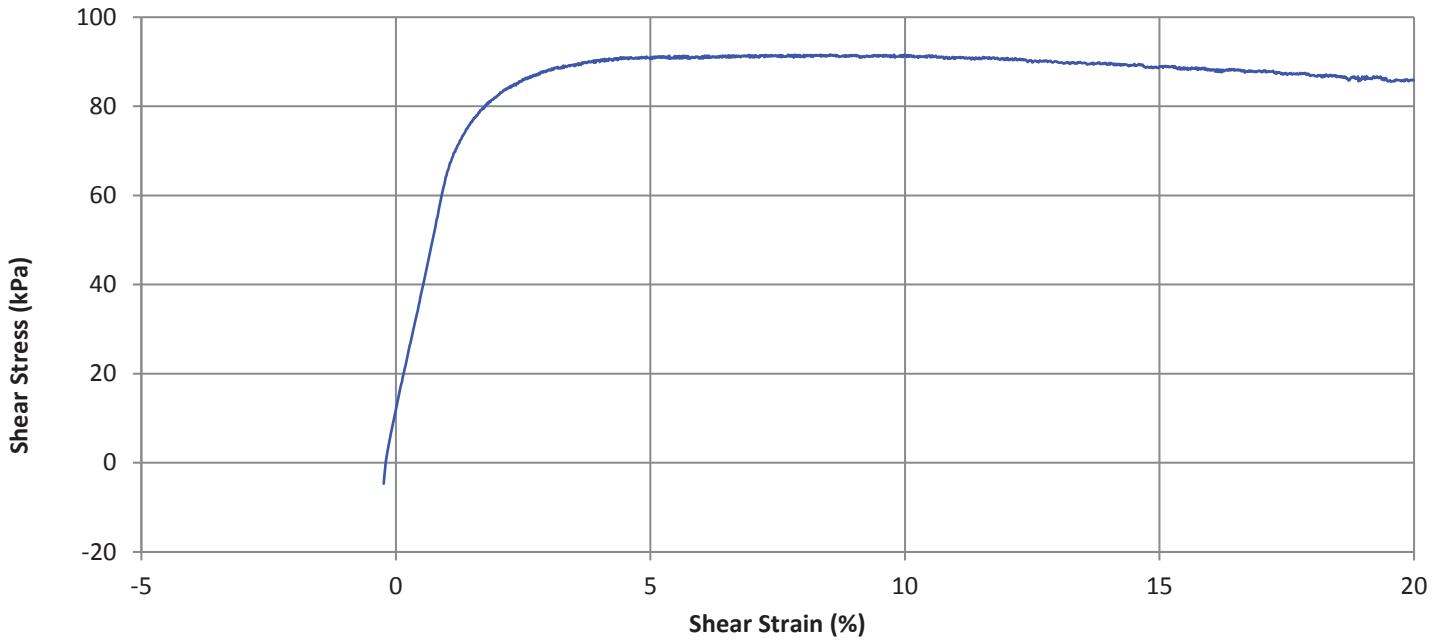

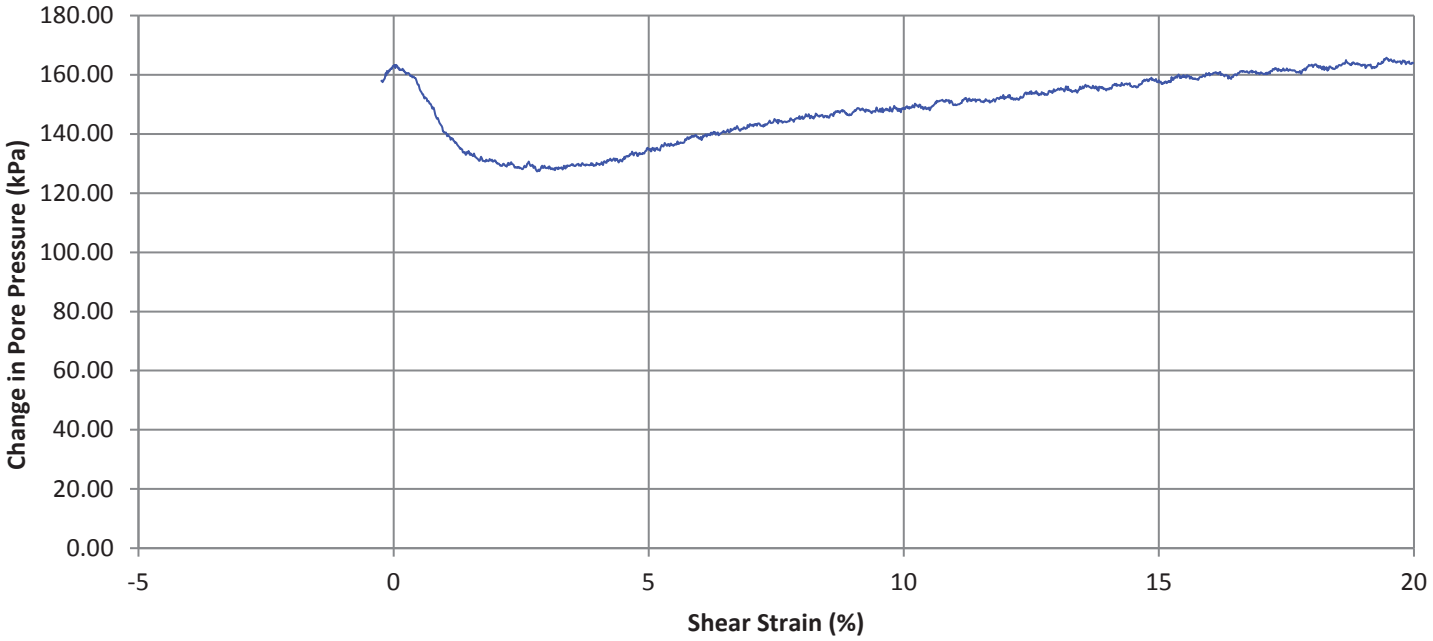

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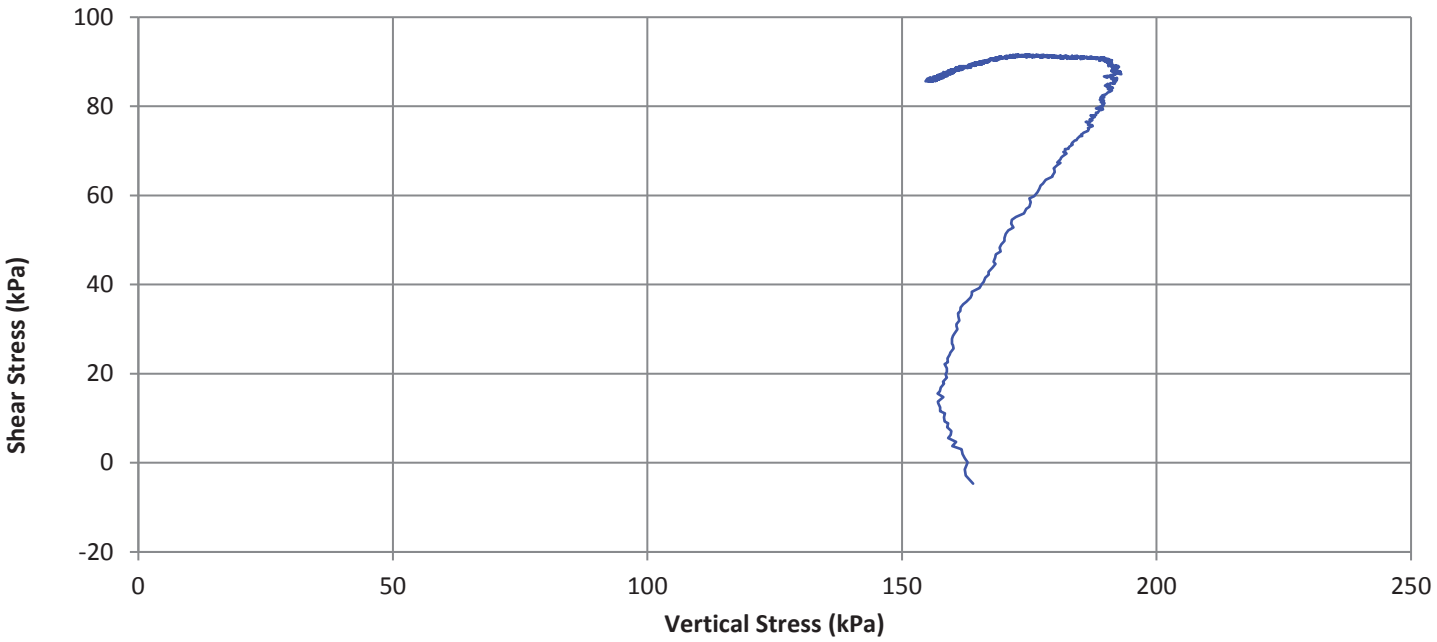

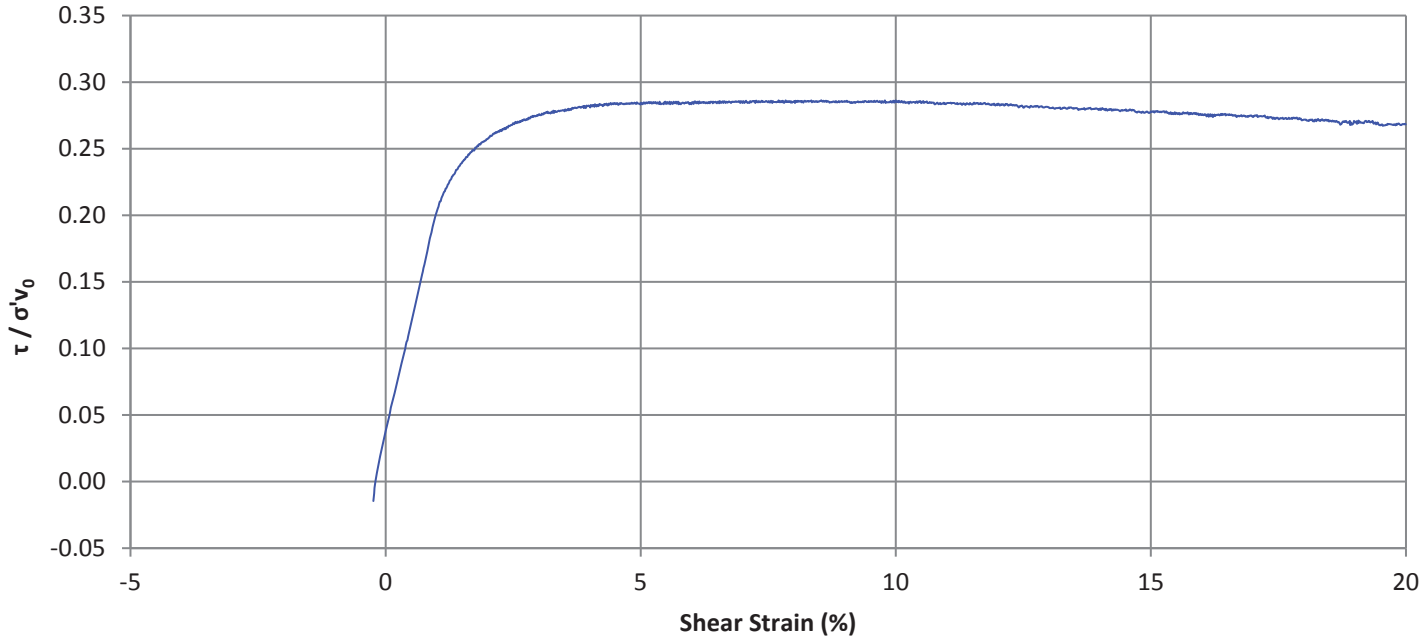

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Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.25CSR
Location:	Redmond, WA	**Depth (m):**	36.31-36.35
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 50mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 3

Vertical LVDT	Serial No.:	11894
Vertical Load Cell	Serial No.:	38407
Shear Load Cell	Serial No.:	158879

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.42
Diameter (mm)	70.85
Area (cm^2)	39.42
Volume (cm^3)	92.33
Specific Gravity (Measured)	2.73

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	18.09	Liquid Limit	30
Fines Fraction (%)	81.91	Plastic Limit	15
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	185.89	Initial Water Content (%)	26.09
Dry Mass (g)	147.43	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	19.75	Final Water Content (%)	22.34
Initial Dry Unit Weight (kN/m^3)	15.66	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	3.93
Max Applied Vertical Stress (kPa)	320.41	Axial Strain at end of Consol. %	3.93
Vertical Stress at end of Consol (kPa)	320.05	Change in Height ΔH_c (mm)	0.92
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.25
Cycles to 3.75% Shear Strain	11
Initial Vertical Stress (kPa)	320.10
Max Abs. Cyclic Shear Stress (kPa)	79.92
Max. Shear Strain at N=11 (zero load)	2.55
Min. Shear Strain at N=11 (zero load)	-1.46
Max. DU at N=11 (zero load)	233.91
Min. DU at N=11 (zero load)	231.68

Post Cyclic Reconsolidation Test Results [1]

Initial Vertical Stress (kPa)	51.57
Max. Applied Vertical Stress (kPa)	319.88
Initial Shear Stress (kPa)	14.28
Height at beginning of Reconsol (mm)	22.50
Change in Height ΔH_c (mm)	0.41
Axial Strain at end of Reconsol. %	1.82

[1] *Reconsolidation data calculated from the sample height at end of initial consolidation*

Comments / Special Instructions

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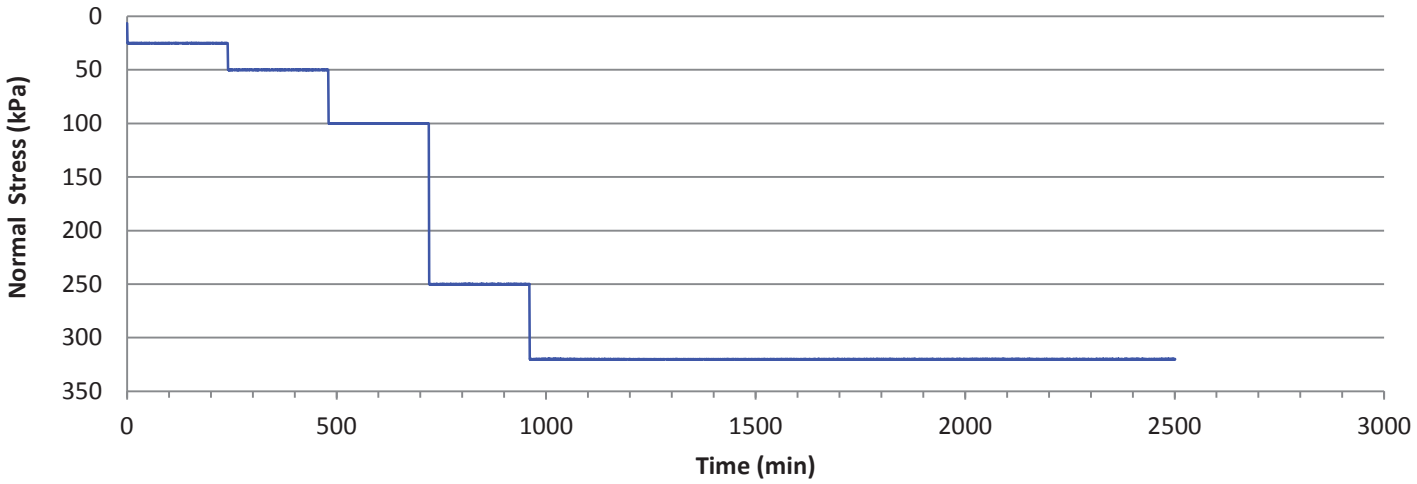
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.25CSR
Location:	Redmond, WA	**Depth (m):**	36.31-36.35
Client:	GAI	**Lab ID No:**	33

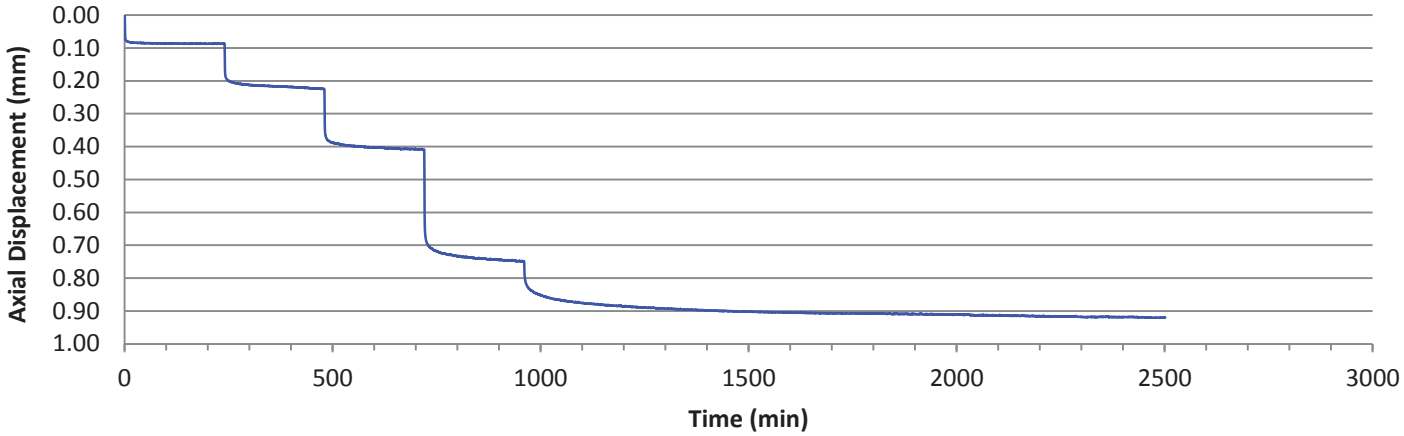
Consolidation Summary

Stress at end of Consolidation (kPa)	320.05
Axial Strain at end of Consolidation (%)	3.93
OCR	N/A
Change in Height ΔH_c (mm)	0.92

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	320		
Load (kN)	0.0994	0.1978	0.3952	0.9873	1.2632		
Duration (min)	240	240	240	240	1541		
Axial Strain (%)	0.37	0.96	1.75	3.20	3.93		





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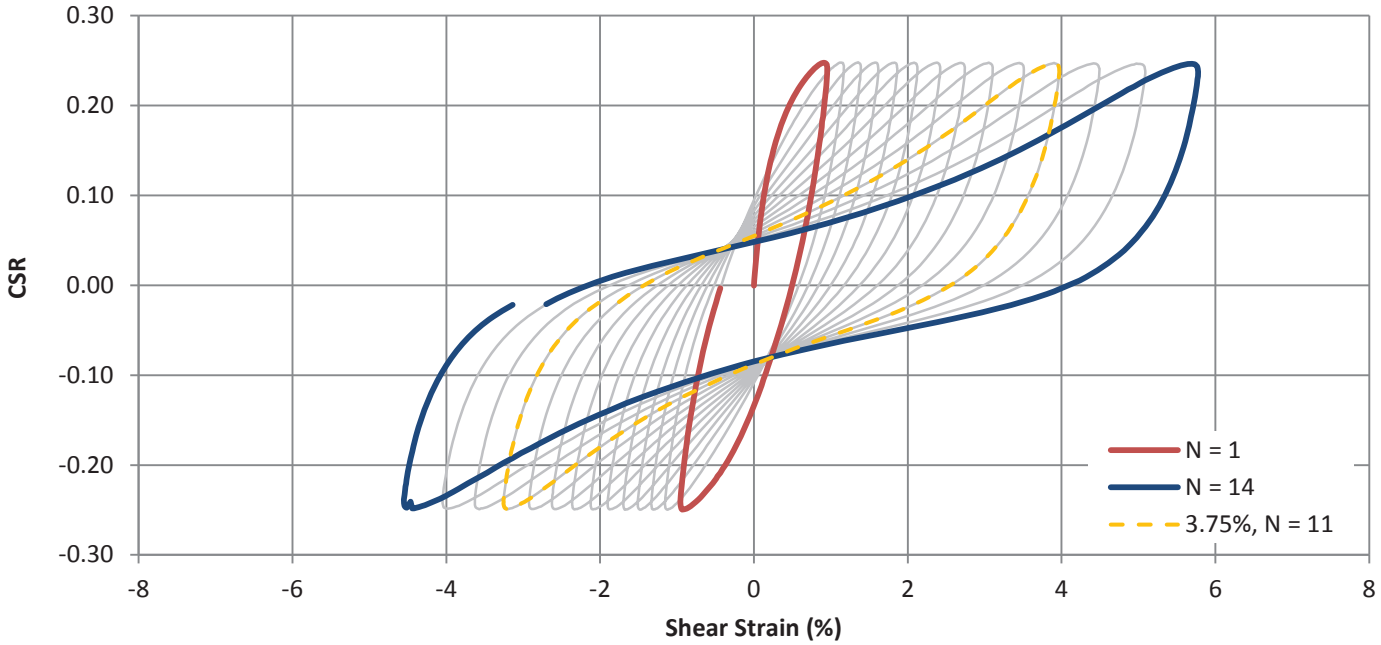

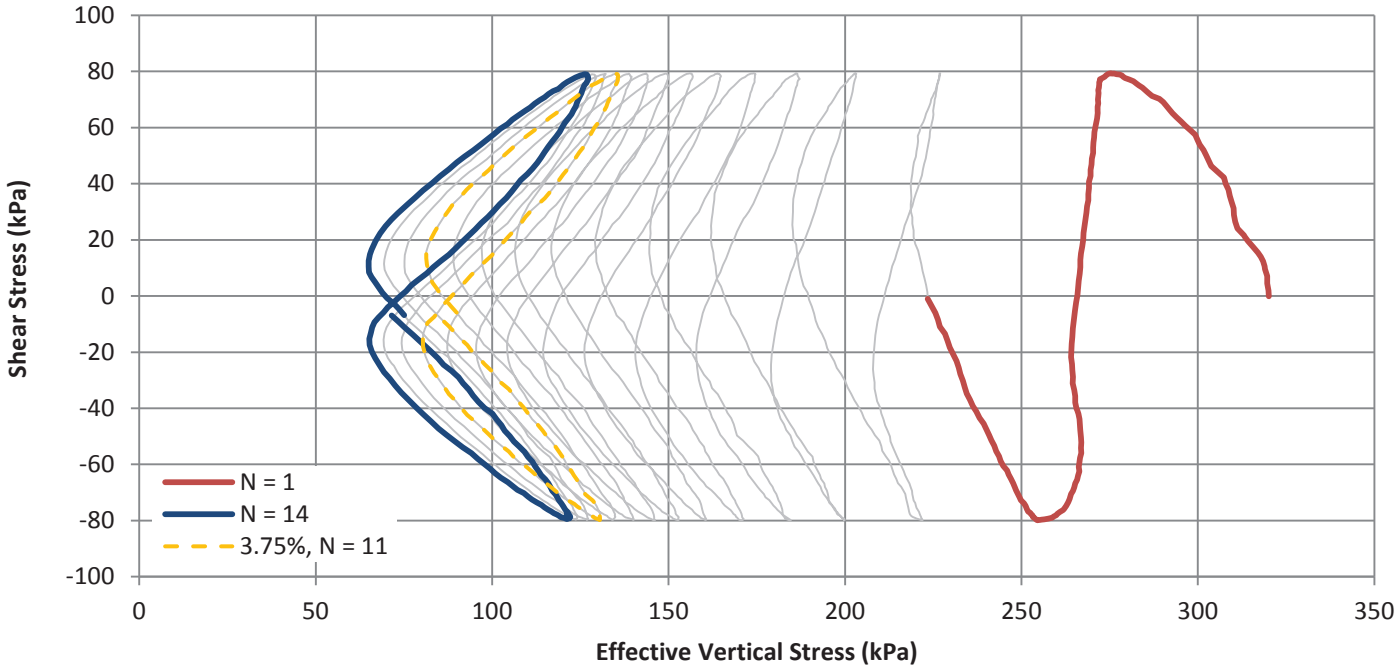

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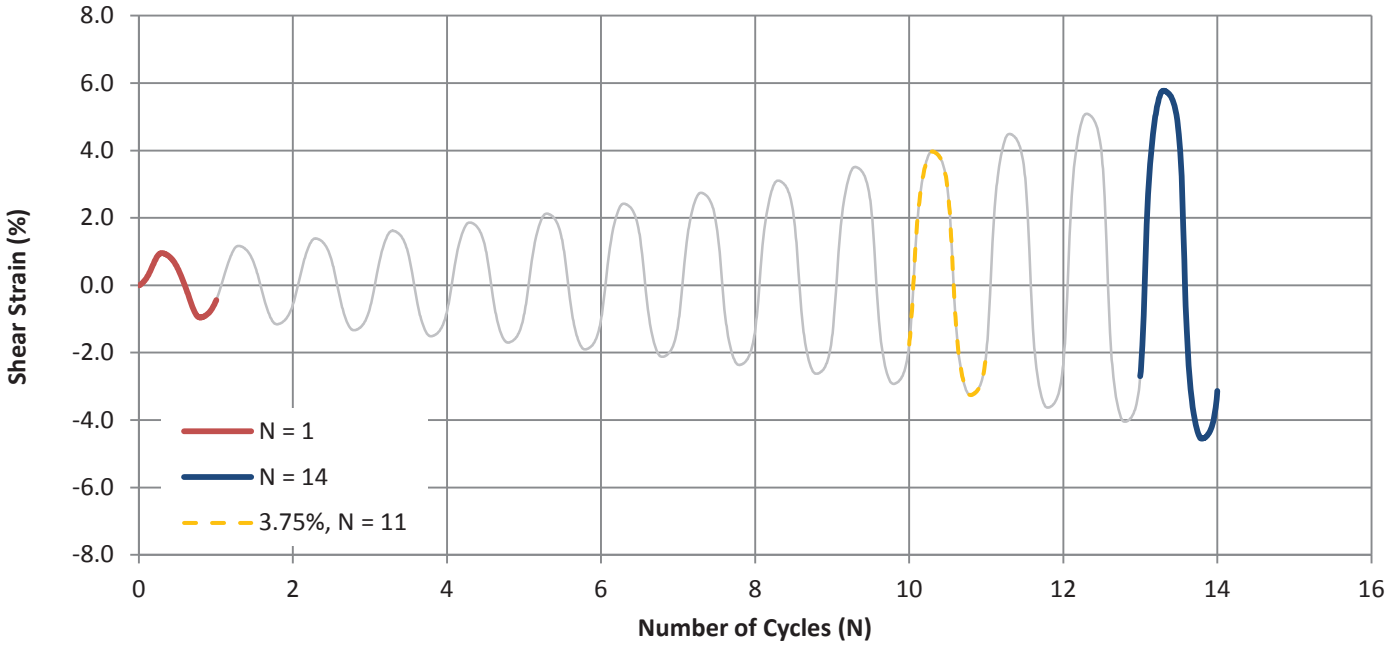
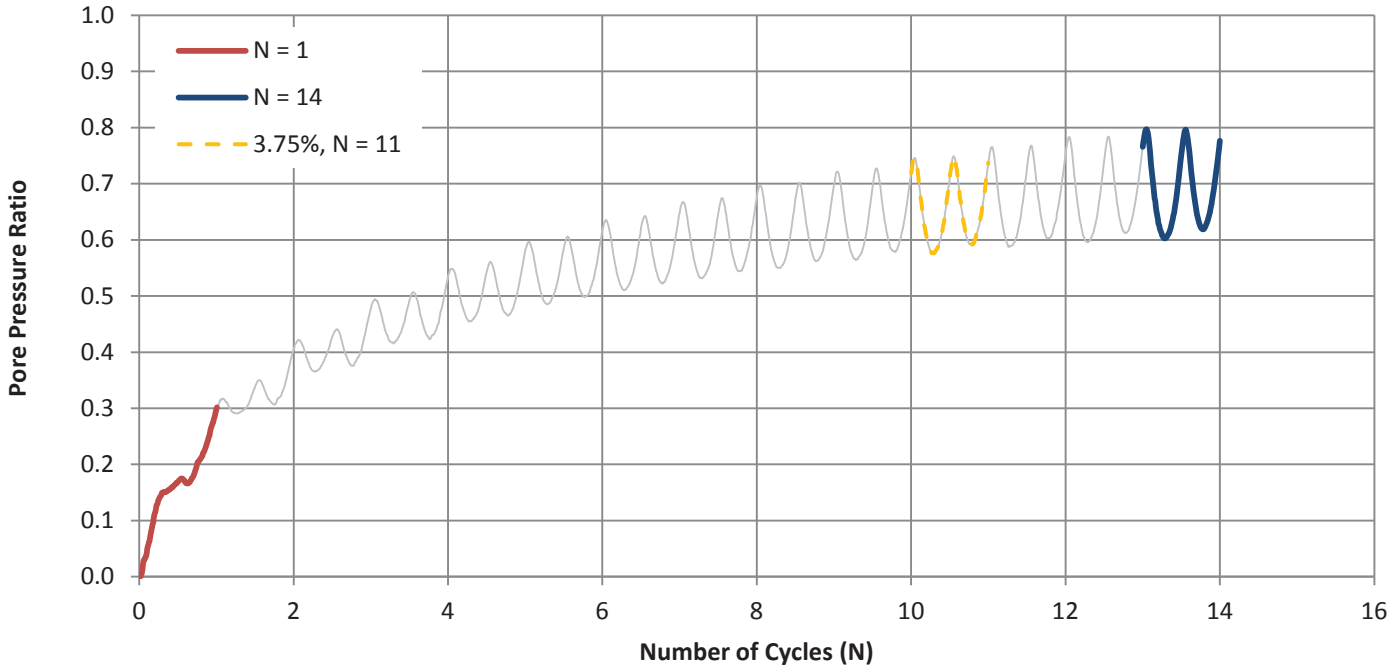
Location:	Redmond, WA	**Depth (m):**	36.31-36.35
Client:	GAI	**Lab ID No:**	33





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G. Patton	March 17, 2018	M. Sanin	March 28, 2018
TESTED BY	DATE	CHECKED BY	DATE

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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

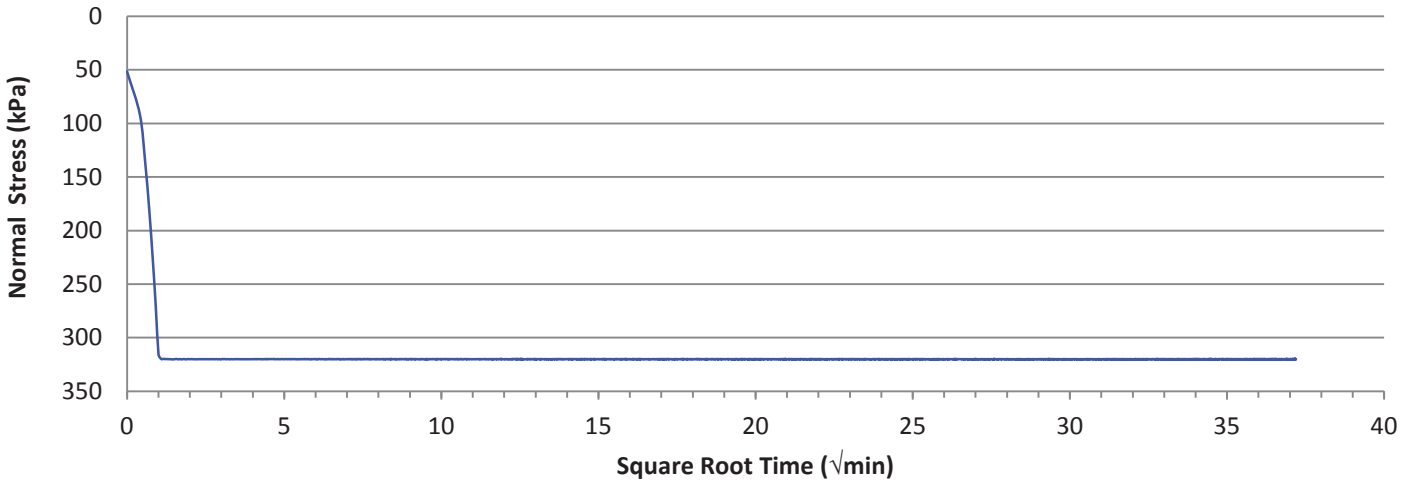
NORSOK G-001

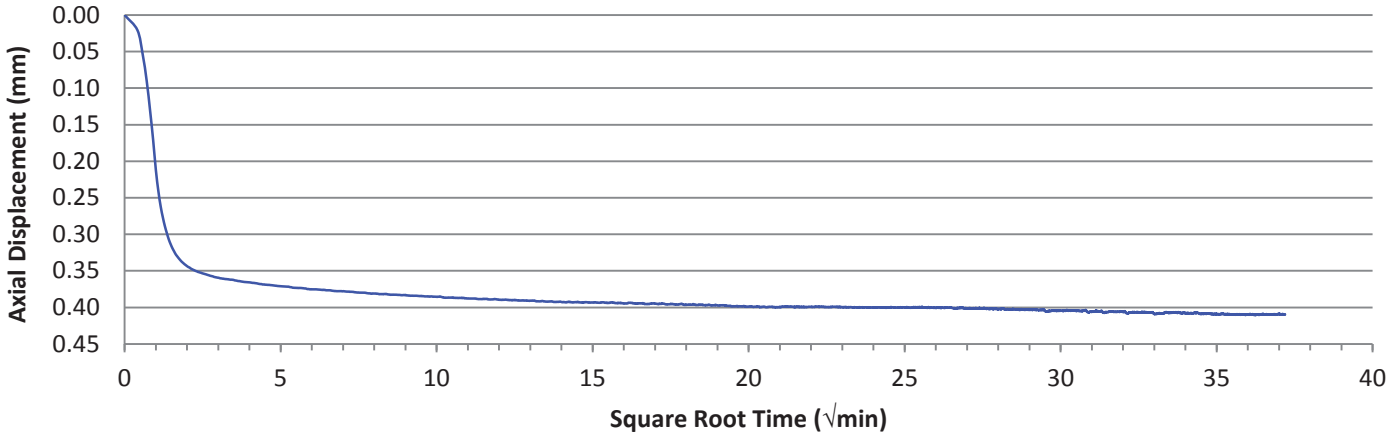
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.25CSR
Location:	Redmond, WA	**Depth (m):**	36.31-36.35
Client:	GAI	**Lab ID No:**	33

Stress at Start of Reconsolidation (kPa)	51.57
Stress at end of Reconsolidation (kPa)	319.88
Axial Strain at end of Reconsolidation (%)	1.82
Change in Height ΔH_c (mm)	0.41

Comments
Reconsolidation data calculated from the sample height at end of initial consolidation

Increment (kPa)	320						
Load (kN)	1.2632						
Duration (min)	1383						
Axial Strain (%)	1.82						





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NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G037 ST-1
Project:	Sound Transit Redmond Link Extension	**Test ID:**	320kPa, 0.25CSR
Location:	Redmond, WA	**Depth (m):**	36.31-36.35
Client:	GAI	**Lab ID No:**	33

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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G045 ST-3
Project:	Sound Transit Redmond Link Extension	**Test ID:**	415kPa, 0.20CSR
Location:	Redmond, WA	**Depth (m):**	43.09-43.13
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 50mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 2

Vertical LVDT	Serial No.:	11897
Vertical Load Cell	Serial No.:	38408
Shear Load Cell	Serial No.:	158877

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.32
Diameter (mm)	70.72
Area (cm^2)	39.28
Volume (cm^3)	91.60
Specific Gravity (Measured)	2.76

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	N/A	Liquid Limit	37
Fines Fraction (%)	N/A	Plastic Limit	20
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	181.77	Initial Water Content (%)	27.70
Dry Mass (g)	142.34	Initial Saturation (%)	98.91
Initial Wet Unit Weight (kN/m^3)	19.47	Final Water Content (%)	23.09
Initial Dry Unit Weight (kN/m^3)	15.24	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	5.62
Max Applied Vertical Stress (kPa)	415.78	Axial Strain at end of Consol. %	5.62
Vertical Stress at end of Consol (kPa)	415.32	Change in Height ΔH_c (mm)	1.31
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.20
Cycles to 3.75% Shear Strain	24
Initial Vertical Stress (kPa)	416.37
Max Abs. Cyclic Shear Stress (kPa)	83.04
Max. Shear Strain at N=24 (zero load)	1.92
Min. Shear Strain at N=24 (zero load)	-2.14
Max. DU at N=24 (zero load)	319.56
Min. DU at N=24 (zero load)	312.40

Post Cyclic Reconsolidation Test Results [1]

Initial Vertical Stress (kPa)	63.03
Max. Applied Vertical Stress (kPa)	415.43
Initial Shear Stress (kPa)	23.17
Height at beginning of Reconsol (mm)	22.01
Change in Height ΔH_c (mm)	0.47
Axial Strain at end of Reconsol. %	2.15

[1] *Reconsolidation data calculated from the sample height at end of initial consolidation*

Comments / Special Instructions

Comments / Special Instructions

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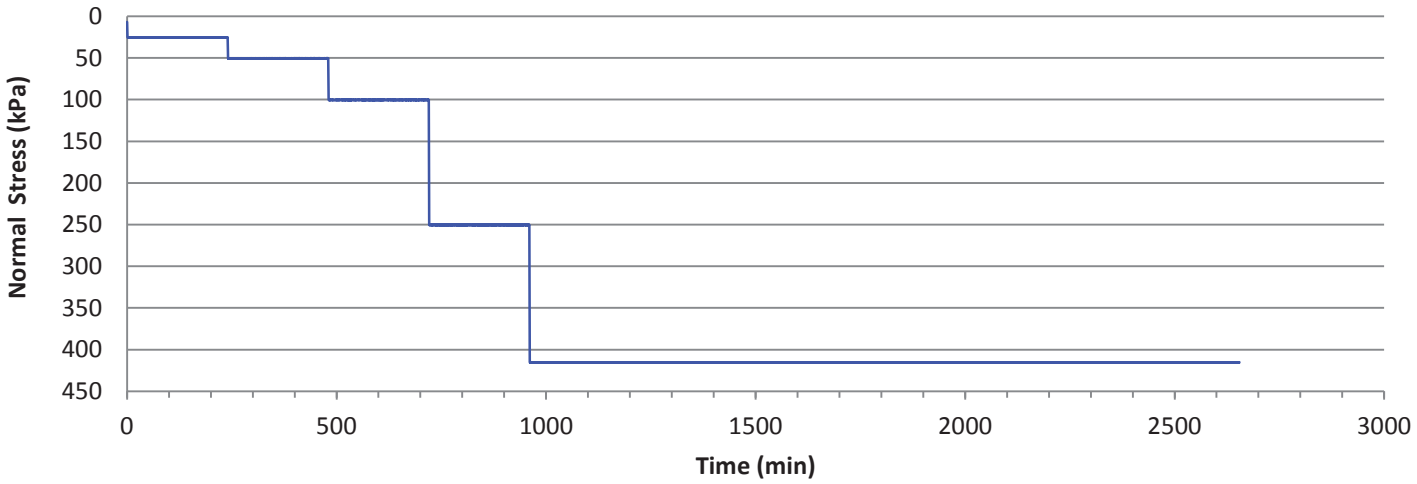
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G045 ST-3
Project:	Sound Transit Redmond Link Extension	**Test ID:**	415kPa, 0.20CSR
Location:	Redmond, WA	**Depth (m):**	43.09-43.13
Client:	GAI	**Lab ID No:**	33

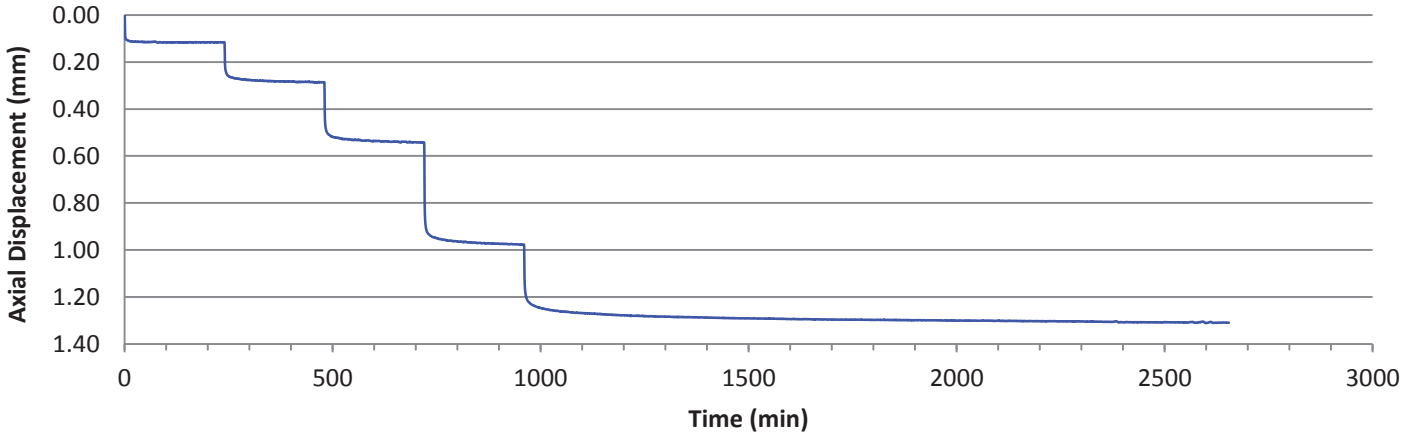
Consolidation Summary

Stress at end of Consolidation (kPa)	415.32
Axial Strain at end of Consolidation (%)	5.62
OCR	N/A
Change in Height ΔH_c (mm)	1.31

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	415		
Load (kN)	0.1015	0.1995	0.3953	0.9854	1.6332		
Duration (min)	240	240	240	240	1694		
Axial Strain (%)	0.50	1.23	2.33	4.19	5.62		





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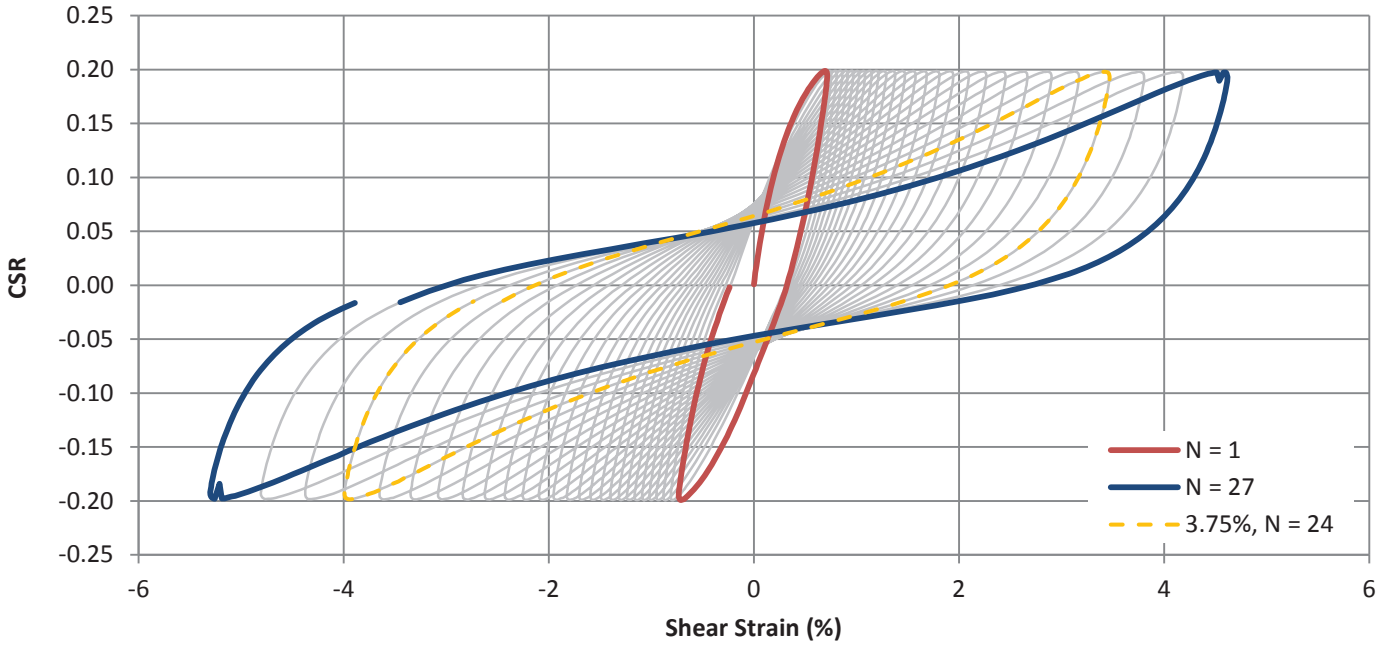
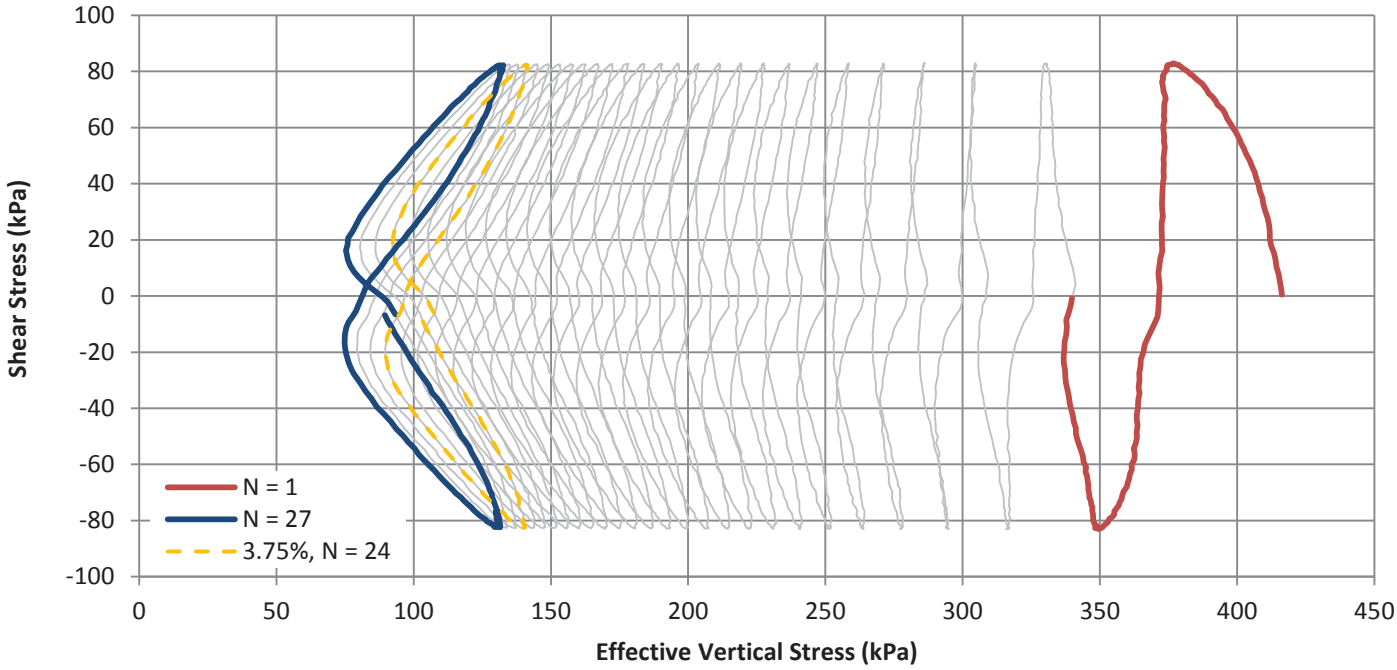
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G045 ST-3
Project:	Sound Transit Redmond Link Extension	**Test ID:**	415kPa, 0.20CSR
Location:	Redmond, WA	**Depth (m):**	43.09-43.13
Client:	GAI	**Lab ID No:**	33





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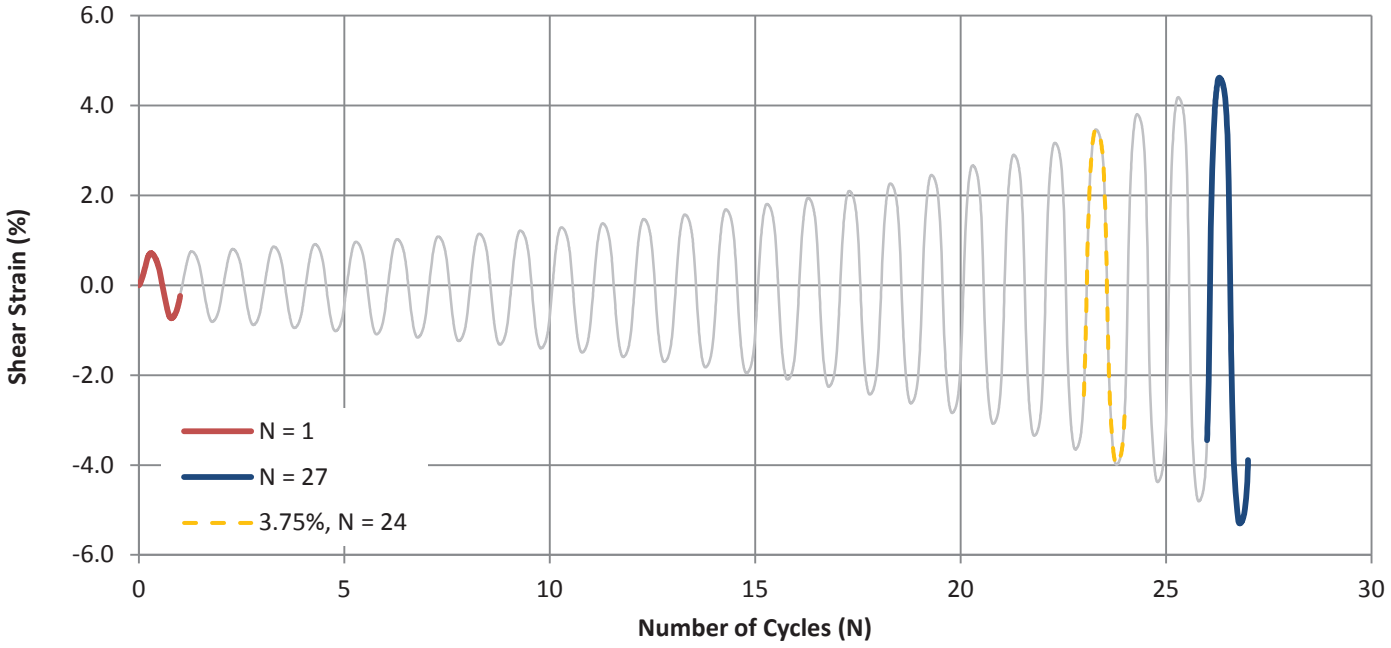
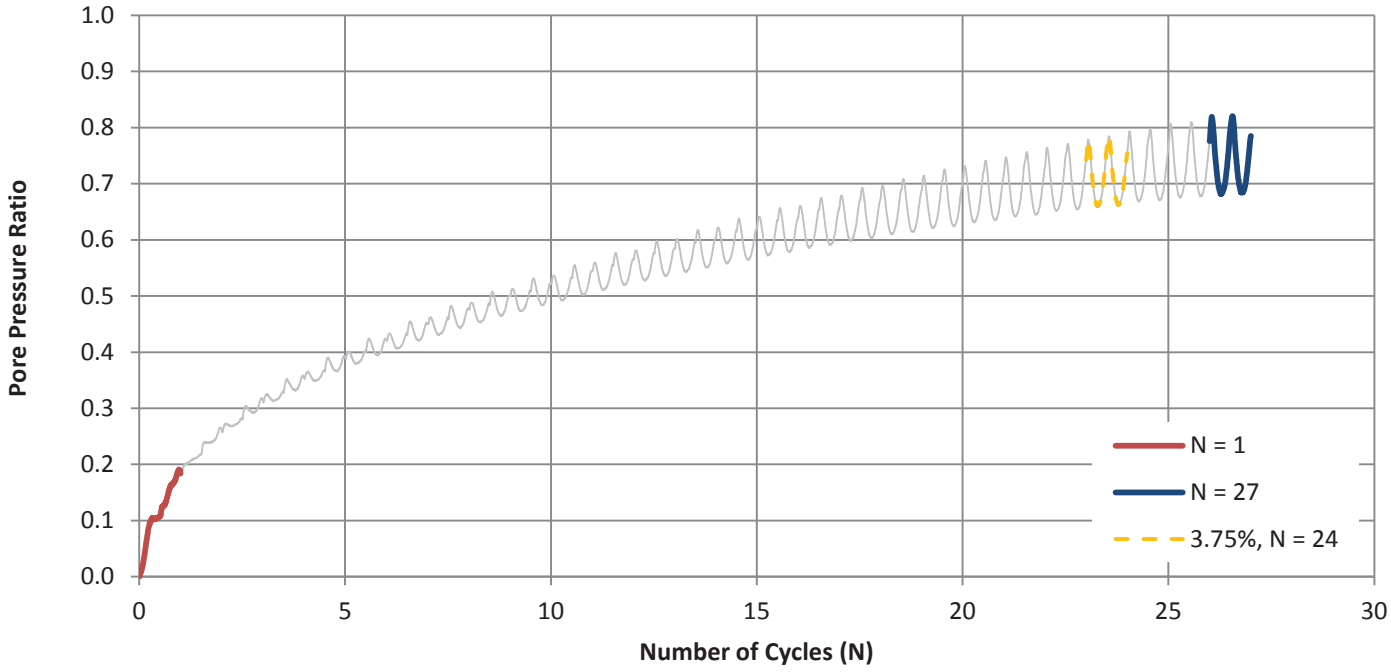
Location:	Redmond, WA	**Depth (m):**	43.09-43.13
Client:	GAI	**Lab ID No:**	33





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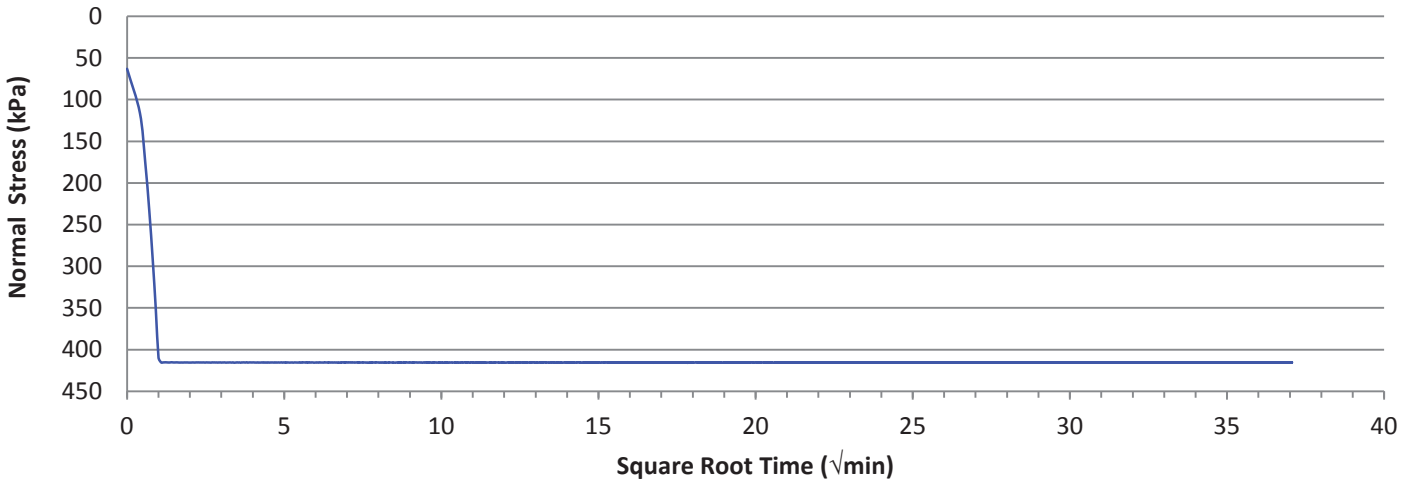
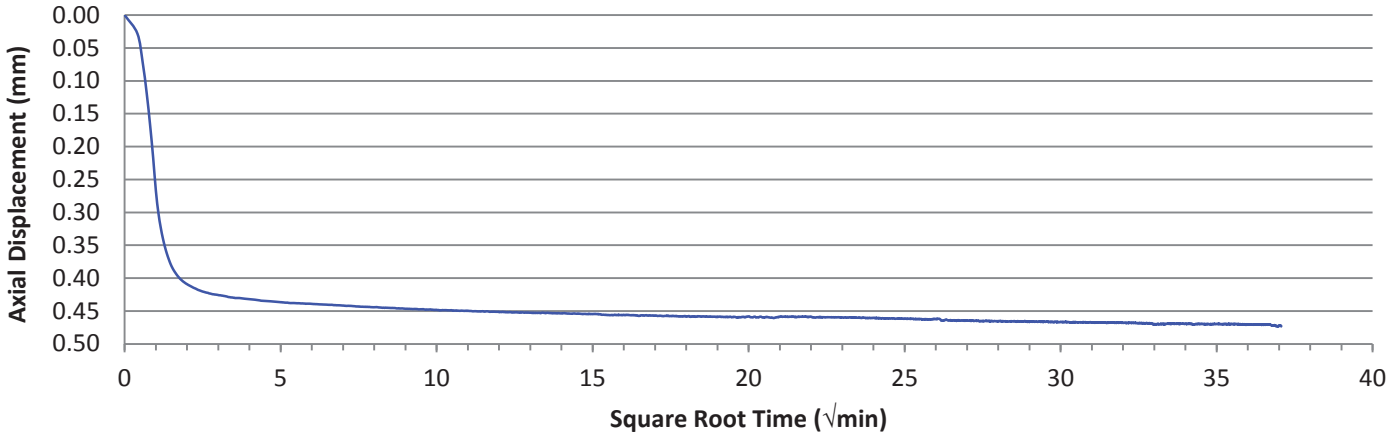
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G045 ST-3
Project:	Sound Transit Redmond Link Extension	**Test ID:**	415kPa, 0.20CSR
Location:	Redmond, WA	**Depth (m):**	43.09-43.13
Client:	GAI	**Lab ID No:**	33

Stress at Start of Reconsolidation (kPa)	63.03
Stress at end of Reconsolidation (kPa)	415.43
Axial Strain at end of Reconsolidation (%)	2.15
Change in Height ΔH_c (mm)	0.47

Comments
Reconsolidation data calculated from the sample height at end of initial consolidation

Increment (kPa)	415						
Load (kN)	1.6339						
Duration (min)	1374						
Axial Strain (%)	2.15						





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Location:	Redmond, WA	**Depth (m):**	43.09-43.13
Client:	GAI	**Lab ID No:**	33

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Cyclic Direct Simple Shear Testing of Soils Under Consolidated Constant-Volume Conditions

NORSOK G-001

Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G045 ST-3
Project:	Sound Transit Redmond Link Extension	**Test ID:**	415kPa, 0.25CSR
Location:	Redmond, WA	**Depth (m):**	43.13-43.17
Client:	GAI	**Lab ID No:**	33

General Remarks

~ 50mL of water passed through sample during consolidation.

Equipment Description: GDS - Station 3

Vertical LVDT	Serial No.:	11894
Vertical Load Cell	Serial No.:	38407
Shear Load Cell	Serial No.:	158879

Sample Properties

Preparation Method	Trim from Undisturbed
Height (mm)	23.41
Diameter (mm)	70.51
Area (cm^2)	39.05
Volume (cm^3)	91.41
Specific Gravity (Measured)	2.76

Visual Description	SILTY CLAY; some sand; grey, w>PL, firm.		
Sand Fraction (%)	N/A	Liquid Limit	37
Fines Fraction (%)	N/A	Plastic Limit	20
Shear Strength est. (kPa)		N/A	
Sensitivity		N/A	

Weight Volume Relationships

Initial Wet Mass (g)	180.57	Initial Water Content (%)	29.93
Dry Mass (g)	138.97	Initial Saturation (%)	>100
Initial Wet Unit Weight (kN/m^3)	19.38	Final Water Content (%)	24.76
Initial Dry Unit Weight (kN/m^3)	14.91	Final Saturation (%)	100.00

Consolidation

Effective Overburden Pressure (kPa)	N/A	Max. Axial Strain %	5.34
Max Applied Vertical Stress (kPa)	415.55	Axial Strain at end of Consol. %	5.34
Vertical Stress at end of Consol (kPa)	415.11	Change in Height ΔH_c (mm)	1.25
Laboratory OCR	N/A		

Cyclic Test Results

Frequency (Hz)	0.10
CSR	0.25
Cycles to 3.75% Shear Strain	10
Initial Vertical Stress (kPa)	414.83
Max Abs. Cyclic Shear Stress (kPa)	103.69
Max. Shear Strain at N=10 (zero load)	2.27
Min. Shear Strain at N=10 (zero load)	-1.47
Max. DU at N=10 (zero load)	277.54
Min. DU at N=10 (zero load)	274.15

Post Cyclic Reconsolidation Test Results [1]

Initial Vertical Stress (kPa)	88.46
Max. Applied Vertical Stress (kPa)	415.11
Initial Shear Stress (kPa)	25.56
Height at beginning of Reconsol (mm)	22.16
Change in Height ΔH_c (mm)	0.41
Axial Strain at end of Reconsol. %	1.86

[1] *Reconsolidation data calculated from the sample height at end of initial consolidation*

Comments / Special Instructions

Comments / Special Instructions

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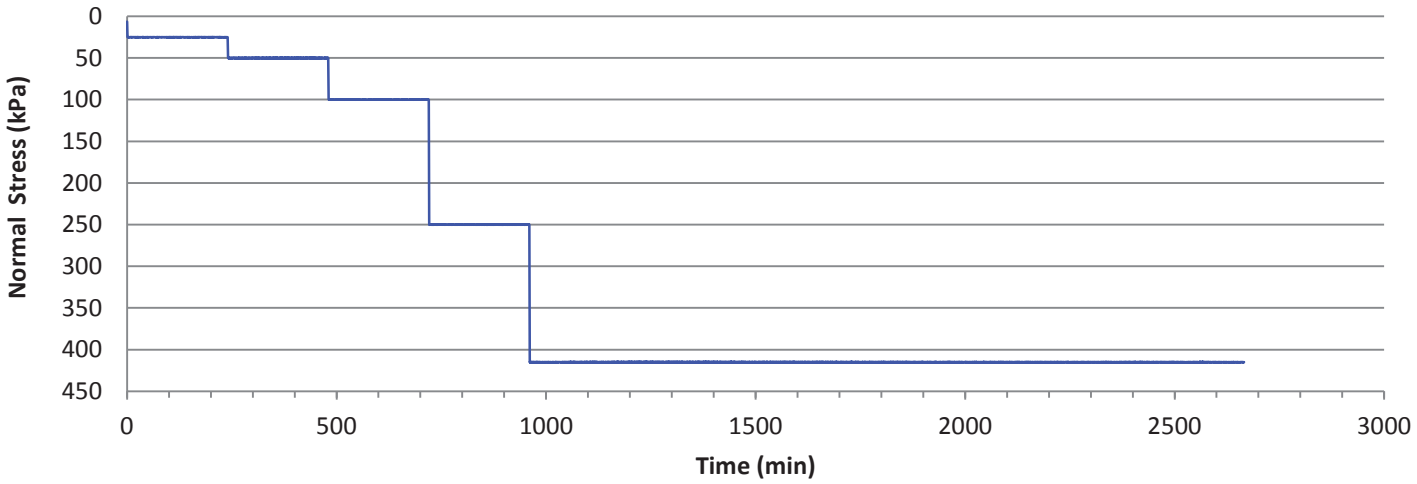
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G045 ST-3
Project:	Sound Transit Redmond Link Extension	**Test ID:**	415kPa, 0.25CSR
Location:	Redmond, WA	**Depth (m):**	43.13-43.17
Client:	GAI	**Lab ID No:**	33

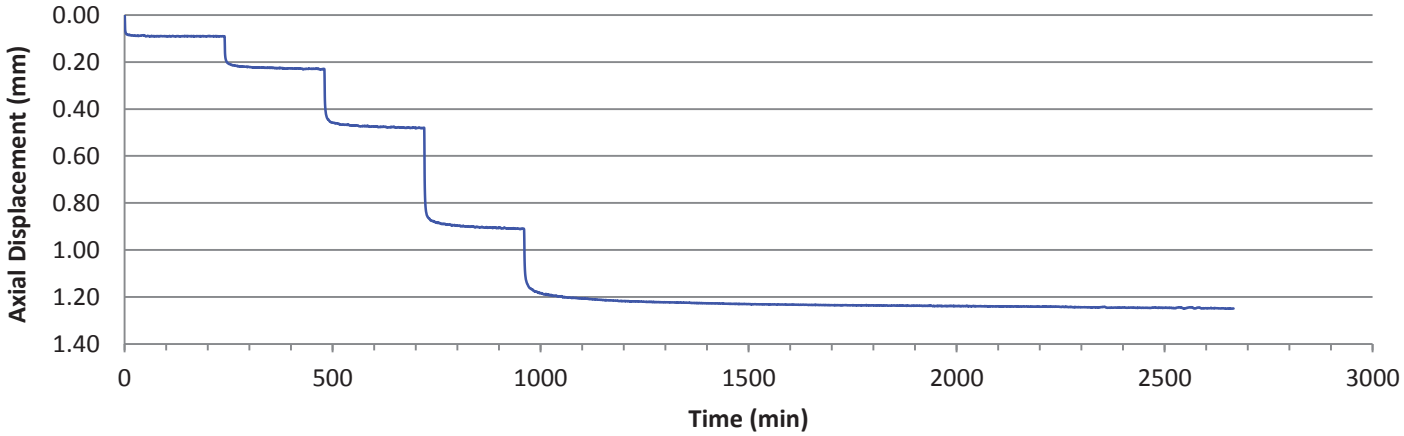
Consolidation Summary

Stress at end of Consolidation (kPa)	415.11
Axial Strain at end of Consolidation (%)	5.34
OCR	N/A
Change in Height ΔH_c (mm)	1.25

Comments
Volumetric strains during consolidation may not be comparable to those measured in an oedometer test due to seating of the platens and possible lateral sample deformation during loading.

Increment (kPa)	25	50	100	250	415		
Load (kN)	0.0982	0.1965	0.3913	0.9774	1.6226		
Duration (min)	240	240	240	240	1706		
Axial Strain (%)	0.39	0.99	2.06	3.89	5.34		





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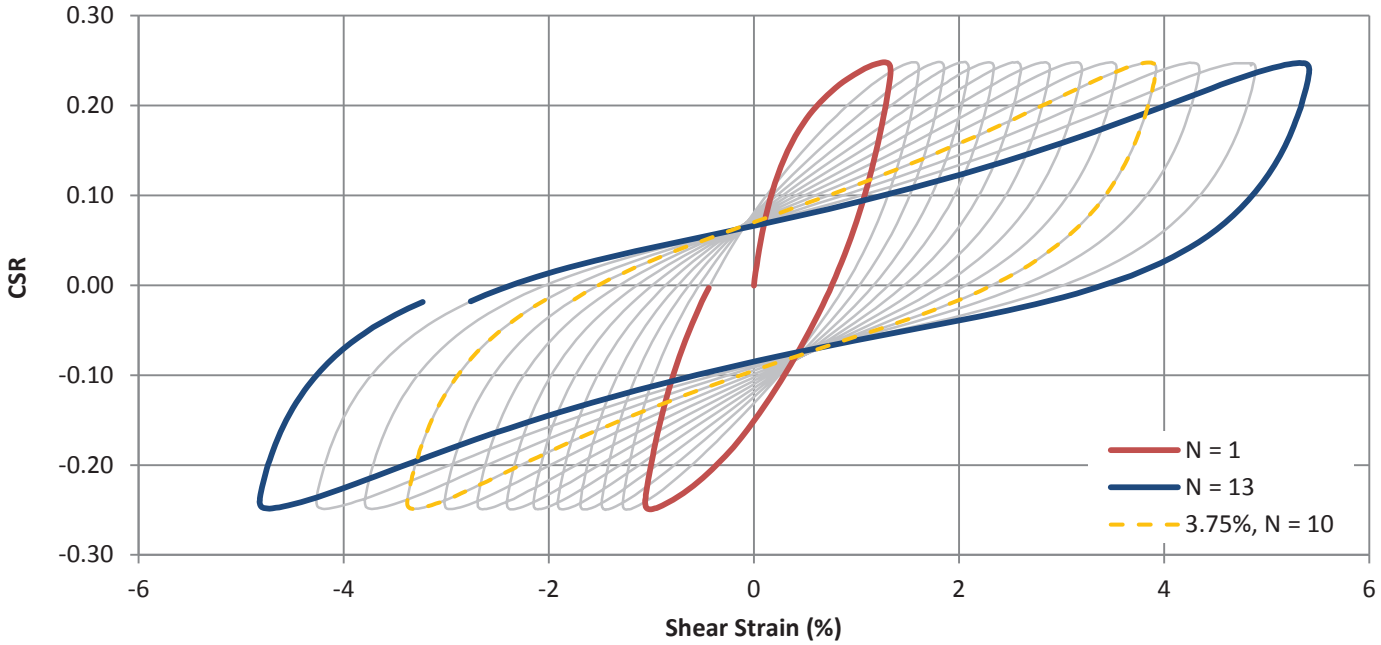
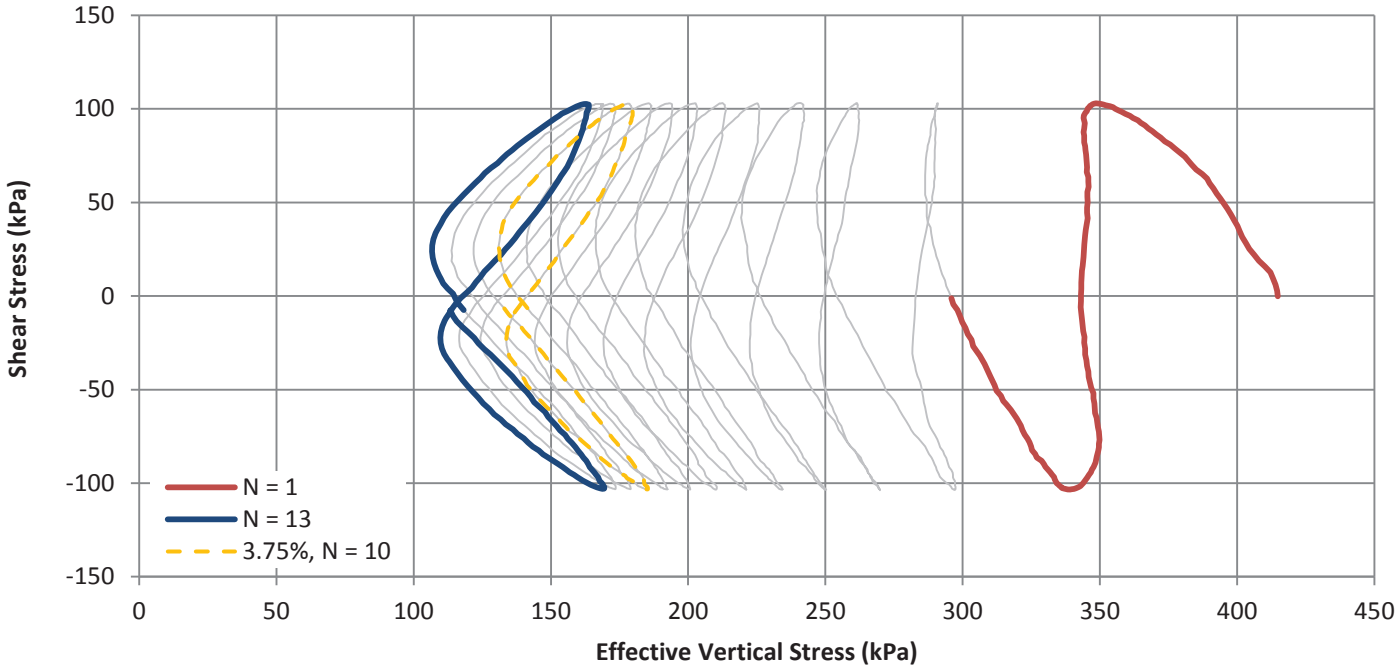
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G045 ST-3
Project:	Sound Transit Redmond Link Extension	**Test ID:**	415kPa, 0.25CSR
Location:	Redmond, WA	**Depth (m):**	43.13-43.17
Client:	GAI	**Lab ID No:**	33





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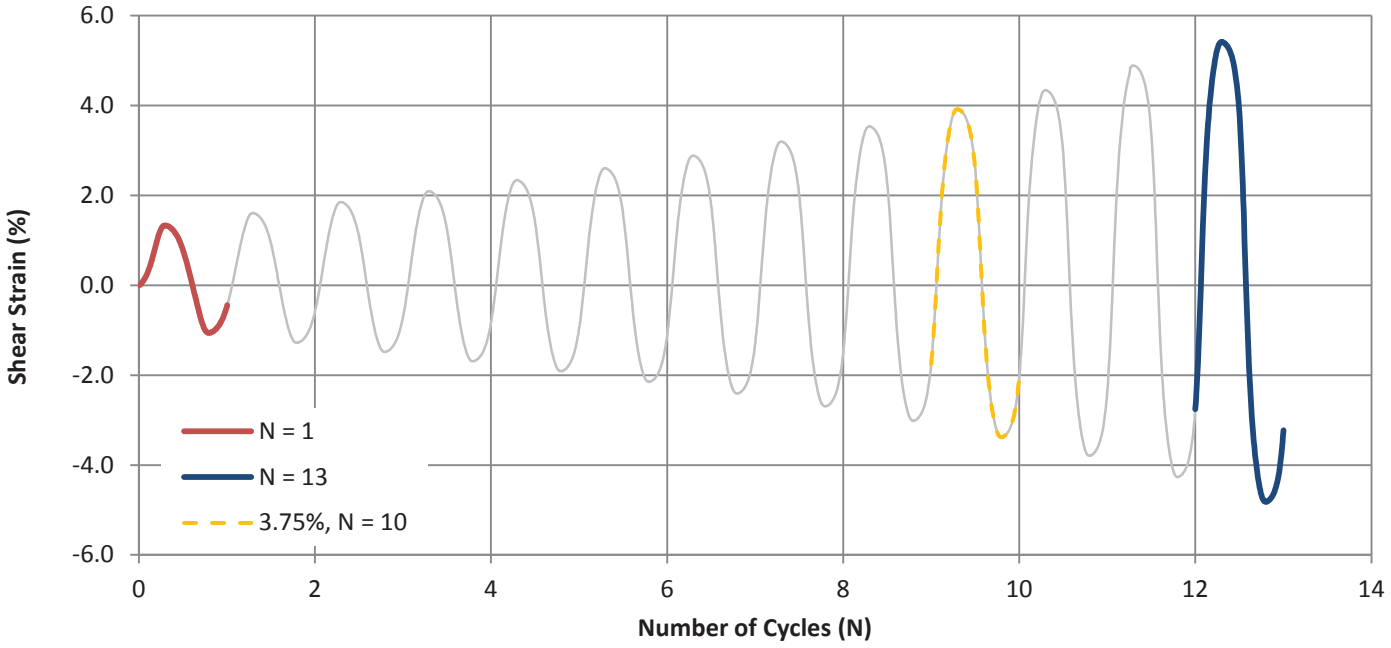
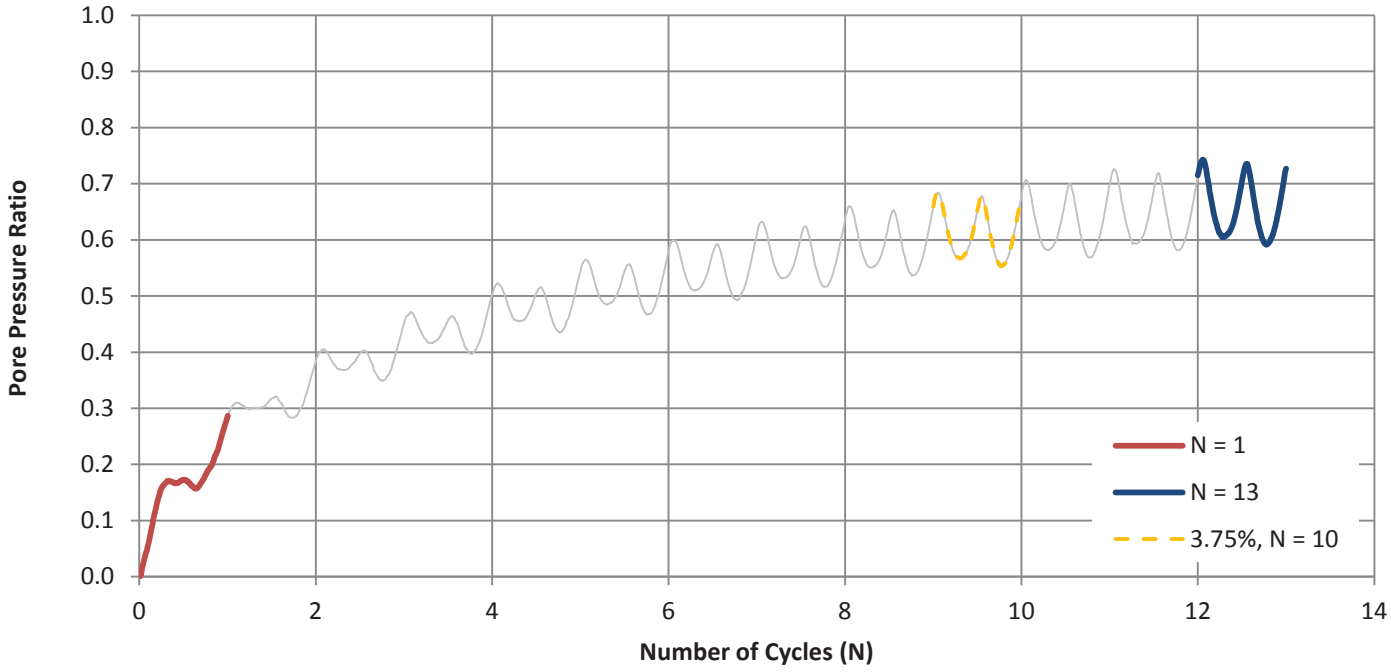
Location:	Redmond, WA	**Depth (m):**	43.13-43.17
Client:	GAI	**Lab ID No:**	33





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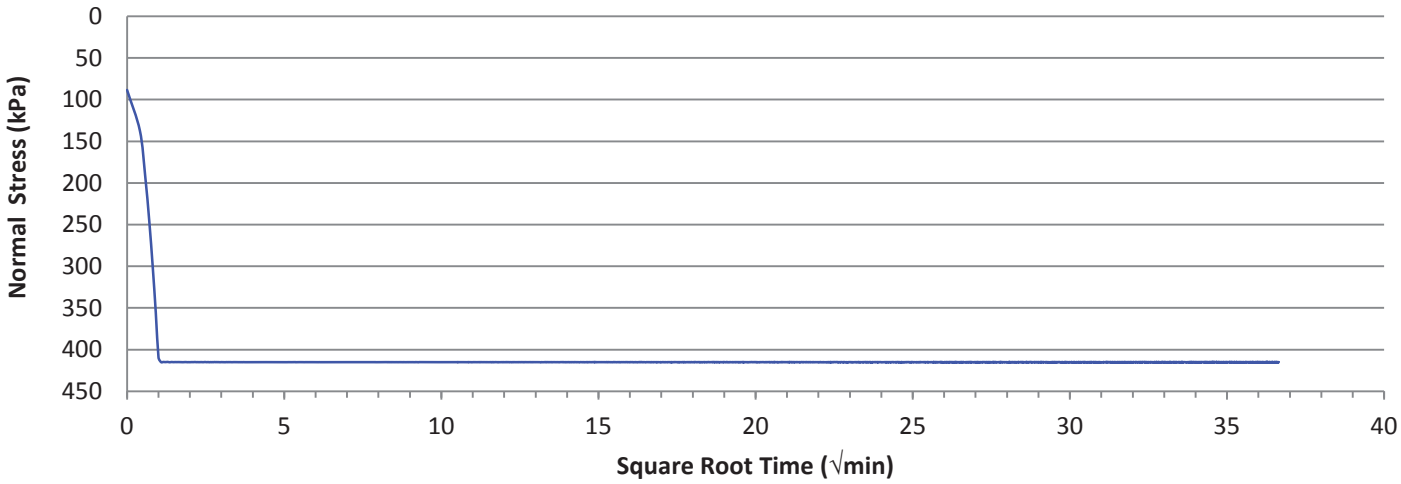
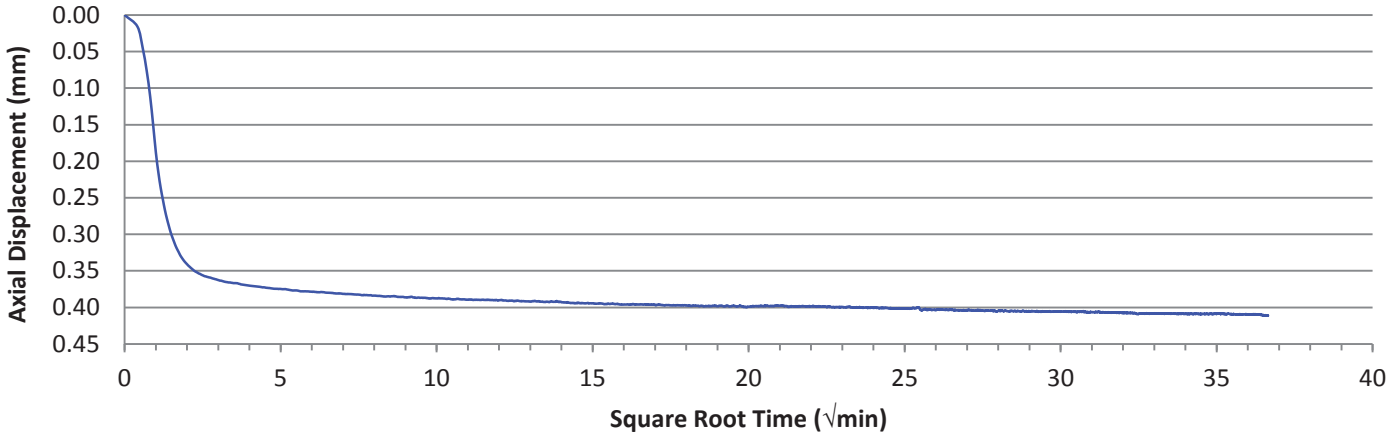
Project No.:	1657705.200.200.3	**Sample Number:**	DRLE-G045 ST-3
Project:	Sound Transit Redmond Link Extension	**Test ID:**	415kPa, 0.25CSR
Location:	Redmond, WA	**Depth (m):**	43.13-43.17
Client:	GAI	**Lab ID No:**	33

Stress at Start of Reconsolidation (kPa)	88.46
Stress at end of Reconsolidation (kPa)	415.11
Axial Strain at end of Reconsolidation (%)	1.86
Change in Height ΔH_c (mm)	0.41

Comments
Reconsolidation data calculated from the sample height at end of initial consolidation

Increment (kPa)	415						
Load (kN)	1.6216						
Duration (min)	1343						
Axial Strain (%)	1.86						





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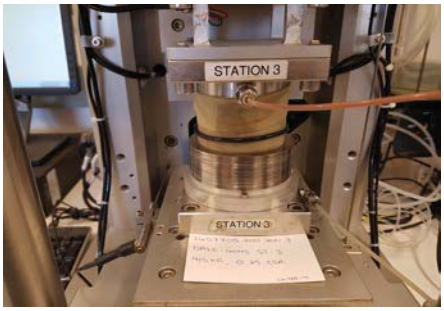
Project:	Sound Transit Redmond Link Extension	**Test ID:**	415kPa, 0.25CSR
Location:	Redmond, WA	**Depth (m):**	43.13-43.17
Client:	GAI	**Lab ID No:**	33



The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

G. Patton	March 24, 2018	M. Sanin	March 28, 2018
TESTED BY	DATE	CHECKED BY	DATE

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

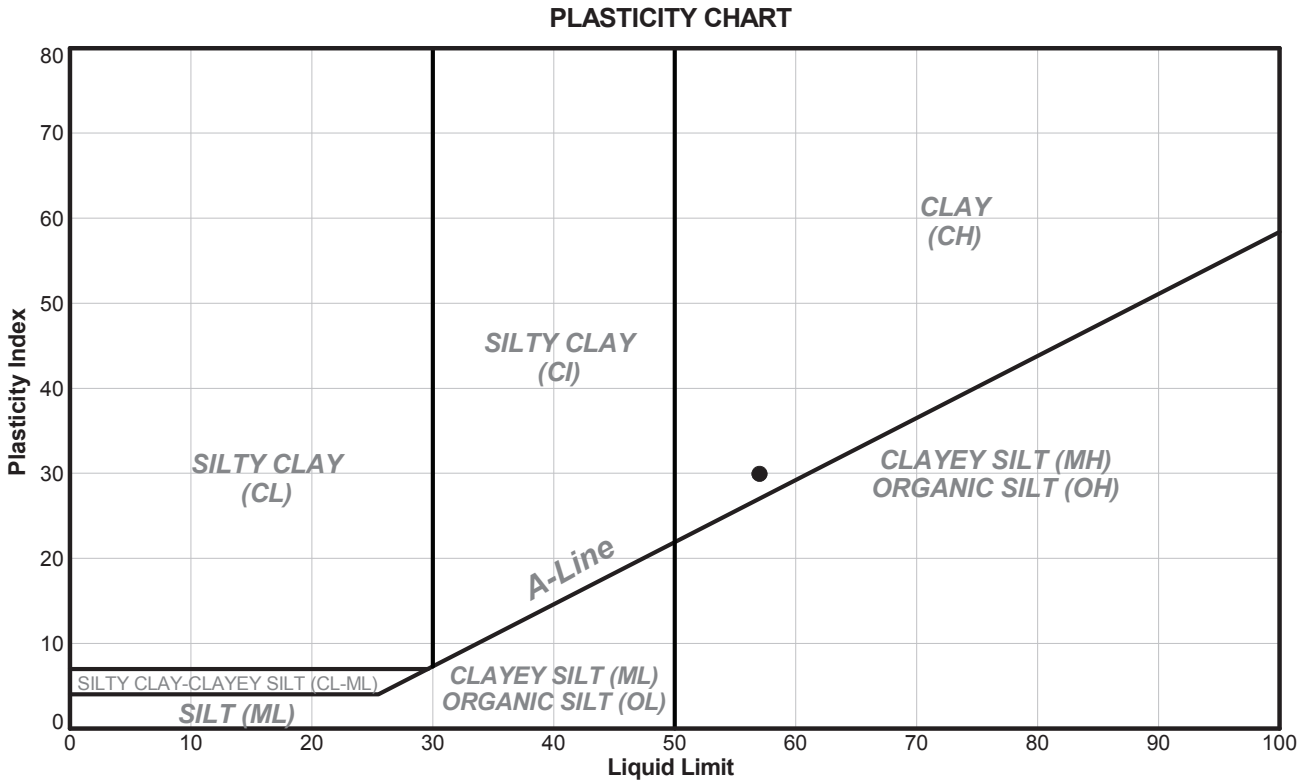
ASTM D 4318-10

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

ID: DRLE-G018
Sample No.: ST-1
Depth Interval (m): 35.96 to 35.99
Lab Schedule No.:

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G018	ST-1	35.96	35.99	ND	57	27	30.0	42.3	0.5

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

DT	3/9/2018	LP	3/13/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 sjohn 13/3/18

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Tel: +1 (604) 412 6899 Fax: +1 (604) 412 6816 www.golder.com

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

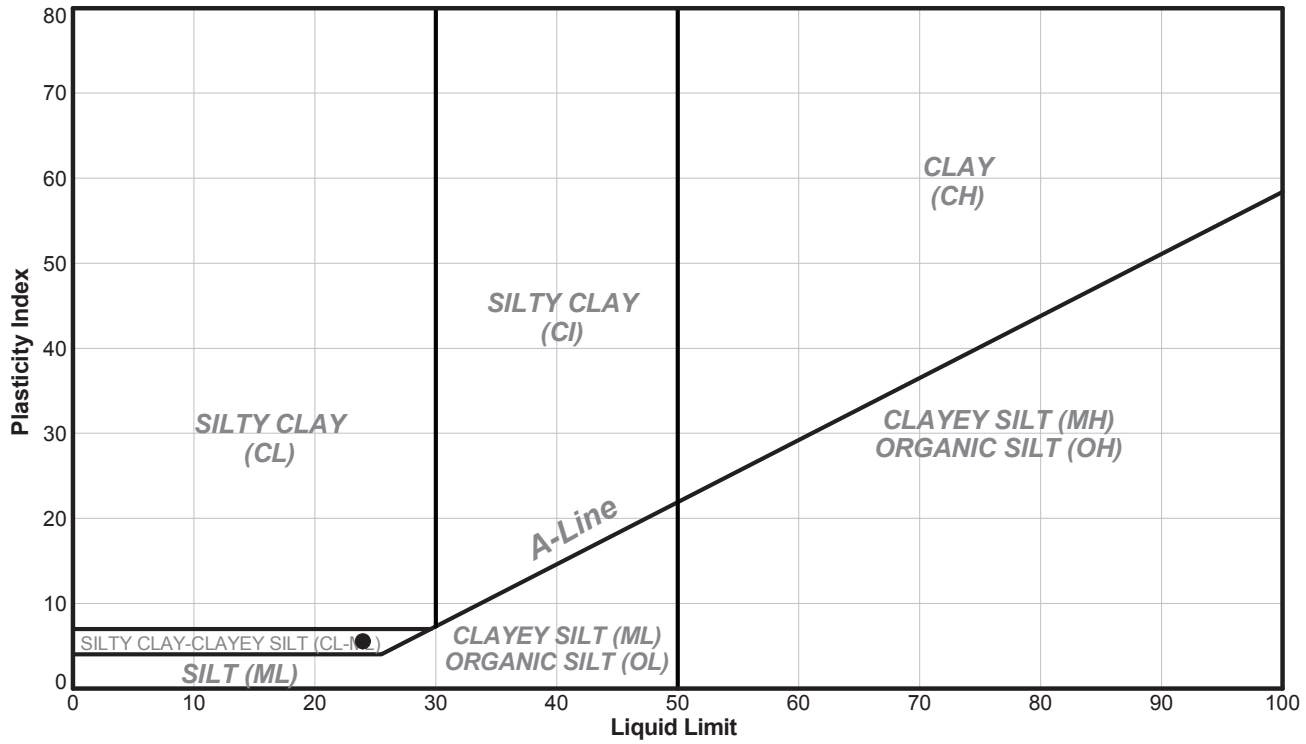
ASTM D 4318-10

Client:	GAI	**ID:**	**DRLE-G018**
Project:	Sound Transit Redmond Link Extension	**Sample No.:**	**ST-2**
Location:	Redmond, WA	**Depth Interval (m):**	34.77 to 34.83
Project No.:	1657705 **Phase:** 200 **Task:** 200.3	**Lab Schedule No.:**	

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**

PLASTICITY CHART



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G018	ST-2	34.77	34.83	ND	24	18	6.0	21.1	0.5

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

FF	2/26/2018	LH	2/28/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 lhu 2/02/18

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

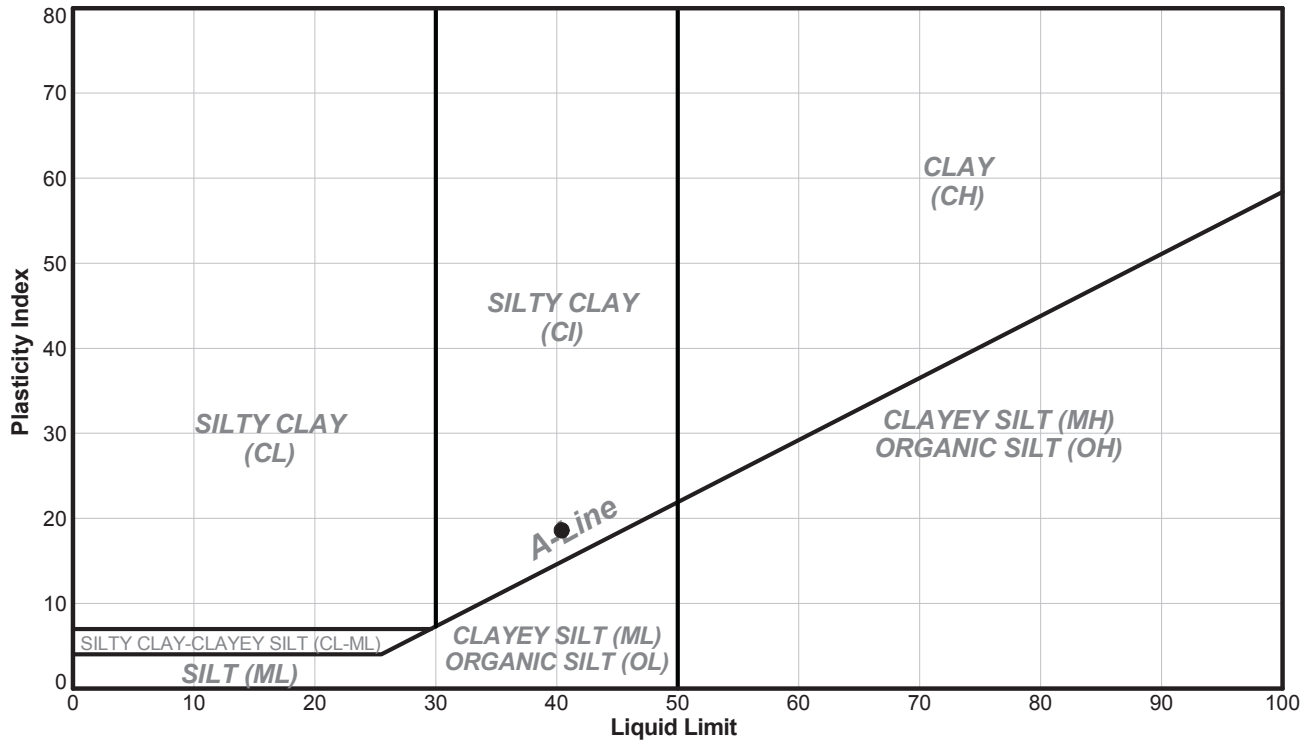
ASTM D 4318-10

Client:	GAI	**ID:**	**DRLE-G020**
Project:	Sound Transit Redmond Link Extension	**Sample No.:**	**ST-1**
Location:	Redmond, WA	**Depth Interval (m):**	35.70 to 35.75
Project No.:	1657705 **Phase:** 200 **Task:** 200.3	**Lab Schedule No.:**	

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**

PLASTICITY CHART



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G020	ST-1	35.70	35.75	ND	40	22	18.0	31.6	0.5

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

FF	2/27/2018	LH	2/28/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 Thu 2/8/2/18

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Tel: +1 (604) 412 6899 Fax: +1 (604) 412 6816 www.golder.com

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

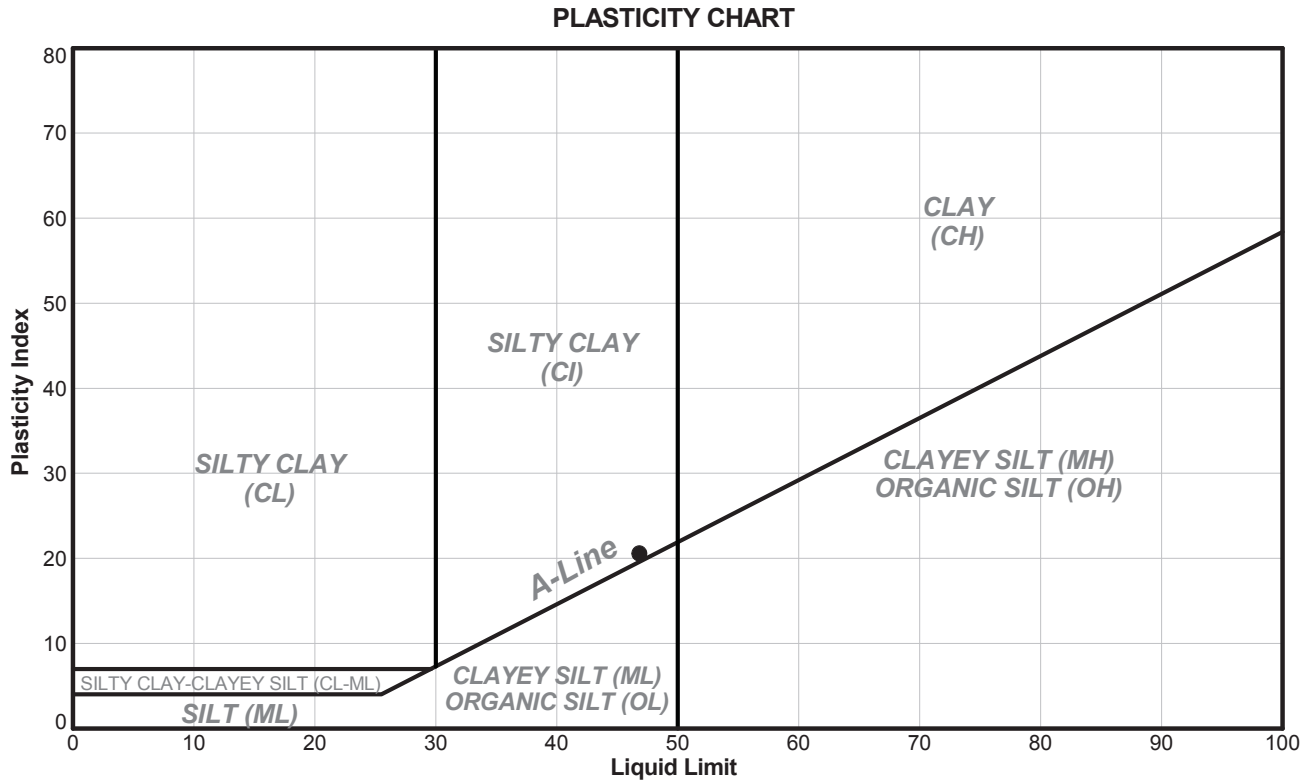
ASTM D 4318-10

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

ID: DRLE-G033
Sample No.: S-25
Depth Interval (m): 32.85 to 32.88
Lab Schedule No.:

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G033	S-25	32.85	32.88	ND	47	26	21.0	39.8	0.7

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

SJ/DC	3/8/2018	LP	3/12/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 sjohn 13/3/18

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Tel: +1 (604) 412 6899 Fax: +1 (604) 412 6816 www.golder.com

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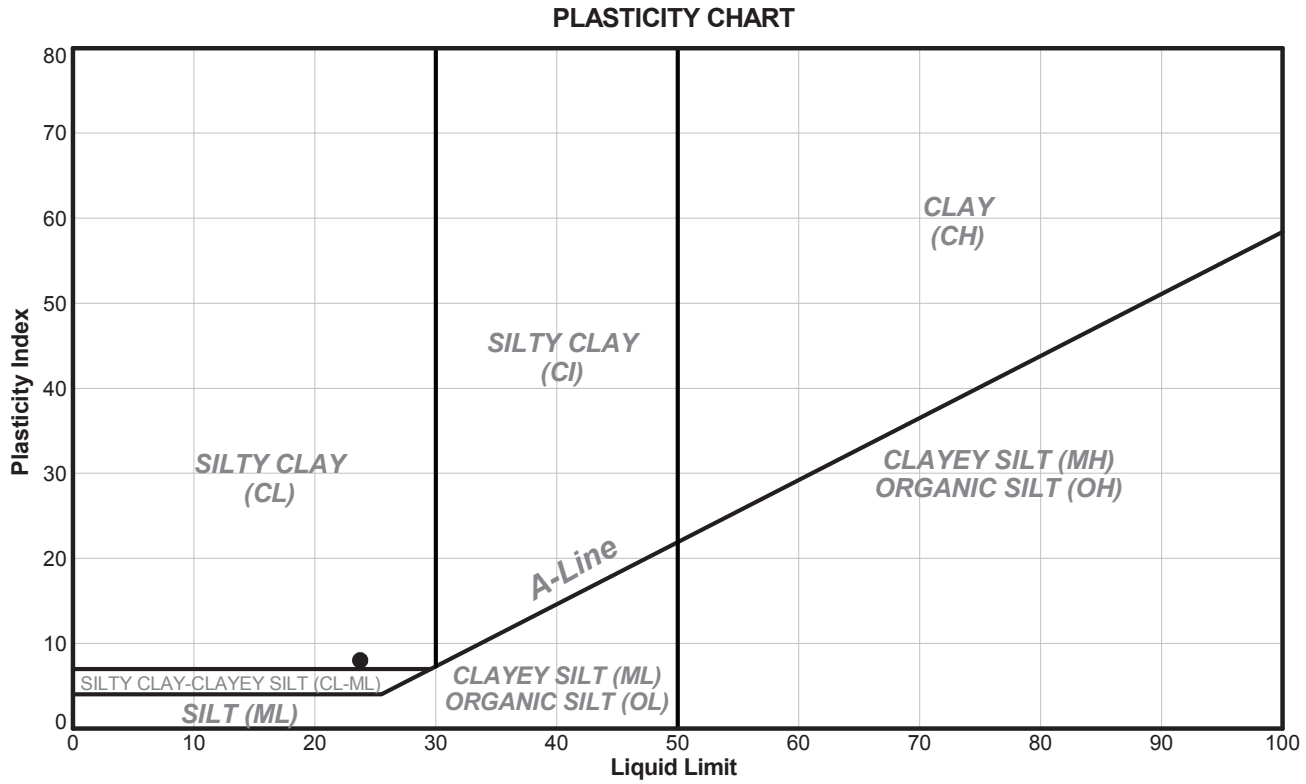
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

ASTM D 4318-10

Client:	GAI	**ID:**	**DRLE-G033**
Project:	Sound Transit Redmond Link Extension	**Sample No.:**	**S-28**
Location:	Redmond, WA	**Depth Interval (m):**	10.36 to 12.80
Project No.:	1657705 **Phase:** 200 **Task:** 200.3	**Lab Schedule No.:**	

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Air Dried**



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G033	S-28	10.36	12.80	100	24	16	8.0	21.3	0.7

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

RG	2/7/2018	LH	2/9/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 lhu 9/2/18

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

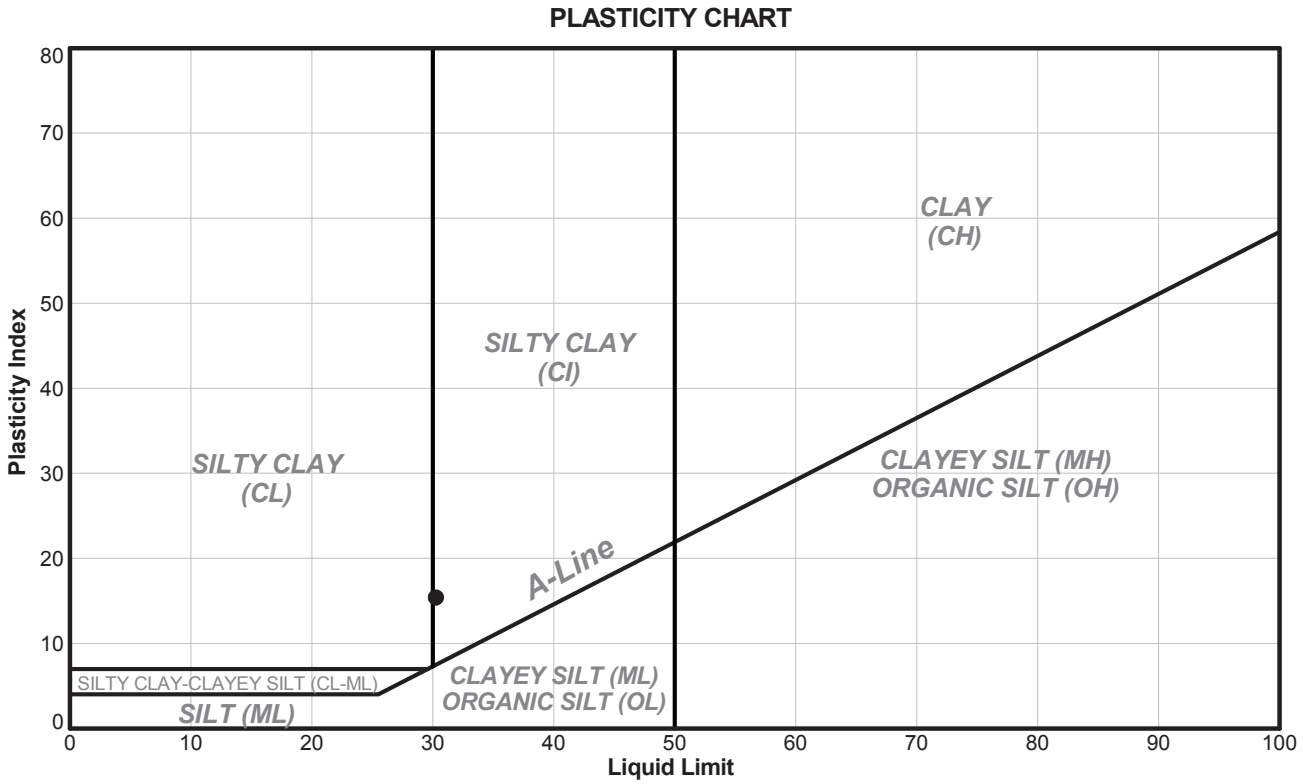
ASTM D 4318-10

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

ID: DRLE-G037
Sample No.: ST-1
Depth Interval (m): 36.37 to 36.42
Lab Schedule No.:

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G037	ST-1	36.37	36.42	ND	30	15	15.0	23.4	0.6

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

DT	3/9/2018	LP	3/13/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 sjohn 13/3/18

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

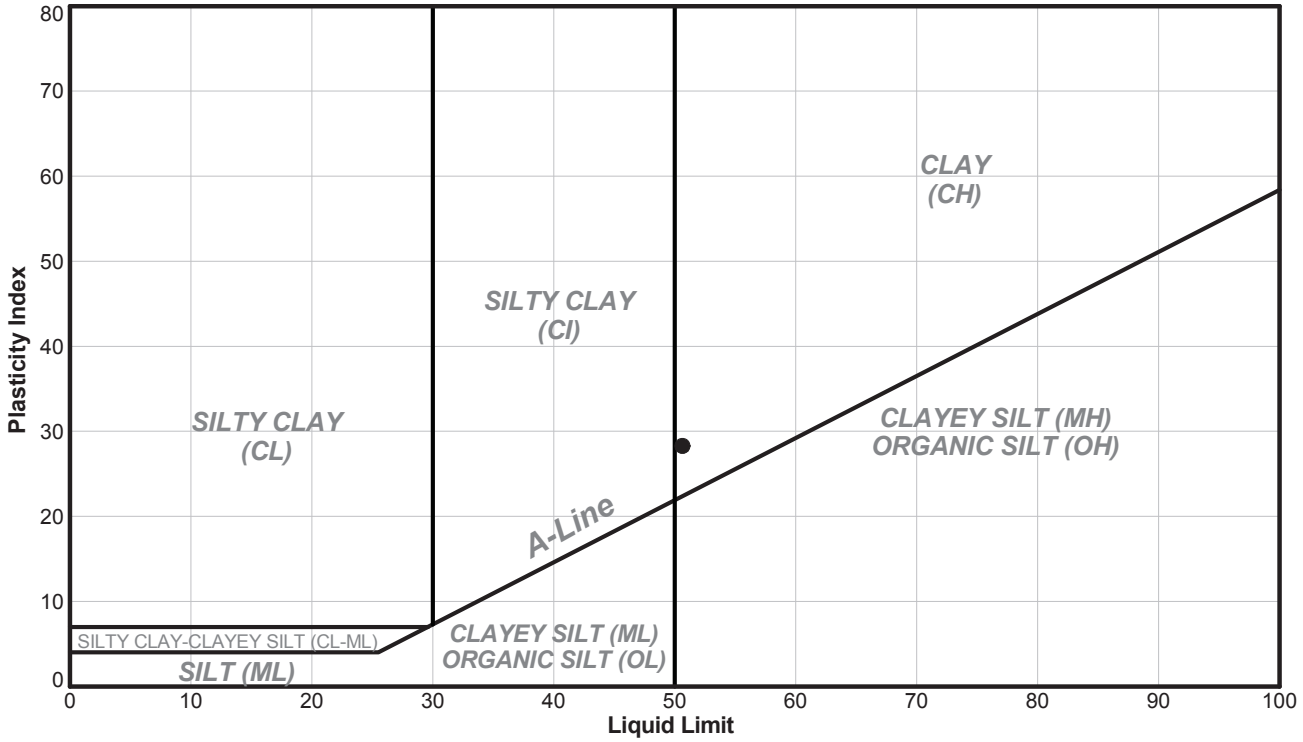
ASTM D 4318-10

Client:	GAI	**ID:**	**DRLE-G037**
Project:	Sound Transit Redmond Link Extension	**Sample No.:**	**ST-2**
Location:	Redmond, WA	**Depth Interval (m):**	34.28 to 34.32
Project No.:	1657705 **Phase:** 200 **Task:** 200.3	**Lab Schedule No.:**	

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**

PLASTICITY CHART



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G037	ST-2	34.28	34.32	ND	51	22	29.0	38.5	0.6

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

RG	2/15/2018	LH	2/23/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 Thu 2/7/2/18

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Tel: +1 (604) 412 6899 Fax: +1 (604) 412 6816 www.golder.com

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

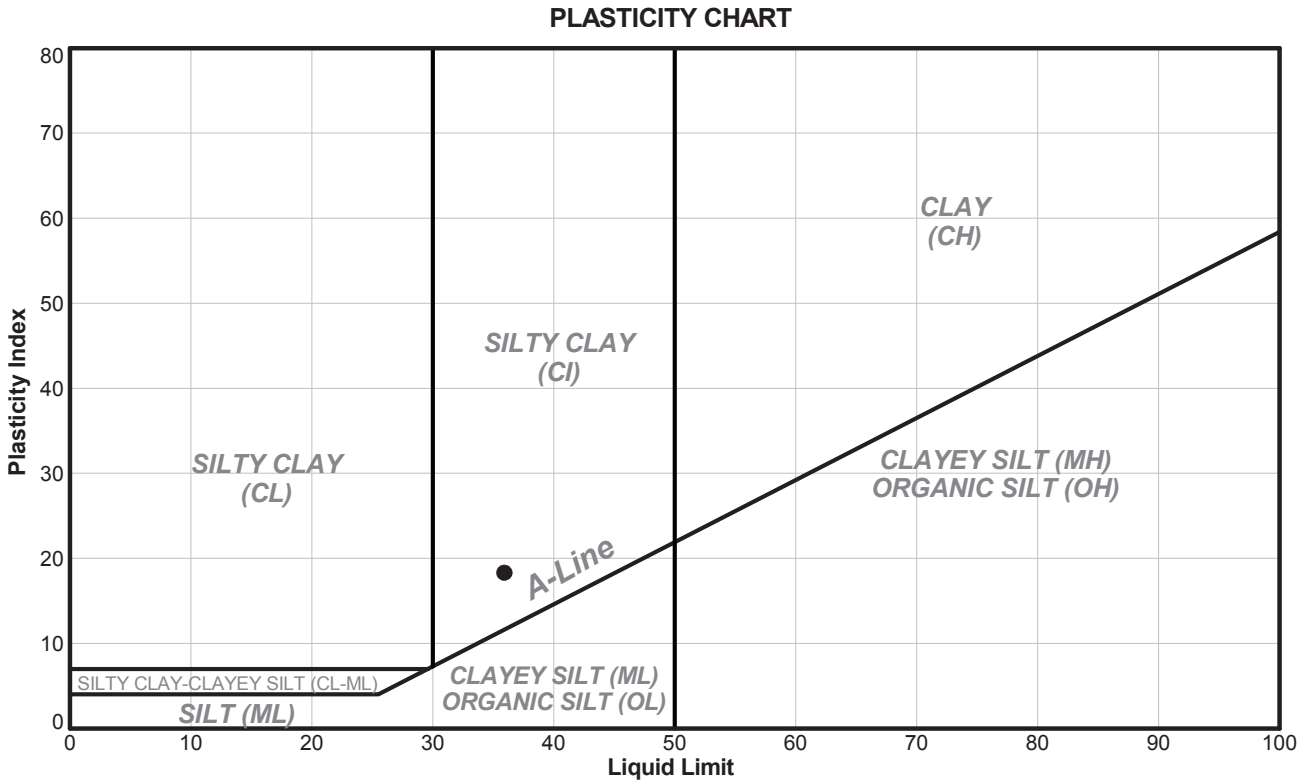
ASTM D 4318-10

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

ID: DRLE-G037A
Sample No.: S-21
Depth Interval (m): 30.06 to 30.11
Lab Schedule No.:

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G037A	S-21	30.06	30.11	ND	36	18	18.0	27.6	0.5

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

DT	3/12/2018	LP	3/13/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 sjohn 13/3/18

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

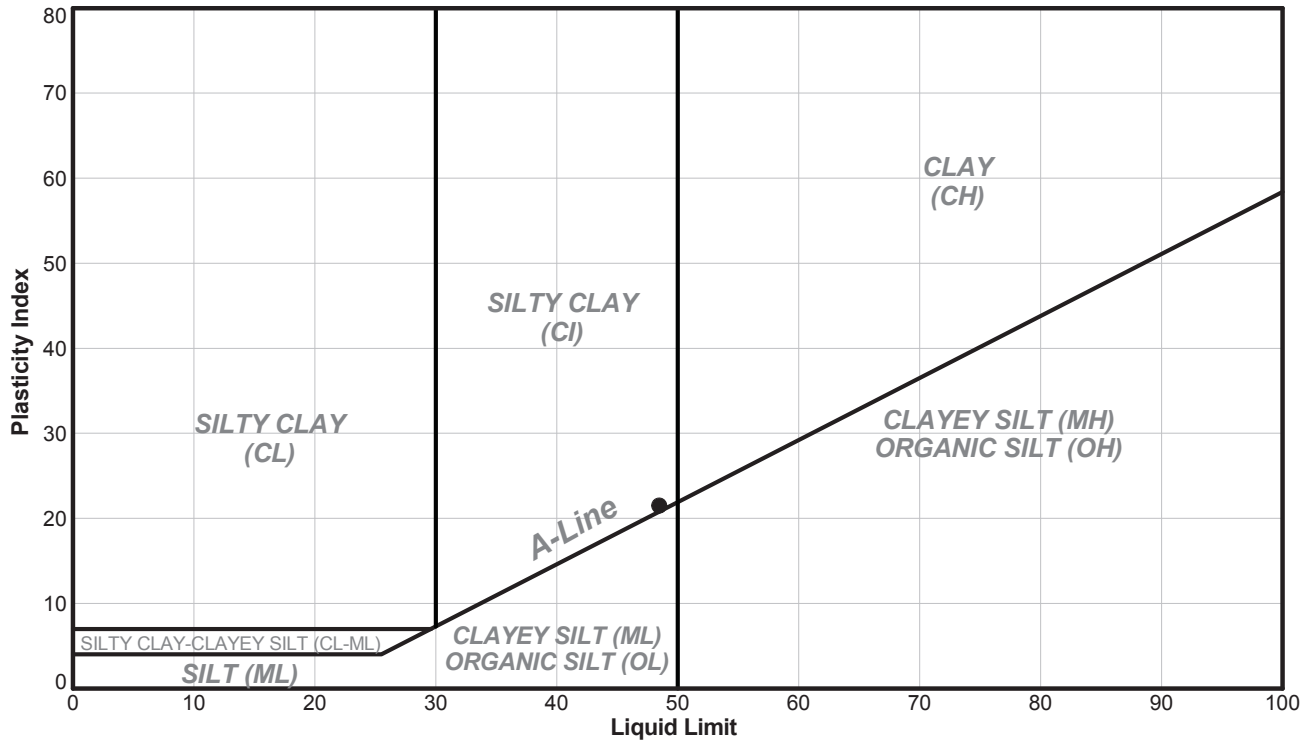
ASTM D 4318-10

Client:	GAI	**ID:**	**DRLE-G044**
Project:	Sound Transit Redmond Link Extension	**Sample No.:**	**ST-1**
Location:	Redmond, WA	**Depth Interval (m):**	32.11 to 32.14
Project No.:	1657705 **Phase:** 200 **Task:** 200.3	**Lab Schedule No.:**	

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**

PLASTICITY CHART



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G044	ST-1	32.11	32.14	100	48	27	21.0	35.7	0.4

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

KS	2/13/2018	LH	2/23/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG GASAGRANDE (SINGLE) 2015 Thu 2/7/2/18

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

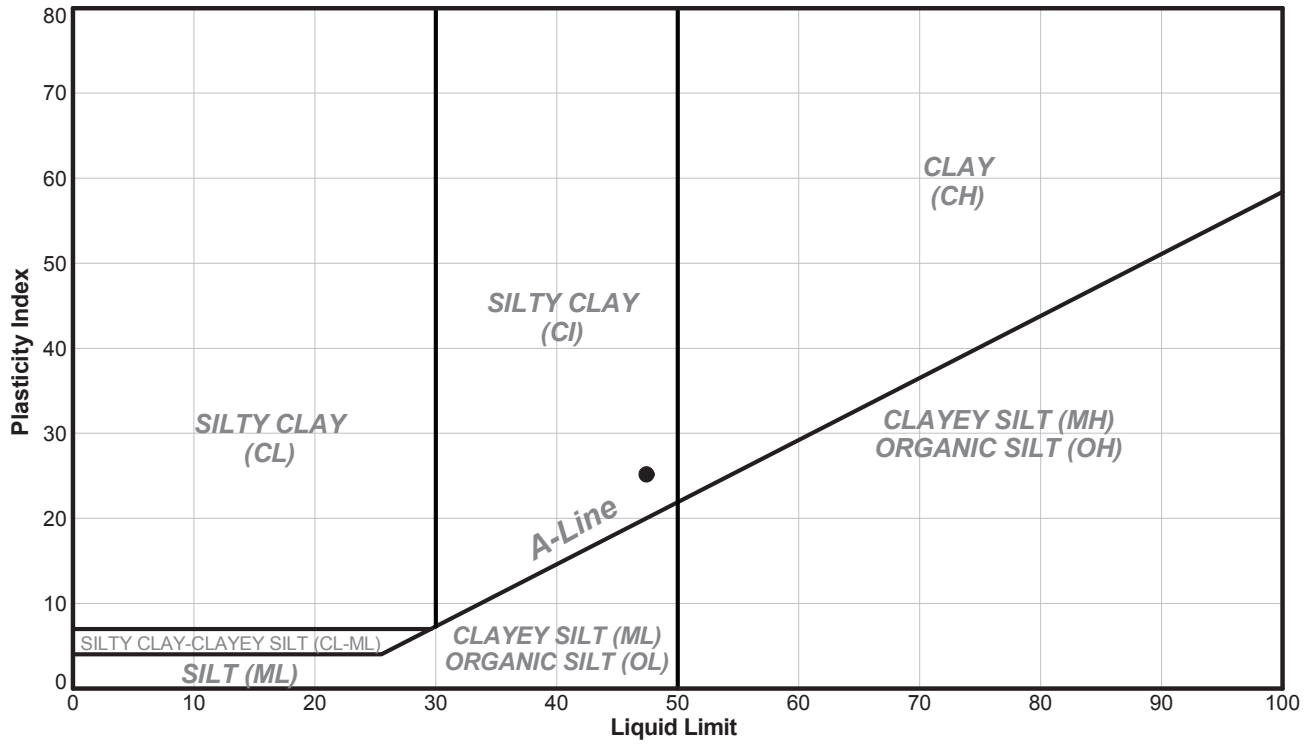
ASTM D 4318-10

Client:	GAI	**ID:**	**DRLE-G044**
Project:	Sound Transit Redmond Link Extension	**Sample No.:**	**ST-2**
Location:	Redmond, WA	**Depth Interval (m):**	40.64 to 40.68
Project No.:	1657705 **Phase:** 200 **Task:** 200.3	**Lab Schedule No.:**	

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**

PLASTICITY CHART



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G044	ST-2	40.64	40.68	ND	47	22	25.0	35.1	0.5

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

RG	2/15/2018	LH	2/23/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 Thu 2/7/2/18

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

ASTM D 4318-10

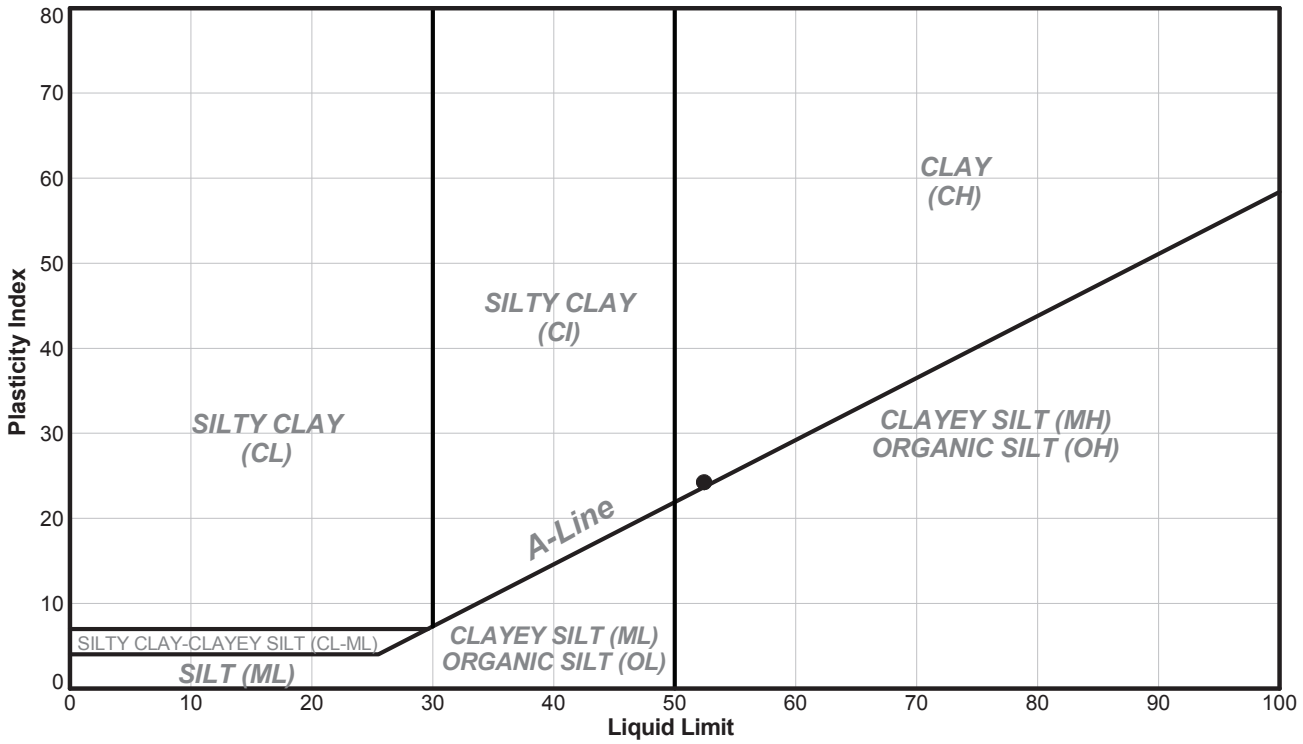
Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

ID: DRLE-G045
Sample No.: ST-1
Depth Interval (m): 27.64 to 27.68
Lab Schedule No.:

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Air Dried**

PLASTICITY CHART



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G045	ST-1	27.64	27.68	100	52	28	24.0	39.9	0.5

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

KS	2/14/2018	LH	2/23/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 Thu 2/7/2/18

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Tel: +1 (604) 412 6899 Fax: +1 (604) 412 6816 www.golder.com

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

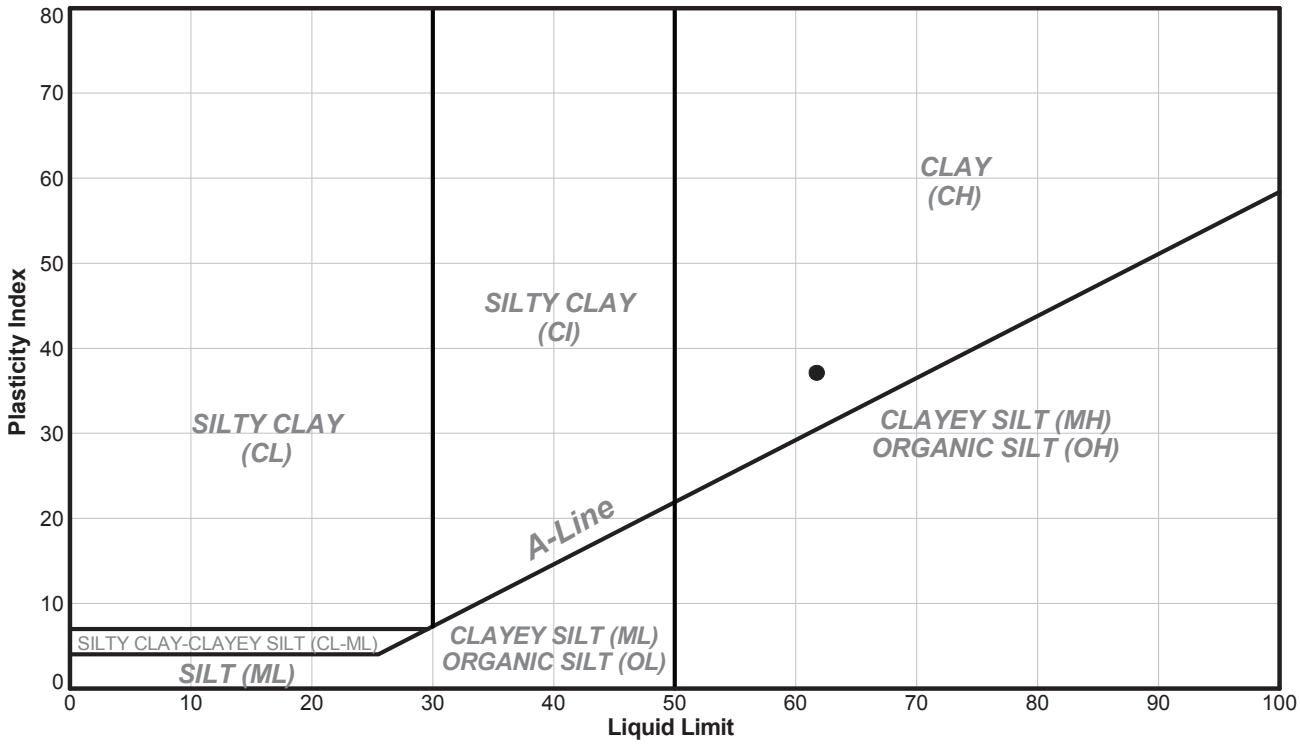
ASTM D 4318-10

Client:	GAI	**ID:**	**DRLE-G045**
Project:	Sound Transit Redmond Link Extension	**Sample No.:**	**ST-2**
Location:	Redmond, WA	**Depth Interval (m):**	33.77 to 33.81
Project No.:	1657705 **Phase:** 200 **Task:** 200.3	**Lab Schedule No.:**	

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**

PLASTICITY CHART



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G045	ST-2	33.77	33.81	ND	62	25	37.0	47.4	0.6

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

SJ/FF	3/15/2018	LP	3/19/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 gpatton 20/3/18

Golder Associates Ltd.
Suite 200 - 2920 Virtual Way Vancouver, BC, V5M 0C4 CANADA
Tel: +1 (604) 296 4200 Fax: +1 (604) 298 5253 www.golder.com

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

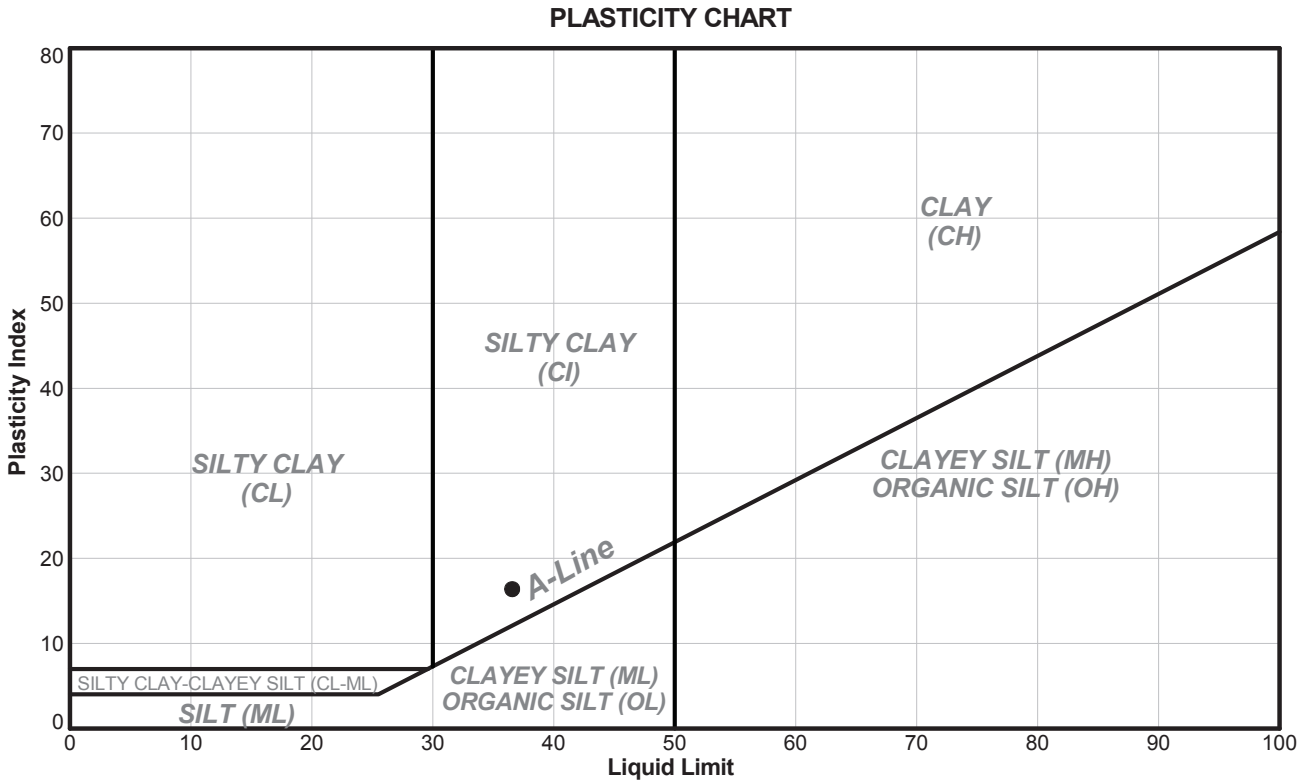
ASTM D 4318-10

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

ID: DRLE-G045
Sample No.: ST-3
Depth Interval (m): 42.97 to 42.99
Lab Schedule No.:

Other Remarks: **N/A**

Test Method: A-Multi Point | **Preparation Method: Wet**



Sym.	Sample Location	Sample / Specimen Number	Depth (m)	Bottom (m)	Percent Passing #40 Sieve (%)	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content (%)	Liquidity Index
●	DRLE-G045	ST-3	42.97	42.99	ND	37	20	17.0	30.3	0.6

NP - NON-PLASTIC RESULT ND - NOT DETERMINED

Note: The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

SJ/DC	3/8/2018	LP	3/12/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form: _LAB ATTERBERG CASAGRANDE (SINGLE) 2015 sjohn 13/3/18

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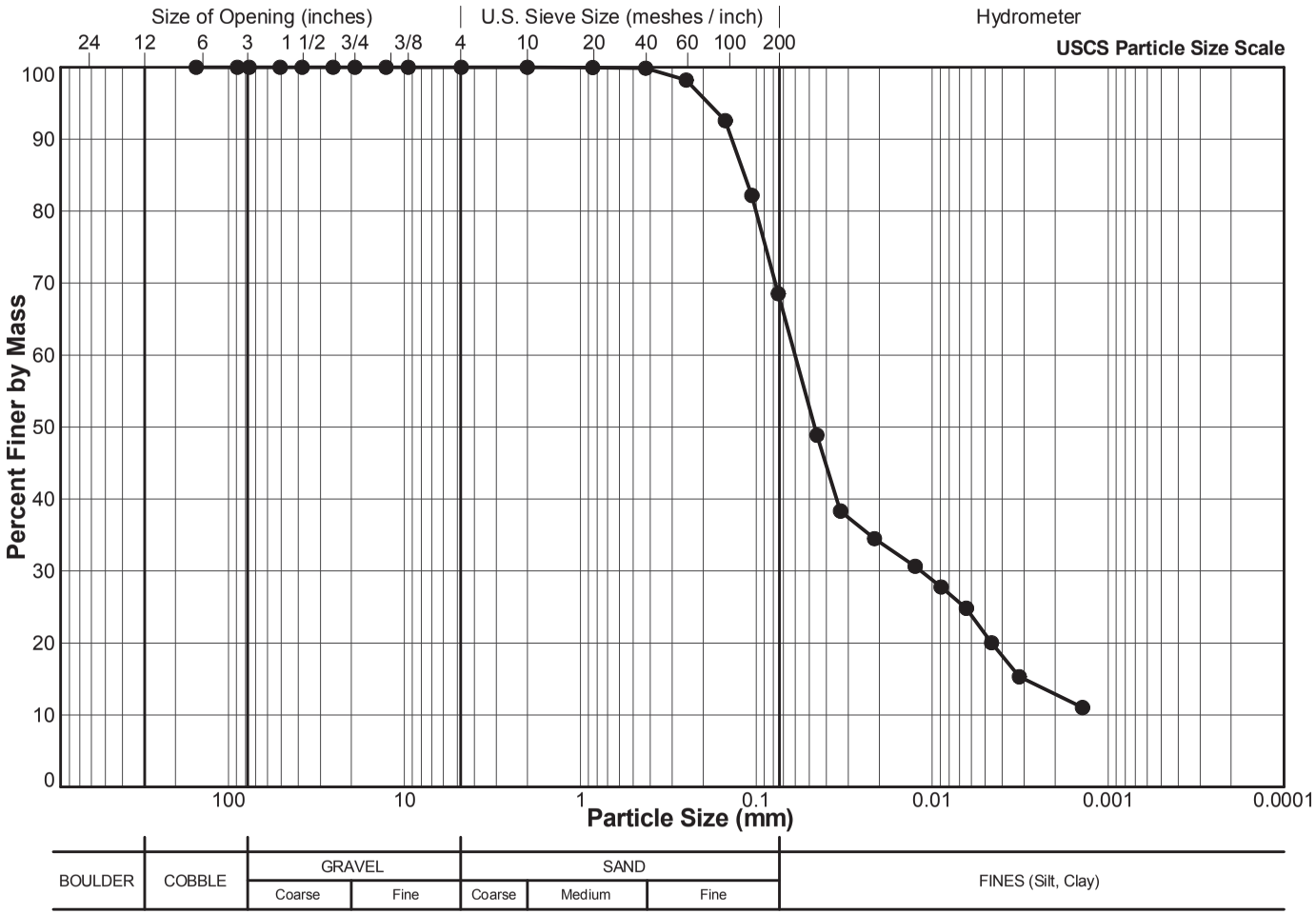
SUMMARY OF PARTICLE SIZE DISTRIBUTION

ASTM D 422

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

Sample Location: DRLE-G018
Sample No.: ST-2
Depth Interval (m): 34.59 to 34.67
Lab Schedule No.:



Legend

Sieve Size (USS)	(mm)	Particle Size (mm)	Percent Passing
6"	152.4		100.0
3.5"	88.9		100.0
3"	76.2		100.0
2"	50.8		100.0
1 1/2"	38.1		100.0
1"	25.4		100.0
3/4"	19.1		100.0
1/2"	12.7		100.0
3/8"	9.5		100.0
#4 US MESH	4.75		100.0
#10 US MESH	2		100.0
#20 US MESH	0.85		100.0
#40 US MESH	0.425		99.9
#60 US MESH	0.25		98.2
#100 US MESH	0.15		92.6
#140 US MESH	0.106		82.2
#200 US MESH	0.075		68.5
		0.0452	48.9
		0.0332	38.3
		0.0213	34.5
		0.0125	30.7
		0.0089	27.8
		0.0064	24.8
		0.0046	20.0
		0.0032	15.3
		0.0014	11.0

SJ/FF	3/2/2018	LP	3/12/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID:1870 Output Form: LAB_PARTICLE SIZE (W/ GRADATIONS) 2015 sjohn 13/3/18

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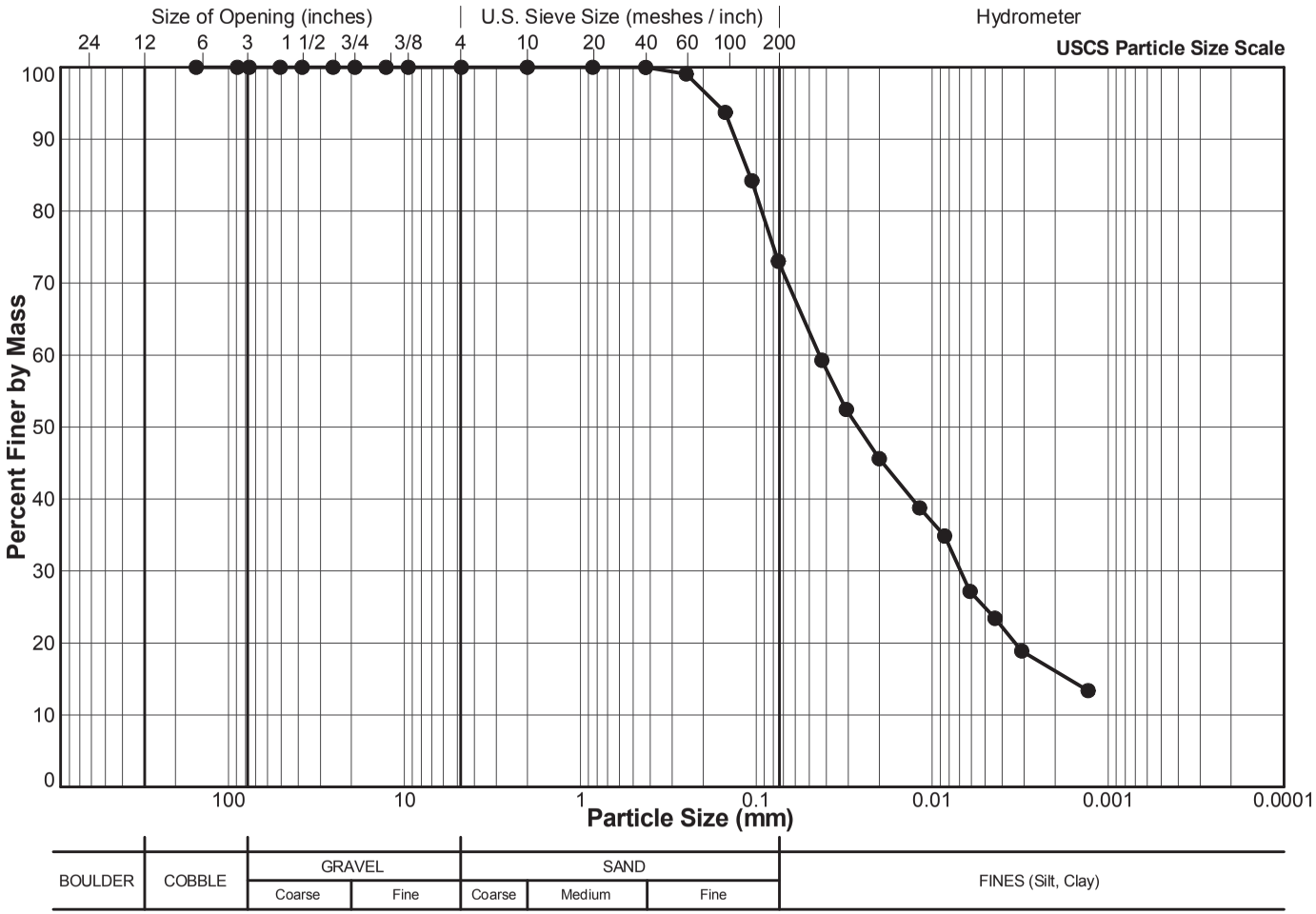
SUMMARY OF PARTICLE SIZE DISTRIBUTION

ASTM D 422

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

Sample Location: DRLE-G033
Sample No.: S-28
Depth Interval (m): 10.36 to 12.80
Lab Schedule No.:



Legend

Sieve Size (USS)	(mm)	Particle Size (mm)	Percent Passing
6"	152.4		100.0
3.5"	88.9		100.0
3"	76.2		100.0
2"	50.8		100.0
1 1/2"	38.1		100.0
1"	25.4		100.0
3/4"	19.1		100.0
1/2"	12.7		100.0
3/8"	9.5		100.0
#4 US MESH	4.75		100.0
#10 US MESH	2		100.0
#20 US MESH	0.85		100.0
#40 US MESH	0.425		100.0
#60 US MESH	0.25		99.1
#100 US MESH	0.15		93.7
#140 US MESH	0.106		84.2
#200 US MESH	0.075		73.1
		0.0424	59.3
		0.0308	52.4
		0.0200	45.6
		0.0118	38.8
		0.0085	34.9
		0.0061	27.2
		0.0044	23.4
		0.0031	18.9
		0.0013	13.4

DC/VN	2/7/2018	LH	2/9/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID:1870 Output Form: LAB PARTICLE SIZE (W/ GRADATIONS) 2015 lhu 9/2/18

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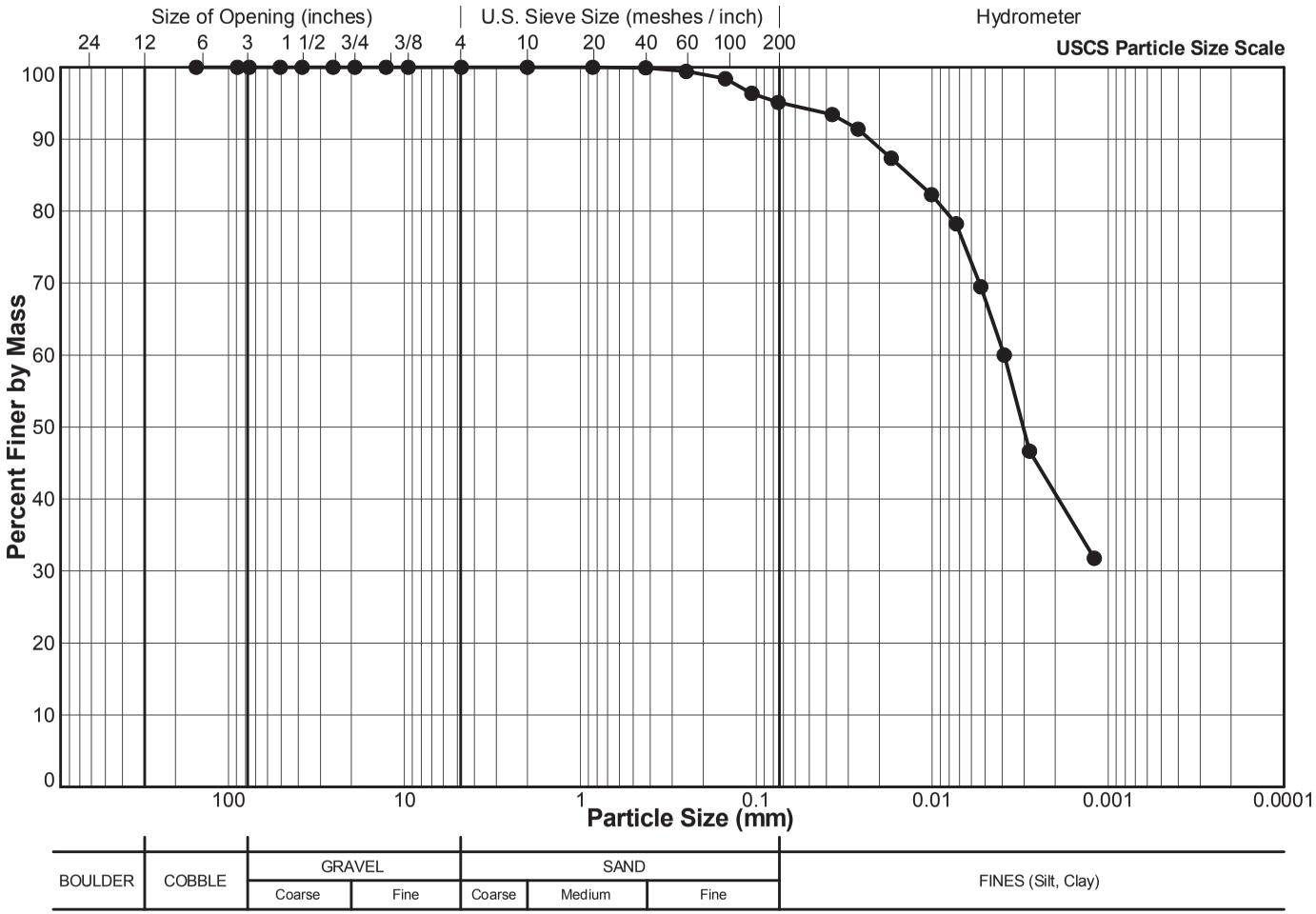
SUMMARY OF PARTICLE SIZE DISTRIBUTION

ASTM D 422

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

Sample Location: DRLE-G044
Sample No.: ST-1
Depth Interval (m): 32.11 to 32.14
Lab Schedule No.:



Legend

Sieve Size (USS)	(mm)	Particle Size (mm)	Percent Passing
6"	152.4		100.0
3.5"	88.9		100.0
3"	76.2		100.0
2"	50.8		100.0
1 1/2"	38.1		100.0
1"	25.4		100.0
3/4"	19.1		100.0
1/2"	12.7		100.0
3/8"	9.5		100.0
#4 US MESH	4.75		100.0
#10 US MESH	2		100.0
#20 US MESH	0.85		100.0
#40 US MESH	0.425		99.9
#60 US MESH	0.25		99.4
#100 US MESH	0.15		98.4
#140 US MESH	0.106		96.4
#200 US MESH	0.075		95.1
		0.0370	93.4
		0.0264	91.4
		0.0171	87.4
		0.0101	82.3
		0.0073	78.2
		0.0053	69.5
		0.0039	60.0
		0.0028	46.7
		0.0012	31.8

DC/VN	2/14/2018	LH	2/23/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID:1870 Output Form: LAB_PARTICLE SIZE (W/ GRADATIONS) 2015 lhu 27/2/18

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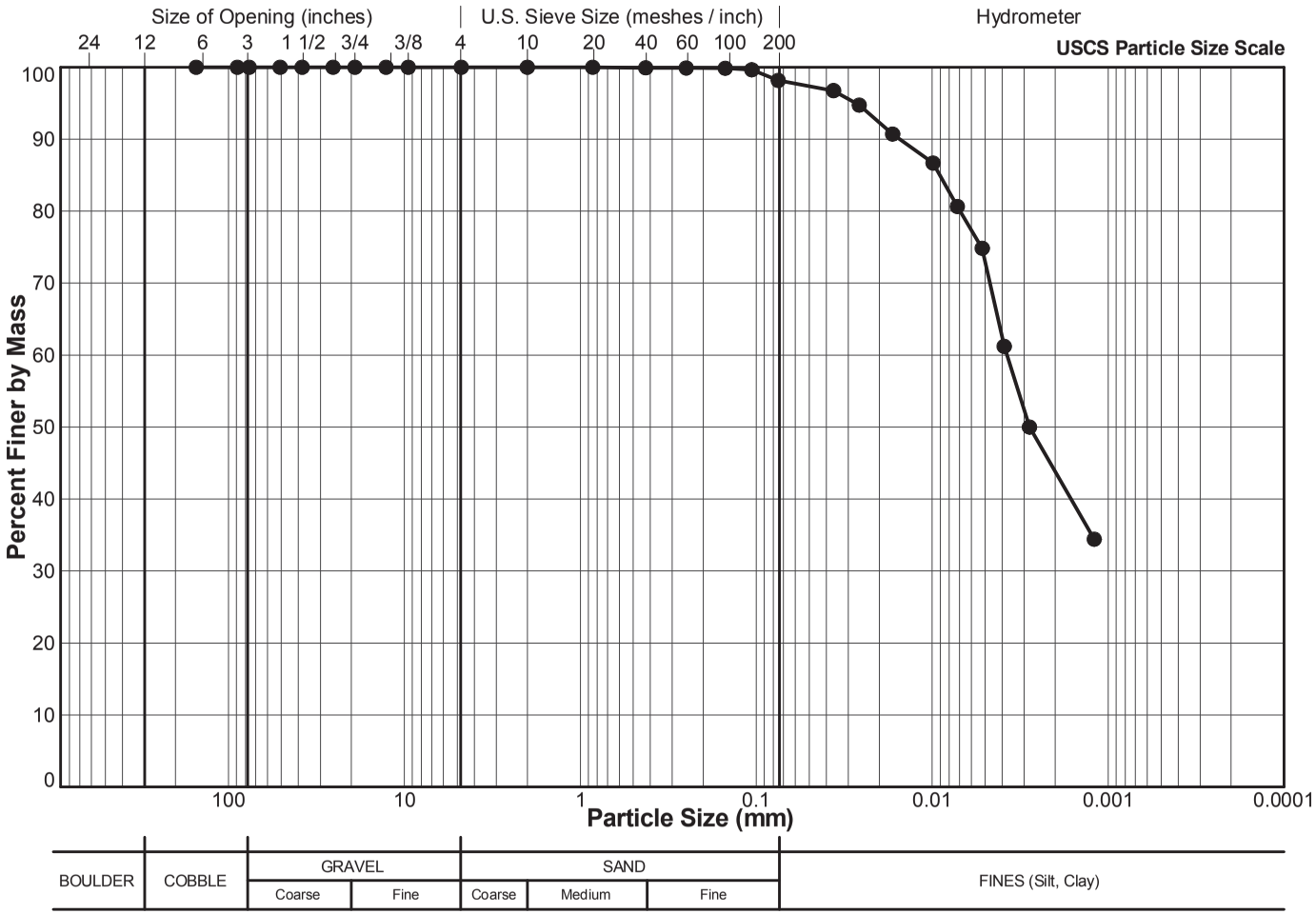
SUMMARY OF PARTICLE SIZE DISTRIBUTION

ASTM D 422

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

Sample Location: DRLE-G045
Sample No.: ST-1
Depth Interval (m): 27.64 to 27.68
Lab Schedule No.:



Legend

Sieve Size (USS)	(mm)	Particle Size (mm)	Percent Passing
6"	152.4		100.0
3.5"	88.9		100.0
3"	76.2		100.0
2"	50.8		100.0
1 1/2"	38.1		100.0
1"	25.4		100.0
3/4"	19.1		100.0
1/2"	12.7		100.0
3/8"	9.5		100.0
#4 US MESH	4.75		100.0
#10 US MESH	2		100.0
#20 US MESH	0.85		100.0
#40 US MESH	0.425		99.9
#60 US MESH	0.25		99.9
#100 US MESH	0.15		99.9
#140 US MESH	0.106		99.7
#200 US MESH	0.075		98.2
		0.0364	96.8
		0.0260	94.7
		0.0168	90.7
		0.0099	86.7
		0.0072	80.6
		0.0052	74.8
		0.0039	61.2
		0.0028	50.0
		0.0012	34.4

DC/VN	2/14/2018	LH	2/23/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID:1870 Output Form: LAB_PARTICLE SIZE (W/ GRADATIONS) 2015 lhu 27/2/18

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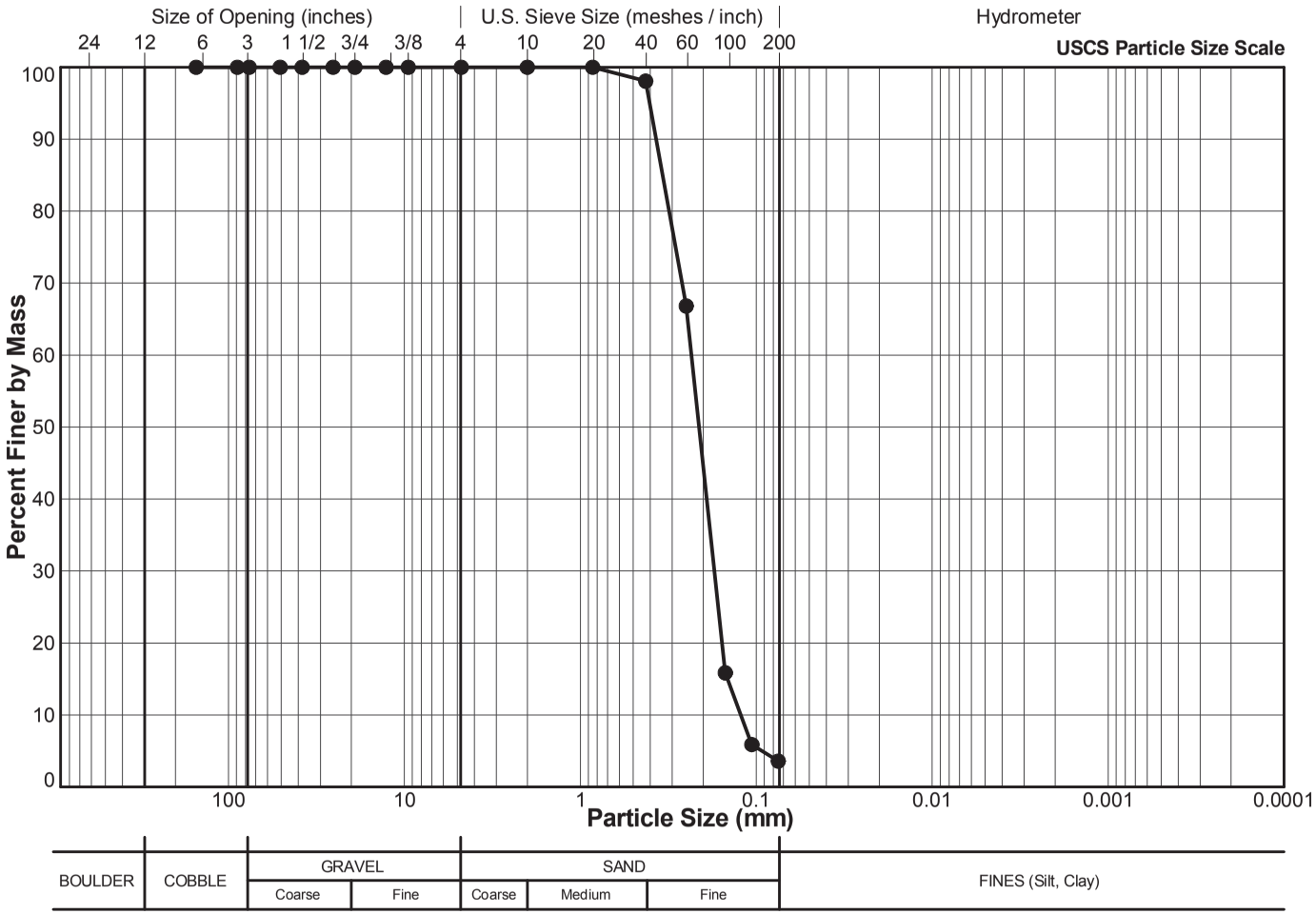
SUMMARY OF PARTICLE SIZE DISTRIBUTION

ASTM D6913

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

Sample Location: DRLE-G045
Sample No.: ST-1
Depth Interval (m): 27.76 to 27.81
Lab Schedule No.:



Legend

Sieve Size (USS)	(mm)	Particle Size (mm)	Percent Passing
6"	152.4		100.0
3.5"	88.9		100.0
3"	76.2		100.0
2"	50.8		100.0
1 1/2"	38.1		100.0
1"	25.4		100.0
3/4"	19.1		100.0
1/2"	12.7		100.0
3/8"	9.5		100.0
#4 US MESH	4.75		100.0
#10 US MESH	2		100.0
#20 US MESH	0.85		100.0
#40 US MESH	0.425		98.1
#60 US MESH	0.25		66.8
#100 US MESH	0.15		15.9
#140 US MESH	0.106		5.9
#200 US MESH	0.075		3.6

DC/VN	2/14/2018	LH	2/23/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID:1870 Output Form: LAB_PARTICLE SIZE (W/ GRADATIONS) 2015 lhu 27/2/18

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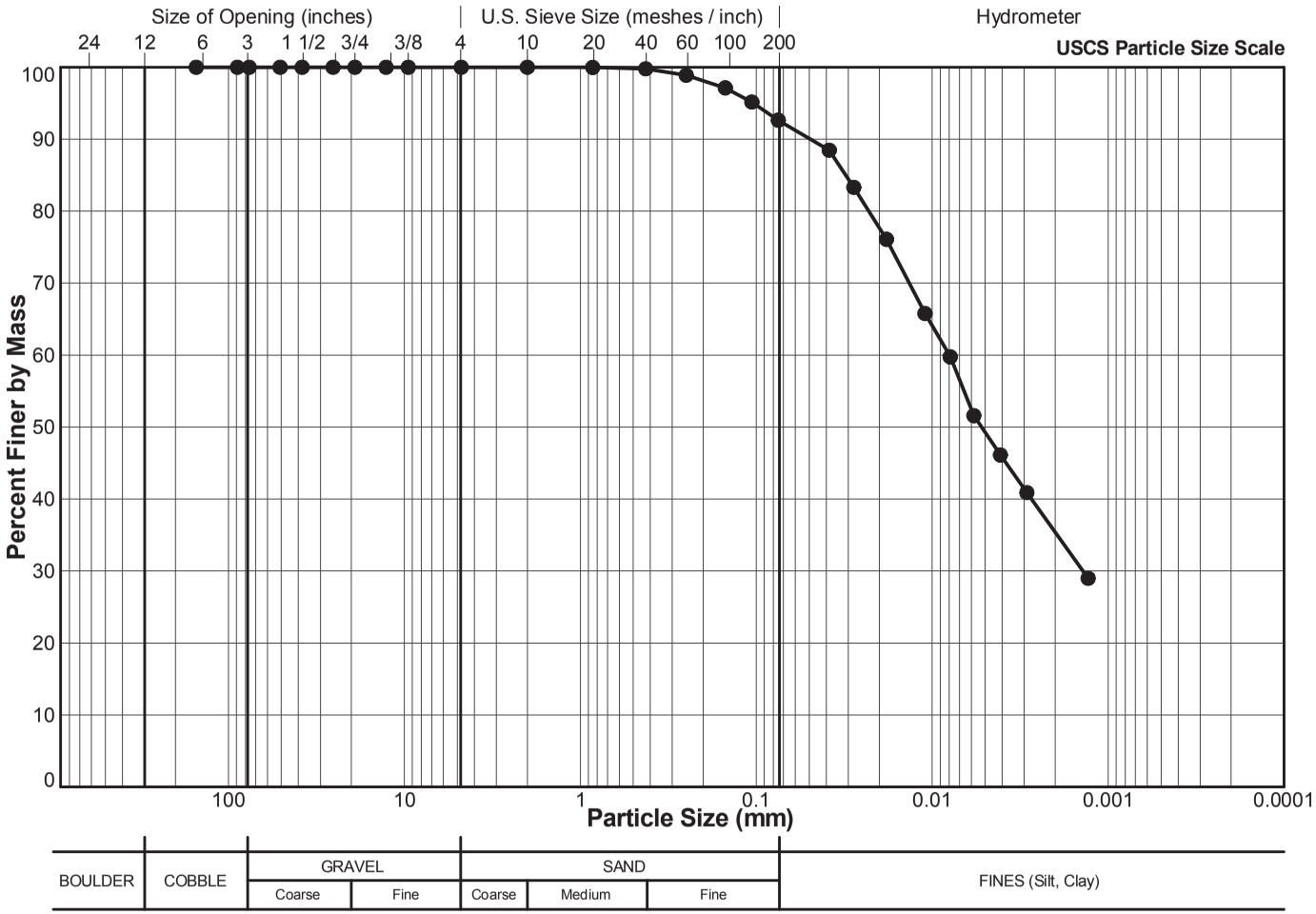
SUMMARY OF PARTICLE SIZE DISTRIBUTION

ASTM D 422

Client: GAI
Project: Sound Transit Redmond Link Extension
Location: Redmond, WA
Project No.: 1657705 **Phase:** 200 **Task:** 200.3

Sample Location: DRLE-G045
Sample No.: ST-3
Depth Interval (m): 42.97 to 42.99
Lab Schedule No.:



Legend

Sieve Size (USS)	(mm)	Particle Size (mm)	Percent Passing
6"	152.4		100.0
3.5"	88.9		100.0
3"	76.2		100.0
2"	50.8		100.0
1 1/2"	38.1		100.0
1"	25.4		100.0
3/4"	19.1		100.0
1/2"	12.7		100.0
3/8"	9.5		100.0
#4 US MESH	4.75		100.0
#10 US MESH	2		100.0
#20 US MESH	0.85		100.0
#40 US MESH	0.425		99.8
#60 US MESH	0.25		98.9
#100 US MESH	0.15		97.1
#140 US MESH	0.106		95.2
#200 US MESH	0.075		92.6
		0.0385	88.5
		0.0279	83.3
		0.0182	76.1
		0.0110	65.8
		0.0079	59.8
		0.0058	51.6
		0.0041	46.1
		0.0029	40.9
		0.0013	29.0

DC	3/28/2018	LH	4/26/2018
Tech	Date	Checked	Date

National IM Server:GINT_GAL_NATIONALIM Unique Project ID:1870 Output Form:_LAB_PARTICLE SIZE (W/ GRADATIONS) 2018 lhu 26/4/18

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Specific Gravity of Soil Solids By Water Pycnometer

Reference
ASTM D854 -14

Project No.:	1657705 Phase 200	**Borehole:**	**DRLE-G018**
Project:	Sound Transit Redmond Link Extension	**Sample Number:**	ST-2
Location:	Redmond, WA	**Depth (m):**	34.59 - 34.67
Client:	GAI	**Lab ID No:**	33

Visual Description:	**% Passing 4.75mm**	100.00
	Excluded Material Description	No excluded material

Specific Gravity of Fine Fraction Method B - Oven Dried Samples

		Trial 1	Trial 2
Flask Number		C	D
Air Removal Method	M_p	Hot Plate	Hot Plate
Mass of Flask (g)		90.23	90.43
Mass of Flask + Dry Soil (g)		127.85	128.18
Mass of Flask + Soil + Water (g)	$M_{\rho ws,t}$	363.45	363.64
Test Temperature (°C)	T_t	19.1	18.9
Mass of Flask + Water (g)	$M_{\rho w,t}$	339.76	339.96
Tare Number		12D	13D
Mass of Tare + Dry Soil (g)		221.16	220.76
Mass of Tare (g)		183.61	183.06
Mass of Oven Dry Soil (g)	M_S	37.55	37.7
Temperature Coefficient	K	1.00	1.00
Specific Gravity at Test Temperature	G_t	2.71	2.69
Specific Gravity at 20ºC	$G_{20ºC}$	2.71	2.69

AVERAGE SPECIFIC GRAVITY OF TRIALS	2.70

DC	March 6, 2018	LP	March 13,2018
TESTED BY	DATE	CHECKED BY	DATE

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SPECIFIC GRAVITY OF SOIL SOLIDS BY WATER PYCNOMETER				Reference(s) ASTM D854 -14	
Client:	GAI			**Borehole:**	DRLE-G033
Project:	Sound Transit Redmond Link Extension			**Sample Number:**	S-28
Location:	Redmond, WA			**Depth (ft):**	34 - 42
Project No.:	1657705	**Phase:** 200	**Task:** 200.3	**Lab ID No:**	33

Visual Description:	% Passing 4.75mm	100.00
Golder Classification	Excluded Material Description	No excluded material

Specific Gravity of Fine Fraction Method B - Oven Dried Samples

		Trial 1	Trial 2
Flask Number		H	I
Air Removal Method	M_p	Hot Plate	Hot Plate
Mass of Flask (g)		89.34	91
Mass of Flask + Dry Soil (g)		128.53	130.27
Mass of Flask + Soil + Water (g)	$M_{\rho ws,t}$	363.36	365.02
Test Temperature (°C)	T_t	21.1	21.1
Mass of Flask + Water (g)	$M_{\rho w,t}$	338.68	340.27
Tare Number		6D	7D
Mass of Tare + Dry Soil (g)		220.45	221.61
Mass of Tare (g)		181.19	182.18
Mass of Oven Dry Soil (g)	M_S	39.26	39.43
Temperature Coefficient	K	1.00	1.00
Specific Gravity at Test Temperature	G_t	2.69	2.69
Specific Gravity at 20ºC	$G_{20ºC}$	2.69	2.69

AVERAGE SPECIFIC GRAVITY OF TRIALS	2.69

DC	February 6, 2018	LH	September 2, 2018
TESTED BY	DATE	CHECKED BY	DATE

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SPECIFIC GRAVITY OF SOIL SOLIDS BY WATER PYCNOMETER		Reference(s) ASTM D854 -14	
Client:	GAI	**Borehole:**	DRLE-G044
Project:	Sound Transit Redmond Link Extension	**Sample Number:**	ST-1
Location:	Redmond, WA	**Depth (m):**	32.11 - 32.14
Project No.: 1657705 **Phase:** 200 **Task:** 200.3		**Lab ID No:**	33

Visual Description:	% Passing 4.75mm	100.00
Golder Classification	Excluded Material Description	No excluded material

Specific Gravity of Fine Fraction Method B - Oven Dried Samples

		Trial 1	Trial 2
Flask Number		C	D
Air Removal Method	M_p	Hot Plate	Hot Plate
Mass of Flask (g)		90.27	90.44
Mass of Flask + Dry Soil (g)		130.35	130.35
Mass of Flask + Soil + Water (g)	$M_{\rho ws,t}$	364.98	365.09
Test Temperature (°C)	T_t	20.2	20.2
Mass of Flask + Water (g)	$M_{\rho w,t}$	339.72	339.92
Tare Number		3D	VN
Mass of Tare + Dry Soil (g)		224.21	223.80
Mass of Tare (g)		184.39	184.20
Mass of Oven Dry Soil (g)	M_S	39.82	39.60
Temperature Coefficient	K	1.00	1.00
Specific Gravity at Test Temperature	G_t	2.73	2.74
Specific Gravity at 20ºC	$G_{20ºC}$	2.73	2.74

AVERAGE SPECIFIC GRAVITY OF TRIALS	2.74

SJ	February 15, 2018	LH	February 23, 2018
TESTED BY	DATE	CHECKED BY	DATE

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SPECIFIC GRAVITY OF SOIL SOLIDS BY WATER PYCNOMETER				Reference(s) ASTM D854 -14	
Client:	GAI			**Borehole:**	DRLE-G045
Project:	Sound Transit Redmond Link Extension			**Sample Number:**	ST-1
Location:	Redmond, WA			**Depth (m):**	27.64 - 27.68
Project No.:	1657705	**Phase:** 200	**Task:** 200.3	**Lab ID No:**	33

Visual Description:	% Passing 4.75mm	100.00
Golder Classification	Excluded Material Description	No excluded material

Specific Gravity of Fine Fraction Method B - Oven Dried Samples

		Trial 1	Trial 2
Flask Number		E	F
Air Removal Method	M_p	Hot Plate	Hot Plate
Mass of Flask (g)		90.50	90.28
Mass of Flask + Dry Soil (g)		130.30	130.4
Mass of Flask + Soil + Water (g)	$M_{\rho ws,t}$	364.95	365
Test Temperature (°C)	T_t	20.3	20.3
Mass of Flask + Water (g)	$M_{\rho w,t}$	339.66	339.60
Tare Number		KC1	DC
Mass of Tare + Dry Soil (g)		224.93	224.90
Mass of Tare (g)		185.38	185.00
Mass of Oven Dry Soil (g)	M_S	39.55	39.90
Temperature Coefficient	K	1.00	1.00
Specific Gravity at Test Temperature	G_t	2.77	2.75
Specific Gravity at 20ºC	$G_{20ºC}$	2.77	2.75

AVERAGE SPECIFIC GRAVITY OF TRIALS	2.76

SJ	February 15, 2018	LH	February 23, 2018
TESTED BY	DATE	CHECKED BY	DATE

SPECIFIC GRAVITY OF SOIL SOLIDS BY WATER PYCNOMETER				Reference(s) ASTM D854 -14	
Client:	GAI			**Borehole:**	DRLE-G045
Project:	Sound Transit Redmond Link Extension			**Sample Number:**	ST-3
Location:	Redmond, WA			**Depth (m):**	42.97 - 42.99
Project No.:	1657705	**Phase:** 200	**Task:** 200.3	**Lab ID No:**	33

Visual Description:	% Passing 4.75mm	100.00
Golder Classification	Excluded Material Description	No excluded material

Specific Gravity of Fine Fraction Method B - Oven Dried Samples

		Trial 1	Trial 2
Flask Number		C	D
Air Removal Method	M_p	Vacuum	Vacuum
Mass of Flask (g)		90.21	90.45
Mass of Flask + Dry Soil (g)		147.79	147.87
Mass of Flask + Soil + Water (g)	$M_{\rho ws,t}$	376.22	376.43
Test Temperature (°C)	T_t	23.3	23.2
Mass of Flask + Water (g)	$M_{\rho w,t}$	339.61	339.75
Tare Number		1D	3D
Mass of Tare + Dry Soil (g)		239.6	238.00
Mass of Tare (g)		182.1	180.66
Mass of Oven Dry Soil (g)	M_S	57.50	57.34
Temperature Coefficient	K	1.00	1.00
Specific Gravity at Test Temperature	G_t	2.75	2.78
Specific Gravity at 20ºC	$G_{20ºC}$	2.75	2.77

AVERAGE SPECIFIC GRAVITY OF TRIALS	2.76

SJ	March 27, 2018	LH	April 26, 2018
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd -Burnaby Laboratory
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Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils

Reference
ASTM D2850

Client:	GAI	**Borehole:**	DRLE-G018
Project:	Sound Transit Redmond Link Extension	**Sample:**	ST-1
Location:	Redmond, WA	**Depth (m):**	35.81
Project No.:	1657705.200.200.3	**Lab ID No:**	33

Visual Description:	CLAY, some silt, trace sand, W > PL, grey, stiff
Sample Type:	Intact
Other Remarks:	
Confining Pressure:	715 kPa

Sample Data		**Equipment**	
	Initial Sample Characteristics	**Machine:**	Truepath Load Frame - Stn. 5
Height (cm):	15.06	**Load Cell:**	691946
Diameter (cm):	7.08	**Axial DCDT:**	LP-946
Area (cm^2):	39.39	**Cell Pressure:**	PS5-156
Volume (cm^3):	593	**Feed Rate (%/min):**	1.00
Wet Weight (g):	1073.95		
γ_{wet} (kN/m^3):	17.76		
γ_{dry} (kN/m^3):	12.49		
Water content, w (%):	42.1		
Saturation (%):	102		
Void ratio, e:	1.12		
Specific Gravity (assumed):	2.70		

Atterberg Limit Results	
Liquid Limits	57
Plastic Limits	27
Plastic Index	30
Classification	CH

Strength Results	
q_{MAX} ($\sigma_{1\ total}$ - $\sigma_{3\ total}$) at failure (kPa):	176.4
Strain, ε_f:	7.04
$\sigma_{1\ total}$ (kPa):	891
$\sigma_{3\ total}$ (kPa):	715

TM	April 26, 2018	MS	April 27, 2018
TESTED BY	DATE	CHECKED BY	DATE

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#300-3811 North Fraser Way
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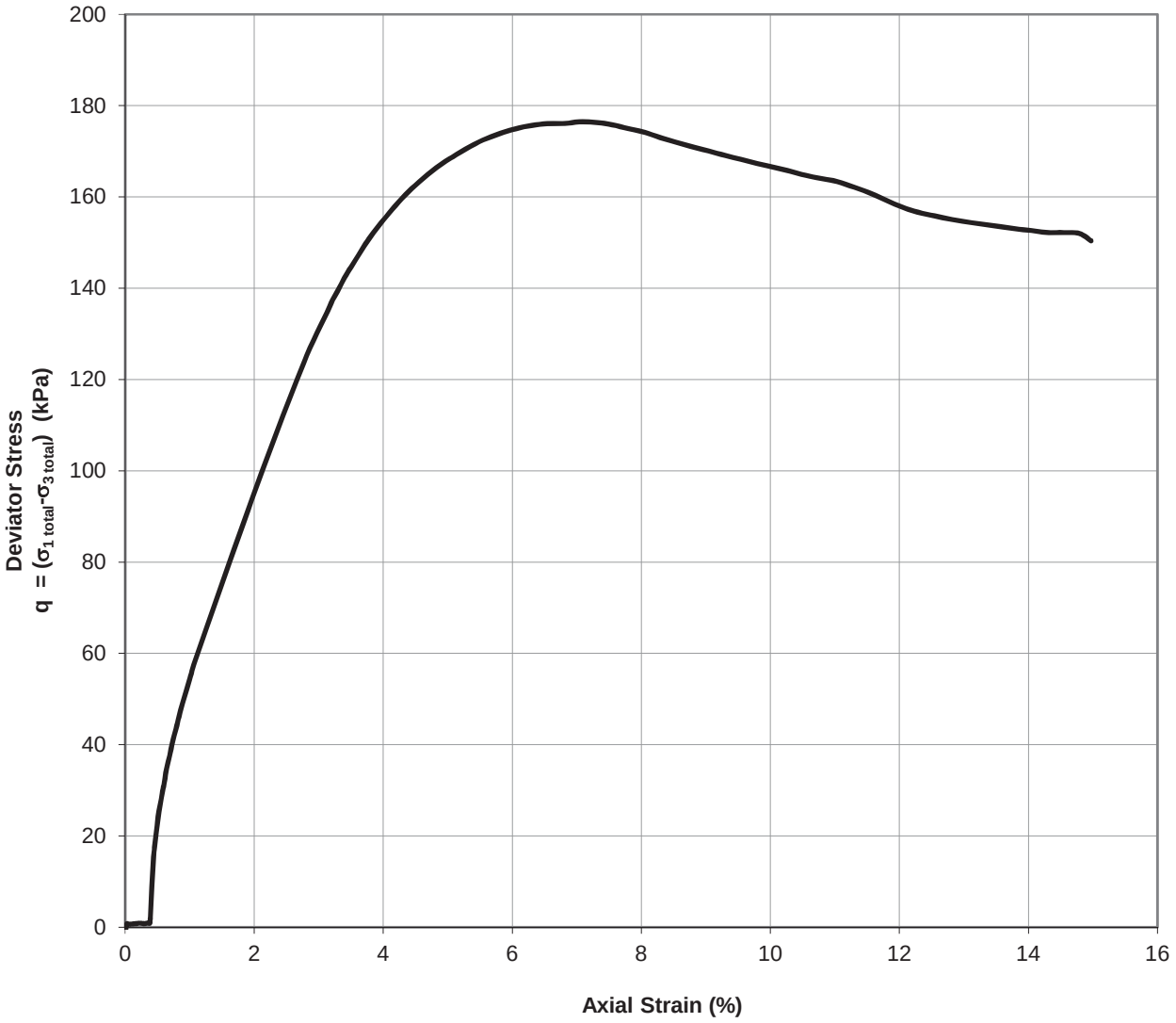
Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils

Reference
ASTM D2850

Client:	GAI	**Borehole:**	DRLE-G018
Project:	Sound Transit Redmond Link Extension	**Sample:**	ST-1
Location:	Redmond, WA	**Depth (m):**	35.81
Project No.:	1657705.200.200.3	**Lab ID No:**	33



TM	April 26, 2018	MS	April 27, 2018
TESTED BY	DATE	CHECKED BY	DATE

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Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils

Reference
ASTM D2850

Client:	GAI	**Borehole:**	DRLE-G033
Project:	Sound Transit Redmond Link Extension	**Sample:**	S-25
Location:	Redmond, WA	**Depth (m):**	32.46
Project No.:	1657705.200.200.3	**Lab ID No:**	33

Visual Description:	SANDY SILT, some clay, W > PL, grey, very stiff
Sample Type:	Intact
Other Remarks:	Sand lenses throughout the sample
Confining Pressure:	625 kPa

Sample Data		**Equipment**	
	Initial Sample Characteristics	**Machine:**	Truepath Load Frame - Stn. 5
Height (cm):	15.65	**Load Cell:**	205857
Diameter (cm):	7.11	**Axial DCDT:**	LP-174
Area (cm^2):	39.70	**Cell Pressure:**	PS-3322
Volume (cm^3):	621	**Feed Rate (%/min):**	1.00
Wet Weight (g):	1150.09		
γ_{wet} (kN/m^3):	18.15		
γ_{dry} (kN/m^3):	13.56		
Water content, w (%):	33.8		
Saturation (%):	92		
Void ratio, e:	1.02		
Specific Gravity (assumed):	2.80		

Atterberg Limit Results	
Liquid Limits	47
Plastic Limits	26
Plastic Index	21
Classification	CI

Strength Results	
q_{MAX} ($\sigma_{1\ total}$ - $\sigma_{3\ total}$) at failure (kPa):	332.6
Strain, ε_f:	5.01
$\sigma_{1\ total}$ (kPa):	956
$\sigma_{3\ total}$ (kPa):	624

TM	April 17, 2018	DL	April 23, 2018
TESTED BY	DATE	CHECKED BY	DATE

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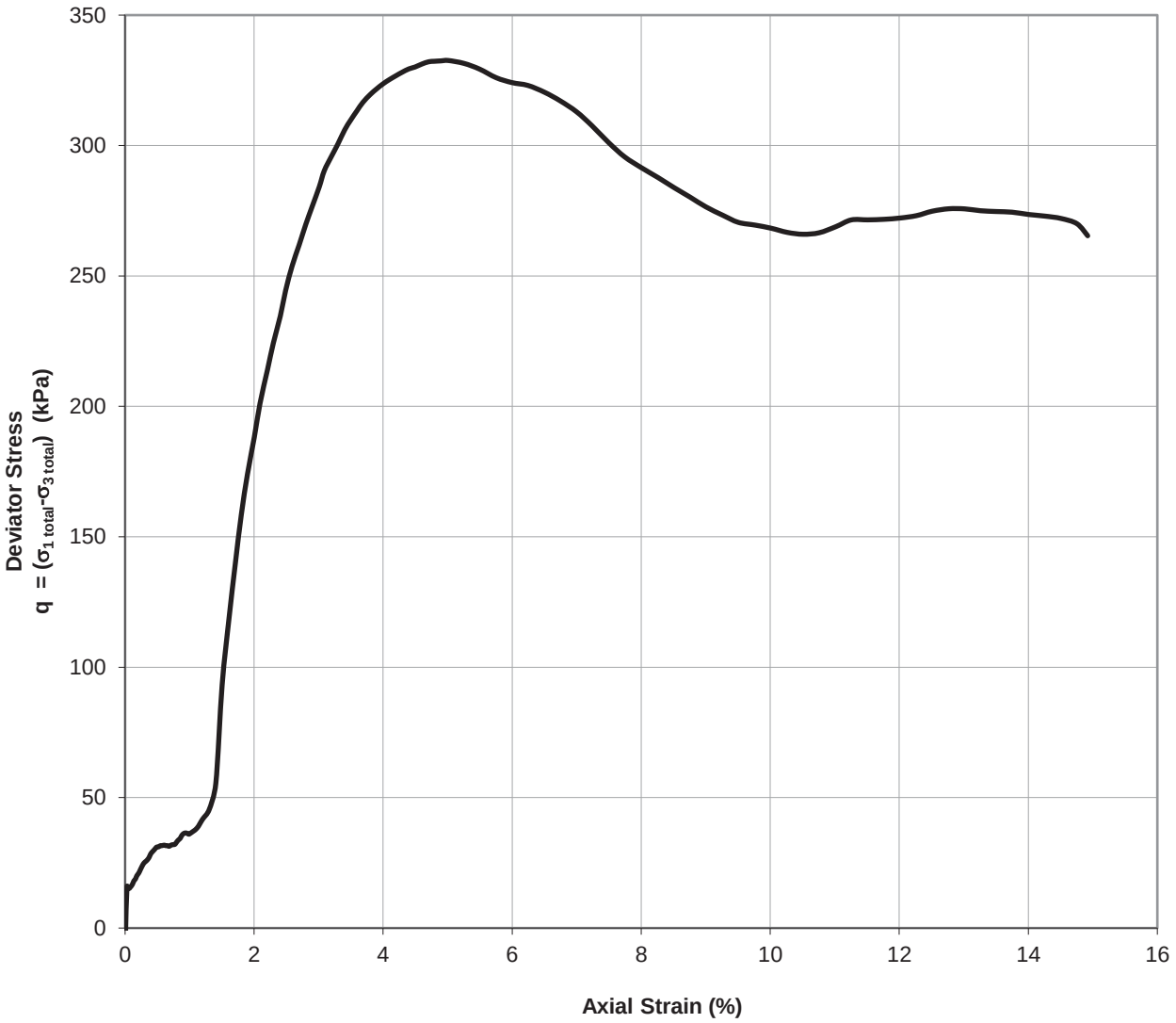
Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils

Reference
ASTM D2850

Client:	GAI	**Borehole:**	DRLE-G033
Project:	Sound Transit Redmond Link Extension	**Sample:**	S-25
Location:	Redmond, WA	**Depth (m):**	32.46
Project No.:	1657705.200.200.3	**Lab ID No:**	33



TM	April 17, 2018	DL	April 23, 2018
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates
Golder Associates Ltd -Burnaby Laboratory
#300-3811 North Fraser Way
Burnaby ,B.C. Canada V5J 5J2

Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils

Reference
ASTM D2850

Client:	GAI	**Borehole:**	DRLE-G037
Project:	Sound Transit Redmond Link Extension	**Sample:**	ST-2
Location:	Redmond, WA	**Depth (m):**	34.14
Project No.:	1657705.200.200.3	**Lab ID No:**	33

Visual Description:	SILTY CLAY, W>PL, grey, stiff
Sample Type:	Intact
Other Remarks:	
Confining Pressure:	660 kPa

Sample Data		**Equipment**	
	Initial Sample Characteristics	**Machine:**	Truepath Load Frame - Stn. 5
Height (cm):	15.35	**Load Cell:**	205857
Diameter (cm):	7.22	**Axial DCDT:**	LP-174
Area (cm^2):	40.98	**Cell Pressure:**	PS-3322
Volume (cm^3):	629	**Feed Rate (%/min):**	1.00
Wet Weight (g):	1172.63		
γ_{wet} (kN/m^3):	18.28		
γ_{dry} (kN/m^3):	13.21		
Water content, w (%):	38.4		
Saturation (%):	100		
Void ratio, e:	1.08		
Specific Gravity (assumed):	2.80		

Atterberg Limit Results	
Liquid Limits	51
Plastic Limits	22
Plastic Index	29
Classification	CH

Strength Results	
q_{MAX} ($\sigma_{1\ total}$ - $\sigma_{3\ total}$) at failure (kPa):	147.2
Strain, ε_f:	4.17
$\sigma_{1\ total}$ (kPa):	797
$\sigma_{3\ total}$ (kPa):	659

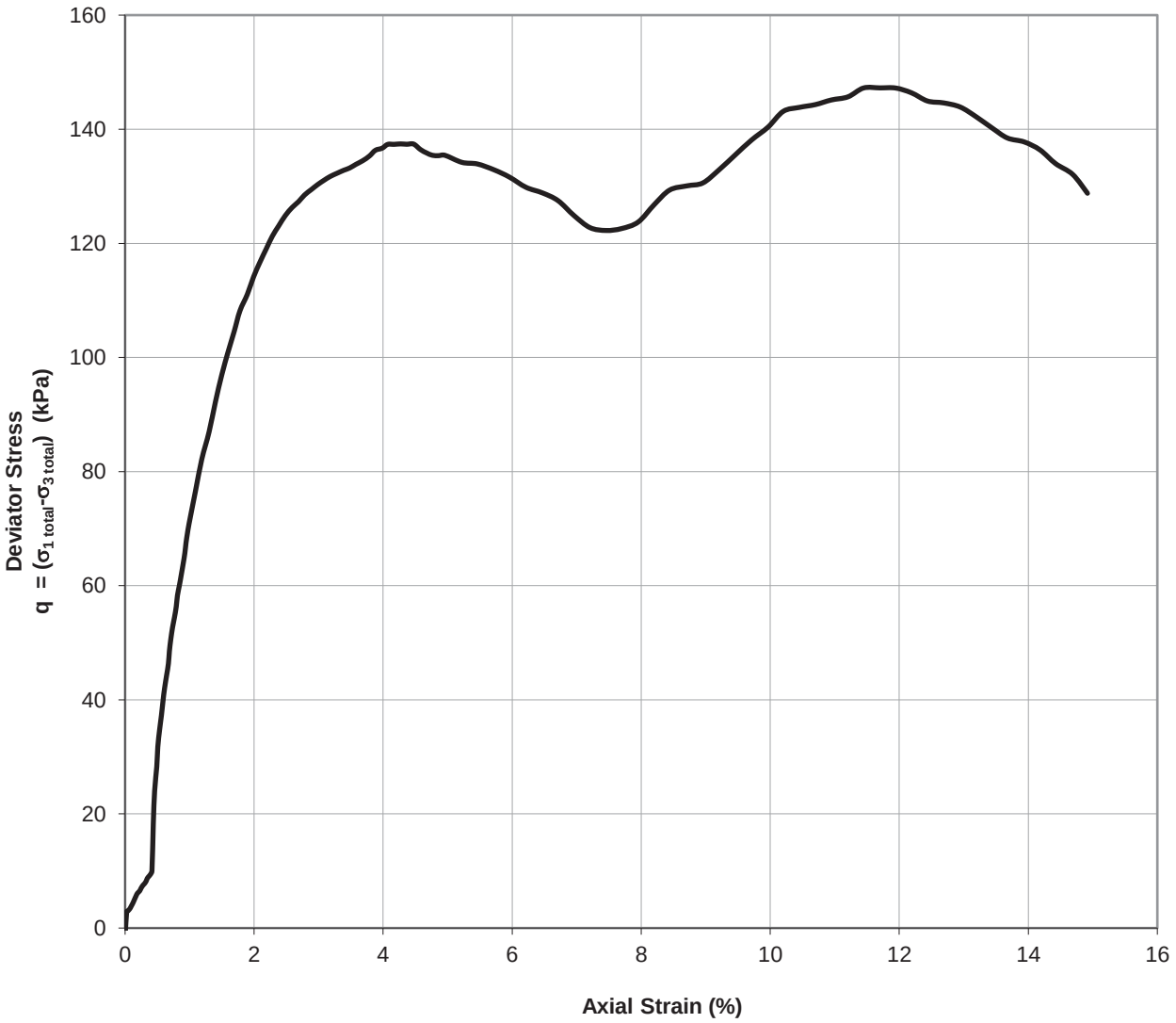
TM	April 17, 2018	DL	April 23, 2018
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd -Burnaby Laboratory
#300-3811 North Fraser Way
Burnaby ,B.C. Canada V5J 5J2

Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils

Reference
ASTM D2850

Client:	GAI	**Borehole:**	DRLE-G037
Project:	Sound Transit Redmond Link Extension	**Sample:**	ST-2
Location:	Redmond, WA	**Depth (m):**	34.14
Project No.:	1657705.200.200.3	**Lab ID No:**	33



TM	April 17, 2018	DL	April 23, 2018
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates
Golder Associates Ltd -Burnaby Laboratory
#300-3811 North Fraser Way
Burnaby ,B.C. Canada V5J 5J2

Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils

Reference
ASTM D2850

Client:	GAI	**Borehole:**	DRLE-G044
Project:	Sound Transit Redmond Link Extension	**Sample:**	ST-2
Location:	Redmond, WA	**Depth (m):**	40.08
Project No.:	1657705.200.200.3	**Lab ID No:**	33

Visual Description:	SILTY CLAY, trace sand, W~PL, grey, very stiff
Sample Type:	Intact
Other Remarks:	
Confining Pressure:	820 kPa

Sample Data		**Equipment**	
	Initial Sample Characteristics	**Machine:**	Truepath Load Frame - Stn. 5
Height (cm):	14.93	**Load Cell:**	205857
Diameter (cm):	7.10	**Axial DCDT:**	LP-174
Area (cm^2):	39.64	**Cell Pressure:**	PS-3322
Volume (cm^3):	592	**Feed Rate (%/min):**	1.00
Wet Weight (g):	1127.24		
γ_{wet} (kN/m^3):	18.67		
γ_{dry} (kN/m^3):	14.00		
Water content, w (%):	33.4		
Saturation (%):	97		
Void ratio, e:	0.96		
Specific Gravity (assumed):	2.80		

Atterberg Limit Results	
Liquid Limits	47
Plastic Limits	22
Plastic Index	25
Classification	CI

Strength Results	
q_{MAX} ($\sigma_{1\ total}$ - $\sigma_{3\ total}$) at failure (kPa):	241.9
Strain, ε_f:	5.75
$\sigma_{1\ total}$ (kPa):	1063
$\sigma_{3\ total}$ (kPa):	821

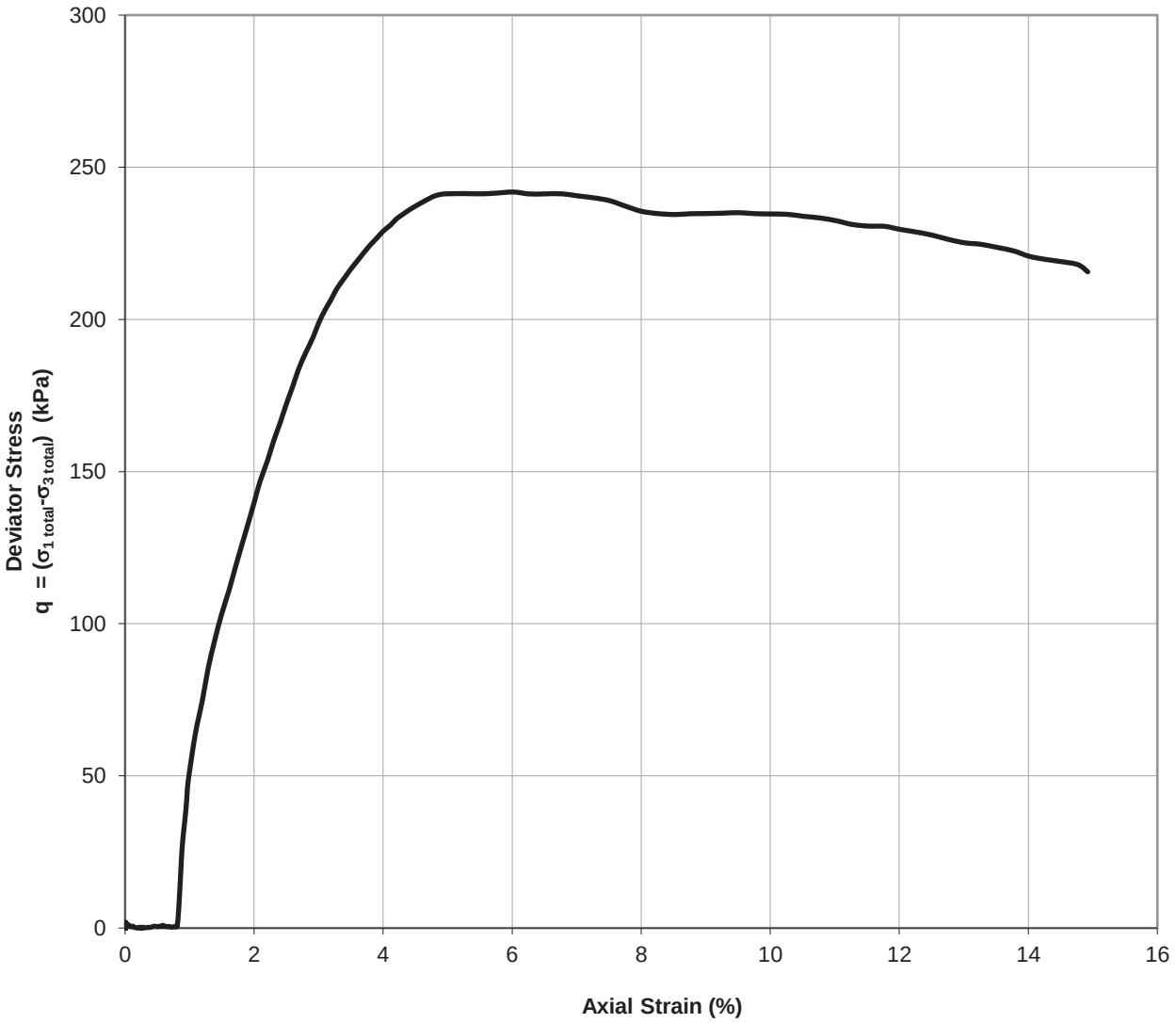
TM	April 17, 2018	DL	April 23, 2018
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd -Burnaby Laboratory
#300-3811 North Fraser Way
Burnaby ,B.C. Canada V5J 5J2

Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils

Reference
ASTM D2850

Client:	GAI	**Borehole:**	DRLE-G044
Project:	Sound Transit Redmond Link Extension	**Sample:**	ST-2
Location:	Redmond, WA	**Depth (m):**	40.08
Project No.:	1657705.200.200.3	**Lab ID No:**	33



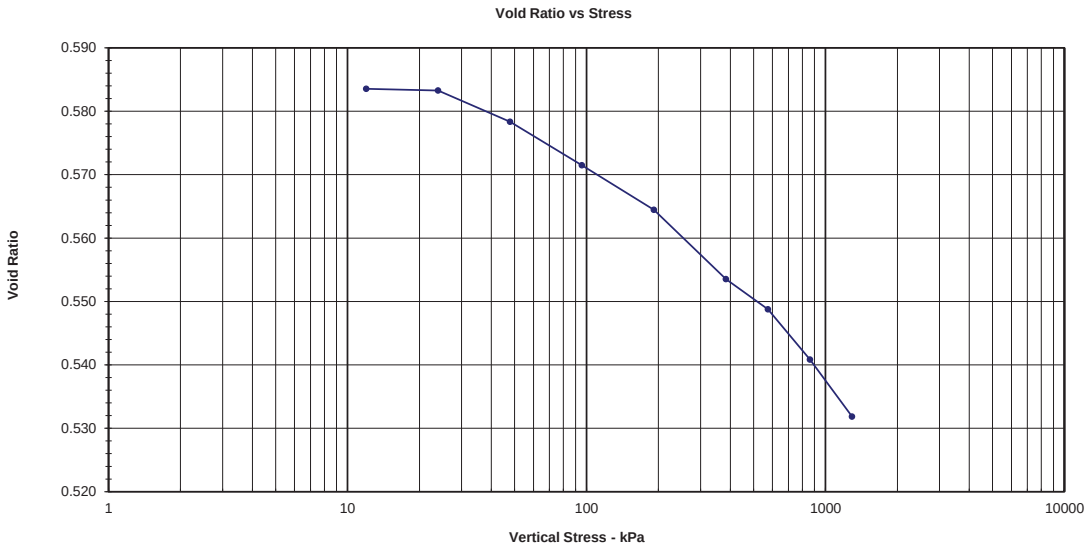
TM	April 17, 2018	DL	April 23, 2018
TESTED BY	DATE	CHECKED BY	DATE

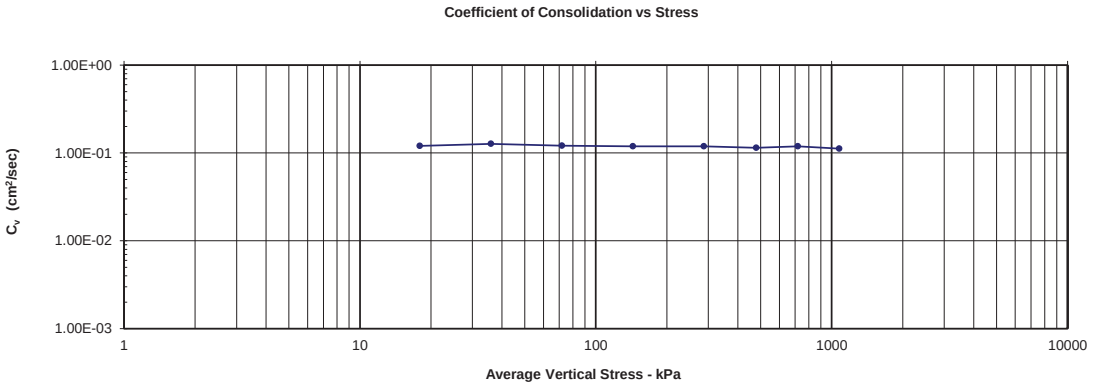
Golder Associates Ltd. - Burnaby Laboratory
Unit 300 - 3811 North Fraser Way
Burnaby, B.C. Canada V5J 5J2

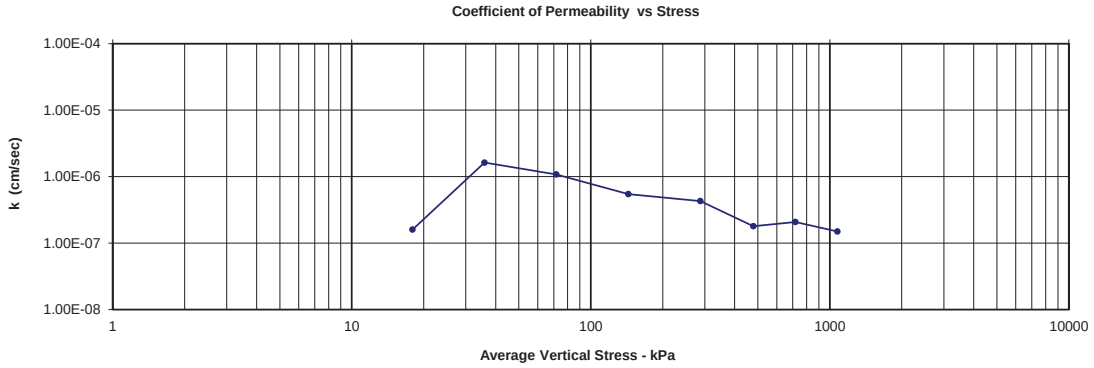
One-Dimensional Consolidation Properties of Soils

Reference(s)
ASTM D 2435/D 2435M-11

Project No. :	1657705.200.200.3	**Client :**	GAI	**Borehole:**	DRLE-G033
Sch No.	33	**Project :**	Sound Transit Redmond Link Extension	**Sample:**	S-28
Lab Work:	TM	**Location:**	Redmond, WA	**Depth(m):**	35.51







TM	April 10, 2018	MS	April 26, 2018
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Laboratory
Unit 300 - 3811 North Fraser Way
Burnaby, B.C. Canada V5J 5J2

One-Dimensional Consolidation Properties of Soils

Reference(s)
ASTM D 2435/D 2435M-11

Project No. :	1657705.200.200.3	**Client :**	GAI	**Borehole:**	DRLE-G033
Sch No.	33	**Project :**	Sound Transit Redmond Link Extension	**Sample:**	S-28
Lab Work:	TM	**Location:**	Redmond, WA	**Depth(m):**	35.51

Equipment

Machine:	Sigma-1
Mach No.	7
Ring No.	M
Drainage:	Double-sided

Specimen Geometry

	Initial	Final
Height (mm) =	22.15	20.64
Diameter (mm) =	63.36	63.36
Area (cm^2) =	31.53	31.53
Volume (cm^3) =	69.82	65.06

Phase Relationships

	Initial	Final
Wet Wt (g) =	139.13	139.36
Dry Wt (g) =	118.26	118.26
w (%) =	17.65	17.84
e =	0.588	0.480
ρ_{wet} (kg/m^3) =	1993	2142
ρ_{drv} (kg/m^3) =	1694	1818
S (%) =	81	100

Remarks

ASTM Method:	B - Constant Time Increment @ EOP
Method for Cv :	Taylor
H_{avg} **:**	Half the specimen height
Time Increment:	600 min

Estimated Preconsolidation Stress: N/A

Sample Properties

G_s =	2.69	Measured
H_s (mm) =	13.94	

Atterberg Limits

Liquid Limit:	24
Plastic Limit:	16
Plasticity Index:	8
Soil Classification:	CL

Load #	Stress (kPa)	ΔH (mm)	Corrected d_f (mm)	ε Σ ΔH / Ho (%)	$H-H_s$ (mm)	e $(H-H_s)/H_s$	Stress $_{avg}$ (kPa)	e_{avg}	H_{avg} (mm)	t 90 (min)	Cv (cm^2/sec)	k (cm/sec)
1	12	0.08	22.08	0.30	8.14	0.584						
2	24	0.08	22.08	0.31	8.13	0.583	18	0.58	11.04	0.14	1.2E-01	1.6E-07
3	48	0.14	22.01	0.63	8.06	0.578	36	0.58	11.02	0.14	1.3E-01	1.6E-06
4	96	0.17	21.91	1.06	7.97	0.571	72	0.57	10.98	0.14	1.2E-01	1.1E-06
5	192	0.20	21.82	1.50	7.87	0.564	144	0.57	10.93	0.14	1.2E-01	5.4E-07
6	383	0.25	21.66	2.19	7.72	0.554	287	0.56	10.87	0.14	1.2E-01	4.3E-07
7	575	0.14	21.60	2.49	7.65	0.549	479	0.55	10.81	0.14	1.1E-01	1.8E-07
8	862	0.19	21.49	2.99	7.54	0.541	718	0.54	10.77	0.14	1.2E-01	2.1E-07
9	1293	0.21	21.36	3.55	7.42	0.532	1077	0.54	10.71	0.14	1.1E-01	1.5E-07

Comments: Void Ratio Vs. Stress computed for end of primary consolidation.
Final height measured after unloading.

Description: SILTY CLAY; some sand, dark grey, moist, very dense.

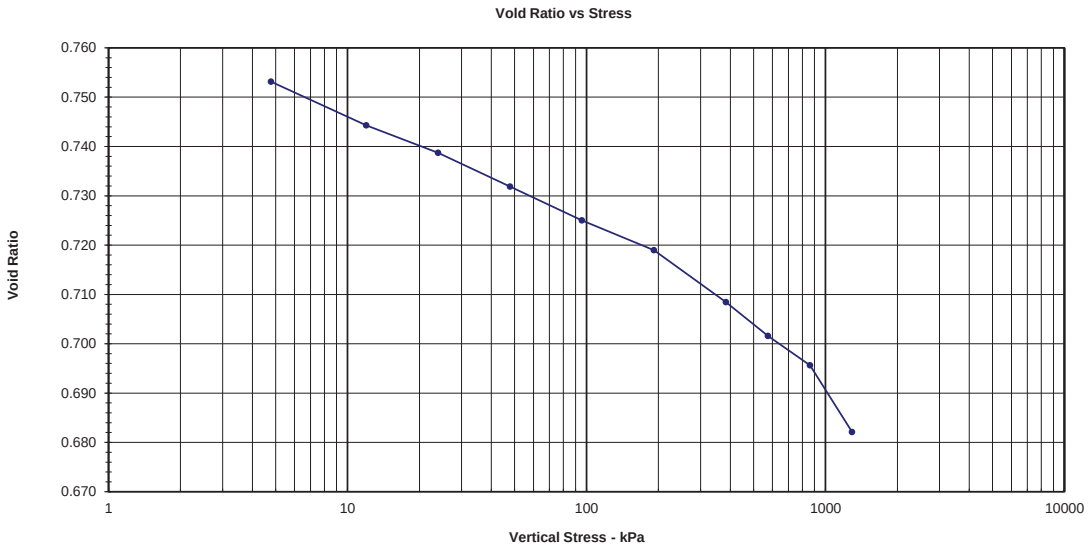
TM	April 10, 2018	MS	April 26, 2018
TESTED BY	DATE	CHECKED BY	DATE

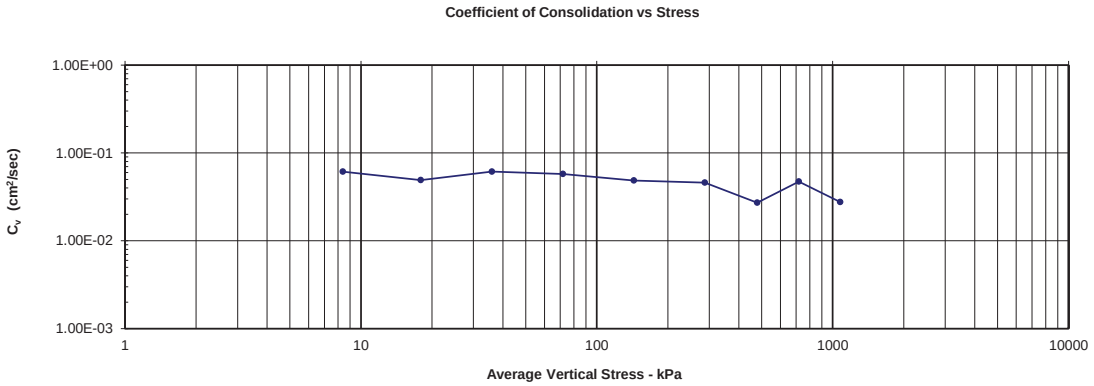
Golder Associates Ltd. - Burnaby Laboratory
Unit 300 - 3811 North Fraser Way
Burnaby, B.C. Canada V5J 5J2

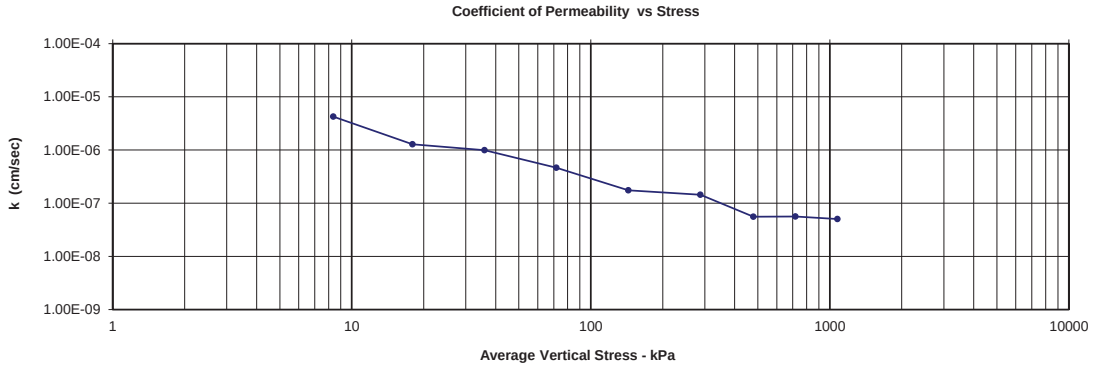
One-Dimensional Consolidation Properties of Soils

Reference(s)
ASTM D 2435/D 2435M-11

Project No. :	1657705.200.200.3	**Client :**	GAI	**Borehole:**	DRLE-G045
Sch No.	33	**Project :**	Sound Transit Redmond Link Extension	**Sample:**	ST-3
Lab Work:	TM	**Location:**	Redmond, WA	**Depth(m):**	42.67







TM	April 9, 2018	MS	April 26, 2018
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Laboratory
Unit 300 - 3811 North Fraser Way
Burnaby, B.C. Canada V5J 5J2

One-Dimensional Consolidation Properties of Soils

Reference(s)
ASTM D 2435/D 2435M-11

Project No. :	1657705.200.200.3	**Client :**	GAI	**Borehole:**	DRLE-G045
Sch No.	33	**Project :**	Sound Transit Redmond Link Extension	**Sample:**	ST-3
Lab Work:	TM	**Location:**	Redmond, WA	**Depth(m):**	42.67

Equipment

Machine:	Sigma-1
Mach No.	6
Ring No.	Stn1
Drainage:	Double-sided

Specimen Geometry

	Initial	Final
Height (mm) =	21.85	20.40
Diameter (mm) =	63.42	63.42
Area (cm^2) =	31.59	31.59
Volume (cm^3) =	69.02	64.43

Phase Relationships

	Initial	Final
Wet Wt (g) =	133.00	133.90
Dry Wt (g) =	108.93	108.93
w (%) =	22.10	22.92
e =	0.749	0.632
ρ_{wet} (kg/m^3) =	1927	2078
ρ_{drv} (kg/m^3) =	1578	1691
S (%) =	81	100

Remarks

ASTM Method:	B - Constant Time Increment @ EOP
Method for Cv :	Taylor
H_{avg} **:**	Half the specimen height
Time Increment:	600 min

Sample Properties

G_s = 2.76 Measured

H_s (mm) = 12.49

Atterberg Limits

Liquid Limit:	37
Plastic Limit:	20
Plasticity Index:	15
Soil Classification:	CI

Estimated Preconsolidation Stress: N/A

Load #	Stress (kPa)	ΔH (mm)	Corrected d_f (mm)	ε Σ ΔH / Ho (%)	$H-H_s$ (mm)	e $(H-H_s)/H_s$	Stress $_{avg}$ (kPa)	e_{avg}	H_{avg} (mm)	t 90 (min)	Cv (cm^2/sec)	k (cm/sec)
1	5	0.01	21.91	0.01	9.41	0.753						
2	12	0.21	21.79	0.52	9.30	0.744	8	0.75	10.92	0.28	6.1E-02	4.2E-06
3	24	0.14	21.72	0.83	9.23	0.739	18	0.74	10.88	0.34	4.9E-02	1.3E-06
4	48	0.17	21.64	1.22	9.14	0.732	36	0.74	10.84	0.27	6.1E-02	9.9E-07
5	96	0.16	21.55	1.61	9.06	0.725	72	0.73	10.80	0.29	5.8E-02	4.7E-07
6	192	0.19	21.48	1.96	8.98	0.719	144	0.72	10.76	0.34	4.9E-02	1.7E-07
7	383	0.26	21.35	2.56	8.85	0.708	287	0.71	10.71	0.35	4.6E-02	1.4E-07
8	575	0.16	21.26	2.95	8.77	0.702	479	0.71	10.65	0.59	2.7E-02	5.6E-08
9	862	0.19	21.19	3.29	8.69	0.696	718	0.70	10.61	0.34	4.7E-02	5.6E-08
10	1293	0.25	21.02	4.06	8.52	0.682	1077	0.69	10.55	0.57	2.8E-02	5.0E-08

Comments: Void Ratio Vs. Stress computed for end of primary consolidation.
Final height taken from last LVDT reading.

Description: SILTY CLAY; some sand, dark grey, moist, very dense.

TM	April 9, 2018	MS	April 26, 2018
TESTED BY	DATE	CHECKED BY	DATE

APPENDIX J

LABORATORY TESTS - RADIOGRAPHIC EXAMINATION (ACUREN GROUP INC.)

ACUREN

DRAFT

AcurenGroup Inc.
12271 Horseshoe Way
Richmond, BC, Canada V7A 4V4
www.acuren.com
Phone: 604.275.3800
Fax: 604.274.7235

ISO 17025:2005

NDT, Inspection and Engineering

ACCREDITED CERT #3977.03

ISO 9001:2008 QUASAR REGISTERED Acuren: An ISO 9001 certified company

RADIOGRAPHIC EXAMINATION

TO: GOLDER ASSOCIATES LTD.
300 – 3811 NORTH FRASER WAY
BURNABY , BC V57 5J2

PAGE: 1 of 2

DATE: 31 Jan. 2018
ACUREN JOB #: 616-14104
REPORT #: -
PO: 1657705 WO:

ATTENTION: Mallory MacEachern
WORK LOCATION: Acuren – Richmond , BC
PROJECT: 1657705 - RT-5 Shelby Tubes / Digitize Images

ACCEPTANCE STANDARD: Client Information Only REVISION: NA MATERIAL: Shelby Tube/Soil
PROCEDURE/TECHNIQUE: CAN-RT-14P001 REVISION: 08 FILM BRAND: AGFA
RT SOURCE: Iridium 192 FOCAL SPOT: 3.4 SCREENS: Pb(Lead) THICKNESS (F): 0.005" (B): 0.010"

One film used per cassette, unless noted in remarks

RESULTS:

Exp. #	IDENTIFICATION	WS*	VIEW (cm)	O.D. (in.)	NOM. THK. (in.)	REIN. (in.)	SOD (in.)	OFD (in.)	FILM TYPE	TECH #	# of EXP	REMARKS	ACC. (✓)	REJ. (×)
1	DRLE-G033 S-28	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
2		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
3	DRLE-G037 ST-2	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
4		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
5	DRLE-G044 ST-1	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
6		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
7	DRLE-G044 ST-2	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
8		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
9	DRLE-G045 ST-1	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
10		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA

*** Disposition Determined By Client**

THIS DOCUMENT AND ALL SERVICES AND/OR PRODUCTS PROVIDED IN CONNECTION WITH THIS DOCUMENT AND ALL FUTURE SALES ARE SUBJECT TO AND SHALL BE GOVERNED BY THE "ACUREN STANDARD SERVICE TERMS" IN EFFECT WHEN THE SERVICES AND/OR PRODUCTS ARE ORDERED. THOSE TERMS ARE AVAILABLE AT WWW.ACUREN.COM/SERVICETERMS, ARE EXPRESSLY INCORPORATED BY REFERENCE INTO THIS DOCUMENT AND SHALL SUPERSEDE ANY CONFLICTING TERMS IN ANY OTHER DOCUMENT (EXCEPT WHERE EXPRESSLY AGREED OTHERWISE IN THAT OTHER DOCUMENT).

The Client Representative who receives this report is responsible for verifying that the acceptance standard and hours listed in the report are correct, confirming that all radiographs listed in the report have been received by Client and promptly notifying Acuren of any issues with this report and/or the work summarized herein. The owner is responsible for the permanent custody of all radiographs and the final disposition of all items inspected.

CLIENT REPRESENTATIVE:
TECHNICIAN:
John Orstad
1st Technician
CGSB / SNT Level 2 CGSB Reg.# 291
2nd Technician

REVIEWER:

(Generated Using: CAN-QUA-02F018 R01 - 12/07/2016)

	TOTAL HOURS	S.T.	O.T.	SHIFT
1ST TECHNICIAN:	5	5		Day ☒
2ND TECHNICIAN:				PM ☐

FILM: 10 PCS 7" × 17"
FILM: PCS ×
FILM: PCS ×
KILOMETRES: --0-- OTHER CHARGES: YES ☐ NO ☒
(IF YES, SEE DAILY OR PROJECT TIME REPORT)

ACUREN

DRAFT

Acuren Group Inc.
12271 Horseshoe Way
Richmond, BC, Canada V7A 4V4
www.acuren.com
Phone: 604.275.3800
Fax: 604.274.7235

ISO 17025:2005

NDT, Inspection and Engineering

ACCREDITED CERT #3977.03

ISO 9001:2008 REGISTERED QUASAR

RADIOGRAPHIC EXAMINATION

TO: GOLDER ASSOCIATES LTD.
300 – 3811 NORTH FRASER WAY
BURNABY , BC V57 5J2

DATE: 21,22 Feb. 2018
ACUREN JOB #: 616-14152
REPORT #: -
PO: 1657705 WO:

ATTENTION: George Patton
WORK LOCATION: Acuren – Richmond , BC
PROJECT: 1657705 - RT-8 Shelby Tubes / Digitize Images

ACCEPTANCE STANDARD: Client Information Only REVISION: NA MATERIAL: Shelby Tube/Soil
PROCEDURE/TECHNIQUE: CAN-RT-14P001 REVISION: 08 FILM BRAND: AGFA
RT SOURCE: Iridium 192 FOCAL SPOT: 3.4 SCREENS: Pb(Lead) THICKNESS (F): 0.005" (B): 0.010"

One film used per cassette, unless noted in remarks

RESULTS:

Exp. #	IDENTIFICATION	WS*	VIEW (cm)	O.D. (in.)	NOM. THK. (in.)	REIN. (in.)	SOD (in.)	OFD (in.)	FILM TYPE	TECH #	# of EXP	REMARKS	ACC. (✓)	REJ. (×)
1	DRLE-G018 ST-1	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
2		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
3	DRLE-G018 ST-2	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
4		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
5	DRLE-G020 ST-1	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
6		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
7	DRLE-G033 ST-25	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
8		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
9	DRLE-G037 ST-1	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
10		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
11	DRLE-G037A ST-21	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
12		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
13	DRLE-G045 ST-2	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
14		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA
15	DRLE-G045 ST-3	NA	0-35	3	3	NA	22	3	D7	7	1	*	NA	NA
16		NA	35-70	3	3	NA	22	3	D7	7	1	*	NA	NA

* Disposition Determined By Client

Sample ID on borehole log: S-25

Sample ID on borehole log: S-21

THIS DOCUMENT AND ALL SERVICES AND/OR PRODUCTS PROVIDED IN CONNECTION WITH THIS DOCUMENT AND ALL FUTURE SALES ARE SUBJECT TO AND SHALL BE GOVERNED BY THE "ACUREN STANDARD SERVICE TERMS" IN EFFECT WHEN THE SERVICES AND/OR PRODUCTS ARE ORDERED. THOSE TERMS ARE AVAILABLE AT WWW.ACUREN.COM/SERVICETERMS, ARE EXPRESSLY INCORPORATED BY REFERENCE INTO THIS DOCUMENT AND SHALL SUPERSEDE ANY CONFLICTING TERMS IN ANY OTHER DOCUMENT (EXCEPT WHERE EXPRESSLY AGREED OTHERWISE IN THAT OTHER DOCUMENT).

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CLIENT REPRESENTATIVE:
TECHNICIAN:

John Orstad
1st Technician
CGSB / SNT Level 2 CGSB Reg.# 291

Andrew Pike
2nd Technician
Level I / CEDO

REVIEWER:

	TOTAL HOURS	S.T.	O.T.	SHIFT
1ST TECHNICIAN:	3	3		Day ☒
2ND TECHNICIAN:	3	3		PM ☐

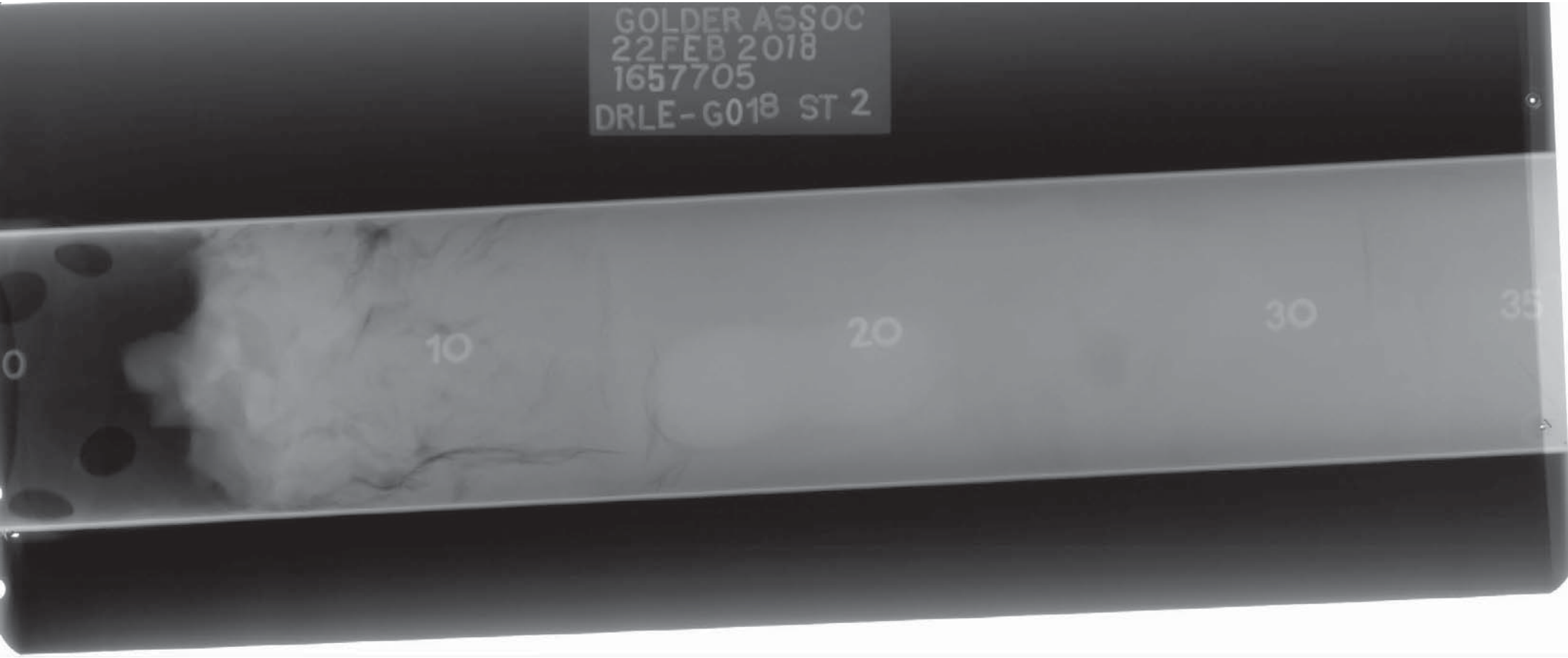
FILM: 16 PCS 7" × 17"
FILM: PCS ×
FILM: PCS ×

KILOMETRES: --0-- OTHER CHARGES: YES ☐ NO ☒
(IF YES, SEE DAILY OR PROJECT TIME REPORT)

(Generated Using: CAN-QUA-02F018 R01 - 12/07/2016)

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G018 ST1
10
20
30
35

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G018 ST1
35
40
50
60
70


GOLDER ASSOC
22FEB 2018
1657705
DRLE-G018 ST 2
0
10
20
30
35

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G018 ST 2
35
40
50
60
70

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G020 ST 1
0
10
20
30

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G020 ST 1
35
40
50
60
70

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G033 ST25
0
10
20
30
35

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G033 ST25
35
40
50
60
70

GOLDER ASSOC
31 JAN 2018
1657705
DRLE-G033S 28
35
30
20
10
0

GOLDER ASSOC
31 JAN 2018
1657705
DRLE-G033S 28
35
40
50
60
70

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G0 37 ST 1
0
10
20
30

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G0 37 ST 1
35
40
50
60
70

GOLDER ASSOC
31 JAN 2018
1657705
DRLE-G037 ST 2
10
20
30
35

GOLDER ASSOC
31 JAN 2018
1657705
DRLE-G037 ST 2
35
40
50
60
70

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G037AST 21
0
10
20
30
35

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G037AST 27
35
40
50
60
70

GOLDER ASSOC
31 JAN 2018
1657705
DRLE-GO44 ST 1
10
20
30
35

GOLDER ASSOC
31 JAN 2018
1657705
DRLE-GO44 ST 1
35
40
50
60
70

GOLDER ASSOC
31 JAN 2018
1657705
DRLE-GO44 ST 2
10
20
30
35

GOLDER ASSOC
31 JAN 2018
1657705
DRLE-GO44 ST2
35
40
50
60
70

GOLDER ASSOC
31 JAN 2018
1657705
DRLE-GO45 ST 1
10
20
30
35

GOLDER ASSOC
31 JAN 2018
1657705
DRLE-GO 45 ST 1
35
40
50
60
70

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G0 45ST 2
0
10
20
30

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G0 45ST 2
35
40
50
60
70

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G045 ST 3
0
10
20
30
35

GOLDER ASSOC
22FEB 2018
1657705
DRLE-G045 ST 3
35
40
50
60
70

APPENDIX K

LABORATORY TESTS – SOIL RESISTIVITY AND CORROSIVITY TESTING

hayremcelroy & associates, llc

Corrosivity Potential of Soil and Aggregates

ASTM G187-12a

Project Name:	DRLE
HMA Project No:	17-940/1657705
HMA Lab No:	8052-3
Date Tested:	5/14/2018
Tested by:	GD
Approved by:	JAM

ORP / PH Meter/Probe

manufacturer:	Hanna
model #:	HI 9126

Soil Data

Type:	
Location:	GO13 / S5 & S7
Depth / Elevation:	12.5-14' & 20-21.5'
Extraction date:	

Resistivity Meter

manufacturer:	MC Miller
model #:	400A

ORP results

Time	Reading (mV)
2 minutes	13.2
	13.1
	13.1

Temperature: 72.8 deg F

pH: 6.80

Resistivity: 24000 ohm-cm

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Corrosivity Potential of Soil and Aggregates

ASTM G187-12a

Project Name:	DRLE
HMA Project No:	17-940/1657705
HMA Lab No:	8052-4
Date Tested:	5/14/2018
Tested by:	GD
Approved by:	JAM

ORP / PH Meter/Probe	
manufacturer:	Hanna
model #:	HI 9126

Soil Data

Type:	
Location:	GO28 / S1-4
Depth / Elevation:	7.5-16.5'
Extraction date:	

Resistivity Meter	
manufacturer:	MC Miller
model #:	400A

ORP results

Time	Reading (mV)
2 minutes	56.3
	57.0
	57.1

Temperature: 74.1 deg F

pH: 5.30

Resistivity: 14000 ohm-cm

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Corrosivity Potential of Soil and Aggregates

ASTM G187-12a

Project Name:	DRLE
HMA Project No:	17-940/1657705
HMA Lab No:	8052-5
Date Tested:	5/14/2018
Tested by:	GD
Approved by:	JAM

ORP / PH Meter/Probe	
manufacturer:	Hanna
model #:	HI 9126

Soil Data

Type:	
Location:	GO14 / S2,4&7
Depth / Elevation:	5.0-21.5'
Extraction date:	

Resistivity Meter	
manufacturer:	MC Miller
model #:	400A

ORP results

Time	Reading (mV)
2 minutes	15.8
	15.9
	15.9

Temperature: 74.8 deg F

pH: 7.10

Resistivity: 1800 ohm-cm

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Standard Test Method for pH of Soils

ASTM D4972-13

Project Name:	DRLE
HMA Project No:	17-940/1657705
HMA Lab No:	8052-1
Date Tested:	5/14/2018
Tested by:	GD
Approved by:	JAM

ORP / PH Meter/Probe	
manufactu	Hanna
model #:	HI 9126

Soil Data

Type:	
Location:	GO29 / S1
Depth / Elevation:	5-6.5'
Extraction date:	

Temperature:	74.5	deg F
pH:	6.4	

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Standard Test Method for pH of Soils

ASTM D4972-13

Project Name:	DRLE
HMA Project No:	17-940/1657705
HMA Lab No:	8052-2
Date Tested:	5/14/2018
Tested by:	GD
Approved by:	JAM

ORP / PH Meter/Probe	
manufactu	Hanna
model #:	HI 9126

Soil Data

Type:	
Location:	GO13 / S1
Depth / Elevation:	2.5-4.0'
Extraction date:	

Temperature: 74.1 deg F

pH: 6.6

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OnSite Environmental Inc.
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May 10, 2018

Jim McElroy
Hayre McElroy & Associates, LLC
9644 153rd Ave NE, Suite B8
Redmond, WA 98052

Re: Analytical Data for Project DRLE
Laboratory Reference No. 1805-014

Dear Jim:

Enclosed are the analytical results and associated quality control data for samples submitted on May 2, 2018.

The standard policy of OnSite Environmental, Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Manager

Enclosures

This report pertains to the samples analyzed in accordance with the chain of custody, and is intended only for the use of the individual or company to whom it is addressed.

Date of Report: May 10, 2018
Samples Submitted: May 2, 2018
Laboratory Reference: 1805-014
Project: DRLE

Case Narrative

Samples were collected on May 2, 2018 and received by the laboratory on May 2, 2018. They were maintained at the laboratory at a temperature of 2°C to 6°C.

Please note that any and all soil sample results are reported on a dry-weight basis, unless otherwise noted below.

General QA/QC issues associated with the analytical data enclosed in this laboratory report will be indicated with a reference to a comment or explanation on the Data Qualifier page. More complex and involved QA/QC issues will be discussed in detail below.

Date of Report: May 10, 2018
Samples Submitted: May 2, 2018
Laboratory Reference: 1805-014
Project: DRLE

CHLORIDE
SM 4500-Cl E

Matrix: Soil
Units: mg/Kg

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**G013 S507 12.5-21-5'**					
Laboratory ID:	05-014-01					
Chloride	**ND**	24	SM 4500-Cl E	5-3-18	5-3-18	
Client ID:	**G013 S1 2.5-4.0'**					
Laboratory ID:	05-014-02					
Chloride	**ND**	22	SM 4500-Cl E	5-3-18	5-3-18	
Client ID:	**G014 S2-7 5'-21.5'**					
Laboratory ID:	05-014-03					
Chloride	**ND**	24	SM 4500-Cl E	5-3-18	5-3-18	
Client ID:	**G028 S1-4 7.5'-16.5'**					
Laboratory ID:	05-014-04					
Chloride	**ND**	21	SM 4500-Cl E	5-3-18	5-3-18	
Client ID:	**G029 S1 5-6.5'**					
Laboratory ID:	05-014-05					
Chloride	**ND**	22	SM 4500-Cl E	5-3-18	5-3-18	

This report pertains to the samples analyzed in accordance with the chain of custody,
and is intended only for the use of the individual or company to whom it is addressed.

Date of Report: May 10, 2018
Samples Submitted: May 2, 2018
Laboratory Reference: 1805-014
Project: DRLE

CHLORIDE
SM 4500-Cl E
QUALITY CONTROL

Matrix: Soil
Units: mg/Kg

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB0503S1					
Chloride	**ND**	20	SM 4500-Cl E	5-3-18	5-3-18	

Analyte	Result		Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE									
Laboratory ID:	05-014-04								
	ORIG	DUP							
Chloride	**ND**	**ND**	NA	NA	NA	NA	NA	20	
MATRIX SPIKE									
Laboratory ID:	05-014-04								
	MS		MS		MS				
Chloride	**461**		500	ND	92	75-125	NA	NA	
SPIKE BLANK									
Laboratory ID:	SB0503S1								
	SB		SB		SB				
Chloride	**459**		500	NA	92	75-125	NA	NA	

This report pertains to the samples analyzed in accordance with the chain of custody,
and is intended only for the use of the individual or company to whom it is addressed.

Date of Report: May 10, 2018
Samples Submitted: May 2, 2018
Laboratory Reference: 1805-014
Project: DRLE

% MOISTURE

Date Analyzed: 5-3-18

Client ID	Lab ID	% Moisture
G013 S5&7 12.5-21-5'	05-014-01	15
G013 S1 2.5-4.0'	05-014-02	10
G014 S2-7 5'-21.5'	05-014-03	15
G028 S1-4 7.5'-16.5'	05-014-04	6
G029 S1 5-6.5'	05-014-05	9

This report pertains to the samples analyzed in accordance with the chain of custody,
and is intended only for the use of the individual or company to whom it is addressed.

OnSite Environmental Inc.

Data Qualifiers and Abbreviations

A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

E - The value reported exceeds the quantitation range and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.

I - Compound recovery is outside of the control limits.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeneity. The sample was re-extracted and re-analyzed with similar results.

L - The RPD is outside of the control limits.

M - Hydrocarbons in the gasoline range are impacting the diesel range result.

M1 - Hydrocarbons in the gasoline range (toluene-naphthalene) are present in the sample.

N - Hydrocarbons in the lube oil range are impacting the diesel range result.

N1 - Hydrocarbons in diesel range are impacting lube oil range results.

O - Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

P - The RPD of the detected concentrations between the two columns is greater than 40.

Q - Surrogate recovery is outside of the control limits.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

U1 - The practical quantitation limit is elevated due to interferences present in the sample.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

X - Sample extract treated with a mercury cleanup procedure.

X1- Sample extract treated with a sulfuric acid/silica gel cleanup procedure.

Y - The calibration verification for this analyte exceeded the 20% drift specified in method 8260C, and therefore the reported result should be considered an estimate. The overall performance of the calibration verification standard met the acceptance criteria of the method.

Z -

ND - Not Detected at PQL
PQL - Practical Quantitation Limit
RPD - Relative Percent Difference

This report pertains to the samples analyzed in accordance with the chain of custody, and is intended only for the use of the individual or company to whom it is addressed.

APPENDIX L

LABORATORY TESTS – ANALYTICAL DATA (ONSITE ENVIRONMENTAL INC.)

OnSite Environmental Inc.
14648 NE 95th Street, Redmond, WA 98052 • (425) 883-3881

November 6, 2017

Reda Mikhail
Golder Associates Inc.
18300 NE Union Hill Road
Suite 200
Redmond, WA 98052-3333

Re: Analytical Data for Project 1657705.200.200.6
Laboratory Reference No. 1710-377

Dear Reda:

Enclosed are the analytical results and associated quality control data for samples submitted on October 27, 2017.

The standard policy of OnSite Environmental, Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Manager

Enclosures

This report pertains to the samples analyzed in accordance with the chain of custody, and is intended only for the use of the individual or company to whom it is addressed.

Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

Case Narrative

Samples were collected on October 26, 2017 and received by the laboratory on October 27, 2017. They were maintained at the laboratory at a temperature of 2°C to 6°C.

Please note that any and all soil sample results are reported on a dry-weight basis, unless otherwise noted below.

General QA/QC issues associated with the analytical data enclosed in this laboratory report will be indicated with a reference to a comment or explanation on the Data Qualifier page. More complex and involved QA/QC issues will be discussed in detail below.

Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

NWTPH-HCID

Matrix: Soil
Units: mg/Kg (ppm)

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**G34-10261215**					
Laboratory ID:	10-377-01					
Gasoline Range Organics	**ND**	23	NWTPH-HCID	10-31-17	10-31-17	
Diesel Range Organics	**ND**	58	NWTPH-HCID	10-31-17	10-31-17	
Lube Oil Range Organics	**ND**	120	NWTPH-HCID	10-31-17	10-31-17	
Surrogate:	*Percent Recovery*	*Control Limits*				
o-Terphenyl	*105*	*50-150*				

This report pertains to the samples analyzed in accordance with the chain of custody,
and is intended only for the use of the individual or company to whom it is addressed.

Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

NWTPH-HCID
QUALITY CONTROL

Matrix: Soil
Units: mg/Kg (ppm)

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB1031S1					
Gasoline Range Organics	**ND**	20	NWTPH-HCID	10-31-17	10-31-17	
Diesel Range Organics	**ND**	50	NWTPH-HCID	10-31-17	10-31-17	
Lube Oil Range Organics	**ND**	100	NWTPH-HCID	10-31-17	10-31-17	
Surrogate:	*Percent Recovery*	*Control Limits*				
o-Terphenyl	*108*	*50-150*				

This report pertains to the samples analyzed in accordance with the chain of custody,
and is intended only for the use of the individual or company to whom it is addressed.

Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

VOLATILES EPA 8260C
page 1 of 2

Matrix: Soil
Units: mg/kg

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**G34-10261215**					
Laboratory ID:	10-377-01					
Dichlorodifluoromethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Chloromethane	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
Vinyl Chloride	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Bromomethane	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
Chloroethane	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
Trichlorofluoromethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,1-Dichloroethene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Acetone	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
Iodomethane	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
Carbon Disulfide	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Methylene Chloride	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
(trans) 1,2-Dichloroethene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Methyl t-Butyl Ether	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,1-Dichloroethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Vinyl Acetate	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
2,2-Dichloropropane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
(cis) 1,2-Dichloroethene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
2-Butanone	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
Bromochloromethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Chloroform	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,1,1-Trichloroethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Carbon Tetrachloride	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,1-Dichloropropene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Benzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,2-Dichloroethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Trichloroethene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,2-Dichloropropane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Dibromomethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Bromodichloromethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
2-Chloroethyl Vinyl Ether	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
(cis) 1,3-Dichloropropene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Methyl Isobutyl Ketone	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
Toluene	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
(trans) 1,3-Dichloropropene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	

This report pertains to the samples analyzed in accordance with the chain of custody,
and is intended only for the use of the individual or company to whom it is addressed.

Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

VOLATILES EPA 8260C
page 2 of 2

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**G34-10261215**					
Laboratory ID:	10-377-01					
1,1,2-Trichloroethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Tetrachloroethene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,3-Dichloropropane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
2-Hexanone	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
Dibromochloromethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,2-Dibromoethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Chlorobenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,1,1,2-Tetrachloroethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Ethylbenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
m,p-Xylene	ND	0.00095	EPA 8260C	10-30-17	10-30-17	
o-Xylene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Styrene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Bromoform	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
Isopropylbenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Bromobenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,1,2,2-Tetrachloroethane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,2,3-Trichloropropane	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
n-Propylbenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
2-Chlorotoluene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
4-Chlorotoluene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,3,5-Trimethylbenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
tert-Butylbenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,2,4-Trimethylbenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
sec-Butylbenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,3-Dichlorobenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
p-Isopropyltoluene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,4-Dichlorobenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,2-Dichlorobenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
n-Butylbenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,2-Dibromo-3-chloropropane	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
1,2,4-Trichlorobenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Hexachlorobutadiene	ND	0.0024	EPA 8260C	10-30-17	10-30-17	
Naphthalene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
1,2,3-Trichlorobenzene	ND	0.00048	EPA 8260C	10-30-17	10-30-17	
Surrogate:	*Percent Recovery*	*Control Limits*				
Dibromofluoromethane	*126*	*75-131*				
Toluene-d8	*112*	*83-126*				
4-Bromofluorobenzene	*107*	*78-125*				

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

VOLATILES by EPA 8260C
METHOD BLANK QUALITY CONTROL
page 1 of 2

Matrix: Soil
Units: mg/kg

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Laboratory ID:	MB1030S1					
Dichlorodifluoromethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Chloromethane	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
Vinyl Chloride	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Bromomethane	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
Chloroethane	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
Trichlorofluoromethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,1-Dichloroethene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Acetone	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
Iodomethane	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
Carbon Disulfide	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Methylene Chloride	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
(trans) 1,2-Dichloroethene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Methyl t-Butyl Ether	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,1-Dichloroethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Vinyl Acetate	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
2,2-Dichloropropane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
(cis) 1,2-Dichloroethene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
2-Butanone	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
Bromochloromethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Chloroform	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,1,1-Trichloroethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Carbon Tetrachloride	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,1-Dichloropropene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Benzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,2-Dichloroethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Trichloroethene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,2-Dichloropropane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Dibromomethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Bromodichloromethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
2-Chloroethyl Vinyl Ether	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
(cis) 1,3-Dichloropropene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Methyl Isobutyl Ketone	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
Toluene	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
(trans) 1,3-Dichloropropene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

VOLATILES by EPA 8260C
METHOD BLANK QUALITY CONTROL
page 2 of 2

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Laboratory ID:	MB1030S1					
1,1,2-Trichloroethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Tetrachloroethene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,3-Dichloropropane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
2-Hexanone	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
Dibromochloromethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,2-Dibromoethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Chlorobenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,1,1,2-Tetrachloroethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Ethylbenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
m,p-Xylene	ND	0.0020	EPA 8260C	10-30-17	10-30-17	
o-Xylene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Styrene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Bromoform	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
Isopropylbenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Bromobenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,1,2,2-Tetrachloroethane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,2,3-Trichloropropane	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
n-Propylbenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
2-Chlorotoluene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
4-Chlorotoluene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,3,5-Trimethylbenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
tert-Butylbenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,2,4-Trimethylbenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
sec-Butylbenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,3-Dichlorobenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
p-Isopropyltoluene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,4-Dichlorobenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,2-Dichlorobenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
n-Butylbenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,2-Dibromo-3-chloropropane	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
1,2,4-Trichlorobenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Hexachlorobutadiene	ND	0.0050	EPA 8260C	10-30-17	10-30-17	
Naphthalene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
1,2,3-Trichlorobenzene	ND	0.0010	EPA 8260C	10-30-17	10-30-17	
Surrogate:	*Percent Recovery*	*Control Limits*				
Dibromofluoromethane	*107*	*75-131*				
Toluene-d8	*110*	*83-126*				
4-Bromofluorobenzene	*112*	*78-125*				

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

VOLATILES by EPA 8260C
SB/SBD QUALITY CONTROL

Matrix: Soil
Units: mg/kg

Analyte	Result		Spike Level		Percent Recovery		Recovery Limits	RPD	RPD Limit	Flags
SPIKE BLANKS										
Laboratory ID:	SB1030S1									
	SB	SBD	SB	SBD	SB	SBD				
1,1-Dichloroethene	**0.0522**	**0.0515**	0.0500	0.0500	104	103	58-126	1	20	
Benzene	**0.0563**	**0.0555**	0.0500	0.0500	113	111	72-122	1	19	
Trichloroethene	**0.0472**	**0.0480**	0.0500	0.0500	94	96	75-120	2	20	
Toluene	**0.0518**	**0.0513**	0.0500	0.0500	104	103	78-123	1	19	
Chlorobenzene	**0.0487**	**0.0486**	0.0500	0.0500	97	97	75-120	0	18	
Surrogate:										
Dibromofluoromethane					*102*	*104*	*75-131*			
Toluene-d8					*105*	*107*	*83-126*			
4-Bromofluorobenzene					*108*	*109*	*78-125*			

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

SEMIVOLATILES EPA 8270D/SIM
page 1 of 2

Matrix: Soil
Units: mg/Kg

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**G34-10261215**					
Laboratory ID:	10-377-01					
n-Nitrosodimethylamine	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Pyridine	**ND**	0.39	EPA 8270D	11-2-17	11-2-17	
Phenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Aniline	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
bis(2-Chloroethyl)ether	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2-Chlorophenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
1,3-Dichlorobenzene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
1,4-Dichlorobenzene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Benzyl alcohol	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
1,2-Dichlorobenzene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2-Methylphenol (o-Cresol)	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
bis(2-Chloroisopropyl)ether	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
(3+4)-Methylphenol (m,p-Cresol)	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
n-Nitroso-di-n-propylamine	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Hexachloroethane	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Nitrobenzene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Isophorone	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2-Nitrophenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2,4-Dimethylphenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
bis(2-Chloroethoxy)methane	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2,4-Dichlorophenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
1,2,4-Trichlorobenzene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Naphthalene	**0.011**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
4-Chloroaniline	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
Hexachlorobutadiene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
4-Chloro-3-methylphenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2-Methylnaphthalene	**0.015**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
1-Methylnaphthalene	**0.019**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Hexachlorocyclopentadiene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2,4,6-Trichlorophenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2,3-Dichloroaniline	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2,4,5-Trichlorophenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2-Chloronaphthalene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2-Nitroaniline	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
1,4-Dinitrobenzene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Dimethylphthalate	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
1,3-Dinitrobenzene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2,6-Dinitrotoluene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
1,2-Dinitrobenzene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Acenaphthylene	**0.012**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
3-Nitroaniline	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

SEMIVOLATILES EPA 8270D/SIM
page 2 of 2

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**G34-10261215**					
Laboratory ID:	10-377-01					
2,4-Dinitrophenol	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
Acenaphthene	**ND**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
4-Nitrophenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2,4-Dinitrotoluene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Dibenzofuran	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2,3,5,6-Tetrachlorophenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
2,3,4,6-Tetrachlorophenol	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Diethylphthalate	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
4-Chlorophenyl-phenylether	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
4-Nitroaniline	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Fluorene	**ND**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
4,6-Dinitro-2-methylphenol	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
n-Nitrosodiphenylamine	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
1,2-Diphenylhydrazine	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
4-Bromophenyl-phenylether	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Hexachlorobenzene	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Pentachlorophenol	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
Phenanthrene	**0.017**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Anthracene	**0.014**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Carbazole	**ND**	0.039	EPA 8270D	11-2-17	11-2-17	
Di-n-butylphthalate	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
Fluoranthene	**0.020**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Benzidine	**ND**	0.39	EPA 8270D	11-2-17	11-2-17	
Pyrene	**0.021**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Butylbenzylphthalate	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
bis-2-Ethylhexyladipate	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
3,3'-Dichlorobenzidine	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
Benzo[a]anthracene	**0.012**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Chrysene	**0.020**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
bis(2-Ethylhexyl)phthalate	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
Di-n-octylphthalate	**ND**	0.19	EPA 8270D	11-2-17	11-2-17	
Benzo[b]fluoranthene	**0.031**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Benzo(j,k)fluoranthene	**0.0086**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Benzo[a]pyrene	**0.014**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Indeno[1,2,3-cd]pyrene	**0.016**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Dibenz[a,h]anthracene	**ND**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Benzo[g,h,i]perylene	**0.015**	0.0078	EPA 8270D/SIM	11-2-17	11-2-17	
Surrogate:	*Percent Recovery*	*Control Limits*				
2-Fluorophenol	*47*	*18 - 113*				
Phenol-d6	*59*	*19 - 119*				
Nitrobenzene-d5	*53*	*19 - 119*				
2-Fluorobiphenyl	*67*	*33 - 109*				
2,4,6-Tribromophenol	*69*	*19 - 121*				
Terphenyl-d14	*69*	*30 - 116*				

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Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

SEMIVOLATILES EPA 8270D/SIM
METHOD BLANK QUALITY CONTROL
page 1 of 2

Matrix: Soil
Units: mg/Kg

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Laboratory ID:	MB1102S2					
n-Nitrosodimethylamine	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Pyridine	**ND**	0.33	EPA 8270D	11-2-17	11-2-17	
Phenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Aniline	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
bis(2-Chloroethyl)ether	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2-Chlorophenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
1,3-Dichlorobenzene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
1,4-Dichlorobenzene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Benzyl alcohol	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
1,2-Dichlorobenzene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2-Methylphenol (o-Cresol)	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
bis(2-Chloroisopropyl)ether	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
(3+4)-Methylphenol (m,p-Cresol)	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
n-Nitroso-di-n-propylamine	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Hexachloroethane	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Nitrobenzene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Isophorone	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2-Nitrophenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2,4-Dimethylphenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
bis(2-Chloroethoxy)methane	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2,4-Dichlorophenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
1,2,4-Trichlorobenzene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Naphthalene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
4-Chloroaniline	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
Hexachlorobutadiene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
4-Chloro-3-methylphenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2-Methylnaphthalene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
1-Methylnaphthalene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Hexachlorocyclopentadiene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2,4,6-Trichlorophenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2,3-Dichloroaniline	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2,4,5-Trichlorophenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2-Chloronaphthalene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2-Nitroaniline	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
1,4-Dinitrobenzene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Dimethylphthalate	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
1,3-Dinitrobenzene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2,6-Dinitrotoluene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
1,2-Dinitrobenzene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Acenaphthylene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
3-Nitroaniline	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

SEMIVOLATILES EPA 8270D/SIM
METHOD BLANK QUALITY CONTROL
page 2 of 2

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Laboratory ID:	MB1102S2					
2,4-Dinitrophenol	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
Acenaphthene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
4-Nitrophenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2,4-Dinitrotoluene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Dibenzofuran	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2,3,5,6-Tetrachlorophenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
2,3,4,6-Tetrachlorophenol	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Diethylphthalate	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
4-Chlorophenyl-phenylether	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
4-Nitroaniline	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Fluorene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
4,6-Dinitro-2-methylphenol	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
n-Nitrosodiphenylamine	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
1,2-Diphenylhydrazine	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
4-Bromophenyl-phenylether	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Hexachlorobenzene	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Pentachlorophenol	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
Phenanthrene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Anthracene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Carbazole	**ND**	0.033	EPA 8270D	11-2-17	11-2-17	
Di-n-butylphthalate	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
Fluoranthene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Benzidine	**ND**	0.33	EPA 8270D	11-2-17	11-2-17	
Pyrene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Butylbenzylphthalate	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
bis-2-Ethylhexyladipate	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
3,3'-Dichlorobenzidine	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
Benzo[a]anthracene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Chrysene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
bis(2-Ethylhexyl)phthalate	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
Di-n-octylphthalate	**ND**	0.17	EPA 8270D	11-2-17	11-2-17	
Benzo[b]fluoranthene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Benzo(j,k)fluoranthene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Benzo[a]pyrene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Indeno[1,2,3-cd]pyrene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Dibenz[a,h]anthracene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Benzo[g,h,i]perylene	**ND**	0.0067	EPA 8270D/SIM	11-2-17	11-2-17	
Surrogate:	*Percent Recovery*	*Control Limits*				
2-Fluorophenol	*82*	*18 - 113*				
Phenol-d6	*85*	*19 - 119*				
Nitrobenzene-d5	*78*	*19 - 119*				
2-Fluorobiphenyl	*85*	*33 - 109*				
2,4,6-Tribromophenol	*88*	*19 - 121*				
Terphenyl-d14	*91*	*30 - 116*				

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

SEMIVOLATILES EPA 8270D/SIM
MS/MSD QUALITY CONTROL

Matrix: Soil
Units: mg/Kg

Analyte	Result		Spike Level		Source Result	Percent Recovery		Recovery Limits	RPD	RPD Limit	Flags
MATRIX SPIKES											
Laboratory ID:	10-377-01										
	MS	MSD	MS	MSD		MS	MSD				
Phenol	**0.707**	**0.759**	1.33	1.33	ND	53	57	25 - 103	7	36	
2-Chlorophenol	**0.646**	**0.723**	1.33	1.33	ND	49	54	21 - 109	11	38	
1,4-Dichlorobenzene	**0.233**	**0.286**	0.667	0.667	ND	35	43	20 - 110	20	40	
n-Nitroso-di-n-propylamine	**0.351**	**0.402**	0.667	0.667	ND	53	60	20 - 111	14	38	
1,2,4-Trichlorobenzene	**0.324**	**0.366**	0.667	0.667	ND	49	55	20 - 107	12	40	
4-Chloro-3-methylphenol	**0.820**	**0.835**	1.33	1.33	ND	62	63	30 - 111	2	29	
Acenaphthene	**0.385**	**0.408**	0.667	0.667	ND	58	61	27 - 109	6	30	
4-Nitrophenol	**0.722**	**0.702**	1.33	1.33	ND	54	53	20 - 119	3	29	
2,4-Dinitrotoluene	**0.379**	**0.382**	0.667	0.667	ND	57	57	32 - 103	1	30	
Pentachlorophenol	**1.03**	**0.986**	1.33	1.33	ND	77	74	20 - 127	4	31	
Pyrene	**0.437**	**0.433**	0.667	0.667	ND	66	65	37 - 111	1	28	
Surrogate:											
2-Fluorophenol						*42*	*47*	*18 - 113*			
Phenol-d6						*52*	*56*	*19 - 119*			
Nitrobenzene-d5						*49*	*51*	*19 - 119*			
2-Fluorobiphenyl						*64*	*64*	*33 - 109*			
2,4,6-Tribromophenol						*65*	*63*	*19 - 121*			
Terphenyl-d14						*65*	*64*	*30 - 116*			

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

TOTAL METALS
EPA 6010C/7471B

Matrix: Soil
Units: mg/kg (ppm)

Analyte	Result	PQL	EPA Method	Date Prepared	Date Analyzed	Flags
Lab ID:	10-377-01					
Client ID:	**G34-10261215**					
Arsenic	**ND**	12	6010C	10-30-17	10-30-17	
Barium	**83**	2.9	6010C	10-30-17	10-30-17	
Cadmium	**ND**	0.58	6010C	10-30-17	10-30-17	
Chromium	**27**	0.58	6010C	10-30-17	10-30-17	
Lead	**13**	5.8	6010C	10-30-17	10-30-17	
Mercury	**ND**	0.29	7471B	10-31-17	10-31-17	
Selenium	**ND**	12	6010C	10-30-17	10-30-17	
Silver	**ND**	1.2	6010C	10-30-17	10-30-17	

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

TOTAL METALS
EPA 6010C/7471B
METHOD BLANK QUALITY CONTROL

Date Extracted: 10-30&31-17
Date Analyzed: 10-30&31-17

Matrix: Soil
Units: mg/kg (ppm)

Lab ID: MB1030SM1&MB1031S1

Analyte	Method	Result	PQL
Arsenic	6010C	**ND**	10
Barium	6010C	**ND**	2.5
Cadmium	6010C	**ND**	0.50
Chromium	6010C	**ND**	0.50
Lead	6010C	**ND**	5.0
Mercury	7471B	**ND**	0.25
Selenium	6010C	**ND**	10
Silver	6010C	**ND**	1.0

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

TOTAL METALS
EPA 6010C/7471B
DUPLICATE QUALITY CONTROL

Date Extracted: 10-30&31-17
Date Analyzed: 10-30&31-17

Matrix: Soil
Units: mg/kg (ppm)

Lab ID: 10-364-08

Analyte	Sample Result	Duplicate Result	RPD	PQL	Flags
Arsenic	**ND**	**ND**	NA	10	
Barium	**41.2**	**42.1**	2	2.5	
Cadmium	**ND**	**ND**	NA	0.50	
Chromium	**30.3**	**30.1**	1	0.50	
Lead	**ND**	**ND**	NA	5.0	
Mercury	**ND**	**ND**	NA	0.25	
Selenium	**ND**	**ND**	NA	10	
Silver	**ND**	**ND**	NA	1.0	

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

TOTAL METALS
EPA 6010C/7471B
MS/MSD QUALITY CONTROL

Date Extracted: 10-30&31-17
Date Analyzed: 10-30&31-17

Matrix: Soil
Units: mg/kg (ppm)

Lab ID: 10-364-08

Analyte	Spike Level	MS	Percent Recovery	MSD	Percent Recovery	RPD	Flags
Arsenic	100	**91.6**	92	**92.2**	92	1	
Barium	100	**136**	95	**135**	94	0	
Cadmium	50.0	**47.1**	94	**46.7**	93	1	
Chromium	100	**118**	87	**116**	86	1	
Lead	250	**222**	89	**217**	87	2	
Mercury	0.500	**0.506**	101	**0.503**	101	1	
Selenium	100	**95.9**	96	**94.7**	95	1	
Silver	25.0	**20.5**	82	**20.2**	81	2	

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

pH
EPA 9045D

Matrix: Soil
Units: pH (@ 25ºC)

Analyte	Result	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**G34-10261215**				
Laboratory ID:	10-377-01				
pH	**5.8**	EPA 9045D	10-27-17	10-27-17	

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Date of Report: November 6, 2017
Samples Submitted: October 27, 2017
Laboratory Reference: 1710-377
Project: 1657705.200.200.6

% MOISTURE

Date Analyzed: 10-30-17

Client ID	Lab ID	% Moisture
G34-10261215	10-377-01	14

This report pertains to the samples analyzed in accordance with the chain of custody,
and is intended only for the use of the individual or company to whom it is addressed.

OnSite Environmental Inc.

Data Qualifiers and Abbreviations

A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

E - The value reported exceeds the quantitation range and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.

I - Compound recovery is outside of the control limits.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeneity. The sample was re-extracted and re-analyzed with similar results.

L - The RPD is outside of the control limits.

M - Hydrocarbons in the gasoline range are impacting the diesel range result.

M1 - Hydrocarbons in the gasoline range (toluene-napthalene) are present in the sample.

N - Hydrocarbons in the lube oil range are impacting the diesel range result.

N1 - Hydrocarbons in diesel range are impacting lube oil range results.

O - Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

P - The RPD of the detected concentrations between the two columns is greater than 40.

Q - Surrogate recovery is outside of the control limits.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

U1 - The practical quantitation limit is elevated due to interferences present in the sample.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

X - Sample extract treated with a mercury cleanup procedure.

X1- Sample extract treated with a Sulfuric acid/Silica gel cleanup procedure.

Y - The calibration verification for this analyte exceeded the 20% drift specified in method 8260C, and therefore the reported result should be considered an estimate. The overall performance of the calibration verification standard met the acceptance criteria of the method.

Z -

ND - Not Detected at PQL
PQL - Practical Quantitation Limit
RPD - Relative Percent Difference

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Attachment 15
Volume 3 - Item 06 - Environmental Documentation - 03-06-07.02
Addendum 10, Item 11

OnSite Environmental Inc.
Analytical Laboratory Testing Services
14648 NE 95th Street • Redmond, WA 98052
Phone: (425) 883-3881 • www.onsite-env.com

Chain of Custody

Company: Golder Associates
Project Number: 1657705.200.200.6
Project Name: Redmond Link Extension
Project Manager: Reda Mikhail
Sampled by: Chris Jackson

Turnaround Request (in working days)
(Check One)
- ☐ Same Day
- ☐ 1 Day
- ☐ 2 Days
- ☐ 3 Days
- ☒ Standard (7 Days) (TPH analysis 5 Days)
- ☐ _____ (other)

Laboratory Number: 10-377

Lab ID	Sample Identification	Date Sampled	Time Sampled	Matrix	Number of Containers	NWTPH-HCID	NWTPH-Gx/BTEX	NWTPH-Gx	NWTPH-Dx (☐ Acid / SG Clean-up)	Volatiles 8260C	Halogenated Volatiles 8260C	EDB EPA 8011 (Waters Only)	Semivolatiles 8270D/SIM (with low-level PAHs)	PAHs 8270D/SIM (low-level)	PCBs 8082A	Organochlorine Pesticides 8081B	Organophosphorus Pesticides 8270D/SIM	Chlorinated Acid Herbicides 8151A	Total RCRA Metals	Total MTCA Metals	TCLP Metals	HEM (oil and grease) 1664A	RCRA metals EPA 6010D 7471B	Corrosivity (pH) EPA 9045D			% Moisture
	G34-10261215	10-26	1215	S	5	X				X			X										X	X			X

	Signature	Company	Date	Time
Relinquished	[signature]	Golder Associates	10-27	1430
Received	[signature]	[signature]	10/27/17	1430
Relinquished				
Received				
Relinquished				
Received				
Reviewed/Date		Reviewed/Date		

Comments/Special Instructions

Data Package: Standard ☐ Level III ☐ Level IV ☐

Chromatograms with final report ☐ Electronic Data Deliverables (EDDs) ☐

APPENDIX M

SUPPLEMENTARY DATA – VWP CALIBRATION SHEETS

VW Piezometer Calibration Certificate

Serial #: 1703581
Range : 700 kPa
Cable Length: 30 m
Date of Calibration: 11/8/2017

Part #: 52611033
Cable Part # : 50613824
Calibrated by: KB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.075410E-4	-1.607471E-1	1.420471E+3
psi	-1.559750E-5	-2.331440E-2	2.060219E+2

Pressure in kPa/psi = $(A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.418535E+3	-1.615573E-1	1.605829E-1	-1.075484E-4	5.823049E-5	-1.898985E-3
psi	2.057339E+2	-2.343108E-2	2.328976E-2	-1.559803E-5	8.445321E-6	-2.754148E-4

Pressure in kPa/psi = $C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.
TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C.
Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.4 °C.

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2962.2	0.7	0.10	-0.10
70.0	10.15	2874.3	70.0	10.15	0.00
140.0	20.31	2783.8	139.6	20.25	0.06
210.0	30.46	2690.6	209.4	30.38	0.08
280.0	40.61	2594.4	279.6	40.55	0.06
350.0	50.76	2495.2	349.8	50.74	0.03
420.0	60.92	2392.6	420.2	60.95	-0.04
490.0	71.07	2286.7	490.6	71.15	-0.08
560.0	81.22	2177.5	560.5	81.30	-0.08
630.0	91.37	2064.5	630.2	91.41	-0.04
700.0	101.53	1947.9	699.3	101.43	0.10

GEOKON 48 Spencer St Lebanon, NH 03766 USA

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-700 kPa

Date of Calibration: July 10, 2017

This calibration has been verified/validated as of 07/17/2017

Serial Number: 1724156

Temperature: 23.30 °C

Calibration Instruction: VW Pressure Transducers

Barometric Pressure: 993.8 mbar

Cable Length: 160 feet

Technician: Kelly Rogers

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8585	8586	8586	0.085	0.01	0.031	0.00
140.0	7764	7764	7764	140.0	0.00	140.0	0.00
280.0	6943	6944	6944	279.7	-0.04	279.8	-0.03
420.0	6120	6120	6120	420.0	0.00	420.1	0.01
560.0	5297	5297	5297	560.2	0.02	560.2	0.02
700.0	4476	4476	4476	700.0	-0.01	699.9	-0.01

(kPa) Linear Gage Factor (G): -0.1703 **(kPa/ digit)**

Polynomial Gage factors: **A:** -3.206E-08 **B:** -0.1699 **C:** _____

Thermal Factor (K): -0.05557 **(kPa/ °C)**

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.02470 **(psi/ digit)**

Polynomial Gage Factors: **A:** -4.65E-09 **B:** -0.02464 **C:** _____

Thermal Factor (K): -0.008060 **(psi/ °C)**

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8578 **Temperature:** 21.9 °C **Barometer:** 997.2 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

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GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-700 kPa

Date of Calibration: August 07, 2017

This calibration has been verified/validated as of 08/10/2017

Serial Number: 1726356

Temperature: 23.20 °C

Calibration Instruction: VW Pressure Transducers

Barometric Pressure: 996.7 mbar

Cable Length: 160 feet

Technician: Kelly Rogers

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8428	8428	8428	-1.867	-0.27	0.251	0.04
140.0	7668	7668	7668	140.0	0.00	139.7	-0.05
280.0	6911	6911	6911	281.3	0.19	279.8	-0.04
420.0	6159	6159	6159	421.7	0.25	420.2	0.03
560.0	5414	5415	5415	560.7	0.10	560.4	0.05
700.0	4681	4681	4681	697.6	-0.34	699.8	-0.04

(kPa) Linear Gage Factor (G): -0.1867 (kPa/ digit)

Polynomial Gage factors: A: 1.086E-06 B: -0.2009 C: _____

Thermal Factor (K): -0.06775 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.02708 (psi/ digit)

Polynomial Gage Factors: A: 1.576E-07 B: -0.02914 C: _____

Thermal Factor (K): -0.009826 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8423 Temperature: 22.5 °C Barometer: 1003.7 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

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VW Piezometer Calibration Certificate

Serial #: 1702626
Range : 350 kPa
Cable Length: 45 m
Date of Calibration: 8/23/2017

Part #: 52611027
Cable Part # : 50613824
Calibrated by: AVM
Note:

ABC Calibration Factors

	A	B	C
kPa	-8.680535E-5	-3.133460E-2	8.938819E+2
psi	-1.259005E-5	-4.544700E-3	1.296466E+2

Pressure in kPa/psi = $(A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	8.952930E+2	-3.365489E-2	7.030014E-2	-8.647616E-5	4.202112E-5	-1.124925E-3
psi	1.298467E+2	-4.881057E-3	1.019581E-2	-1.254187E-5	6.094434E-6	-1.631508E-4

Pressure in kPa/psi = $C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.
TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C.
Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.6 °C.

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3033.4	0.1	0.01	-0.03
35.0	5.08	2970.2	35.0	5.08	0.00
70.0	10.15	2905.7	69.9	10.14	0.02
105.0	15.23	2839.7	104.9	15.22	0.03
140.0	20.31	2772.1	140.0	20.30	0.01
175.0	25.38	2703.0	175.0	25.38	0.01
210.0	30.46	2632.0	210.1	30.47	-0.02
245.0	35.53	2559.3	245.1	35.55	-0.03
280.0	40.61	2484.8	280.1	40.62	-0.02
315.0	45.69	2408.2	315.0	45.69	0.00
350.0	50.76	2329.3	349.9	50.75	0.02

VW Piezometer Calibration Certificate

Serial #: 1701362
Range : 700 kPa
Cable Length: 90 m
Date of Calibration: 4/21/2017

Part #: 52611036
Cable Part # : 50613524
Calibrated by: AM
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.628864E-4	1.666454E-2	1.367978E+3
psi	-2.362468E-5	2.416987E-3	1.984084E+2

Pressure in kPa/psi = $(A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.367340E+3	1.505272E-2	1.647148E-1	-1.626258E-4	2.801698E-5	-2.058106E-3
psi	1.983089E+2	2.183136E-3	2.388902E-2	-2.358605E-5	4.063376E-6	-2.984925E-4

Pressure in kPa/psi = $C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.
TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C.
Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.8 °C.

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2949.7	-0.1	-0.01	0.01
70.0	10.15	2874.3	70.2	10.18	-0.02
140.0	20.31	2797.3	140.0	20.31	0.00
210.0	30.46	2718.0	209.9	30.45	0.01
280.0	40.61	2636.2	279.9	40.60	0.01
350.0	50.76	2551.7	349.9	50.75	0.01
420.0	60.92	2464.1	420.0	60.92	0.00
490.0	71.07	2373.2	490.1	71.09	-0.02
560.0	81.22	2278.8	560.1	81.24	-0.01
630.0	91.37	2180.3	630.0	91.37	0.00
700.0	101.53	2077.0	699.9	101.51	0.01

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Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-700 kPa

Date of Calibration: July 10, 2017

This calibration has been verified/validated as of 07/17/2017

Serial Number: 1724158

Temperature: 23.30 °C

Calibration Instruction: VW Pressure Transducers

Barometric Pressure: 993.8 mbar

Cable Length: 110 feet

Technician: Kelly Rogers

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8702	8702	8702	0.175	0.03	0.041	0.01
140.0	7901	7902	7902	139.9	-0.01	140.0	0.00
280.0	7101	7101	7101	279.7	-0.05	279.8	-0.02
420.0	6298	6298	6298	419.9	-0.02	420.0	0.00
560.0	5494	5495	5495	560.1	0.01	560.2	0.02
700.0	4693	4693	4693	700.1	0.01	699.9	-0.01

(kPa) Linear Gage Factor (G): -0.1746 **(kPa/ digit)**

Polynomial Gage factors: **A:** -8.063E-08 **B:** -0.1735 **C:** _____

Thermal Factor (K): -0.03237 **(kPa/ °C)**

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.02532 **(psi/ digit)**

Polynomial Gage Factors: **A:** -1.169E-08 **B:** -0.02516 **C:** _____

Thermal Factor (K): -0.004695 **(psi/ °C)**

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8696 **Temperature:** 22.2 °C **Barometer:** 997.2 mbar

The above instrument was found to be in tolerance in all operating ranges
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

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Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: July 10, 2017

This calibration has been verified/validated as of 07/17/2017

Serial Number: 1724351

Temperature: 23.20 °C

Calibration Instruction: VW Pressure Transducers

Barometric Pressure: 993.8 mbar

Cable Length: 60 feet

Technician: Kelly Rogers

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8837	8838	8838	-0.165	-0.05	-0.117	-0.03
70.0	8200	8200	8200	70.15	0.04	70.20	0.06
140.0	7567	7567	7567	140.0	-0.01	140.0	0.00
210.0	6933	6933	6933	209.9	-0.03	210.0	-0.02
280.0	6299	6299	6299	279.8	-0.05	279.9	-0.03
350.0	5663	5663	5663	350.0	0.01	350.0	0.02

(kPa) Linear Gage Factor (G): -0.1103 (kPa/ digit)

Polynomial Gage factors: A: 1.759E-09 B: -0.1103 C: _____

Thermal Factor (K): -0.03869 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.01600 (psi/ digit)

Polynomial Gage Factors: A: 2.552E-10 B: -0.01600 C: _____

Thermal Factor (K): -0.005612 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8835 Temperature: 21.9 °C Barometer: 997.2 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

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Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Serial Number: 1724352

Calibration Instruction: VW Pressure Transducers

Cable Length: 60 feet

Date of Calibration: July 10, 2017

This calibration has been verified/validated as of 07/17/2017

Temperature: 23.20 °C

Barometric Pressure: 993.8 mbar

Technician: Kelly Rogers

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8904	8905	8905	-0.054	-0.01	-0.168	-0.05
70.0	8250	8250	8250	70.23	0.06	70.28	0.08
140.0	7601	7601	7601	139.9	-0.03	140.1	0.01
210.0	6951	6951	6951	209.7	-0.08	209.9	-0.04
280.0	6298	6298	6298	279.8	-0.05	279.9	-0.03
350.0	5643	5643	5643	350.2	0.06	350.1	0.03

(kPa) Linear Gage Factor (G): -0.1074 **(kPa/ digit)**

Polynomial Gage factors: **A:** -9.792E-08 **B:** -0.1060 **C:** _____

Thermal Factor (K): -0.06684 **(kPa/ °C)**

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.01558 **(psi/ digit)**

Polynomial Gage Factors: **A:** -1.42E-08 **B:** -0.01537 **C:** _____

Thermal Factor (K): -0.009694 **(psi/ °C)**

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8900 **Temperature:** 21.1 °C **Barometer:** 997.2 mbar

The above instrument was found to be in tolerance in all operating ranges
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

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Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-350 kPa

Date of Calibration: August 03, 2017

This calibration has been verified/validated as of 08/10/2017

Serial Number: 1727315

Temperature: 22.80 °C

Calibration Instruction: VW Pressure Transducers

Barometric Pressure: 999.1 mbar

Cable Length: 60 feet

Technician: Kelly Rogers

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8732	8732	8732	0.343	0.10	-0.016	0.00
70.0	8123	8123	8123	69.99	0.00	70.02	0.01
140.0	7513	7513	7513	139.8	-0.07	140.0	-0.01
210.0	6901	6901	6901	209.8	-0.07	210.0	0.00
280.0	6287	6287	6287	280.0	0.00	280.0	0.01
350.0	5671	5672	5672	350.4	0.10	350.0	0.00

(kPa) Linear Gage Factor (G): -0.1144 **(kPa/ digit)**

Polynomial Gage factors: **A:** -2.606E-07 **B:** -0.1106 **C:**

Thermal Factor (K): -0.05819 **(kPa/ °C)**

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.01659 **(psi/ digit)**

Polynomial Gage Factors: **A:** -3.78E-08 **B:** -0.01604 **C:**

Thermal Factor (K): -0.008440 **(psi/ °C)**

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8717 **Temperature:** 22.4 °C **Barometer:** 999.7 mbar

The above instrument was found to be in tolerance in all operating ranges
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

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SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 1703893
Range : 350 kPa
Cable Length: 30 m
Date of Calibration: 11/30/2017

Part #: 52611024
Cable Part # : 50613824
Calibrated by: KB
Note: DRLE-G029

ABC Calibration Factors

	A	B	C
kPa	-9.537165E-5	-1.046729E-1	1.172213E+3
psi	-1.383249E-5	-1.518152E-2	1.700151E+2

Pressure in kPa/psi = $(A \times Hz^2) + (B \times Hz) + C$, where Hz is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.169942E+3	-1.039963E-1	1.143659E-2	-9.567262E-5	6.777068E-5	-8.878275E-4
psi	1.696798E+2	-1.508286E-2	1.658679E-3	-1.387565E-5	9.828960E-6	-1.287640E-4

Pressure in kPa/psi = $C0 + (C1 \times Hz) + (C2 \times T) + (C3 \times Hz^2) + (C4 \times Hz \times T) + (C5 \times T^2)$

Where Hz is the frequency reading in Hertz and T is the Thermistor reading in degrees C.
TI factors are calculated from temperatures at 5.0, 15.0 and 25.0 degrees C.
Applied pressure and temperature are NIST traceable.

Summary of Test Results at 15°C

Thermistor reading is 14.6 °C.

Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2999.6	0.1	0.02	-0.03
35.0	5.08	2947.5	35.1	5.09	-0.04
70.0	10.15	2895.0	69.9	10.13	0.04
105.0	15.23	2841.5	104.7	15.19	0.07
140.0	20.31	2786.7	139.9	20.29	0.03
175.0	25.38	2730.9	175.1	25.40	-0.03
210.0	30.46	2674.4	210.1	30.48	-0.04
245.0	35.53	2617.1	245.1	35.54	-0.02
280.0	40.61	2558.6	280.1	40.62	-0.02
315.0	45.69	2499.1	315.0	45.68	0.01
350.0	50.76	2438.4	349.9	50.75	0.02

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Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-700 kPa

Date of Calibration: August 07, 2017

This calibration has been verified/validated as of 08/10/2017

Serial Number: 1726357

Temperature: 23.20 °C

Calibration Instruction: VW Pressure Transducers

Barometric Pressure: 996.7 mbar

Cable Length: 110 feet

Technician: Kelly Rogers

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8815	8815	8815	1.231	0.18	0.060	0.01
140.0	8028	8028	8028	139.7	-0.05	139.9	-0.01
280.0	7236	7236	7236	279.0	-0.14	280.0	-0.01
420.0	6440	6440	6440	419.0	-0.13	420.0	0.01
560.0	5639	5640	5640	559.9	-0.02	560.1	0.01
700.0	4836	4837	4837	701.1	0.16	700.0	-0.01

(kPa) Linear Gage Factor (G): -0.1759 (kPa/ digit)

Polynomial Gage factors: A: -5.613E-07 B: -0.1683 C: _____

Thermal Factor (K): -0.09514 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.02552 (psi/ digit)

Polynomial Gage Factors: A: -8.141E-08 B: -0.02440 C: _____

Thermal Factor (K): -0.01380 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8812 Temperature: 21.4 °C Barometer: 1003.7 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

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Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-700 kPa

Date of Calibration: July 10, 2017

This calibration has been verified/validated as of 07/17/2017

Serial Number: 1724157

Temperature: 23.30 °C

Calibration Instruction: VW Pressure Transducers

Barometric Pressure: 993.8 mbar

Cable Length: 120 feet

Technician: Kelly Rogers

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8611	8611	8611	0.881	0.13	0.029	0.00
140.0	7823	7823	7823	139.7	-0.04	139.9	-0.01
280.0	7031	7031	7031	279.3	-0.10	280.0	0.00
420.0	6236	6237	6237	419.3	-0.10	420.0	0.00
560.0	5439	5439	5439	559.8	-0.03	560.0	0.00
700.0	4638	4639	4639	700.9	0.12	700.0	0.00

(kPa) Linear Gage Factor (G): -0.1762 (kPa/ digit)

Polynomial Gage factors: A: -4.193E-07 B: -0.1707 C: _____

Thermal Factor (K): -0.05298 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.02556 (psi/ digit)

Polynomial Gage Factors: A: -6.082E-08 B: -0.02475 C: _____

Thermal Factor (K): -0.007685 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi Barometric compensation is not required with vented transducers

Factory Zero Reading: 8606 Temperature: 21.2 °C Barometer: 997.2 mbar

The above instrument was found to be in tolerance in all operating ranges
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

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Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-700 kPa

Date of Calibration: August 07, 2017

This calibration has been verified/validated as of 08/10/2017

Serial Number: 1726358

Temperature: 23.20 °C

Calibration Instruction: VW Pressure Transducers

Barometric Pressure: 996.7 mbar

Cable Length: 110 feet

Technician: Kelly Rogers

Applied Pressure (kPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8813	8814	8814	1.170	0.17	0.002	0.00
140.0	8043	8043	8043	139.8	-0.02	140.0	0.00
280.0	7269	7269	7269	279.1	-0.13	280.0	-0.01
420.0	6491	6491	6491	419.2	-0.11	420.0	0.01
560.0	5709	5710	5710	559.8	-0.03	560.0	0.00
700.0	4924	4924	4924	701.2	0.17	700.0	0.00

(kPa) Linear Gage Factor (G): -0.1800 (kPa/ digit)

Polynomial Gage factors: A: -5.534E-07 B: -0.1724 C: _____

Thermal Factor (K): -0.1126 (kPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.02610 (psi/ digit)

Polynomial Gage Factors: A: -8.026E-08 B: -0.02500 C: _____

Thermal Factor (K): -0.01633 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in kPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8817 Temperature: 22.6 °C Barometer: 1003.7 mbar

The above instrument was found to be in tolerance in all operating ranges
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1

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APPENDIX N

SUPPLEMENTARY DATA – DRILL RIG HAMMER EFFICIENCIES

Table N-1: Drill Rig Hammer Efficiencies

Borehole	Subcontractor	Rig Type	Rig Model	ETR	Reference
DRLE-G001	HOLT	Truck	CME-85	90	Report 3, pg 2
DRLE-G002	HOLT	Truck	Mobile B-58	83	Report 4, pg 2
DRLE-G003	HOLT	Truck	CME-85	90	Report 3, pg 2
DRLE-G004	HOLT	Truck	CME-85	90	Report 3, pg 2
DRLE-G005	HOLT	Truck	CME-85	90	Report 3, pg 2
DRLE-G006	HOLT	Truck	Mobile B-58	83	Report 4, pg 2
DRLE-G007	HOLT	Truck	Mobile B-58	83	Report 4, pg 2
DRLE-G008	HOLT	Truck	Mobile B-58	83	Report 4, pg 2
DRLE-G010	HOLT	Truck	Mobile B-59	98	Report 5, pg 3
DRLE-G011	HOLT	Truck	Mobile B-58	83	Report 4, pg 2
DRLE-G012	HOLT	Truck	Mobile B-58	83	Report 4, pg 2
DRLE-G013	HOLT	Truck	Mobile B-58	83	Report 4, pg 2
DRLE-G014	HOLT	Truck	Mobile B-58	83	Report 4, pg 2
DRLE-G015	HOLT	Truck	Mobile B-58	83	Report 4, pg 2
DRLE-G016	Holocene	Truck	CME-850	86.1	Report 1, pg 4
DRLE-G017	Holocene	Track	CME-850	86.1	Report 1, pg 4
DRLE-G017A	Holocene	Truck	Mobile B-58	89.7	Report 2, pg 2
DRLE-G018	Holocene	Track	CME-850	86.1	Report 1, pg 4
DRLE-G019	HOLT	Track	Mobile B-54	88.2	Report 6, pg4
DRLE-G020	HOLT	Track	Mobile B-54	88.2	Report 6, pg4
DRLE-G021	HOLT	Track	Mobile B-54	88.2	Report 6, pg4
DRLE-G022	HOLT	Track	Mobile B-54	88.2	Report 6, pg4
DRLE-G023	HOLT	Track	Mobile B-54	88.2	Report 6, pg4
DRLE-G023b	HOLT	Track	Mobile B-54	88.2	Report 6, pg4
DRLE-G024	HOLT	Track	Mobile B-54	88.2	Report 6, pg4
DRLE-G025	HOLT	Track	Mobile B-54	88.2	Report 6, pg4
DRLE-G027	HOLT	Truck	CME-85	90	Report 3, pg 2
DRLE-G028	HOLT	Truck	Mobile B-59	98	Report 5, pg 3
DRLE-G029	Holocene	Truck	Mobile B-58	89.7	Report 2, pg 2
DRLE-G031	HOLT	Truck	Mobile B-58	83	Report 4, pg 2
DRLE-G032	HOLT	Truck	CME-85	90	Report 3, pg 2
DRLE-G033	Holocene	Truck	Mobile B-58	89.7	Report 2, pg 2
DRLE-G034	HOLT	Track	Mobile B-54	88.2	Report 6, pg4
DRLE-G034A	Holocene	Truck	Mobile B-58	89.7	Report 2, pg 2
DRLE-G035	Holocene	Truck	Mobile B-58	89.7	Report 2, pg 2
DRLE-G036	HOLT	Track	Mobile B-54	88.2	Report 6, pg4
DRLE-G036A	Holocene	Truck	Mobile B-58	89.7	Report 2, pg 2
DRLE-G037	HOLT	Sonic	Terra Sonic CC 150	95	Report 5, pg 5
DRLE-G037A	Holocene	Truck	Mobile B-58	89.7	Report 2, pg 2
DRLE-G038	Holocene	Truck	Mobile B-58	89.7	Report 2, pg 2
DRLE-G044	Holocene	Track	CME-850	86.1	Report 1, pg 4
DRLE-G045	Holocene	Track	CME-850	86.1	Report 1, pg 4

Attachment 15

Report 1
Holocene CME 850

Job No. 176009-1

Report on: SPT Energy Calibration

Prepared for: Holocene Drilling, Inc.

By: Marty Bixler, P.E.
Anna Klesney

April 20, 2017

GRL engineers, inc.
Dynamic Measurements and Analyses

www.GRLengineers.com info@GRLengineers.com

GRL engineers, inc. Dynamic Measurements and Analyses

April 20, 2017

Jon M. Root
Holocene Drilling, Inc.
11412 62nd Ave E.
Puyallup, WA 98373

Re: Energy Measurement for Dynamic Penetrometers
Standard Penetration Tests (SPT)
Various locations, Washington GRL Job No. 176009-1

Dear Mr. Root:

This report transmits our findings from energy measurements and related data analysis conducted by GRL Engineers, Inc. (GRL) for your two drill rigs operating in Kent and Shelton, Washington. Two automatic hammer and penetrometer systems were monitored during Standard Penetration Tests. Dynamic testing summarized in this report was conducted on April 14 and 17, 2017.

A Pile Driving Analyzer® Model 8G recorded, processed and displayed the dynamic data to meet the objectives of the hammer system calibration. Discussions on the test methods, limitations and implementation are provided in Appendix A. The energy measurement results are summarized in the appended tables with the average and standard deviation provided in Appendix B together with representative plots of force and normalized velocity.

EQUIPMENT

Hammer and Penetrometer System

Energy measurements were recorded during standard penetration tests conducted for two automatic hammers and the following drill rig types and numbers.

Drill Rig Type	Drill Rig Number
Mobile B-59 (truck rig)	Holocene Rig #74
CME 850 (track rig)	Holocene Rig #31

Measurements were recorded for one boring location for each of the two drill rigs. Holocene Drilling, Inc. advanced the penetrometer to depths of approximately 10 and 15 feet, respectively, prior to energy measurements for the above tabulated rigs. The instrumented subassembly was connected to the top of the drill rod string and measurements recorded at intervals for several depths of data. Selected data is presented in this report.

Measurements were recorded for every blow required to advance the sampler typically 18 inches. Results are provided for the final 12 inches or less of the sampler advancement alone (i.e., excluding the initial 6 inches of advancement). Please refer to ASTM D4633 regarding recommendations on blow counts and instrumented drill rod lengths, as well as other details of the test method.

The following drill rod dimensions, of rod size NWJ, were employed during testing.

Drill Rod Area sq. inch	Outside Diameter Inch	Inside Diameter inch
1.44	2.63	2.25
Depth of Penetrometer feet	Drill Rod Section Lengths feet	Transducer to Penetrometer Length feet
A	A	A
10.0	13	15
20.0	23	25
35.0	38	40
B	B	B
15.0	16	18
45.0	46	48
50.0	51	53
55.0	56	58
60.0	61	63
70.0	71	73

* A (Mobile B-59 Number 74); B (CME 850 Number 31).

Instrumentation

A Pile Driving Analyzer was employed for recording, processing, and displaying the dynamic data. An instrumented subassembly, inserted at the top of the drill rod string below the hammer and anvil system and above the drill rods, was used to record force and acceleration data. The subassembly was instrumented with two foil strain gages in a full bridge circuit and two piezoresistive accelerometers attached on diametrically opposite sides of the subassembly. Data sampling frequency was 50.0 kHz.

The 8G utilizes a digital system, and with the employed sampling frequency of 50.0 kHz, the signal conditioning conforms to ASTM D4633. Results for the maximum hammer operating rate,

rod top force and velocity, and transferred energy are provided in Appendix B and summarized in the appended tables. Discussions on the test method and its limitations can be found in Appendix A.

MEASUREMENTS AND CALCULATIONS

The primary objective of testing was the measurement of the energy transmitted from the hammer impact through the anvil into the instrumented subassembly and drill rods. Strain transducers and accelerometers were employed for the calculation of the transferred energy using force, F(t) and velocity v(t), records as follows:

$$EMX = \int_{b}^{a} F(t)v(t)dt$$

where time "b" is to the beginning of the energy transfer and time "a" is to the time at which the energy transfer reaches a maximum. Force is calculated as the product of the measured strain, elastic modulus and cross-sectional area, and measured acceleration is integrated to velocity.

Integrated over the complete impact event and calculated from measured force and velocity, the energy transferred to the top of the drill rod was calculated as a function of time. The maximum transferred energy (i.e., EFV or also referred to as EMX) is used as an indicator of the energy content of the event. The described method is the only theoretically correct method of measuring energy transfer and automatically corrects for rod non-uniformities such as connector masses or loose joints.

TEST RESULTS

Result Discussion

Dynamic data was evaluated for the hammer operating rate, rod top force and velocity, and transferred energy. Appendix B provides the evaluated quantities for blows making up the SPT N-value, with their averages and standard deviation, plotted and printed as a function of depth for the monitored sequences of the standard penetration tests. Measurements collected for relevant samples are presented herein.

The tables in Appendix B include:

- FMX – the maximum measured rod top force
- VMX – the maximum measured rod top velocity
- BPM – the hammer operating rate in blows per minute
- EFV – the maximum calculated energy (EMX) transferred to the rod top
- ETR – ratio of transferred energy (EFV) to the maximum theoretical potential energy

The maximum theoretical potential energy is the product of the standard 140 lb hammer impact mass dropped the standard 30 inches.

A representative plot of force and normalized velocity versus time for a typical blow from each data set is provided in Appendix B to demonstrate the data quality.

Summary of Results

I. Two automatic hammers were monitored during standard penetration tests conducted on April 14 and 17, 2017. The average energy transfer ratio calculated with the EFV method for the monitored sequences for the drill rigs are tabulated below together with the corresponding, average hammer operating rates.

Drill Rig	Energy Transfer Ratio percent	Operating Rate bpm
Mobile B-59 (Rig #74)	89.5	45.2
CME 850 (Rig #31)	86.1	42.8

II. The uncorrected N-values encountered during the sequences ranged from 28 blows to refusal conditions.

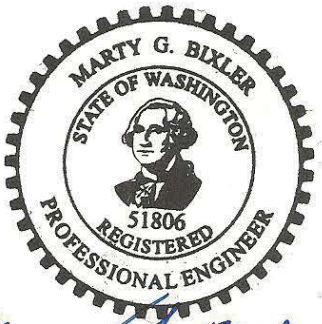
III. To convert the uncorrected N-values for the employed hammer and penetrometer system and operators, the Schmertman correction for adjustment to 60 percent transfer efficiency is

$$N_{60} = \left(\frac{e_m}{60}\right) N_m$$

where N_{60} is the corrected hammer N-value, e_m is the percent energy transfer efficiency (i.e., e_m = 100*ETR) and N_m is the measured SPT N-value. N_{60} values for the measurements and monitored depths meeting ASTM requirements are presented in the appended tables. The measured overall energy transfer ratios tabulated above for the respective drill rigs produce a respective N_{60} equivalent of roughly $1.49N_m$ and $1.43N_m$. Further corrections due to overburden stresses in the soil may be made prior to use of the N-values for design purposes.

We appreciate the opportunity to be of assistance to you on this project. Please contact our offices should you have any questions regarding the contents of this report, or if we may be of further service.

Respectfully,
GRL ENGINEERS, INC.



4-20-17

Marty G. Bixler, P.E. (Washington #51806)
Senior Engineer

Anna M. Klesney, MSCE, E.I.T.
Project Engineer

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

The following has been written by GRL Engineers, Inc. and may only be copied with its written permission.

1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m [E_m / (0.6E_r)] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_0^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v / c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

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Appendix B

Results of SPT Rig Calibration

GRL Engineers, Inc.
SPT Analyzer Results

PDA-S Ver. 2016.16 - Printed: 4/18/2017

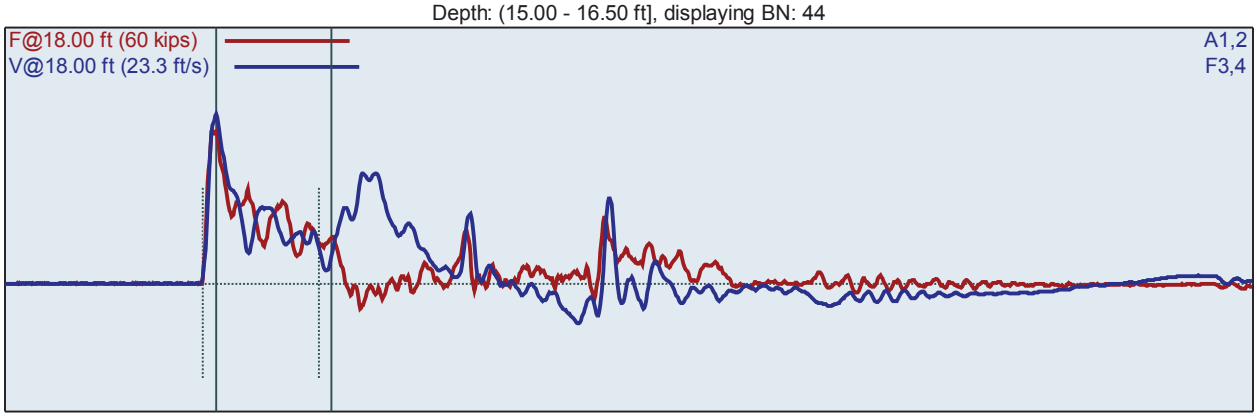
CME 850 #31
GRL-MGB

15
Test date: 4/17/2017

AR: 1.44 in^2
LE: 18.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (15.00 - 16.50 ft], displaying BN: 44



FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR (%)
1	9	15.06	36	14.4	6.9	276.5	79.0
2	9	15.11	38	16.2	37.5	297.4	85.0
3	9	15.17	36	15.3	38.2	288.3	82.4
4	9	15.22	38	15.9	38.4	297.5	85.0
5	9	15.28	39	16.3	38.3	306.7	87.6
6	9	15.33	38	15.8	38.5	298.2	85.2
7	9	15.39	37	15.1	38.6	289.3	82.7
8	9	15.44	38	16.4	38.8	299.3	85.5
9	9	15.50	38	16.3	38.7	301.1	86.0
10	13	15.54	36	15.5	38.7	294.1	84.0
11	13	15.58	38	16.2	38.8	300.6	85.9
12	13	15.62	36	15.3	38.8	290.4	83.0
13	13	15.65	36	15.4	39.0	291.7	83.3
14	13	15.69	38	16.1	38.9	303.5	86.7
15	13	15.73	39	16.2	39.0	305.4	87.3
16	13	15.77	39	16.3	39.0	302.4	86.4
17	13	15.81	37	15.6	38.9	296.6	84.7
18	13	15.85	38	15.9	39.0	302.4	86.4
19	13	15.88	39	16.1	39.2	306.9	87.7
20	13	15.92	38	15.7	39.0	297.1	84.9
21	13	15.96	37	15.6	39.2	296.3	84.7
22	13	16.00	37	15.5	39.0	299.4	85.5
23	24	16.02	36	16.0	39.0	295.8	84.5
24	24	16.04	37	15.4	39.1	300.7	85.9
25	24	16.06	38	16.2	39.0	305.8	87.4
26	24	16.08	37	15.9	39.2	300.3	85.8
27	24	16.10	37	15.6	39.1	300.3	85.8
28	24	16.13	37	15.6	39.3	296.8	84.8
29	24	16.15	38	15.7	39.2	302.9	86.5
30	24	16.17	36	15.9	39.1	301.0	86.0
31	24	16.19	37	15.9	39.2	302.6	86.5
32	24	16.21	37	15.8	39.1	305.4	87.2
33	24	16.23	38	15.7	39.1	300.9	86.0

34	24	16.25	38	15.7	39.1	302.4	86.4
35	24	16.27	37	15.6	39.4	299.9	85.7
36	24	16.29	39	16.0	38.9	301.2	86.0
37	24	16.31	39	16.1	39.0	305.6	87.3
38	24	16.33	36	15.1	39.1	297.8	85.1
39	24	16.35	37	15.4	39.0	298.3	85.2
40	24	16.38	37	15.6	38.9	303.3	86.7
41	24	16.40	37	15.5	38.9	303.1	86.6
42	24	16.42	37	15.4	39.0	302.6	86.4
43	24	16.44	39	16.3	38.9	306.2	87.5
44	24	16.46	36	15.4	38.9	300.6	85.9
45	24	16.48	36	15.0	39.1	291.2	83.2
46	24	16.50	38	15.9	38.9	304.8	87.1
		Average	37	15.7	39.0	300.4	85.8
		Std Dev	1	0.3	0.1	4.2	1.2
		Maximum	39	16.3	39.4	306.9	87.7
		Minimum	36	15.0	38.7	290.4	83.0

N-value: 37

Sample Interval Time: 69.42 seconds.

GRL Engineers, Inc.
SPT Analyzer Results

PDA-S Ver. 2016.16 - Printed: 4/18/2017

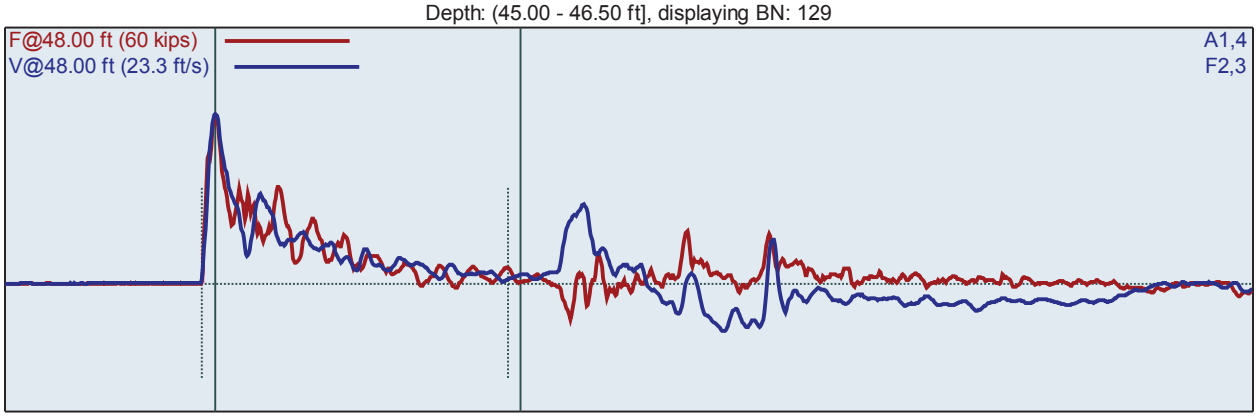
CME 850 #31
GRL-MGB

15
Test date: 4/17/2017

AR: 1.44 in^2
LE: 48.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (45.00 - 46.50 ft], displaying BN: 129



BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR (%)
47	16	45.03	35	13.8	19.6	277.9	79.4
48	16	45.06	35	14.8	40.5	297.5	85.0
49	16	45.09	35	14.6	41.2	299.1	85.5
50	16	45.13	37	14.8	41.6	301.7	86.2
51	16	45.16	37	14.5	41.6	300.6	85.9
52	16	45.19	38	15.0	41.6	298.6	85.3
53	16	45.22	37	14.4	41.8	289.4	82.7
54	16	45.25	39	14.9	41.8	300.4	85.8
55	16	45.28	37	14.5	42.0	287.1	82.0
56	16	45.31	37	15.0	41.8	294.0	84.0
57	16	45.34	38	14.6	41.9	287.8	82.2
58	16	45.38	38	14.6	41.8	293.0	83.7
59	16	45.41	36	14.3	41.9	279.6	79.9
60	16	45.44	37	14.2	42.0	281.8	80.5
61	16	45.47	38	14.4	41.7	289.5	82.7
62	16	45.50	39	14.7	42.0	291.4	83.2
63	33	45.52	37	14.1	41.6	293.0	83.7
64	33	45.53	37	14.0	41.9	285.4	81.5
65	33	45.55	39	14.6	41.9	300.1	85.7
66	33	45.56	38	14.4	41.8	288.3	82.4
67	33	45.58	36	13.9	42.0	280.8	80.2
68	33	45.59	36	14.5	41.7	302.4	86.4
69	33	45.61	36	14.0	41.9	288.0	82.3
70	33	45.62	38	14.5	41.9	296.9	84.8
71	33	45.64	38	14.6	41.7	296.8	84.8
72	33	45.65	37	14.7	41.9	294.3	84.1
73	33	45.67	36	14.3	41.7	287.6	82.2
74	33	45.68	36	14.1	42.0	283.3	81.0
75	33	45.70	36	14.2	41.9	289.4	82.7
76	33	45.71	36	14.2	42.0	287.5	82.1
77	33	45.73	38	14.8	41.7	307.6	87.9
78	33	45.74	37	14.4	41.9	292.0	83.4
79	33	45.76	36	14.1	42.1	285.4	81.6
80	33	45.77	35	14.1	41.9	286.1	81.8
81	33	45.79	35	13.8	42.0	282.3	80.7
82	33	45.80	37	14.0	41.7	287.2	82.1

83	33	45.82	37	14.0	42.1	285.6	81.6
84	33	45.83	35	13.8	41.9	287.1	82.0
85	33	45.85	37	14.1	42.0	289.5	82.7
86	33	45.86	36	14.1	41.9	289.8	82.8
87	33	45.88	39	14.8	41.7	298.8	85.4
88	33	45.89	36	13.7	42.2	284.7	81.3
89	33	45.91	35	13.7	41.7	288.5	82.4
90	33	45.92	37	14.2	42.1	292.8	83.6
91	33	45.94	37	14.2	42.1	291.5	83.3
92	33	45.95	36	14.2	41.9	293.1	83.8
93	33	45.97	35	13.9	41.8	286.1	81.7
94	33	45.98	34	13.8	42.1	286.1	81.7
95	33	46.00	34	13.7	42.0	282.2	80.6
96	36	46.01	37	15.0	42.0	297.8	85.1
97	36	46.03	34	13.5	42.0	282.3	80.7
98	36	46.04	35	13.8	42.1	283.9	81.1
99	36	46.06	37	14.6	42.0	295.1	84.3
100	36	46.07	36	14.0	42.0	287.7	82.2
101	36	46.08	36	14.1	42.2	291.0	83.2
102	36	46.10	37	14.2	42.0	295.1	84.3
103	36	46.11	37	14.3	42.0	290.0	82.9
104	36	46.13	36	14.2	41.7	291.4	83.2
105	36	46.14	37	15.0	41.8	300.6	85.9
106	36	46.15	35	13.8	42.0	281.7	80.5
107	36	46.17	37	14.6	42.1	296.7	84.8
108	36	46.18	35	13.8	41.9	286.5	81.9
109	36	46.19	36	14.0	42.0	288.9	82.5
110	36	46.21	36	13.8	42.0	286.1	81.7
111	36	46.22	38	14.7	41.9	297.1	84.9
112	36	46.24	36	13.7	42.0	285.2	81.5
113	36	46.25	35	13.5	42.0	284.7	81.3
114	36	46.26	36	14.0	42.0	288.1	82.3
115	36	46.28	36	13.7	41.8	283.1	80.9
116	36	46.29	38	14.6	41.9	297.0	84.9
117	36	46.31	35	13.7	42.1	284.3	81.2
118	36	46.32	37	14.4	41.9	294.9	84.3
119	36	46.33	36	13.9	42.0	286.7	81.9
120	36	46.35	36	14.1	41.9	289.0	82.6
121	36	46.36	35	13.9	42.1	287.1	82.0
122	36	46.38	35	13.8	42.1	283.9	81.1
123	36	46.39	35	13.6	41.9	282.1	80.6
124	36	46.40	35	14.1	42.0	290.6	83.0
125	36	46.42	35	14.1	42.0	291.4	83.3
126	36	46.43	36	14.0	42.0	291.5	83.3
127	36	46.44	35	13.9	42.0	289.9	82.8
128	36	46.46	35	13.8	42.0	288.2	82.3
129	36	46.47	39	15.5	42.2	314.0	89.7
130	36	46.49	37	16.5	42.0	310.3	88.7
131	36	46.50	36	15.9	41.9	310.9	88.8
		Average	36	14.2	41.9	290.7	83.0
		Std Dev	1	0.5	0.1	7.1	2.0
		Maximum	39	16.5	42.2	314.0	89.7
		Minimum	34	13.5	41.6	280.8	80.2

N-value: 69

Sample Interval Time: 120.31 seconds.

GRL Engineers, Inc.
SPT Analyzer Results

PDA-S Ver. 2016.16 - Printed: 4/18/2017

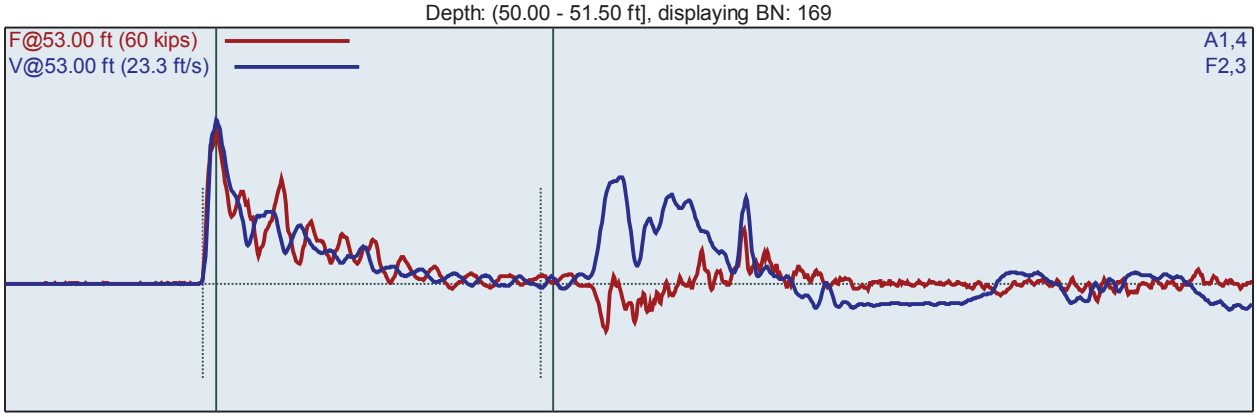
CME 850 #31
GRL-MGB

15
Test date: 4/17/2017

AR: 1.44 in^2
LE: 53.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (50.00 - 51.50 ft], displaying BN: 169



BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR (%)
132	12	50.04	36	14.2	1.9	290.2	82.9
133	12	50.08	37	15.1	44.1	299.9	85.7
134	12	50.13	35	14.3	44.5	293.9	84.0
135	12	50.17	37	15.2	45.2	301.3	86.1
136	12	50.21	37	14.7	45.2	295.9	84.5
137	12	50.25	36	14.6	45.5	292.4	83.5
138	12	50.29	38	14.9	45.4	301.9	86.2
139	12	50.33	38	15.5	45.3	307.1	87.7
140	12	50.38	36	14.7	45.4	288.8	82.5
141	12	50.42	38	15.1	45.4	298.6	85.3
142	12	50.46	38	15.3	45.4	306.5	87.6
143	12	50.50	36	14.8	45.6	298.6	85.3
144	11	50.55	37	15.0	45.3	300.8	86.0
145	11	50.59	35	14.5	45.5	288.5	82.4
146	11	50.64	37	15.2	45.5	306.2	87.5
147	11	50.68	39	15.9	45.5	315.1	90.0
148	11	50.73	38	15.1	45.5	305.2	87.2
149	11	50.77	38	15.4	45.5	307.0	87.7
150	11	50.82	37	15.5	45.8	306.0	87.4
151	11	50.86	36	14.8	45.6	295.6	84.5
152	11	50.91	37	15.1	45.6	301.0	86.0
153	11	50.95	37	15.2	45.6	303.3	86.7
154	11	51.00	37	15.2	45.6	307.2	87.8
155	17	51.03	37	15.2	45.8	305.6	87.3
156	17	51.06	37	15.0	45.7	298.0	85.1
157	17	51.09	37	15.2	45.7	305.5	87.3
158	17	51.12	37	15.2	45.7	304.1	86.9
159	17	51.15	37	15.4	45.6	307.4	87.8
160	17	51.18	37	15.3	45.6	303.2	86.6
161	17	51.21	36	14.9	45.6	301.2	86.0
162	17	51.24	37	15.0	45.6	304.7	87.0
163	17	51.26	37	14.9	45.6	305.0	87.1
164	17	51.29	37	15.1	45.8	307.3	87.8
165	17	51.32	38	15.4	45.6	306.0	87.4
166	17	51.35	38	15.5	45.9	302.6	86.5
167	17	51.38	37	15.0	45.7	299.3	85.5

168	17	51.41	37	15.3	45.7	304.9	87.1
169	17	51.44	37	14.9	45.8	300.2	85.8
170	17	51.47	35	15.4	45.8	304.7	87.1
171	17	51.50	38	16.2	45.9	312.4	89.3
		Average	37	15.2	45.7	303.9	86.8
		Std Dev	1	0.3	0.1	4.9	1.4
		Maximum	39	16.2	45.9	315.1	90.0
		Minimum	35	14.5	45.3	288.5	82.4
			N-value: 28				

Sample Interval Time: 51.39 seconds.

GRL Engineers, Inc.
SPT Analyzer Results

PDA-S Ver. 2016.16 - Printed: 4/18/2017

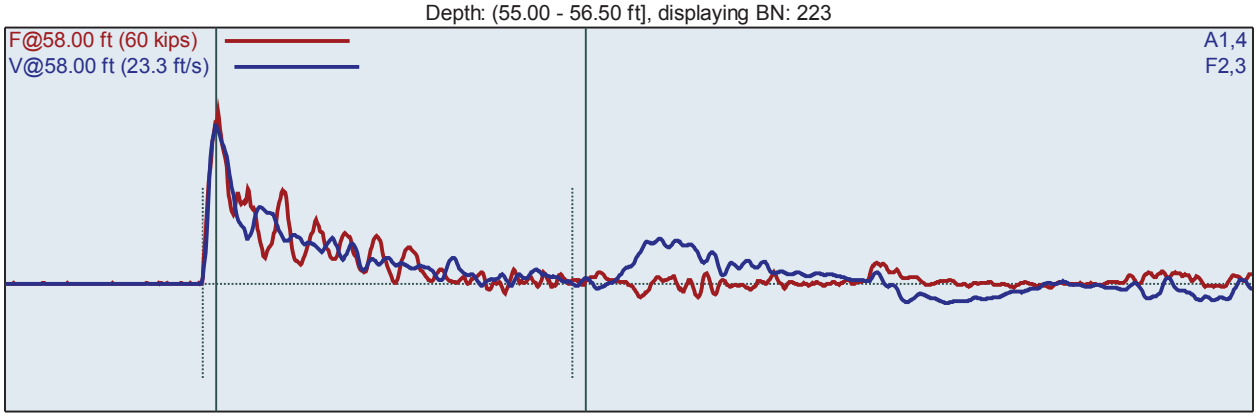
CME 850 #31
GRL-MGB

15
Test date: 4/17/2017

AR: 1.44 in^2
LE: 58.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (55.00 - 56.50 ft], displaying BN: 223



BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR (%)
172	14	55.04	38	15.0	1.9	304.5	87.0
173	14	55.07	39	14.7	42.1	298.1	85.2
174	14	55.11	39	14.8	42.3	304.1	86.9
175	14	55.14	39	15.1	42.9	308.8	88.2
176	14	55.18	39	15.1	42.9	305.5	87.3
177	14	55.21	38	14.2	42.9	301.8	86.2
178	14	55.25	39	14.9	42.9	305.5	87.3
179	14	55.29	39	14.4	42.8	301.6	86.2
180	14	55.32	41	15.3	43.0	314.3	89.8
181	14	55.36	39	15.1	42.9	308.9	88.2
182	14	55.39	40	15.0	42.9	311.0	88.9
183	14	55.43	40	15.2	42.9	315.3	90.1
184	14	55.46	40	15.2	42.9	308.9	88.3
185	14	55.50	40	15.3	43.1	310.5	88.7
186	16	55.53	39	15.0	42.9	308.9	88.2
187	16	55.56	38	14.5	43.0	305.8	87.4
188	16	55.59	40	15.3	42.9	308.3	88.1
189	16	55.63	41	15.2	43.0	309.2	88.4
190	16	55.66	39	14.5	43.0	306.4	87.5
191	16	55.69	38	14.2	43.1	302.5	86.4
192	16	55.72	37	13.8	42.9	304.7	87.1
193	16	55.75	37	14.0	43.2	299.8	85.7
194	16	55.78	38	14.5	43.1	304.7	87.1
195	16	55.81	36	13.1	43.2	289.3	82.7
196	16	55.84	36	13.8	43.2	300.3	85.8
197	16	55.88	37	14.0	43.1	300.7	85.9
198	16	55.91	39	14.6	43.2	304.7	87.1
199	16	55.94	37	14.2	43.3	306.5	87.6
200	16	55.97	35	13.2	43.4	291.6	83.3
201	16	56.00	37	14.4	42.9	306.5	87.6
202	24	56.02	37	14.2	43.4	305.2	87.2
203	24	56.04	36	13.2	43.4	299.7	85.6
204	24	56.06	38	13.9	43.2	300.1	85.7
205	24	56.08	38	14.0	43.1	300.8	86.0
206	24	56.10	39	14.5	43.2	307.0	87.7
207	24	56.13	40	15.0	43.0	311.6	89.0

208	24	56.15	38	14.0	43.4	297.9	85.1
209	24	56.17	38	14.6	43.1	303.1	86.6
210	24	56.19	40	14.6	43.1	304.2	86.9
211	24	56.21	40	14.8	43.1	310.3	88.7
212	24	56.23	38	14.7	43.2	302.3	86.4
213	24	56.25	38	13.8	43.3	295.7	84.5
214	24	56.27	39	14.7	43.0	311.5	89.0
215	24	56.29	34	13.3	43.1	296.1	84.6
216	24	56.31	38	14.3	42.9	307.0	87.7
217	24	56.33	37	14.1	43.1	304.0	86.9
218	24	56.35	38	14.0	43.1	301.8	86.2
219	24	56.38	40	14.8	43.2	311.4	89.0
220	24	56.40	39	14.6	43.0	310.3	88.7
221	24	56.42	37	14.5	43.2	305.1	87.2
222	24	56.44	41	14.4	43.1	319.4	91.2
223	24	56.46	40	14.4	43.2	316.4	90.4
224	24	56.48	40	14.4	43.2	315.9	90.3
225	24	56.50	40	14.8	42.9	322.5	92.1
		Average	38	14.3	43.1	305.2	87.2
		Std Dev	1	0.5	0.1	6.7	1.9
		Maximum	41	15.3	43.4	322.5	92.1
		Minimum	34	13.1	42.9	289.3	82.7

N-value: 40

Sample Interval Time: 73.87 seconds.

GRL Engineers, Inc.
SPT Analyzer Results

PDA-S Ver. 2016.16 - Printed: 4/18/2017

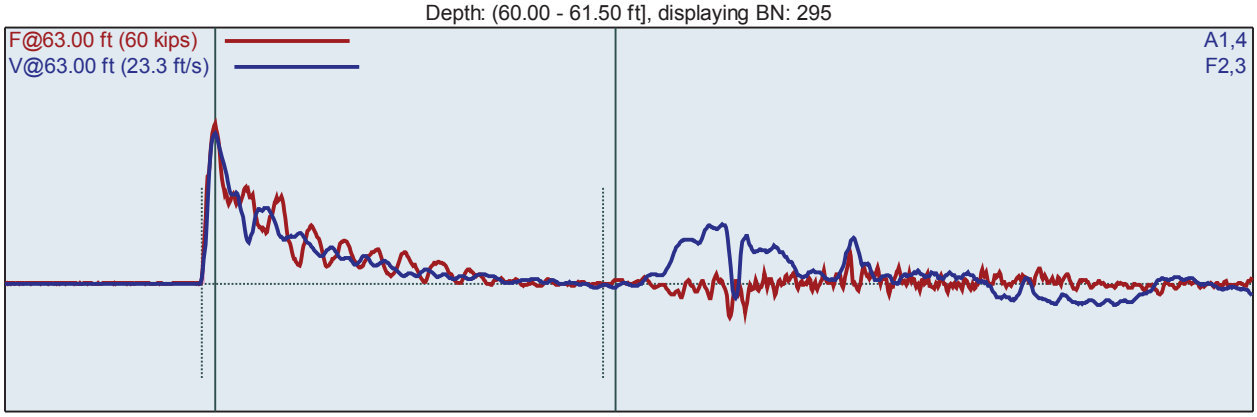
CME 850 #31
GRL-MGB

15
Test date: 4/17/2017

AR: 1.44 in^2
LE: 63.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (60.00 - 61.50 ft], displaying BN: 295



BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR (%)
226	31	60.02	36	14.8	1.9	305.8	87.4
227	31	60.03	39	14.5	48.7	319.3	91.2
228	31	60.05	37	14.4	49.8	301.6	86.2
229	31	60.06	38	14.4	44.3	305.1	87.2
230	31	60.08	38	14.6	44.1	303.9	86.8
231	31	60.10	37	14.6	44.1	300.2	85.8
232	31	60.11	38	14.8	44.1	311.3	89.0
233	31	60.13	36	14.4	44.2	298.0	85.1
234	31	60.15	37	14.6	44.3	302.3	86.4
235	31	60.16	38	14.7	44.3	310.9	88.8
236	31	60.18	36	15.3	44.1	311.5	89.0
237	31	60.19	38	16.2	44.2	313.6	89.6
238	31	60.21	39	15.1	44.3	310.0	88.6
239	31	60.23	35	16.5	44.2	307.6	87.9
240	31	60.24	36	15.9	44.3	311.7	89.1
241	31	60.26	36	15.7	44.3	307.9	88.0
242	31	60.27	35	15.7	44.5	310.1	88.6
243	31	60.29	35	16.1	44.2	309.1	88.3
244	31	60.31	36	15.7	44.4	302.7	86.5
245	31	60.32	35	15.6	44.6	304.1	86.9
246	31	60.34	33	15.7	44.6	303.4	86.7
247	31	60.35	34	15.6	44.6	303.9	86.8
248	31	60.37	32	15.5	44.5	295.0	84.3
249	31	60.39	32	14.4	44.7	290.3	83.0
250	31	60.40	30	15.3	44.3	296.0	84.6
251	31	60.42	34	15.6	44.8	307.1	87.7
252	31	60.44	36	14.8	44.5	300.6	85.9
253	31	60.45	34	15.5	44.6	301.2	86.0
254	31	60.47	34	15.2	44.5	299.6	85.6
255	31	60.48	30	15.1	44.7	296.5	84.7
256	31	60.50	34	15.8	44.3	303.1	86.6
257	23	60.52	35	14.6	44.7	298.0	85.2
258	23	60.54	38	14.7	44.6	303.6	86.7
259	23	60.57	37	13.5	44.6	298.0	85.1
260	23	60.59	35	13.9	44.6	298.1	85.2
261	23	60.61	35	13.5	44.7	299.1	85.5

262	23	60.63	39	14.3	44.7	312.7	89.3
263	23	60.65	38	14.3	44.5	305.2	87.2
264	23	60.67	40	14.4	44.6	310.8	88.8
265	23	60.70	39	14.5	44.6	309.9	88.5
266	23	60.72	39	14.5	44.6	308.1	88.0
267	23	60.74	39	14.5	44.5	310.5	88.7
268	23	60.76	36	13.6	44.5	301.1	86.0
269	23	60.78	39	14.3	44.4	306.1	87.5
270	23	60.80	37	13.8	44.5	305.6	87.3
271	23	60.83	36	14.0	44.3	304.0	86.8
272	23	60.85	39	14.5	44.4	308.5	88.2
273	23	60.87	38	14.2	44.5	305.5	87.3
274	23	60.89	36	13.4	44.6	300.4	85.8
275	23	60.91	38	14.1	44.3	305.6	87.3
276	23	60.93	38	14.1	44.5	307.6	87.9
277	23	60.96	39	14.4	44.5	314.9	90.0
278	23	60.98	38	14.1	44.5	305.1	87.2
279	23	61.00	38	14.1	44.4	308.4	88.1
280	18	61.03	36	13.7	44.4	301.4	86.1
281	18	61.06	39	14.4	44.6	308.1	88.0
282	18	61.08	38	14.1	44.5	305.6	87.3
283	18	61.11	38	14.1	44.5	307.9	88.0
284	18	61.14	39	14.5	44.6	308.1	88.0
285	18	61.17	37	14.0	44.6	304.2	86.9
286	18	61.19	38	14.0	44.5	304.6	87.0
287	18	61.22	36	13.4	44.6	298.7	85.4
288	18	61.25	37	14.0	44.3	306.4	87.5
289	18	61.28	37	13.8	44.5	305.6	87.3
290	18	61.31	36	13.4	44.5	298.0	85.2
291	18	61.33	40	14.3	44.5	308.4	88.1
292	18	61.36	37	13.8	44.6	304.4	87.0
293	18	61.39	36	13.2	44.3	299.9	85.7
294	18	61.42	37	13.4	44.7	300.7	85.9
295	18	61.44	37	13.7	44.5	301.6	86.2
296	18	61.47	37	12.8	44.4	293.3	83.8
297	18	61.50	39	14.7	44.5	322.2	92.1
		Average	38	14.0	44.5	305.0	87.1
		Std Dev	1	0.4	0.1	5.3	1.5
		Maximum	40	14.7	44.7	322.2	92.1
		Minimum	35	12.8	44.3	293.3	83.8

N-value: 41

Sample Interval Time: 95.50 seconds.

GRL Engineers, Inc.
SPT Analyzer Results

PDA-S Ver. 2016.16 - Printed: 4/18/2017

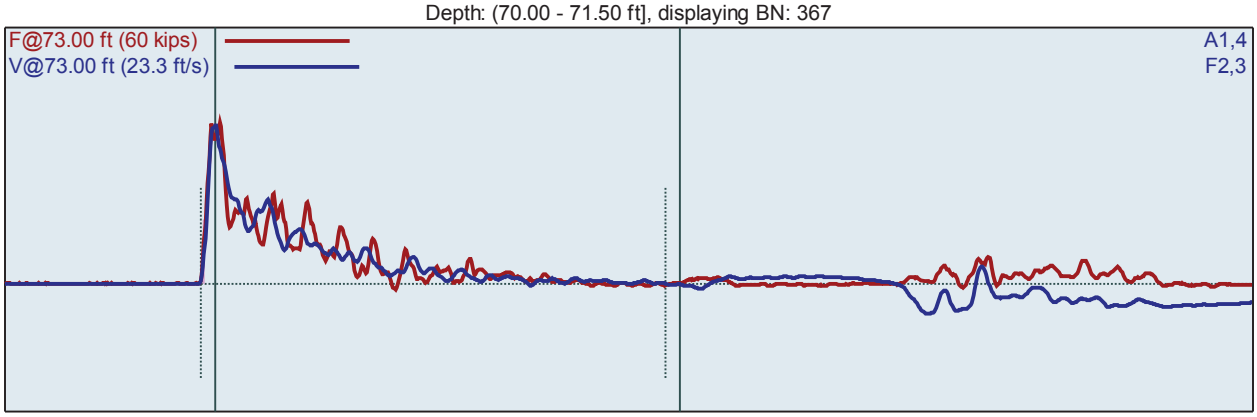
CME 850 #31
GRL-MGB

15
Test date: 4/17/2017

AR: 1.44 in^2
LE: 73.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (70.00 - 71.50 ft], displaying BN: 367



BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR (%)
298	16	70.03	37	15.9	1.9	319.8	91.4
299	16	70.06	36	15.6	47.6	314.8	89.9
300	16	70.09	37	16.0	48.7	317.6	90.7
301	16	70.13	37	16.3	44.6	314.3	89.8
302	16	70.16	36	15.8	43.4	312.6	89.3
303	16	70.19	36	16.6	43.3	313.9	89.7
304	16	70.22	36	15.7	43.4	311.3	88.9
305	16	70.25	36	16.1	43.4	309.5	88.4
306	16	70.28	36	16.4	43.4	312.3	89.2
307	16	70.31	36	16.0	43.4	312.3	89.2
308	16	70.34	35	15.7	43.5	308.5	88.1
309	16	70.38	36	16.6	43.4	315.1	90.0
310	16	70.41	36	16.4	43.5	317.6	90.7
311	16	70.44	36	16.6	43.5	319.9	91.4
312	16	70.47	36	16.4	43.4	316.3	90.4
313	16	70.50	36	16.0	43.4	314.8	89.9
314	24	70.52	35	16.0	43.5	315.0	90.0
315	24	70.54	36	16.8	43.6	320.2	91.5
316	24	70.56	36	16.4	43.4	320.5	91.6
317	24	70.58	36	16.4	43.6	317.5	90.7
318	24	70.60	36	16.5	43.4	318.7	91.0
319	24	70.63	37	16.7	43.4	315.6	90.2
320	24	70.65	36	16.3	43.4	317.9	90.8
321	24	70.67	37	16.7	43.4	321.0	91.7
322	24	70.69	35	15.9	43.6	313.8	89.7
323	24	70.71	35	15.8	43.6	307.5	87.8
324	24	70.73	35	15.5	43.5	313.4	89.5
325	24	70.75	35	15.3	43.5	307.1	87.7
326	24	70.77	34	15.2	43.7	301.9	86.3
327	24	70.79	35	15.3	43.6	307.0	87.7
328	24	70.81	34	14.5	43.7	301.3	86.1
329	24	70.83	34	15.2	43.4	305.5	87.3
330	24	70.85	34	14.8	43.5	303.6	86.8
331	24	70.88	34	15.5	43.4	307.6	87.9
332	24	70.90	35	15.6	43.6	307.0	87.7
333	24	70.92	35	15.1	43.6	307.5	87.9

334	24	70.94	35	15.5	43.4	308.9	88.3
335	24	70.96	33	15.3	43.7	307.9	88.0
336	24	70.98	35	15.9	43.6	314.1	89.7
337	24	71.00	34	15.1	43.7	309.3	88.4
338	32	71.02	33	14.8	43.6	309.3	88.4
339	32	71.03	34	14.6	43.6	310.2	88.6
340	32	71.05	35	14.6	43.7	306.2	87.5
341	32	71.06	34	15.1	43.7	307.8	87.9
342	32	71.08	35	14.7	43.5	308.1	88.0
343	32	71.09	36	15.1	43.8	311.3	88.9
344	32	71.11	36	14.1	43.6	305.4	87.2
345	32	71.13	36	15.7	43.7	312.7	89.3
346	32	71.14	35	14.6	43.5	308.0	88.0
347	32	71.16	35	14.5	43.8	306.8	87.7
348	32	71.17	37	15.1	43.7	311.1	88.9
349	32	71.19	34	14.2	43.8	304.9	87.1
350	32	71.20	34	14.2	43.9	300.0	85.7
351	32	71.22	36	14.1	43.6	306.2	87.5
352	32	71.23	35	14.2	43.8	304.5	87.0
353	32	71.25	35	12.6	43.7	289.4	82.7
354	32	71.27	35	14.2	43.5	309.6	88.5
355	32	71.28	35	14.2	43.7	307.0	87.7
356	32	71.30	36	14.0	43.5	304.7	87.0
357	32	71.31	36	13.3	43.6	299.1	85.4
358	32	71.33	36	14.1	43.5	306.0	87.4
359	32	71.34	36	13.1	43.8	298.6	85.3
360	32	71.36	36	13.4	43.8	307.5	87.9
361	32	71.38	35	13.2	43.5	306.5	87.6
362	32	71.39	36	13.1	43.5	297.3	84.9
363	32	71.41	35	14.1	43.5	304.5	87.0
364	32	71.42	36	14.3	43.6	311.3	88.9
365	32	71.44	38	14.5	43.7	308.8	88.2
366	32	71.45	39	15.0	43.3	318.9	91.1
367	32	71.47	38	14.4	43.7	310.2	88.6
368	32	71.48	38	15.8	43.8	321.0	91.7
369	32	71.50	36	15.6	43.5	315.9	90.3
		Average	35	14.9	43.6	308.9	88.3
		Std Dev	1	1.0	0.1	6.3	1.8
		Maximum	39	16.8	43.9	321.0	91.7
		Minimum	33	12.6	43.3	289.4	82.7

N-value: 56

Sample Interval Time: 97.50 seconds.

GRL Engineers, Inc.
SPT Analyzer Results

PDA-S Ver. 2016.16 - Printed: 4/18/2017

Summary of SPT Test Results

Project: CME 850 #31, Test Date: 4/17/2017

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ETR (%)
18.00	**9-13-24**	15.00	16.50	**37**	**53**	37	15.7	39.0	300.4	85.8
48.00	**16-33-36**	45.00	46.50	**69**	**99**	36	14.2	41.9	290.7	83.0
53.00	**12-11-17**	50.00	51.50	**28**	**40**	37	15.2	45.7	303.9	86.8
58.00	**14-16-24**	55.00	56.50	**40**	**57**	38	14.3	43.1	305.2	87.2
63.00	**31-23-18**	60.00	61.50	**41**	**58**	38	14.0	44.5	305.0	87.1
73.00	**16-24-32**	70.00	71.50	**56**	**80**	35	14.9	43.6	308.9	88.3
				Overall Average Values:		37	14.6	42.8	301.5	86.1
				Standard Deviation:		2	0.8	1.9	9.1	2.6
				Overall Maximum Value:		41	16.8	45.9	322.5	92.1
				Overall Minimum Value:		33	12.6	38.7	280.8	80.2

Robert Miner Dynamic Testi
Dynamic Measurements and Analyses for Deep Fou

August 31, 2017

Re: Penetration Test Energy Measurements
Foremost Mobile B58, Mobil Autohammer
Borehole HPG09, July 14, 2017
Bellevue, Washington

RMDT Job No. 17F37

This letter presents energy transfer measurements made during Penetration Tests for the drill holes and drill rig referenced above. Robert Miner Dynamic Testing, Inc. (RMDT) made dynamic measurements with a Pile Driving Analyzer® as a hammer advanced the NW rod during sampling with a split spoon sampler.

The purpose of RMDT's testing was the measurement of energy transferred to the drill rods. Measurements were made on a section of NW gauge rod at the top of the drill rod. Strain gages and accelerometers on the rod were connected to a Pile Driving Analyzer® (PDA) which generally processed acceleration and strain measurements from each hammer blow and stored both the measurements and computed results. Measurements and data processing generally followed the ASTM D 4633-16 standard. Energy transfer past the gage location, EFV, was computed by the PDA using force and velocity records as follows:

$$EFV = \int_a^b F(t)\ v(t)\ dt$$

The value "a" corresponds to the start of the record which is when the energy transfer begins and *"b"* is the time at which energy transferred to the rod reaches a maximum value. Appendix A contains more information on our measurement equipment and methods of analysis. The EFV energy calculation is identical to the EMX energy result discussed in Appendix A. The EFV and EMX values apply to the sensor location near the top of the rod.

TEST DETAILS

On the morning of July 14, 2017, a boring was advances at your project site referenced above. The drill rig was a truck mounted B58 unit manufactured by Foremost Mobile; this rig was identified as Truck #92 with Washington State Licence number C93096E. The Penetration Test hammer was a Mobile chain-drive automatic hammer equipped with a 140 lb ram. Sampling rods were NW gage with J threads. We collected data for sample starting depths of 40, 45, 50, 55 and 60 ft.

Mailing Address: P.O. Box 340, Manchester, WA, 98353, USA **Phone:** 360-871-5480
Location: 2288 Colchester Dr. E., Ste A, Manchester, WA, 98353 **Fax:** 360-871-5483

RESULTS

Sampling at each depth ended with penetration rates exceeding 50 blows for 6 inches and in some cases this occurred within the first of the standard three 6-inch intervals. For this circumstance we judged that the transfer energy may be characterized best by considering results for all hammer blows. One attached figure presents a graphical summary of pertinent results, and Appendix B contains the results for each hammer blow. The results for each hammer blow include the measured energy transfer, EFV, the computed transfer efficiency, ETR, and the hammer blow rate, BPM.

Energy measurements must be divided by the theoretical free fall energy of the hammer to obtain an efficiency. A 140 lb ram raised 30 inches above an impact surface has 350 lb-ft of potential energy. Thus, the transfer energy results for sampling with the 140 lb ram may be divided by 350 lb-ft to yield the ratio of the delivered energy to the nominal potential energy. This efficiency ratio, ETR, is plotted on the attached graphical summary and given numerically for each blows in Appendix 8. Within the five sample intervals we monitored the ETR result was relatively consistent and the overall average was 89.7 percent.

It was a pleasure to assist you and to participate on this project.. Please do not hesitate to contact us if you or other project participants have any questions about this report.

Sincerely,

Robert Miner, P.E.

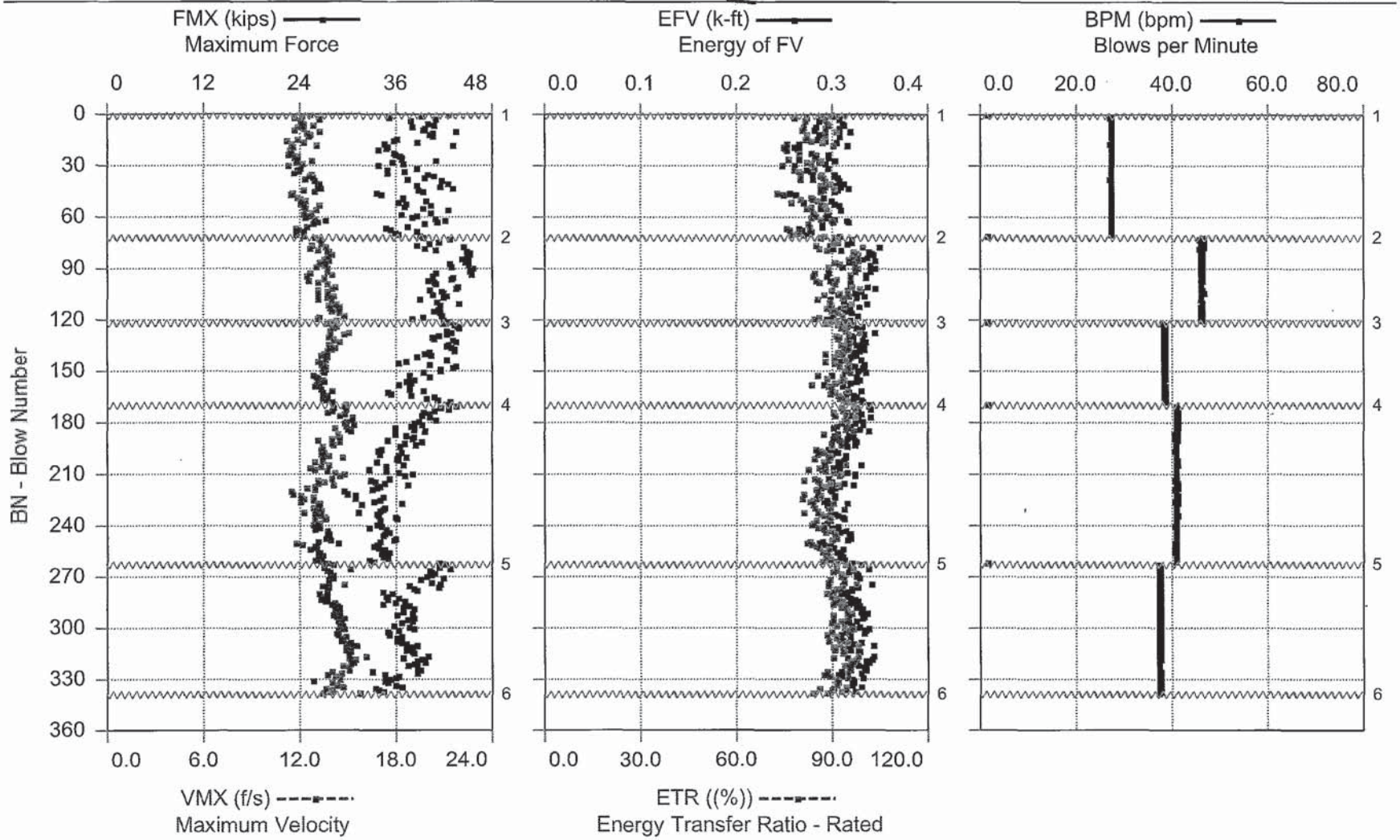
August 31, 2017

Robert Miner Dynamic Testing, Inc.

Robert Miner Dynamic Testing, Inc. - PDIPLOT2 Ver 2016.1.56.3 - Case Method & iCAP® Results

Printed: 31-August-2017

Test started: 14-July-2017



1 - Begin Sample at 40 ft.
2 - Begin Sample at 45 ft.
3 - Begin Sample at 50 ft.
4 - Begin Sample at 55 ft.
5 - Begin Sample at 60 ft.
6 - End of testing.

APPENDIX A
AN INTRODUCTION INTO DYNAMIC PILE TESTING METHODS

The following has been written by Goble Rausche Likins and Associates, Inc. and may only be copied with its written permission.

BACKGROUND

Modern procedures of design and construction control require verification of bearing capacity and integrity of deep foundations during preconstruction test programs and also production installation. Dynamic pile testing methods meet this need economically and reliably, and therefore, form an important part of a quality assurance program when deep foundations are executed. Several dynamic pile testing methods exist; they have different benefits and limitations and different requirements for proper execution.

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (such as that of a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. The method is therefore also referred to as a "High Strain Method". The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then an evaluation of various quantities based on closed form solutions of the wave equation, a partial differential equation describing the motion of a rod under the effect of an impact. Conveniently, measurements and analyses are done by a single piece of equipment: the Pile Driving Analyzer® (PDA). However, for bearing capacity evaluations an important additional method is CAPWAP® which performs a much more rigorous analysis of the dynamic records than the simpler Case Method.

A related analysis method is the "Wave Equation Analysis" which calculates a relationship between bearing capacity and pile stress and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data.

The following description deals primarily with the Case Method or "High Strain Test" Method of pile testing, however, for the sake of completeness, the "Low Strain Test" performed with the Pile Integrity Test™ (PIT), mainly for pile integrity evaluation, will also be described.

RESULTS FROM DYNAMIC TESTING

There are two main objectives of high strain dynamic pile testing:

- *Dynamic Pile Monitoring* and
- *Dynamic Load Testing*.

Dynamic pile monitoring is conducted during the installation of impact driven piles to achieve a safe and economical pile installation. Dynamic load testing, on the other hand, has as its primary goal the assessment of pile bearing capacity. It is applicable to both cast *insitu* piles or drilled shafts and impact driven piles during restrike.

Dynamic Pile Monitoring

During pile installation, the sensors attached to the pile measure pile top force and velocity. A PDA conditions and processes these signals and calculates or evaluates:

- Bearing capacity at the time of testing, including an assessment of shaft resistance development and driving resistance. This information supports formulation of a driving criterion.

- Dynamic pile stresses, axial and averaged over the pile cross section, both tensile and compressive, during pile driving to limit the potential of damage either near the pile top or along its length. Bending stresses can be evaluated at the point of sensor attachment.

- Pile integrity assessment by the PDA is based on the recognition of certain wave reflections from along the pile. If detected early enough, a pile may be saved from complete destruction. On the other hand, once damage is recognized measures can be taken to prevent reoccurrence.

- Hammer performance parameters including the energy transferred to the pile, the hammer speed in blows per minute and the stroke of open ended diesel hammers.

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Dynamic Pile Load Testing

Bearing capacity testing of either driven piles or drilled shafts applies the same basic measurement approach of dynamic pile monitoring. However, the test is done independent of the pile installation process and therefore a pile driving hammer or other dynamic loading device may not be available. If a special ram has to be mobilized then its weight should be between 0.8 and 2% of the test load (e.g. between 4 and 10 tons for a 500 ton test load) to assure sufficient soil resistance activation.

For a successful test, it most important that the test is conducted after a sufficient waiting time following pile installation for soil properties approaching their long term condition or concrete to properly set. During testing, PDA results of pile/shaft stresses and transferred energy are used to maintain safe stresses and assure sufficient resistance activation. For safe and sufficient testing of drilled shafts, ram energies are often increased from blow to blow until the test capacity has been activated. On the other hand, restrike tests on driven piles may require a warm hammer so that the very first blow produces a complete resistance activation. Data must be evaluated by CAPWAP for bearing capacity.

After the dynamic load test has been conducted with sufficient energy and safe stresses, the CAPWAP analysis provides the following results:

- Bearing capacity i.e. the mobilized capacity present at the time of testing
- Resistance distribution including shaft resistance and end bearing components
- Stresses in pile or shaft calculated for both the static load application and the dynamic test. These stresses are averages over the cross section and do not include bending effects or nonuniform contact stresses, e.g. when the pile toe is on uneven rock.
- Shaft impedance vs depth; this is an estimate of the shaft shape if it differs substantially from the planned profile
- Dynamic soil parameters for shaft and toe, i.e. damping factors and quakes (related to the dynamic stiffness of the resistance at the pile/soil interface.)

MEASUREMENTS

PDA

The basis for the results calculated by the PDA are pile top strain and acceleration measurements which are converted to force and velocity records, respectively. The PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. Using closed form Case Method solutions, based on the one-dimensional linear wave equation, the PDA calculates the results described in the analytical solutions section below.

HPA

The ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. For this unit to be applicable, the ram must be visible. The impact velocity results can be automatically processed with a PC or recorded on a strip chart.

Saximeter™

For open end diesel hammers, the time between two impacts indicates the magnitude of the ram fall height or stroke. This information is not only measured and calculated by the PDA but also by the convenient, hand-held Saximeter.

PIT

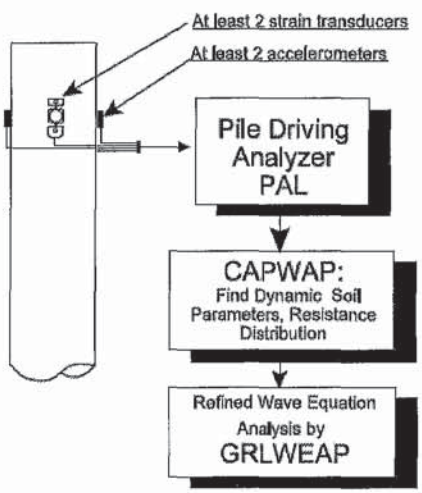
The Pile Integrity Tester™ (PIT) can be used to evaluate defects in concrete piles or shafts which may have occurred during driving or casting. Also timber piles of limited length can be tested in that manner. This so-called "Low Strain Method" or "Pulse-Echo Method" of integrity testing requires only the measurement of acceleration at the pile top. The stress wave producing impact is then generated by a small hand-held hammer and the records interpreted in the time domain. PIT also supports the so-called "Transient Response Method" which requires the additional measurement of the hammer force and an analysis in the frequency domain. This method may also be used to evaluate the unknown length of deep foundations under existing structures.

ANALYTICAL SOLUTIONS
BEARING CAPACITY

Wave Equation

GRL has written the GRLWEAP™ program which calculates a relationship between bearing capacity, pile stress and blow count. This relationship is often called the "bearing graph." Once the blow count is known from pile installation logs, the bearing graph yields the bearing capacity. This approach requires no measurements and therefore can be performed during the design stage of a project, for example for the selection of hammer, cushion and pile size.

After dynamic pile monitoring and/or dynamic load testing has been performed, the "Refined Wave Equation Analysis" or RWEA (see schematic below) is often performed by inputting the PDA and CAPWAP calculated parameters. Then the bearing graph from the RWEA is the basis for a safe and sufficient driving criteria.



Case Method

The Case Method is a closed form solution based on a few simplifying assumptions such as ideal plastic soil behavior and an ideally elastic and uniform pile. Given the measured pile top force F(t) and pile top velocity v(t), the total soil resistance is

$$R(t) = \tfrac{1}{2}\{[F(t) + F(t_2)] + Z[v(t) - v(t_2)]\} \qquad (1)$$

where

- t = a point in time after impact
- t_2 = time $t + 2L/c$
- L = pile length below gages
- c = $(E/\rho)^{1/2}$ is the speed of the stress wave
- ρ = pile mass density
- Z = EA/c is the pile impedance
- E = elastic modulus of the pile (ρc^2)
- A = pile cross sectional area

The total soil resistance consists of a dynamic (R_d) and a static (R_s) component. The static component is therefore

$$R_s(t) = R(t) - R_d(t) \qquad (2)$$

The dynamic component may be computed from a soil damping factor, J, and a pile toe velocity, $v_t(t)$ which is conveniently calculated for the pile toe. Using wave considerations, this approach leads immediately to the dynamic resistance

$$R_d(t) = J[F(t) + Zv(t) - R(t)] \qquad (3)$$

and finally to the static resistance by means of Equation 2.

There are a number of ways in which Eq. 1 through 3 can be evaluated. Most commonly, t_2 is set to that time at which the static resistance becomes maximum. The result is the so-called **RMX** capacity. Damping factors for RMX typically range between 0.5 for coarse grained materials to 1.0 for clays. The **RSP** capacity (this method is most commonly referred to in the literature, yet it is not very frequently used) requires damping factors between 0.1 for sand and 1.0 for clay. Another capacity, **RA2**, determines the capacity at a time when the pile is essentially at rest and thus damping is small; RA2

therefore requires no damping parameter. In any event, the proper Case Method and its associated damping parameter is most conveniently found after a CAPWAP analysis has been performed.

The static resistance calculated by Case Method or CAPWAP is the mobilized resistance at the time of testing. Consideration therefore has to be given to soil setup or relaxation effects and whether or not a sufficient set has been achieved under the test loading that would correspond to a full activation of the ultimate soil resistance.

The PDA also calculates an estimate of shaft resistance as the difference between force and velocity times impedance at the time immediately prior to the return of the stress wave from the pile toe. This shaft resistance is not reduced by damping effects and is therefore called the total shaft resistance **SFT**. A correction for damping effects produces the static shaft resistance estimate, **SFR**.

The Case Method solution is simple enough to be evaluated "in real time," i.e. between hammer blows, using the PDA. It is therefore possible to calculate all relevant results for all hammer blows and plot these results as a function of depth or blow number. This is done in the PDAPLOT program.

CAPWAP

The CAse Pile Wave Analysis Program combines the wave equation pile and soil model with the Case Method measurements. Thus, the solution includes not only the total and static bearing capacity values but also the shaft resistance, end bearing, damping factors and soil stiffnesses. The method iteratively calculates a number of unknowns by signal matching. While it is necessary to make hammer performance assumptions for a GRLWEAP analysis, the CAPWAP program works with the pile top measurements. Furthermore, while GRLWEAP and Case Method require certain assumptions regarding the soil behavior, CAPWAP calculates these soil parameters.

STRESSES

During pile monitoring, it is important that compressive stress maxima at pile top and toe and tensile stress maxima somewhere along the pile be calculated for each hammer blow.

At the pile top (location of sensors) both the maximum compression stress, **CSX**, and the maximum stress from individual strain transducers, **CSI**, are directly obtained from the measurements. Note that CSI is greater than or equal to CSX and the difference between CSI and CSX is a measure of bending in the plane of the strain transducers. Note also that all stresses calculated for locations below the sensors are averaged over the pile cross section and therefore do not include components from either bending or eccentric soil resistance effects.

The PDA calculates the compressive stress at the pile bottom, **CSB**, assuming (a) a uniform pile and (b) that the pile toe force is the maximum value of the total resistance R(t) minus the total shaft resistance, SFT. Again, for this stress estimation uniform resistance force are assumed (e.g. not a sloping rock.)

For concrete piles, the maximum tension stress, **TSX**, is also of great importance. It occurs at some point below the pile top. The maximum tension stress can be computed from the pile top measurements by finding the maximum tension wave (either traveling upward, W_U, or downward, W_d) and reducing it by the minimum compressive wave traveling in opposite direction.

$$W_u = \tfrac{1}{2}[F(t) - Zv(t)] \qquad (4)$$

$$W_d = \tfrac{1}{2}[F(t) + Zv(t)] \qquad (5)$$

CAPWAP also calculates tensile and compressive stresses along the pile and, in general, more accurately than the PDA. In fact, for non-uniform piles or piles with joints, cracks or other discontinuities, the closed form solutions from the PDA may be in error.

PILE INTEGRITY

High Strain Tests (PDA)

Stress waves in a pile are reflected wherever the pile impedance, $Z = EA/c = \rho cA = A\sqrt{(E\rho)}$, changes. Therefore, the pile impedance is a measure of the quality of the pile material (E, ρ, c) and the size of its cross section (A). The reflected waves arrive at the pile top at a time which is greater the farther away from the pile top the reflection occurs. The

magnitude of the change of the upward traveling wave (calculated from the measured force and velocity, Eq. 4) indicates the extent of the cross sectional change. Thus, with β_i (**BTA**) being a relative integrity factor which is unity for no impedance change and zero for the pile end, the following is calculated by the PDA.

$$\beta_i = (1 - \alpha_i)/(1 + \alpha_i) \quad (6)$$

with

$$\alpha_i = ½(W_{UR} - W_{UD})/(W_{Di} - W_{UR}) \quad (7)$$

where

W_{UR} is the upward traveling wave at the onset of the reflected wave. It is caused by resistance.

W_{UD} is the upwards traveling wave due to the damage reflection.

W_{Di} is the maximum downward traveling wave due to impact.

It can be shown that this formulation is quite accurate as long as individual reflections from different pile impedance changes have no overlapping effects on the stress wave reflections.

Without rigorous derivation, it has been proposed to consider as slight damage when β is above 0.8 and a serious damage when β is less than 0.6.

Low Strain Tests (PIT)

The pile top is struck with a held hand hammer and the resulting pile top velocity is measured, displayed and interpreted for signs of wave reflections. In general, a comparison of the reflected acceleration leads to a relative measure of extent of damage, again the location of the problem is indicated by the arrival time of the reflection. PIT records can also be interpreted by the β-Method. However, low strain tests do not activate much resistance which simplifies Eq. 7 since W_{UR} is then equal to zero.

For drilled shafts and PIT records that clearly show a toe reflection, an approximate shaft profile can be calculated from low strain records using the PITSTOP program's PROFILE routine.

HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = {}_0\int^t F(t)v(t)\,dt \quad (8a)$$

The maximum of the E(t) curve is the most important information for an overall evaluation of the performance of a hammer and driving system. This **EMX** value allows for a classification of the hammer's performance when presented as the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency

$$e_T = EMX/E_R \quad (8b)$$

where

E_R is the manufacturer's rated energy value.

Both Saximeter and PDA calculate the stroke (**STK**) of an open end diesel hammer using

$$STK = (g/8)\,T_B^2 - h_L \quad (9)$$

where

g is the earth's gravitational acceleration,
T_B is the time between two hammer blows,
h_L is a stroke loss value due to gas compression and time losses during impact (usually 0.3 ft or 0.1 m).

DETERMINATION OF WAVE SPEED

An important facet of dynamic pile testing is an assessment of pile material properties. Since in general force is determined from strain by multiplication with elastic modulus, E, and cross sectional area, A, the dynamic elastic modulus has to be determined for pile materials other than steel. In general, the records measured by the PDA clearly indicate a pile toe reflection as long as pile penetration per blow is greater than 1 mm or .04 inches. The time between the onset of the force and velocity records at impact and the onset of the reflection from the toe (usually apparent by a local maximum of the wave up curve) is the so-called wave travel time, T. Dividing 2L (L is here the length of the pile below sensors) by T leads to the stress wave speed in the pile:

$$c = 2L/T \quad (10)$$

The elastic modulus of the pile material is related to the wave speed according to the linear elastic wave equation theory by

$$E = c^2\rho \qquad (11)$$

Since the mass density of the pile material, ρ, is usually well known (an exception is timber for which samples should be weighed), the elastic modulus is easily found from the wave speed. Note, however, that this is a dynamic modulus which is generally higher than the static one and that the wave speed depends to some degree on the strain level of the stress wave. For example, experience shows that the wave speed from PIT is roughly 5% higher than the wave speed observed during a high strain test.

Other Notes:

- If the pile material is nonuniform then the wave speed c, according to Eq. 10, is an average wave speed and does not necessarily reflect the pile material properties of the location where the strain sensors are attached to the pile top. For example, pile driving often causes fine tension cracks some distance below the top of concrete piles. Then the average c is slower than that at the pile top. It is therefore recommended to determine E in the beginning of pile driving and not adjust it when the average c changes.

- If the pile has such a high resistance that there is no clear indication of a toe reflection then the wave speed of the pile material must be determined either by assumption or by taking a sample of the concrete and measuring its wave speed in a simple free column test. Another possibility is to use the proportionality relationship, discussed under "DATA QUALITY CHECKS" to find c as the ratio between the measured velocity and measured strain.

DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing PDA or PIT tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to certain relationships.

Proportionality

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the pile, force and velocity measured at the pile top are proportional

$$F = v\,Z = v\,(EA/c) \qquad (12a)$$

This relationship can also be expressed in terms of stress

$$\sigma = v\,(E/c) \qquad (12b)$$

or strain

$$\epsilon = v / c \qquad (12c)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements.

Measurements are always taken at opposite sides of the pile as a means of calculating the average force and velocity in the pile. The velocity on the two sides of the pile is very similar even when high bending exists. Thus, an independent check of the velocity measurements is easy and simple.

Strain measurements may differ greatly between the two sides of the pile when bending exists. It is even possible that tension is measured on one side while very high compression exists on the other side of the pile. In extreme cases, bending might be so high that it leads to a nonlinear stress distribution. The averaging of the two strain signals does then not lead to the average pile force and proportionality will not be achieved.

When testing drilled shafts, measurements of strain may also be affected by local concrete quality variations. It is then often necessary to use four strain transducers spaced at 90 degrees around the pile for an improved strain data quality. The use of four transducers is also recommended for large pile

diameters, particularly when it is difficult to mount the sensors at least two pile widths or diameters below the pile top.

LIMITATIONS, ADDITIONAL CONSIDERATIONS

Mobilization of capacity

Estimates of pile capacity from dynamic testing indicate the **mobilized pile capacity at the time of testing**. At very high blow counts (low set per blow), dynamic test methods tend to produce lower bound capacity estimates as not all resistance (particularly at and near the toe) is fully activated.

Time dependent soil resistance effects

Static pile capacity from dynamic method calculations provide an estimate of the axial pile capacity. Increases and decreases in the pile capacity with time typically occur (soil setup/relaxation). Therefore, **restrike testing usually yields a better indication of long term pile capacity than a test at the end of pile driving**. Often a wait period of one or two days between end of driving and restrike is satisfactory for a realistic prediction of pile capacity but this waiting time depends, among other factors, on the permeability of the soil.

(A) Soil setup

Because excess positive pore pressures often develop during pile driving in fine grained soil (clays, silts or even fine sands), the capacity of a pile at the time of driving may often be less than the long term pile capacity. These pore pressures reduce the effective stress acting on the pile thereby reducing the soil resistance to pile penetration, and thus the pile capacity at the time of driving. As these pore pressures dissipate, the soil resistance acting on the pile increases as does the axial pile capacity. This phenomena is routinely called soil setup or soil freeze.

(B) Relaxation

Relaxation (capacity reduction with time) has been observed for piles driven into weathered shale, and may take several days to fully develop. Pile capacity estimates based upon initial driving or short term restrike tests can significantly overpredict long term pile capacity. Therefore, piles driven into shale should be tested after a minimum one week wait either statically or dynamically (with particular emphasis than on the first few blows). Relaxation has also been observed for displacement piles driven into dense saturated silts or fine sands due to a negative pore pressure effect at the pile toe. Again, restrike tests should be used, with great emphasis on early blows.

Capacity results for open pile profiles

Larger diameter open ended pipe piles (or H-piles which do not bear on rock) may behave differently under dynamic and static loading conditions. Under dynamic loads the soil inside the pile or between its flanges may slip and produce internal friction while under static loads the plug may move with the pile, thereby creating end bearing over the full pile cross section. As a result both friction and end bearing components may be different under static and dynamic conditions.

CAPWAP Analysis Results

A portion of the soil resistance calculated on an individual soil segment in a CAPWAP analysis can usually be shifted up or down the shaft one soil segment without significantly altering the match quality. Therefore, use of the CAPWAP resistance distribution for uplift, downdrag, scour, or other geotechnical considerations should be made with an understanding of these analysis limitations.

Stresses

PDA and CAPWAP calculated stresses are average values over the cross section. Additional allowance has to be made for bending or non-uniform contact stresses. To prevent damage it is therefore important to maintain good hammer-pile alignment and to protect the pile toes using appropriate devices or an increased cross sectional area.

In the United States is has become generally acceptable to limit the dynamic installation stresses of driven piles to the following levels:

90% of yield strength for steel piles

85% of the concrete compressive strength - after subtraction of the effective prestress - for concrete piles in compression

100% of effective prestress plus ½ of the concrete's tension strength for prestressed piles in tension

70% of the reinforcement strength for regularly reinforced concrete piles in tension

300% of the static design allowable stress for timber

Note that the dynamic stresses may either be directly measured at the pile top by the PDA or calculated by the PDA for other locations along the pile based on the pile top measurements.

Additional design considerations

Numerous factors have to be considered in pile foundation design. Some of these considerations include

- additional pile loading from downdrag or negative skin friction,
- lateral and uplift loading requirements
- effective stress changes (due to changes in water table, excavations, fills or other changes in overburden),
- long term settlements in general and settlement from underlying weaker layers and/or pile group effects,

These factors have not been evaluated by GRL and have not been considered in the interpretation of the dynamic testing results. The foundation designer should determine if these or any other considerations are applicable to this project and the foundation design.

Wave equation analysis results

The results calculated by the wave equation analysis program depend on a variety of hammer, pile and soil input parameters. Although attempts have been made to base the analysis on the best available information, actual field conditions may vary and therefore stresses and blow counts may differ from the predictions reported. Capacity predictions derived from wave equation analyses should use restrike information. However, because of the uncertainties associated with restrike blow counts and restrike hammer energies, correlations of such results with static test capacities with have often displayed considerable scatter.

As for PDA and CAPWAP, the theory on which GRLWEAP is based is the one-dimensional wave equation. For that reason, stress predictions by the wave equation analysis can only be averages over the pile cross section. Thus, bending stresses or stress concentrations due to non-uniform impact or uneven soil or rock resistance are not considered in these results. Stress maxima calculated by the wave equation are usually subjected to the same limits as those measured directly or calculated from measurements by the PDA.

Appendix B

Summary of Case Method Field Results

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

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NW-J, AUTO HAMMER
OP: RMDT
Date: 14-July-2017

AR: 1.42 in²
LE: 48.40 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.35 []

FMX: Maximum Force
VMX: Maximum Velocity
EFV: Energy of FV

ETR: Energy Transfer Ratio - Rated
BPM: Blows per Minute
AMX: Maximum Acceleration

BL#	TYPE	FMX kips	VMX f/s	EFV k-ft	ETR (%)	BPM bpm	AMX g's
1	AV1	43	12.7	0.31	89.6	1.9	2,409
2	AV1	39	12.2	0.30	86.7	27.4	2,259
3	AV1	35	11.7	0.28	78.6	27.3	2,206
4	AV1	41	13.2	0.31	88.2	27.5	2,582
5	AV1	38	12.1	0.29	82.0	27.4	2,330
6	AV1	40	12.4	0.31	89.0	27.5	2,410
7	AV1	41	12.9	0.31	89.4	27.4	2,493
8	AV1	38	11.9	0.28	81.3	27.5	2,269
9	AV1	40	12.3	0.31	88.0	27.4	2,391
10	AV1	39	11.7	0.28	80.8	27.4	2,298
11	AV1	44	13.2	0.32	91.4	27.5	2,567
12	AV1	41	12.5	0.31	88.4	27.5	2,429
13	AV1	40	12.7	0.29	82.2	27.5	2,577
14	AV1	41	12.6	0.31	88.3	27.4	2,395
15	AV1	36	11.9	0.29	81.8	27.5	2,056
16	AV1	36	11.3	0.29	83.9	27.4	2,184
17	AV1	39	12.3	0.31	87.5	27.5	2,220
18	AV1	35	11.5	0.27	76.2	27.3	2,132
19	AV1	43	13.1	0.32	90.6	27.6	2,568
20	AV1	35	11.6	0.26	75.1	27.4	2,054
21	AV1	35	11.5	0.26	75.7	27.5	2,225
22	AV1	34	11.5	0.27	76.1	27.5	1,974
23	AV1	36	11.5	0.28	79.8	27.5	2,136
24	AV1	36	11.3	0.30	85.1	27.5	2,337
25	AV1	37	11.9	0.30	85.1	27.6	2,236
26	AV1	37	11.8	0.30	85.0	27.5	2,292
27	AV1	37	12.0	0.27	76.4	27.4	2,330
28	AV1	41	12.8	0.30	86.7	27.7	2,583
29	AV1	36	11.8	0.29	82.2	27.5	2,226
30	AV1	37	12.2	0.29	83.9	27.5	2,275
31	AV1	34	11.3	0.26	74.8	27.5	1,943
32	AV1	39	12.2	0.30	84.8	27.5	2,373
33	AV1	35	12.0	0.28	78.7	27.6	2,131
34	AV1	37	12.1	0.28	80.1	27.5	2,299
35	AV1	35	11.7	0.28	80.4	27.5	2,333
36	AV1	40	12.8	0.30	87.0	27.6	2,560
37	AV1	41	12.7	0.30	86.6	27.5	2,630
38	AV1	40	12.9	0.31	87.8	27.5	2,541
39	AV1	38	12.4	0.28	80.5	27.3	2,410
40	AV1	42	13.0	0.31	88.3	27.6	2,553
41	AV1	43	13.3	0.31	89.8	27.5	2,683
42	AV1	39	13.2	0.30	86.8	27.5	2,709
43	AV1	42	13.2	0.31	88.4	27.5	2,588
44	AV1	43	13.3	0.32	91.0	27.5	2,853
45	AV1	39	12.3	0.31	87.7	27.5	2,567
46	AV1	40	13.0	0.30	86.7	27.6	2,556
47	AV1	34	11.7	0.26	73.3	27.4	2,134

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BL#	TYPE	FMX kips	VMX f/s	EFV k-ft	ETR (%)	BPM bpm	AMX g's
48	AV1	34	11.6	0.26	75.1	27.5	1,994
49	AV1	37	11.9	0.29	83.7	27.6	2,246
50	AV1	37	12.1	0.28	80.4	27.5	2,256
51	AV1	40	12.5	0.30	85.9	27.4	2,537
52	AV1	36	12.3	0.27	77.5	27.5	2,539
53	AV1	37	12.1	0.30	86.7	27.5	2,416
54	AV1	41	13.3	0.31	88.4	27.6	2,725
55	AV1	37	12.3	0.29	84.1	27.5	2,421
56	AV1	39	12.4	0.29	82.6	27.6	2,477
57	AV1	43	13.1	0.31	88.7	27.5	2,713
58	AV1	40	12.8	0.30	84.5	27.5	2,837
59	AV1	37	12.3	0.30	85.0	27.5	2,330
60	AV1	39	12.7	0.30	85.1	27.6	2,584
61	AV1	38	12.4	0.29	84.0	27.5	2,470
62	AV1	41	13.0	0.30	87.0	27.6	2,769
63	AV1	42	13.7	0.32	90.3	27.5	2,951
64	AV1	41	13.2	0.32	90.9	27.6	2,891
65	AV1	40	12.9	0.29	83.0	27.5	2,666
66	AV1	38	12.5	0.29	83.3	27.6	2,424
67	AV1	35	11.9	0.27	76.1	27.4	2,138
68	AV1	35	12.0	0.27	77.0	27.5	2,228
69	AV1	39	12.4	0.28	79.9	27.5	2,502
70	AV1	36	12.3	0.28	79.5	27.6	2,278
71	AV1	36	11.8	0.27	77.6	27.5	2,523
72	AV1	39	12.3	0.31	88.0	1.9	2,271
73	AV1	40	13.0	0.30	86.6	46.5	2,542
74	AV1	43	13.3	0.32	91.9	45.9	2,762
75	AV1	42	13.4	0.32	92.0	46.8	2,860
76	AV1	40	13.3	0.32	90.6	46.4	2,706
77	AV1	39	12.8	0.30	85.3	46.2	2,591
78	AV1	44	13.7	0.35	100.0	46.9	3,020
79	AV1	40	12.7	0.30	86.4	46.0	2,529
80	AV1	41	13.2	0.31	88.6	46.2	2,729
81	AV1	45	13.8	0.34	96.9	46.4	3,035
82	AV1	45	13.7	0.34	97.9	46.6	2,835
83	AV1	45	14.1	0.34	98.3	46.4	2,586
84	AV1	45	13.7	0.34	96.6	46.4	2,608
85	AV1	44	13.6	0.33	95.3	46.5	2,638
86	AV1	45	13.9	0.34	98.6	46.3	2,907
87	AV1	45	13.3	0.32	91.1	46.4	2,552
88	AV1	43	13.4	0.32	92.6	46.6	2,660
89	AV1	45	13.7	0.34	97.6	46.6	2,685
90	AV1	43	13.1	0.31	89.2	46.5	2,432
91	AV1	46	13.7	0.34	98.6	46.3	2,863
92	AV1	45	13.8	0.34	97.6	46.5	2,891
93	AV1	41	12.7	0.30	84.8	46.4	2,520
94	AV1	45	14.1	0.34	96.0	46.5	2,945
95	AV1	41	12.6	0.30	84.4	46.4	2,232
96	AV1	43	13.6	0.34	95.9	46.5	2,945
97	AV1	43	13.5	0.32	91.5	46.5	2,606
98	AV1	40	12.6	0.30	85.2	46.6	2,194
99	AV1	41	13.2	0.30	86.4	46.2	2,525
100	AV1	41	13.7	0.32	91.3	46.4	2,644

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NW-J, AUTO HAMMER
OP: RMDT
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BL#	TYPE	FMX kips	VMX f/s	EFV k-ft	ETR (%)	BPM bpm	AMX g's
101	AV1	44	14.3	0.34	96.4	46.4	2,954
102	AV1	44	14.1	0.35	98.9	46.4	2,914
103	AV1	40	13.2	0.32	90.4	46.5	2,483
104	AV1	42	13.7	0.33	94.8	46.2	2,672
105	AV1	42	13.8	0.32	92.8	47.0	2,478
106	AV1	41	13.2	0.31	87.9	46.3	2,588
107	AV1	42	14.1	0.33	95.5	46.3	2,963
108	AV1	42	13.8	0.33	93.4	46.4	2,630
109	AV1	39	13.2	0.30	85.6	46.2	2,481
110	AV1	41	14.1	0.31	89.5	46.7	2,514
111	AV1	44	14.4	0.34	96.5	46.7	2,837
112	AV1	42	13.9	0.32	90.4	46.6	2,654
113	AV1	42	14.6	0.33	94.0	46.2	2,903
114	AV1	42	13.9	0.31	88.6	46.5	2,441
115	AV1	41	14.4	0.32	91.2	46.5	2,625
116	AV1	41	14.1	0.32	90.1	46.4	2,587
117	AV1	42	14.5	0.32	92.0	46.5	2,593
118	AV1	42	14.8	0.33	93.5	46.3	2,833
119	AV1	40	13.3	0.30	86.3	46.5	2,237
120	AV1	38	13.2	0.30	84.7	46.3	2,530
121	AV1	42	14.4	0.32	91.6	46.7	2,738
122	AV1	43	14.1	0.31	89.6	1.9	2,768
123	AV1	42	13.8	0.31	88.1	38.3	2,876
124	AV1	43	14.1	0.32	92.2	38.8	2,800
125	AV1	44	14.3	0.33	94.9	38.7	2,757
126	AV1	44	14.2	0.33	93.0	38.6	2,915
127	AV1	42	14.0	0.33	94.7	38.8	2,915
128	AV1	43	15.1	0.35	98.8	38.8	3,114
129	AV1	42	14.9	0.33	95.7	38.6	3,043
130	AV1	42	14.0	0.32	91.8	38.6	3,034
131	AV1	41	13.9	0.32	92.4	38.7	2,782
132	AV1	41	14.2	0.32	92.3	38.6	2,788
133	AV1	43	14.1	0.33	95.2	38.7	2,759
134	AV1	44	14.6	0.34	96.1	38.7	2,902
135	AV1	43	13.8	0.33	93.2	38.6	2,893
136	AV1	42	14.0	0.33	94.3	38.8	3,008
137	AV1	43	14.3	0.33	95.5	38.6	3,310
138	AV1	43	14.1	0.33	95.5	38.7	2,771
139	AV1	43	13.8	0.33	94.0	38.6	2,915
140	AV1	40	13.7	0.32	92.1	38.7	2,789
141	AV1	40	13.6	0.31	88.4	38.7	2,742
142	AV1	41	13.4	0.33	93.4	38.7	2,808
143	AV1	39	13.7	0.32	91.3	38.5	2,987
144	AV1	42	13.7	0.33	94.7	38.8	2,699
145	AV1	37	13.2	0.31	88.1	38.6	2,518
146	AV1	36	13.5	0.32	90.9	38.7	2,626
147	AV1	40	13.4	0.33	95.4	38.6	2,700
148	AV1	44	13.6	0.32	92.8	38.6	3,163
149	AV1	43	13.6	0.33	95.1	38.7	3,120
150	AV1	42	13.7	0.33	95.6	38.7	2,920
151	AV1	42	13.5	0.33	93.9	38.7	2,971
152	AV1	40	13.6	0.34	95.9	38.6	2,771
153	AV1	38	12.9	0.30	85.9	38.7	2,265

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BL#	TYPE	FMX kips	VMX f/s	EFV k-ft	ETR (%)	BPM bpm	AMX g's
154	AV1	40	13.1	0.33	93.4	38.6	2,858
155	AV1	38	13.2	0.31	88.9	38.7	2,386
156	AV1	38	13.4	0.33	94.0	38.6	2,772
157	AV1	37	13.6	0.33	93.1	38.6	2,740
158	AV1	38	13.3	0.32	91.2	38.6	2,656
159	AV1	36	13.1	0.29	83.7	38.6	2,425
160	AV1	38	13.0	0.31	89.2	38.7	2,507
161	AV1	38	13.3	0.32	90.4	38.6	2,871
162	AV1	40	14.0	0.33	94.8	38.8	2,917
163	AV1	35	13.5	0.32	91.0	38.7	2,280
164	AV1	35	13.5	0.31	89.8	38.6	2,651
165	AV1	38	13.8	0.32	92.2	38.7	2,780
166	AV1	41	13.8	0.33	93.2	38.6	2,921
167	AV1	40	13.4	0.32	92.4	38.7	2,913
168	AV1	41	13.7	0.33	94.6	38.8	2,909
169	AV1	43	14.0	0.33	94.9	38.7	3,063
170	AV1	43	14.9	0.34	96.8	1.9	2,823
171	AV1	44	14.8	0.34	96.9	41.0	2,767
172	AV1	42	14.2	0.33	93.2	41.1	2,453
173	AV1	43	15.0	0.34	97.6	41.0	2,875
174	AV1	41	14.1	0.33	93.8	41.0	2,466
175	AV1	39	13.8	0.32	90.6	41.4	2,433
176	AV1	40	14.8	0.33	94.6	41.0	2,968
177	AV1	39	14.6	0.32	91.4	41.0	2,781
178	AV1	40	15.3	0.34	97.5	41.3	2,971
179	AV1	41	15.3	0.33	93.8	41.1	2,841
180	AV1	39	15.0	0.33	95.1	41.0	2,913
181	AV1	38	14.8	0.33	92.9	41.4	2,992
182	AV1	39	15.5	0.33	95.1	41.0	2,888
183	AV1	38	15.0	0.32	91.4	41.1	2,929
184	AV1	36	14.2	0.32	90.4	41.2	2,666
185	AV1	38	15.0	0.33	94.3	41.3	2,796
186	AV1	40	15.2	0.34	97.0	41.1	2,915
187	AV1	36	14.5	0.31	87.8	40.9	2,669
188	AV1	38	14.5	0.32	91.1	41.4	2,734
189	AV1	38	14.5	0.32	92.2	41.2	2,842
190	AV1	38	14.1	0.32	90.5	40.9	2,901
191	AV1	35	13.2	0.32	92.6	41.3	2,515
192	AV1	39	14.6	0.33	93.1	41.1	3,037
193	AV1	37	14.0	0.32	90.3	41.1	2,642
194	AV1	39	14.2	0.33	92.9	41.2	2,676
195	AV1	37	13.5	0.32	90.4	41.2	2,576
196	AV1	34	13.4	0.30	85.1	41.1	2,500
197	AV1	34	13.4	0.30	86.7	40.9	2,485
198	AV1	37	13.6	0.31	87.7	41.1	2,613
199	AV1	34	13.3	0.30	85.9	41.2	2,414
200	AV1	36	13.9	0.31	89.8	41.0	2,688
201	AV1	37	14.7	0.31	89.9	41.2	2,714
202	AV1	36	13.5	0.30	85.0	41.2	2,579
203	AV1	36	13.5	0.31	89.4	41.3	2,566
204	AV1	34	13.0	0.31	87.8	41.0	2,422
205	AV1	37	13.9	0.33	94.5	41.3	2,619
206	AV1	35	13.4	0.31	88.4	41.0	2,491

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT2 2016.1.56.3 - Printed 31-August-2017

NW-J, AUTO HAMMER
OP: RMDT
Date: 14-July-2017

BL#	TYPE	FMX kips	VMX f/s	EFV k-ft	ETR (%)	BPM bpm	AMX g's
207	AV1	35	12.7	0.30	86.3	41.0	2,538
208	AV1	33	13.0	0.29	83.1	41.1	2,416
209	AV1	35	13.7	0.31	88.0	41.2	2,509
210	AV1	37	14.3	0.32	90.5	41.1	2,646
211	AV1	38	14.8	0.33	93.0	41.2	2,846
212	AV1	37	14.6	0.32	92.7	41.1	2,678
213	AV1	35	14.1	0.30	85.0	41.2	2,540
214	AV1	33	13.2	0.29	81.6	40.9	2,354
215	AV1	34	13.6	0.30	86.1	41.1	2,562
216	AV1	35	13.2	0.31	89.5	41.3	2,500
217	AV1	38	14.1	0.32	92.3	41.2	2,745
218	AV1	34	13.0	0.31	88.1	41.0	2,526
219	AV1	34	12.5	0.30	86.7	41.4	2,348
220	AV1	33	13.0	0.30	85.4	40.9	2,464
221	AV1	30	11.6	0.30	86.0	41.1	2,058
222	AV1	30	11.7	0.29	81.6	41.0	2,082
223	AV1	31	12.1	0.30	86.8	41.3	2,160
224	AV1	34	12.9	0.30	87.0	41.0	2,454
225	AV1	31	12.3	0.28	81.2	41.3	2,146
226	AV1	34	12.9	0.30	84.3	41.3	2,261
227	AV1	33	12.2	0.29	83.5	40.7	2,204
228	AV1	37	13.3	0.32	90.6	41.3	2,568
229	AV1	32	13.2	0.30	84.3	41.2	2,175
230	AV1	35	12.9	0.30	84.7	41.1	2,444
231	AV1	35	13.3	0.31	89.7	41.1	2,595
232	AV1	34	13.4	0.30	85.6	41.1	2,499
233	AV1	31	12.3	0.29	81.5	41.1	2,088
234	AV1	34	13.0	0.30	86.6	41.0	2,418
235	AV1	34	13.1	0.31	87.8	41.3	2,495
236	AV1	36	13.6	0.31	89.0	41.0	2,635
237	AV1	36	13.7	0.31	89.7	41.1	2,679
238	AV1	34	13.0	0.30	85.3	41.2	2,440
239	AV1	34	13.3	0.30	84.4	41.1	2,484
240	AV1	34	12.9	0.29	83.8	41.0	2,229
241	AV1	34	13.2	0.31	87.8	40.9	2,494
242	AV1	33	13.3	0.30	85.9	41.0	2,431
243	AV1	35	13.0	0.31	87.7	41.2	2,499
244	AV1	35	13.7	0.32	90.2	41.2	2,683
245	AV1	35	13.8	0.31	88.1	41.0	2,687
246	AV1	35	13.8	0.32	91.4	41.0	2,659
247	AV1	34	13.8	0.32	91.1	41.1	2,582
248	AV1	36	13.7	0.32	91.6	41.1	2,726
249	AV1	36	14.0	0.32	90.3	41.2	2,785
250	AV1	34	13.2	0.29	83.3	41.1	2,383
251	AV1	29	11.9	0.29	82.2	40.8	2,175
252	AV1	34	12.2	0.29	83.8	41.1	2,270
253	AV1	33	13.0	0.30	85.5	40.8	2,433
254	AV1	34	13.1	0.30	86.3	41.2	2,401
255	AV1	35	12.7	0.31	89.2	41.0	2,342
256	AV1	35	13.3	0.31	87.4	40.7	2,547
257	AV1	34	13.2	0.31	88.3	41.2	2,644
258	AV1	35	13.4	0.31	88.6	41.1	2,591
259	AV1	34	13.3	0.31	89.3	41.1	2,496

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

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NW-J, AUTO HAMMER
OP: RMDT
Date: 14-July-2017

BL#	TYPE	FMX kips	VMX f/s	EFV k-ft	ETR (%)	BPM bpm	AMX g's
260	AV1	35	13.3	0.31	88.2	41.0	2,404
261	AV1	33	13.0	0.31	89.5	41.0	2,457
262	AV1	33	13.4	0.31	87.4	41.0	2,572
263	AV1	41	13.7	0.32	91.9	1.9	2,661
264	AV1	42	14.2	0.33	94.4	37.6	2,907
265	AV1	42	13.6	0.32	91.9	37.8	2,936
266	AV1	43	15.2	0.34	97.0	37.9	3,115
267	AV1	40	13.8	0.32	91.5	37.7	2,804
268	AV1	40	14.0	0.32	90.8	37.7	2,901
269	AV1	41	14.0	0.33	93.2	37.7	2,733
270	AV1	41	14.2	0.33	93.5	37.8	2,726
271	AV1	40	14.1	0.33	93.1	38.0	2,880
272	AV1	42	14.2	0.33	94.2	37.6	2,990
273	AV1	39	13.9	0.31	89.6	37.6	2,987
274	AV1	41	13.8	0.31	89.4	37.8	2,978
275	AV1	42	14.8	0.34	97.9	37.9	3,136
276	AV1	38	13.5	0.31	89.1	37.7	2,962
277	AV1	42	13.9	0.33	93.5	37.7	3,139
278	AV1	38	13.8	0.32	91.8	37.9	2,781
279	AV1	39	13.8	0.32	92.0	37.8	3,131
280	AV1	34	13.8	0.32	90.6	37.8	2,685
281	AV1	36	13.3	0.31	88.5	37.7	2,772
282	AV1	35	13.5	0.32	90.3	37.7	2,746
283	AV1	36	13.8	0.32	91.4	37.8	2,732
284	AV1	35	13.4	0.32	92.7	37.8	2,614
285	AV1	37	13.6	0.33	93.7	37.8	2,797
286	AV1	36	14.2	0.32	92.2	37.7	2,708
287	AV1	35	14.1	0.32	90.9	37.8	2,591
288	AV1	38	14.4	0.33	94.0	37.7	2,784
289	AV1	37	14.5	0.33	93.1	37.8	2,875
290	AV1	38	14.3	0.33	95.1	37.7	2,978
291	AV1	37	14.5	0.33	94.8	37.8	3,215
292	AV1	38	14.4	0.34	96.4	37.7	3,056
293	AV1	36	14.2	0.32	90.9	37.7	2,712
294	AV1	38	14.4	0.33	95.5	37.8	2,976
295	AV1	38	14.8	0.33	95.1	37.7	3,050
296	AV1	38	14.6	0.32	90.8	37.7	2,976
297	AV1	38	14.4	0.33	93.1	37.8	3,155
298	AV1	37	14.5	0.32	90.1	37.7	2,722
299	AV1	36	14.7	0.32	91.8	37.7	2,780
300	AV1	38	14.5	0.33	94.2	37.8	2,737
301	AV1	38	14.8	0.34	97.1	37.8	3,176
302	AV1	36	14.4	0.34	95.9	37.7	3,066
303	AV1	35	14.4	0.32	90.1	37.7	2,751
304	AV1	35	14.3	0.33	95.3	37.8	3,002
305	AV1	35	14.5	0.31	88.8	37.7	2,816
306	AV1	37	15.0	0.32	91.5	37.8	2,775
307	AV1	36	14.7	0.32	91.5	37.7	2,764
308	AV1	36	14.6	0.31	89.1	37.7	2,974
309	AV1	37	15.2	0.33	94.8	37.8	2,830
310	AV1	37	15.0	0.32	92.5	37.7	3,076
311	AV1	39	15.6	0.34	98.2	37.9	3,150
312	AV1	38	14.9	0.32	90.8	37.6	3,000

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NW-J, AUTO HAMMER
OP: RMDT
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BL#	TYPE	FMX kips	VMX f/s	EFV k-ft	ETR (%)	BPM bpm	AMX g's
313	AV1	38	15.2	0.33	93.7	37.7	2,952
314	AV1	38	14.9	0.32	91.2	37.8	2,874
315	AV1	38	15.2	0.33	94.2	37.7	3,079
316	AV1	38	15.2	0.33	93.6	37.8	2,932
317	AV1	40	16.2	0.34	98.5	37.7	3,064
318	AV1	37	15.1	0.32	90.6	37.8	2,789
319	AV1	39	15.5	0.34	97.7	37.8	3,245
320	AV1	39	15.4	0.34	96.0	37.7	2,854
321	AV1	40	15.4	0.34	97.1	37.7	3,188
322	AV1	38	15.2	0.34	96.2	37.7	3,262
323	AV1	38	14.7	0.33	93.9	37.7	3,117
324	AV1	39	15.1	0.33	95.6	37.7	3,090
325	AV1	39	15.1	0.34	96.1	37.7	3,215
326	AV1	33	14.1	0.31	88.7	37.8	2,614
327	AV1	39	14.6	0.33	94.8	37.7	3,026
328	AV1	35	13.8	0.31	87.7	37.7	2,489
329	AV1	36	14.3	0.31	89.8	37.7	2,667
330	AV1	36	14.5	0.33	95.1	37.8	3,049
331	AV1	36	14.5	0.32	91.8	37.7	2,658
332	AV1	35	12.9	0.32	92.3	37.9	2,467
333	AV1	35	14.1	0.32	92.2	37.7	2,516
334	AV1	36	14.3	0.32	91.7	37.7	2,816
335	AV1	37	14.8	0.33	94.6	37.8	2,844
336	AV1	34	13.7	0.30	86.3	37.7	2,505
337	AV1	34	14.0	0.32	90.2	37.6	2,462
338	AV1	35	13.9	0.33	93.0	37.9	2,474
339	AV1	32	13.4	0.30	84.3	37.7	2,301
Average		38	13.5	0.31	89.7	37.4	2,651

Total number of blows analyzed: 339

BL# Comments

1 Begin Sample at 40 ft.
72 Begin Sample at 45 ft.
122 Begin Sample at 50 ft.
170 Begin Sample at 55 ft.
263 Begin Sample at 60 ft.
339 End of testing.

Time Summary

Drive 2 minutes 32 seconds 9:25 AM - 9:28 AM (7/14/2017) BN 1 - 71
Stop 21 minutes 44 seconds 9:28 AM - 9:49 AM
Drive 1 minute 3 seconds 9:49 AM - 9:51 AM BN 72 - 121
Stop 14 minutes 1 second 9:51 AM - 10:05 AM
Drive 1 minute 12 seconds 10:05 AM - 10:06 AM BN 122 - 169
Stop 15 minutes 55 seconds 10:06 AM - 10:22 AM
Drive 2 minutes 14 seconds 10:22 AM - 10:24 AM BN 170 - 262
Stop 15 minutes 44 seconds 10:24 AM - 10:40 AM
Drive 2 minutes 0 second 10:40 AM - 10:42 AM BN 263 - 339

Total time [01:16:28] = (Driving [00:09:03] + Stop [01:07:25])

Robert Miner Dynamic Testing, In

Dynamic Measurements and Analyses for Deep Foundations

July 2, 2013

Mr. Dale Abernathy
Holt Services, Inc.
13000 Lakeholme Road Sw
Lakewood, WA 98498

Re: Penetration Test Energy Measurements
Bore Hole: E340-B-07A, July 1, 2013
Truck Mounted CME Rig No. 7, 140lb ram, NW-J Rod
Bellevue, Washington RMDT Job No. 13F36

Dear Mr. Abernathy,

This letter presents energy transfer measurements made during Standard Penetration Tests for the drill hole and drill rig referenced above. Robert Miner Dynamic Testing, Inc. (RMDT) made dynamic measurements with a Pile Driving Analyzer® as a hammer advanced the NW rod during sampling with a split spoon sampler.

The purpose of RMDT's testing was the measurement of energy transferred to the drill rods. Measurements were made on a section of NW gauge rod at the top of the drill rod. Strain gages and accelerometers on the rod were connected to a Pile Driving Analyzer® (PDA) which generally processed acceleration and strain measurements from each hammer blow and stored both the measurements and computed results. Measurements and data processing generally followed the ASTM D 4633-10 standard. Energy transfer past the gage location, EFV, was computed by the PDA using force and velocity records as follows:

$$EFV = \int_a^b F(t)\ v(t)\ dt$$

The value "a" corresponds to the start of the record which is when the energy transfer begins and *"b"* is the time at which energy transferred to the rod reaches a maximum value. Appendix A contains more information on our measurement equipment and methods of analysis. The EFV energy calculation is identical to the EMX energy result discussed in Appendix A. The EFV and EMX values apply to the sensor location near the top of the rod.

TEST DETAILS

Testing occurred on July 1, 2013. Boring E340-B-07A was advanced in the maintenance yard for the Microsoft Connector Buses in Bellevue, Washington. NW size rod was used to advance a split spoon sampler. The automatic hammer in use during our testing was manufactured by Central Mine Equipment (CME) and was reported to use a 140 lb ram. The drill rig was a truck-mounted CME-85 and referred to as Rig No. 7 by the operator.

RESULTS

A summary of testing and monitoring results is given in Table 1. The tabulated results include the starting sample depth, the penetration resistance, the number of hammers blows in our data set, measured energy transfer, EFV, the computed transfer efficiency, ETR, and the hammer blow rate, BPM. Appendix B contains detailed numeric results for each individual test.

Energy measurements must be divided by the theoretical free fall energy of the hammer to obtain an efficiency. A 140 lb ram raised 30 inches above an impact surface has 350 lb-ft of potential energy. Thus, the transfer energy results for sampling with the 140 ram may be divided by 350 lb-ft to yield the ratio of the delivered energy to the nominal potential energy. This efficiency ratio, ETR, is given for each sample interval as a percent efficiency.

Table 1. Summary of Test Details and Results for the 140-lb ram and Split Spoon Sampler

Sample Name and Sample Start Depth	Penetration Resistance (Blow/Set)	Number of Blows in Data Set	Average Transfer Energy EFV (lb-ft)	Average Transfer Efficiency ETR (percent)	Average Hammer Blow Rate BPM (blow/min)
Sample 1, 15ft	48/1ft	48	298	85	46
Sample 2, 20ft	58/1ft	58	306	87	46
Sample 3, 30ft	89/1ft	89	317	91	47
Sample 4, 40ft	81/1ft	81	316	90	47
Sample 5, 50ft	50/6in	49	325	93	45
Sample 6, 60ft	57/6in	57	321	92	46
Average for Split Spoon samples:			**314**	**90**	**46**

Six sample returns were monitored while the 140 lb ram and standard split spoon sampler were in use. The overall average ETR and hammer blow rate was 90 percent and 46 blows per minute, respectively.

It was a pleasure to assist you and to participate on this project with the staff of Holt Services, Inc. Please do not hesitate to contact us if you or your client have any questions about this report.

Sincerely,

Andrew Banas
Staff Engineer
Robert Miner Dynamic Testing, Inc.

APPENDIX A
AN INTRODUCTION INTO DYNAMIC PILE TESTING METHODS

The following has been written by Goble Rausche Likins and Associates, Inc. and may only be copied with its written permission.

BACKGROUND

Modern procedures of design and construction control require verification of bearing capacity and integrity of deep foundations during preconstruction test programs and also production installation. Dynamic pile testing methods meet this need economically and reliably, and therefore, form an important part of a quality assurance program when deep foundations are executed. Several dynamic pile testing methods exist; they have different benefits and limitations and different requirements for proper execution.

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (such as that of a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. The method is therefore also referred to as a "High Strain Method". The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then an evaluation of various quantities based on closed form solutions of the wave equation, a partial differential equation describing the motion of a rod under the effect of an impact. Conveniently, measurements and analyses are done by a single piece of equipment: the Pile Driving Analyzer® (PDA). However, for bearing capacity evaluations an important additional method is CAPWAP® which performs a much more rigorous analysis of the dynamic records than the simpler Case Method.

A related analysis method is the "Wave Equation Analysis" which calculates a relationship between bearing capacity and pile stress and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data.

The following description deals primarily with the Case Method or "High Strain Test" Method of pile testing, however, for the sake of completeness, the "Low Strain Test" performed with the Pile Integrity Test™ (PIT), mainly for pile integrity evaluation, will also be described.

RESULTS FROM DYNAMIC TESTING

There are two main objectives of high strain dynamic pile testing:

- *Dynamic Pile Monitoring* and
- *Dynamic Load Testing*.

Dynamic pile monitoring is conducted during the installation of impact driven piles to achieve a safe and economical pile installation. Dynamic load testing, on the other hand, has as its primary goal the assessment of pile bearing capacity. It is applicable to both cast *insitu* piles or drilled shafts and impact driven piles during restrike.

Dynamic Pile Monitoring

During pile installation, the sensors attached to the pile measure pile top force and velocity. A PDA conditions and processes these signals and calculates or evaluates:

- Bearing capacity at the time of testing, including an assessment of shaft resistance development and driving resistance. This information supports formulation of a driving criterion.

- Dynamic pile stresses, axial and averaged over the pile cross section, both tensile and compressive, during pile driving to limit the potential of damage either near the pile top or along its length. Bending stresses can be evaluated at the point of sensor attachment.

- Pile integrity assessment by the PDA is based on the recognition of certain wave reflections from along the pile. If detected early enough, a pile may be saved from complete destruction. On the other hand, once damage is recognized measures can be taken to prevent reoccurrence.

- Hammer performance parameters including the energy transferred to the pile, the hammer speed in blows per minute and the stroke of open ended diesel hammers.

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Dynamic Pile Load Testing

Bearing capacity testing of either driven piles or drilled shafts applies the same basic measurement approach of dynamic pile monitoring. However, the test is done independent of the pile installation process and therefore a pile driving hammer or other dynamic loading device may not be available. If a special ram has to be mobilized then its weight should be between 0.8 and 2% of the test load (e.g. between 4 and 10 tons for a 500 ton test load) to assure sufficient soil resistance activation.

For a successful test, it most important that the test is conducted after a sufficient waiting time following pile installation for soil properties approaching their long term condition or concrete to properly set. During testing, PDA results of pile/shaft stresses and transferred energy are used to maintain safe stresses and assure sufficient resistance activation. For safe and sufficient testing of drilled shafts, ram energies are often increased from blow to blow until the test capacity has been activated. On the other hand, restrike tests on driven piles may require a warm hammer so that the very first blow produces a complete resistance activation. Data must be evaluated by CAPWAP for bearing capacity.

After the dynamic load test has been conducted with sufficient energy and safe stresses, the CAPWAP analysis provides the following results:

- Bearing capacity i.e. the mobilized capacity present at the time of testing
- Resistance distribution including shaft resistance and end bearing components
- Stresses in pile or shaft calculated for both the static load application and the dynamic test. These stresses are averages over the cross section and do not include bending effects or nonuniform contact stresses, e.g. when the pile toe is on uneven rock.
- Shaft impedance vs depth; this is an estimate of the shaft shape if it differs substantially from the planned profile
- Dynamic soil parameters for shaft and toe, i.e. damping factors and quakes (related to the dynamic stiffness of the resistance at the pile/soil interface.)

MEASUREMENTS

PDA

The basis for the results calculated by the PDA are pile top strain and acceleration measurements which are converted to force and velocity records, respectively. The PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. Using closed form Case Method solutions, based on the one-dimensional linear wave equation, the PDA calculates the results described in the analytical solutions section below.

HPA

The ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. For this unit to be applicable, the ram must be visible. The impact velocity results can be automatically processed with a PC or recorded on a strip chart.

Saximeter™

For open end diesel hammers, the time between two impacts indicates the magnitude of the ram fall height or stroke. This information is not only measured and calculated by the PDA but also by the convenient, hand-held Saximeter.

PIT

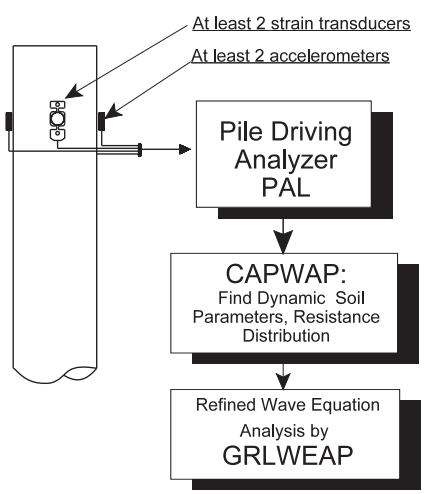
The Pile Integrity Tester™ (PIT) can be used to evaluate defects in concrete piles or shafts which may have occurred during driving or casting. Also timber piles of limited length can be tested in that manner. This so-called "Low Strain Method" or “Pulse-Echo Method” of integrity testing requires only the measurement of acceleration at the pile top. The stress wave producing impact is then generated by a small hand-held hammer and the records interpreted in the time domain. PIT also supports the so-called “Transient Response Method” which requires the additional measurement of the hammer force and an analysis in the frequency domain. This method may also be used to evaluate the unknown length of deep foundations under existing structures.

ANALYTICAL SOLUTIONS
BEARING CAPACITY

Wave Equation

GRL has written the GRLWEAP™ program which calculates a relationship between bearing capacity, pile stress and blow count. This relationship is often called the "bearing graph." Once the blow count is known from pile installation logs, the bearing graph yields the bearing capacity. This approach requires no measurements and therefore can be performed during the design stage of a project, for example for the selection of hammer, cushion and pile size.

After dynamic pile monitoring and/or dynamic load testing has been performed, the "Refined Wave Equation Analysis" or RWEA (see schematic below) is often performed by inputting the PDA and CAPWAP calculated parameters. Then the bearing graph from the RWEA is the basis for a safe and sufficient driving criteria.



Case Method

The Case Method is a closed form solution based on a few simplifying assumptions such as ideal plastic soil behavior and an ideally elastic and uniform pile. Given the measured pile top force F(t) and pile top velocity v(t), the total soil resistance is

$$R(t) = \tfrac{1}{2}\{[F(t) + F(t_2)] + Z[v(t) - v(t_2)]\} \qquad (1)$$

where

t	=	a point in time after impact
t_2	=	time $t + 2L/c$
L	=	pile length below gages
c	=	$(E/\rho)^{1/2}$ is the speed of the stress wave
ρ	=	pile mass density
Z	=	EA/c is the pile impedance
E	=	elastic modulus of the pile (ρc^2)
A	=	pile cross sectional area

The total soil resistance consists of a dynamic (R_d) and a static (R_s) component. The static component is therefore

$$R_s(t) = R(t) - R_d(t) \qquad (2)$$

The dynamic component may be computed from a soil damping factor, J, and a pile toe velocity, $v_t(t)$ which is conveniently calculated for the pile toe. Using wave considerations, this approach leads immediately to the dynamic resistance

$$R_d(t) = J[F(t) + Zv(t) - R(t)] \qquad (3)$$

and finally to the static resistance by means of Equation 2.

There are a number of ways in which Eq. 1 through 3 can be evaluated. Most commonly, t_2 is set to that time at which the static resistance becomes maximum. The result is the so-called **RMX** capacity. Damping factors for RMX typically range between 0.5 for coarse grained materials to 1.0 for clays. The **RSP** capacity (this method is most commonly referred to in the literature, yet it is not very frequently used) requires damping factors between 0.1 for sand and 1.0 for clay. Another capacity, **RA2**, determines the capacity at a time when the pile is essentially at rest and thus damping is small; RA2

therefore requires no damping parameter. In any event, the proper Case Method and its associated damping parameter is most conveniently found after a CAPWAP analysis has been performed.

The static resistance calculated by Case Method or CAPWAP is the mobilized resistance at the time of testing. Consideration therefore has to be given to soil setup or relaxation effects and whether or not a sufficient set has been achieved under the test loading that would correspond to a full activation of the ultimate soil resistance.

The PDA also calculates an estimate of shaft resistance as the difference between force and velocity times impedance at the time immediately prior to the return of the stress wave from the pile toe. This shaft resistance is not reduced by damping effects and is therefore called the total shaft resistance **SFT**. A correction for damping effects produces the static shaft resistance estimate, **SFR**.

The Case Method solution is simple enough to be evaluated "in real time," i.e. between hammer blows, using the PDA. It is therefore possible to calculate all relevant results for all hammer blows and plot these results as a function of depth or blow number. This is done in the PDAPLOT program.

CAPWAP

The CAse Pile Wave Analysis Program combines the wave equation pile and soil model with the Case Method measurements. Thus, the solution includes not only the total and static bearing capacity values but also the shaft resistance, end bearing, damping factors and soil stiffnesses. The method iteratively calculates a number of unknowns by signal matching. While it is necessary to make hammer performance assumptions for a GRLWEAP analysis, the CAPWAP program works with the pile top measurements. Furthermore, while GRLWEAP and Case Method require certain assumptions regarding the soil behavior, CAPWAP calculates these soil parameters.

STRESSES

During pile monitoring, it is important that compressive stress maxima at pile top and toe and tensile stress maxima somewhere along the pile be calculated for each hammer blow.

At the pile top (location of sensors) both the maximum compression stress, **CSX**, and the maximum stress from individual strain transducers, **CSI**, are directly obtained from the measurements. Note that CSI is greater than or equal to CSX and the difference between CSI and CSX is a measure of bending in the plane of the strain transducers. Note also that all stresses calculated for locations below the sensors are averaged over the pile cross section and therefore do not include components from either bending or eccentric soil resistance effects.

The PDA calculates the compressive stress at the pile bottom, **CSB**, assuming (a) a uniform pile and (b) that the pile toe force is the maximum value of the total resistance R(t) minus the total shaft resistance, SFT. Again, for this stress estimation uniform resistance force are assumed (e.g. not a sloping rock.)

For concrete piles, the maximum tension stress, **TSX**, is also of great importance. It occurs at some point below the pile top. The maximum tension stress can be computed from the pile top measurements by finding the maximum tension wave (either traveling upward, W_U, or downward, W_d) and reducing it by the minimum compressive wave traveling in opposite direction.

$$W_u = ½[F(t) - Zv(t)] \quad (4)$$

$$W_d = ½[F(t) + Zv(t)] \quad (5)$$

CAPWAP also calculates tensile and compressive stresses along the pile and, in general, more accurately than the PDA. In fact, for non-uniform piles or piles with joints, cracks or other discontinuities, the closed form solutions from the PDA may be in error.

PILE INTEGRITY

High Strain Tests (PDA)

Stress waves in a pile are reflected wherever the pile impedance, $Z = EA/c = \rho cA = A \sqrt{(E \rho)}$, changes. Therefore, the pile impedance is a measure of the quality of the pile material (E, ρ, c) and the size of its cross section (A). The reflected waves arrive at the pile top at a time which is greater the farther away from the pile top the reflection occurs. The

magnitude of the change of the upward traveling wave (calculated from the measured force and velocity, Eq. 4) indicates the extent of the cross sectional change. Thus, with β_i (**BTA**) being a relative integrity factor which is unity for no impedance change and zero for the pile end, the following is calculated by the PDA.

$$\beta_i = (1 - \alpha_i)/(1 + \alpha_i) \quad (6)$$

with

$$\alpha_i = ½(W_{UR} - W_{UD})/(W_{Di} - W_{UR}) \quad (7)$$

where

W_{UR} is the upward traveling wave at the onset of the reflected wave. It is caused by resistance.

W_{UD} is the upwards traveling wave due to the damage reflection.

W_{Di} is the maximum downward traveling wave due to impact.

It can be shown that this formulation is quite accurate as long as individual reflections from different pile impedance changes have no overlapping effects on the stress wave reflections.

Without rigorous derivation, it has been proposed to consider as slight damage when β is above 0.8 and a serious damage when β is less than 0.6.

Low Strain Tests (PIT)

The pile top is struck with a held hand hammer and the resulting pile top velocity is measured, displayed and interpreted for signs of wave reflections. In general, a comparison of the reflected acceleration leads to a relative measure of extent of damage, again the location of the problem is indicated by the arrival time of the reflection. PIT records can also be interpreted by the β-Method. However, low strain tests do not activate much resistance which simplifies Eq. 7 since W_{UR} is then equal to zero.

For drilled shafts and PIT records that clearly show a toe reflection, an approximate shaft profile can be calculated from low strain records using the PITSTOP program's PROFILE routine.

HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(t)v(t)\,dt \quad (8a)$$

The maximum of the E(t) curve is the most important information for an overall evaluation of the performance of a hammer and driving system. This **EMX** value allows for a classification of the hammer's performance when presented as the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency

$$e_T = EMX/E_R \quad (8b)$$

where

E_R is the manufacturer's rated energy value.

Both Saximeter and PDA calculate the stroke (**STK**) of an open end diesel hammer using

$$STK = (g/8)\,T_B^2 - h_L \quad (9)$$

where

g is the earth's gravitational acceleration,
T_B is the time between two hammer blows,
h_L is a stroke loss value due to gas compression and time losses during impact (usually 0.3 ft or 0.1 m).

DETERMINATION OF WAVE SPEED

An important facet of dynamic pile testing is an assessment of pile material properties. Since in general force is determined from strain by multiplication with elastic modulus, E, and cross sectional area, A, the dynamic elastic modulus has to be determined for pile materials other than steel. In general, the records measured by the PDA clearly indicate a pile toe reflection as long as pile penetration per blow is greater than 1 mm or .04 inches. The time between the onset of the force and velocity records at impact and the onset of the reflection from the toe (usually apparent by a local maximum of the wave up curve) is the so-called wave travel time, T. Dividing 2L (L is here the length of the pile below sensors) by T leads to the stress wave speed in the pile:

$$c = 2L/T \quad (10)$$

The elastic modulus of the pile material is related to the wave speed according to the linear elastic wave equation theory by

$$E = c^2\rho \qquad (11)$$

Since the mass density of the pile material, ρ, is usually well known (an exception is timber for which samples should be weighed), the elastic modulus is easily found from the wave speed. Note, however, that this is a dynamic modulus which is generally higher than the static one and that the wave speed depends to some degree on the strain level of the stress wave. For example, experience shows that the wave speed from PIT is roughly 5% higher than the wave speed observed during a high strain test.

Other Notes:

- If the pile material is nonuniform then the wave speed c, according to Eq. 10, is an average wave speed and does not necessarily reflect the pile material properties of the location where the strain sensors are attached to the pile top. For example, pile driving often causes fine tension cracks some distance below the top of concrete piles. Then the average c is slower than that at the pile top. It is therefore recommended to determine E in the beginning of pile driving and not adjust it when the average c changes.

- If the pile has such a high resistance that there is no clear indication of a toe reflection then the wave speed of the pile material must be determined either by assumption or by taking a sample of the concrete and measuring its wave speed in a simple free column test. Another possibility is to use the proportionality relationship, discussed under "DATA QUALITY CHECKS" to find c as the ratio between the measured velocity and measured strain.

DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing PDA or PIT tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to certain relationships.

Proportionality

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the pile, force and velocity measured at the pile top are proportional

$$F = v\,Z = v\,(EA/c) \qquad (12a)$$

This relationship can also be expressed in terms of stress

$$\sigma = v\,(E/c) \qquad (12b)$$

or strain

$$\epsilon = v / c \qquad (12c)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements.

Measurements are always taken at opposite sides of the pile as a means of calculating the average force and velocity in the pile. The velocity on the two sides of the pile is very similar even when high bending exists. Thus, an independent check of the velocity measurements is easy and simple.

Strain measurements may differ greatly between the two sides of the pile when bending exists. It is even possible that tension is measured on one side while very high compression exists on the other side of the pile. In extreme cases, bending might be so high that it leads to a nonlinear stress distribution. The averaging of the two strain signals does then not lead to the average pile force and proportionality will not be achieved.

When testing drilled shafts, measurements of strain may also be affected by local concrete quality variations. It is then often necessary to use four strain transducers spaced at 90 degrees around the pile for an improved strain data quality. The use of four transducers is also recommended for large pile

diameters, particularly when it is difficult to mount the sensors at least two pile widths or diameters below the pile top.

LIMITATIONS, ADDITIONAL CONSIDERATIONS

Mobilization of capacity

Estimates of pile capacity from dynamic testing indicate the **mobilized pile capacity at the time of testing**. At very high blow counts (low set per blow), dynamic test methods tend to produce lower bound capacity estimates as not all resistance (particularly at and near the toe) is fully activated.

Time dependent soil resistance effects

Static pile capacity from dynamic method calculations provide an estimate of the axial pile capacity. Increases and decreases in the pile capacity with time typically occur (soil setup/relaxation). Therefore, **restrike testing usually yields a better indication of long term pile capacity than a test at the end of pile driving**. Often a wait period of one or two days between end of driving and restrike is satisfactory for a realistic prediction of pile capacity but this waiting time depends, among other factors, on the permeability of the soil.

(A) Soil setup

Because excess positive pore pressures often develop during pile driving in fine grained soil (clays, silts or even fine sands), the capacity of a pile at the time of driving may often be less than the long term pile capacity. These pore pressures reduce the effective stress acting on the pile thereby reducing the soil resistance to pile penetration, and thus the pile capacity at the time of driving. As these pore pressures dissipate, the soil resistance acting on the pile increases as does the axial pile capacity. This phenomena is routinely called soil setup or soil freeze.

(*B) Relaxation*

Relaxation (capacity reduction with time) has been observed for piles driven into weathered shale, and may take several days to fully develop. Pile capacity estimates based upon initial driving or short term restrike tests can significantly overpredict long term pile capacity. Therefore, piles driven into shale should be tested after a minimum one week wait either statically or dynamically (with particular emphasis than on the first few blows). Relaxation has also been observed for displacement piles driven into dense saturated silts or fine sands due to a negative pore pressure effect at the pile toe. Again, restrike tests should be used, with great emphasis on early blows.

Capacity results for open pile profiles

Larger diameter open ended pipe piles (or H-piles which do not bear on rock) may behave differently under dynamic and static loading conditions. Under dynamic loads the soil inside the pile or between its flanges may slip and produce internal friction while under static loads the plug may move with the pile, thereby creating end bearing over the full pile cross section. As a result both friction and end bearing components may be different under static and dynamic conditions.

CAPWAP Analysis Results

A portion of the soil resistance calculated on an individual soil segment in a CAPWAP analysis can usually be shifted up or down the shaft one soil segment without significantly altering the match quality. Therefore, use of the CAPWAP resistance distribution for uplift, downdrag, scour, or other geotechnical considerations should be made with an understanding of these analysis limitations.

Stresses

PDA and CAPWAP calculated stresses are average values over the cross section. Additional allowance has to be made for bending or non-uniform contact stresses. To prevent damage it is therefore important to maintain good hammer-pile alignment and to protect the pile toes using appropriate devices or an increased cross sectional area.

In the United States is has become generally acceptable to limit the dynamic installation stresses of driven piles to the following levels:

90% of yield strength for steel piles

85% of the concrete compressive strength - after subtraction of the effective prestress - for concrete piles in compression

100% of effective prestress plus ½ of the concrete's tension strength for prestressed piles in tension

70% of the reinforcement strength for regularly reinforced concrete piles in tension

300% of the static design allowable stress for timber

Note that the dynamic stresses may either be directly measured at the pile top by the PDA or calculated by the PDA for other locations along the pile based on the pile top measurements.

Additional design considerations

Numerous factors have to be considered in pile foundation design. Some of these considerations include

- additional pile loading from downdrag or negative skin friction,
- lateral and uplift loading requirements
- effective stress changes (due to changes in water table, excavations, fills or other changes in overburden),
- long term settlements in general and settlement from underlying weaker layers and/or pile group effects,

These factors have not been evaluated by GRL and have not been considered in the interpretation of the dynamic testing results. The foundation designer should determine if these or any other considerations are applicable to this project and the foundation design.

Wave equation analysis results

The results calculated by the wave equation analysis program depend on a variety of hammer, pile and soil input parameters. Although attempts have been made to base the analysis on the best available information, actual field conditions may vary and therefore stresses and blow counts may differ from the predictions reported. Capacity predictions derived from wave equation analyses should use restrike information. However, because of the uncertainties associated with restrike blow counts and restrike hammer energies, correlations of such results with static test capacities with have often displayed considerable scatter.

As for PDA and CAPWAP, the theory on which GRLWEAP is based is the one-dimensional wave equation. For that reason, stress predictions by the wave equation analysis can only be averages over the pile cross section. Thus, bending stresses or stress concentrations due to non-uniform impact or uneven soil or rock resistance are not considered in these results. Stress maxima calculated by the wave equation are usually subjected to the same limits as those measured directly or calculated from measurements by the PDA.

Appendix B

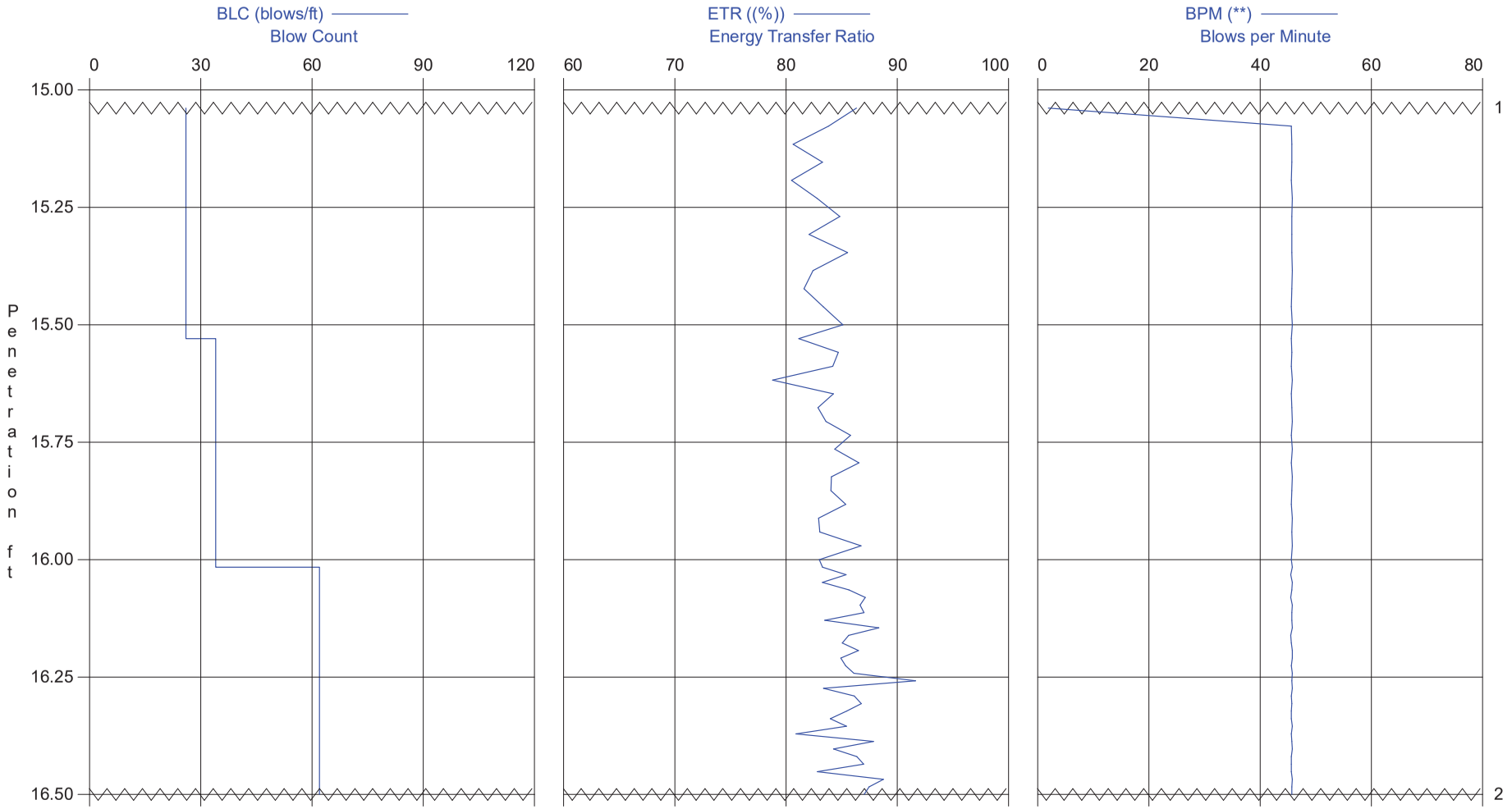
Summary of Case Method Field Results

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

Test date: 1-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 1, 15 FT -BH E340-B-07A



1 - Start of test on 7/1/2013 at 10:58:11 AM

2 - End of test on 7/1/2013 at 10:59:30 AM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 1, 15 FT
OP: RMDT

BH E340-B-07A
Test date: 1-Jul-2013

AR: 1.42 in^2
LE: 19.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute

FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio
RAU: Auto Capacity End Bearing Piles

BL#	BLC bl/ft	CSI ksi	CSX ksi	EFV k-ft	ETR (%)	BPM **	FMX kips	VMX f/s	RAT []	RAU kips
14	34	29.0	28.4	0.284	81.1	45.6	40	13.8	1.2	3
15	34	29.4	28.8	0.296	84.7	45.7	41	15.1	1.2	4
16	34	29.2	28.7	0.295	84.2	45.6	41	14.6	1.2	0
17	34	28.4	28.0	0.276	78.8	45.8	40	13.7	1.2	5
18	34	29.4	28.8	0.295	84.2	45.6	41	14.6	1.2	4
19	34	29.0	28.2	0.290	82.9	45.7	40	13.7	1.2	4
20	34	28.8	28.3	0.293	83.6	45.8	40	14.0	1.2	3
21	34	29.2	28.5	0.300	85.8	45.6	40	14.7	1.2	0
22	34	29.0	28.2	0.295	84.4	45.8	40	14.5	1.2	0
23	34	29.6	28.9	0.303	86.5	45.6	41	15.4	1.2	4
24	34	29.1	28.4	0.294	84.1	45.8	40	14.5	1.2	0
25	34	29.3	28.5	0.294	84.0	45.7	40	14.8	1.2	5
26	34	29.2	28.5	0.299	85.4	45.6	40	15.0	1.1	1
27	34	28.1	27.6	0.290	82.9	45.8	39	14.2	1.4	4
28	34	28.8	27.9	0.291	83.0	45.7	40	13.4	2.7	0
29	34	29.1	28.4	0.304	86.7	45.8	40	15.9	2.7	4
30	34	28.8	28.1	0.290	83.0	45.6	40	14.2	2.7	6
31	62	29.3	28.4	0.291	83.3	45.8	40	13.9	2.7	0
32	62	28.5	27.9	0.299	85.4	45.5	40	15.2	2.7	5
33	62	29.0	28.2	0.291	83.3	45.8	40	13.9	2.7	5
34	62	29.3	28.2	0.300	85.7	45.7	40	14.1	2.7	8
35	62	29.3	28.5	0.305	87.1	45.5	40	15.0	2.7	8
36	62	29.0	28.1	0.303	86.7	45.8	40	14.3	2.7	4
37	62	29.4	28.5	0.305	87.0	45.7	40	14.8	2.7	7
38	62	28.5	27.6	0.292	83.5	45.7	39	13.8	2.7	3
39	62	29.5	28.7	0.309	88.3	45.8	41	15.8	2.7	5
40	62	29.0	28.1	0.300	85.6	45.5	40	14.3	2.7	8
41	62	28.9	28.1	0.298	85.1	45.6	40	15.2	2.7	8
42	62	31.5	29.9	0.303	86.5	45.8	42	15.0	2.7	3
43	62	28.2	27.7	0.297	84.9	45.8	39	14.6	2.7	7
44	62	29.4	28.3	0.299	85.3	45.6	40	13.9	2.7	7
45	62	29.0	28.0	0.301	86.1	45.8	40	14.4	2.7	8
46	62	28.9	28.3	0.321	91.6	45.7	40	16.1	2.7	5
47	62	30.8	29.2	0.292	83.4	45.8	41	14.1	2.7	5
48	62	29.5	28.4	0.301	86.1	45.6	40	15.2	2.7	10
49	62	29.1	28.3	0.304	86.8	45.7	40	15.1	2.7	4
50	62	28.4	27.9	0.299	85.5	45.6	40	14.6	2.7	9
51	62	30.3	28.6	0.294	84.0	45.6	41	14.6	2.7	7
52	62	28.9	28.2	0.299	85.4	45.8	40	15.3	2.7	7
53	62	29.0	27.9	0.283	80.9	45.6	40	12.8	2.7	7
54	62	30.0	28.8	0.308	87.9	45.7	41	15.7	2.7	8
55	62	29.2	27.8	0.295	84.3	45.8	39	13.5	2.7	3
56	62	29.1	28.0	0.302	86.4	45.6	40	14.2	2.7	6
57	62	28.4	27.8	0.304	87.0	45.6	40	15.5	2.7	7
58	62	29.0	28.1	0.290	82.8	45.6	40	13.0	2.7	7
59	62	29.4	28.6	0.311	88.8	45.8	41	15.0	2.7	6
60	62	29.4	28.3	0.306	87.5	45.7	40	14.7	2.7	6
61	62	29.0	27.9	0.305	87.0	45.7	40	14.3	2.7	7
Average		29.1	28.3	0.298	85.1	45.7	40	14.5	2.2	5
Std. Dev.		0.6	0.4	0.008	2.2	0.1	1	0.7	0.7	3
Maximum		31.5	29.9	0.321	91.6	45.8	42	16.1	2.7	10

Total number of blows analyzed: 48

BL#	Comments
1	Start of test on 7/1/2013 at 10:58:11 AM
61	End of test on 7/1/2013 at 10:59:30 AM

Time Summary

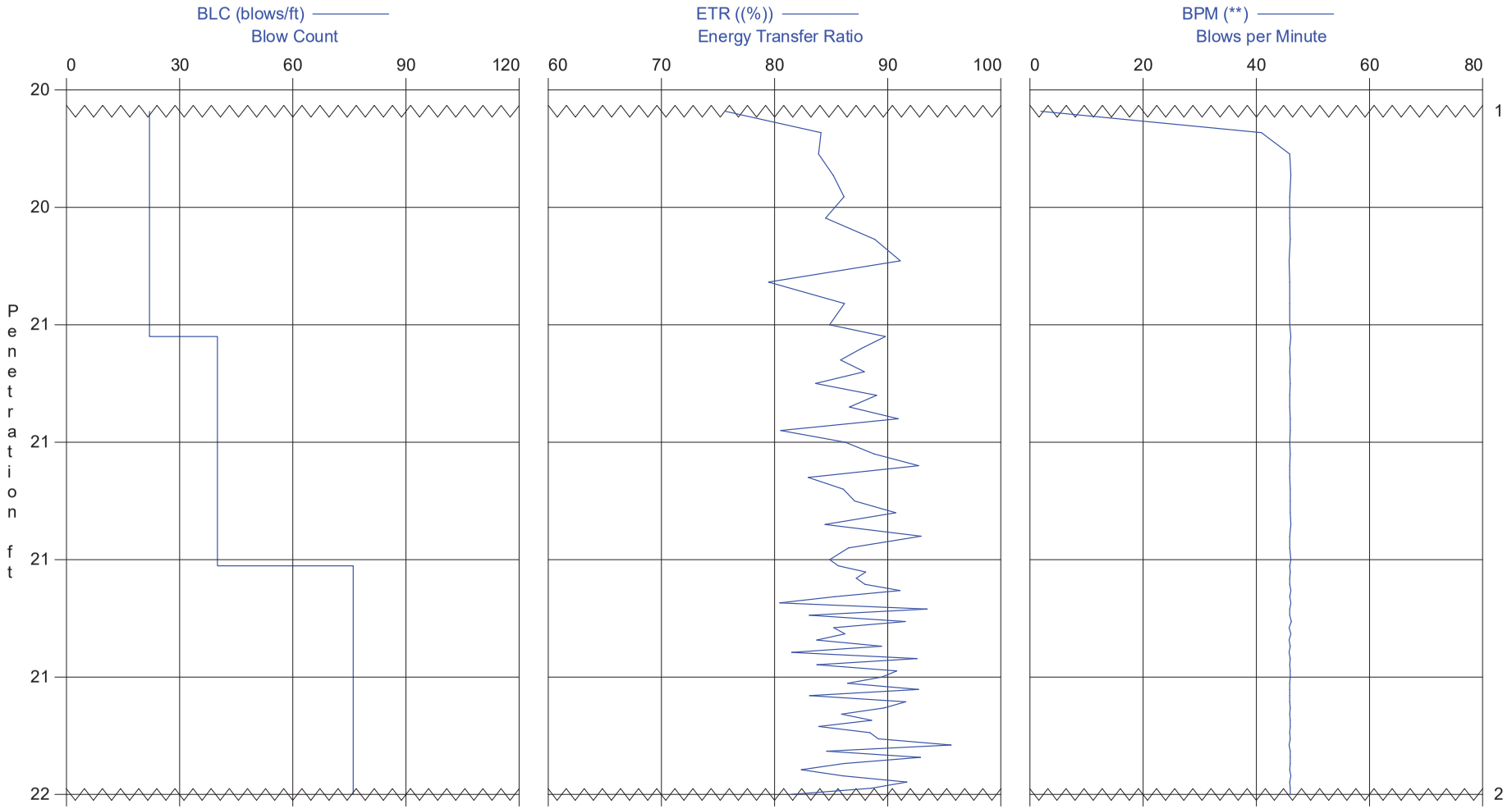
Drive 1 minute 19 seconds 10:58:11 AM - 10:59:30 AM (7/1/2013) BN 1 - 61

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

Test date: 1-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 2, 20 FT -BH E340-B-07A



1 - Start of test on 7/1/2013 at 11:09:34 AM

2 - End of test on 7/1/2013 at 11:11:03 AM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 2, 20 FT
OP: RMDT

BH E340-B-07A
Test date: 1-Jul-2013

AR: 1.42 in^2
LE: 24.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute

FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio
RAU: Auto Capacity End Bearing Piles

BL#	BLC	CSI	CSX	EFV	ETR	BPM	FMX	VMX	RAT	RAU
	bl/ft	ksi	ksi	k-ft	(%)	**	kips	f/s	[]	kips
12	40	31.6	29.9	0.314	89.8	46.1	42	15.2	1.1	0
13	40	30.9	29.6	0.307	87.7	45.9	42	14.3	1.1	0
14	40	29.7	28.6	0.300	85.8	46.0	41	14.7	1.1	3
15	40	29.8	28.7	0.308	87.9	45.9	41	14.8	1.1	0
16	40	29.3	28.3	0.293	83.6	46.0	40	13.4	1.1	0
17	40	31.7	30.3	0.312	89.0	45.9	43	15.0	1.1	0
18	40	29.9	28.7	0.303	86.6	45.9	41	13.6	1.1	0
19	40	30.3	29.1	0.318	90.9	46.0	41	15.5	1.1	0
20	40	28.6	27.6	0.282	80.5	46.0	39	12.4	1.1	0
21	40	30.1	29.0	0.302	86.3	45.9	41	14.5	1.1	0
22	40	30.9	29.7	0.311	88.8	46.0	42	14.7	1.1	0
23	40	31.2	29.6	0.325	92.7	45.9	42	16.2	1.1	1
24	40	29.9	28.7	0.290	83.0	45.9	41	12.7	1.1	1
25	40	28.9	27.9	0.301	86.1	46.0	40	14.7	1.2	1
26	40	30.0	28.9	0.305	87.1	46.0	41	14.3	1.1	3
27	40	29.5	28.3	0.317	90.7	46.0	40	15.3	1.2	4
28	40	29.4	28.4	0.296	84.5	46.1	40	13.5	1.1	1
29	40	30.0	28.9	0.325	92.9	45.9	41	15.7	1.1	3
30	40	30.2	29.1	0.303	86.5	45.9	41	14.3	1.1	3
31	40	30.2	29.0	0.297	84.9	46.1	41	14.2	1.1	6
32	76	29.3	28.3	0.300	85.6	45.9	40	14.7	1.2	4
33	76	30.5	29.4	0.308	88.1	46.0	42	14.8	1.1	4
34	76	30.4	29.4	0.305	87.2	45.9	42	14.6	1.1	13
35	76	30.3	29.1	0.308	88.0	45.9	41	15.0	1.2	5
36	76	30.1	29.0	0.319	91.1	46.1	41	15.5	1.1	7
37	76	30.0	29.0	0.299	85.3	45.9	41	13.8	1.1	5
38	76	28.7	27.6	0.282	80.5	46.1	39	12.3	1.2	7
39	76	30.3	29.2	0.327	93.5	45.9	42	16.4	1.1	7
40	76	30.2	29.1	0.291	83.1	45.9	41	13.1	1.1	7
41	76	31.8	30.1	0.320	91.6	46.2	43	16.2	1.1	12
42	76	30.7	29.2	0.298	85.2	45.8	41	14.0	1.2	14
43	76	31.1	29.5	0.302	86.2	46.1	42	14.5	1.1	12
44	76	28.9	28.0	0.293	83.7	45.8	40	13.4	1.2	10
45	76	30.8	29.4	0.313	89.5	46.0	42	15.6	1.1	8
46	76	28.8	27.8	0.285	81.5	45.8	39	13.0	1.2	10
47	76	30.3	29.3	0.324	92.6	46.0	42	16.3	1.1	15
48	76	29.9	28.9	0.293	83.7	45.9	41	13.0	1.1	9
49	76	31.4	29.7	0.318	90.8	46.0	42	15.8	1.1	10
50	76	29.5	28.5	0.313	89.5	46.0	40	15.0	1.1	10
51	76	30.6	29.4	0.303	86.4	45.9	42	13.3	1.1	9
52	76	29.7	28.7	0.325	92.7	45.9	41	16.2	1.2	11
53	76	29.5	28.5	0.291	83.1	45.9	40	12.4	1.2	8
54	76	30.8	29.7	0.321	91.6	45.9	42	15.2	1.1	9
55	76	30.4	29.3	0.314	89.7	46.0	42	15.1	1.1	10
56	76	29.3	28.2	0.301	85.9	45.9	40	13.8	1.2	12
57	76	29.4	28.5	0.310	88.6	46.0	40	14.4	1.2	9
58	76	28.8	28.1	0.294	83.9	46.0	40	14.1	1.2	7
59	76	30.3	29.3	0.310	88.4	45.9	42	14.6	1.1	11
60	76	30.1	29.1	0.312	89.2	46.0	41	14.3	1.1	11
61	76	30.4	29.4	0.335	95.6	45.8	42	16.5	1.1	15
62	76	29.9	28.7	0.296	84.6	46.0	41	12.7	1.1	11
63	76	31.3	29.8	0.325	92.9	46.0	42	15.6	1.1	12
64	76	28.9	28.0	0.301	86.1	46.0	40	13.5	1.1	9
65	76	28.6	28.0	0.288	82.4	45.9	40	14.1	1.2	12
66	76	29.6	28.7	0.301	86.0	46.1	41	14.2	1.2	14
67	76	30.4	29.5	0.321	91.7	45.9	42	14.9	1.1	14
68	76	30.7	29.8	0.310	88.6	46.0	42	14.4	1.1	13
69	76	28.7	28.0	0.285	81.5	46.0	40	13.3	1.2	15
Average		30.0	28.9	0.306	87.4	46.0	41	14.5	1.2	7
Std. Dev.		0.8	0.6	0.012	3.6	0.1	1	1.1	0.0	5
Maximum		31.8	30.3	0.335	95.6	46.2	43	16.5	1.2	15

Total number of blows analyzed: 58

BL#	Comments
1	Start of test on 7/1/2013 at 11:09:34 AM

HOLT, SPT RIG 7 - SAMPLE 2, 20 FT
OP: RMDT
BH E340-B-07A
Test date: 1-Jul-2013

BL#	Comments
69	End of test on 7/1/2013 at 11:11:03 AM

Time Summary

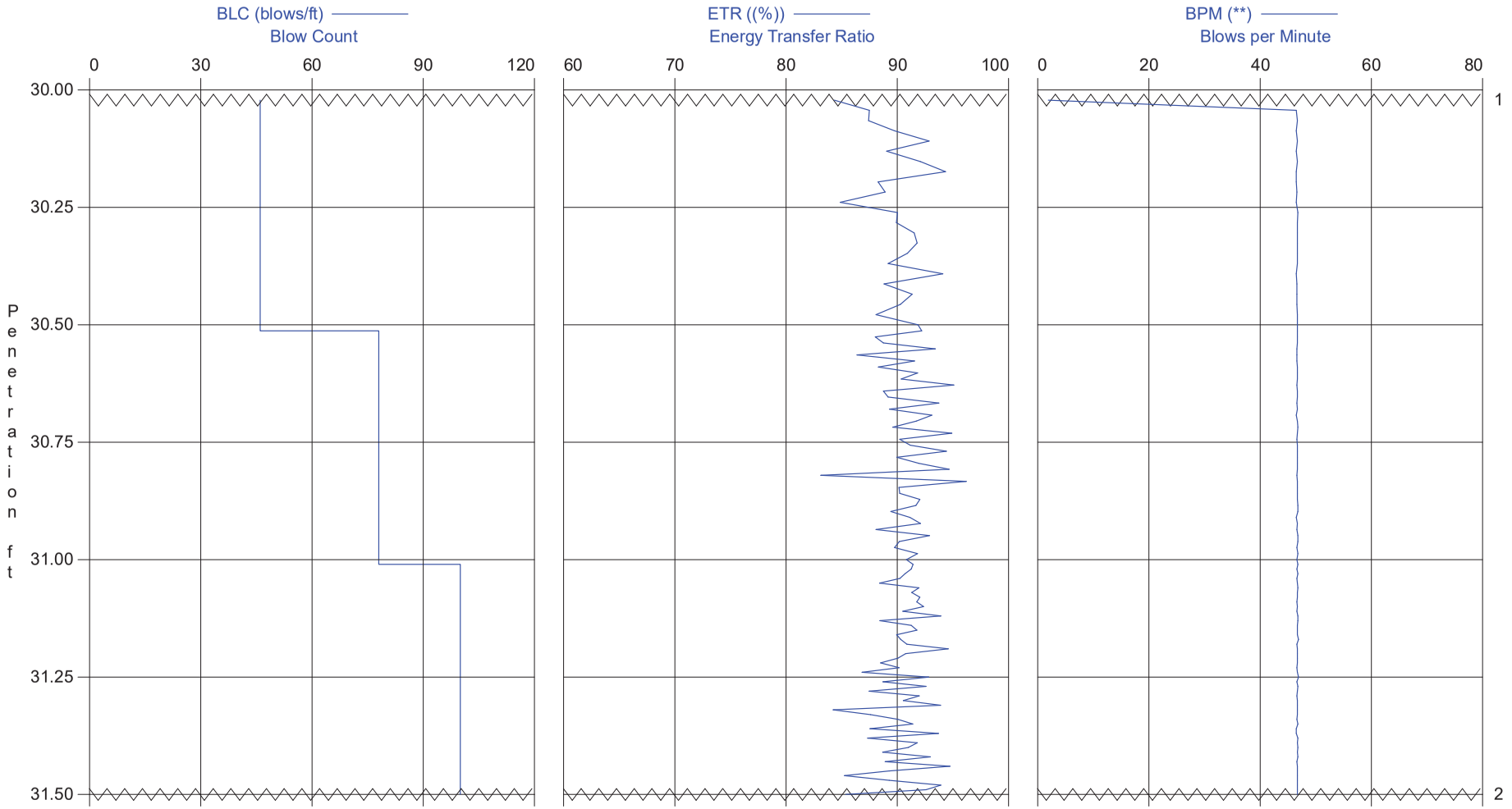
Drive	1 minute 29 seconds	11:09:34 AM - 11:11:03 AM (7/1/2013)	BN 1 - 69

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

Test date: 1-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 3, 30 FT -BH E340-B-07A



1 - Start of test on 7/1/2013 at 11:33:06 AM

2 - End of test on 7/1/2013 at 11:35:29 AM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 3, 30 FT
OP: RMDT

BH E340-B-07A
Test date: 1-Jul-2013

AR: 1.42 in^2
LE: 34.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute

FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio
RAU: Auto Capacity End Bearing Piles

BL#	BLC bl/ft	CSI ksi	CSX ksi	EFV k-ft	ETR (%)	BPM **	FMX kips	VMX f/s	RAT []	RAU kips
24	78	31.0	29.9	0.323	92.2	46.7	42	15.3	1.1	4
26	78	29.8	29.0	0.311	88.8	46.7	41	14.5	1.1	5
28	78	30.4	29.6	0.302	86.4	46.6	42	13.7	1.1	4
30	78	30.7	29.8	0.309	88.3	46.7	42	13.8	1.1	2
32	78	31.3	30.2	0.316	90.3	46.7	43	14.9	0.9	11
34	78	30.4	29.6	0.311	88.8	46.7	42	14.2	1.1	12
36	78	31.4	30.2	0.328	93.7	46.6	43	16.0	1.1	13
38	78	31.9	30.5	0.326	93.1	46.5	43	15.4	1.1	13
40	78	31.2	30.1	0.314	89.6	46.8	43	14.5	1.1	11
42	78	31.3	30.3	0.316	90.2	46.6	43	14.5	1.1	14
44	78	31.5	30.4	0.330	94.4	46.7	43	15.6	1.1	11
46	78	32.0	30.9	0.322	91.9	46.7	44	14.7	1.1	12
48	78	30.2	29.0	0.291	83.1	46.6	41	13.0	1.1	13
50	78	32.3	30.8	0.316	90.2	46.7	44	14.2	1.1	11
52	78	31.6	30.4	0.322	92.0	46.7	43	14.9	1.1	11
54	78	31.4	30.6	0.313	89.4	46.8	43	14.3	1.1	11
56	78	31.6	30.3	0.322	92.1	46.7	43	15.1	1.1	12
58	78	33.5	31.4	0.325	92.9	46.8	45	15.3	1.1	13
60	78	31.9	30.8	0.314	89.8	46.6	44	14.0	0.9	10
62	78	31.8	30.7	0.318	90.8	46.6	44	14.4	1.1	12
64	100	31.0	30.0	0.319	91.2	46.6	43	15.1	1.1	12
66	100	30.9	30.0	0.316	90.2	46.6	43	14.5	1.1	12
68	100	33.2	31.1	0.322	91.9	46.8	44	15.0	0.9	14
70	100	31.1	30.0	0.322	92.0	46.7	43	15.0	1.1	14
72	100	32.2	31.1	0.323	92.4	46.7	44	14.9	0.9	13
74	100	31.2	30.4	0.329	93.9	46.8	43	15.5	1.1	12
76	100	31.8	30.6	0.319	91.3	46.7	43	14.7	1.1	9
78	100	30.8	29.7	0.315	89.9	46.7	42	14.7	1.1	12
80	100	32.3	30.8	0.318	90.9	46.6	44	14.8	0.9	9
82	100	31.2	30.2	0.318	90.8	46.7	43	14.4	1.1	10
84	100	30.6	29.8	0.310	88.5	46.7	42	14.0	1.1	14
86	100	31.0	29.6	0.304	86.8	46.7	42	14.2	1.1	10
88	100	31.5	30.0	0.310	88.7	46.6	43	14.1	1.1	11
90	100	31.3	30.3	0.306	87.5	46.7	43	13.3	1.1	14
92	100	31.5	30.3	0.317	90.5	46.7	43	14.5	1.1	15
94	100	30.8	29.3	0.295	84.2	46.7	42	13.0	1.1	14
96	100	31.3	30.1	0.315	90.1	46.6	43	14.4	1.1	18
98	100	30.6	29.4	0.306	87.5	46.5	42	14.2	1.9	21
100	100	31.2	30.2	0.306	87.3	46.8	43	13.5	1.1	23
102	100	31.0	29.9	0.318	91.0	46.8	42	14.5	1.8	16
104	100	32.1	30.4	0.325	93.0	46.8	43	15.4	1.8	19
106	100	32.0	30.7	0.332	94.7	46.7	44	15.6	1.8	18
108	100	30.3	28.8	0.298	85.2	46.7	41	13.7	1.9	18
110	100	32.6	30.6	0.329	93.9	46.7	43	15.3	1.7	21
112	100	30.5	29.2	0.299	85.4	46.7	41	13.9	1.8	23
Average		31.6	30.3	0.317	90.7	46.7	43	14.7	1.2	13
Std. Dev.		0.8	0.6	0.009	2.5	0.1	1	0.7	0.3	4
Maximum		33.5	31.4	0.337	96.2	46.9	45	16.3	1.9	23

Total number of blows analyzed: 89

BL#	Comments
1	Start of test on 7/1/2013 at 11:33:06 AM
112	End of test on 7/1/2013 at 11:35:29 AM

Time Summary

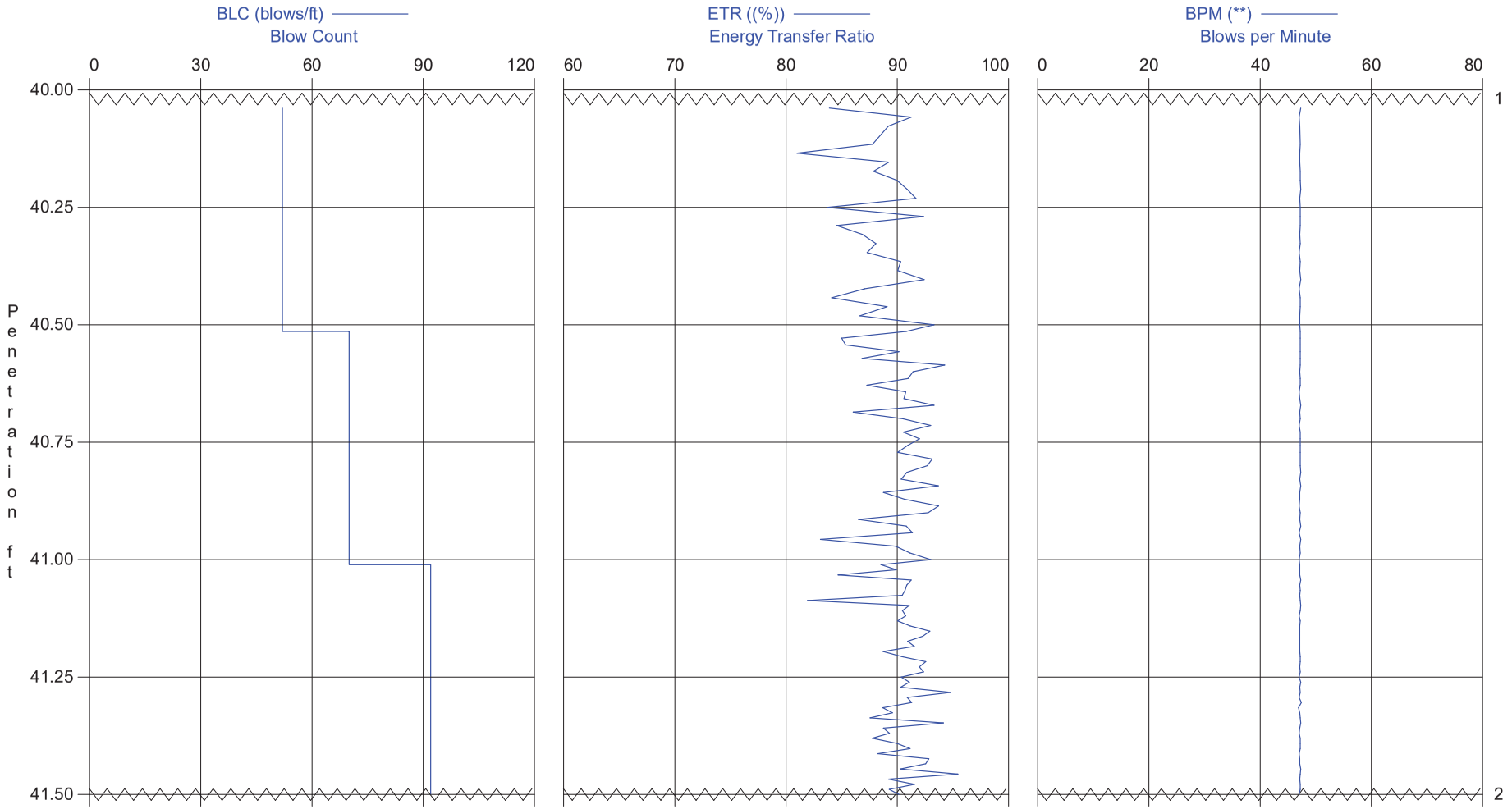
Drive 2 minutes 23 seconds 11:33:06 AM - 11:35:29 AM (7/1/2013) BN 1 - 112

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

Test date: 1-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 4, 40 FT -BH E340-B-07A



1 - Start of test on 7/1/2013 at 12:04:57 PM

2 - End of test on 7/1/2013 at 12:07:13 PM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 4, 40 FT
OP: RMDT

BH E340-B-07A
Test date: 1-Jul-2013

AR: 1.42 in^2
LE: 44.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute

FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio
RAU: Auto Capacity End Bearing Piles

BL#	BLC bl/ft	CSI ksi	CSX ksi	EFV k-ft	ETR (%)	BPM **	FMX kips	VMX f/s	RAT []	RAU kips
27	70	30.3	29.8	0.318	90.8	47.2	42	15.0	0.7	10
29	70	28.2	27.3	0.299	85.4	47.2	39	13.5	1.0	7
31	70	29.6	29.0	0.304	86.8	47.2	41	13.9	0.7	12
33	70	30.2	29.9	0.320	91.4	47.1	42	14.6	0.9	11
35	70	29.4	29.0	0.305	87.3	47.2	41	13.7	0.9	11
37	70	29.4	29.3	0.317	90.6	47.1	42	14.2	0.9	12
39	70	29.3	28.4	0.301	86.0	47.1	40	14.3	1.1	5
41	70	30.2	29.8	0.326	93.0	47.0	42	15.1	0.9	11
43	70	31.0	30.2	0.322	92.0	47.2	43	14.3	0.4	12
45	70	29.9	29.6	0.315	90.0	47.2	42	14.0	0.7	9
47	70	32.5	30.6	0.324	92.7	47.2	43	14.5	0.9	12
49	70	30.3	29.7	0.316	90.3	47.1	42	14.1	0.9	12
51	70	29.3	29.0	0.311	88.8	47.1	41	13.6	0.7	9
53	70	32.2	31.2	0.328	93.7	47.0	44	14.9	0.4	8
55	70	29.5	28.5	0.303	86.5	47.1	40	13.5	0.7	7
57	70	30.2	29.5	0.320	91.4	47.0	42	14.6	0.9	9
59	70	30.0	29.3	0.314	89.8	47.1	42	14.3	0.9	11
61	70	30.5	29.6	0.326	93.0	47.0	42	14.5	0.9	13
63	92	30.1	29.2	0.315	89.9	47.1	41	13.9	1.1	14
65	92	32.1	30.8	0.319	91.2	47.3	44	14.2	0.4	12
67	92	30.7	29.7	0.317	90.7	47.2	42	14.1	0.4	11
69	92	28.6	27.5	0.287	81.9	47.2	39	13.2	1.1	6
71	92	30.8	29.5	0.317	90.5	47.2	42	14.1	0.7	13
73	92	29.8	29.1	0.315	90.0	47.2	41	14.0	0.7	11
75	92	30.1	29.3	0.325	92.9	47.1	42	14.8	0.9	8
77	92	30.1	29.1	0.318	90.9	47.1	41	14.6	0.9	9
79	92	29.2	28.9	0.311	88.7	47.1	41	14.4	0.7	13
81	92	31.9	30.7	0.324	92.6	47.2	44	14.8	0.4	9
83	92	32.0	30.8	0.323	92.4	47.2	44	14.7	0.4	12
85	92	30.5	29.5	0.319	91.1	47.3	42	14.3	0.5	6
87	92	32.4	31.2	0.332	94.8	47.2	44	15.2	0.4	8
89	92	29.2	28.6	0.320	91.3	47.4	41	14.5	0.7	9
91	92	31.7	30.7	0.313	89.6	47.1	44	14.4	0.7	9
93	92	30.9	29.8	0.330	94.2	47.3	42	15.1	0.9	11
95	92	32.4	31.1	0.313	89.3	47.0	44	13.9	0.7	10
97	92	29.6	28.8	0.315	90.0	47.2	41	14.2	0.9	12
99	92	29.2	28.9	0.309	88.3	47.0	41	13.8	0.7	13
101	92	29.7	28.9	0.324	92.5	47.1	41	14.9	0.9	14
103	92	30.7	29.6	0.334	95.5	47.2	42	15.4	0.9	13
105	92	29.4	28.5	0.320	91.6	47.2	40	14.7	0.9	13
107	92	29.5	28.8	0.316	90.2	47.0	41	14.1	0.9	13
Average		30.3	29.5	0.316	90.4	47.2	42	14.3	0.8	10
Std. Dev.		1.1	0.9	0.009	2.5	0.1	1	0.5	0.2	2
Maximum		32.5	31.2	0.334	95.5	47.4	44	15.4	1.1	14

Total number of blows analyzed: 81

BL#	Comments
1	Start of test on 7/1/2013 at 12:04:57 PM
107	End of test on 7/1/2013 at 12:07:13 PM

Time Summary

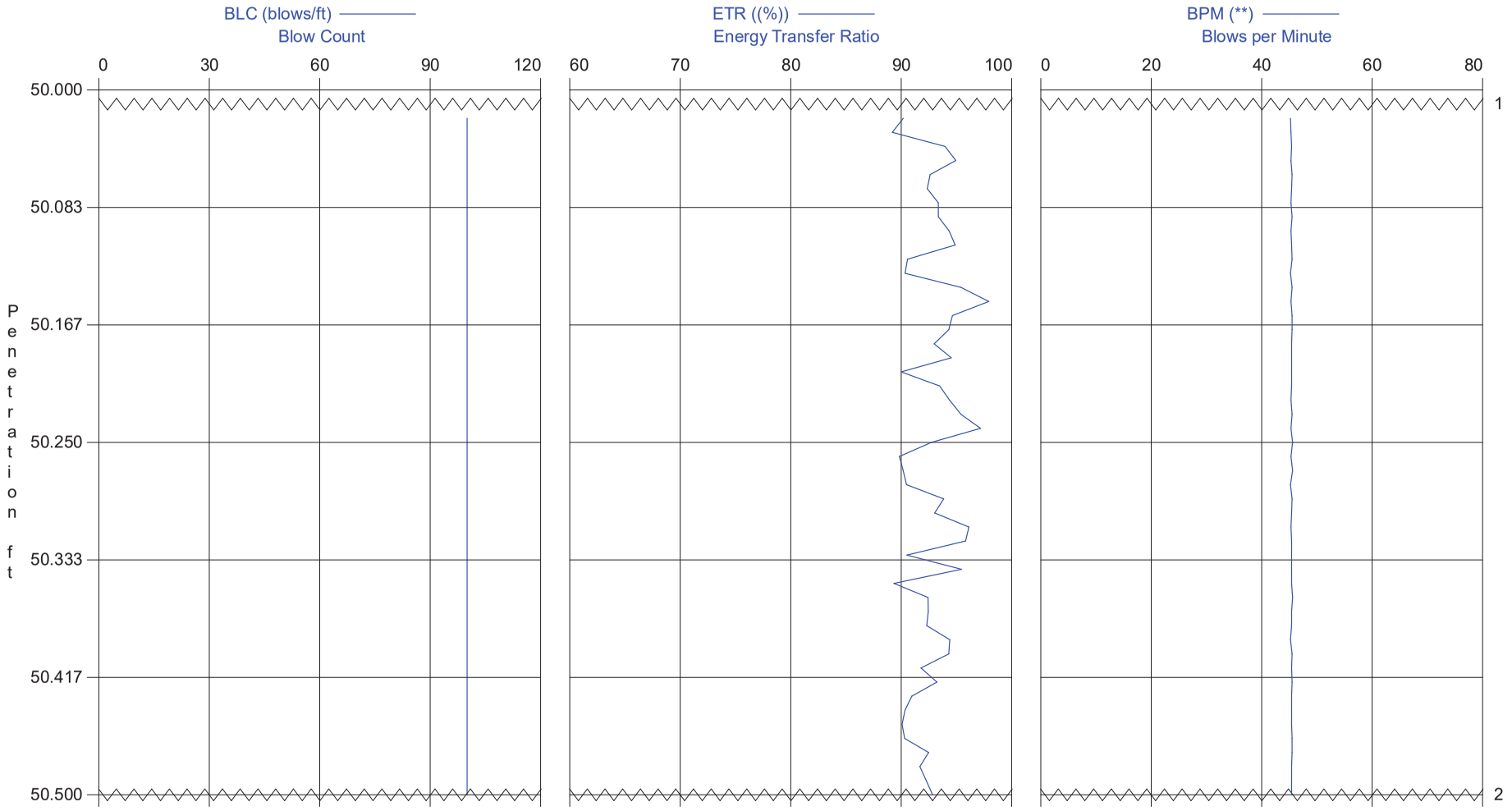
Drive 2 minutes 16 seconds 12:04:57 PM - 12:07:13 PM (7/1/2013) BN 1 - 107

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

Test date: 1-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 5, 50 FT -BH E340-B-07A



1 - Start of test on 7/1/2013 at 12:32:13 PM

2 - End of test on 7/1/2013 at 12:33:17 PM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 5, 50 FT
OP: RMDT

BH E340-B-07A
Test date: 1-Jul-2013

AR: 1.42 in^2
LE: 54.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute

FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio
RAU: Auto Capacity End Bearing Piles

BL#	BLC	CSI	CSX	EFV	ETR	BPM	FMX	VMX	RAT	RAU
	bl/ft	ksi	ksi	k-ft	(%)	**	kips	f/s	[]	kips
2	100	29.9	29.6	0.316	90.2	45.2	42	14.6	1.1	9
3	100	29.7	29.5	0.312	89.2	45.3	42	14.4	0.5	6
4	100	30.0	29.5	0.329	94.0	45.4	42	14.4	0.6	12
5	100	30.8	30.5	0.332	95.0	45.3	43	14.9	0.6	7
6	100	29.6	29.2	0.324	92.6	45.5	41	14.9	1.0	8
7	100	29.7	29.3	0.323	92.4	45.4	42	14.3	0.6	9
8	100	30.1	30.0	0.327	93.4	45.3	43	14.9	0.8	10
9	100	29.2	29.1	0.327	93.4	45.5	41	14.7	0.6	12
10	100	29.7	29.6	0.330	94.3	45.3	42	15.0	0.6	12
11	100	30.7	30.4	0.332	94.9	45.4	43	15.3	0.5	13
12	100	29.7	29.7	0.317	90.6	45.5	42	14.4	0.6	12
13	100	29.0	28.6	0.316	90.3	45.2	41	14.4	0.6	10
14	100	31.9	31.4	0.334	95.4	45.5	45	15.5	0.5	15
15	100	30.3	30.2	0.343	97.9	45.3	43	14.8	0.6	10
16	100	29.3	29.2	0.331	94.6	45.5	41	14.8	0.6	12
17	100	30.6	30.2	0.330	94.3	45.5	43	15.3	0.7	12
18	100	29.5	29.1	0.325	93.0	45.4	41	14.5	0.6	11
19	100	30.2	30.0	0.331	94.5	45.4	43	15.2	0.6	14
20	100	28.9	28.6	0.315	90.0	45.4	41	14.7	0.7	15
21	100	29.1	28.7	0.327	93.5	45.4	41	14.6	0.6	11
22	100	29.5	29.5	0.330	94.4	45.3	42	15.1	0.6	14
23	100	32.1	31.4	0.334	95.4	45.5	45	15.6	0.4	13
24	100	32.0	31.3	0.340	97.2	45.3	44	15.5	0.5	16
25	100	29.6	29.5	0.325	92.7	45.6	42	15.1	0.7	15
26	100	28.8	28.2	0.314	89.8	45.3	40	14.2	0.6	11
27	100	28.9	28.4	0.316	90.2	45.6	40	14.6	0.6	11
28	100	28.8	28.4	0.317	90.5	45.2	40	14.7	0.8	11
29	100	29.0	28.9	0.328	93.8	45.5	41	14.8	0.7	10
30	100	29.3	29.2	0.326	93.0	45.4	42	15.1	0.6	13
31	100	31.5	31.1	0.336	96.1	45.3	44	15.2	0.6	16
32	100	30.4	30.0	0.335	95.8	45.4	43	15.5	0.7	20
33	100	29.7	29.2	0.317	90.5	45.4	41	14.1	0.6	12
34	100	30.5	30.3	0.334	95.5	45.4	43	14.9	0.7	15
35	100	29.5	29.0	0.313	89.3	45.4	41	14.3	0.8	13
36	100	30.5	30.5	0.324	92.4	45.6	43	14.9	0.5	16
37	100	29.9	29.3	0.324	92.5	45.4	42	15.1	0.7	15
38	100	29.5	29.0	0.323	92.3	45.4	41	14.4	0.5	16
39	100	29.5	28.8	0.330	94.4	45.2	41	15.2	0.5	20
40	100	32.1	30.4	0.330	94.3	45.5	43	14.4	0.5	16
41	100	29.3	28.6	0.321	91.8	45.4	41	14.5	0.6	18
42	100	29.5	29.3	0.326	93.2	45.5	42	14.2	0.6	14
43	100	29.7	29.6	0.318	91.0	45.4	42	15.1	0.6	19
44	100	28.8	28.6	0.316	90.3	45.4	41	14.2	0.6	16
45	100	28.1	28.1	0.315	90.1	45.4	40	13.9	0.6	16
46	100	29.2	28.5	0.316	90.3	45.5	40	14.5	0.5	13
47	100	31.2	29.7	0.324	92.5	45.5	42	14.9	0.5	16
48	100	30.2	29.7	0.321	91.7	45.4	42	13.9	1.0	16
49	100	30.5	29.9	0.323	92.3	45.4	42	14.3	0.7	16
50	100	29.8	29.3	0.325	92.8	45.4	42	14.5	0.5	15
Average		29.9	29.5	0.325	92.9	45.4	42	14.7	0.6	13
Std. Dev.		0.9	0.8	0.007	2.1	0.1	1	0.4	0.1	3
Maximum		32.1	31.4	0.343	97.9	45.6	45	15.6	1.1	20

Total number of blows analyzed: 49

BL#	Comments
1	Start of test on 7/1/2013 at 12:32:13 PM
50	End of test on 7/1/2013 at 12:33:17 PM

Time Summary

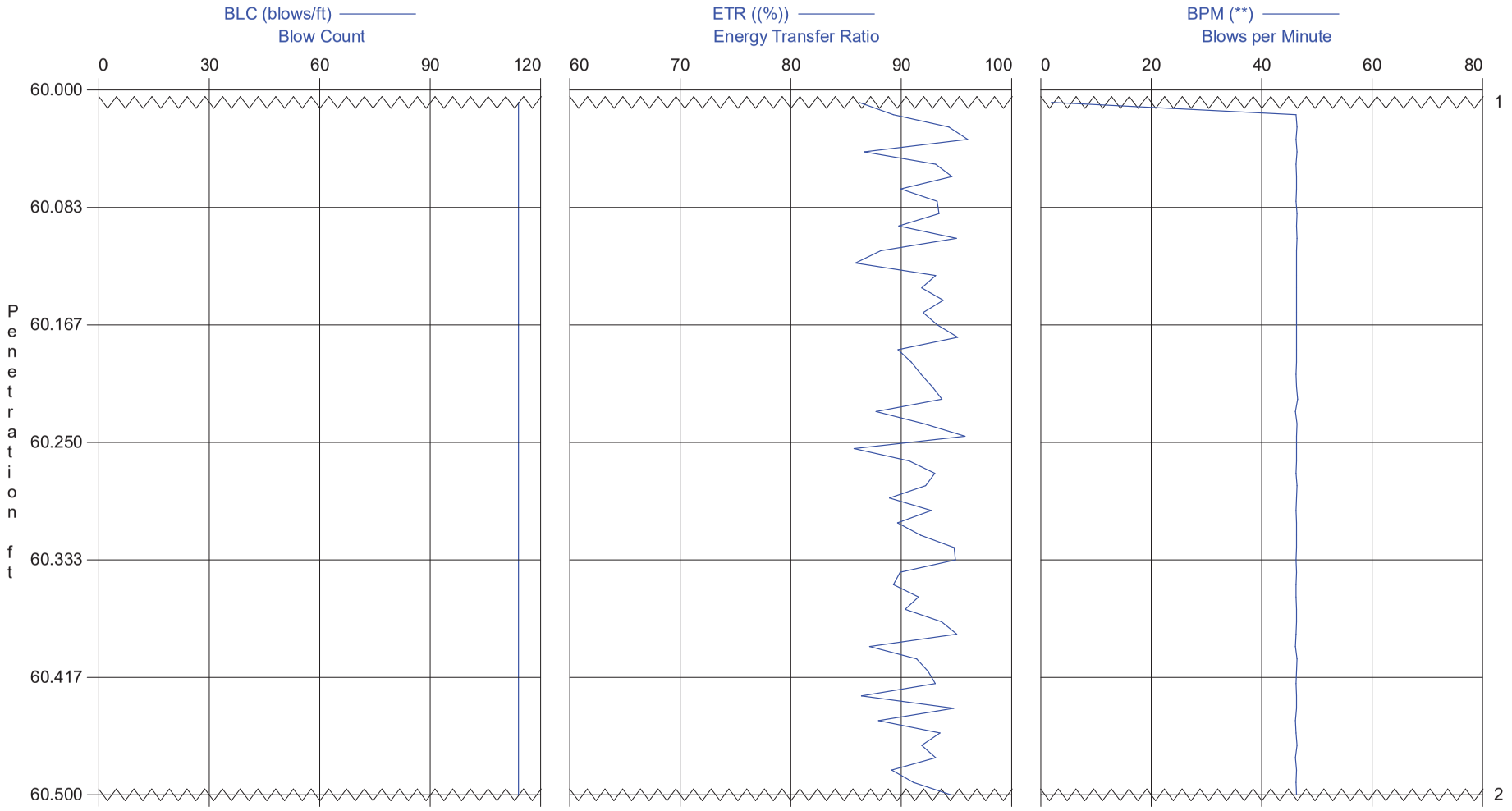
Drive 1 minute 4 seconds 12:32:13 PM - 12:33:17 PM (7/1/2013) BN 1 - 50

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

Test date: 1-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 6, 60 FT -BH E340-B-07A



1 - Start of test on 7/1/2013 at 1:05:07 PM

2 - End of test on 7/1/2013 at 1:06:20 PM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 2-Jul-2013

HOLT, SPT RIG 7 - SAMPLE 6, 60 FT
OP: RMDT

BH E340-B-07A
Test date: 1-Jul-2013

AR: 1.42 in^2
LE: 64.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute

FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio
RAU: Auto Capacity End Bearing Piles

BL#	BLC	CSI	CSX	EFV	ETR	BPM	FMX	VMX	RAT	RAU
	bl/ft	ksi	ksi	k-ft	(%)	**	kips	f/s	[]	kips
1	114	29.5	28.6	0.302	86.2	1.9	41	14.3	0.6	0
2	114	30.3	29.1	0.313	89.3	46.2	41	13.8	0.6	0
3	114	33.6	31.9	0.330	94.3	46.4	45	15.3	0.5	0
4	114	32.8	31.2	0.336	96.0	46.2	44	15.6	0.5	4
5	114	30.2	28.9	0.303	86.7	46.4	41	13.5	0.6	4
6	114	33.0	30.8	0.326	93.1	46.2	44	14.8	0.5	2
7	114	34.2	31.8	0.331	94.6	46.3	45	16.0	0.5	4
8	114	31.3	29.7	0.315	90.0	46.3	42	14.0	0.6	6
9	114	31.6	30.1	0.326	93.3	46.2	43	14.9	0.6	9
10	114	32.7	31.0	0.327	93.4	46.4	44	14.4	0.5	12
11	114	30.1	29.2	0.314	89.8	46.3	41	14.5	0.6	11
12	114	33.3	31.4	0.333	95.0	46.4	45	15.3	0.5	10
13	114	30.6	29.2	0.309	88.2	46.3	42	13.8	0.5	9
14	114	30.6	29.2	0.300	85.9	46.3	41	13.6	0.6	9
15	114	30.8	29.3	0.326	93.1	46.3	42	14.9	0.5	15
16	114	30.6	29.4	0.322	91.9	46.3	42	13.7	0.6	12
17	114	32.9	30.4	0.328	93.8	46.3	43	15.0	0.5	12
18	114	30.8	29.6	0.322	92.0	46.3	42	14.2	0.6	12
19	114	32.3	30.7	0.326	93.3	46.3	44	15.8	0.5	10
20	114	33.4	31.8	0.333	95.1	46.3	45	15.3	0.5	8
21	114	31.6	30.1	0.314	89.7	46.3	43	14.3	0.5	9
22	114	30.5	29.5	0.318	90.9	46.3	42	14.6	0.5	10
23	114	31.4	30.3	0.321	91.8	46.2	43	14.5	0.5	12
24	114	32.9	31.0	0.325	92.8	46.3	44	15.1	0.5	13
25	114	31.2	29.6	0.328	93.7	46.5	42	15.4	0.6	11
26	114	31.2	29.6	0.307	87.7	46.1	42	12.9	0.6	14
27	114	29.9	29.0	0.322	92.1	46.4	41	14.0	0.6	11
28	114	32.1	30.1	0.335	95.8	46.3	43	15.7	0.6	12
29	114	29.5	29.0	0.300	85.7	46.3	41	13.1	0.5	18
30	114	30.9	29.7	0.318	90.7	46.3	42	15.1	0.5	12
31	114	31.8	30.3	0.326	93.0	46.2	43	15.5	0.5	15
32	114	30.8	29.5	0.323	92.2	46.4	42	14.5	0.5	10
33	114	30.0	29.1	0.311	88.9	46.3	41	14.2	0.5	12
34	114	32.8	31.3	0.325	92.7	46.2	44	14.9	0.5	11
35	114	30.4	29.4	0.314	89.7	46.3	42	14.5	0.6	11
36	114	32.0	30.6	0.321	91.8	46.3	43	15.0	0.5	14
37	114	33.1	31.6	0.332	94.8	46.3	45	15.6	0.5	12
38	114	32.9	31.3	0.332	94.9	46.2	44	16.0	0.5	16
39	114	32.4	30.2	0.315	89.9	46.3	43	13.8	0.5	23
40	114	30.0	29.1	0.313	89.3	46.2	41	14.1	0.6	27
41	114	31.1	29.2	0.320	91.6	46.2	42	14.8	0.5	26
42	114	30.0	29.0	0.316	90.4	46.3	41	14.1	0.6	26
43	114	31.7	29.6	0.328	93.7	46.3	42	14.8	0.5	15
44	114	31.2	29.7	0.333	95.0	46.2	42	15.6	0.5	17
45	114	30.7	29.4	0.305	87.1	46.1	42	13.0	0.6	14
46	114	30.8	29.7	0.320	91.4	46.4	42	14.4	0.6	14
47	114	31.0	30.3	0.324	92.4	46.3	43	14.4	0.5	14
48	114	31.5	30.2	0.326	93.1	46.2	43	15.1	0.6	16
49	114	30.4	29.6	0.302	86.4	46.3	42	13.1	0.6	14
50	114	32.0	30.6	0.332	94.8	46.3	43	15.3	0.5	15
51	114	31.5	30.4	0.308	87.9	46.1	43	13.7	0.6	16
52	114	33.4	31.9	0.327	93.5	46.2	45	15.2	0.5	23
53	114	31.3	30.1	0.321	91.9	46.4	43	14.9	0.5	15
54	114	31.8	30.5	0.326	93.1	46.1	43	14.9	0.6	13
55	114	31.3	30.2	0.312	89.1	46.3	43	13.6	0.5	13
56	114	31.3	30.3	0.319	91.1	46.2	43	14.3	0.6	13
57	114	32.1	30.9	0.331	94.5	46.3	44	15.8	0.5	15
Average		31.5	30.1	0.321	91.6	45.5	43	14.6	0.5	12
Std. Dev.		1.1	0.9	0.010	2.7	5.8	1	0.8	0.1	6
Maximum		34.2	31.9	0.336	96.0	46.5	45	16.0	0.6	27

Total number of blows analyzed: 57

BL#	Comments
1	Start of test on 7/1/2013 at 1:05:07 PM
57	End of test on 7/1/2013 at 1:06:20 PM

Time Summary

Drive	1 minute 13 seconds	1:05:07 PM - 1:06:20 PM (7/1/2013)	BN 1 - 57

Robert Miner Dynamic Testing, Inc.
Dynamic Measurements and Analyses for Deep Foundations

September 26, 2017

Mr. Dale Abernathy
Holt Services, Inc.
10621 Todd Rd. East
Edgewood, WA 98372

Re: Penetration Test Energy Measurements
Mobile B-58 Rig No. 17, Mobile Auto Hammer
Bore Hole: Yard Test Hole, August 25, 2017
Holt Services Yard, Edgewood, Washington

RMDT Job No. 17F39

Dear Mr. Abernathy,

This letter presents energy transfer measurements made during Standard Penetration Tests for the drill hole and drill rig referenced above. Robert Miner Dynamic Testing, Inc. (RMDT) made dynamic measurements with a Pile Driving Analyzer® as a hammer advanced the NW rod during sampling with a split spoon sampler.

The purpose of RMDT's testing was the measurement of energy transferred to the drill rods. Measurements were made on a section of NW gauge rod at the top of the drill string. Strain gages and accelerometers on the rod were connected to a Pile Driving Analyzer® (PDA) which generally processed acceleration and strain measurements from each hammer blow and stored both the measurements and computed results. Measurements and data processing generally followed the ASTM D 4633-16 standard. Energy transfer past the gage location, EFV, was computed by the PDA using force and velocity records as follows:

$$EFV = \int_a^b F(t)\ v(t)\ dt$$

The value "a" corresponds to the start of the record which is when the energy transfer begins and *"b"* is the time at which energy transferred to the rod reaches a maximum value. Appendix A contains more information on our measurement equipment and methods of analysis. The EFV energy calculation is identical to the EMX energy result discussed in Appendix A. The EFV and EMX values apply to the sensor location near the top of the rod.

TEST DETAILS

On August 25, 2017, a single boring was advanced at the maintenance yard of Holt Services in Edgewood, Washington. The drill rig used during sampling was a truck mounted Mobile B-58 auger unit manufactured by Mobile Drill International and referred to as Rig 17 by the operator. The B-58 unit drilled to six predetermined depth intervals ranging from 20 to 50 ft below ground

Mailing Address: P.O. Box 340, Manchester, WA, 98353, USA **Phone:** 360-871-5480
Location: 2288 Colchester Dr. E., Ste A, Manchester, WA, 98353 **Fax:** 360-871-5483

surface. The rod used to advance the spoon at each sample depth had a diameter matching that of NW rod. The automatic hammer in use during our testing was manufactured by Mobile Dill International and appeared to use a chain drive powered by a hydraulic motor, with the ram and chain drive enclosed within an outer casing.

RESULTS

A summary of testing and monitoring results is given in Table 1. The tabulated results include the starting sample depth, the penetration resistance, the number of hammers blows in our data set, measured energy transfer, EFV, the computed transfer efficiency, ETR, and the hammer blow rate, BPM. Appendix B contains detailed numeric results for each individual test.

Energy measurements must be divided by the theoretical free fall energy of the hammer to obtain an efficiency. A 140 lb ram raised 30 inches above an impact surface has 350 lb-ft of potential energy. Thus, the transfer energy results for sampling with the 140 lb ram may be divided by 350 lb-ft to yield the ratio of the delivered energy to the nominal potential energy. This efficiency ratio, ETR, is given for each sample interval as a percent efficiency.

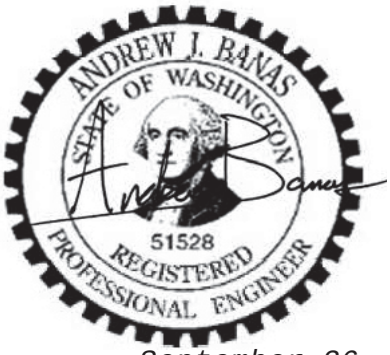
Table 1. Summary of Test Details and Results for the 140-lb ram and Split Spoon Sampler

Sample Name and Sample Depth	Penetration Resistance (Blow/Set)	Number of Blows in Data Set	Average Transfer Energy EFV (lb-ft)	Average Transfer Efficiency ETR (percent)	Average Hammer Blow Rate BPM (blow/min)
20 ft Sample	30/1 ft	30	289	83	28
25 ft Sample	25/1 ft	25	288	82	29
30 ft Sample	33/1 ft	33	288	82	32
35 ft Sample	27/1 ft	27	290	83	32
40 ft Sample	23/1 ft	23	291	83	32
50 ft Sample	50/3 in	49	285	82	32
Average for Split Spoon samples:			**289**	**83**	**31**

Six sample returns were monitored while the 140 lb ram and standard split spoon sampler were in use. The overall average ETR and hammer blow rate was 83 percent and 31 blows per minute, respectively.

It was a pleasure to assist you and to participate on this project with the staff of Holt Services Inc. Please do not hesitate to contact us if you or other project participants have any questions about this report.

Sincerely,



September 26, 2017

Andrew J. Banas, P.E.

Robert Miner Dynamic Testing, Inc.

APPENDIX A
AN INTRODUCTION INTO DYNAMIC PILE TESTING METHODS

The following has been written by Goble Rausche Likins and Associates, Inc. and may only be copied with its written permission.

BACKGROUND

Modern procedures of design and construction control require verification of bearing capacity and integrity of deep foundations during preconstruction test programs and also production installation. Dynamic pile testing methods meet this need economically and reliably, and therefore, form an important part of a quality assurance program when deep foundations are executed. Several dynamic pile testing methods exist; they have different benefits and limitations and different requirements for proper execution.

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (such as that of a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. The method is therefore also referred to as a "High Strain Method". The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then an evaluation of various quantities based on closed form solutions of the wave equation, a partial differential equation describing the motion of a rod under the effect of an impact. Conveniently, measurements and analyses are done by a single piece of equipment: the Pile Driving Analyzer® (PDA). However, for bearing capacity evaluations an important additional method is CAPWAP® which performs a much more rigorous analysis of the dynamic records than the simpler Case Method.

A related analysis method is the "Wave Equation Analysis" which calculates a relationship between bearing capacity and pile stress and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data.

The following description deals primarily with the Case Method or "High Strain Test" Method of pile testing, however, for the sake of completeness, the "Low Strain Test" performed with the Pile Integrity Test™ (PIT), mainly for pile integrity evaluation, will also be described.

RESULTS FROM DYNAMIC TESTING

There are two main objectives of high strain dynamic pile testing:

- *Dynamic Pile Monitoring* and
- *Dynamic Load Testing*.

Dynamic pile monitoring is conducted during the installation of impact driven piles to achieve a safe and economical pile installation. Dynamic load testing, on the other hand, has as its primary goal the assessment of pile bearing capacity. It is applicable to both cast *insitu* piles or drilled shafts and impact driven piles during restrike.

Dynamic Pile Monitoring

During pile installation, the sensors attached to the pile measure pile top force and velocity. A PDA conditions and processes these signals and calculates or evaluates:

- Bearing capacity at the time of testing, including an assessment of shaft resistance development and driving resistance. This information supports formulation of a driving criterion.

- Dynamic pile stresses, axial and averaged over the pile cross section, both tensile and compressive, during pile driving to limit the potential of damage either near the pile top or along its length. Bending stresses can be evaluated at the point of sensor attachment.

- Pile integrity assessment by the PDA is based on the recognition of certain wave reflections from along the pile. If detected early enough, a pile may be saved from complete destruction. On the other hand, once damage is recognized measures can be taken to prevent reoccurrence.

- Hammer performance parameters including the energy transferred to the pile, the hammer speed in blows per minute and the stroke of open ended diesel hammers.

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Dynamic Pile Load Testing

Bearing capacity testing of either driven piles or drilled shafts applies the same basic measurement approach of dynamic pile monitoring. However, the test is done independent of the pile installation process and therefore a pile driving hammer or other dynamic loading device may not be available. If a special ram has to be mobilized then its weight should be between 0.8 and 2% of the test load (e.g. between 4 and 10 tons for a 500 ton test load) to assure sufficient soil resistance activation.

For a successful test, it most important that the test is conducted after a sufficient waiting time following pile installation for soil properties approaching their long term condition or concrete to properly set. During testing, PDA results of pile/shaft stresses and transferred energy are used to maintain safe stresses and assure sufficient resistance activation. For safe and sufficient testing of drilled shafts, ram energies are often increased from blow to blow until the test capacity has been activated. On the other hand, restrike tests on driven piles may require a warm hammer so that the very first blow produces a complete resistance activation. Data must be evaluated by CAPWAP for bearing capacity.

After the dynamic load test has been conducted with sufficient energy and safe stresses, the CAPWAP analysis provides the following results:

- Bearing capacity i.e. the mobilized capacity present at the time of testing
- Resistance distribution including shaft resistance and end bearing components
- Stresses in pile or shaft calculated for both the static load application and the dynamic test. These stresses are averages over the cross section and do not include bending effects or nonuniform contact stresses, e.g. when the pile toe is on uneven rock.
- Shaft impedance vs depth; this is an estimate of the shaft shape if it differs substantially from the planned profile
- Dynamic soil parameters for shaft and toe, i.e. damping factors and quakes (related to the dynamic stiffness of the resistance at the pile/soil interface.)

MEASUREMENTS

PDA

The basis for the results calculated by the PDA are pile top strain and acceleration measurements which are converted to force and velocity records, respectively. The PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. Using closed form Case Method solutions, based on the one-dimensional linear wave equation, the PDA calculates the results described in the analytical solutions section below.

HPA

The ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. For this unit to be applicable, the ram must be visible. The impact velocity results can be automatically processed with a PC or recorded on a strip chart.

Saximeter™

For open end diesel hammers, the time between two impacts indicates the magnitude of the ram fall height or stroke. This information is not only measured and calculated by the PDA but also by the convenient, hand-held Saximeter.

PIT

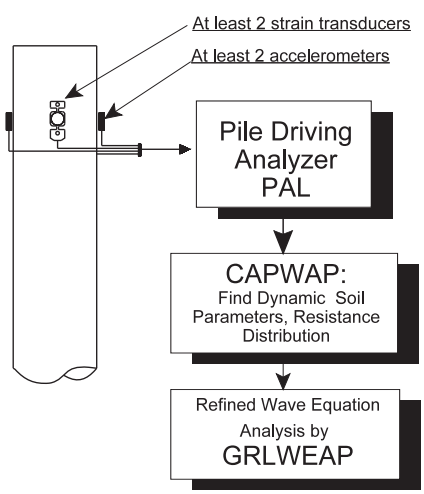
The Pile Integrity Tester™ (PIT) can be used to evaluate defects in concrete piles or shafts which may have occurred during driving or casting. Also timber piles of limited length can be tested in that manner. This so-called "Low Strain Method" or “Pulse-Echo Method” of integrity testing requires only the measurement of acceleration at the pile top. The stress wave producing impact is then generated by a small hand-held hammer and the records interpreted in the time domain. PIT also supports the so-called “Transient Response Method” which requires the additional measurement of the hammer force and an analysis in the frequency domain. This method may also be used to evaluate the unknown length of deep foundations under existing structures.

ANALYTICAL SOLUTIONS
BEARING CAPACITY

Wave Equation

GRL has written the GRLWEAP™ program which calculates a relationship between bearing capacity, pile stress and blow count. This relationship is often called the "bearing graph." Once the blow count is known from pile installation logs, the bearing graph yields the bearing capacity. This approach requires no measurements and therefore can be performed during the design stage of a project, for example for the selection of hammer, cushion and pile size.

After dynamic pile monitoring and/or dynamic load testing has been performed, the "Refined Wave Equation Analysis" or RWEA (see schematic below) is often performed by inputting the PDA and CAPWAP calculated parameters. Then the bearing graph from the RWEA is the basis for a safe and sufficient driving criteria.



Case Method

The Case Method is a closed form solution based on a few simplifying assumptions such as ideal plastic soil behavior and an ideally elastic and uniform pile. Given the measured pile top force F(t) and pile top velocity v(t), the total soil resistance is

$$R(t) = \tfrac{1}{2}\{[F(t) + F(t_2)] + Z[v(t) - v(t_2)]\} \qquad (1)$$

where

t	=	a point in time after impact
t_2	=	time t + 2L/c
L	=	pile length below gages
c	=	$(E/\rho)^{1/2}$ is the speed of the stress wave
ρ	=	pile mass density
Z	=	EA/c is the pile impedance
E	=	elastic modulus of the pile ($\rho\, c^2$)
A	=	pile cross sectional area

The total soil resistance consists of a dynamic (R_d) and a static (R_s) component. The static component is therefore

$$R_s(t) = R(t) - R_d(t) \qquad (2)$$

The dynamic component may be computed from a soil damping factor, J, and a pile toe velocity, $v_t(t)$ which is conveniently calculated for the pile toe. Using wave considerations, this approach leads immediately to the dynamic resistance

$$R_d(t) = J[F(t) + Zv(t) - R(t)] \qquad (3)$$

and finally to the static resistance by means of Equation 2.

There are a number of ways in which Eq. 1 through 3 can be evaluated. Most commonly, t_2 is set to that time at which the static resistance becomes maximum. The result is the so-called **RMX** capacity. Damping factors for RMX typically range between 0.5 for coarse grained materials to 1.0 for clays. The **RSP** capacity (this method is most commonly referred to in the literature, yet it is not very frequently used) requires damping factors between 0.1 for sand and 1.0 for clay. Another capacity, **RA2**, determines the capacity at a time when the pile is essentially at rest and thus damping is small; RA2

therefore requires no damping parameter. In any event, the proper Case Method and its associated damping parameter is most conveniently found after a CAPWAP analysis has been performed.

The static resistance calculated by Case Method or CAPWAP is the mobilized resistance at the time of testing. Consideration therefore has to be given to soil setup or relaxation effects and whether or not a sufficient set has been achieved under the test loading that would correspond to a full activation of the ultimate soil resistance.

The PDA also calculates an estimate of shaft resistance as the difference between force and velocity times impedance at the time immediately prior to the return of the stress wave from the pile toe. This shaft resistance is not reduced by damping effects and is therefore called the total shaft resistance **SFT**. A correction for damping effects produces the static shaft resistance estimate, **SFR**.

The Case Method solution is simple enough to be evaluated "in real time," i.e. between hammer blows, using the PDA. It is therefore possible to calculate all relevant results for all hammer blows and plot these results as a function of depth or blow number. This is done in the PDAPLOT program.

CAPWAP

The CAse Pile Wave Analysis Program combines the wave equation pile and soil model with the Case Method measurements. Thus, the solution includes not only the total and static bearing capacity values but also the shaft resistance, end bearing, damping factors and soil stiffnesses. The method iteratively calculates a number of unknowns by signal matching. While it is necessary to make hammer performance assumptions for a GRLWEAP analysis, the CAPWAP program works with the pile top measurements. Furthermore, while GRLWEAP and Case Method require certain assumptions regarding the soil behavior, CAPWAP calculates these soil parameters.

STRESSES

During pile monitoring, it is important that compressive stress maxima at pile top and toe and tensile stress maxima somewhere along the pile be calculated for each hammer blow.

At the pile top (location of sensors) both the maximum compression stress, **CSX**, and the maximum stress from individual strain transducers, **CSI**, are directly obtained from the measurements. Note that CSI is greater than or equal to CSX and the difference between CSI and CSX is a measure of bending in the plane of the strain transducers. Note also that all stresses calculated for locations below the sensors are averaged over the pile cross section and therefore do not include components from either bending or eccentric soil resistance effects.

The PDA calculates the compressive stress at the pile bottom, **CSB**, assuming (a) a uniform pile and (b) that the pile toe force is the maximum value of the total resistance R(t) minus the total shaft resistance, SFT. Again, for this stress estimation uniform resistance force are assumed (e.g. not a sloping rock.)

For concrete piles, the maximum tension stress, **TSX**, is also of great importance. It occurs at some point below the pile top. The maximum tension stress can be computed from the pile top measurements by finding the maximum tension wave (either traveling upward, W_U, or downward, W_d) and reducing it by the minimum compressive wave traveling in opposite direction.

$$W_u = ½[F(t) - Zv(t)] \quad (4)$$

$$W_d = ½[F(t) + Zv(t)] \quad (5)$$

CAPWAP also calculates tensile and compressive stresses along the pile and, in general, more accurately than the PDA. In fact, for non-uniform piles or piles with joints, cracks or other discontinuities, the closed form solutions from the PDA may be in error.

PILE INTEGRITY

High Strain Tests (PDA)

Stress waves in a pile are reflected wherever the pile impedance, $Z = EA/c = \rho cA = A\sqrt{(E\rho)}$, changes. Therefore, the pile impedance is a measure of the quality of the pile material (E, ρ, c) and the size of its cross section (A). The reflected waves arrive at the pile top at a time which is greater the farther away from the pile top the reflection occurs. The

magnitude of the change of the upward traveling wave (calculated from the measured force and velocity, Eq. 4) indicates the extent of the cross sectional change. Thus, with β_i (**BTA**) being a relative integrity factor which is unity for no impedance change and zero for the pile end, the following is calculated by the PDA.

$$\beta_i = (1 - \alpha_i)/(1 + \alpha_i) \quad (6)$$

with

$$\alpha_i = ½(W_{UR} - W_{UD})/(W_{Di} - W_{UR}) \quad (7)$$

where

W_{UR} is the upward traveling wave at the onset of the reflected wave. It is caused by resistance.

W_{UD} is the upwards traveling wave due to the damage reflection.

W_{Di} is the maximum downward traveling wave due to impact.

It can be shown that this formulation is quite accurate as long as individual reflections from different pile impedance changes have no overlapping effects on the stress wave reflections.

Without rigorous derivation, it has been proposed to consider as slight damage when β is above 0.8 and a serious damage when β is less than 0.6.

Low Strain Tests (PIT)

The pile top is struck with a held hand hammer and the resulting pile top velocity is measured, displayed and interpreted for signs of wave reflections. In general, a comparison of the reflected acceleration leads to a relative measure of extent of damage, again the location of the problem is indicated by the arrival time of the reflection. PIT records can also be interpreted by the β-Method. However, low strain tests do not activate much resistance which simplifies Eq. 7 since W_{UR} is then equal to zero.

For drilled shafts and PIT records that clearly show a toe reflection, an approximate shaft profile can be calculated from low strain records using the PITSTOP program's PROFILE routine.

HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(t)v(t)\,dt \quad (8a)$$

The maximum of the E(t) curve is the most important information for an overall evaluation of the performance of a hammer and driving system. This **EMX** value allows for a classification of the hammer's performance when presented as the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency

$$e_T = EMX/E_R \quad (8b)$$

where

E_R is the manufacturer's rated energy value.

Both Saximeter and PDA calculate the stroke (**STK**) of an open end diesel hammer using

$$STK = (g/8)\,T_B^2 - h_L \quad (9)$$

where

g is the earth's gravitational acceleration,
T_B is the time between two hammer blows,
h_L is a stroke loss value due to gas compression and time losses during impact (usually 0.3 ft or 0.1 m).

DETERMINATION OF WAVE SPEED

An important facet of dynamic pile testing is an assessment of pile material properties. Since in general force is determined from strain by multiplication with elastic modulus, E, and cross sectional area, A, the dynamic elastic modulus has to be determined for pile materials other than steel. In general, the records measured by the PDA clearly indicate a pile toe reflection as long as pile penetration per blow is greater than 1 mm or .04 inches. The time between the onset of the force and velocity records at impact and the onset of the reflection from the toe (usually apparent by a local maximum of the wave up curve) is the so-called wave travel time, T. Dividing 2L (L is here the length of the pile below sensors) by T leads to the stress wave speed in the pile:

$$c = 2L/T \quad (10)$$

The elastic modulus of the pile material is related to the wave speed according to the linear elastic wave equation theory by

$$E = c^2\rho \tag{11}$$

Since the mass density of the pile material, ρ, is usually well known (an exception is timber for which samples should be weighed), the elastic modulus is easily found from the wave speed. Note, however, that this is a dynamic modulus which is generally higher than the static one and that the wave speed depends to some degree on the strain level of the stress wave. For example, experience shows that the wave speed from PIT is roughly 5% higher than the wave speed observed during a high strain test.

Other Notes:

- If the pile material is nonuniform then the wave speed c, according to Eq. 10, is an average wave speed and does not necessarily reflect the pile material properties of the location where the strain sensors are attached to the pile top. For example, pile driving often causes fine tension cracks some distance below the top of concrete piles. Then the average c is slower than that at the pile top. It is therefore recommended to determine E in the beginning of pile driving and not adjust it when the average c changes.

- If the pile has such a high resistance that there is no clear indication of a toe reflection then the wave speed of the pile material must be determined either by assumption or by taking a sample of the concrete and measuring its wave speed in a simple free column test. Another possibility is to use the proportionality relationship, discussed under "DATA QUALITY CHECKS" to find c as the ratio between the measured velocity and measured strain.

DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing PDA or PIT tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to certain relationships.

Proportionality

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the pile, force and velocity measured at the pile top are proportional

$$F = v\,Z = v\,(EA/c) \tag{12a}$$

This relationship can also be expressed in terms of stress

$$\sigma = v\,(E/c) \tag{12b}$$

or strain

$$\epsilon = v / c \tag{12c}$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements.

Measurements are always taken at opposite sides of the pile as a means of calculating the average force and velocity in the pile. The velocity on the two sides of the pile is very similar even when high bending exists. Thus, an independent check of the velocity measurements is easy and simple.

Strain measurements may differ greatly between the two sides of the pile when bending exists. It is even possible that tension is measured on one side while very high compression exists on the other side of the pile. In extreme cases, bending might be so high that it leads to a nonlinear stress distribution. The averaging of the two strain signals does then not lead to the average pile force and proportionality will not be achieved.

When testing drilled shafts, measurements of strain may also be affected by local concrete quality variations. It is then often necessary to use four strain transducers spaced at 90 degrees around the pile for an improved strain data quality. The use of four transducers is also recommended for large pile

diameters, particularly when it is difficult to mount the sensors at least two pile widths or diameters below the pile top.

LIMITATIONS, ADDITIONAL CONSIDERATIONS

Mobilization of capacity

Estimates of pile capacity from dynamic testing indicate the **mobilized pile capacity at the time of testing**. At very high blow counts (low set per blow), dynamic test methods tend to produce lower bound capacity estimates as not all resistance (particularly at and near the toe) is fully activated.

Time dependent soil resistance effects

Static pile capacity from dynamic method calculations provide an estimate of the axial pile capacity. Increases and decreases in the pile capacity with time typically occur (soil setup/relaxation). Therefore, **restrike testing usually yields a better indication of long term pile capacity than a test at the end of pile driving**. Often a wait period of one or two days between end of driving and restrike is satisfactory for a realistic prediction of pile capacity but this waiting time depends, among other factors, on the permeability of the soil.

(A) Soil setup

Because excess positive pore pressures often develop during pile driving in fine grained soil (clays, silts or even fine sands), the capacity of a pile at the time of driving may often be less than the long term pile capacity. These pore pressures reduce the effective stress acting on the pile thereby reducing the soil resistance to pile penetration, and thus the pile capacity at the time of driving. As these pore pressures dissipate, the soil resistance acting on the pile increases as does the axial pile capacity. This phenomena is routinely called soil setup or soil freeze.

(*B) Relaxation*

Relaxation (capacity reduction with time) has been observed for piles driven into weathered shale, and may take several days to fully develop. Pile capacity estimates based upon initial driving or short term restrike tests can significantly overpredict long term pile capacity. Therefore, piles driven into shale should be tested after a minimum one week wait either statically or dynamically (with particular emphasis than on the first few blows). Relaxation has also been observed for displacement piles driven into dense saturated silts or fine sands due to a negative pore pressure effect at the pile toe. Again, restrike tests should be used, with great emphasis on early blows.

Capacity results for open pile profiles

Larger diameter open ended pipe piles (or H-piles which do not bear on rock) may behave differently under dynamic and static loading conditions. Under dynamic loads the soil inside the pile or between its flanges may slip and produce internal friction while under static loads the plug may move with the pile, thereby creating end bearing over the full pile cross section. As a result both friction and end bearing components may be different under static and dynamic conditions.

CAPWAP Analysis Results

A portion of the soil resistance calculated on an individual soil segment in a CAPWAP analysis can usually be shifted up or down the shaft one soil segment without significantly altering the match quality. Therefore, use of the CAPWAP resistance distribution for uplift, downdrag, scour, or other geotechnical considerations should be made with an understanding of these analysis limitations.

Stresses

PDA and CAPWAP calculated stresses are average values over the cross section. Additional allowance has to be made for bending or non-uniform contact stresses. To prevent damage it is therefore important to maintain good hammer-pile alignment and to protect the pile toes using appropriate devices or an increased cross sectional area.

In the United States is has become generally acceptable to limit the dynamic installation stresses of driven piles to the following levels:

90% of yield strength for steel piles

85% of the concrete compressive strength - after subtraction of the effective prestress - for concrete piles in compression

100% of effective prestress plus ½ of the concrete's tension strength for prestressed piles in tension

70% of the reinforcement strength for regularly reinforced concrete piles in tension

300% of the static design allowable stress for timber

Note that the dynamic stresses may either be directly measured at the pile top by the PDA or calculated by the PDA for other locations along the pile based on the pile top measurements.

Additional design considerations

Numerous factors have to be considered in pile foundation design. Some of these considerations include

- additional pile loading from downdrag or negative skin friction,
- lateral and uplift loading requirements
- effective stress changes (due to changes in water table, excavations, fills or other changes in overburden),
- long term settlements in general and settlement from underlying weaker layers and/or pile group effects,

These factors have not been evaluated by GRL and have not been considered in the interpretation of the dynamic testing results. The foundation designer should determine if these or any other considerations are applicable to this project and the foundation design.

Wave equation analysis results

The results calculated by the wave equation analysis program depend on a variety of hammer, pile and soil input parameters. Although attempts have been made to base the analysis on the best available information, actual field conditions may vary and therefore stresses and blow counts may differ from the predictions reported. Capacity predictions derived from wave equation analyses should use restrike information. However, because of the uncertainties associated with restrike blow counts and restrike hammer energies, correlations of such results with static test capacities with have often displayed considerable scatter.

As for PDA and CAPWAP, the theory on which GRLWEAP is based is the one-dimensional wave equation. For that reason, stress predictions by the wave equation analysis can only be averages over the pile cross section. Thus, bending stresses or stress concentrations due to non-uniform impact or uneven soil or rock resistance are not considered in these results. Stress maxima calculated by the wave equation are usually subjected to the same limits as those measured directly or calculated from measurements by the PDA.

Appendix B

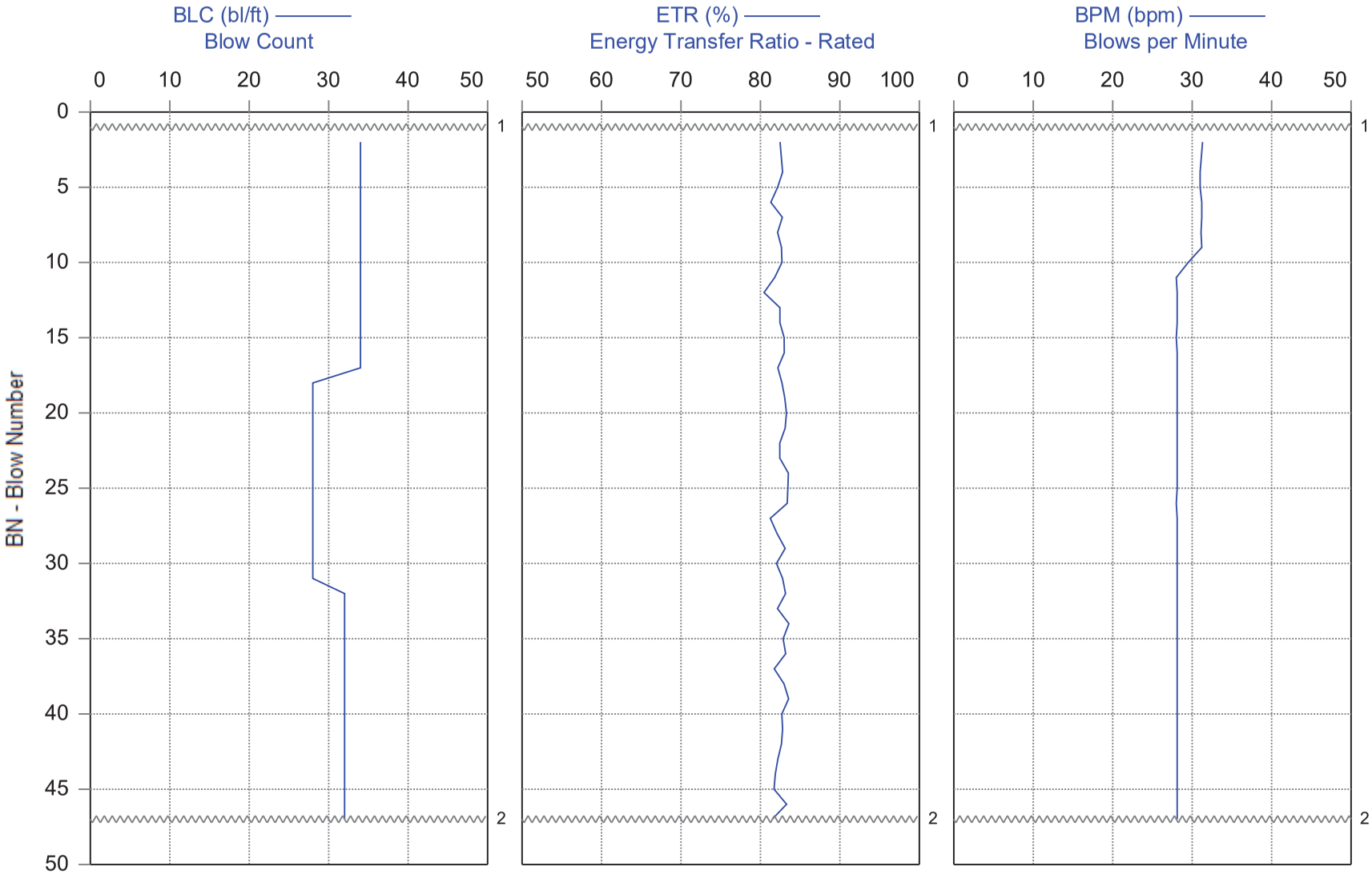
Summary of Case Method Results

Pile Dynamics, Inc. - PDIPLOT2 Ver 2016.2.57.6 - Case Method & iCAP® Results

Printed: 25-September-2017

Test started: 25-August-2017

HOLT DRILLING, RIG 17 - 20.0 FT SAMPLE



1 - Start of test on 8/25/2017 at 12:56 PM

2 - End of test on 8/25/2017 at 12:58 PM

Pile Dynamics, Inc.
Case Method & iCAP® Results

PDIPLOT2 2016.2.57.6 - Printed 25-September-2017

HOLT DRILLING, RIG 17 - 20.0 FT SAMPLE
OP: RMDT

RIG NO 17, MOBILE 140 LB SPT
Date: 25-August-2017

AR: 1.40 in²
LE: 26.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.35 []

EFV: Energy of FV
ETR: Energy Transfer Ratio - Rated
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

CSX: Max Measured Compr. Stress
DMX: Maximum Displacement
RAT: SPT Length Ratio
DFN: Final Displacement

BL#	Depth ft	BLC bl/ft	EFV k-ft	ETR (%)	BPM bpm	FMX kips	VMX f/s	CSX ksi	DMX in	RAT []	DFN in
18	20.54	28	289.5	82.7	28.1	43	14.5	30.7	0.47	0.8	0.43
19	20.57	28	290.7	83.1	28.1	43	14.5	30.5	0.47	0.8	0.43
20	20.61	28	291.4	83.3	28.1	43	14.4	30.9	0.47	0.8	0.43
21	20.64	28	290.9	83.1	28.1	43	14.5	31.1	0.47	0.8	0.43
22	20.68	28	288.5	82.4	28.1	43	14.5	31.0	0.47	0.8	0.43
23	20.71	28	288.5	82.4	28.1	43	14.5	31.1	0.47	0.8	0.43
24	20.75	28	292.3	83.5	28.1	43	14.6	31.0	0.47	0.8	0.43
25	20.79	28	292.1	83.5	28.1	43	14.6	30.8	0.48	0.8	0.43
26	20.82	28	291.8	83.4	28.0	43	14.6	30.8	0.49	0.8	0.43
27	20.86	28	284.3	81.2	28.1	43	14.4	31.0	0.46	0.8	0.43
28	20.89	28	287.3	82.1	28.1	44	14.5	31.2	0.47	0.8	0.43
29	20.93	28	290.9	83.1	28.1	44	14.6	31.2	0.48	0.8	0.43
30	20.96	28	287.0	82.0	28.1	43	14.5	30.5	0.48	0.8	0.43
31	21.00	28	289.8	82.8	28.1	43	14.6	31.0	0.48	0.8	0.43
32	21.03	32	291.1	83.2	28.1	43	14.6	31.0	0.49	0.8	0.38
33	21.06	32	287.5	82.1	28.1	44	14.5	31.2	0.50	1.1	0.38
34	21.09	32	292.5	83.6	28.1	43	14.6	31.0	0.49	0.8	0.38
35	21.13	32	290.0	82.8	28.1	44	14.5	31.2	0.49	0.8	0.38
36	21.16	32	291.1	83.2	28.1	43	14.6	31.0	0.50	0.8	0.38
37	21.19	32	286.1	81.7	28.1	43	14.4	30.9	0.52	1.1	0.38
38	21.22	32	290.4	83.0	28.1	43	14.6	30.8	0.52	0.8	0.38
39	21.25	32	292.4	83.5	28.1	44	14.7	31.2	0.53	0.8	0.38
40	21.28	32	289.4	82.7	28.1	43	14.6	30.8	0.51	1.1	0.38
41	21.31	32	289.7	82.8	28.1	44	14.6	31.1	0.54	1.1	0.38
42	21.34	32	289.2	82.6	28.1	42	14.4	29.9	0.53	1.1	0.38
43	21.38	32	287.6	82.2	28.1	43	14.5	30.9	0.51	1.1	0.38
44	21.41	32	286.5	81.9	28.1	43	14.4	30.8	0.52	1.1	0.38
45	21.44	32	286.0	81.7	28.1	43	14.5	30.7	0.53	1.1	0.38
46	21.47	32	291.5	83.3	28.1	43	14.6	30.7	0.53	1.1	0.38
47	21.50	32	285.2	81.5	28.1	43	14.4	30.7	0.56	1.1	0.38
		Average	289.4	82.7	28.1	43	14.5	30.9	0.50	0.9	0.40
		Std. Dev.	2.3	0.6	0.0	0	0.1	0.3	0.03	0.2	0.03
		Maximum	292.5	83.6	28.1	44	14.7	31.2	0.56	1.1	0.43
		Minimum	284.3	81.2	28.0	42	14.4	29.9	0.46	0.8	0.38

Total number of blows analyzed: 30

BL# Sensors

2-47 F1: [328NWJ2] 220.6 (1.00); F2: [328NWJ2] 220.6 (1.00); A1: [K2449] 340.0 (1.00); A2: [K3258] 337.0 (1.00)

BL# Comments

1 Start of test on 8/25/2017 at 12:56 PM

47 End of test on 8/25/2017 at 12:58 PM

Time Summary

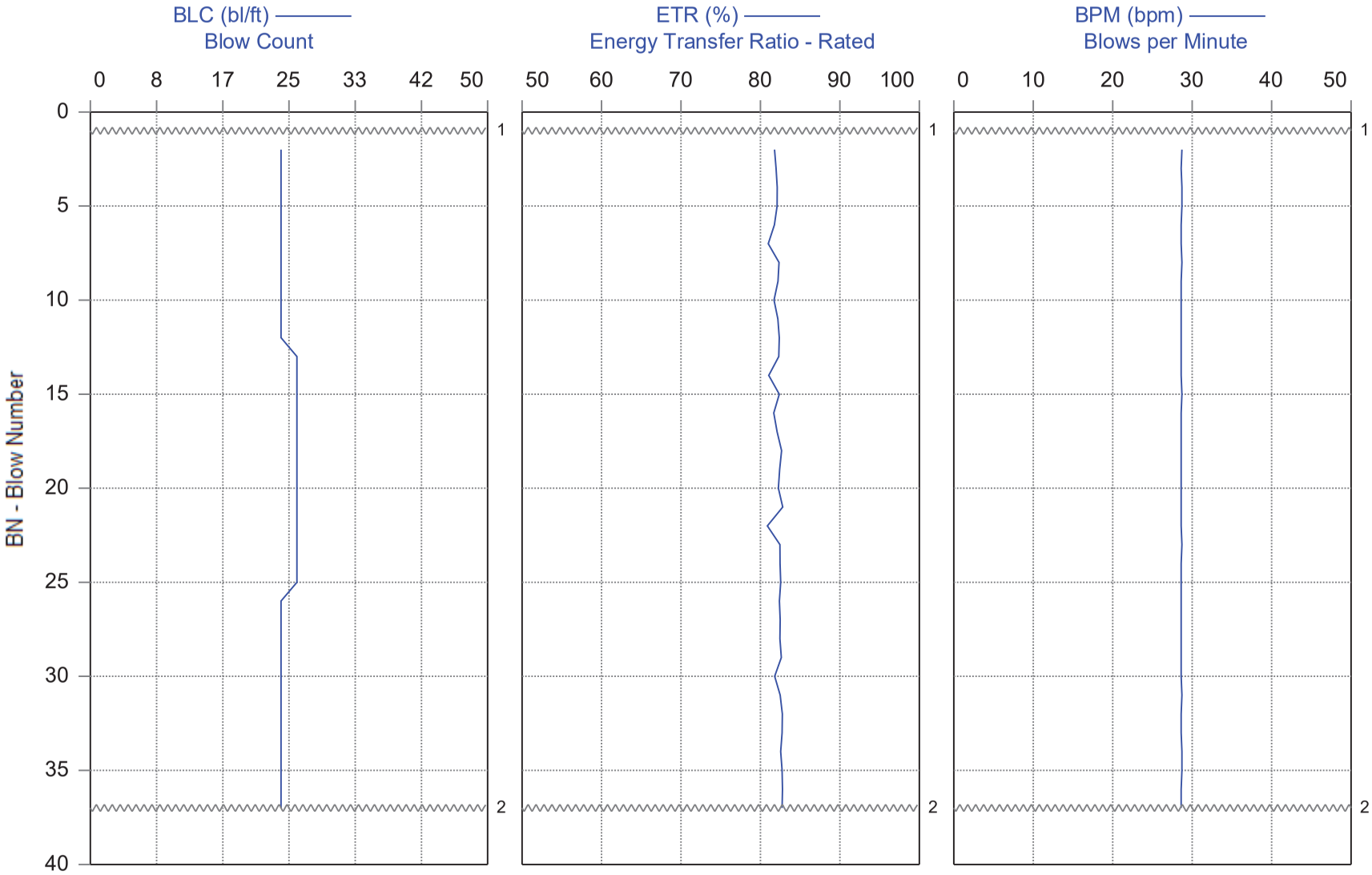
Drive 2 minutes 3 seconds 12:56 PM - 12:58 PM BN 1 - 47

Pile Dynamics, Inc. - PDIPLOT2 Ver 2016.2.57.6 - Case Method & iCAP® Results

Printed: 25-September-2017

Test started: 25-August-2017

HOLT DRILLING, RIG 17 - 25.0 FT SAMPLE



1 - Start of test on 8/25/2017 at 1:09 PM

2 - End of test on 8/25/2017 at 1:10 PM

Pile Dynamics, Inc.
Case Method & iCAP® Results

PDIPLOT2 2016.2.57.6 - Printed 25-September-2017

HOLT DRILLING, RIG 17 - 25.0 FT SAMPLE
OP: RMDT

RIG NO 17, MOBILE 140 LB SPT
Date: 25-August-2017

AR: 1.40 in²
LE: 31.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.35 []

EFV: Energy of FV
ETR: Energy Transfer Ratio - Rated
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

CSX: Max Measured Compr. Stress
DMX: Maximum Displacement
RAT: SPT Length Ratio
DFN: Final Displacement

BL#	Depth	BLC	EFV	ETR	BPM	FMX	VMX	CSX	DMX	RAT	DFN
	ft	bl/ft	k-ft	(%)	bpm	kips	f/s	ksi	in	[]	in
13	25.54	26	288.1	82.3	28.6	41	13.8	29.6	0.57	0.8	0.46
14	25.58	26	283.6	81.0	28.6	42	14.0	30.3	0.55	0.8	0.46
15	25.62	26	288.3	82.4	28.7	42	14.0	30.2	0.57	0.8	0.46
16	25.65	26	285.8	81.7	28.6	41	13.8	29.6	0.55	0.8	0.46
17	25.69	26	287.3	82.1	28.6	42	13.9	29.7	0.55	0.8	0.46
18	25.73	26	289.3	82.7	28.6	43	14.0	30.6	0.56	0.8	0.46
19	25.77	26	288.5	82.4	28.6	42	13.9	30.0	0.55	0.8	0.46
20	25.81	26	287.9	82.3	28.6	42	13.9	29.9	0.55	0.8	0.46
21	25.85	26	289.8	82.8	28.6	43	14.1	30.4	0.56	0.8	0.46
22	25.88	26	283.0	80.9	28.6	42	14.0	30.0	0.56	0.8	0.46
23	25.92	26	288.6	82.4	28.7	42	14.0	30.2	0.57	0.8	0.46
24	25.96	26	288.6	82.5	28.6	43	14.1	30.6	0.59	0.8	0.46
25	26.00	26	288.9	82.5	28.6	43	14.0	30.5	0.59	0.8	0.46
26	26.04	24	288.3	82.4	28.6	43	14.0	30.6	0.60	0.8	0.50
27	26.08	24	288.7	82.5	28.6	43	14.1	30.6	0.62	0.8	0.50
28	26.13	24	288.6	82.4	28.6	42	13.9	30.1	0.58	0.8	0.50
29	26.17	24	289.2	82.6	28.6	42	14.0	30.2	0.63	0.8	0.50
30	26.21	24	286.2	81.8	28.6	42	13.9	30.0	0.64	0.8	0.50
31	26.25	24	288.7	82.5	28.7	43	14.1	30.7	0.66	0.8	0.50
32	26.29	24	289.6	82.8	28.6	42	14.0	30.3	0.66	0.8	0.50
33	26.33	24	289.5	82.7	28.6	42	14.0	30.0	0.67	0.8	0.50
34	26.38	24	288.9	82.5	28.7	42	14.0	30.1	0.64	0.8	0.50
35	26.42	24	289.5	82.7	28.7	43	14.1	30.8	0.65	0.8	0.50
36	26.46	24	289.7	82.8	28.6	43	14.1	30.4	0.65	0.8	0.50
37	26.50	24	289.5	82.7	28.6	42	14.0	29.9	0.64	0.8	0.50
		Average	288.2	82.3	28.6	42	14.0	30.2	0.60	0.8	0.48
		Std. Dev.	1.7	0.5	0.0	0	0.1	0.3	0.04	0.0	0.02
		Maximum	289.8	82.8	28.7	43	14.1	30.8	0.67	0.8	0.50
		Minimum	283.0	80.9	28.6	41	13.8	29.6	0.55	0.8	0.46

Total number of blows analyzed: 25

BL# Sensors

2-37 F1: [328NWJ2] 220.6 (1.00); F2: [328NWJ2] 220.6 (1.00); A1: [K2449] 340.0 (1.00);
A2: [K3258] 337.0 (1.00)

BL# Comments

1 Start of test on 8/25/2017 at 1:09 PM
37 End of test on 8/25/2017 at 1:10 PM

HOLT DRILLING, RIG 17 - 25.0 FT SAMPLE
OP: RMDT
RIG NO 17, MOBILE 140 LB SPT
Date: 25-August-2017

Time Summary

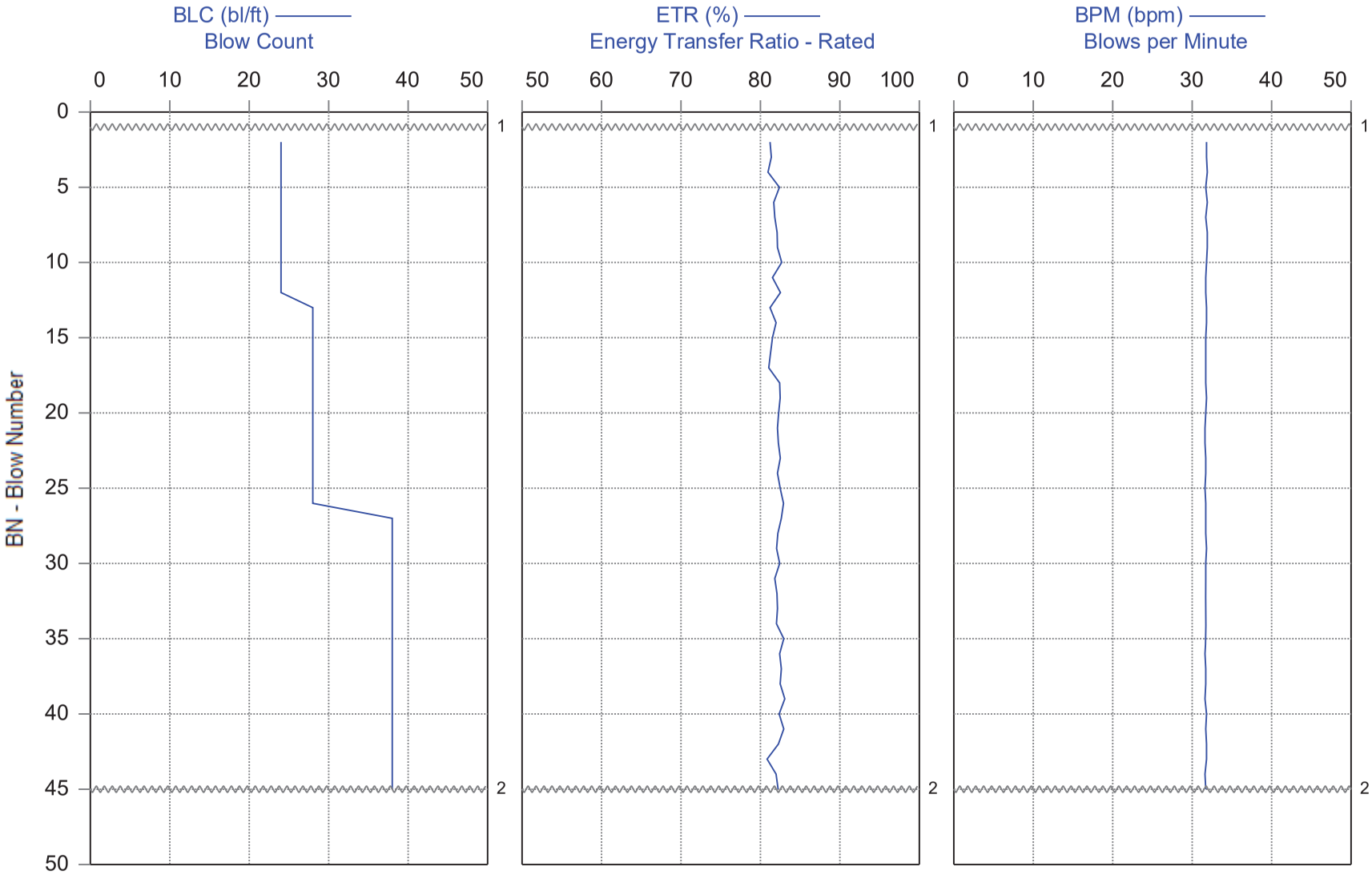
Drive 1 minute 15 seconds 1:09 PM - 1:10 PM BN 1 - 37

Pile Dynamics, Inc. - PDIPLOT2 Ver 2016.2.57.6 - Case Method & iCAP® Results

Printed: 25-September-2017

Test started: 25-August-2017

HOLT DRILLING, RIG 17 - 30.0 FT SAMPLE



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2 - End of test on 8/25/2017 at 1:23 PM

Pile Dynamics, Inc.
Case Method & iCAP® Results

PDIPLOT2 2016.2.57.6 - Printed 25-September-2017

HOLT DRILLING, RIG 17 - 30.0 FT SAMPLE
OP: RMDT

RIG NO 17, MOBILE 140 LB SPT
Date: 25-August-2017

AR: 1.40 in²
LE: 36.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.35 []

EFV: Energy of FV
ETR: Energy Transfer Ratio - Rated
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

CSX: Max Measured Compr. Stress
DMX: Maximum Displacement
RAT: SPT Length Ratio
DFN: Final Displacement

BL#	Depth ft	BLC bl/ft	EFV k-ft	ETR (%)	BPM bpm	FMX kips	VMX f/s	CSX ksi	DMX in	RAT []	DFN in
13	30.54	28	284.2	81.2	31.8	40	13.6	28.9	0.54	0.8	0.43
14	30.57	28	286.9	82.0	31.8	41	13.7	28.9	0.54	0.8	0.43
15	30.61	28	285.3	81.5	31.7	41	13.8	29.5	0.52	0.8	0.43
16	30.64	28	284.4	81.3	31.7	42	13.8	29.8	0.51	0.8	0.43
17	30.68	28	283.7	81.0	31.7	41	13.9	29.2	0.51	0.8	0.43
18	30.71	28	288.4	82.4	31.7	41	13.9	29.6	0.51	0.8	0.43
19	30.75	28	288.7	82.5	31.8	41	13.8	29.3	0.50	0.8	0.43
20	30.79	28	288.0	82.3	31.7	41	13.8	29.2	0.49	0.8	0.43
21	30.82	28	287.5	82.1	31.6	41	13.9	29.4	0.49	0.8	0.43
22	30.86	28	287.9	82.3	31.6	41	13.8	29.4	0.48	0.8	0.43
23	30.89	28	288.7	82.5	31.7	41	13.9	29.6	0.47	0.8	0.43
24	30.93	28	287.5	82.1	31.7	41	13.9	29.5	0.46	0.8	0.43
25	30.96	28	288.7	82.5	31.6	42	13.9	30.0	0.46	0.8	0.43
26	31.00	28	290.2	82.9	31.7	41	13.9	29.5	0.45	0.8	0.43
27	31.03	38	289.2	82.6	31.7	42	13.9	29.7	0.43	0.8	0.31
28	31.05	38	287.7	82.2	31.7	41	13.8	29.3	0.42	0.8	0.32
29	31.08	38	287.1	82.0	31.8	41	13.8	29.3	0.41	0.8	0.31
30	31.11	38	288.5	82.4	31.7	41	13.9	29.6	0.42	0.8	0.32
31	31.13	38	286.3	81.8	31.7	41	13.8	29.3	0.41	0.8	0.31
32	31.16	38	287.2	82.1	31.7	41	13.9	29.6	0.41	0.8	0.31
33	31.18	38	287.5	82.1	31.7	41	13.9	29.4	0.41	0.8	0.31
34	31.21	38	287.1	82.0	31.7	41	13.9	29.4	0.40	0.8	0.31
35	31.24	38	290.3	82.9	31.7	42	14.0	29.7	0.41	0.8	0.31
36	31.26	38	288.5	82.4	31.6	41	13.8	29.2	0.40	0.8	0.31
37	31.29	38	289.2	82.6	31.7	42	13.9	29.8	0.40	0.8	0.31
38	31.32	38	288.7	82.5	31.7	41	13.9	29.2	0.41	0.8	0.31
39	31.34	38	290.7	83.1	31.6	41	13.9	29.3	0.41	0.8	0.32
40	31.37	38	288.2	82.4	31.8	41	13.9	29.2	0.41	0.8	0.31
41	31.39	38	290.2	82.9	31.7	41	13.9	29.4	0.41	0.8	0.31
42	31.42	38	287.9	82.3	31.8	42	13.9	29.7	0.41	0.8	0.31
43	31.45	38	282.9	80.8	31.8	41	13.9	29.3	0.40	0.8	0.31
44	31.47	38	286.9	82.0	31.6	42	14.0	30.3	0.41	0.8	0.31
45	31.50	38	287.8	82.2	31.7	42	14.0	29.9	0.41	0.8	0.31
		Average	287.6	82.2	31.7	41	13.9	29.5	0.45	0.8	0.36
		Std. Dev.	1.8	0.5	0.1	0	0.1	0.3	0.05	0.0	0.06
		Maximum	290.7	83.1	31.8	42	14.0	30.3	0.54	0.8	0.43
		Minimum	282.9	80.8	31.6	40	13.6	28.9	0.40	0.8	0.31

Total number of blows analyzed: 33

BL# Sensors

2-45 F1: [328NWJ2] 220.6 (1.00); F2: [328NWJ2] 220.6 (1.00); A1: [K2449] 340.0 (1.00); A2: [K3258] 337.0 (1.00)

HOLT DRILLING, RIG 17 - 30.0 FT SAMPLE
OP: RMDT

RIG NO 17, MOBILE 140 LB SPT
Date: 25-August-2017

BL#	Comments
1	Start of test on 8/25/2017 at 1:21 PM
45	End of test on 8/25/2017 at 1:23 PM

Time Summary

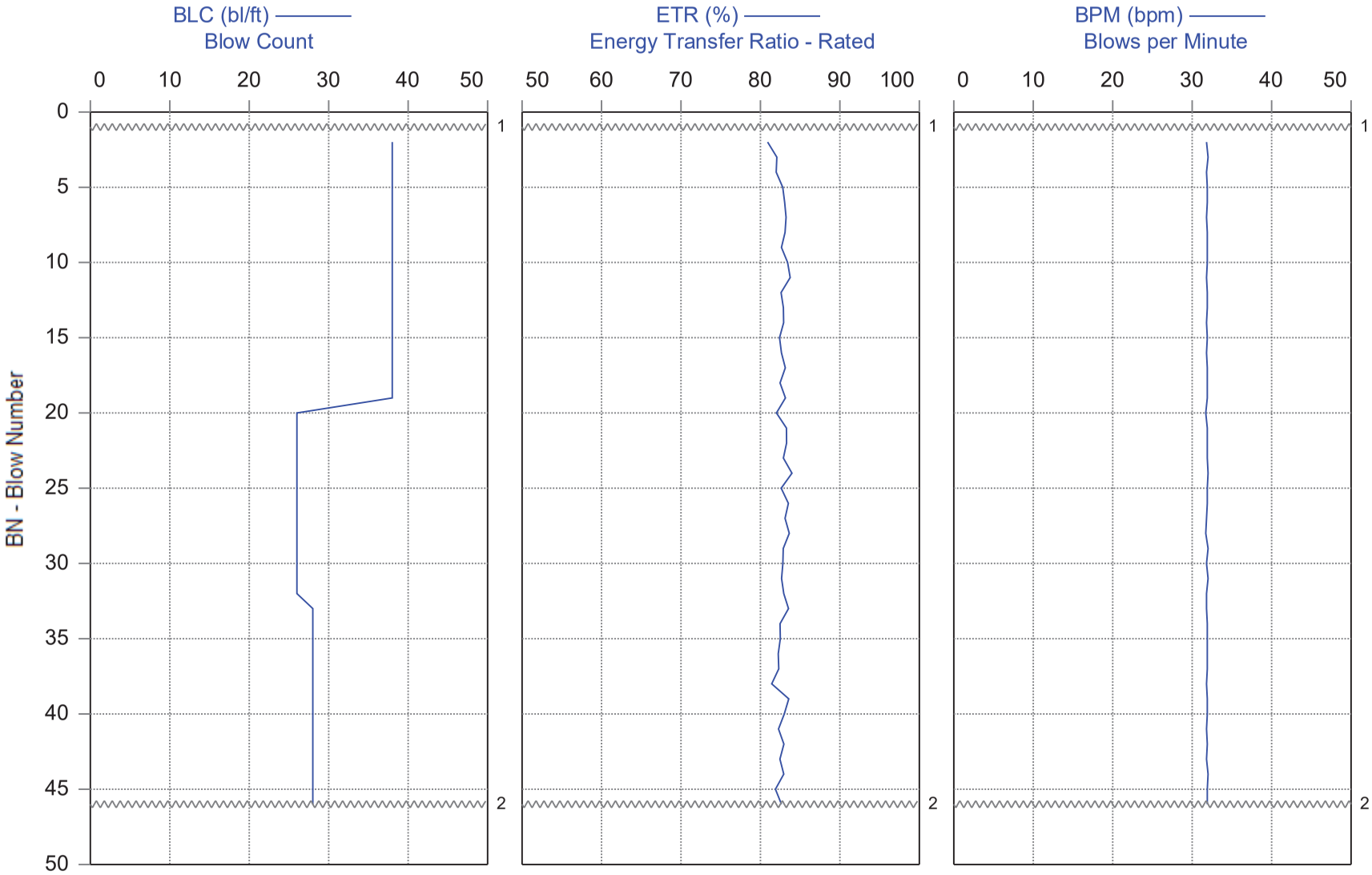
Drive 1 minute 23 seconds 1:21 PM - 1:23 PM BN 1 - 45

Pile Dynamics, Inc. - PDIPLOT2 Ver 2016.2.57.6 - Case Method & iCAP® Results

Printed: 25-September-2017

Test started: 25-August-2017

HOLT DRILLING, RIG 17 - 35.0 FT SAMPLE



1 - Start of test on 8/25/2017 at 1:31 PM

2 - End of test on 8/25/2017 at 1:33 PM

Pile Dynamics, Inc.
Case Method & iCAP® Results

PDIPLOT2 2016.2.57.6 - Printed 25-September-2017

HOLT DRILLING, RIG 17 - 35.0 FT SAMPLE
OP: RMDT

RIG NO 17, MOBILE 140 LB SPT
Date: 25-August-2017

AR: 1.40 in²
LE: 41.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.35 []

EFV: Energy of FV
ETR: Energy Transfer Ratio - Rated
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

CSX: Max Measured Compr. Stress
RAT: SPT Length Ratio
DMX: Maximum Displacement
DFN: Final Displacement

BL#	Depth ft	BLC bl/ft	EFV k-ft	ETR (%)	BPM bpm	FMX kips	VMX f/s	CSX ksi	RAT []	DMX in	DFN in
20	35.54	26	287.1	82.0	31.7	41	14.2	29.2	0.9	0.56	0.46
21	35.58	26	291.4	83.3	31.9	41	14.3	29.5	0.6	0.57	0.46
22	35.62	26	291.5	83.3	31.9	41	14.2	29.4	0.6	0.56	0.46
23	35.65	26	290.1	82.9	31.9	41	14.3	29.3	0.6	0.57	0.46
24	35.69	26	293.9	84.0	32.0	41	14.3	29.4	0.9	0.59	0.46
25	35.73	26	289.1	82.6	31.9	41	14.2	29.2	0.6	0.56	0.46
26	35.77	26	292.3	83.5	31.9	41	14.3	29.2	0.6	0.56	0.46
27	35.81	26	290.8	83.1	31.8	41	14.3	29.1	0.6	0.55	0.46
28	35.85	26	292.7	83.6	31.7	41	14.3	29.4	0.6	0.58	0.46
29	35.88	26	290.0	82.9	32.0	41	14.3	29.0	0.6	0.56	0.46
30	35.92	26	289.8	82.8	31.8	42	14.3	29.9	0.6	0.58	0.46
31	35.96	26	289.3	82.7	32.0	40	14.3	28.9	0.6	0.55	0.46
32	36.00	26	290.3	82.9	31.8	41	14.3	29.2	0.6	0.54	0.46
33	36.04	28	292.4	83.5	31.8	41	14.3	29.5	0.6	0.53	0.43
34	36.07	28	288.6	82.5	31.9	41	14.2	29.0	0.6	0.52	0.43
35	36.11	28	288.7	82.5	31.9	41	14.2	29.6	0.9	0.53	0.43
36	36.14	28	287.8	82.2	31.9	42	14.2	29.8	0.9	0.52	0.43
37	36.18	28	288.0	82.3	31.9	42	14.2	30.0	0.9	0.54	0.43
38	36.21	28	284.9	81.4	31.8	40	14.1	28.9	0.9	0.51	0.43
39	36.25	28	292.5	83.6	31.9	42	14.3	30.0	0.6	0.51	0.43
40	36.29	28	290.5	83.0	31.9	41	14.3	29.2	0.6	0.51	0.43
41	36.32	28	287.9	82.3	31.8	40	14.3	28.8	0.9	0.49	0.43
42	36.36	28	290.3	82.9	31.9	42	14.3	29.8	0.6	0.50	0.43
43	36.39	28	288.5	82.4	31.8	40	14.3	28.8	0.9	0.48	0.43
44	36.43	28	290.3	82.9	32.0	41	14.4	29.4	0.6	0.49	0.43
45	36.46	28	286.6	81.9	31.9	41	14.3	29.2	0.9	0.52	0.43
46	36.50	28	289.2	82.6	31.9	41	14.3	29.1	0.9	0.51	0.43
		Average	289.8	82.8	31.9	41	14.3	29.3	0.7	0.54	0.44
		Std. Dev.	2.0	0.6	0.1	0	0.1	0.3	0.1	0.03	0.02
		Maximum	293.9	84.0	32.0	42	14.4	30.0	0.9	0.59	0.46
		Minimum	284.9	81.4	31.7	40	14.1	28.8	0.6	0.48	0.43

Total number of blows analyzed: 27

BL# Sensors

2-46 F1: [328NWJ2] 220.6 (1.00); F2: [328NWJ2] 220.6 (1.00); A1: [K2449] 340.0 (1.00);
A2: [K3258] 337.0 (1.00)

BL# Comments

1 Start of test on 8/25/2017 at 1:31 PM
46 End of test on 8/25/2017 at 1:33 PM

HOLT DRILLING, RIG 17 - 35.0 FT SAMPLE
OP: RMDT
RIG NO 17, MOBILE 140 LB SPT
Date: 25-August-2017

Time Summary

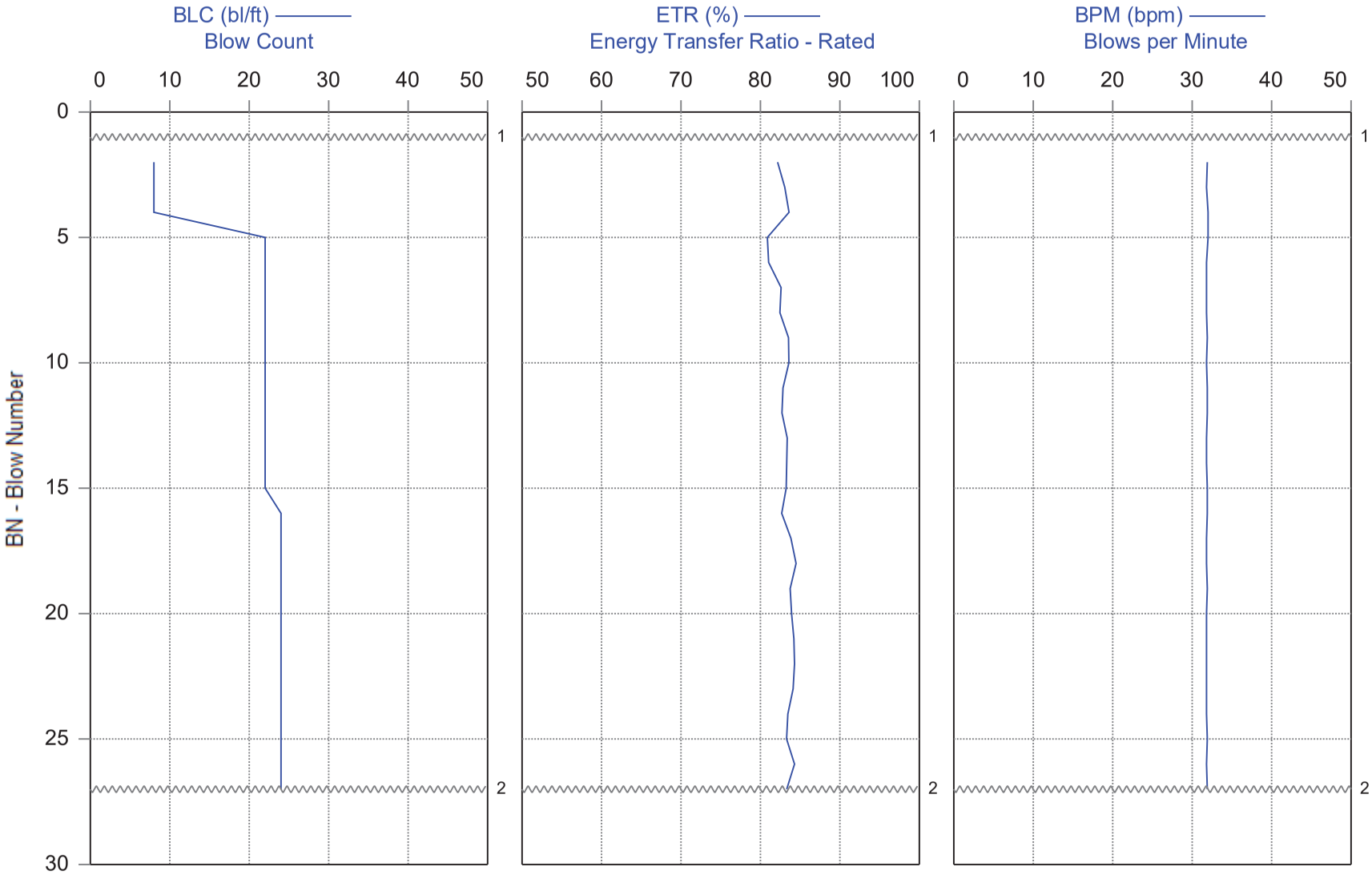
Drive 1 minute 24 seconds 1:31 PM - 1:33 PM BN 1 - 46

Pile Dynamics, Inc. - PDIPLOT2 Ver 2016.2.57.6 - Case Method & iCAP® Results

Printed: 25-September-2017

Test started: 25-August-2017

HOLT DRILLING, RIG 17 - 40.0 FT SAMPLE



1 - Start of test on 8/25/2017 at 1:42 PM

2 - End of test on 8/25/2017 at 1:42 PM

Pile Dynamics, Inc.
Case Method & iCAP® Results

PDIPLOT2 2016.2.57.6 - Printed 25-September-2017

HOLT DRILLING, RIG 17 - 40.0 FT SAMPLE
OP: RMDT

RIG NO 17, MOBILE 140 LB SPT
Date: 25-August-2017

AR: 1.40 in²
LE: 46.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.35 []

EFV: Energy of FV
ETR: Energy Transfer Ratio - Rated
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

CSX: Max Measured Compr. Stress
RAT: SPT Length Ratio
DMX: Maximum Displacement
DFN: Final Displacement

BL#	Depth	BLC	EFV	ETR	BPM	FMX	VMX	CSX	RAT	DMX	DFN
	ft	bl/ft	k-ft	(%)	bpm	kips	f/s	ksi	[]	in	in
5	40.55	22	283.1	80.9	32.0	42	14.4	29.9	0.4	0.69	0.54
6	40.59	22	283.6	81.0	31.8	42	14.4	29.7	0.4	0.66	0.54
7	40.64	22	289.1	82.6	31.8	42	14.4	29.9	0.4	0.65	0.54
8	40.68	22	288.6	82.4	31.8	42	14.4	30.3	0.4	0.64	0.54
9	40.73	22	292.3	83.5	31.9	42	14.5	30.3	0.4	0.61	0.54
10	40.77	22	292.5	83.6	31.8	43	14.5	30.5	0.4	0.60	0.54
11	40.82	22	289.9	82.8	31.9	42	14.3	30.3	0.4	0.60	0.54
12	40.86	22	289.5	82.7	31.9	42	14.3	30.2	0.4	0.58	0.54
13	40.91	22	291.8	83.4	31.8	43	14.4	30.5	0.4	0.59	0.54
14	40.95	22	291.5	83.3	31.8	43	14.3	30.4	0.9	0.58	0.54
15	41.00	22	291.3	83.2	31.9	42	14.3	30.2	0.9	0.59	0.54
16	41.04	24	289.4	82.7	31.9	42	14.1	30.1	0.9	0.55	0.50
17	41.08	24	293.4	83.8	31.8	43	14.4	30.4	0.4	0.56	0.50
18	41.13	24	295.7	84.5	31.8	43	14.4	30.5	0.9	0.56	0.50
19	41.17	24	293.1	83.7	31.9	43	14.4	30.4	0.4	0.54	0.50
20	41.21	24	293.7	83.9	31.8	43	14.4	30.5	0.9	0.54	0.50
21	41.25	24	294.7	84.2	31.8	43	14.4	30.5	0.4	0.53	0.50
22	41.29	24	295.0	84.3	31.8	43	14.4	30.5	0.4	0.56	0.50
23	41.33	24	294.4	84.1	31.8	42	14.4	30.3	0.4	0.52	0.50
24	41.38	24	292.0	83.4	31.8	43	14.4	30.4	0.7	0.53	0.50
25	41.42	24	291.5	83.3	31.9	42	14.2	30.1	0.4	0.54	0.50
26	41.46	24	295.0	84.3	31.8	42	14.4	30.3	0.4	0.56	0.50
27	41.50	24	291.6	83.3	31.9	42	14.4	30.2	0.4	0.53	0.50
		Average	291.4	83.3	31.8	42	14.4	30.3	0.5	0.58	0.52
		Std. Dev.	3.2	0.9	0.1	0	0.1	0.2	0.2	0.05	0.02
		Maximum	295.7	84.5	32.0	43	14.5	30.5	0.9	0.69	0.54
		Minimum	283.1	80.9	31.8	42	14.1	29.7	0.4	0.52	0.50

Total number of blows analyzed: 23

BL# Sensors

2-27 F1: [328NWJ2] 220.6 (1.00); F2: [328NWJ2] 220.6 (1.00); A1: [K2449] 340.0 (1.00); A2: [K3258] 337.0 (1.00)

BL# Comments

1 Start of test on 8/25/2017 at 1:42 PM
27 End of test on 8/25/2017 at 1:42 PM

HOLT DRILLING, RIG 17 - 40.0 FT SAMPLE
OP: RMDT

RIG NO 17, MOBILE 140 LB SPT
Date: 25-August-2017

Time Summary

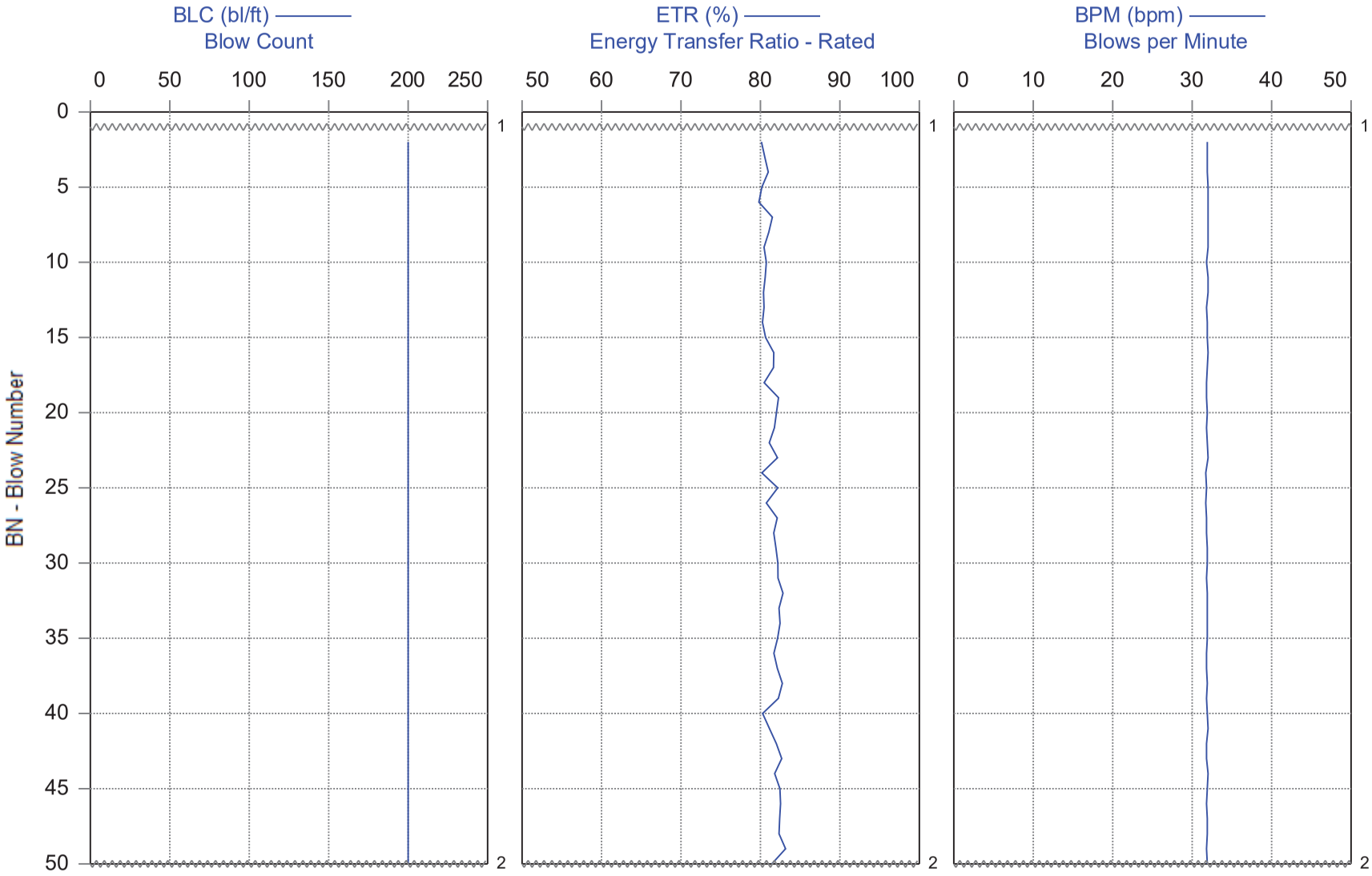
Drive 48 seconds 1:42 PM - 1:42 PM BN 1 - 27

Pile Dynamics, Inc. - PDIPLOT2 Ver 2016.2.57.6 - Case Method & iCAP® Results

Printed: 25-September-2017

Test started: 25-August-2017

HOLT DRILLING, RIG 17 - 50.0 FT SAMPLE



1 - Start of test on 8/25/2017 at 1:59 PM

2 - End of test on 8/25/2017 at 2:00 PM

Pile Dynamics, Inc.
Case Method & iCAP® Results

PDIPLOT2 2016.2.57.6 - Printed 25-September-2017

HOLT DRILLING, RIG 17 - 50.0 FT SAMPLE
OP: RMDT

RIG NO 17, MOBILE 140 LB SPT
Date: 25-August-2017

AR: 1.40 in²
LE: 56.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.35 []

EFV: Energy of FV
ETR: Energy Transfer Ratio - Rated
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

CSX: Max Measured Compr. Stress
RAT: SPT Length Ratio
DMX: Maximum Displacement
DFN: Final Displacement

BL#	Depth	BLC	EFV	ETR	BPM	FMX	VMX	CSX	RAT	DMX	DFN
	ft	bl/ft	k-ft	(%)	bpm	kips	f/s	ksi	[]	in	in
2	50.01	200	280.4	80.1	31.9	42	14.1	30.2	0.4	0.27	0.06
3	50.02	200	281.9	80.5	31.9	43	14.2	30.5	0.9	0.27	0.06
4	50.02	200	283.4	81.0	31.9	43	14.2	30.5	0.4	0.27	0.06
5	50.03	200	280.6	80.2	32.0	43	14.2	30.4	0.6	0.28	0.05
6	50.03	200	279.3	79.8	32.0	42	14.0	30.2	0.6	0.32	0.06
7	50.04	200	285.2	81.5	32.0	43	14.3	30.6	0.4	0.29	0.06
8	50.04	200	283.7	81.0	32.0	42	14.2	30.1	0.4	0.27	0.06
9	50.05	200	281.6	80.5	32.0	42	14.1	30.0	0.4	0.25	0.06
10	50.05	200	282.6	80.7	31.8	42	14.1	29.9	0.6	0.27	0.06
11	50.06	200	282.1	80.6	32.0	42	14.2	30.3	0.4	0.24	0.07
12	50.06	200	281.3	80.4	32.0	42	14.1	30.1	0.6	0.27	-0.03
13	50.07	200	281.6	80.4	31.8	42	14.1	30.2	0.4	0.25	0.06
14	50.07	200	280.9	80.3	31.9	42	14.1	30.0	0.4	0.23	0.06
15	50.08	200	282.2	80.6	31.9	42	14.1	30.0	0.4	0.22	0.06
16	50.08	200	285.8	81.7	32.0	42	14.2	30.0	0.7	0.23	0.06
17	50.09	200	285.7	81.6	31.9	42	14.2	30.2	0.7	0.22	0.06
18	50.09	200	281.6	80.5	31.8	42	14.0	29.8	0.7	0.22	0.06
19	50.10	200	287.9	82.3	31.8	42	14.1	30.0	0.7	0.23	0.06
20	50.10	200	287.0	82.0	31.9	42	14.1	30.0	0.7	0.23	0.06
21	50.11	200	286.1	81.7	31.8	42	14.0	30.1	0.4	0.23	0.06
22	50.11	200	283.9	81.1	31.9	42	14.0	29.9	0.4	0.23	0.06
23	50.12	200	287.5	82.1	32.0	42	14.0	30.0	0.7	0.23	0.06
24	50.12	200	280.6	80.2	31.7	41	13.7	29.5	0.7	0.23	0.06
25	50.13	200	287.6	82.2	31.8	42	14.0	29.9	0.4	0.23	0.06
26	50.13	200	282.6	80.7	31.7	41	13.8	29.5	0.7	0.23	0.06
27	50.14	200	287.4	82.1	31.8	42	13.9	30.0	0.7	0.23	0.06
28	50.14	200	285.9	81.7	31.8	42	13.9	29.9	0.7	0.23	0.06
29	50.15	200	286.8	82.0	31.9	42	14.0	29.9	0.7	0.23	0.06
30	50.15	200	287.6	82.2	31.9	42	14.0	29.8	0.7	0.23	0.06
31	50.16	200	287.7	82.2	31.8	42	14.1	29.8	0.7	0.25	0.06
32	50.16	200	289.9	82.8	31.9	42	14.0	29.9	0.7	0.27	0.06
33	50.17	200	288.1	82.3	31.9	42	14.0	29.7	0.7	0.25	0.06
34	50.17	200	288.6	82.5	31.9	42	14.1	29.8	0.7	0.25	0.06
35	50.18	200	287.5	82.2	31.9	42	13.9	29.9	0.7	0.25	0.06
36	50.18	200	285.9	81.7	31.8	41	14.2	29.4	0.4	0.26	0.06
37	50.19	200	287.4	82.1	31.8	40	14.2	28.8	0.5	0.26	0.06
38	50.19	200	289.6	82.8	31.9	42	14.3	29.7	0.4	0.25	0.06
39	50.20	200	287.9	82.2	31.8	42	14.2	29.8	0.4	0.25	0.06
40	50.20	200	280.9	80.3	31.9	41	13.9	29.5	0.7	0.25	0.06
41	50.21	200	284.0	81.1	32.0	42	14.1	29.8	0.6	0.25	0.06
42	50.21	200	287.0	82.0	31.8	42	14.2	30.2	0.4	0.25	0.06
43	50.22	200	289.3	82.7	31.8	43	14.2	30.5	0.4	0.25	0.06
44	50.22	200	286.2	81.8	32.0	43	14.1	30.4	0.6	0.25	0.06
45	50.23	200	288.6	82.4	31.9	43	14.3	30.4	0.4	0.25	0.06
46	50.23	200	288.8	82.5	31.8	43	14.2	30.4	0.4	0.25	0.06

HOLT DRILLING, RIG 17 - 50.0 FT SAMPLE
RIG NO 17, MOBILE 140 LB SPT
OP: RMDT
Date: 25-August-2017

BL#	Depth	BLC	EFV	ETR	BPM	FMX	VMX	CSX	RAT	DMX	DFN
	ft	bl/ft	k-ft	(%)	bpm	kips	f/s	ksi	[]	in	in
47	50.24	200	288.4	82.4	31.9	42	14.1	30.3	0.4	0.24	0.06
48	50.24	200	288.2	82.3	31.9	42	14.0	30.3	0.7	0.24	0.06
49	50.25	200	291.1	83.2	31.8	43	14.2	30.4	0.4	0.25	0.06
50	50.25	200	285.0	81.4	31.9	42	13.8	30.0	0.7	0.25	0.06
		Average	285.3	81.5	31.9	42	14.1	30.0	0.5	0.25	0.06
		Std. Dev.	3.1	0.9	0.1	0	0.1	0.3	0.2	0.02	0.01
		Maximum	291.1	83.2	32.0	43	14.3	30.6	0.9	0.32	0.07
		Minimum	279.3	79.8	31.7	40	13.7	28.8	0.4	0.22	-0.03

Total number of blows analyzed: 49

BL# Sensors

2-50 F1: [328NWJ2] 220.6 (1.00); F2: [328NWJ2] 220.6 (1.00); A1: [K2449] 340.0 (1.00);
A2: [K3258] 337.0 (1.00)

BL# Comments

1 Start of test on 8/25/2017 at 1:59 PM
50 End of test on 8/25/2017 at 2:00 PM

Time Summary

Drive 1 minute 32 seconds 1:59 PM - 2:00 PM BN 1 - 50

Robert Miner Dynamic Test
Dynamic Measurements and Analyses for Deep Fou

May 9, 2013

Mr. Dale Abernathy
Holt Services, Inc.
13000 Lakeholme Road Sw
Lakewood, WA 98498

Re: Penetration Test Energy Measurements
Rig B2177GW, 140lb and 300 lb ram, NW-J, November 1, 2012
Landa Track Rig Model L-10-T, 140 lb ram, NW-J, April 17, 2013
Tera-Sonic CC-150, 140 lb ram, AW-J, April 19, 2013
King and Pierce County, Washington

RMDT Job No. 12F53

Dear Mr. Abernathy,

This letter presents energy transfer measurements made during Penetration Tests for the drill rigs referenced above. Robert Miner Dynamic Testing, Inc. (RMDT) made dynamic measurements with a Pile Driving Analyzer® as a hammer advanced the NW or AW rod during soil sampling.

The purpose of RMDT's testing was the measurement of energy transferred to the drill rods. Measurements were made on a sections of NW or AW gauge rod at the top of the drill rod. Strain gages and accelerometers on the rod were connected to a Pile Driving Analyzer® (PDA) which generally processed acceleration and strain measurements from each hammer blow and stored both the measurements and computed results. Measurements and data processing generally followed the ASTM D 4633-10 standard. Energy transfer past the gage location, EFV, was computed by the PDA using force and velocity records as follows:

$$EFV = \int_a^b F(t)\ v(t)\ dt$$

The value "a" corresponds to the start of the record which is when the energy transfer begins and *"b"* is the time at which energy transferred to the rod reaches a maximum value. Appendix A contains more information on our measurement equipment and methods of analysis. The EFV energy calculation is identical to the EMX energy result discussed in Appendix A. The EFV and EMX values apply to the sensor location near the top of the rod.

TEST DETAILS

Rig B2177GW, November 1, 2012

Testing occurred on November 1, 2012. Boring B59 was advanced at the Holt Services Yard located in Lakewood. Washington. The drill rig was a Model B59 manufactured by Mobile Drill International (Mobile). The automatic hammer in use during our testing was also manufactured

Mailing Address: P.O. Box 340, Manchester, WA, 98353, USA **Phone:** 360-871-5480
Location: 2288 Colchester Dr. E., Ste A, Manchester, WA, 98353 **Fax:** 360-871-5483

by Mobile and was reported to use either a 140 lb or a 300 lb ram. A 140 lb and 300 lb ram were used to advance a standard split spoon and a 3" O.D. split spoon sampler, respectively. NW size rod was used during all testing.

Track Rig Model L-10-T, April 17, 2013

Testing occurred on April 17, 2013. Boring E330-B28 was advanced along the proposed Sound Transit East Link Lightrail Line near 116th Ave NE and NE 8th St in Bellevue, Washington. The drill rig was a track-mounted Landa Drilling Services, Inc. Limited Access Rig (SN:130115). The automatic hammer in use during our testing was reported to use a 140 lb ram to advance a standard split spoon sampler. NW size rod was used during all testing

Terra-Sonic CC150 Track Rig, April 19, 2013

Testing occurred on April 19, 2013. Boring E340-B12 was advanced along the proposed Sound Transit East Link Lightrail Line near 124th Ave NE and NE 14th St in Bellevue, Washington. The drill rig was a track-mounted Terra-Sonic Rig. The automatic hammer in use during our testing was a Mobile self compensating autohammer and was reported to use a 140 lb ram to advance a standard split spoon sampler. AW size rod was used during all testing.

RESULTS

Summaries of the results for tests conducted at each of the three test sites (and ram weights) are given in Tables 1 through 4. The tabulated results include the starting sample depth, the penetration resistance, the number of hammers blows in our data set, measured energy transfer, EFV, the computed transfer efficiency, ETR, and the hammer blow rate, BPM. Appendix B contains detailed numeric results for each individual test.

Energy measurements must be divided by the theoretical free fall energy of the hammer to obtain an efficiency. A 140 lb ram raised 30 inches above an impact surface has 350 lb-ft of potential energy. A 300 lb ram raised 30 inches above an impact surface has 750 lb-ft of potential energy. Thus, the transfer energy results for sampling with the 140 and 300 lb rams may be divided by 350 and 750 lb-ft, respectively, to yield the ratio of the delivered energy to the nominal potential energy. This efficiency ratio, ETR, is given for each sample interval as a percent efficiency.

Rig B2177GW, November 1, 2012

Five sample returns were monitored while a 140 lb ram and standard split spoon sampler were in use. The overall average ETR was 98 percent and the average hammer blow rate was 22 blows per minute.

Table 1. Summary of Test Details and Results for Rig B2177GW using a 140-lb ram and Split Spoon Sampler, November 1, 2012

Sample Name and Start Depth	Penetration Resistance (Blow/Set)	Number of Blows in Data Set	Average Transfer Energy EFV (lb-ft)	Average Transfer Efficiency ETR (percent)	Average Hammer Blow Rate BPM (blow/min)
20 ft	7/1 ft	7	300	86	24
35 ft	6/1 ft	6	354	101	21
40 ft	4/1 ft	4	353	101	22
55 ft	5/1 ft	5	354	101	22
65 ft	19/1 ft	19	356	102	22
		Average:	**343**	**98**	**22**

For this drilling rig on November 1, 2012 five sample intervals were monitored while a 300 lb ram and a 3" O.D. split spoon sampler were used. For the 300 lb ram the average ETR values within the sample intervals ranged from 99 to 103 percent. The overall average ETR was 101 percent and the average hammer blow rate was 23 blows per minute.

Table 2. Summary of Test Details and Results for Rig B2177GW using a 300-lb ram and 3"O.D. Sampler, November 1, 2012

Sample Name and Start Depth	Penetration Resistance (Blow/Set)	Number of Blows in Data Set	Average Transfer Energy EFV (lb-ft)	Average Transfer Efficiency ETR (percent)	Average Hammer Blow Rate BPM (blow/min)
25 ft	12/1 ft	12	739	99	25
30 ft	6/1 ft	6	738	98	24
45 ft	3/1 ft	3	769	103	21
50 ft	3/1 ft	3	770	103	23
60 ft	3/1 ft	3	759	101	20
		Average:	**755**	**101**	**23**

Track Rig Model L-10-T, April 17, 2013

Six sample returns were monitored while the 140 lb ram and standard split spoon sampler were in use. For the 140 lb ram the average ETR values within the sample intervals ranged from 83 to 90 percent. The overall average ETR value was 87 percent. The hammer strike rate was reduced after Sample 50 ft was recorded to determine if the hammer strike rate (BPM) influenced the recorded transfer energy (EFV). Test results reported only modest variations to the calculated EFV at hammer strike rates between 24 and 49 BPM.

Table 3. Summary of Test Details and Results for Rig L-10-T using a 140-lb ram and Standard Split Spoon Sampler, April 17, 2013

Sample Name and Start Depth	Penetration Resistance (Blow/Set)	Number of Blows in Data Set	Average Transfer Energy EFV (lb-ft)	Average Transfer Efficiency ETR (percent)	Average Hammer Blow Rate BPM (blow/min)
35 ft	50/6 in	49	296	85	48
40 ft	50/6 in	50	307	88	46
45 ft	75/1 ft	75	308	88	49
50 ft	66/1 ft	66	315	90	49
55 ft	50/4 in	40	292	83	24
60 ft	50/6 in	50	311	89	25
		Average:	**305**	**87**	**40**

Terra-Sonic CC150 Track Rig

Three sample returns were monitored while the 140 lb ram and standard split spoon sampler were in use before artesian pressures forced drilling to halt for the day. The overall average ETR and hammer blow rate was 95 percent and 46 blows per minute, respectively.

Table 4. Summary of Test Details and Results for Terra-Sonic CC150 Track Rig using a 140-lb ram and Standard Split Spoon Sampler, April 19, 2013

Sample Name and Start Depth	Penetration Resistance (Blow/Set)	Number of Blows in Data Set	Average Transfer Energy EFV (lb-ft)	Average Transfer Efficiency ETR (percent)	Average Hammer Blow Rate BPM (blow/min)
20 ft	30/1 ft	30	339	97	44
30 ft	50/4 in	50	325	93	47
45 ft	50/6 in	44	338	97	48
		Average:	**334**	**95**	**46**

It was a pleasure to assist you and to participate on this project with the staff of Holt Services, Inc. Please do not hesitate to contact us if you or your client have any questions about this report.

Sincerely,

Andrew Banas
Staff Engineer
Robert Miner Dynamic Testing, Inc.

Robert Miner
President

Appendix B

Summary of Case Method Field Results

APPENDIX A
AN INTRODUCTION INTO DYNAMIC PILE TESTING METHODS

The following has been written by Goble Rausche Likins and Associates, Inc. and may only be copied with its written permission.

BACKGROUND

Modern procedures of design and construction control require verification of bearing capacity and integrity of deep foundations during preconstruction test programs and also production installation. Dynamic pile testing methods meet this need economically and reliably, and therefore, form an important part of a quality assurance program when deep foundations are executed. Several dynamic pile testing methods exist; they have different benefits and limitations and different requirements for proper execution.

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (such as that of a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. The method is therefore also referred to as a "High Strain Method". The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then an evaluation of various quantities based on closed form solutions of the wave equation, a partial differential equation describing the motion of a rod under the effect of an impact. Conveniently, measurements and analyses are done by a single piece of equipment: the Pile Driving Analyzer® (PDA). However, for bearing capacity evaluations an important additional method is CAPWAP® which performs a much more rigorous analysis of the dynamic records than the simpler Case Method.

A related analysis method is the "Wave Equation Analysis" which calculates a relationship between bearing capacity and pile stress and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data.

The following description deals primarily with the Case Method or "High Strain Test" Method of pile testing, however, for the sake of completeness, the "Low Strain Test" performed with the Pile Integrity Test™ (PIT), mainly for pile integrity evaluation, will also be described.

RESULTS FROM DYNAMIC TESTING

There are two main objectives of high strain dynamic pile testing:

- *Dynamic Pile Monitoring* and
- *Dynamic Load Testing*.

Dynamic pile monitoring is conducted during the installation of impact driven piles to achieve a safe and economical pile installation. Dynamic load testing, on the other hand, has as its primary goal the assessment of pile bearing capacity. It is applicable to both cast *insitu* piles or drilled shafts and impact driven piles during restrike.

Dynamic Pile Monitoring

During pile installation, the sensors attached to the pile measure pile top force and velocity. A PDA conditions and processes these signals and calculates or evaluates:

- Bearing capacity at the time of testing, including an assessment of shaft resistance development and driving resistance. This information supports formulation of a driving criterion.

- Dynamic pile stresses, axial and averaged over the pile cross section, both tensile and compressive, during pile driving to limit the potential of damage either near the pile top or along its length. Bending stresses can be evaluated at the point of sensor attachment.

- Pile integrity assessment by the PDA is based on the recognition of certain wave reflections from along the pile. If detected early enough, a pile may be saved from complete destruction. On the other hand, once damage is recognized measures can be taken to prevent reoccurrence.

- Hammer performance parameters including the energy transferred to the pile, the hammer speed in blows per minute and the stroke of open ended diesel hammers.

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Dynamic Pile Load Testing

Bearing capacity testing of either driven piles or drilled shafts applies the same basic measurement approach of dynamic pile monitoring. However, the test is done independent of the pile installation process and therefore a pile driving hammer or other dynamic loading device may not be available. If a special ram has to be mobilized then its weight should be between 0.8 and 2% of the test load (e.g. between 4 and 10 tons for a 500 ton test load) to assure sufficient soil resistance activation.

For a successful test, it most important that the test is conducted after a sufficient waiting time following pile installation for soil properties approaching their long term condition or concrete to properly set. During testing, PDA results of pile/shaft stresses and transferred energy are used to maintain safe stresses and assure sufficient resistance activation. For safe and sufficient testing of drilled shafts, ram energies are often increased from blow to blow until the test capacity has been activated. On the other hand, restrike tests on driven piles may require a warm hammer so that the very first blow produces a complete resistance activation. Data must be evaluated by CAPWAP for bearing capacity.

After the dynamic load test has been conducted with sufficient energy and safe stresses, the CAPWAP analysis provides the following results:

- Bearing capacity i.e. the mobilized capacity present at the time of testing
- Resistance distribution including shaft resistance and end bearing components
- Stresses in pile or shaft calculated for both the static load application and the dynamic test. These stresses are averages over the cross section and do not include bending effects or nonuniform contact stresses, e.g. when the pile toe is on uneven rock.
- Shaft impedance vs depth; this is an estimate of the shaft shape if it differs substantially from the planned profile
- Dynamic soil parameters for shaft and toe, i.e. damping factors and quakes (related to the dynamic stiffness of the resistance at the pile/soil interface.)

MEASUREMENTS

PDA

The basis for the results calculated by the PDA are pile top strain and acceleration measurements which are converted to force and velocity records, respectively. The PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. Using closed form Case Method solutions, based on the one-dimensional linear wave equation, the PDA calculates the results described in the analytical solutions section below.

HPA

The ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. For this unit to be applicable, the ram must be visible. The impact velocity results can be automatically processed with a PC or recorded on a strip chart.

Saximeter™

For open end diesel hammers, the time between two impacts indicates the magnitude of the ram fall height or stroke. This information is not only measured and calculated by the PDA but also by the convenient, hand-held Saximeter.

PIT

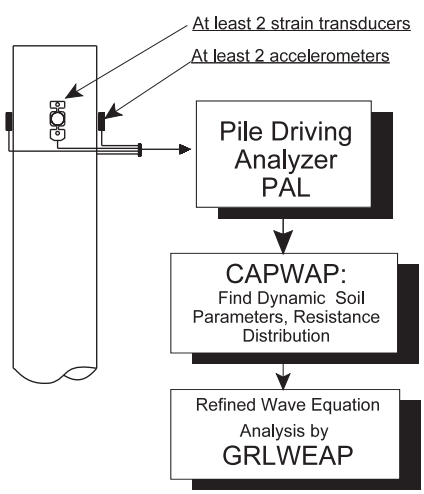
The Pile Integrity Tester™ (PIT) can be used to evaluate defects in concrete piles or shafts which may have occurred during driving or casting. Also timber piles of limited length can be tested in that manner. This so-called "Low Strain Method" or “Pulse-Echo Method” of integrity testing requires only the measurement of acceleration at the pile top. The stress wave producing impact is then generated by a small hand-held hammer and the records interpreted in the time domain. PIT also supports the so-called “Transient Response Method” which requires the additional measurement of the hammer force and an analysis in the frequency domain. This method may also be used to evaluate the unknown length of deep foundations under existing structures.

ANALYTICAL SOLUTIONS
BEARING CAPACITY

Wave Equation

GRL has written the GRLWEAP™ program which calculates a relationship between bearing capacity, pile stress and blow count. This relationship is often called the "bearing graph." Once the blow count is known from pile installation logs, the bearing graph yields the bearing capacity. This approach requires no measurements and therefore can be performed during the design stage of a project, for example for the selection of hammer, cushion and pile size.

After dynamic pile monitoring and/or dynamic load testing has been performed, the "Refined Wave Equation Analysis" or RWEA (see schematic below) is often performed by inputting the PDA and CAPWAP calculated parameters. Then the bearing graph from the RWEA is the basis for a safe and sufficient driving criteria.



Case Method

The Case Method is a closed form solution based on a few simplifying assumptions such as ideal plastic soil behavior and an ideally elastic and uniform pile. Given the measured pile top force F(t) and pile top velocity v(t), the total soil resistance is

$$R(t) = \tfrac{1}{2}\{[F(t) + F(t_2)] + Z[v(t) - v(t_2)]\} \qquad (1)$$

where

t	=	a point in time after impact
t_2	=	time $t + 2L/c$
L	=	pile length below gages
c	=	$(E/\rho)^{1/2}$ is the speed of the stress wave
ρ	=	pile mass density
Z	=	EA/c is the pile impedance
E	=	elastic modulus of the pile (ρc^2)
A	=	pile cross sectional area

The total soil resistance consists of a dynamic (R_d) and a static (R_s) component. The static component is therefore

$$R_s(t) = R(t) - R_d(t) \qquad (2)$$

The dynamic component may be computed from a soil damping factor, J, and a pile toe velocity, $v_t(t)$ which is conveniently calculated for the pile toe. Using wave considerations, this approach leads immediately to the dynamic resistance

$$R_d(t) = J[F(t) + Zv(t) - R(t)] \qquad (3)$$

and finally to the static resistance by means of Equation 2.

There are a number of ways in which Eq. 1 through 3 can be evaluated. Most commonly, t_2 is set to that time at which the static resistance becomes maximum. The result is the so-called **RMX** capacity. Damping factors for RMX typically range between 0.5 for coarse grained materials to 1.0 for clays. The **RSP** capacity (this method is most commonly referred to in the literature, yet it is not very frequently used) requires damping factors between 0.1 for sand and 1.0 for clay. Another capacity, **RA2**, determines the capacity at a time when the pile is essentially at rest and thus damping is small; RA2

therefore requires no damping parameter. In any event, the proper Case Method and its associated damping parameter is most conveniently found after a CAPWAP analysis has been performed.

The static resistance calculated by Case Method or CAPWAP is the mobilized resistance at the time of testing. Consideration therefore has to be given to soil setup or relaxation effects and whether or not a sufficient set has been achieved under the test loading that would correspond to a full activation of the ultimate soil resistance.

The PDA also calculates an estimate of shaft resistance as the difference between force and velocity times impedance at the time immediately prior to the return of the stress wave from the pile toe. This shaft resistance is not reduced by damping effects and is therefore called the total shaft resistance **SFT**. A correction for damping effects produces the static shaft resistance estimate, **SFR**.

The Case Method solution is simple enough to be evaluated "in real time," i.e. between hammer blows, using the PDA. It is therefore possible to calculate all relevant results for all hammer blows and plot these results as a function of depth or blow number. This is done in the PDAPLOT program.

CAPWAP

The CAse Pile Wave Analysis Program combines the wave equation pile and soil model with the Case Method measurements. Thus, the solution includes not only the total and static bearing capacity values but also the shaft resistance, end bearing, damping factors and soil stiffnesses. The method iteratively calculates a number of unknowns by signal matching. While it is necessary to make hammer performance assumptions for a GRLWEAP analysis, the CAPWAP program works with the pile top measurements. Furthermore, while GRLWEAP and Case Method require certain assumptions regarding the soil behavior, CAPWAP calculates these soil parameters.

STRESSES

During pile monitoring, it is important that compressive stress maxima at pile top and toe and tensile stress maxima somewhere along the pile be calculated for each hammer blow.

At the pile top (location of sensors) both the maximum compression stress, **CSX**, and the maximum stress from individual strain transducers, **CSI**, are directly obtained from the measurements. Note that CSI is greater than or equal to CSX and the difference between CSI and CSX is a measure of bending in the plane of the strain transducers. Note also that all stresses calculated for locations below the sensors are averaged over the pile cross section and therefore do not include components from either bending or eccentric soil resistance effects.

The PDA calculates the compressive stress at the pile bottom, **CSB**, assuming (a) a uniform pile and (b) that the pile toe force is the maximum value of the total resistance R(t) minus the total shaft resistance, SFT. Again, for this stress estimation uniform resistance force are assumed (e.g. not a sloping rock.)

For concrete piles, the maximum tension stress, **TSX**, is also of great importance. It occurs at some point below the pile top. The maximum tension stress can be computed from the pile top measurements by finding the maximum tension wave (either traveling upward, W_U, or downward, W_d) and reducing it by the minimum compressive wave traveling in opposite direction.

$$W_u = ½[F(t) - Zv(t)] \quad (4)$$

$$W_d = ½[F(t) + Zv(t)] \quad (5)$$

CAPWAP also calculates tensile and compressive stresses along the pile and, in general, more accurately than the PDA. In fact, for non-uniform piles or piles with joints, cracks or other discontinuities, the closed form solutions from the PDA may be in error.

PILE INTEGRITY

High Strain Tests (PDA)

Stress waves in a pile are reflected wherever the pile impedance, $Z = EA/c = \rho cA = A \sqrt{(E \rho)}$, changes. Therefore, the pile impedance is a measure of the quality of the pile material (E, ρ, c) and the size of its cross section (A). The reflected waves arrive at the pile top at a time which is greater the farther away from the pile top the reflection occurs. The

magnitude of the change of the upward traveling wave (calculated from the measured force and velocity, Eq. 4) indicates the extent of the cross sectional change. Thus, with β_i (**BTA**) being a relative integrity factor which is unity for no impedance change and zero for the pile end, the following is calculated by the PDA.

$$\beta_i = (1 - \alpha_i)/(1 + \alpha_i) \quad (6)$$

with

$$\alpha_i = ½(W_{UR} - W_{UD})/(W_{Di} - W_{UR}) \quad (7)$$

where

W_{UR} is the upward traveling wave at the onset of the reflected wave. It is caused by resistance.

W_{UD} is the upwards traveling wave due to the damage reflection.

W_{Di} is the maximum downward traveling wave due to impact.

It can be shown that this formulation is quite accurate as long as individual reflections from different pile impedance changes have no overlapping effects on the stress wave reflections.

Without rigorous derivation, it has been proposed to consider as slight damage when β is above 0.8 and a serious damage when β is less than 0.6.

Low Strain Tests (PIT)

The pile top is struck with a held hand hammer and the resulting pile top velocity is measured, displayed and interpreted for signs of wave reflections. In general, a comparison of the reflected acceleration leads to a relative measure of extent of damage, again the location of the problem is indicated by the arrival time of the reflection. PIT records can also be interpreted by the β-Method. However, low strain tests do not activate much resistance which simplifies Eq. 7 since W_{UR} is then equal to zero.

For drilled shafts and PIT records that clearly show a toe reflection, an approximate shaft profile can be calculated from low strain records using the PITSTOP program's PROFILE routine.

HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(t)v(t)\,dt \quad (8a)$$

The maximum of the E(t) curve is the most important information for an overall evaluation of the performance of a hammer and driving system. This **EMX** value allows for a classification of the hammer's performance when presented as the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency

$$e_T = EMX/E_R \quad (8b)$$

where

E_R is the manufacturer's rated energy value.

Both Saximeter and PDA calculate the stroke (**STK**) of an open end diesel hammer using

$$STK = (g/8)\,T_B^2 - h_L \quad (9)$$

where

g is the earth's gravitational acceleration,
T_B is the time between two hammer blows,
h_L is a stroke loss value due to gas compression and time losses during impact (usually 0.3 ft or 0.1 m).

DETERMINATION OF WAVE SPEED

An important facet of dynamic pile testing is an assessment of pile material properties. Since in general force is determined from strain by multiplication with elastic modulus, E, and cross sectional area, A, the dynamic elastic modulus has to be determined for pile materials other than steel. In general, the records measured by the PDA clearly indicate a pile toe reflection as long as pile penetration per blow is greater than 1 mm or .04 inches. The time between the onset of the force and velocity records at impact and the onset of the reflection from the toe (usually apparent by a local maximum of the wave up curve) is the so-called wave travel time, T. Dividing 2L (L is here the length of the pile below sensors) by T leads to the stress wave speed in the pile:

$$c = 2L/T \quad (10)$$

The elastic modulus of the pile material is related to the wave speed according to the linear elastic wave equation theory by

$$E = c^2\rho \qquad (11)$$

Since the mass density of the pile material, ρ, is usually well known (an exception is timber for which samples should be weighed), the elastic modulus is easily found from the wave speed. Note, however, that this is a dynamic modulus which is generally higher than the static one and that the wave speed depends to some degree on the strain level of the stress wave. For example, experience shows that the wave speed from PIT is roughly 5% higher than the wave speed observed during a high strain test.

Other Notes:

- If the pile material is nonuniform then the wave speed c, according to Eq. 10, is an average wave speed and does not necessarily reflect the pile material properties of the location where the strain sensors are attached to the pile top. For example, pile driving often causes fine tension cracks some distance below the top of concrete piles. Then the average c is slower than that at the pile top. It is therefore recommended to determine E in the beginning of pile driving and not adjust it when the average c changes.

- If the pile has such a high resistance that there is no clear indication of a toe reflection then the wave speed of the pile material must be determined either by assumption or by taking a sample of the concrete and measuring its wave speed in a simple free column test. Another possibility is to use the proportionality relationship, discussed under "DATA QUALITY CHECKS" to find c as the ratio between the measured velocity and measured strain.

DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing PDA or PIT tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to certain relationships.

Proportionality

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the pile, force and velocity measured at the pile top are proportional

$$F = v\,Z = v\,(EA/c) \qquad (12a)$$

This relationship can also be expressed in terms of stress

$$\sigma = v\,(E/c) \qquad (12b)$$

or strain

$$\epsilon = v / c \qquad (12c)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements.

Measurements are always taken at opposite sides of the pile as a means of calculating the average force and velocity in the pile. The velocity on the two sides of the pile is very similar even when high bending exists. Thus, an independent check of the velocity measurements is easy and simple.

Strain measurements may differ greatly between the two sides of the pile when bending exists. It is even possible that tension is measured on one side while very high compression exists on the other side of the pile. In extreme cases, bending might be so high that it leads to a nonlinear stress distribution. The averaging of the two strain signals does then not lead to the average pile force and proportionality will not be achieved.

When testing drilled shafts, measurements of strain may also be affected by local concrete quality variations. It is then often necessary to use four strain transducers spaced at 90 degrees around the pile for an improved strain data quality. The use of four transducers is also recommended for large pile

diameters, particularly when it is difficult to mount the sensors at least two pile widths or diameters below the pile top.

LIMITATIONS, ADDITIONAL CONSIDERATIONS

Mobilization of capacity

Estimates of pile capacity from dynamic testing indicate the **mobilized pile capacity at the time of testing**. At very high blow counts (low set per blow), dynamic test methods tend to produce lower bound capacity estimates as not all resistance (particularly at and near the toe) is fully activated.

Time dependent soil resistance effects

Static pile capacity from dynamic method calculations provide an estimate of the axial pile capacity. Increases and decreases in the pile capacity with time typically occur (soil setup/relaxation). Therefore, **restrike testing usually yields a better indication of long term pile capacity than a test at the end of pile driving**. Often a wait period of one or two days between end of driving and restrike is satisfactory for a realistic prediction of pile capacity but this waiting time depends, among other factors, on the permeability of the soil.

(A) Soil setup

Because excess positive pore pressures often develop during pile driving in fine grained soil (clays, silts or even fine sands), the capacity of a pile at the time of driving may often be less than the long term pile capacity. These pore pressures reduce the effective stress acting on the pile thereby reducing the soil resistance to pile penetration, and thus the pile capacity at the time of driving. As these pore pressures dissipate, the soil resistance acting on the pile increases as does the axial pile capacity. This phenomena is routinely called soil setup or soil freeze.

(*B) Relaxation*

Relaxation (capacity reduction with time) has been observed for piles driven into weathered shale, and may take several days to fully develop. Pile capacity estimates based upon initial driving or short term restrike tests can significantly overpredict long term pile capacity. Therefore, piles driven into shale should be tested after a minimum one week wait either statically or dynamically (with particular emphasis than on the first few blows). Relaxation has also been observed for displacement piles driven into dense saturated silts or fine sands due to a negative pore pressure effect at the pile toe. Again, restrike tests should be used, with great emphasis on early blows.

Capacity results for open pile profiles

Larger diameter open ended pipe piles (or H-piles which do not bear on rock) may behave differently under dynamic and static loading conditions. Under dynamic loads the soil inside the pile or between its flanges may slip and produce internal friction while under static loads the plug may move with the pile, thereby creating end bearing over the full pile cross section. As a result both friction and end bearing components may be different under static and dynamic conditions.

CAPWAP Analysis Results

A portion of the soil resistance calculated on an individual soil segment in a CAPWAP analysis can usually be shifted up or down the shaft one soil segment without significantly altering the match quality. Therefore, use of the CAPWAP resistance distribution for uplift, downdrag, scour, or other geotechnical considerations should be made with an understanding of these analysis limitations.

Stresses

PDA and CAPWAP calculated stresses are average values over the cross section. Additional allowance has to be made for bending or non-uniform contact stresses. To prevent damage it is therefore important to maintain good hammer-pile alignment and to protect the pile toes using appropriate devices or an increased cross sectional area.

In the United States is has become generally acceptable to limit the dynamic installation stresses of driven piles to the following levels:

90% of yield strength for steel piles

85% of the concrete compressive strength - after subtraction of the effective prestress - for concrete piles in compression

100% of effective prestress plus ½ of the concrete's tension strength for prestressed piles in tension

70% of the reinforcement strength for regularly reinforced concrete piles in tension

300% of the static design allowable stress for timber

Note that the dynamic stresses may either be directly measured at the pile top by the PDA or calculated by the PDA for other locations along the pile based on the pile top measurements.

Additional design considerations

Numerous factors have to be considered in pile foundation design. Some of these considerations include

- additional pile loading from downdrag or negative skin friction,
- lateral and uplift loading requirements
- effective stress changes (due to changes in water table, excavations, fills or other changes in overburden),
- long term settlements in general and settlement from underlying weaker layers and/or pile group effects,

These factors have not been evaluated by GRL and have not been considered in the interpretation of the dynamic testing results. The foundation designer should determine if these or any other considerations are applicable to this project and the foundation design.

Wave equation analysis results

The results calculated by the wave equation analysis program depend on a variety of hammer, pile and soil input parameters. Although attempts have been made to base the analysis on the best available information, actual field conditions may vary and therefore stresses and blow counts may differ from the predictions reported. Capacity predictions derived from wave equation analyses should use restrike information. However, because of the uncertainties associated with restrike blow counts and restrike hammer energies, correlations of such results with static test capacities with have often displayed considerable scatter.

As for PDA and CAPWAP, the theory on which GRLWEAP is based is the one-dimensional wave equation. For that reason, stress predictions by the wave equation analysis can only be averages over the pile cross section. Thus, bending stresses or stress concentrations due to non-uniform impact or uneven soil or rock resistance are not considered in these results. Stress maxima calculated by the wave equation are usually subjected to the same limits as those measured directly or calculated from measurements by the PDA.

Appendix B

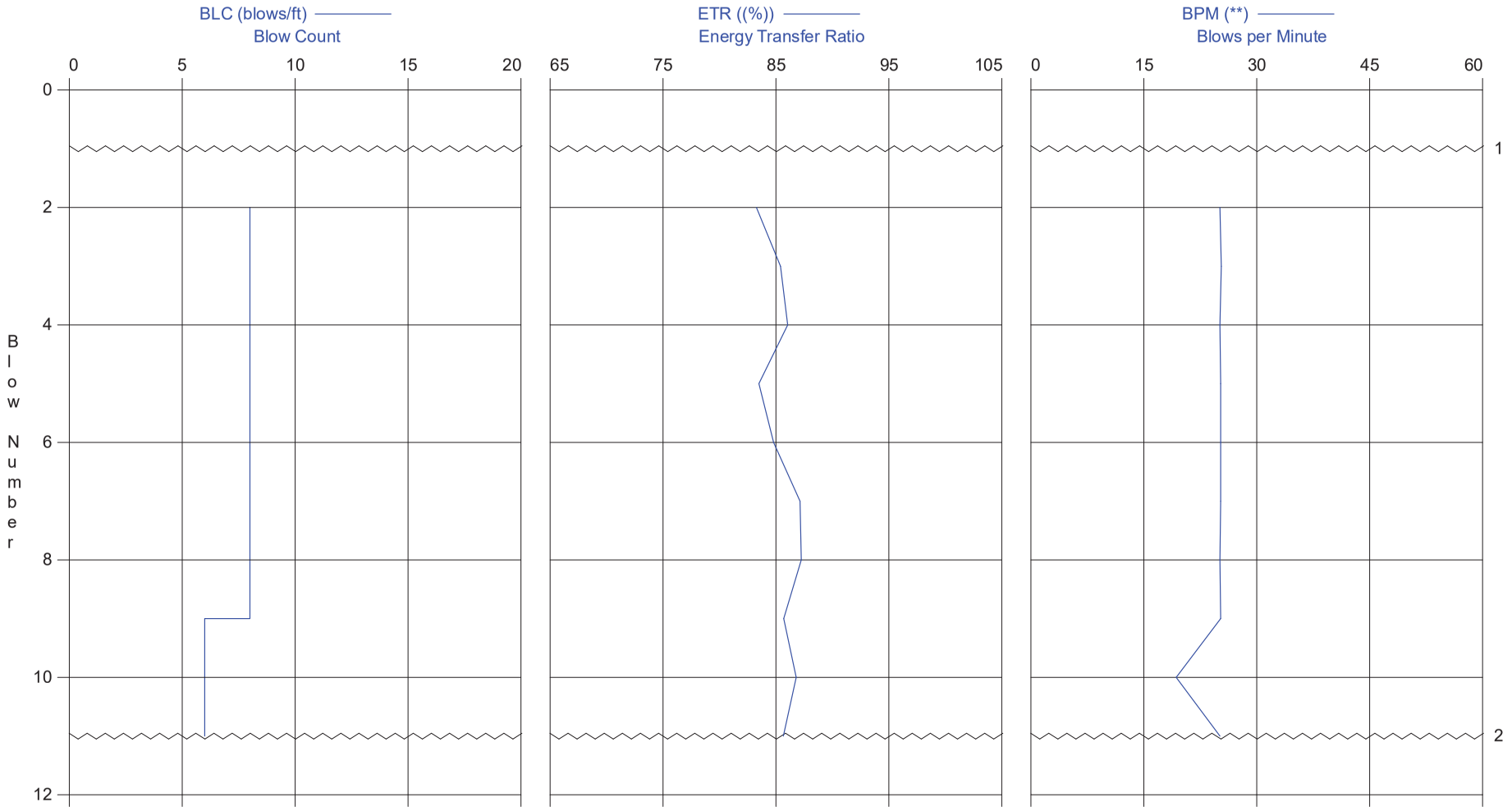
Summary of Case Method Field Results

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

Test date: 1-Nov-2012

HOLT SERVICES - 20 FT, B59 -NWJ



1 - Start of test on 11/1/2012 at 9:18:43 AM

2 - End of test on 11/1/2012 at 9:19:08 AM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES - 20 FT, B59
OP: RMDT

NWJ
Test date: 1-Nov-2012

AR: 1.43 in^2
LE: 23.40 ft
WS: 16,771.1 f/s

SP: 0.492 k/ft3
EM: 29,869 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
ETR: Energy Transfer Ratio
EFV: Energy of FV

BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio

BL#	depth	BLC	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ft	bl/ft	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
5	20.63	8	29.3	27.9	83.5	0.292	25.2	40	15.3	1.1
6	20.75	8	29.2	28.0	84.8	0.297	25.2	40	16.6	1.1
7	20.88	8	28.4	27.4	87.1	0.305	25.2	39	16.2	1.1
8	21.00	8	30.2	28.4	87.2	0.305	25.1	41	16.7	1.1
9	21.17	6	30.4	28.4	85.7	0.300	25.2	41	16.3	1.1
10	21.33	6	28.1	27.5	86.8	0.304	19.3	39	16.8	1.1
11	21.50	6	29.7	28.2	85.7	0.300	25.1	40	15.8	1.1
		Average	29.3	28.0	85.8	0.300	24.3	40	16.2	1.1
		Std. Dev.	0.8	0.4	1.3	0.004	2.1	1	0.5	0.0
		Maximum	30.4	28.4	87.2	0.305	25.2	41	16.8	1.1
		Minimum	28.1	27.4	83.5	0.292	19.3	39	15.3	1.1

Total number of blows analyzed: 7

BL#	depth (ft)	Comments
1	20.13	Start of test on 11/1/2012 at 9:18:43 AM
11	21.50	End of test on 11/1/2012 at 9:19:08 AM

Time Summary

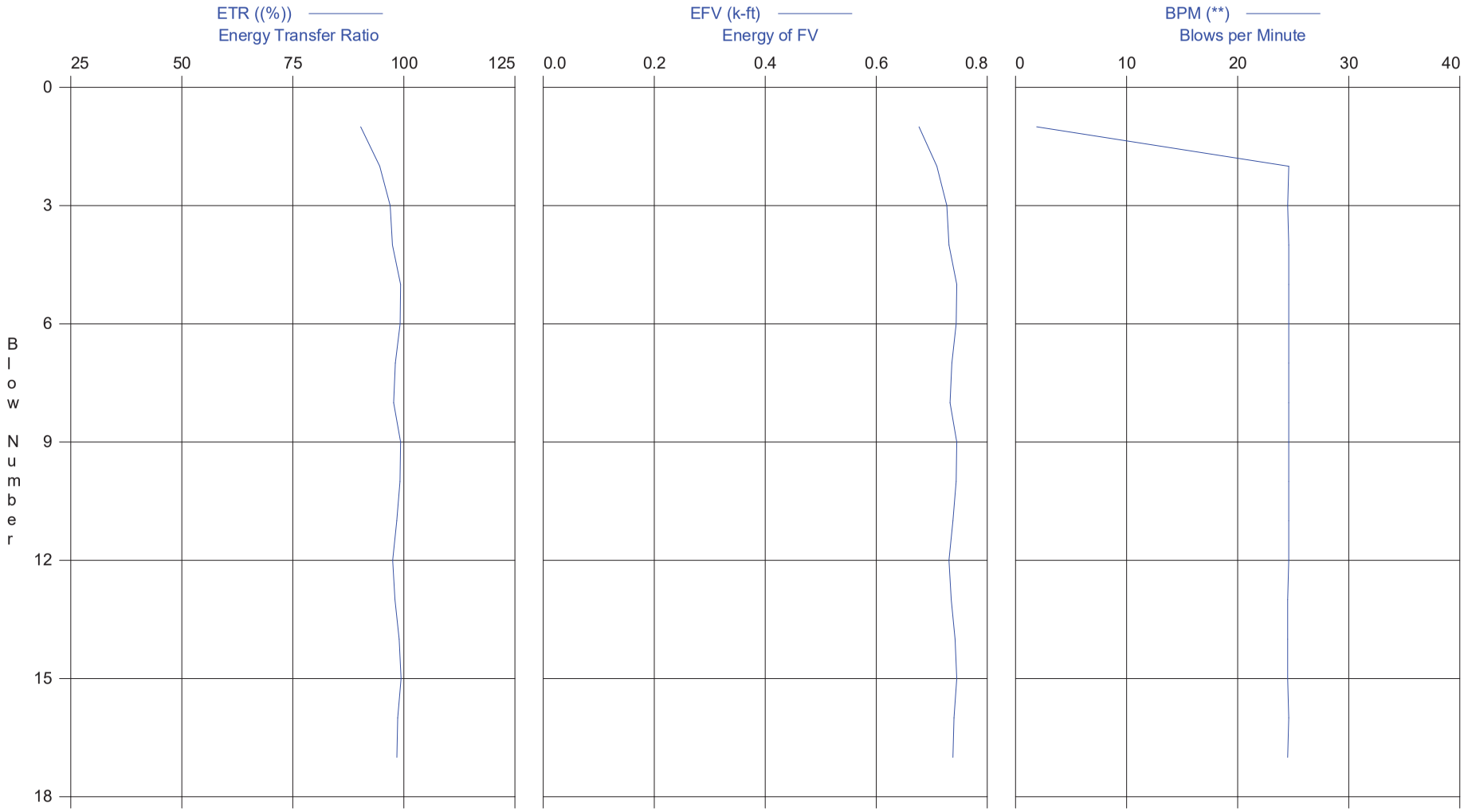
Drive 25 seconds 9:18:43 AM - 9:19:08 AM (11/1/2012) BN 1 - 11

Robert Miner Dynamic Testing, Inc. - Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

Test date: 1-Nov-2012

HOLT SERVICES - 25 FT B59 NWJ



Robert Miner Dynamic Testing, Inc.
Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

HOLT SERVICES - 25 FT B59
OP: RMDT

NWJ
Test date: 1-Nov-2012

AR: 1.43 in^2
LE: 30.40 ft
WS: 16,771.1 f/s

SP: 0.492 k/ft3
EM: 29,869 ksi
JC: 0.35

ETR: Energy Transfer Ratio
EFV: Energy of FV
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

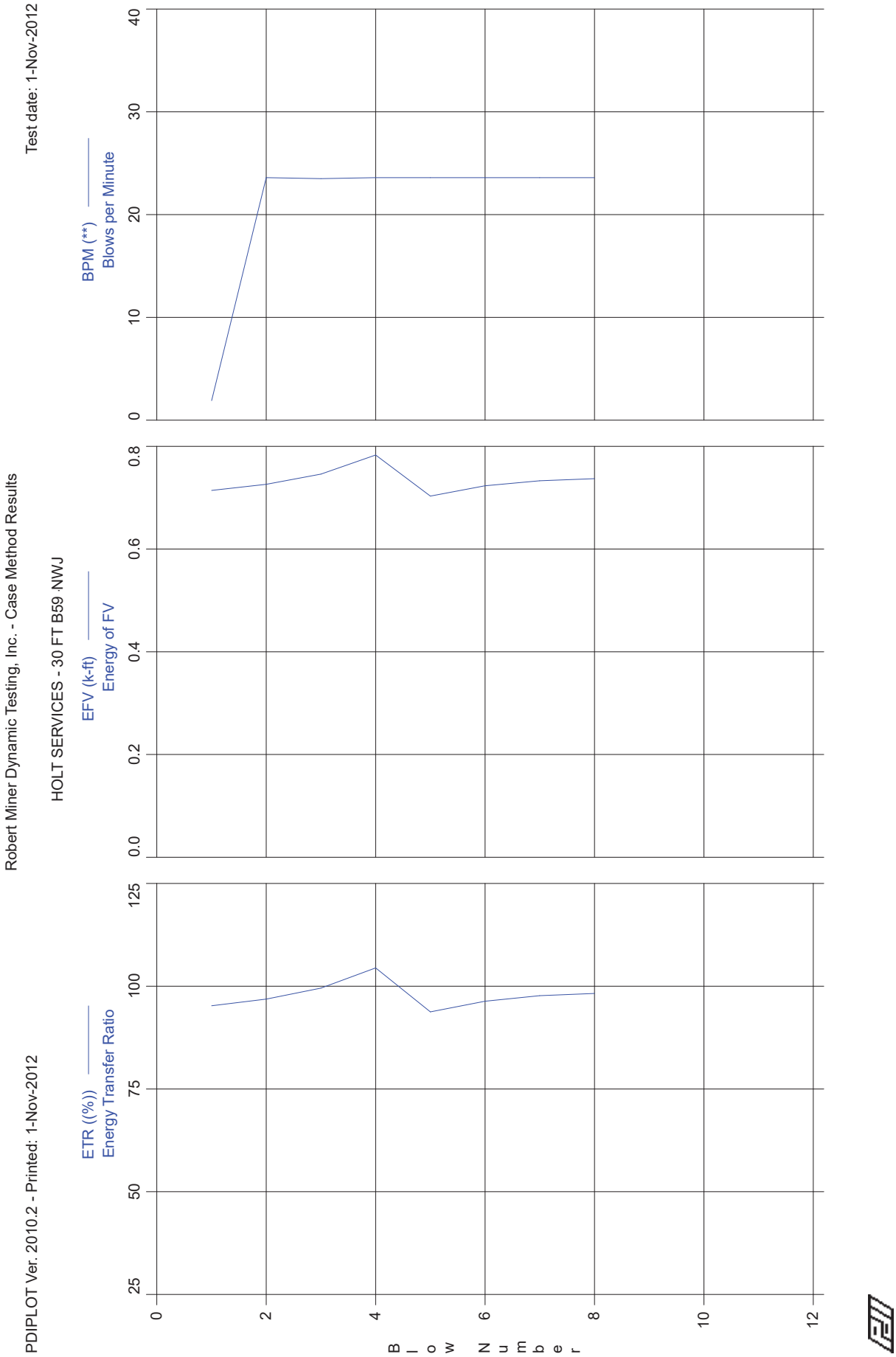
AMX: Maximum Acceleration
SFT: Skin friction total
EF2: Energy of F^2
RAT: SPT Length Ratio

BL#	BLC	ETR	EFV	BPM	FMX	VMX	AMX	SFT	EF2	RAT
	bl/ft	(%)	k-ft	**	kips	f/s	g's	kips	k-ft	[]
6	10	99.2	0.744	24.6	43	16.2	2,531	25	0.813	1.1
7	10	98.1	0.736	24.6	43	16.4	2,487	26	0.806	1.1
8	10	97.7	0.733	24.6	44	16.4	2,541	27	0.808	1.1
9	10	99.3	0.745	24.6	43	16.3	2,388	26	0.812	1.1
10	10	99.1	0.744	24.6	43	16.3	2,360	24	0.808	1.1
11	14	98.4	0.738	24.6	43	16.3	2,395	26	0.807	1.1
12	14	97.5	0.731	24.6	43	16.4	2,434	25	0.803	1.1
13	14	98.0	0.735	24.5	43	16.7	2,727	25	0.806	1.1
14	14	98.9	0.742	24.5	43	16.6	2,624	26	0.806	1.1
15	14	99.4	0.745	24.5	43	16.7	2,658	25	0.810	1.1
16	14	98.6	0.740	24.6	43	16.6	2,646	26	0.806	1.1
17	14	98.4	0.738	24.5	42	16.5	2,606	26	0.802	1.1
Average		98.5	0.739	24.6	43	16.4	2,533	26	0.807	1.1
Maximum		99.4	0.745	24.6	44	16.7	2,727	27	0.813	1.1
@ Blow#		15	9	6	8	15	13	8	6	10

Total number of blows analyzed: 12

Time Summary

Drive 39 seconds 10:03:13 - 10:03:52 (11/1/2012) BN 1 - 17


Robert Miner Dynamic Testing, Inc. - Case Method Results
HOLT SERVICES - 30 FT B59 NWJ
Test date: 1-Nov-2012
PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012
ETR ((%))
Energy Transfer Ratio
EFV (k-ft)
Energy of FV
BPM (**)
Blows per Minute
Blow Number
0
2
4
6
8
10
12
25
50
75
100
125
0.0
0.2
0.4
0.6
0.8
0
10
20
30
40

Robert Miner Dynamic Testing, Inc.
Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

HOLT SERVICES - 30 FT B59 NWJ
OP: RMDT Test date: 1-Nov-2012

AR: 1.43 in^2 SP: 0.492 k/ft3
LE: 35.40 ft EM: 29,869 ksi
WS: 16,771.1 f/s JC: 0.35

ETR: Energy Transfer Ratio
EFV: Energy of FV
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
AMX: Maximum Acceleration
SFT: Skin friction total
EF2: Energy of F^2
RAT: SPT Length Ratio

BL#	BLC	ETR	EFV	BPM	FMX	VMX	AMX	SFT	EF2	RAT
	bl/ft	(%)	k-ft	**	kips	f/s	g's	kips	k-ft	[]
3	4	99.5	0.746	23.5	40	17.4	2,801	23	0.819	1.1
4	4	104.5	0.783	23.6	41	17.7	2,966	26	0.832	1.1
5	8	93.8	0.703	23.6	40	17.6	2,811	26	0.835	1.1
6	8	96.4	0.723	23.6	41	17.5	2,811	27	0.830	1.1
7	8	97.7	0.733	23.6	40	17.8	2,827	26	0.825	1.1
8	8	98.2	0.737	23.6	40	17.4	2,842	28	0.822	1.1
Average		98.3	0.738	23.6	40	17.5	2,843	26	0.827	1.1
Maximum		104.5	0.783	23.6	41	17.8	2,966	28	0.835	1.1
@ Blow#		4	4	4	6	7	4	8	5	8

Total number of blows analyzed: 6

Time Summary

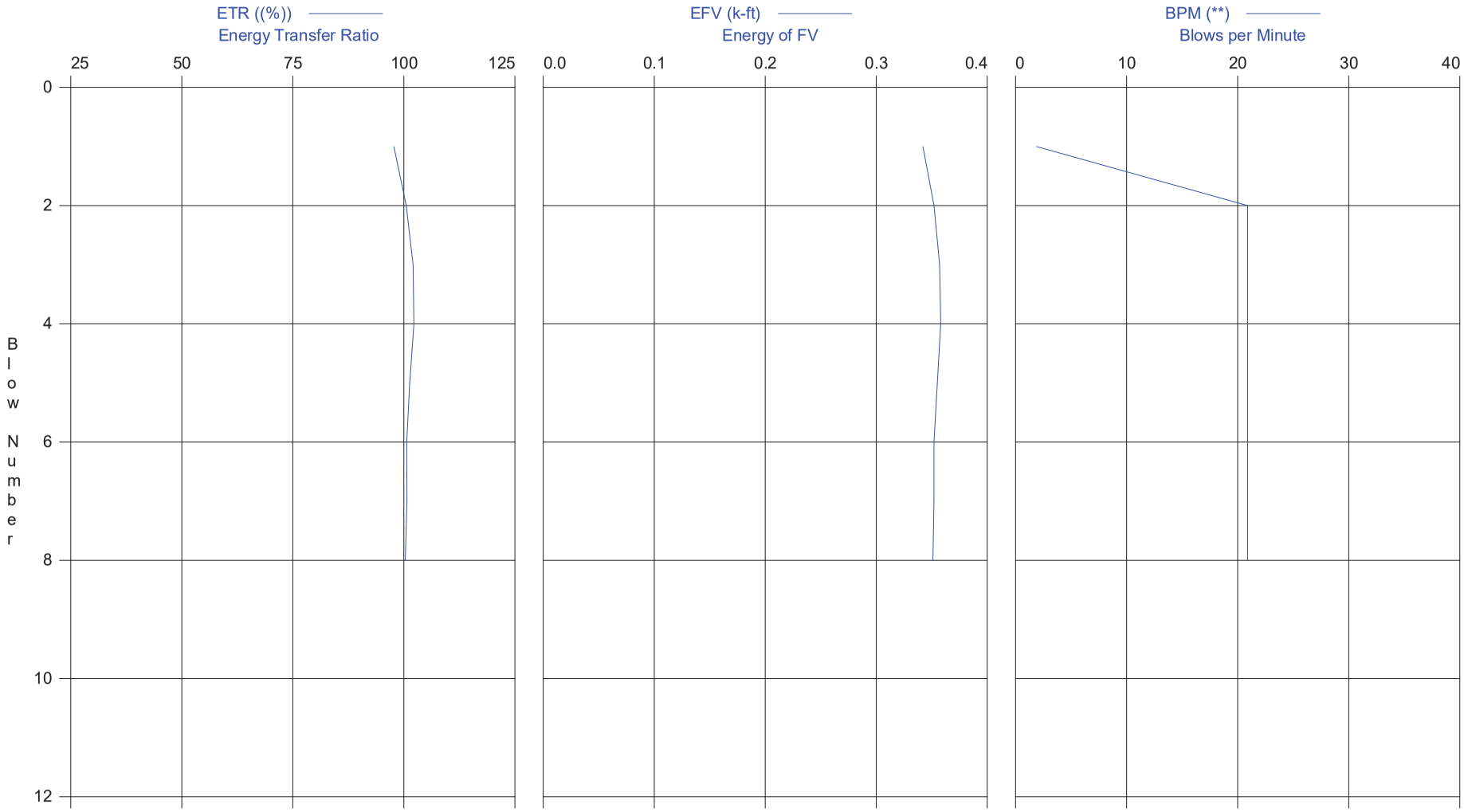
Drive 18 seconds 10:21:04 - 10:21:22 (11/1/2012) BN 1 - 8

Robert Miner Dynamic Testing, Inc. - Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

Test date: 1-Nov-2012

HOLT SERVICES - 35 FT B59 NWJ



Robert Miner Dynamic Testing, Inc.
Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

HOLT SERVICES - 35 FT B59
OP: RMDT

NWJ
Test date: 1-Nov-2012

AR: 1.43 in^2
LE: 40.40 ft
WS: 16,771.1 f/s

SP: 0.492 k/ft3
EM: 29,869 ksi
JC: 0.35

ETR: Energy Transfer Ratio
EFV: Energy of FV
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

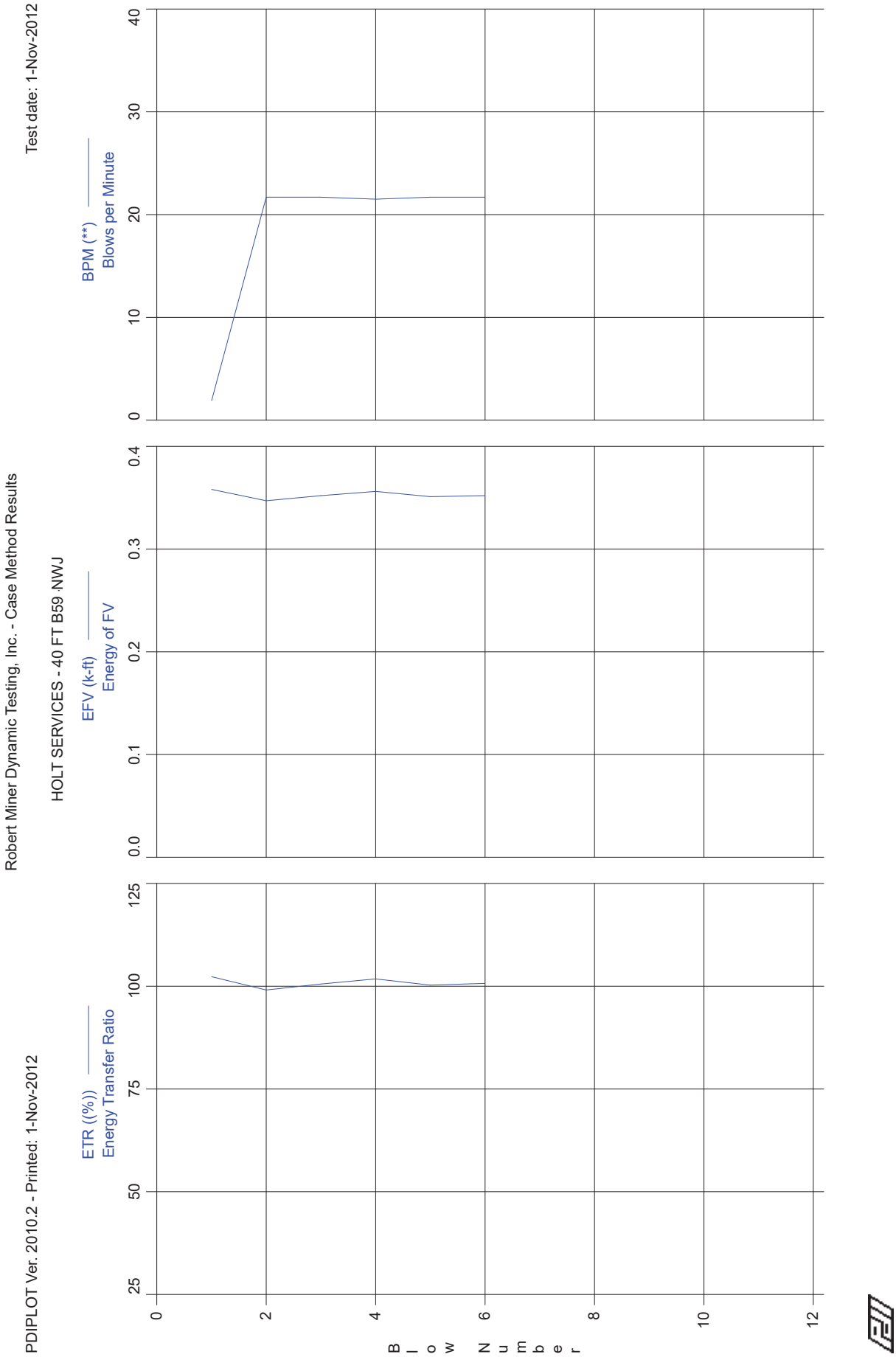
AMX: Maximum Acceleration
SFT: Skin friction total
EF2: Energy of F^2
RAT: SPT Length Ratio

BL#	BLC	ETR	EFV	BPM	FMX	VMX	AMX	SFT	EF2	RAT
	bl/ft	(%)	k-ft	**	kips	f/s	g's	kips	k-ft	[]
3	4	102.1	0.357	20.9	41	15.5	2,358	22	0.398	1.1
4	4	102.2	0.358	20.9	41	15.9	2,467	22	0.383	0.8
5	8	101.3	0.355	20.9	40	15.8	2,461	23	0.384	0.8
6	8	100.7	0.352	20.9	41	15.5	2,364	23	0.383	0.8
7	8	100.7	0.352	20.9	40	15.6	2,440	24	0.382	0.8
8	8	100.3	0.351	20.9	40	15.4	2,386	23	0.394	1.1
Average		101.2	0.354	20.9	41	15.6	2,413	23	0.387	0.9
Maximum		102.2	0.358	20.9	41	15.9	2,467	24	0.398	1.1
@ Blow#		4	4	3	3	4	4	7	3	3

Total number of blows analyzed: 6

Time Summary

Drive 20 seconds 11:08:09 - 11:08:29 (11/1/2012) BN 1 - 8


PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012
Robert Miner Dynamic Testing, Inc. - Case Method Results
HOLT SERVICES - 40 FT B59 NWJ
Test date: 1-Nov-2012
ETR ((%))
Energy Transfer Ratio
EFV (k-ft)
Energy of FV
BPM (**)
Blows per Minute
Blow Number
0
2
4
6
8
10
12
25
50
75
100
125
0.0
0.1
0.2
0.3
0.4
0
10
20
30
40

Robert Miner Dynamic Testing, Inc.
Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

HOLT SERVICES - 40 FT B59
OP: RMDT

NWJ
Test date: 1-Nov-2012

AR: 1.43 in^2
LE: 45.40 ft
WS: 16,771.1 f/s

SP: 0.492 k/ft3
EM: 29,869 ksi
JC: 0.35

ETR: Energy Transfer Ratio
EFV: Energy of FV
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

AMX: Maximum Acceleration
SFT: Skin friction total
EF2: Energy of F^2
RAT: SPT Length Ratio

BL#	BLC	ETR	EFV	BPM	FMX	VMX	AMX	SFT	EF2	RAT
	bl/ft	(%)	k-ft	**	kips	f/s	g's	kips	k-ft	[]
3	4	100.5	0.352	21.7	40	16.0	2,799	26	0.402	1.1
4	4	101.8	0.356	21.5	39	16.4	2,745	28	0.397	1.1
5	4	100.3	0.351	21.7	39	15.9	2,747	28	0.395	1.1
6	4	100.7	0.352	21.7	39	15.9	2,557	24	0.397	1.1
Average		100.8	0.353	21.6	39	16.1	2,712	27	0.398	1.1
Maximum		101.8	0.356	21.7	40	16.4	2,799	28	0.402	1.1
@ Blow#		4	4	3	3	4	3	5	3	6

Total number of blows analyzed: 4

Time Summary

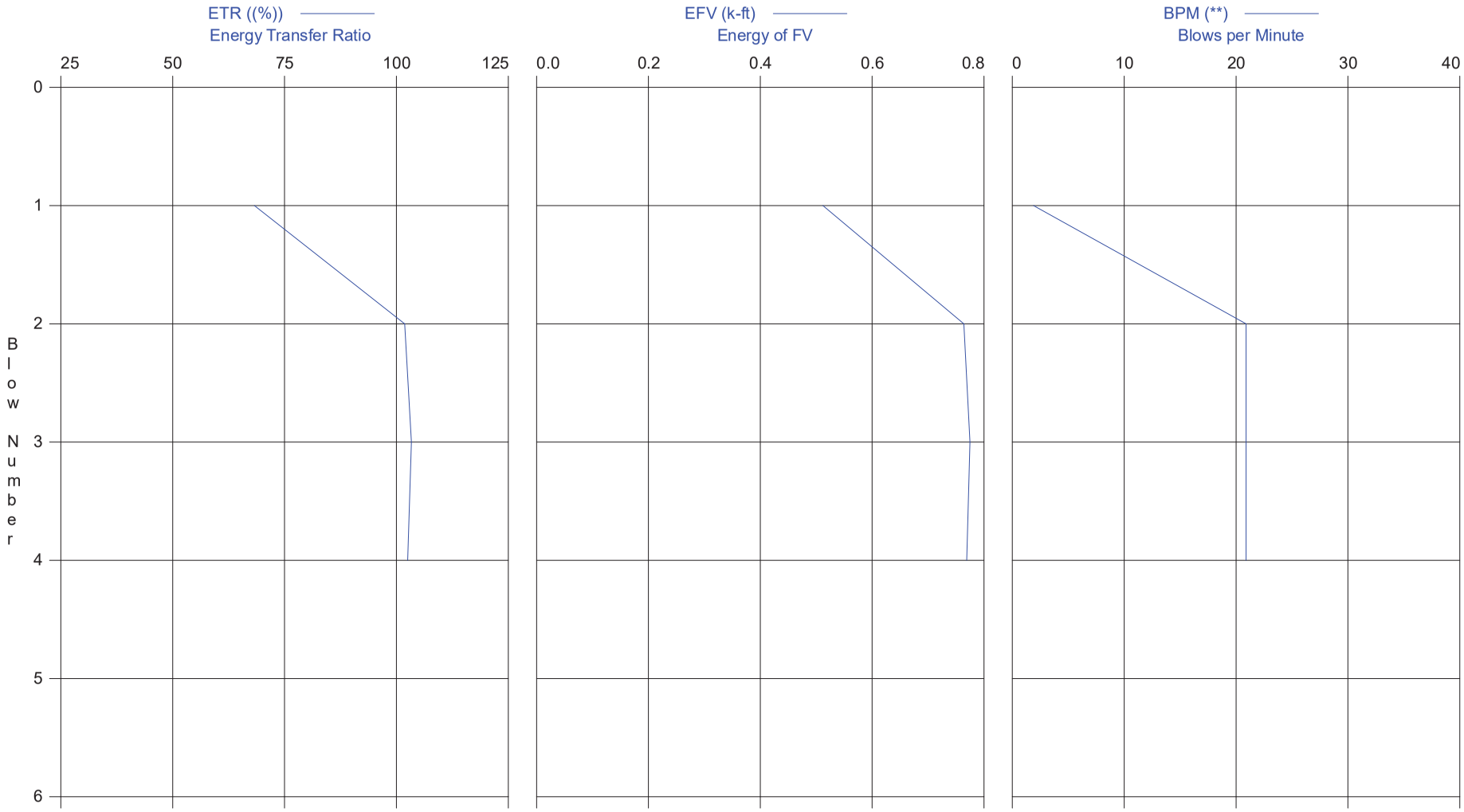
Drive 14 seconds 11:17:40 - 11:17:54 (11/1/2012) BN 1 - 6

Robert Miner Dynamic Testing, Inc. - Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

Test date: 1-Nov-2012

HOLT SERVICES - 45 FT, B59 -NWJ



Robert Miner Dynamic Testing, Inc.
Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

HOLT SERVICES - 45 FT, B59
OP: RMDT

NWJ
Test date: 1-Nov-2012

AR: 1.43 in^2
LE: 50.40 ft
WS: 16,771.1 f/s

SP: 0.492 k/ft3
EM: 29,869 ksi
JC: 0.35

ETR: Energy Transfer Ratio
EFV: Energy of FV
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

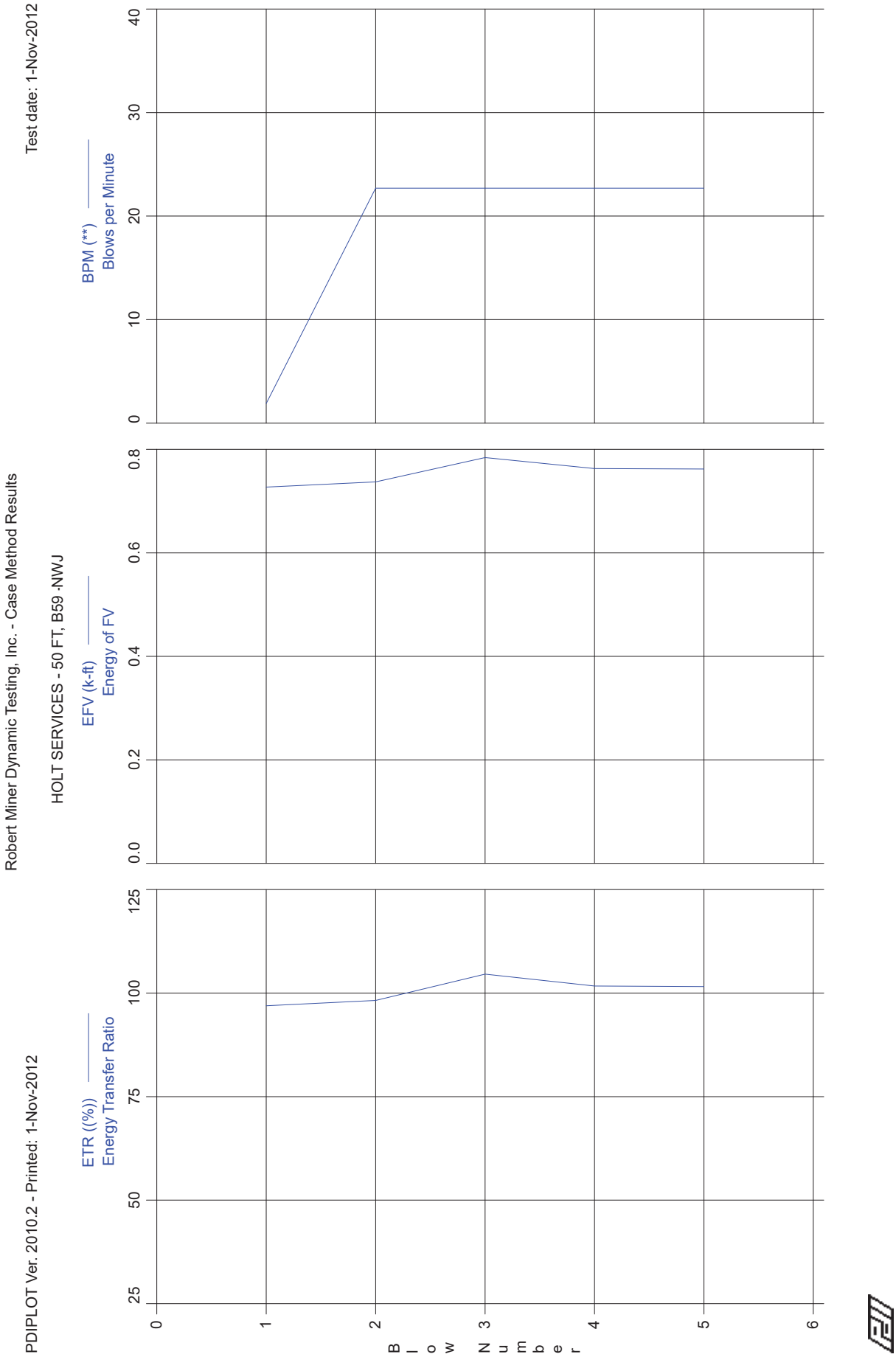
AMX: Maximum Acceleration
SFT: Skin friction total
EF2: Energy of F^2
RAT: SPT Length Ratio

BL#	BLC	ETR	EFV	BPM	FMX	VMX	AMX	SFT	EF2	RAT
	bl/ft	(%)	k-ft	**	kips	f/s	g's	kips	k-ft	[]
2	2	101.8	0.764	20.9	40	17.3	2,409	33	0.841	1.1
3	2	103.3	0.775	20.9	40	16.3	2,358	36	0.845	1.1
4	2	102.5	0.769	20.9	40	16.5	2,433	39	0.847	1.1
Average		102.6	0.769	20.9	40	16.7	2,400	36	0.844	1.1
Maximum		103.3	0.775	20.9	40	17.3	2,433	39	0.847	1.1
@ Blow#		3	3	2	4	2	4	4	4	2

Total number of blows analyzed: 3

Time Summary

Drive 9 seconds 11:43:57 - 11:44:06 (11/1/2012) BN 1 - 4


PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012
Robert Miner Dynamic Testing, Inc. - Case Method Results
HOLT SERVICES - 50 FT, B59 -NWJ
Test date: 1-Nov-2012
ETR ((%))
Energy Transfer Ratio
EFV (k-ft)
Energy of FV
BPM (**)
Blows per Minute
25
50
75
100
125
0.0
0.2
0.4
0.6
0.8
0
10
20
30
40
0
1
2
3
4
5
6
Blow Number

Robert Miner Dynamic Testing, Inc.
Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

HOLT SERVICES - 50 FT, B59 NWJ
OP: RMDT Test date: 1-Nov-2012

AR: 1.43 in^2 SP: 0.492 k/ft3
LE: 55.40 ft EM: 29,869 ksi
WS: 16,771.1 f/s JC: 0.35

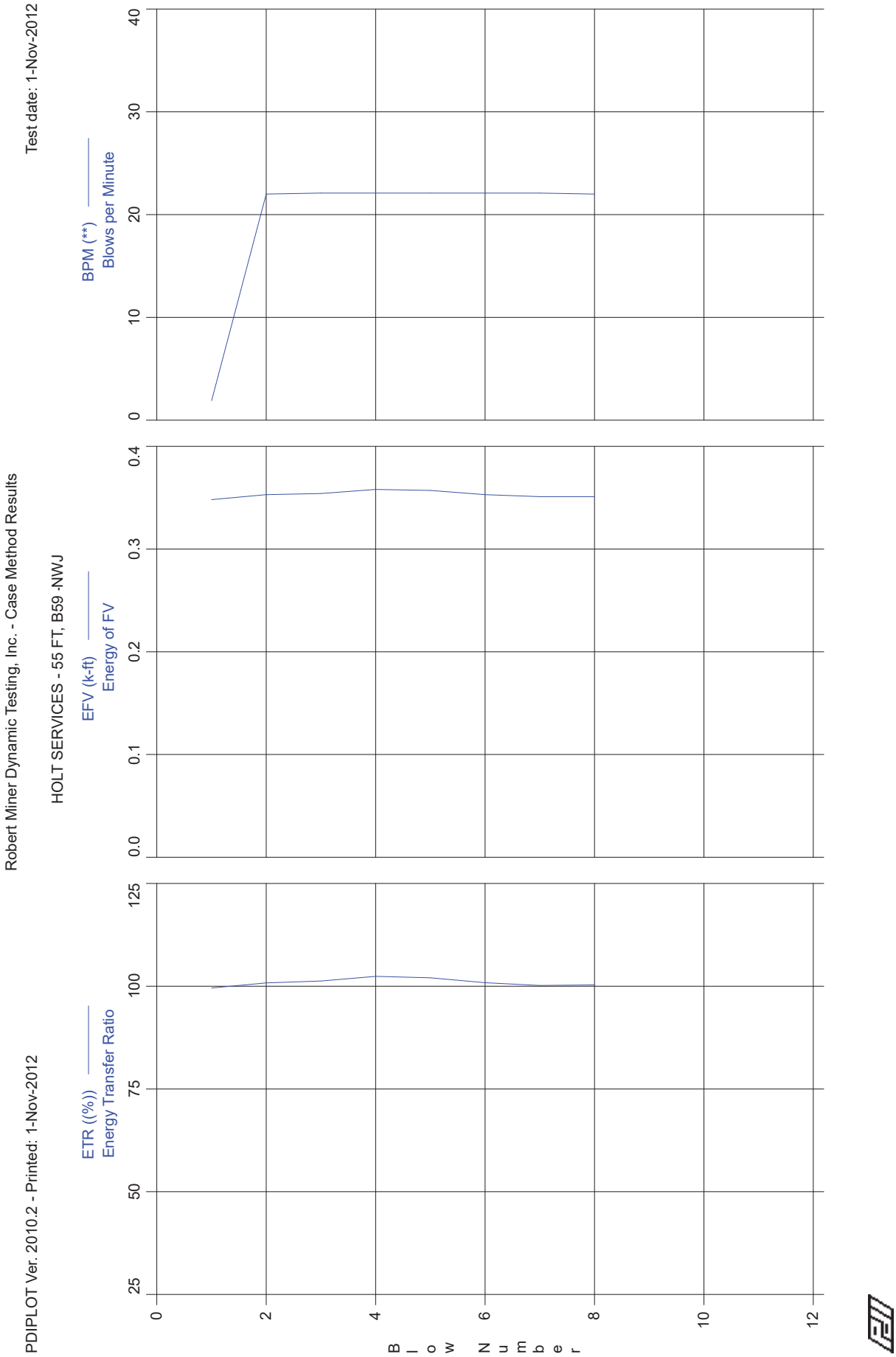
ETR: Energy Transfer Ratio
EFV: Energy of FV
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
AMX: Maximum Acceleration
SFT: Skin friction total
EF2: Energy of F^2
RAT: SPT Length Ratio

BL#	BLC	ETR	EFV	BPM	FMX	VMX	AMX	SFT	EF2	RAT
	bl/ft	(%)	k-ft	**	kips	f/s	g's	kips	k-ft	[]
3	0	104.6	0.784	22.7	41	16.7	2,977	35	0.889	1.1
4	4	101.7	0.763	22.7	43	16.5	2,924	38	0.894	1.1
5	4	101.6	0.762	22.7	42	16.5	2,916	36	0.888	1.1
Average		102.6	0.770	22.7	42	16.6	2,939	36	0.890	1.1
Maximum		104.6	0.784	22.7	43	16.7	2,977	38	0.894	1.1
@ Blow#		3	3	3	4	3	3	4	4	4

Total number of blows analyzed: 3

Time Summary

Drive 10 seconds 11:55:44 - 11:55:54 (11/1/2012) BN 1 - 5


PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012
Robert Miner Dynamic Testing, Inc. - Case Method Results
HOLT SERVICES - 55 FT, B59 -NWJ
Test date: 1-Nov-2012
ETR ((%))
Energy Transfer Ratio
EFV (k-ft)
Energy of FV
BPM (**)
Blows per Minute
Blow Number
0
2
4
6
8
10
12
25
50
75
100
125
0.0
0.1
0.2
0.3
0.4
0
10
20
30
40

Robert Miner Dynamic Testing, Inc.
Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

HOLT SERVICES - 55 FT, B59
OP: RMDT

NWJ
Test date: 1-Nov-2012

AR: 1.43 in^2
LE: 60.40 ft
WS: 16,771.1 f/s

SP: 0.492 k/ft3
EM: 29,869 ksi
JC: 0.35

ETR: Energy Transfer Ratio
EFV: Energy of FV
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

AMX: Maximum Acceleration
SFT: Skin friction total
EF2: Energy of F^2
RAT: SPT Length Ratio

BL#	BLC	ETR	EFV	BPM	FMX	VMX	AMX	SFT	EF2	RAT
	bl/ft	(%)	k-ft	**	kips	f/s	g's	kips	k-ft	[]
4	4	102.4	0.358	22.1	39	15.9	2,496	18	0.389	0.7
5	4	102.1	0.357	22.1	39	15.9	2,505	15	0.390	0.7
6	6	100.9	0.353	22.1	39	15.9	2,609	19	0.386	0.7
7	6	100.2	0.351	22.1	39	15.9	2,422	17	0.384	0.7
8	6	100.3	0.351	22.0	38	15.8	2,422	13	0.377	0.7
Average		101.2	0.354	22.1	39	15.9	2,491	16	0.385	0.7
Maximum		102.4	0.358	22.1	39	15.9	2,609	19	0.390	0.7
@ Blow#		4	4	4	6	5	6	6	5	8

Total number of blows analyzed: 5

Time Summary

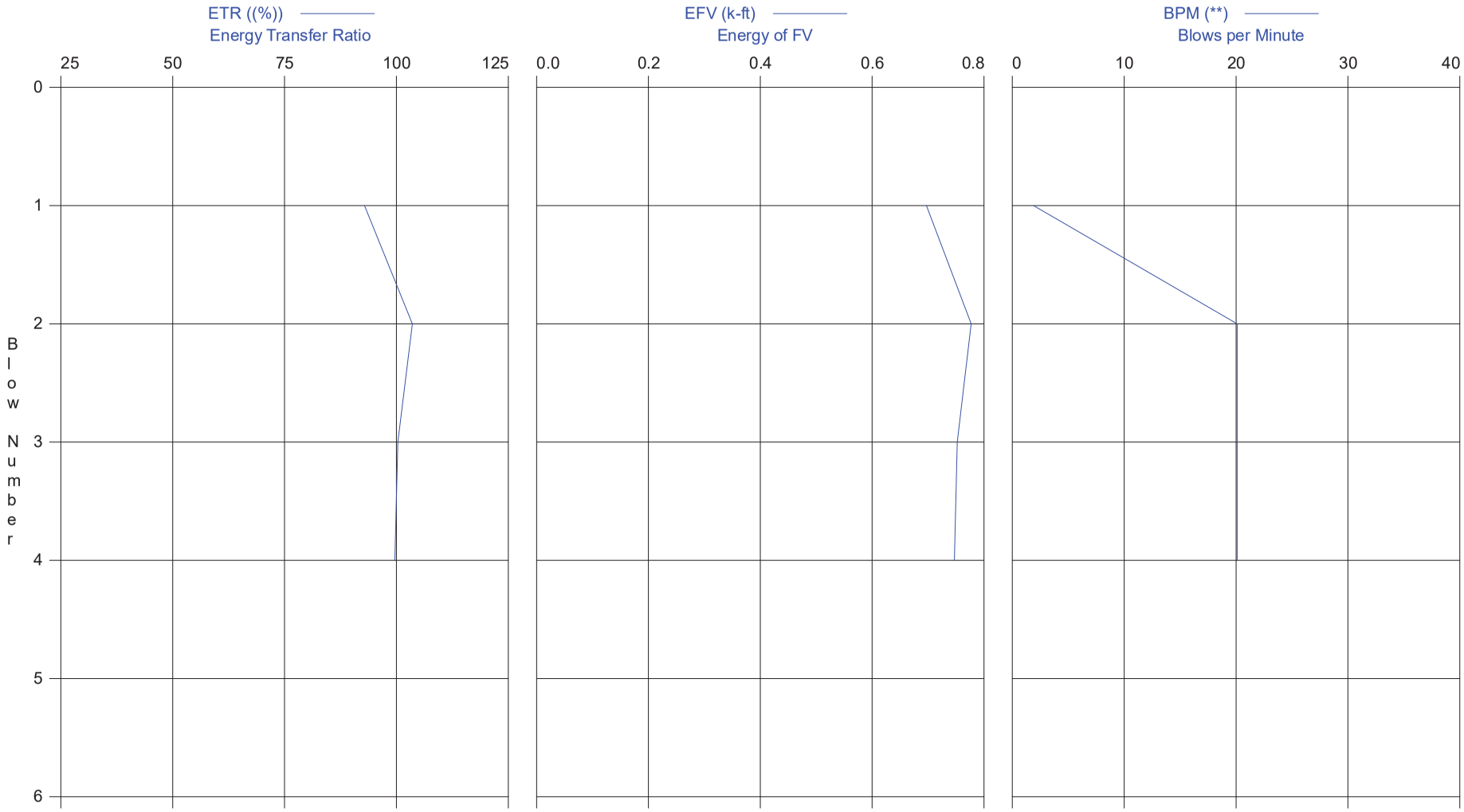
Drive 19 seconds 12:19:01 - 12:19:20 (11/1/2012) BN 1 - 8

Robert Miner Dynamic Testing, Inc. - Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

Test date: 1-Nov-2012

HOLT SERVICES - 60 FT, B59 -NWJ



Robert Miner Dynamic Testing, Inc.
Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

HOLT SERVICES - 60 FT, B59
OP: RMDT

NWJ
Test date: 1-Nov-2012

AR: 1.43 in^2
LE: 65.40 ft
WS: 16,771.1 f/s

SP: 0.492 k/ft3
EM: 29,869 ksi
JC: 0.35

ETR: Energy Transfer Ratio
EFV: Energy of FV
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

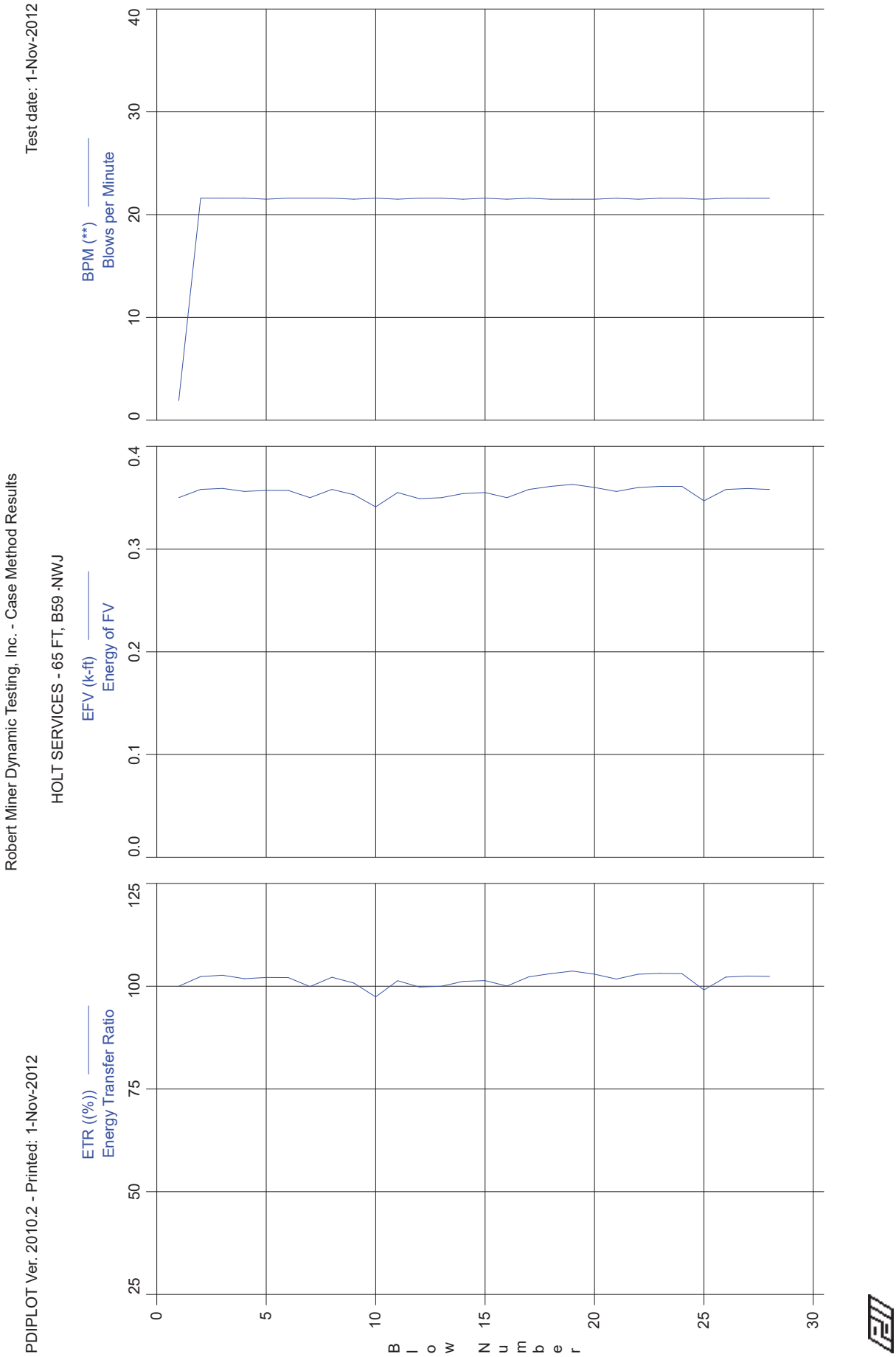
AMX: Maximum Acceleration
SFT: Skin friction total
EF2: Energy of F^2
RAT: SPT Length Ratio

BL#	BLC	ETR	EFV	BPM	FMX	VMX	AMX	SFT	EF2	RAT
	bl/ft	(%)	k-ft	**	kips	f/s	g's	kips	k-ft	[]
2	2	103.6	0.777	20.1	43	16.6	2,808	33	0.858	1.1
3	4	100.3	0.752	20.1	43	16.6	2,932	36	0.868	1.1
4	4	99.6	0.747	20.1	42	16.4	2,753	35	0.857	1.1
Average		101.2	0.759	20.1	43	16.5	2,831	34	0.861	1.1
Maximum		103.6	0.777	20.1	43	16.6	2,932	36	0.868	1.1
@ Blow#		2	2	2	2	2	3	3	3	2

Total number of blows analyzed: 3

Time Summary

Drive 9 seconds 12:38:36 - 12:38:45 (11/1/2012) BN 1 - 4


PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012
Robert Miner Dynamic Testing, Inc. - Case Method Results
HOLT SERVICES - 65 FT, B59 -NWJ
Test date: 1-Nov-2012
ETR ((%))
Energy Transfer Ratio
EFV (k-ft)
Energy of FV
BPM (**)
Blows per Minute
Blow Number
0
5
10
15
20
25
30
25
50
75
100
125
0.0
0.1
0.2
0.3
0.4
0
10
20
30
40

Robert Miner Dynamic Testing, Inc.
Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 1-Nov-2012

HOLT SERVICES - 65 FT, B59
OP: RMDT

NWJ
Test date: 1-Nov-2012

AR: 1.43 in^2
LE: 70.40 ft
WS: 16,771.1 f/s

SP: 0.492 k/ft3
EM: 29,869 ksi
JC: 0.35

ETR: Energy Transfer Ratio
EFV: Energy of FV
BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity

AMX: Maximum Acceleration
SFT: Skin friction total
EF2: Energy of F^2
RAT: SPT Length Ratio

BL#	BLC	ETR	EFV	BPM	FMX	VMX	AMX	SFT	EF2	RAT
	bl/ft	(%)	k-ft	**	kips	f/s	g's	kips	k-ft	[]
10	26	97.4	0.341	21.6	37	13.9	1,849	14	0.363	0.6
11	26	101.4	0.355	21.5	39	14.7	2,041	17	0.376	0.6
12	26	99.8	0.349	21.6	38	14.4	1,922	16	0.373	0.8
13	26	100.0	0.350	21.6	38	14.2	1,813	13	0.370	0.6
14	26	101.2	0.354	21.5	38	14.4	1,903	17	0.372	0.6
15	26	101.4	0.355	21.6	38	14.7	1,935	15	0.377	0.6
16	26	100.1	0.350	21.5	37	13.7	1,692	14	0.372	0.8
17	26	102.3	0.358	21.6	39	14.9	2,093	18	0.379	0.8
18	26	103.1	0.361	21.5	39	15.1	1,979	17	0.385	0.8
19	26	103.7	0.363	21.5	39	15.2	2,020	17	0.384	0.6
20	26	102.9	0.360	21.5	39	15.0	2,039	19	0.385	0.8
21	26	101.8	0.356	21.6	39	14.8	1,952	19	0.385	0.6
22	26	103.0	0.360	21.5	39	15.0	2,034	19	0.387	0.8
23	12	103.1	0.361	21.6	40	15.0	2,009	18	0.389	0.8
24	12	103.1	0.361	21.6	39	15.0	2,004	19	0.387	0.8
25	12	99.1	0.347	21.5	36	14.2	1,634	14	0.362	0.8
26	12	102.2	0.358	21.6	37	14.6	1,878	18	0.375	0.8
27	12	102.5	0.359	21.6	38	14.9	1,959	17	0.377	0.8
28	12	102.4	0.358	21.6	37	14.6	1,963	19	0.378	0.8
Average		101.6	0.356	21.6	38	14.7	1,933	17	0.378	0.7
Maximum		103.7	0.363	21.6	40	15.2	2,093	19	0.389	0.8
@ Blow#		19	19	10	23	19	17	22	23	26

Total number of blows analyzed: 19

Time Summary

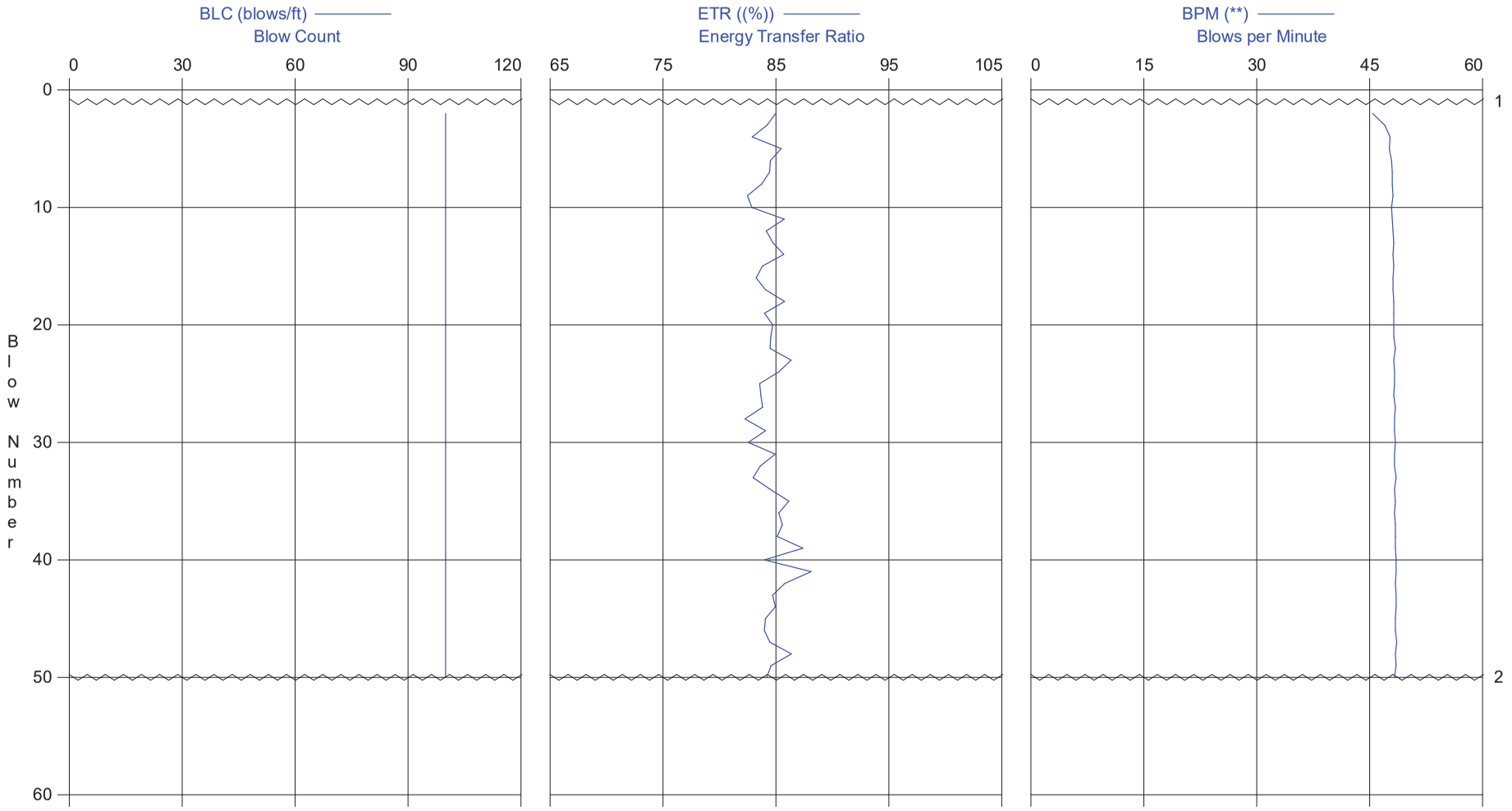
Drive 1 minute 15 seconds 12:59:21 - 13:00:36 (11/1/2012) BN 1 - 28

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

Test date: 17-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 35 FT BHE330-B28



1 - Start of test on 4/17/2013 at 9:28:14 AM

2 - End of test on 4/17/2013 at 9:29:14 AM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 35 FT
OP: RMDT

BHE330-B28
Test date: 17-Apr-2013

AR: 1.43 in^2
LE: 39.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
ETR: Energy Transfer Ratio
EFV: Energy of FV

BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio

BL#	depth	BLC	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ft	bl/ft	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
2	35.02	100	30.1	29.7	85.0	0.297	45.4	43	13.6	1.1
3	35.03	100	30.9	30.3	84.2	0.295	47.0	43	13.9	1.1
4	35.04	100	30.6	29.9	82.9	0.290	47.7	43	14.0	1.1
5	35.05	100	30.7	30.3	85.5	0.299	47.6	43	14.1	1.1
6	35.06	100	31.1	30.6	84.5	0.296	47.9	44	14.1	1.1
7	35.07	100	30.9	30.2	84.4	0.295	48.0	43	14.5	1.1
8	35.08	100	30.8	30.1	83.7	0.293	48.0	43	14.3	1.1
9	35.09	100	30.2	29.7	82.5	0.289	48.1	43	14.1	1.1
10	35.10	100	30.6	30.1	82.9	0.290	47.9	43	14.3	1.1
11	35.11	100	30.6	30.4	85.7	0.300	48.0	43	14.7	1.1
12	35.12	100	29.8	29.4	84.1	0.295	48.1	42	14.3	0.7
13	35.13	100	30.7	30.3	84.7	0.297	48.2	43	14.5	1.1
14	35.14	100	30.5	30.3	85.7	0.300	48.1	43	14.5	0.9
15	35.15	100	30.4	30.1	83.8	0.293	48.2	43	14.2	1.1
16	35.16	100	30.3	30.1	83.2	0.291	48.1	43	14.0	1.1
17	35.17	100	30.6	30.5	84.1	0.294	48.1	44	14.6	1.1
18	35.18	100	30.9	30.7	85.8	0.300	48.2	44	14.6	0.7
19	35.19	100	30.6	30.2	84.0	0.294	48.2	43	14.9	1.1
20	35.20	100	30.6	30.4	84.7	0.296	48.2	43	14.8	0.7
21	35.21	100	30.7	30.5	84.5	0.296	48.2	44	15.0	1.1
22	35.22	100	30.0	29.6	84.5	0.296	48.4	42	14.5	1.1
23	35.23	100	30.5	30.1	86.3	0.302	48.2	43	15.0	1.1
24	35.24	100	30.4	30.4	85.3	0.298	48.3	43	14.9	1.1
25	35.25	100	30.3	30.3	83.6	0.292	48.3	43	14.3	1.1
26	35.26	100	30.0	29.9	83.7	0.293	48.2	43	15.4	1.1
27	35.27	100	29.6	29.1	83.8	0.293	48.4	42	14.8	1.1
28	35.28	100	29.8	29.5	82.3	0.288	48.3	42	15.0	0.7
29	35.29	100	29.8	29.6	84.1	0.294	48.3	42	15.1	1.1
30	35.30	100	29.1	28.7	82.6	0.289	48.4	41	15.0	1.1
31	35.31	100	29.6	29.5	84.9	0.297	48.3	42	15.1	1.0
32	35.32	100	29.8	29.5	83.6	0.293	48.3	42	14.9	0.9
33	35.33	100	30.1	29.6	83.0	0.290	48.5	42	15.0	1.1
34	35.34	100	30.1	29.9	84.5	0.296	48.3	43	14.7	1.1
35	35.35	100	31.2	31.1	86.2	0.302	48.4	44	15.5	0.7
36	35.36	100	30.6	30.5	85.2	0.298	48.3	44	15.6	1.1
37	35.37	100	29.8	29.8	85.6	0.299	48.4	43	15.6	0.7
38	35.38	100	30.5	30.1	85.1	0.298	48.4	43	14.9	1.1
39	35.39	100	31.4	31.3	87.4	0.306	48.4	45	15.6	1.1
40	35.40	100	29.6	29.4	84.0	0.294	48.5	42	14.6	1.1
41	35.41	100	31.6	31.6	88.1	0.308	48.5	45	15.9	1.1
42	35.42	100	31.3	31.2	85.8	0.300	48.4	45	15.4	1.1
43	35.43	100	30.7	30.2	84.7	0.296	48.5	43	14.9	1.1
44	35.44	100	31.5	31.4	84.9	0.297	48.5	45	15.2	1.1
45	35.45	100	30.3	30.0	84.1	0.294	48.4	43	14.8	1.1
46	35.46	100	30.4	30.4	84.0	0.294	48.4	43	15.1	0.9
47	35.47	100	30.4	30.2	84.5	0.296	48.6	43	15.0	1.1
48	35.48	100	31.5	31.3	86.4	0.302	48.4	45	15.6	1.1
49	35.49	100	31.5	31.2	84.6	0.296	48.5	45	15.3	0.7
50	35.50	100	30.0	29.7	84.2	0.295	48.3	42	14.7	1.1
		Average	30.5	30.2	84.5	0.296	48.2	43	14.8	1.0
		Std. Dev.	0.6	0.6	1.2	0.004	0.5	1	0.5	0.1
		Maximum	31.6	31.6	88.1	0.308	48.6	45	15.9	1.1
		Minimum	29.1	28.7	82.3	0.288	45.4	41	13.6	0.7

Total number of blows analyzed: 49

BL#	depth (ft)	Comments
1	35.01	Start of test on 4/17/2013 at 9:28:14 AM
50	35.50	End of test on 4/17/2013 at 9:29:14 AM

Time Summary

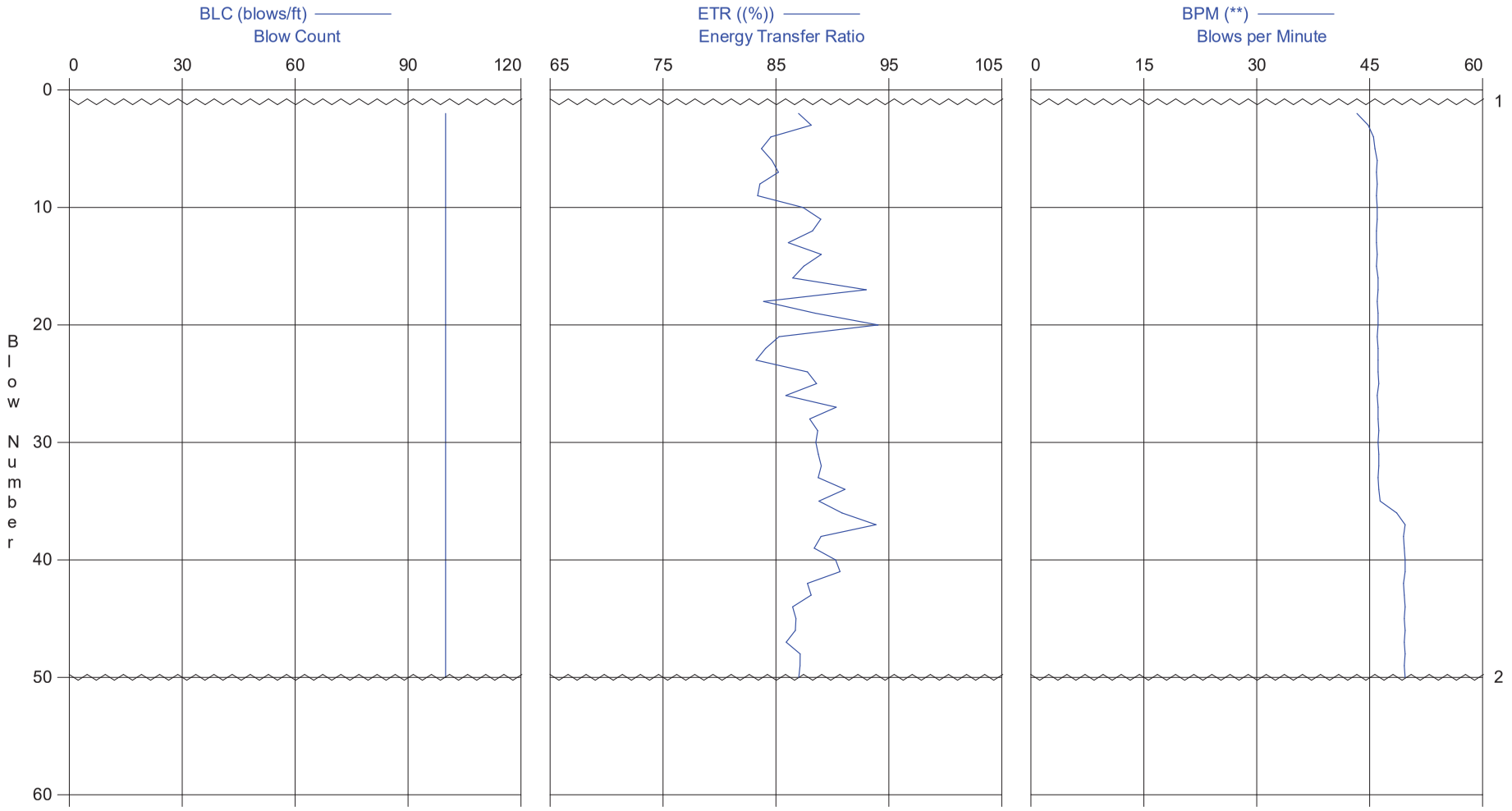
Drive	1 minute	9:28:14 AM - 9:29:14 AM (4/17/2013) BN 1 - 50

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

Test date: 17-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 40 FT BH:330-B28



1 - Start of test on 4/17/2013 at 11:18:01 AM

2 - End of test on 4/17/2013 at 11:19:04 AM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 40 FT
OP: RMDT

BH:330-B28
Test date: 17-Apr-2013

AR: 1.43 in^2
LE: 44.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
ETR: Energy Transfer Ratio
EFV: Energy of FV

BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio

BL#	depth	BLC	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ft	bl/ft	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
2	40.02	100	30.0	29.4	87.0	0.305	43.3	42.1	14.3	0.9
3	40.03	100	30.7	30.6	88.1	0.308	44.8	43.7	16.1	0.8
4	40.04	100	32.3	31.7	84.5	0.296	45.5	45.4	14.3	0.6
5	40.05	100	30.7	30.2	83.7	0.293	45.7	43.1	14.8	0.8
6	40.06	100	32.9	32.9	84.6	0.296	46.0	47.0	14.2	0.6
7	40.07	100	33.0	32.7	85.2	0.298	45.9	46.8	15.4	0.6
8	40.08	100	31.0	30.4	83.6	0.293	46.0	43.6	14.0	0.6
9	40.09	100	30.6	30.0	83.4	0.292	45.9	43.0	14.5	1.1
10	40.10	100	33.6	33.6	87.4	0.306	46.0	48.0	16.2	0.6
11	40.11	100	33.4	33.0	89.0	0.311	46.0	47.3	16.4	0.6
12	40.12	100	34.4	33.9	88.2	0.309	45.9	48.6	15.4	0.8
13	40.13	100	32.9	32.8	86.1	0.301	45.9	47.0	16.0	0.6
14	40.14	100	32.0	31.9	89.0	0.312	46.0	45.6	16.8	0.6
15	40.15	100	34.4	34.0	87.5	0.306	45.9	48.6	15.6	0.8
16	40.16	100	33.7	33.3	86.5	0.303	46.1	47.7	15.9	0.7
17	40.17	100	31.8	31.5	93.0	0.326	46.1	45.1	17.0	0.4
18	40.18	100	33.7	33.5	83.9	0.294	46.0	47.9	14.8	0.6
19	40.19	100	33.9	33.5	88.5	0.310	46.1	47.9	15.8	0.6
20	40.20	100	33.2	32.4	94.0	0.329	46.1	46.3	17.2	0.8
21	40.21	100	31.7	31.5	85.3	0.298	46.0	45.1	15.9	0.6
22	40.22	100	32.0	32.0	84.1	0.294	46.1	45.7	15.2	0.6
23	40.23	100	30.6	30.4	83.2	0.291	46.1	43.5	16.3	0.9
24	40.24	100	30.4	30.2	87.8	0.307	46.1	43.2	16.1	0.6
25	40.25	100	33.3	32.9	88.6	0.310	46.2	47.1	16.2	0.6
26	40.26	100	30.1	29.5	85.9	0.301	46.0	42.2	16.1	0.9
27	40.27	100	33.8	33.2	90.3	0.316	46.1	47.5	16.5	0.6
28	40.28	100	32.3	31.8	88.0	0.308	46.1	45.5	17.1	0.6
29	40.29	100	33.0	32.7	88.7	0.310	46.2	46.8	16.9	0.6
30	40.30	100	31.0	30.6	88.5	0.310	46.1	43.8	17.2	0.6
31	40.31	100	33.4	32.9	88.8	0.311	46.2	47.0	16.5	0.8
32	40.32	100	33.6	33.1	89.0	0.312	46.2	47.3	16.5	0.6
33	40.33	100	32.6	32.0	88.7	0.311	46.1	45.8	17.0	0.6
34	40.34	100	33.0	32.4	91.1	0.319	46.2	46.3	17.7	0.6
35	40.35	100	33.8	33.0	88.8	0.311	46.4	47.2	17.0	0.6
36	40.36	100	33.0	32.3	90.9	0.318	48.6	46.2	18.0	0.6
37	40.37	100	33.2	32.3	93.9	0.329	49.7	46.2	17.1	0.9
38	40.38	100	32.7	32.2	89.0	0.311	49.5	46.1	16.4	0.7
39	40.39	100	31.3	31.1	88.4	0.309	49.6	44.6	16.7	0.9
40	40.40	100	32.2	32.2	90.3	0.316	49.7	46.0	16.6	0.8
41	40.41	100	31.8	31.8	90.7	0.317	49.7	45.5	16.3	0.8
42	40.42	100	31.4	31.0	87.8	0.307	49.5	44.4	16.0	0.9
43	40.43	100	31.1	31.0	88.1	0.308	49.6	44.4	16.2	1.1
44	40.44	100	32.1	31.6	86.5	0.303	49.7	45.2	15.3	0.7
45	40.45	100	31.6	31.2	86.8	0.304	49.6	44.6	16.2	0.6
46	40.46	100	29.6	29.6	86.7	0.304	49.7	42.3	16.4	0.7
47	40.47	100	29.5	29.1	85.9	0.301	49.6	41.7	16.2	0.7
48	40.48	100	30.8	30.7	87.2	0.305	49.7	44.0	16.1	0.9
49	40.49	100	31.6	31.6	87.1	0.305	49.6	45.1	16.1	0.9
50	40.50	100	31.7	31.3	87.0	0.305	49.7	44.8	15.5	0.8
		Average	32.2	31.8	87.7	0.307	47.0	45.5	16.1	0.7
		Std. Dev.	1.3	1.2	2.5	0.009	1.7	1.8	0.9	0.1
		Maximum	34.4	34.0	94.0	0.329	49.7	48.6	18.0	1.1
		Minimum	29.5	29.1	83.2	0.291	43.3	41.7	14.0	0.4

Total number of blows analyzed: 49

BL#	depth (ft)	Comments
1	40.01	Start of test on 4/17/2013 at 11:18:01 AM
50	40.50	End of test on 4/17/2013 at 11:19:04 AM

Time Summary

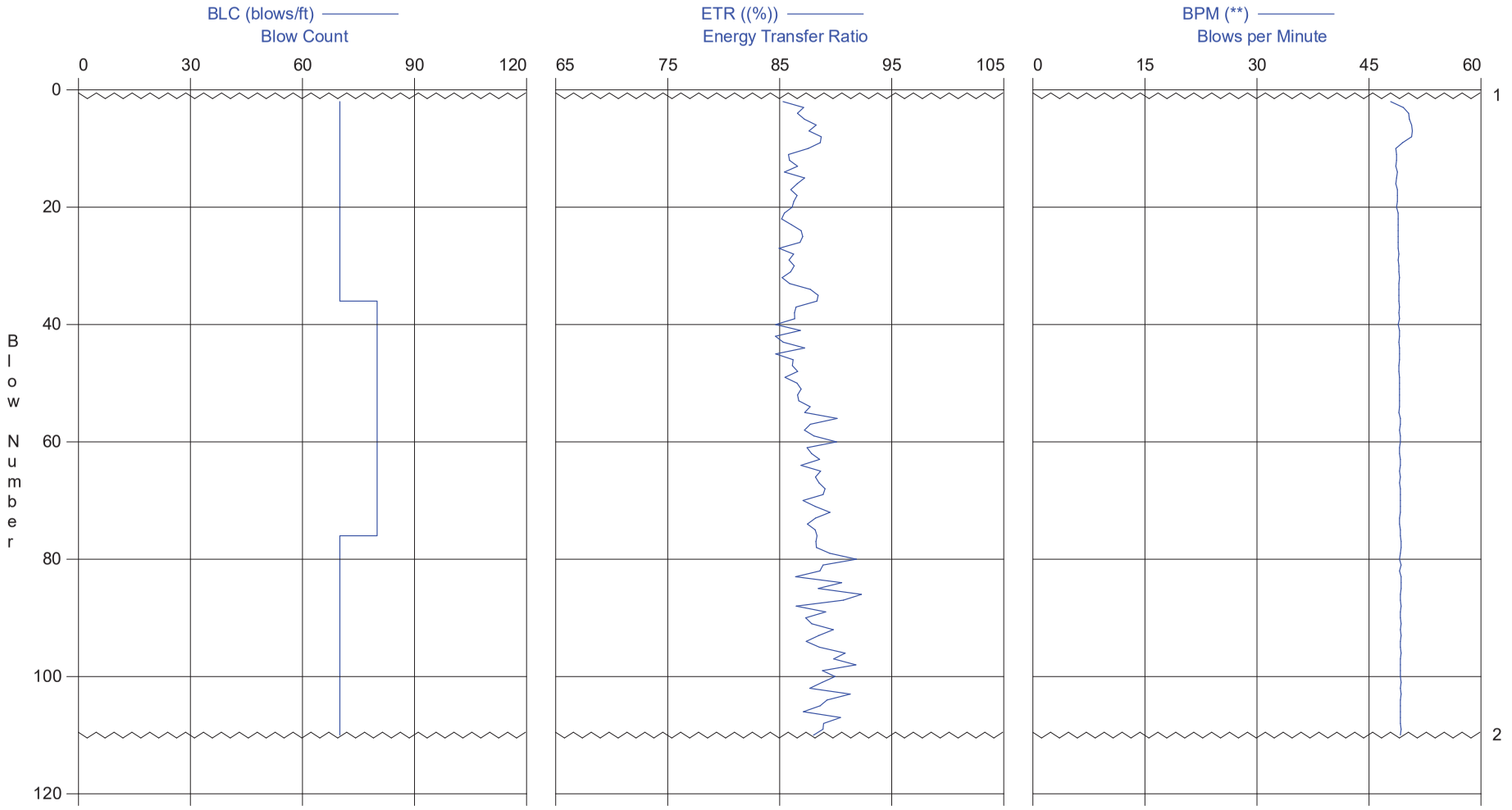
Drive 1 minute 3 seconds 11:18:01 AM - 11:19:04 AM (4/17/2013) BN 1 - 50

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

Test date: 17-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 45 FT BH:E330-B28



1 - Start of test on 4/17/2013 at 12:52:45 PM

2 - End of test on 4/17/2013 at 12:54:58 PM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 45 FT
OP: RMDT

BH:E330-B28
Test date: 17-Apr-2013

AR: 1.43 in^2
LE: 49.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
ETR: Energy Transfer Ratio
EFV: Energy of FV

BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio

BL#	depth	BLC	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ft	bl/ft	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
36	45.51	80	31.3	31.3	88.3	0.309	49.0	44.7	15.7	1.0
37	45.53	80	31.9	31.7	86.5	0.303	49.1	45.4	15.0	1.0
38	45.54	80	31.7	31.2	86.3	0.302	49.0	44.6	15.0	1.1
39	45.55	80	30.5	30.1	86.3	0.302	49.1	43.1	14.8	1.0
40	45.56	80	31.5	31.3	84.7	0.296	48.9	44.8	15.0	1.0
41	45.58	80	32.4	32.1	86.8	0.304	49.1	45.9	14.9	1.0
42	45.59	80	32.1	31.5	84.6	0.296	49.1	45.0	14.7	1.1
43	45.60	80	31.4	31.1	85.3	0.299	49.0	44.5	15.1	1.1
44	45.61	80	31.5	31.1	87.2	0.305	49.1	44.5	15.3	1.0
45	45.63	80	31.3	31.2	84.6	0.296	49.1	44.6	15.4	1.1
46	45.64	80	31.6	31.4	86.2	0.302	49.1	45.0	15.0	1.1
47	45.65	80	30.9	30.4	86.1	0.301	49.0	43.5	15.1	1.0
48	45.66	80	32.6	32.4	86.6	0.303	49.0	46.4	14.9	1.1
49	45.68	80	30.8	30.4	85.5	0.299	49.1	43.5	15.2	1.0
50	45.69	80	31.9	31.8	86.5	0.303	49.1	45.4	15.1	1.1
51	45.70	80	31.4	30.9	86.9	0.304	49.1	44.2	14.8	0.9
52	45.71	80	31.7	31.1	86.6	0.303	49.1	44.5	14.8	1.0
53	45.73	80	31.8	31.2	86.7	0.303	49.1	44.6	15.0	1.0
54	45.74	80	31.3	30.9	87.7	0.307	49.1	44.2	15.5	1.1
55	45.75	80	30.7	30.6	87.2	0.305	49.0	43.7	15.4	1.0
56	45.76	80	30.5	30.4	90.1	0.315	49.2	43.5	15.6	1.1
57	45.78	80	30.9	30.4	87.7	0.307	49.2	43.4	15.6	1.0
58	45.79	80	31.9	31.3	87.2	0.305	49.1	44.8	15.1	1.0
59	45.80	80	29.5	29.4	88.1	0.308	49.2	42.0	16.1	1.0
60	45.81	80	29.3	29.3	90.1	0.315	49.2	42.0	16.3	1.0
61	45.83	80	31.2	30.5	87.4	0.306	49.1	43.6	15.8	0.9
62	45.84	80	32.0	31.7	87.9	0.307	49.1	45.4	15.8	1.1
63	45.85	80	31.2	31.2	88.6	0.310	49.2	44.6	16.4	1.1
64	45.86	80	31.3	31.0	86.9	0.304	49.2	44.4	15.9	1.1
65	45.88	80	31.3	31.3	88.6	0.310	49.1	44.7	16.0	1.1
66	45.89	80	31.7	31.0	88.2	0.309	49.2	44.4	15.8	1.0
67	45.90	80	30.0	29.7	88.5	0.310	49.1	42.5	16.1	1.0
68	45.91	80	31.8	31.7	89.0	0.312	49.2	45.4	16.4	1.1
69	45.93	80	30.9	30.7	88.9	0.311	49.2	43.9	16.3	1.1
70	45.94	80	32.0	31.9	87.1	0.305	49.2	45.7	15.9	1.0
71	45.95	80	30.9	30.6	88.2	0.309	49.2	43.8	16.5	1.1
72	45.96	80	30.6	30.0	89.5	0.313	49.2	43.0	16.4	1.0
73	45.98	80	31.3	31.3	88.2	0.309	49.1	44.7	15.9	1.1
74	45.99	80	31.4	31.1	87.5	0.306	49.1	44.4	15.8	1.1
75	46.00	80	30.2	30.1	88.2	0.309	49.2	43.1	16.4	1.1
76	46.01	70	30.6	30.5	88.3	0.309	49.2	43.7	16.4	1.0
77	46.03	70	30.4	29.8	88.2	0.309	49.3	42.6	16.3	1.0
78	46.04	70	30.1	29.6	88.3	0.309	49.3	42.4	16.5	1.0
79	46.06	70	32.1	31.7	89.5	0.313	49.2	45.4	16.3	1.0
80	46.07	70	29.5	29.3	91.8	0.321	49.1	41.9	17.1	1.0
81	46.09	70	30.0	29.4	88.9	0.311	49.3	42.1	16.7	1.0
82	46.10	70	31.6	31.3	88.6	0.310	49.1	44.8	16.2	1.0
83	46.11	70	29.3	28.8	86.4	0.302	49.3	41.2	16.7	1.0
84	46.13	70	30.9	30.9	90.5	0.317	49.3	44.2	16.6	1.0
85	46.14	70	31.8	31.6	88.4	0.310	49.3	45.2	16.3	1.0
86	46.16	70	31.4	31.0	92.3	0.323	49.2	44.4	16.9	1.0
87	46.17	70	32.5	32.0	90.7	0.317	49.2	45.8	16.6	1.0
88	46.19	70	31.1	30.6	86.5	0.303	49.3	43.7	16.4	1.0
89	46.20	70	31.6	31.3	89.1	0.312	49.2	44.8	16.3	1.0
90	46.21	70	31.5	31.2	87.3	0.306	49.2	44.7	16.4	1.0
91	46.23	70	30.3	30.0	87.9	0.308	49.3	42.9	16.8	1.0
92	46.24	70	31.6	31.3	89.8	0.314	49.2	44.8	16.2	1.0
93	46.26	70	30.4	29.7	88.5	0.310	49.3	42.5	16.6	1.0
94	46.27	70	29.7	29.5	87.4	0.306	49.2	42.2	16.3	1.0
95	46.29	70	32.3	32.1	88.5	0.310	49.2	45.9	15.7	1.1
96	46.30	70	31.7	31.6	90.8	0.318	49.3	45.2	17.0	1.1
97	46.31	70	32.0	31.9	89.8	0.314	49.2	45.6	16.5	1.0
98	46.33	70	29.3	29.2	91.8	0.321	49.2	41.8	17.0	1.0
99	46.34	70	31.7	31.0	88.8	0.311	49.2	44.4	16.1	1.0
100	46.36	70	30.1	29.7	89.9	0.315	49.2	42.4	16.8	1.0
101	46.37	70	29.2	28.8	88.8	0.311	49.3	41.2	16.7	1.0

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 45 FT
OP: RMDT

BH:E330-B28
Test date: 17-Apr-2013

BL#	depth	BLC	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ft	bl/ft	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
102	46.39	70	30.7	30.2	87.7	0.307	49.2	43.3	16.1	1.0
103	46.40	70	29.7	29.6	91.3	0.320	49.3	42.3	16.7	1.0
104	46.41	70	31.7	31.3	89.2	0.312	49.2	44.8	16.5	1.0
105	46.43	70	31.2	30.5	88.6	0.310	49.2	43.7	16.3	1.0
106	46.44	70	31.5	31.2	87.1	0.305	49.2	44.7	16.1	1.0
107	46.46	70	31.8	31.5	90.4	0.317	49.2	45.0	16.2	1.0
108	46.47	70	31.1	30.7	88.9	0.311	49.2	43.9	16.5	1.0
109	46.49	70	32.3	32.0	88.9	0.311	49.3	45.8	16.0	1.0
110	46.50	70	31.1	30.4	88.0	0.308	49.2	43.4	16.3	1.0
		Average	31.1	30.8	88.1	0.308	49.2	44.1	16.0	1.0
		Std. Dev.	0.8	0.8	1.6	0.006	0.1	1.2	0.6	0.0
		Maximum	32.6	32.4	92.3	0.323	49.3	46.4	17.1	1.1
		Minimum	29.2	28.8	84.6	0.296	48.9	41.2	14.7	0.9

Total number of blows analyzed: 75

BL#	depth (ft)	Comments
1	45.01	Start of test on 4/17/2013 at 12:52:45 PM
110	46.50	End of test on 4/17/2013 at 12:54:58 PM

Time Summary

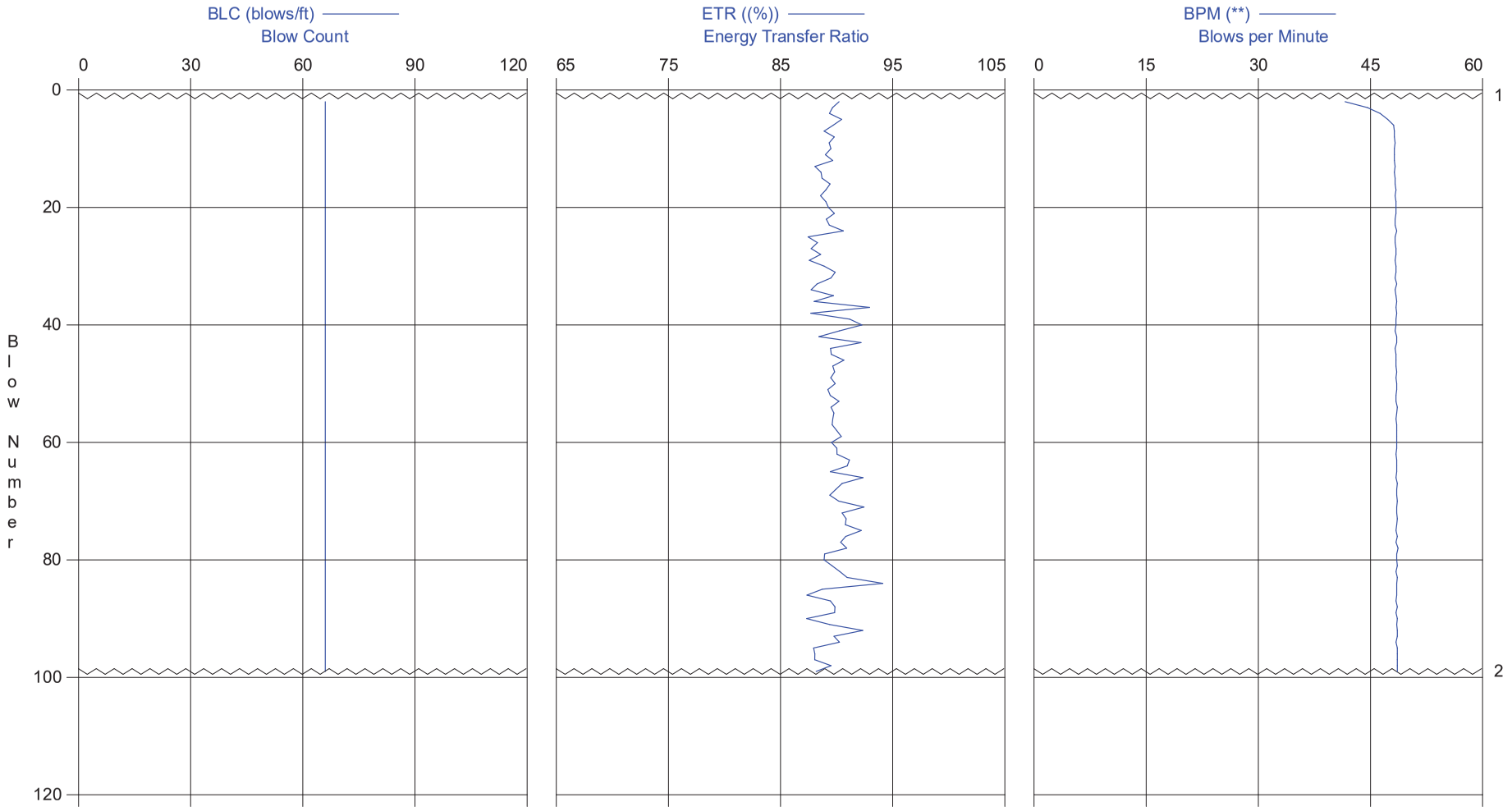
Drive	2 minutes 13 seconds	12:52:45 PM - 12:54:58 PM (4/17/2013) BN 1 - 110

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

Test date: 17-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 50 FT BH:E330-B28



1 - Start of test on 4/17/2013 at 1:16:29 PM

2 - End of test on 4/17/2013 at 1:18:30 PM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 50 FT
OP: RMDT

BH:E330-B28
Test date: 17-Apr-2013

AR: 1.43 in^2
LE: 54.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
ETR: Energy Transfer Ratio
EFV: Energy of FV

BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio

BL#	depth	BLC	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ft	bl/ft	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
34	50.52	66	29.9	29.9	87.7	0.307	48.3	42.7	18.1	0.7
35	50.53	66	28.5	28.4	89.7	0.314	48.4	40.6	17.9	0.6
36	50.55	66	32.1	32.1	88.0	0.308	48.5	45.9	18.6	0.5
37	50.56	66	29.5	29.4	92.9	0.325	48.4	42.1	19.1	0.7
38	50.58	66	30.5	30.5	87.7	0.307	48.5	43.7	18.1	0.5
39	50.59	66	33.2	33.2	91.2	0.319	48.4	47.4	18.2	0.5
40	50.61	66	31.7	31.6	92.3	0.323	48.4	45.2	19.0	0.5
41	50.62	66	30.8	30.6	90.2	0.316	48.3	43.7	18.0	0.7
42	50.64	66	30.5	30.3	88.4	0.309	48.5	43.3	19.0	0.7
43	50.65	66	29.0	28.5	92.2	0.323	48.5	40.8	19.1	0.7
44	50.67	66	30.4	30.3	89.5	0.313	48.3	43.3	18.4	0.5
45	50.68	66	28.8	28.5	89.5	0.313	48.4	40.7	18.0	0.7
46	50.70	66	33.5	33.2	90.7	0.317	48.4	47.6	18.1	0.5
47	50.71	66	30.4	30.3	89.6	0.314	48.4	43.4	18.8	0.5
48	50.73	66	29.2	29.2	89.8	0.314	48.5	41.7	18.1	1.1
49	50.74	66	29.5	29.1	89.5	0.313	48.4	41.7	18.4	0.7
50	50.76	66	30.6	30.3	89.9	0.315	48.5	43.3	18.3	0.5
51	50.77	66	31.5	31.4	89.2	0.312	48.5	45.0	18.2	0.9
52	50.79	66	29.5	28.2	89.4	0.313	48.4	40.4	17.6	0.7
53	50.80	66	29.5	29.0	90.2	0.316	48.4	41.5	18.5	0.7
54	50.82	66	29.6	29.5	89.5	0.313	48.6	42.2	17.9	0.7
55	50.83	66	29.1	28.6	89.7	0.314	48.5	41.0	18.4	0.7
56	50.85	66	31.0	30.7	89.7	0.314	48.4	44.0	17.5	0.7
57	50.86	66	30.4	30.0	89.6	0.314	48.5	42.9	18.1	0.7
58	50.88	66	31.5	31.3	90.0	0.315	48.5	44.8	18.1	0.5
59	50.89	66	30.9	30.8	90.4	0.316	48.5	44.1	18.4	0.7
60	50.91	66	28.8	28.5	89.6	0.313	48.5	40.8	17.9	1.0
61	50.92	66	29.4	29.3	90.0	0.315	48.5	41.9	18.2	0.7
62	50.94	66	29.0	28.7	90.0	0.315	48.4	41.1	18.2	0.8
63	50.96	66	30.3	30.1	91.1	0.319	48.5	43.1	18.9	0.9
64	50.97	66	32.4	32.0	90.9	0.318	48.5	45.8	18.8	0.5
65	50.99	66	30.6	30.3	89.4	0.313	48.5	43.3	18.3	0.8
66	51.00	66	29.9	29.6	92.3	0.323	48.4	42.4	19.0	0.7
67	51.02	66	31.2	31.0	90.5	0.317	48.6	44.4	17.8	0.5
68	51.03	66	30.0	29.7	89.9	0.315	48.5	42.5	18.2	0.7
69	51.05	66	30.1	29.7	89.4	0.313	48.5	42.5	17.7	0.7
70	51.06	66	31.5	31.4	90.2	0.316	48.6	44.9	18.8	0.5
71	51.08	66	30.1	29.9	92.4	0.324	48.5	42.8	19.1	0.7
72	51.09	66	28.9	28.6	90.5	0.317	48.5	40.9	18.0	0.7
73	51.11	66	31.2	30.9	90.8	0.318	48.6	44.2	18.3	0.7
74	51.12	66	29.0	28.8	90.8	0.318	48.5	41.2	18.2	0.7
75	51.14	66	30.4	30.0	92.2	0.323	48.4	42.9	19.5	0.7
76	51.15	66	30.2	30.1	90.8	0.318	48.6	43.1	18.4	0.9
77	51.17	66	28.7	28.2	90.4	0.316	48.4	40.3	18.5	0.7
78	51.18	66	31.1	30.9	90.9	0.318	48.7	44.1	18.6	0.7
79	51.20	66	30.5	30.3	88.9	0.311	48.5	43.4	18.0	0.7
80	51.21	66	30.5	30.2	88.9	0.311	48.5	43.2	18.2	0.7
81	51.23	66	30.6	30.2	89.6	0.314	48.6	43.2	18.1	0.7
82	51.24	66	31.0	30.7	90.3	0.316	48.4	43.9	18.1	0.7
83	51.26	66	32.2	32.1	90.9	0.318	48.6	45.9	18.4	0.5
84	51.27	66	29.4	29.0	94.1	0.329	48.5	41.5	19.3	0.7
85	51.29	66	30.7	30.3	88.7	0.311	48.5	43.3	17.7	0.7
86	51.30	66	30.9	30.4	87.4	0.306	48.5	43.5	17.4	0.7
87	51.32	66	31.3	31.1	89.4	0.313	48.4	44.5	18.1	0.5
88	51.33	66	30.4	30.0	89.9	0.314	48.6	43.0	18.3	0.7
89	51.35	66	31.7	31.3	89.8	0.314	48.4	44.8	17.8	0.5
90	51.36	66	29.4	29.0	87.3	0.306	48.6	41.4	17.7	0.7
91	51.38	66	29.5	29.2	89.4	0.313	48.5	41.8	18.5	0.7
92	51.39	66	30.0	29.7	92.3	0.323	48.6	42.5	19.7	0.7
93	51.41	66	29.1	28.7	89.8	0.314	48.6	41.0	19.0	0.7
94	51.42	66	28.8	28.5	90.2	0.316	48.4	40.7	18.4	0.7
95	51.44	66	29.2	29.0	88.0	0.308	48.6	41.6	18.5	0.7
96	51.46	66	29.1	28.7	88.1	0.308	48.6	41.1	17.9	0.9
97	51.47	66	29.1	29.1	88.0	0.308	48.6	41.7	18.4	0.7
98	51.49	66	28.8	28.5	89.5	0.313	48.6	40.8	18.9	0.7
99	51.50	66	30.7	30.2	88.2	0.309	48.6	43.2	18.4	0.5

HOLT SERVICES, SOUND TRANSIT - SAMPLE 50 FT
OP: RMDT
BH:E330-B28
Test date: 17-Apr-2013

	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
Average	30.3	30.0	90.0	0.315	48.5	42.9	18.4	0.7
Std. Dev.	1.1	1.2	1.4	0.005	0.1	1.7	0.5	0.1
Maximum	33.5	33.2	94.1	0.329	48.7	47.6	19.7	1.1
Minimum	28.5	28.2	87.3	0.306	48.3	40.3	17.4	0.5

Total number of blows analyzed: 66

BL#	depth (ft)	Comments
1	50.02	Start of test on 4/17/2013 at 1:16:29 PM
99	51.50	End of test on 4/17/2013 at 1:18:30 PM

Time Summary

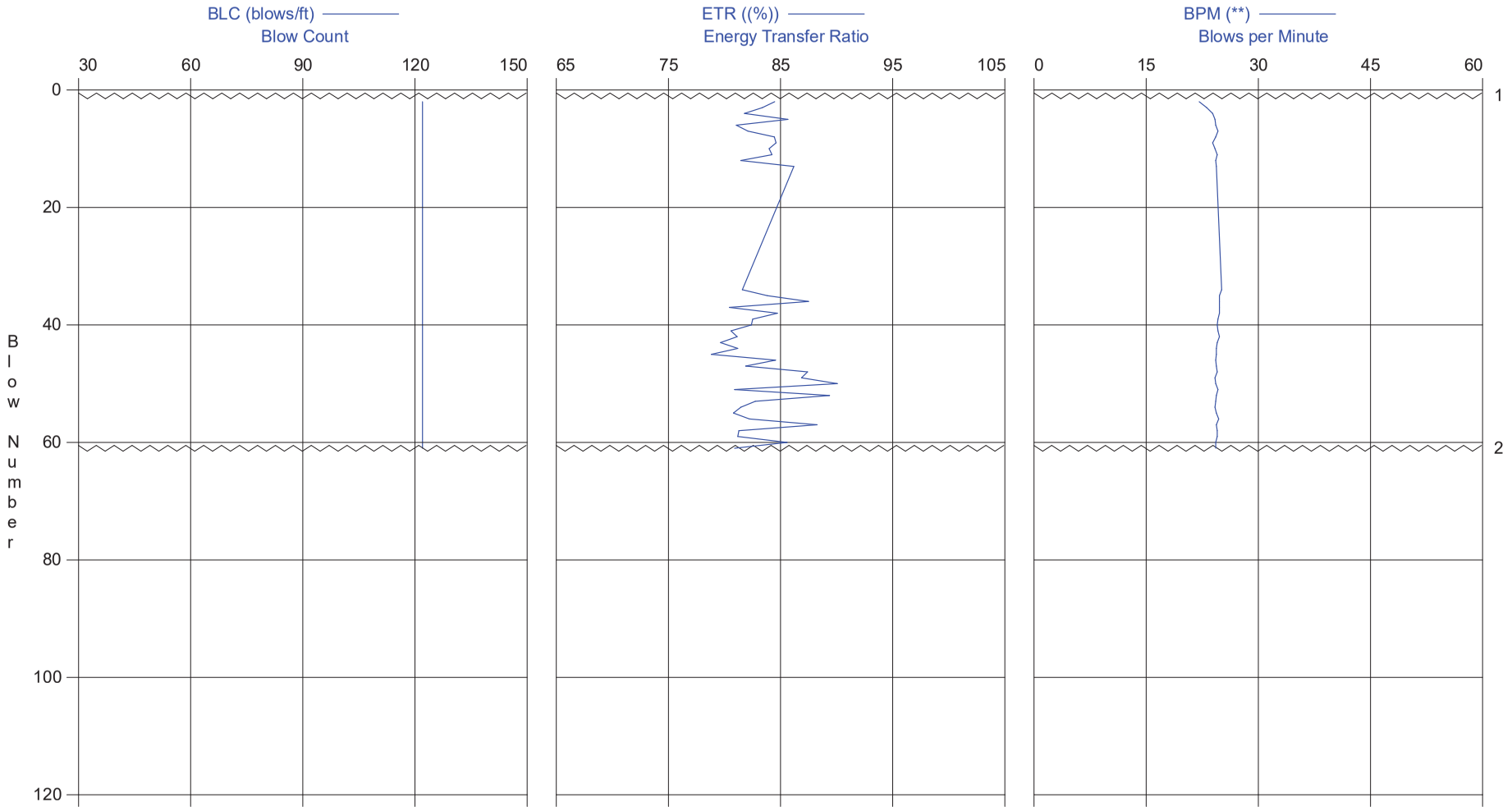
Drive	2 minutes 1 second	1:16:29 PM - 1:18:30 PM (4/17/2013) BN 1 - 99

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

Test date: 17-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 55 FT BH:E330-B28



1 - Start of test on 4/17/2013 at 2:05:19 PM

2 - End of test on 4/17/2013 at 2:08:52 PM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 55 FT
OP: RMDT

BH:E330-B28
Test date: 17-Apr-2013

AR: 1.43 in^2
LE: 59.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
ETR: Energy Transfer Ratio
EFV: Energy of FV

BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio

BL#	depth	BLC	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ft	bl/ft	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
2	55.02	122	29.0	28.2	84.5	0.296	22.1	40.3	14.6	0.8
3	55.03	122	30.0	29.2	83.4	0.292	23.1	41.8	14.7	0.8
4	55.03	122	29.7	29.2	81.8	0.286	23.9	41.8	14.9	0.8
5	55.04	122	30.3	29.6	85.7	0.300	24.2	42.3	14.7	0.8
6	55.05	122	29.2	28.5	81.0	0.284	24.3	40.8	15.2	0.7
7	55.06	122	29.9	28.8	82.1	0.287	24.6	41.3	15.4	0.7
8	55.07	122	30.5	29.3	84.4	0.296	24.3	41.9	15.0	0.7
9	55.07	122	29.4	28.4	84.6	0.296	23.9	40.7	14.7	0.9
10	55.08	122	30.4	29.4	84.0	0.294	24.2	42.0	14.7	0.7
11	55.09	122	30.4	29.3	84.2	0.295	24.5	41.9	14.2	0.9
12	55.10	122	29.6	28.9	81.5	0.285	24.3	41.3	14.7	0.9
13	55.11	122	31.5	30.5	86.2	0.302	24.4	43.6	14.7	1.0
34	55.28	122	28.6	28.0	81.6	0.286	25.1	40.1	14.2	0.8
35	55.29	122	29.3	29.0	83.8	0.293	24.8	41.5	14.0	0.8
36	55.30	122	31.3	30.9	87.5	0.306	24.8	44.3	14.7	0.7
37	55.30	122	28.4	28.0	80.4	0.282	24.8	40.0	14.0	0.7
38	55.31	122	30.1	29.7	84.7	0.297	24.8	42.5	14.2	0.9
39	55.32	122	29.1	28.7	82.5	0.289	24.6	41.1	14.0	0.8
40	55.33	122	29.0	28.7	82.4	0.288	24.5	41.0	14.2	0.8
41	55.34	122	29.0	28.3	80.6	0.282	24.6	40.5	13.9	0.9
42	55.34	122	28.8	28.1	81.1	0.284	24.8	40.2	13.8	0.9
43	55.35	122	28.5	28.1	79.6	0.279	24.5	40.2	13.8	0.8
44	55.36	122	28.7	27.9	81.2	0.284	24.4	39.9	14.0	1.0
45	55.37	122	28.9	28.3	78.8	0.276	24.4	40.5	13.7	0.9
46	55.38	122	29.6	29.5	84.6	0.296	24.3	42.1	14.3	0.7
47	55.39	122	29.5	29.0	81.9	0.287	24.4	41.4	13.9	0.8
48	55.39	122	32.1	31.8	87.4	0.306	24.5	45.5	15.1	0.7
49	55.40	122	30.9	30.8	86.9	0.304	24.2	44.1	14.7	0.7
50	55.41	122	32.5	32.4	90.1	0.315	24.3	46.4	15.6	0.7
51	55.42	122	28.7	28.5	80.9	0.283	24.6	40.7	14.4	0.9
52	55.43	122	33.2	33.1	89.4	0.313	24.4	47.4	15.9	0.6
53	55.43	122	29.6	29.3	82.7	0.290	24.3	41.9	14.5	0.9
54	55.44	122	29.3	29.0	81.5	0.285	24.2	41.4	14.4	0.9
55	55.45	122	29.4	28.8	80.8	0.283	24.4	41.2	14.1	0.9
56	55.46	122	29.3	29.0	82.2	0.288	24.7	41.5	14.4	0.9
57	55.47	122	32.3	32.3	88.3	0.309	24.4	46.1	16.2	0.7
58	55.48	122	28.6	28.1	81.3	0.284	24.5	40.3	13.9	0.9
59	55.48	122	29.3	28.9	81.2	0.284	24.5	41.3	14.5	0.7
60	55.49	122	30.8	30.5	85.6	0.300	24.3	43.6	14.8	0.7
61	55.50	122	29.1	28.4	80.9	0.283	24.3	40.6	14.8	0.9
		Average	29.8	29.3	83.3	0.292	24.4	41.9	14.5	0.8
		Std. Dev.	1.2	1.3	2.7	0.009	0.5	1.8	0.6	0.1
		Maximum	33.2	33.1	90.1	0.315	25.1	47.4	16.2	1.0
		Minimum	28.4	27.9	78.8	0.276	22.1	39.9	13.7	0.6

Total number of blows analyzed: 40

BL#	depth (ft)	Comments
1	55.01	Start of test on 4/17/2013 at 2:05:19 PM
61	55.50	End of test on 4/17/2013 at 2:08:52 PM

Time Summary

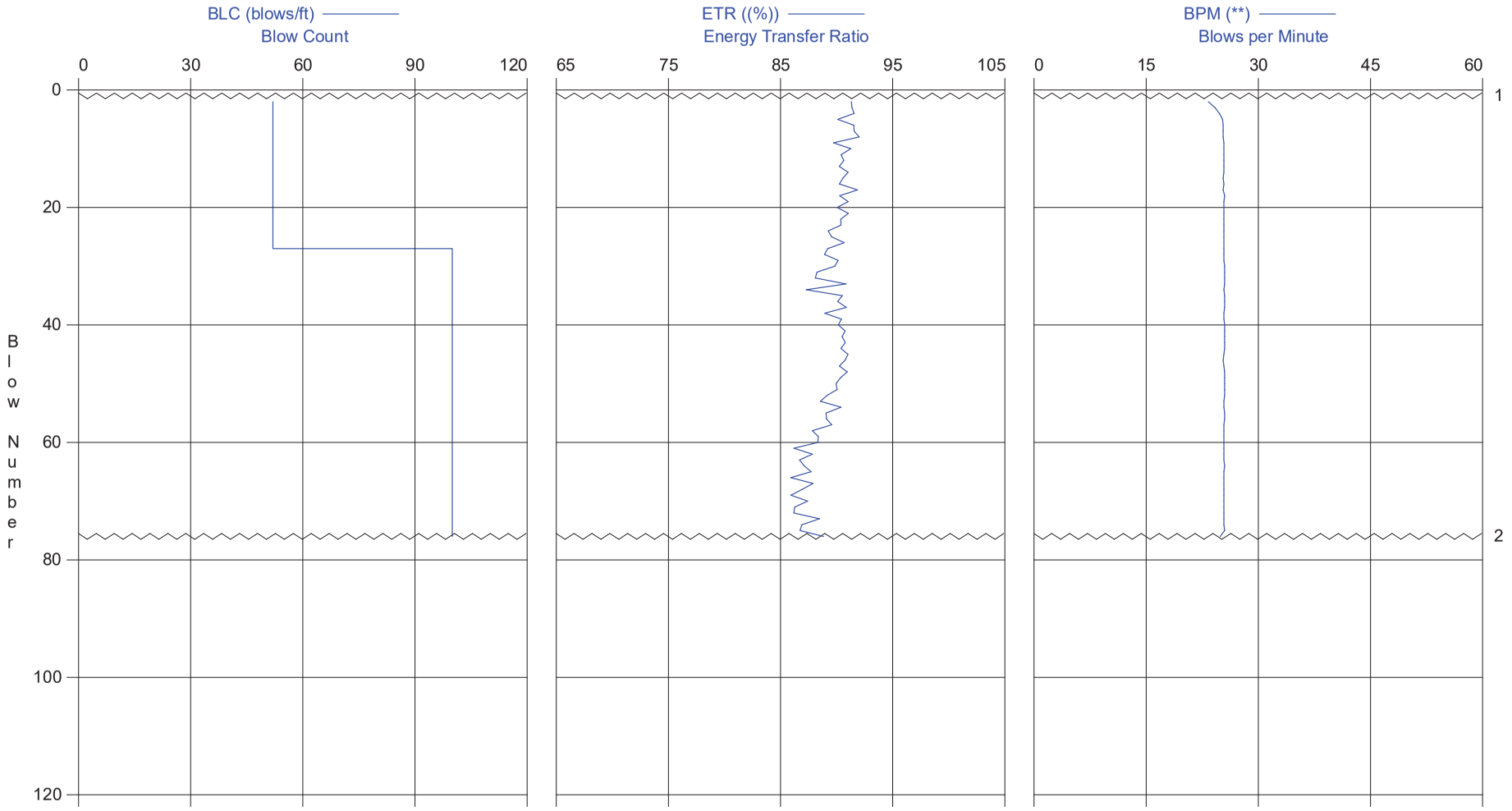
Drive 3 minutes 33 seconds 2:05:19 PM - 2:08:52 PM (4/17/2013) BN 1 - 61

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

Test date: 17-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 60 FT BH:E330-B28



1 - Start of test on 4/17/2013 at 2:36:38 PM

2 - End of test on 4/17/2013 at 2:39:35 PM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES, SOUND TRANSIT - SAMPLE 60 FT
OP: RMDT

BH:E330-B28
Test date: 17-Apr-2013

AR: 1.43 in^2
LE: 64.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
ETR: Energy Transfer Ratio
EFV: Energy of FV

BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio

BL#	depth	BLC	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ft	bl/ft	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
27	60.51	100	30.1	29.6	89.2	0.312	25.4	42	16.2	0.6
28	60.52	100	30.1	29.6	88.9	0.311	25.4	42	16.3	0.6
29	60.53	100	30.1	29.7	90.1	0.315	25.4	42	16.3	0.6
30	60.54	100	30.3	29.7	89.8	0.314	25.5	42	16.3	0.5
31	60.55	100	30.3	29.6	88.2	0.309	25.5	42	16.1	0.6
32	60.56	100	30.2	29.7	88.1	0.308	25.5	42	16.0	0.6
33	60.57	100	30.3	29.8	90.8	0.318	25.5	43	16.4	0.5
34	60.58	100	30.1	29.6	87.3	0.306	25.4	42	16.0	0.6
35	60.59	100	30.0	29.5	90.5	0.317	25.5	42	16.4	0.5
36	60.60	100	29.7	29.2	90.1	0.315	25.5	42	16.4	0.6
37	60.61	100	30.0	29.5	90.9	0.318	25.5	42	16.5	0.5
38	60.62	100	30.0	29.6	88.9	0.311	25.4	42	16.2	0.5
39	60.63	100	30.0	29.5	90.4	0.316	25.4	42	16.4	0.5
40	60.64	100	29.8	29.4	90.2	0.316	25.5	42	16.4	0.6
41	60.65	100	30.0	29.4	90.7	0.318	25.5	42	16.5	0.5
42	60.66	100	29.7	29.2	90.5	0.317	25.5	42	16.2	0.5
43	60.67	100	29.6	29.1	90.8	0.318	25.5	42	16.2	0.5
44	60.68	100	29.7	29.2	90.4	0.316	25.5	42	16.2	0.5
45	60.69	100	29.8	29.2	91.0	0.319	25.4	42	16.3	0.5
46	60.70	100	29.4	28.9	90.7	0.318	25.3	41	16.2	0.5
47	60.71	100	29.5	28.9	90.2	0.316	25.4	41	16.2	0.5
48	60.72	100	29.7	29.3	90.9	0.318	25.5	42	16.0	0.5
49	60.73	100	29.6	29.0	90.3	0.316	25.5	42	16.4	0.6
50	60.74	100	29.4	28.9	89.9	0.315	25.5	41	16.2	0.6
51	60.75	100	29.4	28.9	90.0	0.315	25.5	41	16.1	0.6
52	60.76	100	29.4	28.7	89.1	0.312	25.5	41	16.0	0.6
53	60.77	100	29.3	28.9	88.6	0.310	25.4	41	15.9	0.6
54	60.78	100	29.3	28.8	90.4	0.316	25.4	41	16.1	0.6
55	60.79	100	29.2	28.7	89.1	0.312	25.5	41	16.0	0.6
56	60.80	100	29.4	29.0	89.1	0.312	25.5	41	15.8	0.6
57	60.81	100	29.5	29.0	89.6	0.313	25.4	41	16.1	0.6
58	60.82	100	29.2	28.7	87.8	0.307	25.4	41	16.0	0.6
59	60.83	100	29.4	28.8	88.4	0.309	25.4	41	15.9	0.6
60	60.84	100	29.0	28.5	88.3	0.309	25.4	41	16.0	0.6
61	60.85	100	29.4	28.9	86.2	0.302	25.4	41	15.5	0.6
62	60.86	100	29.8	29.2	87.8	0.307	25.4	42	15.6	0.6
63	60.87	100	29.6	29.0	86.7	0.303	25.4	41	15.5	0.6
64	60.88	100	28.5	28.0	87.1	0.305	25.5	40	15.9	0.6
65	60.89	100	28.6	28.1	87.7	0.307	25.4	40	15.8	0.6
66	60.90	100	28.4	27.8	85.9	0.301	25.4	40	15.9	0.6
67	60.91	100	28.7	28.1	87.9	0.308	25.4	40	16.1	0.6
68	60.92	100	28.2	27.7	86.9	0.304	25.4	40	16.3	0.6
69	60.93	100	27.8	27.4	85.9	0.301	25.4	39	16.5	0.6
70	60.94	100	28.3	27.8	87.4	0.306	25.4	40	16.5	0.6
71	60.95	100	28.0	27.5	86.3	0.302	25.4	39	16.6	0.6
72	60.96	100	27.3	26.7	86.2	0.302	25.4	38	16.7	0.6
73	60.97	100	27.7	27.0	88.5	0.310	25.4	39	17.1	0.6
74	60.98	100	27.2	26.6	86.9	0.304	25.4	38	17.1	0.6
75	60.99	100	27.4	26.8	86.7	0.304	25.5	38	17.0	0.6
76	61.00	100	27.3	26.7	88.8	0.311	24.9	38	17.4	0.6
		Average	29.3	28.7	88.9	0.311	25.4	41	16.2	0.6
		Std. Dev.	0.9	0.9	1.6	0.005	0.1	1	0.4	0.1
		Maximum	30.3	29.8	91.0	0.319	25.5	43	17.4	0.6
		Minimum	27.2	26.6	85.9	0.301	24.9	38	15.5	0.5

Total number of blows analyzed: 50

BL#	depth (ft)	Comments
1	60.02	Start of test on 4/17/2013 at 2:36:38 PM
76	61.00	End of test on 4/17/2013 at 2:39:35 PM

Time Summary

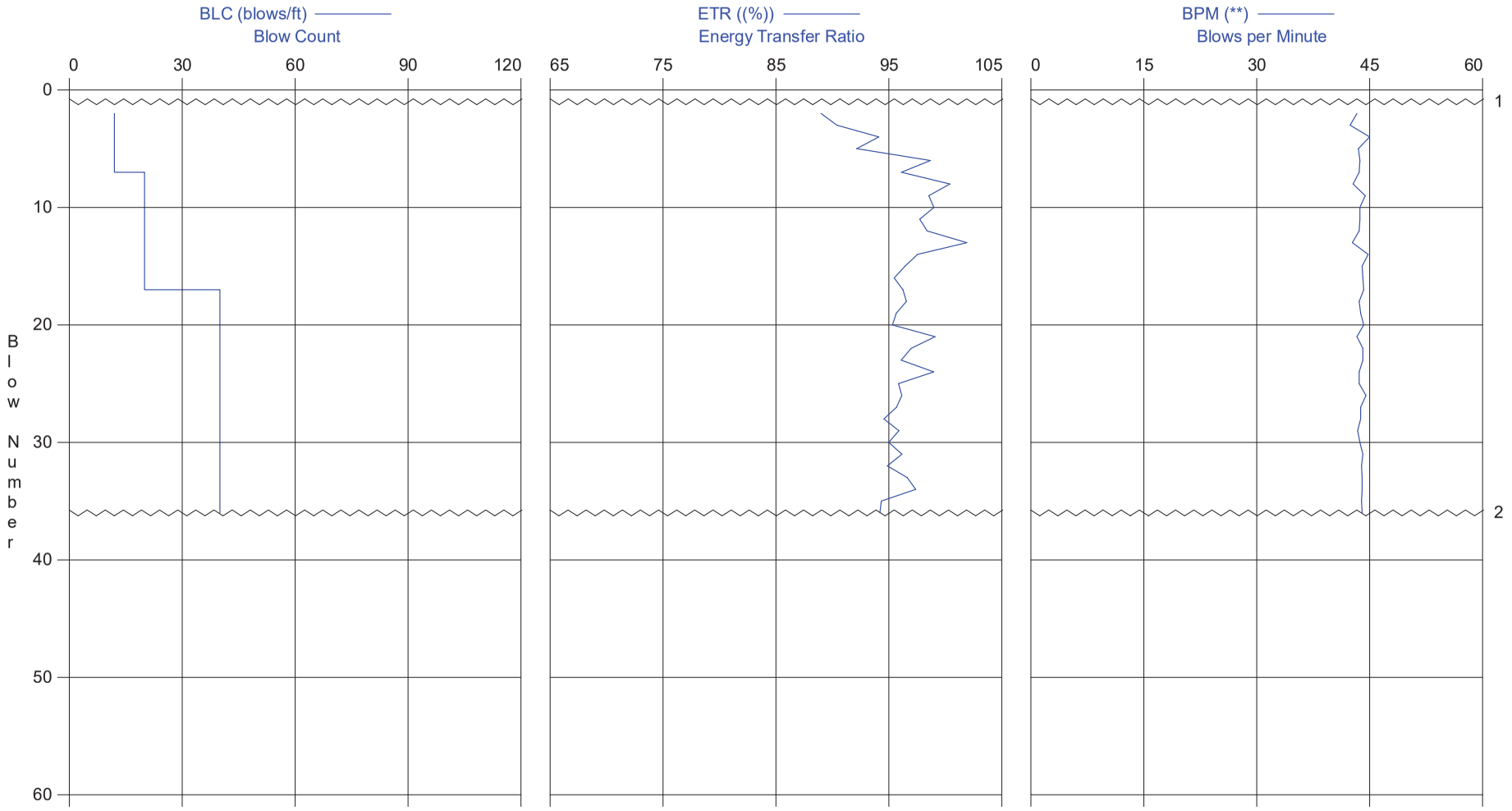
Drive 2 minutes 57 seconds 2:36:38 PM - 2:39:35 PM (4/17/2013) BN 1 - 76

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

Test date: 19-Apr-2013

HOLT SERVICES, SONIC - SAMPLE 20 FT E340-B-12, 140LB MOBILE AUTO



1 - Start of test on 4/19/2013 at 10:59:50 AM

2 - End of test on 4/19/2013 at 11:00:38 AM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES, SONIC - SAMPLE 20 FT
OP: RMDT

E340-B-12, 140LB MOBILE AUTO
Test date: 19-Apr-2013

AR: 1.20 in^2
LE: 23.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
ETR: Energy Transfer Ratio
EFV: Energy of FV

BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio

BL#	depth	BLC	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ft	bl/ft	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
7	20.55	20	23.7	21.9	96.1	0.336	43.6	26	13.6	1.1
8	20.60	20	23.4	21.6	100.4	0.351	42.8	26	13.5	1.1
9	20.65	20	23.7	22.2	98.5	0.345	44.4	27	13.5	1.1
10	20.70	20	24.0	22.3	99.0	0.346	43.7	27	13.5	1.1
11	20.75	20	23.4	21.9	97.7	0.342	43.7	26	13.5	1.1
12	20.80	20	23.3	21.6	98.4	0.344	43.6	26	13.5	1.1
13	20.85	20	23.4	21.7	101.9	0.357	42.7	26	13.9	1.1
14	20.90	20	22.8	20.9	97.5	0.341	44.8	25	13.8	1.1
15	20.95	20	22.3	20.6	96.4	0.338	44.0	25	12.9	1.1
16	21.00	20	22.2	20.6	95.5	0.334	44.1	25	12.8	1.1
17	21.03	40	22.1	20.4	96.2	0.337	44.2	24	13.1	1.1
18	21.05	40	22.3	20.4	96.6	0.338	43.6	25	13.2	1.1
19	21.08	40	22.8	21.1	95.7	0.335	43.8	25	13.4	1.1
20	21.10	40	22.6	21.2	95.3	0.334	44.2	25	13.5	1.1
21	21.13	40	22.2	20.7	99.1	0.347	43.3	25	13.9	1.1
22	21.15	40	22.5	20.8	97.0	0.339	44.1	25	14.4	1.1
23	21.18	40	22.6	21.5	96.1	0.336	44.1	26	14.3	1.1
24	21.20	40	22.6	21.4	99.0	0.346	43.6	26	14.5	1.1
25	21.23	40	23.1	21.6	95.9	0.335	43.6	26	14.1	1.1
26	21.25	40	22.3	20.8	96.1	0.336	44.5	25	13.6	1.1
27	21.28	40	22.3	20.9	95.7	0.335	43.8	25	14.4	1.1
28	21.30	40	23.0	21.1	94.6	0.331	43.8	25	14.4	1.1
29	21.33	40	22.9	21.3	95.9	0.336	43.4	26	13.7	1.1
30	21.35	40	22.9	21.1	95.0	0.332	43.7	25	14.5	1.1
31	21.38	40	22.2	20.5	96.2	0.337	44.1	25	14.2	1.1
32	21.40	40	22.5	20.6	94.9	0.332	43.9	25	14.6	1.1
33	21.43	40	22.8	20.8	96.6	0.338	44.0	25	15.0	1.1
34	21.45	40	22.7	21.0	97.4	0.341	44.0	25	15.4	1.1
35	21.48	40	22.7	20.9	94.3	0.330	43.9	25	14.3	1.1
36	21.50	40	22.0	20.6	94.2	0.330	44.0	25	14.5	1.1
		Average	22.8	21.1	96.8	0.339	43.8	25	13.9	1.1
		Std. Dev.	0.5	0.5	1.8	0.006	0.4	1	0.6	0.0
		Maximum	24.0	22.3	101.9	0.357	44.8	27	15.4	1.1
		Minimum	22.0	20.4	94.2	0.330	42.7	24	12.8	1.1

Total number of blows analyzed: 30

BL#	depth (ft)	Comments
1	20.08	Start of test on 4/19/2013 at 10:59:50 AM
36	21.50	End of test on 4/19/2013 at 11:00:38 AM

Time Summary

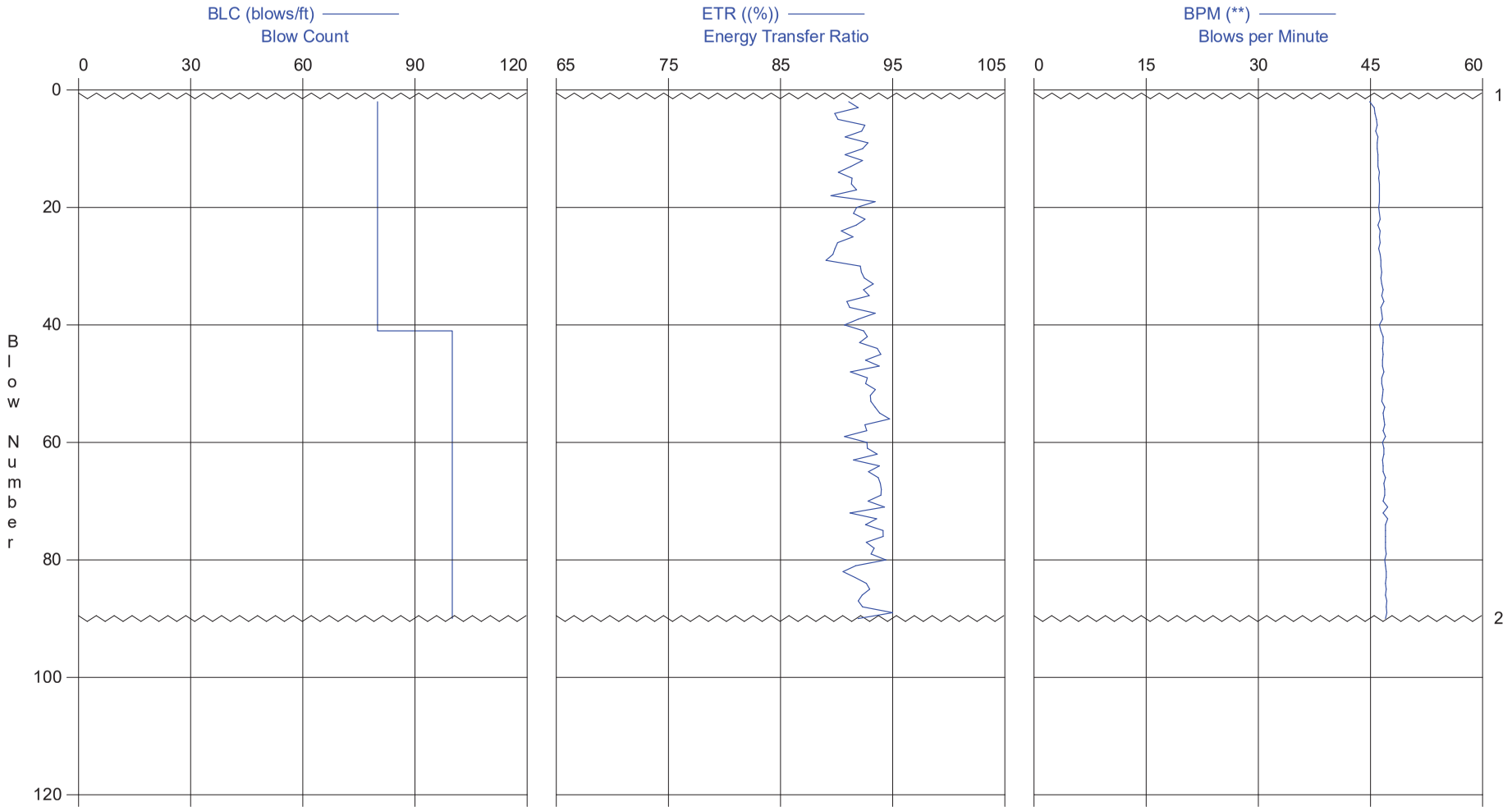
Drive	48 seconds	10:59:50 AM - 11:00:38 AM (4/19/2013) BN 1 - 36

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

Test date: 19-Apr-2013

HOLT SERVICES, SONIC - SAMPLE 30 FT E340-B-12, 140LB MOBILE AUTO



1 - Start of test on 4/19/2013 at 11:37:49 AM

2 - End of test on 4/19/2013 at 11:39:43 AM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES, SONIC - SAMPLE 30 FT
OP: RMDT

E340-B-12, 140LB MOBILE AUTO
Test date: 19-Apr-2013

AR: 1.20 in^2
LE: 33.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
ETR: Energy Transfer Ratio
EFV: Energy of FV

BPM: Blows per Minute
FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio

BL#	depth	BLC	CSI	CSX	ETR	EFV	BPM	FMX	VMX	RAT
	ft	bl/ft	ksi	ksi	(%)	k-ft	**	kips	f/s	[]
41	30.51	100	24.8	24.4	92.4	0.323	46.4	29	14.7	1.1
42	30.52	100	24.5	24.0	92.7	0.325	46.7	29	14.6	1.1
43	30.53	100	24.5	24.1	92.0	0.322	46.7	29	14.0	1.1
44	30.54	100	24.5	24.4	93.6	0.328	46.6	29	14.6	1.1
45	30.55	100	25.0	24.5	93.9	0.329	46.7	29	14.4	1.1
46	30.56	100	25.2	24.7	92.6	0.324	46.6	30	13.7	1.1
47	30.57	100	25.7	25.1	93.8	0.328	46.6	30	14.0	1.1
48	30.58	100	25.1	24.7	91.2	0.319	46.8	30	13.8	1.1
49	30.59	100	24.9	24.4	92.7	0.325	46.5	29	14.0	1.1
50	30.60	100	24.1	23.9	92.6	0.324	46.5	29	14.7	1.1
51	30.61	100	24.7	24.4	93.5	0.327	46.7	29	14.5	1.1
52	30.62	100	24.6	24.5	93.0	0.326	46.6	29	14.7	1.1
53	30.63	100	24.9	24.7	93.0	0.326	46.5	30	14.4	1.1
54	30.64	100	24.9	24.5	93.4	0.327	46.9	29	14.8	1.1
55	30.65	100	25.5	25.0	93.8	0.328	46.7	30	14.1	1.1
56	30.66	100	25.8	25.3	94.7	0.332	46.8	30	14.6	1.1
57	30.67	100	26.0	25.2	92.5	0.324	46.9	30	14.1	1.1
58	30.68	100	24.7	24.1	92.7	0.324	46.7	29	14.3	1.1
59	30.69	100	24.3	23.9	90.7	0.317	47.0	29	14.3	1.1
60	30.70	100	24.8	24.6	92.7	0.324	46.6	30	14.6	1.1
61	30.71	100	25.2	24.9	92.7	0.325	46.8	30	14.7	1.1
62	30.72	100	24.8	23.6	93.6	0.328	46.8	28	14.4	1.1
63	30.73	100	24.6	24.1	91.5	0.320	46.6	29	14.4	1.1
64	30.74	100	25.2	25.0	93.8	0.328	46.7	30	14.6	1.1
65	30.75	100	25.8	25.0	92.8	0.325	46.7	30	14.3	1.1
66	30.76	100	24.7	24.3	93.7	0.328	47.0	29	14.7	1.1
67	30.77	100	24.9	24.2	93.9	0.329	46.8	29	14.5	1.1
68	30.78	100	23.7	23.3	94.0	0.329	46.9	28	15.0	1.1
69	30.79	100	25.3	24.9	94.0	0.329	46.9	30	14.4	1.1
70	30.80	100	25.6	24.5	92.8	0.325	46.7	29	15.0	1.1
71	30.81	100	26.5	25.2	94.3	0.330	47.3	30	14.8	1.1
72	30.82	100	26.5	25.1	91.2	0.319	46.7	30	14.6	1.1
73	30.83	100	27.6	26.2	93.6	0.327	47.3	31	14.2	1.1
74	30.84	100	27.4	26.7	92.6	0.324	47.0	32	15.1	1.1
75	30.85	100	28.0	27.1	94.1	0.329	47.0	33	14.6	1.1
76	30.86	100	27.6	27.2	94.2	0.330	47.0	33	14.6	1.1
77	30.87	100	28.2	27.6	92.6	0.324	47.0	33	14.4	1.1
78	30.88	100	28.7	28.3	93.3	0.327	47.0	34	14.5	1.1
79	30.89	100	29.7	28.6	93.1	0.326	47.1	34	15.7	1.1
80	30.90	100	28.2	27.7	94.4	0.330	46.9	33	14.9	1.1
81	30.91	100	29.9	28.7	91.7	0.321	47.0	34	15.2	1.1
82	30.92	100	28.5	27.9	90.6	0.317	47.1	34	14.9	1.1
83	30.93	100	29.5	28.5	91.6	0.321	47.1	34	15.0	1.1
84	30.94	100	30.4	28.6	92.7	0.324	47.0	34	15.2	1.1
85	30.95	100	28.4	27.5	92.9	0.325	47.1	33	14.7	1.1
86	30.96	100	28.5	28.1	92.3	0.323	47.0	34	14.6	1.1
87	30.97	100	28.5	28.2	91.9	0.322	47.2	34	15.0	1.1
88	30.98	100	29.2	28.4	92.3	0.323	47.1	34	14.7	1.1
89	30.99	100	28.9	28.4	95.0	0.332	47.2	34	14.8	1.1
90	31.00	100	30.3	28.6	91.9	0.322	47.0	34	15.2	1.1
		Average	26.4	25.7	92.9	0.325	46.9	31	14.6	1.1
		Std. Dev.	1.9	1.7	1.0	0.004	0.2	2	0.4	0.0
		Maximum	30.4	28.7	95.0	0.332	47.3	34	15.7	1.1
		Minimum	23.7	23.3	90.6	0.317	46.4	28	13.7	1.1

Total number of blows analyzed: 50

BL#	depth (ft)	Comments
1	30.01	Start of test on 4/19/2013 at 11:37:49 AM
90	31.00	End of test on 4/19/2013 at 11:39:43 AM

Time Summary

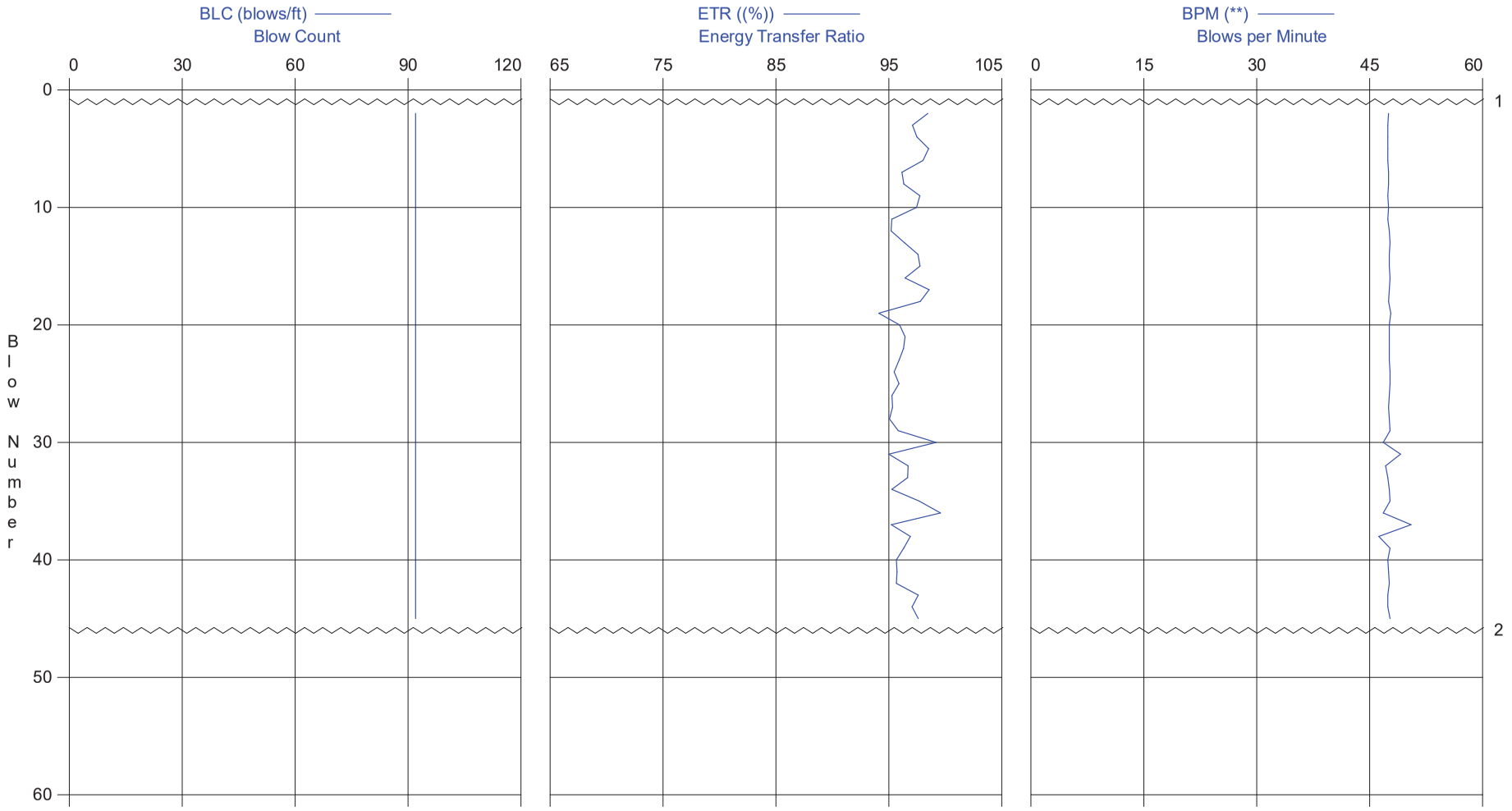
Drive	1 minute 54 seconds	11:37:49 AM - 11:39:43 AM (4/19/2013) BN 1 - 90

Robert Miner Dynamic Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

Test date: 19-Apr-2013

HOLT SERVICES, SONIC - SAMPLE 45 FT E340-B-12, 140LB MOBILE AUTO



1 - Start of test on 4/19/2013 at 1:57:55 PM

2 - End of test on 4/19/2013 at 1:58:55 PM

Robert Miner Dynamic Testing, Inc.
Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 26-Apr-2013

HOLT SERVICES, SONIC - SAMPLE 45 FT
OP: RMDT

E340-B-12, 140LB MOBILE AUTO
Test date: 19-Apr-2013

AR: 1.20 in^2
LE: 48.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.35

CSI: Max F1 or F2 Compr. Stress
CSX: Max Measured Compr. Stress
ETR: Energy Transfer Ratio
EFV: Energy of FV
BPM: Blows per Minute

FMX: Maximum Force
VMX: Maximum Velocity
RAT: SPT Length Ratio
CSB: Compression Stress at Bottom

BL#	depth ft	BLC bl/ft	CSI ksi	CSX ksi	ETR (%)	EFV k-ft	BPM **	FMX kips	VMX f/s	RAT []	CSB ksi
2	45.02	92	23.4	23.0	98.4	0.345	47.5	28	15.4	1.1	23.0
3	45.03	92	24.2	23.9	97.1	0.340	47.4	29	15.9	1.1	24.3
4	45.04	92	22.8	22.4	97.5	0.341	47.4	27	15.9	1.1	23.6
5	45.05	92	23.7	23.7	98.5	0.345	47.4	28	15.9	1.1	22.8
6	45.07	92	23.2	22.6	98.0	0.343	47.4	27	15.9	1.1	24.1
7	45.08	92	22.8	22.1	96.2	0.337	47.5	26	15.7	1.1	22.5
8	45.09	92	23.1	22.9	96.3	0.337	47.5	27	15.9	1.1	23.7
9	45.10	92	24.1	23.0	97.7	0.342	47.4	28	15.6	1.1	22.7
10	45.11	92	22.7	21.8	97.5	0.341	47.5	26	15.6	1.1	23.4
11	45.12	92	22.9	22.0	95.3	0.333	47.4	26	15.4	1.1	22.5
12	45.13	92	23.6	23.0	95.2	0.333	47.6	28	15.5	1.1	20.4
13	45.14	92	23.9	23.5	96.4	0.337	47.7	28	15.1	1.1	19.7
14	45.15	92	23.5	23.4	97.6	0.342	47.6	28	14.9	1.1	20.1
15	45.16	92	22.5	22.3	97.8	0.342	47.6	27	15.4	1.1	21.4
16	45.17	92	24.5	23.8	96.4	0.338	47.7	29	15.2	1.1	21.5
17	45.18	92	23.8	23.5	98.6	0.345	47.6	28	15.0	1.1	21.4
18	45.20	92	22.6	22.3	97.8	0.342	47.5	27	15.2	1.1	23.0
19	45.21	92	22.3	21.8	94.1	0.329	47.8	26	15.3	1.1	23.6
20	45.22	92	23.1	23.0	96.0	0.336	47.6	28	15.2	1.1	23.5
21	45.23	92	23.6	23.1	96.4	0.337	47.6	28	15.3	1.1	23.1
22	45.24	92	23.0	22.9	96.3	0.337	47.6	27	14.7	1.1	23.5
23	45.25	92	24.0	23.4	95.9	0.336	47.6	28	15.5	1.1	24.0
24	45.26	92	24.1	23.5	95.5	0.334	47.7	28	15.4	1.1	24.0
25	45.27	92	23.7	23.3	95.9	0.336	47.7	28	15.3	1.1	23.5
26	45.28	92	24.7	23.1	95.3	0.333	47.6	28	15.4	1.1	24.1
27	45.29	92	23.3	22.4	95.3	0.334	47.5	27	14.7	1.1	24.0
28	45.30	92	22.3	21.9	95.1	0.333	47.6	26	14.7	1.1	22.9
29	45.32	92	22.1	21.8	95.8	0.335	47.7	26	15.3	1.1	23.8
30	45.33	92	23.7	23.1	99.2	0.347	46.8	28	15.6	1.1	24.8
31	45.34	92	24.7	23.7	95.0	0.332	49.1	28	14.6	1.1	22.7
32	45.35	92	22.6	22.5	96.7	0.338	47.1	27	14.6	1.1	23.7
33	45.36	92	21.9	21.6	96.7	0.338	47.4	26	14.4	1.1	24.1
34	45.37	92	24.0	23.3	95.3	0.333	47.6	28	14.9	1.1	25.8
35	45.38	92	24.1	23.7	97.7	0.342	47.7	28	14.3	1.1	23.3
36	45.39	92	23.8	23.2	99.6	0.349	46.8	28	14.5	1.1	23.2
37	45.40	92	22.8	22.6	95.2	0.333	50.5	27	14.2	1.1	22.2
38	45.41	92	22.2	21.9	96.9	0.339	46.2	26	14.5	1.1	22.8
39	45.42	92	22.0	21.9	96.3	0.337	47.7	26	14.5	1.1	21.5
40	45.43	92	23.3	22.7	95.7	0.335	47.4	27	14.7	1.1	22.6
41	45.45	92	22.4	22.3	95.7	0.335	47.5	27	14.6	1.1	21.2
42	45.46	92	22.8	22.3	95.7	0.335	47.6	27	15.3	1.1	22.7
43	45.47	92	22.8	22.5	97.6	0.342	47.4	27	15.1	1.1	21.3
44	45.48	92	22.5	22.1	97.1	0.340	47.4	26	15.3	1.1	22.7
45	45.49	92	22.4	22.2	97.6	0.342	47.7	27	15.1	1.1	21.7
		Average	23.2	22.7	96.6	0.338	47.6	27	15.1	1.1	22.9
		Std. Dev.	0.7	0.6	1.2	0.004	0.6	1	0.5	0.0	1.2
		Maximum	24.7	23.9	99.6	0.349	50.5	29	15.9	1.1	25.8
		Minimum	21.9	21.6	94.1	0.329	46.2	26	14.2	1.1	19.7

Total number of blows analyzed: 44

BL#	depth (ft)	Comments
1	45.01	Start of test on 4/19/2013 at 1:57:55 PM
46	45.50	End of test on 4/19/2013 at 1:58:55 PM

Time Summary

Drive 1 minute 1:57:55 PM - 1:58:55 PM (4/19/2013) BN 1 - 46

Report 6
Holt Mobile B-54

Job No. 186004-1

Report on:
Dynamic Energy Measurements
SPT Rig Calibration Project
Portland, Oregon

Prepared for Holt Services, Inc.
By Marty Bixler and Diego Campos

March 20, 2018

GRL engineers, inc.
Dynamic Measurements and Analyses

www.GRLengineers.com
info@GRLengineers.com

GRL engineers, inc. Dynamic Measurements and Analyses

March 20, 2018

Dale Smith
Holt Services, Inc.
10621 Todd Road, E
Edgewood, WA 98372

Re: Energy Measurement for Dynamic Penetrometers
Standard Penetration Tests (SPT)
Portland, Oregon GRL Job No. 186004-1

Dear Mr. Smith:

This report transmits our findings from energy measurements and related data analysis conducted by GRL Engineers, Inc. (GRL) for your Mobile B-54 track-rig operating in Portland, Oregon. One automatic hammer and penetrometer system was monitored during Standard Penetration Tests. Dynamic testing summarized in this report was conducted on March 19, 2018.

A Pile Driving Analyzer® Model 8G recorded, processed and displayed the dynamic data to meet the objectives of the hammer system calibration. Discussions on the test methods, limitations and implementation are provided in Appendix A. The energy measurement results are summarized in the appended tables with the average and standard deviation provided in Appendix B together with representative plots of force and normalized velocity.

EQUIPMENT

Hammer and Penetrometer System

Energy measurements were recorded during standard penetration tests conducted for one automatic hammer and the following drill rig type.

Drill Rig Type
Mobile B-54 Track-rig #9
SN 2010009

Measurements were recorded for two boring locations; B3 and B4. Holt Services, Inc. advanced the penetrometer to depths of approximately $16\frac{1}{2}$ feet at each boring location with relatively little resistance, and then encountered relatively high resistance conditions. The instrumented subassembly was connected to the top of the drill rod string and measurements recorded at

intervals for several depths of data. Selected data presented in this report is from depths of approximately 20 and 23 feet for boring B3 and a depth of approximately 20 feet for boring B4.

Measurements were recorded for each blow required to advance the sampler. Results are provided for typically 12 inches (or less when refusal conditions were encountered) of the sampler advancement (i.e., excluding the initial 6 inches of advancement when the penetrometer was able to advance the full 18 inches) for the averaging of results. Please refer to ASTM D4633 regarding recommendations on blow counts and instrumented drill rod lengths, as well as other details of the test method.

The following drill rod dimensions, of rod size NWJ, were employed during testing.

Drill Rod Area sq. inch	Outside Diameter Inch	Inside Diameter inch
1.45	2.63	2.25

Note that these are the rod size dimensions for the instrumented section used for the testing, as well as the drill rod string. A split spoon sampler was used as the penetrometer.

Instrumentation

A Pile Driving Analyzer was employed for recording, processing, and displaying the dynamic data. An instrumented subassembly, inserted at the top of the drill rod string below the hammer and anvil system and above the drill rods, was used to record force and acceleration data. The subassembly was instrumented with two foil strain gages in a full bridge circuit and two piezoresistive accelerometers attached on diametrically opposite sides of the subassembly. Data sampling frequency was 50.0 kHz.

The 8G utilizes a digital system, and with the employed sampling frequency of 50.0 kHz, the signal conditioning conforms to ASTM D4633. Results for the maximum hammer operating rate, rod top force and velocity, and transferred energy are provided in Appendix B and summarized in the appended tables. Discussions on the test method and its limitations can be found in Appendix A.

MEASUREMENTS AND CALCULATIONS

The primary objective of testing was the measurement of the energy transmitted from the hammer impact through the anvil into the instrumented subassembly and drill rods. Strain transducers and accelerometers were employed for the calculation of the transferred energy using force, F(t) and velocity v(t), records as follows:

$$EFV = \int_b^a F(t)v(t)dt$$

where time "b" is to the beginning of the energy transfer and time "a" is to the time at which the energy transfer reaches a maximum. Force is calculated as the product of the measured strain, elastic modulus and cross-sectional area, and measured acceleration is integrated to velocity.

Integrated over the complete impact event and calculated from measured force and velocity, the energy transferred to the top of the drill rod was calculated as a function of time. The maximum transferred energy (i.e., EFV) is used as an indicator of the energy content of the event. The described method is the only theoretically correct method of measuring energy transfer and automatically corrects for rod non-uniformities such as connector masses or loose joints.

TEST RESULTS

Result Discussion

Dynamic data was evaluated for the hammer operating rate, rod top force and velocity, and transferred energy. Appendix B provides the evaluated quantities for blows making up the SPT N-value, with their averages and standard deviation, plotted and printed as a function of depth for the monitored sequences of the standard penetration tests. Measurements collected for relevant samples are presented herein.

The tables in Appendix B include:

- FMX – the maximum measured rod top force
- VMX – the maximum measured rod top velocity
- BPM – the hammer operating rate in blows per minute
- EFV – the maximum calculated energy (EMX) transferred to the rod top
- ETR – ratio of transferred energy (EFV) to the maximum theoretical potential energy

The maximum theoretical potential energy is the product of the standard 140 lb hammer impact mass dropped the standard 30 inches.

A representative plot of force and normalized velocity versus time for a typical blow from each data set is provided in Appendix B to demonstrate the data quality.

Summary of Results

I. The automatic hammer was monitored during standard penetration tests conducted on March 19, 2018. The average energy transfer ratio calculated with the EFV method for the monitored sequences for the drill rigs are tabulated below together with the corresponding, average hammer operating rates.

Drill Rig	Energy Transfer Ratio percent	Operating Rate bpm
Mobile B-54 Rig #9	**88.2**	41.5

Please note the first two samples obtained from the rig obtained transfer efficiencies of 85.4 and 89.5 percent, and the third sample had a transfer efficiency of 89.6 percent.

II. The uncorrected N-values encountered during the sequences ranged from 80 to 94.

III. To convert the uncorrected N-values for the employed hammer and penetrometer system and operators, the Schmertman correction for adjustment to 60 percent transfer efficiency is

$$N_{60} = \left(\frac{e_m}{60}\right) N_m$$

where N_{60} is the corrected hammer N-value, e_m is the percent energy transfer efficiency (i.e., e_m = 100*ETR) and N_m is the measured SPT N-value. N_{60} values for the measurements and monitored depths meeting ASTM requirements are presented in the appended tables. The measured overall energy transfer ratio tabulated above for the drill rig produce an N_{60} equivalent of roughly $1.47N_m$. Further corrections due to overburden stresses in the soil may be made prior to use of the N-values for design purposes.

We appreciate the opportunity to be of assistance to you on this project. Please contact our offices should you have any questions regarding the contents of this report, or if we may be of further service.

Respectfully,
GRL ENGINEERS, INC.

REGISTERED PROFESSIONAL ENGINEER
89606PE
OREGON
SEP 9, 2014
MARTY G. BIXLER
Marty G. Bixler 3-20-18
RENEWAL DATE: 12-31-19

Marty G. Bixler, P.E. (Oregon #89606)
Senior Engineer

Diego Campos, E.I.
Staff Engineer

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

The following has been written by GRL Engineers, Inc. and may only be copied with its written permission.

1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m [E_m / (0.6E_r)] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_0^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v / c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

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Appendix B

Results of SPT Rig Calibration

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

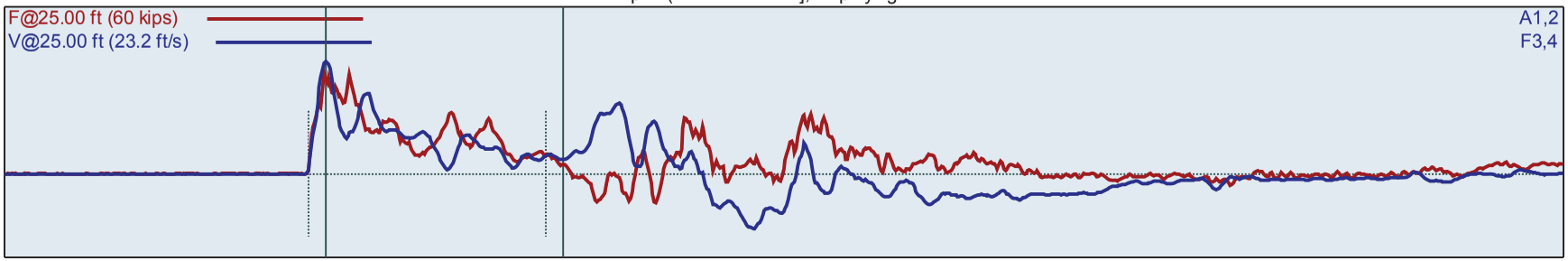
MOBILE B-54 RIG 9
GRL-MGB

20-B3
Test date: 3/19/2018

AR: 1.45 in^2
LE: 25.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (20.00 - 21.00 ft], displaying BN: 82



F3 : [292NWJ] 215.95 PDICAL (1) FF1
F4 : [292NWJ-2] 216.67 PDICAL (1) FF1

A1 (PR): [K4422] 400 mv/6.4v/5000g (1) VF1
A2 (PR): [K4981] 322 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
1	34	20.01	38	13.9	52.9	293.7	83.9
2	34	20.03	37	11.8	48.4	286.5	81.9
3	34	20.04	34	11.4	46.6	280.5	80.1
4	34	20.06	34	11.1	43.8	284.7	81.3
5	34	20.07	34	12.7	43.2	292.6	83.6
6	34	20.09	34	12.4	43.3	295.9	84.5
7	34	20.10	37	13.9	43.4	299.0	85.4
8	34	20.12	36	14.1	43.3	293.3	83.8
9	34	20.13	35	14.1	43.5	293.7	83.9
10	34	20.15	35	14.2	42.9	293.3	83.8
11	34	20.16	35	14.2	43.0	292.2	83.5
12	34	20.18	36	14.7	42.8	302.5	86.4
13	34	20.19	34	14.5	42.9	286.2	81.8
14	34	20.21	35	14.6	43.0	305.4	87.3
15	34	20.22	33	14.8	43.0	292.3	83.5

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

16	34	20.24	35	15.1	42.8	298.6	85.3
17	34	20.25	35	15.1	42.5	303.9	86.8
18	34	20.26	34	15.1	42.4	301.6	86.2
19	34	20.28	35	15.2	42.3	303.9	86.8
20	34	20.29	34	15.4	42.4	296.5	84.7
21	34	20.31	35	15.2	42.2	307.2	87.8
22	34	20.32	35	15.2	42.3	302.6	86.5
23	34	20.34	35	15.2	42.4	305.1	87.2
24	34	20.35	34	15.4	42.1	303.9	86.8
25	34	20.37	36	15.0	41.9	309.8	88.5
26	34	20.38	35	15.3	42.0	302.9	86.5
27	34	20.40	35	15.3	41.8	301.9	86.3
28	34	20.41	34	15.5	41.8	303.9	86.8
29	34	20.43	35	15.6	41.6	303.6	86.7
30	34	20.44	33	16.0	41.9	306.0	87.4
31	34	20.46	34	15.5	41.5	298.6	85.3
32	34	20.47	35	15.6	41.5	310.1	88.6
33	34	20.49	34	15.5	41.7	310.8	88.8
34	34	20.50	35	15.4	41.6	310.1	88.6
35	94	20.51	34	15.6	41.6	303.3	86.7
36	94	20.52	33	15.6	41.4	290.9	83.1
37	94	20.53	35	15.6	41.9	308.0	88.0
38	94	20.54	35	15.7	41.3	294.5	84.2
39	94	20.55	34	15.8	41.4	307.0	87.7
40	94	20.56	35	15.1	41.7	310.5	88.7
41	94	20.57	35	15.8	41.2	306.3	87.5
42	94	20.58	35	15.5	41.3	302.7	86.5
43	94	20.59	35	15.6	41.3	299.5	85.6
44	94	20.60	35	15.8	41.3	298.8	85.4
45	94	20.61	35	15.8	41.2	296.6	84.7
46	94	20.62	35	15.7	41.0	299.7	85.6
47	94	20.63	34	16.4	41.0	300.4	85.8
48	94	20.64	34	16.2	41.2	302.1	86.3
49	94	20.65	35	15.4	41.4	305.4	87.3
50	94	20.66	35	15.3	41.0	298.4	85.3
51	94	20.67	34	15.6	41.1	299.4	85.5
52	94	20.68	35	15.7	41.3	303.8	86.8
53	94	20.69	35	15.3	41.0	297.0	84.9
54	94	20.70	35	15.6	41.0	298.2	85.2
55	94	20.71	35	15.3	41.0	297.7	85.1
56	94	20.72	34	15.5	40.8	298.7	85.4
57	94	20.73	35	15.5	41.2	300.4	85.8
58	94	20.74	34	15.1	40.8	291.6	83.3

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

59	94	20.75	35	15.6	40.9	301.4	86.1
60	94	20.76	34	15.5	41.0	296.3	84.7
61	94	20.77	33	15.0	2.4	294.1	84.0
62	94	20.78	35	15.7	42.6	295.1	84.3
63	94	20.79	33	15.4	40.6	295.5	84.4
64	94	20.80	34	15.6	41.0	295.8	84.5
65	94	20.81	35	15.5	40.9	294.7	84.2
66	94	20.82	34	15.6	40.9	292.6	83.6
67	94	20.83	34	15.6	40.9	292.7	83.6
68	94	20.84	35	15.7	40.7	303.6	86.7
69	94	20.85	35	15.8	41.0	294.3	84.1
70	94	20.86	34	15.7	41.1	288.6	82.4
71	94	20.87	34	15.9	40.5	293.1	83.7
72	94	20.88	34	15.5	41.0	292.5	83.6
73	94	20.89	35	15.5	41.0	299.8	85.7
74	94	20.90	35	16.0	41.0	295.6	84.5
75	94	20.91	35	15.9	41.0	294.7	84.2
76	94	20.92	36	15.9	40.8	299.8	85.7
77	94	20.93	36	15.9	40.6	296.5	84.7
78	94	20.94	36	15.8	40.8	304.4	87.0
79	94	20.95	35	15.8	41.0	297.2	84.9
80	94	20.96	35	15.8	41.2	297.7	85.1
81	94	20.97	36	16.0	40.7	299.7	85.6
82	94	20.98	36	15.6	41.0	298.7	85.3
83	94	20.99	35	16.0	41.1	292.8	83.7
84	94	21.00	37	15.9	41.1	302.2	86.3
		Average	35	15.2	41.4	298.7	85.4
		Std Dev	1	1.0	4.6	6.1	1.7
		Maximum	38	16.4	52.9	310.8	88.8
		Minimum	33	11.1	2.4	280.5	80.1

N-value: 84

Sample Interval Time: 143.07 seconds.

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

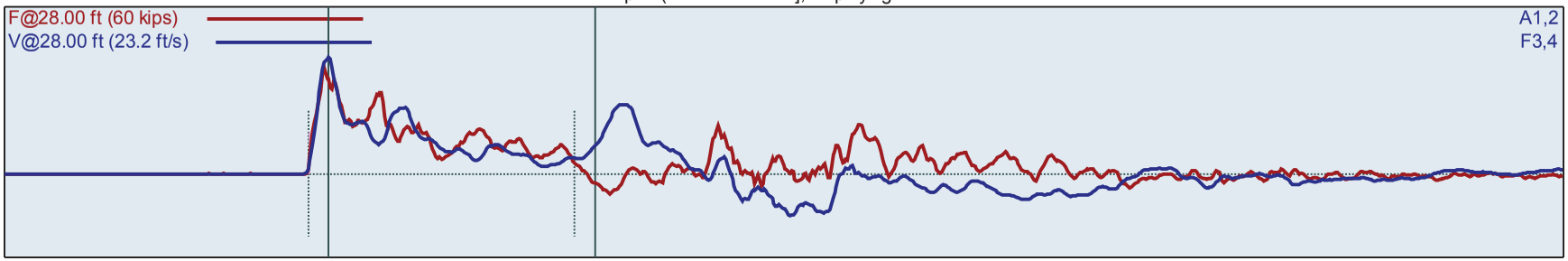
MOBILE B-54 RIG 9
GRL-MGB

20-B3
Test date: 3/19/2018

AR: 1.45 in^2
LE: 28.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (23.00 - 24.50 ft], displaying BN: 185



F3 : [292NWJ] 215.95 PDICAL (1) FF1
F4 : [292NWJ-2] 216.67 PDICAL (1) FF1

A1 (PR): [K4422] 400 mv/6.4v/5000g (1) VF1
A2 (PR): [K4981] 322 mv/6.4v/5000g (1) VF1

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
85	23	23.02	35	15.6	53.8	305.9	87.4
86	23	23.04	34	15.8	46.5	313.2	89.5
87	23	23.07	35	15.6	44.8	304.7	87.0
88	23	23.09	35	15.8	43.8	313.4	89.5
89	23	23.11	34	15.5	43.2	306.1	87.5
90	23	23.13	36	15.8	43.5	309.6	88.5
91	23	23.15	36	15.6	43.4	306.8	87.7
92	23	23.17	35	15.7	43.0	310.9	88.8
93	23	23.20	35	15.7	43.0	312.7	89.3
94	23	23.22	36	15.8	42.7	316.4	90.4
95	23	23.24	37	15.8	42.9	314.5	89.9
96	23	23.26	36	15.9	42.8	312.2	89.2
97	23	23.28	37	15.7	42.5	311.6	89.0
98	23	23.30	35	15.7	42.5	313.5	89.6
99	23	23.33	35	15.6	42.5	306.8	87.6
100	23	23.35	39	16.0	42.7	316.0	90.3
101	23	23.37	34	15.4	42.2	299.2	85.5
102	23	23.39	35	15.5	42.5	306.2	87.5

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

103	23	23.41	35	15.7	42.3	310.1	88.6
104	23	23.43	37	15.9	42.3	310.9	88.8
105	23	23.46	37	15.8	41.8	303.7	86.8
106	23	23.48	36	15.8	42.3	310.3	88.7
107	23	23.50	38	16.3	41.9	314.3	89.8
108	34	23.51	37	16.0	42.1	313.9	89.7
109	34	23.53	38	16.1	41.8	315.6	90.2
110	34	23.54	36	15.9	42.0	310.3	88.6
111	34	23.56	37	15.9	41.9	309.6	88.5
112	34	23.57	38	15.8	42.0	308.6	88.2
113	34	23.59	35	15.8	41.7	320.1	91.4
114	34	23.60	36	15.9	41.7	315.7	90.2
115	34	23.62	36	15.7	41.9	309.7	88.5
116	34	23.63	34	15.6	41.7	313.3	89.5
117	34	23.65	37	15.7	41.5	311.5	89.0
118	34	23.66	34	15.6	41.7	314.6	89.9
119	34	23.68	38	15.9	41.7	316.8	90.5
120	34	23.69	37	15.7	41.5	318.1	90.9
121	34	23.71	36	15.7	41.7	315.4	90.1
122	34	23.72	35	15.6	41.4	314.7	89.9
123	34	23.74	37	15.7	41.8	316.0	90.3
124	34	23.75	38	15.8	41.7	315.4	90.1
125	34	23.76	38	16.0	41.5	316.6	90.5
126	34	23.78	37	15.8	41.6	313.0	89.4
127	34	23.79	35	15.6	41.4	309.6	88.4
128	34	23.81	36	15.3	41.2	314.0	89.7
129	34	23.82	35	15.5	41.6	316.4	90.4
130	34	23.84	38	15.6	41.3	312.4	89.3
131	34	23.85	37	15.5	41.6	310.7	88.8
132	34	23.87	37	15.8	41.5	315.0	90.0
133	34	23.88	39	15.9	41.4	312.9	89.4
134	34	23.90	37	15.7	41.4	312.8	89.4
135	34	23.91	38	15.9	41.4	318.0	90.9
136	34	23.93	39	15.8	41.2	311.9	89.1
137	34	23.94	38	15.7	41.5	315.5	90.1
138	34	23.96	35	15.6	41.4	317.2	90.6
139	34	23.97	39	15.9	41.2	318.5	91.0
140	34	23.99	36	15.8	41.4	307.8	87.9
141	34	24.00	37	15.7	41.5	305.2	87.2
142	46	24.01	36	15.7	41.1	309.5	88.4
143	46	24.02	38	15.8	41.0	313.8	89.7
144	46	24.03	35	15.6	41.5	314.4	89.8
145	46	24.04	36	15.6	41.5	304.5	87.0

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

146	46	24.05	37	15.8	41.6	310.0	88.6
147	46	24.07	36	15.5	41.3	302.2	86.3
148	46	24.08	38	16.1	41.3	317.0	90.6
149	46	24.09	39	16.1	41.3	319.3	91.2
150	46	24.10	38	16.0	41.4	313.7	89.6
151	46	24.11	34	15.6	41.3	308.1	88.0
152	46	24.12	39	16.1	41.4	319.9	91.4
153	46	24.13	40	15.8	41.4	315.6	90.2
154	46	24.14	34	15.5	40.9	318.7	91.1
155	46	24.15	34	15.5	41.2	309.1	88.3
156	46	24.16	36	15.6	41.7	320.3	91.5
157	46	24.17	35	15.6	41.5	307.6	87.9
158	46	24.18	36	15.8	41.4	307.0	87.7
159	46	24.20	36	15.7	41.1	308.7	88.2
160	46	24.21	36	15.8	41.1	311.6	89.0
161	46	24.22	37	15.8	40.9	318.6	91.0
162	46	24.23	34	14.8	41.3	309.3	88.4
163	46	24.24	34	14.9	41.1	309.8	88.5
164	46	24.25	34	15.2	41.1	315.0	90.0
165	46	24.26	34	14.8	41.2	303.2	86.6
166	46	24.27	34	14.7	41.2	304.0	86.9
167	46	24.28	34	15.0	40.8	314.4	89.8
168	46	24.29	35	15.4	41.1	319.5	91.3
169	46	24.30	35	15.6	41.0	318.8	91.1
170	46	24.32	34	15.2	41.0	308.9	88.3
171	46	24.33	36	15.3	41.0	315.1	90.0
172	46	24.34	36	16.0	41.4	313.1	89.5
173	46	24.35	36	16.0	41.4	310.4	88.7
174	46	24.36	36	16.0	41.0	311.7	89.1
175	46	24.37	38	16.1	41.2	321.1	91.7
176	46	24.38	37	16.0	41.4	310.3	88.6
177	46	24.39	35	15.8	41.2	309.1	88.3
178	46	24.40	37	16.1	41.1	312.0	89.2
179	46	24.41	36	16.0	41.3	309.6	88.5
180	46	24.42	37	16.2	41.5	320.2	91.5
181	46	24.43	37	16.0	41.0	308.3	88.1
182	46	24.45	37	16.2	41.3	321.0	91.7
183	46	24.46	36	16.0	41.5	310.5	88.7
184	46	24.47	36	16.0	41.4	309.6	88.4
185	46	24.48	38	16.2	41.2	315.2	90.1
186	46	24.49	36	16.0	41.1	307.7	87.9
187	46	24.50	39	16.3	41.2	323.0	92.3

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

Average	36	15.7	41.4	313.1	89.5
Std Dev	1	0.3	0.3	4.6	1.3
Maximum	40	16.3	42.1	323.0	92.3
Minimum	34	14.7	40.8	302.2	86.3
	N-value: 80				

Sample Interval Time: 146.78 seconds.

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

Summary of SPT Test Results

Project: MOBILE B-54 RIG 9, Test Date: 3/19/2018

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ETR %
25.00	**34-94**	20.00	21.00	**94**	**136**	35	15.2	41.4	298.7	85.4
28.00	**23-34-46**	23.00	24.50	**80**	**116**	36	15.7	41.4	313.1	89.5
				Overall Average Values:		36	15.5	41.4	305.7	87.4
				Standard Deviation:		1	0.8	3.3	9.0	2.6
				Overall Maximum Value:		40	16.4	52.9	323.0	92.3
				Overall Minimum Value:		33	11.1	2.4	280.5	80.1

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

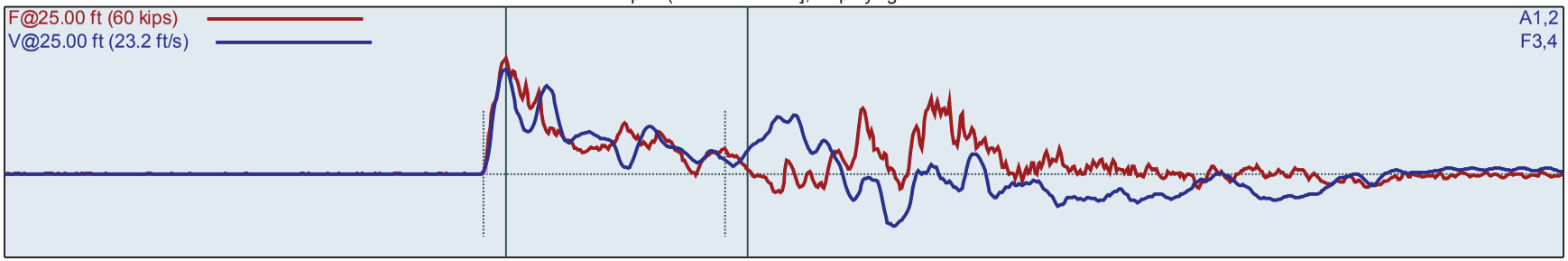
MOBILE B-54 RIG 9
GRL-MGB

20-B4
Test date: 3/19/2018

AR: 1.45 in^2
LE: 25.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (20.00 - 21.50 ft], displaying BN: 92



F3 : [292NWJ] 215.95 PDICAL (1) FF1
F4 : [292NWJ-2] 216.67 PDICAL (1) FF1

A1 (PR): [K4422] 400 mv/6.4v/5000g (1) VF1
A2 (PR): [K4981] 322 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
1	0	20.01	43	15.2	53.8	310.8	88.8
2	0	20.02	42	14.3	46.3	312.3	89.2
3	0	20.03	45	14.7	43.7	321.6	91.9
4	0	20.05	42	14.4	43.0	299.7	85.6
5	0	20.06	41	14.9	42.9	309.4	88.4
6	0	20.07	41	15.2	42.9	302.4	86.4
7	0	20.08	37	15.1	42.9	296.3	84.7
8	0	20.09	40	15.5	42.7	312.1	89.2
9	0	20.10	39	15.9	42.7	305.6	87.3
10	0	20.11	37	15.4	42.3	298.2	85.2
11	0	20.13	41	15.5	42.6	312.1	89.2
12	0	20.14	40	15.7	42.1	309.6	88.4
13	0	20.15	42	15.3	42.4	311.8	89.1
14	0	20.16	40	14.7	42.4	305.6	87.3
15	0	20.17	42	14.7	42.2	307.1	87.8

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

16	0	20.18	40	15.1	42.4	304.7	87.1
17	0	20.19	40	15.0	41.9	304.9	87.1
18	0	20.20	40	16.3	42.1	309.8	88.5
19	0	20.22	41	15.7	42.1	316.2	90.3
20	0	20.23	37	15.8	41.7	307.0	87.7
21	0	20.24	39	16.2	42.1	312.0	89.1
22	0	20.25	42	15.8	42.0	316.1	90.3
23	0	20.26	40	16.0	41.9	313.5	89.6
24	0	20.27	40	15.5	41.7	318.1	90.9
25	0	20.28	41	16.0	41.9	318.5	91.0
26	0	20.30	41	15.5	41.7	314.5	89.9
27	0	20.31	40	15.7	41.6	313.6	89.6
28	0	20.32	39	15.7	41.7	312.1	89.2
29	0	20.33	41	15.7	41.9	320.1	91.5
30	0	20.34	40	15.9	41.8	315.0	90.0
31	0	20.35	40	15.6	41.8	316.9	90.5
32	0	20.36	41	15.7	41.8	317.9	90.8
33	0	20.38	40	16.2	41.7	319.5	91.3
34	0	20.39	39	16.0	41.9	318.1	90.9
35	0	20.40	41	15.5	41.6	316.0	90.3
36	0	20.41	38	15.9	41.7	313.0	89.4
37	0	20.42	38	16.1	41.9	317.6	90.7
38	0	20.43	41	15.7	41.7	319.7	91.3
39	0	20.44	42	15.1	41.6	319.5	91.3
40	0	20.45	40	15.5	41.5	313.8	89.7
41	0	20.47	41	15.5	41.5	317.1	90.6
42	0	20.48	41	15.6	41.4	319.4	91.2
43	0	20.49	39	16.1	41.6	317.0	90.6
44	0	20.50	40	15.8	41.4	317.9	90.8
45	44	20.51	40	16.0	41.4	319.9	91.4
46	44	20.52	40	16.2	41.6	318.2	90.9
47	44	20.53	41	16.1	41.6	322.2	92.1
48	44	20.54	40	15.8	41.5	313.0	89.4
49	44	20.55	41	15.7	41.5	319.1	91.2
50	44	20.56	40	15.4	41.6	311.1	88.9
51	44	20.57	41	15.4	41.2	308.3	88.1
52	44	20.58	41	14.5	41.2	310.8	88.8
53	44	20.59	42	14.8	41.3	316.9	90.5
54	44	20.60	41	14.8	41.3	315.1	90.0
55	44	20.61	41	14.7	41.3	319.3	91.2
56	44	20.62	40	14.0	41.4	308.8	88.2
57	44	20.63	42	15.0	41.0	317.3	90.6
58	44	20.64	41	14.6	41.4	315.0	90.0

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

59	44	20.65	40	14.8	41.3	314.9	90.0
60	44	20.66	40	14.5	41.1	305.9	87.4
61	44	20.67	41	14.6	41.1	309.2	88.3
62	44	20.68	41	14.4	41.2	308.3	88.1
63	44	20.69	41	14.8	41.1	315.9	90.3
64	44	20.70	41	14.7	41.1	307.6	87.9
65	44	20.71	41	14.7	41.3	310.8	88.8
66	44	20.72	41	14.6	41.1	307.7	87.9
67	44	20.73	41	14.7	40.7	308.7	88.2
68	44	20.74	41	14.6	40.9	308.4	88.1
69	44	20.75	41	14.8	41.1	311.8	89.1
70	44	20.76	42	14.6	41.3	307.3	87.8
71	44	20.77	41	14.5	41.2	306.2	87.5
72	44	20.78	42	14.9	41.1	312.3	89.2
73	44	20.79	40	14.7	41.3	319.5	91.3
74	44	20.80	41	14.8	41.1	307.2	87.8
75	44	20.81	41	14.7	41.0	315.8	90.2
76	44	20.82	40	14.7	41.2	317.4	90.7
77	44	20.83	41	14.8	41.2	320.6	91.6
78	44	20.84	41	14.8	41.2	318.9	91.1
79	44	20.85	41	14.4	41.1	314.0	89.7
80	44	20.86	41	14.5	41.1	317.3	90.7
81	44	20.87	41	14.6	41.2	318.5	91.0
82	44	20.88	41	14.4	41.0	320.5	91.6
83	44	20.89	41	14.4	40.9	315.3	90.1
84	44	20.90	41	14.3	41.2	313.3	89.5
85	44	20.91	41	14.5	41.0	314.7	89.9
86	44	20.92	41	14.7	41.2	320.9	91.7
87	44	20.93	41	14.7	41.2	316.9	90.5
88	44	20.94	41	14.6	41.1	314.9	90.0
89	44	20.95	42	14.7	41.1	320.6	91.6
90	44	20.96	40	14.8	41.4	316.9	90.6
91	44	20.97	41	14.4	41.3	308.5	88.1
92	44	20.98	42	14.5	41.5	317.7	90.8
93	44	20.99	42	14.6	41.1	316.5	90.4
94	44	21.00	41	14.6	41.3	319.6	91.3
		Average	41	15.1	41.8	313.5	89.6
		Std Dev	1	0.6	1.4	5.5	1.6
		Maximum	45	16.3	53.8	322.2	92.1
		Minimum	37	14.0	40.7	296.3	84.7

N-value: 94

Pile Dynamics, Inc.
SPT Analyzer Results

Sample Interval Time: 134.04 seconds.

Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.24 - Printed: 3/20/2018

Summary of SPT Test Results

Project: MOBILE B-54 RIG 9, Test Date: 3/19/2018

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ETR %
25.00	**0-44-50**	20.00	21.50	**94**	**140**	41	15.1	41.8	313.5	89.6
				Overall Average Values:		41	15.1	41.8	313.5	89.6
				Standard Deviation:		1	0.6	1.4	5.5	1.6
				Overall Maximum Value:		45	16.3	53.8	322.2	92.1
				Overall Minimum Value:		37	14.0	40.7	296.3	84.7

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Appendix M

Mitigation Bank Use Plan

Downtown Redmond Link Extension
Keller Farm Mitigation Bank Use Plan

February 2019

Prepared for

Central Puget Sound Regional Transit Authority
401 S. Jackson Street
Seattle, WA 98104

Prepared by

Parametrix
719 2nd Avenue, Suite 200
Seattle, WA 98104
T. 206.394.3700 F. 1.855.542.6353
www.parametrix.com

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ACRONYMS AND ABBREVIATIONS

Corps	U.S. Army Corps of Engineers
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
FGDC	Federal Geographic Data Committee
HGM	hydrogeomorphic
KCC	King County Code
MBI	Mitigation Bank Instrument
PEM	palustrine emergent
PFO	palustrine forested
PSS	palustrine scrub-shrub
RZC	Redmond Zoning Code
Sound Transit	Central Puget Sound Regional Transit Authority
SR	State Route
TMDL	Total Maximum Daily Load
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation

1. INTRODUCTION

The Central Puget Sound Regional Transit Authority (Sound Transit) seeks to purchase credits from the Keller Farm Mitigation Bank as mitigation for unavoidable wetland impacts associated with the Downtown Redmond Link Extension Project (Project). While not yet certified, according to City of Redmond staff and the Mitigation Bank Project Sponsor, mitigation bank construction is anticipated to begin in summer of 2019.

Project-related wetland impacts will occur within unincorporated King County (Marymoor Park) and the Redmond city limits. All permanent wetland and buffer impacts within Redmond will be compensated for with a purchase of credits at the Keller Farm Mitigation Bank. Additionally, long-term temporary impacts that occur within Redmond will be compensated with a credit purchase.

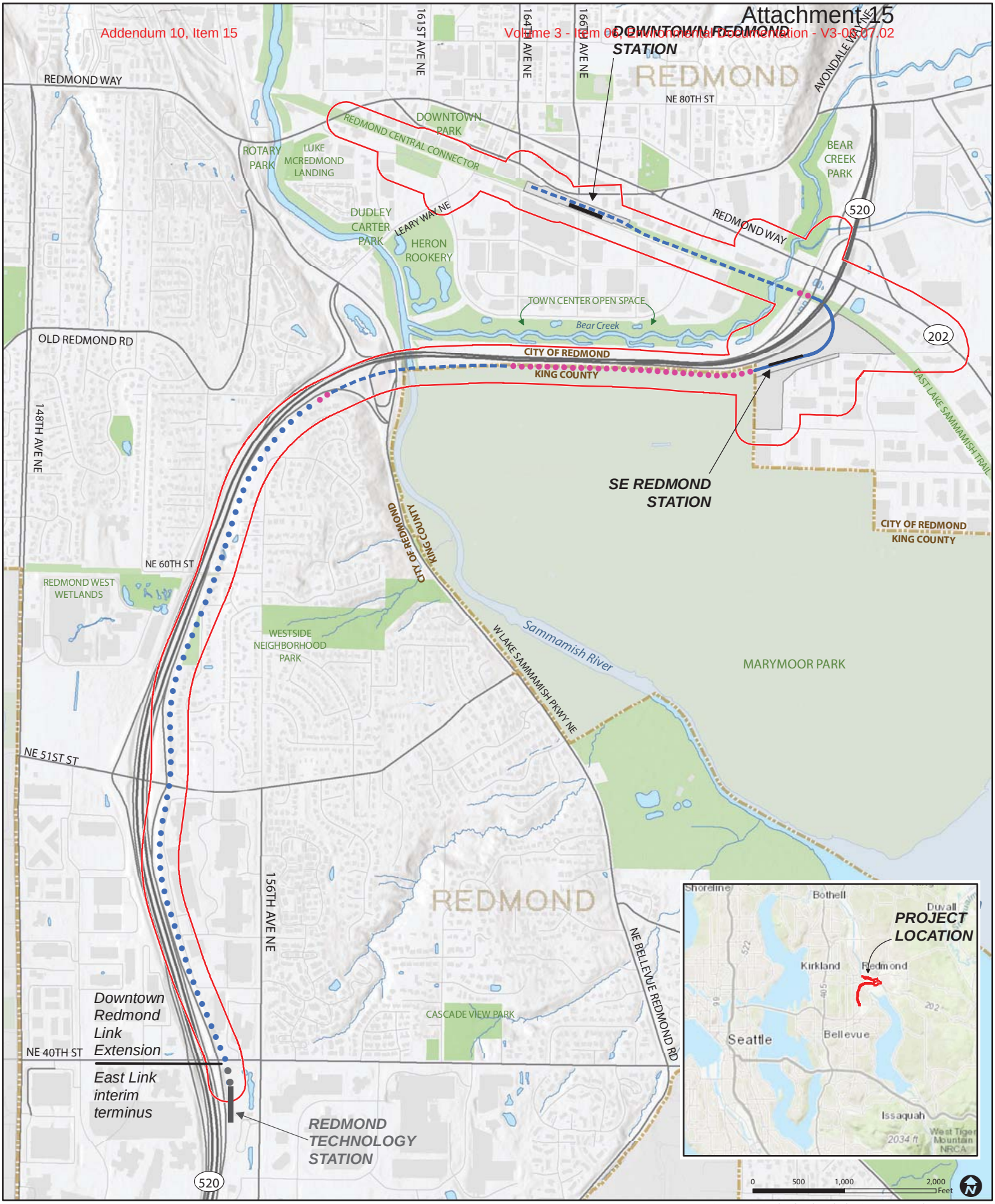
The purpose of this document is to describe the basis for using mitigation bank credits to mitigate for Project wetland impacts that will occur within Redmond city limits. This document reviews the wetland impacts within Redmond city limits and provides details on the Keller Farm Mitigation Bank, including the proposed credit ratios that are anticipated to be used by the Bank.

1.1 Project Description and Background

The Project will add 3.4 miles of light rail and two new light rail stations from the interim terminus of the Redmond Technology Station to downtown Redmond (Figure 1-1). The two new future light rail stations are the SE Redmond Station and Downtown Redmond Station. The Project's alignment will travel within the Redmond city limits in King County and within unincorporated King County (Marymoor Park). Construction of the Project is expected to begin in 2020 and be open for service in 2023.

The Project is documented as "Segment E" of the East Link Extension, a light rail system to service the cities of Seattle, Mercer Island, Bellevue, and Redmond. The Final Environmental Impact Statement (EIS) for the East Link Project was completed in 2011. A lack of funding postponed the final segment of the project (Segment E, Redmond). In 2016, voters approved the Downtown Redmond Link Extension Project and addendums and re-evaluations were made to the East Link EIS to reflect current conditions.

The project alignment will be a combination of surface, elevated, and retained cut and fill elements. The alignment starts at the existing Redmond Technology Station and runs parallel to the east/south side of State Route (SR) 520 until crossing over SR 520 near Redmond Way. There will be elevated guideways for crossings over the Sammamish River and SR 520/Bear Creek. Staging areas in proximity to the stream crossings are required for construction of the elevated guideways. Two new light rail stations will be built: (1) the SE Redmond Station adjacent to Marymoor Park and (2) the Downtown Redmond Station at the intersection of 166th Ave NE and NE 76th Street near Redmond Way (see Figure 1-1).



Source: USGS, City of Redmond, King County, Parametrix

Alignment
- At-Grade
- Elevated
- Retained Fill
- Retained Cut

- Station Platform
- Station Area
- Study Area

Figure 1-1
Vicinity Map
Downtown Redmond Link Extension

2. WETLAND EXISTING CONDITIONS

2.1 Study Area

The portion of the wetland assessment study located within the Redmond city limits in Sections 11, 12, 13, 14, and 23, Township 25N, Range 05E, Willamette Meridian is referred to herein as the Redmond portion of the study area. Consistent with the requirements of the City of Redmond's critical areas code, the study area for wetlands and aquatic habitats (including streams) extends 300 feet from the limits of the project footprint. Project biologists conducted delineations within 200 feet of the project footprint limits and estimated wetland and stream resource conditions beyond that area. In areas without property access, estimates of wetland extent and ratings were based on aerial photography, topographic maps, and other background sources, as well as attributes visible from publicly accessible areas.

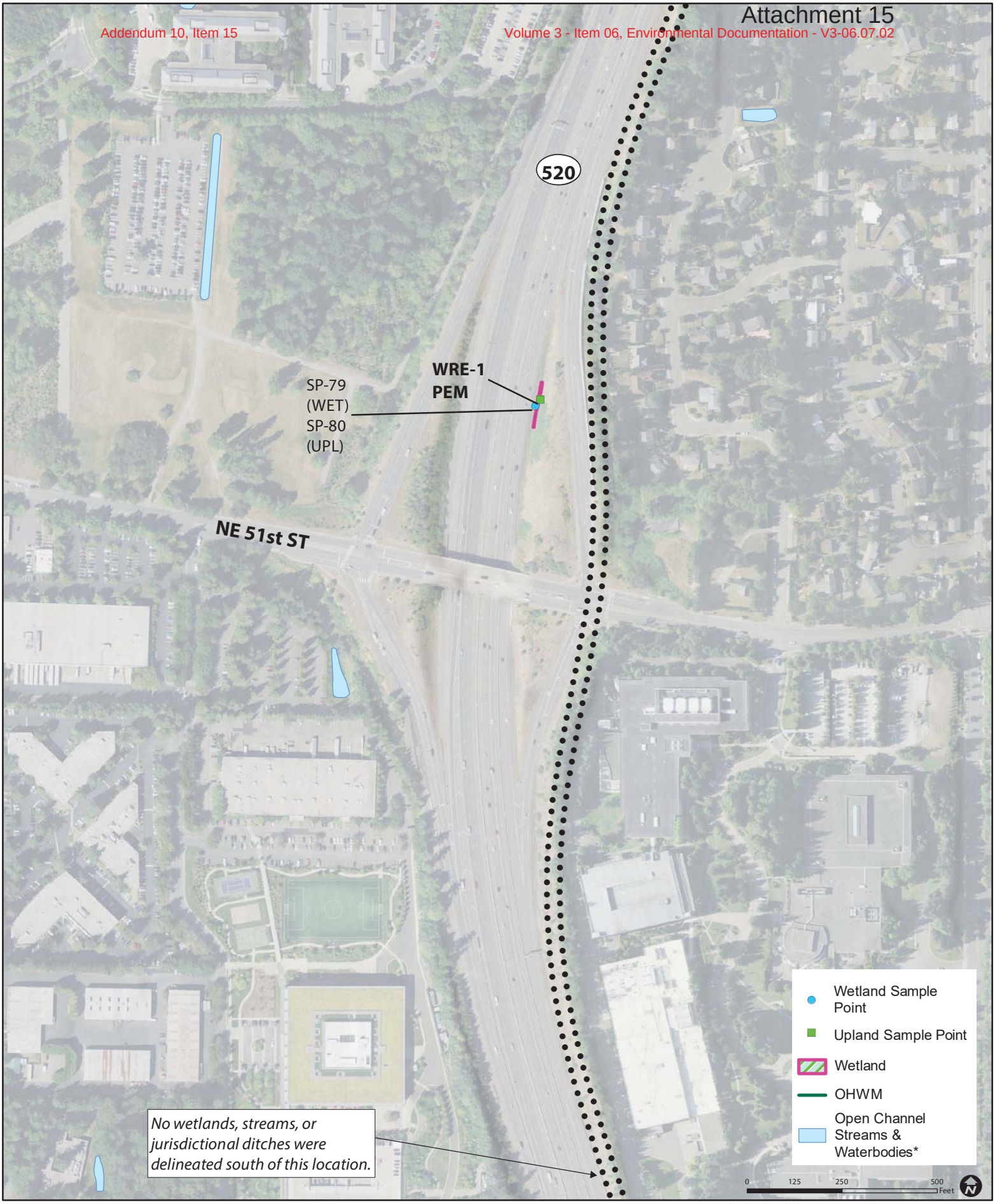
Much of the overall study area consists of developed urban areas, including commercial and residential areas, as well as SR 520. Patches of less-developed areas occur in forested areas along the SR 520 right-of-way and the Bear Creek and Sammamish River riparian corridors. The western portion of the study area drains to the Sammamish River, while the eastern portion drains to Bear Creek, a tributary to the Sammamish River. The study area is in Water Resource Inventory Area (WRIA) 8, Lake Washington/Cedar/Sammamish.

2.2 Wetlands

A total of 10 wetlands (Wetlands WRE-1 through WRE-9 and WKC-3) were delineated within the Redmond portion of the study area, as described in the Downtown Redmond Link Extension: City of Redmond Critical Areas Report (Figure 2-1, sheets A to D) (Parametrix 2019). Wetland WKC-3 is largely within King County (Marymoor Park) and is a mitigation site that was constructed by King County in 2001. This site is protected by a restrictive covenant (King County 2000). However, the northern portion of WKC-3 is located within Washington State Department of Transportation (WSDOT) right-of-way within the Redmond city limits and, therefore, within the Redmond portion of the study area. This wetland area was not part of the previous mitigation action and is not protected within the restrictive covenant.

Biologists used the methods specified in the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987) and the indicators described in the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (U.S. Army Corps of Engineers [Corps] 2010) to delineate on-site wetlands. Delineated wetlands were classified according to the U.S. Fish and Wildlife Service (USFWS) Classification of Wetlands and Deepwater Habitats of the United States (FGDC 2013). The Hydrogeomorphic (HGM) classification was assigned to wetlands using methods developed in a Hydrogeomorphic Classification System for Wetlands (Brinson 1993).

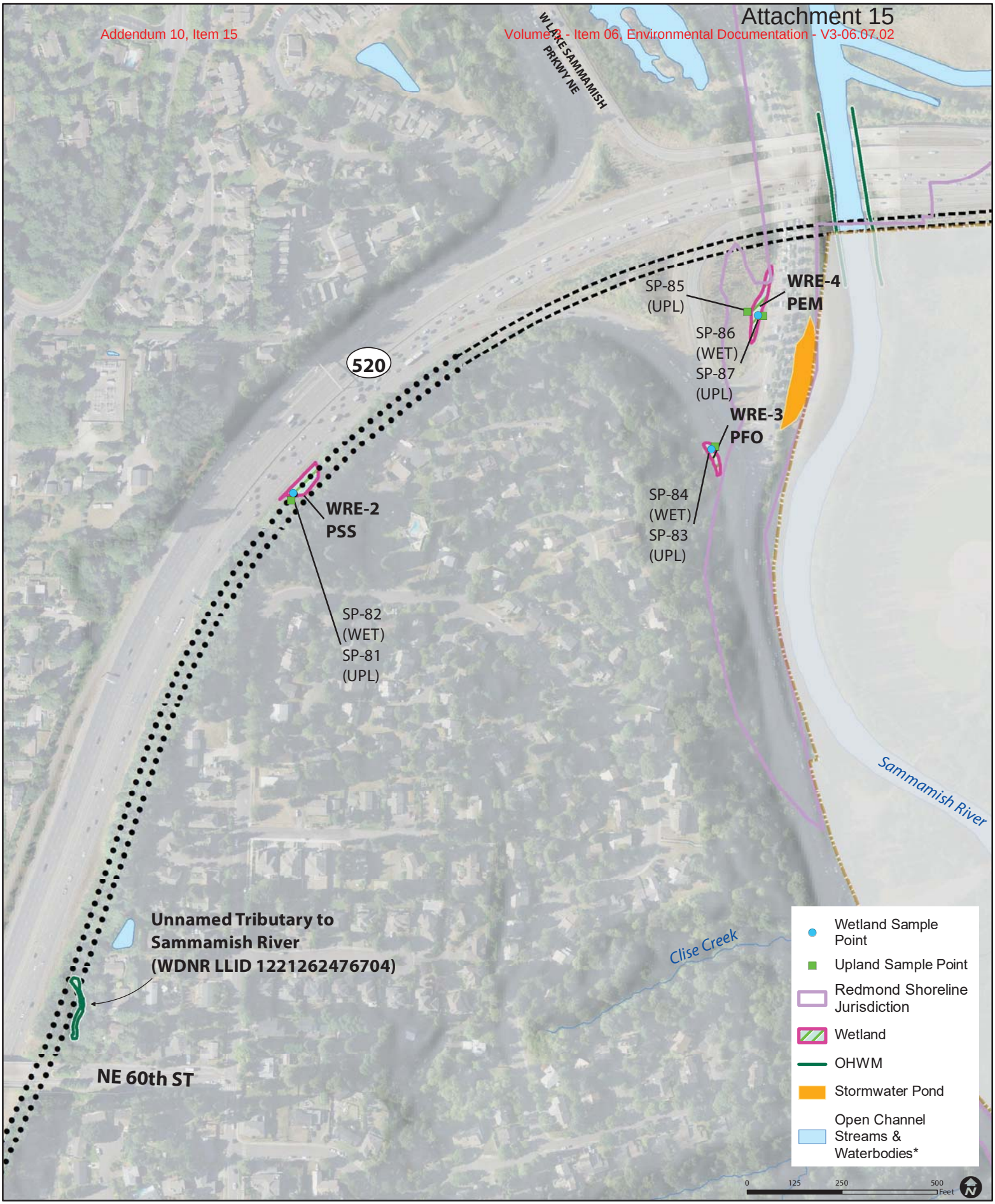
Each wetland was rated for its functional abilities pertaining to water quality, hydrology, and habitat. Rating scores were assigned as "High (H)," "Medium (M)," or "Low (L)" based on these functional abilities at a site level, landscape level, and societal value. After calculating functional scores, each wetland is classified as a Category I, II, III, or IV following the Washington State Department of Ecology's (Ecology) Washington State Wetland Rating System for Western Washington (Hruby 2014).



*Source: USGS, City of Redmond, King County, Parametrix

Alignment
- At-Grade
- Elevated
- Retained Cut/Fill
- Station Platform

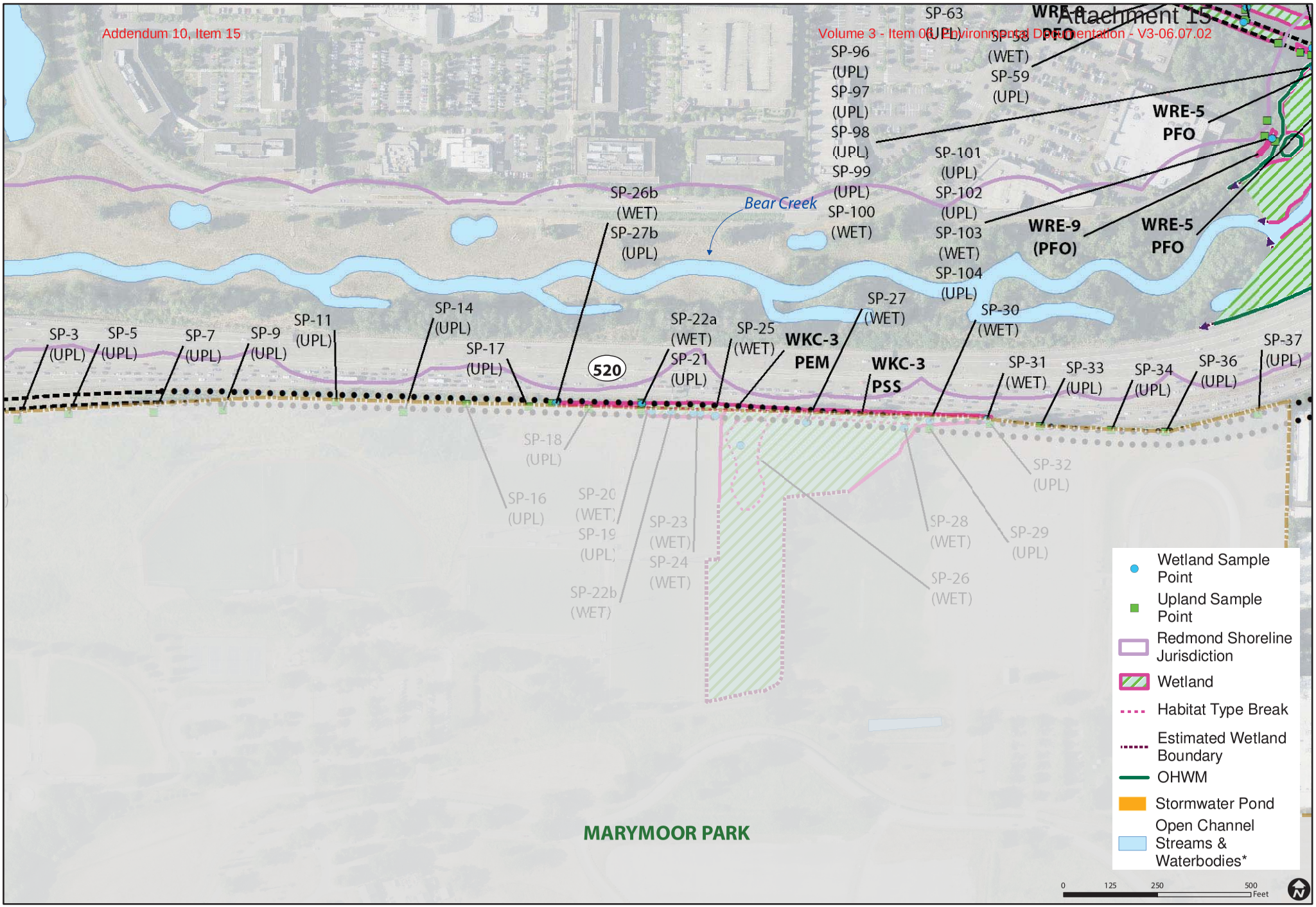
Figure 2-1A
Delineated Wetlands and Stream OHWM
Downtown Redmond Link Extension



*Source: USGS, City of Redmond, King County, Parametrix

Alignment
- At-Grade
- Elevated
- Retained Cut/Fill
- Station Platform
- City Limits

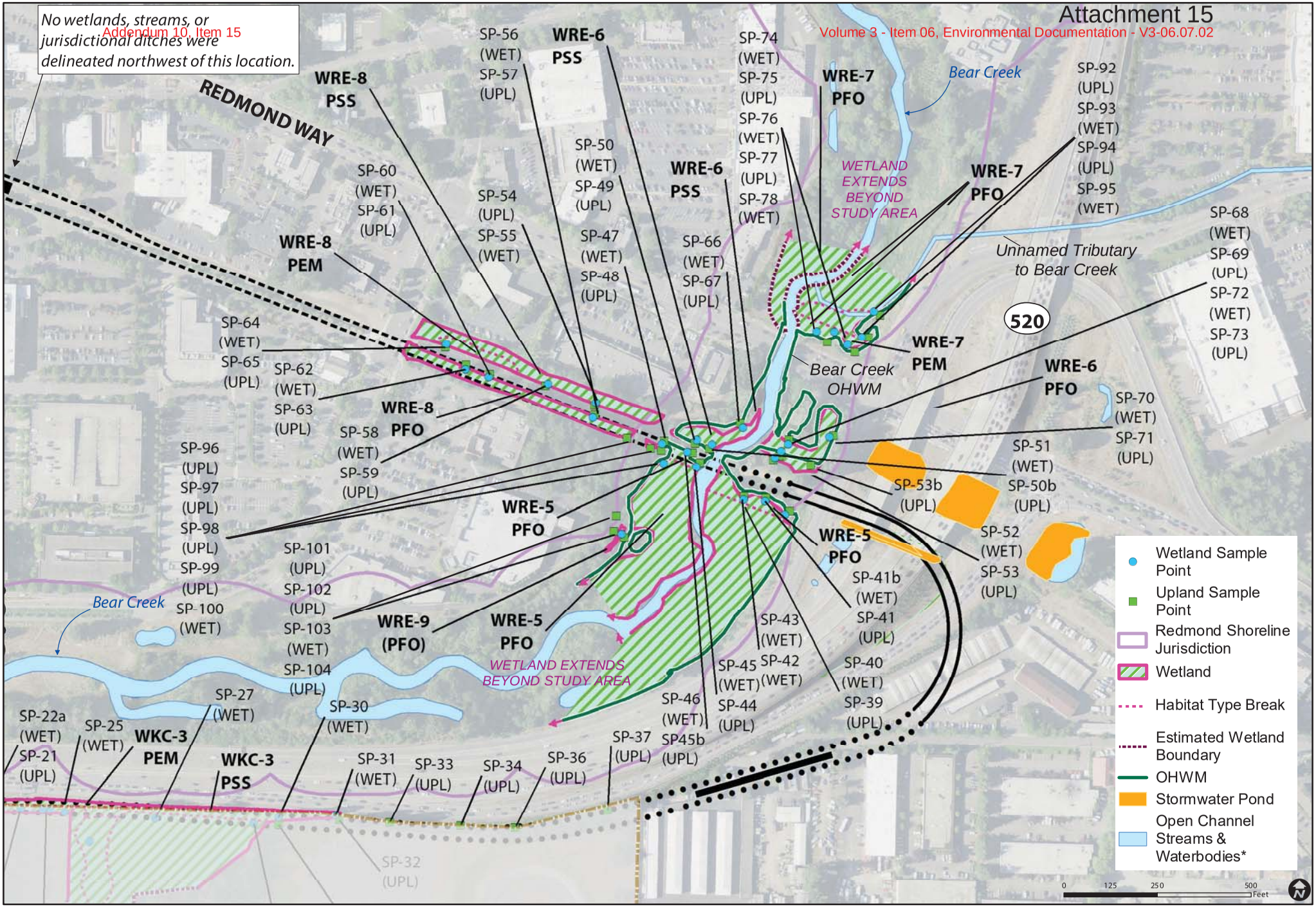
Figure 2-1B
Delineated Wetlands and Stream OHWM
Downtown Redmond Link Extension



*Source: USGS, City of Redmond, King County, Parametrix

Alignment
- At-Grade
- Elevated
- Retained Cut/Fill
- Station Platform
- City Limits

Figure 2-1C
Delineated Wetlands and Stream OHWM
Downtown Redmond Link Extension



*Source: USGS, City of Redmond, King County, Parametrix

Alignment
- At-Grade
- Elevated
- Retained Cut/Fill
- Station Platform
- City Limits

Figure 2-1D
Delineated Wetlands and Stream OHWM
Downtown Redmond Link Extension

There will be unavoidable project impacts to 6 of the 10 wetlands within the Redmond portion of the study area. The Project includes a mix of permanent and temporary wetland impacts, as well as permanent and temporary impacts to wetland buffer. Unavoidable impacts are further detailed in Section 3 of this plan.

Table 2-1 summarizes the 6 impacted wetlands located within the Redmond portion of the study area. Tables 2-2 through 2-7 provide additional details, including wetland classification and functional rating.

Table 2-1. Wetlands Included in the Mitigation Bank Use Plan

Wetland Name	Wetland Size (acres)	Cowardin Class[a]	Hydrogeomorphic Class[b]	Ecology Wetland Category[c]
WKC-3 (Redmond portion of study area)	0.23	PFO, PSS, PEM	Depressional	III
WRE-2	0.07	PSS	Slope	IV
WRE-4	0.08	PEM	Depressional	III
WRE-5	>10	PFO, PSS, PEM	Riverine	I
WRE-6	0.43	PFO, PSS	Riverine	I
WRE-8	1.01	PFO, PSS, PEM	Depressional	II

Ecology = Washington State Department of Ecology

PEM = palustrine emergent

PSS = palustrine scrub-shrub

PFO = palustrine forested

[a] Classification of Wetlands and Deepwater Habitats of the United States (FGDC 2013).

[b] A Hydrogeomorphic Classification for Wetlands (Brinson 1993).

[c] Washington State Wetland Rating System for Western Washington (Hruby 2014*)*.

Table 2-2. Wetland WKC-3 Information Summary

Wetland WKC-3		
Local Jurisdiction:	Redmond (0.23 acre) King County (4.82 acres)	
Ecology Rating (Hruby 2014):	III	
Wetland Size (acres):	5.05 in total	
Cowardin Classification:	PFO, PSS, PEM	
Hydrogeomorphic Classification:	Depressional	

Function	Improving Water Quality	Hydrologic	Habitat
Site Potential	M	M	M
Landscape Potential	M	H	L
Value	H	L	H
Score based on ratings	7	6	6
Total	19		

Function	Functional Assessment
Water Quality	Water quality functions for Wetland WKC-3 scored 7 points (moderately high). Discharges of untreated stormwater to the site and proximity of urban development increase the potential for water quality improvement for Wetland WKC-3. Seasonal ponding within a quarter of the wetland allows sediments to settle out from the water column. Persistent ungrazed vegetation comprises over 95 percent of the site and improves water quality through sediment trapping.
Hydrology	The hydrologic functions score for the site is a moderate 6 points. The constrained outlet and ponding potential allow for greater surface water storage. Marks of ponding at the site measured between 0.5 and 2 feet. Because Wetland WKC-3 has a constrained outlet, surface water is detained, thereby reducing downstream flooding. However, downstream flooding is not a significant issue; therefore, the wetland has limited opportunity to provide this function.
Habitat	The habitat score for the site is 6 points (moderate). Multiple vegetation classes with high species diversity form a high interspersion of habitats at the site. Special habitat features include large woody debris, snags, and thin persistent vegetation. Buffers and wildlife corridors for Wetland WKC-3 are limited by roads and recreational development.

Table 2-3. Wetland WRE-2 Information Summary

Wetland WRE-2				
Local Jurisdiction:	Redmond			
Ecology Rating (Hruby 2014):	IV			
Wetland Size (acre):	0.07			
Cowardin Classification:	PSS			
Hydrogeomorphic Classification:	Slope			
Function	**Improving Water Quality**	**Hydrologic**	**Habitat**	
Site Potential	L	L	L	
Landscape Potential	M	M	L	
Value	H	L	L	
Score based on ratings	6	4	3	
Total	13			
Function	**Functional Assessment**			
Water Quality	Wetland WRE-2 scored 6 points (moderate) for water quality functions. This seep wetland is located near the base of a gradual slope and is adjacent to SR 520. The site intercepts surface water runoff and discharges directly into a 303(d) list water body (the Sammamish River), thus offering potential water quality improvements downstream.			
Hydrology	Wetland WRE-2 has a moderately low hydrologic function score of 4 points. The site contains some rigid vegetation to slow surface flow velocity, and downstream areas are not recognized as having flood problems.			
Habitat	For habitat function, Wetland WRE-2 scored a low 3 points. The site consists of only a single scrub-shrub vegetation class and saturation water regime, with no special habitat features. Habitat connectivity is limited by adjacent residential housing and SR 520.			

Table 2-4. Wetland WRE-4 Information Summary

Wetland WRE-4		
Local Jurisdiction:	Redmond	
Ecology Rating (Hruby 2014):	III	
Wetland Size (acre):	0.08	
Cowardin Classification:	PEM	
Hydrogeomorphic Classification:	Depressional	

Function	Improving Water Quality	Hydrologic	Habitat
Site Potential	M	L	L
Landscape Potential	M	H	L
Value	H	L	M
Score based on ratings	7	5	4
Total	16		

Function	Functional Assessment
Water Quality	Wetland WRE-4 scored 7 points (moderately high) for water quality functions. A constricted outlet contributes to seasonal ponding of a quarter of the total wetland area, slowing the water and allowing for treatment time. Major roads surround Wetland WRE-4 on all sides and discharge surface water runoff into the wetland, thus providing opportunities for treatment.
Hydrology	Hydrologic functions of Wetland WRE-4 scored 5 points (moderate). The site has high potential for surface water runoff catchment and retention; however, marks of ponding were observed at less than 0.5 feet even though the wetland could store 1 to 2 feet of water.
Habitat	Only an emergent vegetation class with less than five species is present at the site. Low plant diversity, lack of habitat features, and lack of connectivity contribute to a moderately low habitat score of 4 for Wetland WRE-4.

Table 2-5. Wetland WRE-5 Information Summary

Wetland WRE-5				
Local Jurisdiction:	Redmond			
Ecology Rating (Hruby 2014):	I			
Wetland Size (acres):	>10			
Cowardin Classification:	PFO, PSS, PEM			
Hydrogeomorphic Classification:	Riverine			
Function	**Improving Water Quality**	**Hydrologic**	**Habitat**	
Site Potential	H	M	H	
Landscape Potential	H	H	L	
Value	H	H	H	
Score based on ratings	9	8	7	
Total	24			
Function	**Functional Assessment**			
Water Quality	With a score of 9 points, Wetland WRE-5 has very high water quality functional abilities. The proximity of the wetland to urban development increases the site's landscape potential for water quality improvements. At a site level, Wetland WRE-5 has depressions and vegetation covering most of the area to slow and retain surface water, thus allowing pollutants to settle out. The wetland is contiguous to Bear Creek, which is on Ecology's 303(d) list. A Total Maximum Daily Load (TMDL) plan for the Bear-Evans watershed has been established to address warm temperatures, low dissolved oxygen, and high bacteria levels.			
Hydrology	Wetland WRE-5 scored 8 points (high) for hydrologic functions. The floodplain width and the large number of trees and shrubs in the area contribute to slowing the velocity of floodwaters. Wetland WRE-5 has been identified as an important flood storage area in the City of Redmond's Final Comprehensive Flood Hazard Management Plan.			
Habitat	Habitat functions of the site scored 7 points (moderately high). Interspersion of habitats is high, with four vegetation classes (including a diversely stratified forested class) and open water. Various habitat features are present such as large downed logs, snags, undercut banks, stable steep slopes for denning, and thin-stemmed persistent plants for amphibian egg-laying. Bear Creek provides habitat for multiple salmon species, including federally listed Chinook salmon. Wetland WRE-5 helps support these fish populations by providing refuge and rearing areas and is mapped as a Priority Habitat by Washington Department of Fish and Wildlife (WDFW).			

Table 2-6. Wetland WRE-6 Information Summary

Wetland WRE-6				
Local Jurisdiction:	Redmond			
Ecology Rating (Hruby 2014):	I			
Wetland Size (acres):	0.43			
Cowardin Classification:	PFO, PSS			
Hydrogeomorphic Classification:	Riverine			
Function	**Improving Water Quality**	**Hydrologic**	**Habitat**	
Site Potential	H	M	H	
Landscape Potential	H	H	L	
Value	H	H	H	
Score based on ratings	9	8	7	
Total	24			
Function	**Functional Assessment**			
Water Quality	Water quality functions of the site scored a high 9 points. Surface depressions cover approximately half of the area, and trees and shrubs cover much of the wetland. Bear Creek flows through Wetland WRE-6 and is on Ecology's 303(d) list. The wetland is contiguous to Bear Creek, which is on Ecology's 303(d) list. A TMDL plan for the Bear-Evans watershed has been established to address warm temperatures, low dissolved oxygen, and high bacteria levels.			
Hydrology	Wetland WRE-6 scored a high 8 points for hydrologic functions. Its urban location increases the landscape potential for flood control. At a site level, Wetland WRE-6 has a high proportion of trees and shrubs to slow flood velocities but a low stream-to-wetland ratio for overbank storage potential. Wetland WRE-6 has been identified as an important flood storage area in the City of Redmond's Final Comprehensive Flood Hazard Management Plan.			
Habitat	The habitat function score for Wetland WRE-6 is 7 points (moderately high). Wetland WRE-6 has a high interspersion of habitats, with two vegetation classes and three water regimes and many habitat features present. Wetland WRE-6 is recognized by WDFW as a priority habitat for multiple salmon species.			

Table 2-7. Wetland WRE-8 Information Summary

Wetland WRE-8		
Local Jurisdiction:	Redmond	
Ecology Rating (Hruby 2014):	II	
Wetland Size (acres):	1.01	
Cowardin Classification:	PFO, PSS, PEM	
Hydrogeomorphic Classification:	Depressional	

Function	Improving Water Quality	Hydrologic	Habitat
Site Potential	M	M	M
Landscape Potential	M	H	L
Value	H	H	H
Score based on ratings	7	8	6
Total	21		

Function	Functional Assessment
Water Quality	Wetland WRE-8 has a moderately high water quality functional score of 7 points. The site receives stormwater discharges from paved trails and roads nearby. A highly constricted outlet contributes to ponding of more than a quarter of the site.
Hydrology	Persistent ungrazed vegetation assists in sediment trapping and comprises over 95 percent of Wetland WRE-8. High ponding marks of 0.5 to 2 feet and potential to reduce flooding downstream contribute to the high hydrologic functions score of 8 for the site.
Habitat	The total habitat score for Wetland WRE-8 is a moderate 6 points. Wetland WRE-8 has high habitat interspersion of four vegetation classes (including a diversely stratified forested community). Habitat features present within the wetland include large woody debris and thin-stemmed persistent plants for amphibian breeding, as well as nearby WDFW priority habitats.

3. WETLAND IMPACTS

3.1 Avoidance and Minimization of Impacts to Wetland Resources

The East Link Project EIS evaluated a wide range of alternatives to meet the Project's purpose and need. The Sound Transit Board of Directors selected a project based on a variety of factors and extensive input from stakeholders, including local jurisdictions. To avoid and minimize impacts to critical areas, the project alignment is generally within the SR 520 right-of-way, where critical areas may have previously been disturbed by construction and routinely maintained. The Project has applied mitigation sequencing to avoid and minimize impacts to wetlands.

The Project will avoid impacts to aquatic resources wherever practicable. Through design refinements, there will be no impacts to 4 of the 10 wetlands delineated within the Redmond portion of the study area. Where unavoidable, the Project will minimize impacts to aquatic resources throughout the final design process. The footprint of the track prism will be minimized through Wetland WKC-3 by using retained fill construction methods. Impacts to wetlands associated with Bear Creek (Wetlands WRE-5 and WRE-6) will be reduced by requiring retaining walls to limit the footprint of adjacent roadway and facility construction and by extending bridges to fully span the stream's active channels. Construction of these retaining walls will reduce the impact area of Wetlands WRE-5 and WRE-6 by approximately 0.03 acre, in total.

Temporary impacts to wetlands will be minimized by refining construction plans to reduce the footprint needed for staging areas and access routes. All temporary impacts to wetlands will be rectified as part of the Project. Where temporary wetland excavation occurs, the contractor will test soil texture and replace it with similar soils if soils cannot be stockpiled and used for site restoration. Additional details on proposed wetland impact avoidance and minimization measures are presented in the City of Redmond Critical Areas Report (Parametrix 2019).

3.2 Summary of Unavoidable Wetland Impacts

The Project will result in a range of impact types to wetlands. Some wetland areas will be permanently affected, either through the placement of fill material or the installation of structures that preclude the regrowth of wetland vegetation (due to shading or physical obstruction). Other wetland areas will have a permanent change in the vegetation type due to height restrictions near guideways and electrical systems. Some wetland areas will be temporarily impacted to varying degrees. The wetland and buffer impacts are summarized in Table 3-1.

Table 3-1. Summary of Wetland Impacts

Wetland	Permanent Wetland Impacts (acres)	Long-Term Temporary Wetland Impacts (acres)	Short-Term Temporary Wetland Impacts (acres)	Wetland Vegetation Conversion (acres)	Permanent Wetland Buffer Impacts (acres)
WKC-3 (Redmond portion of study area)	0.231	0	0	0	0.061
WRE-2	0.074	0	0	0	0
WRE-4	0	0.078	0	0	0.029
WRE-5	0.075	1.178	0	0.023	0.259
WRE-6	0.052	0.186	0	0	0.206
WRE-8	0.506	0	0	0	0.269
Grand Total	0.938	1.442	0	0.023	0.824

3.2.1 Permanent

Permanent wetland impacts will occur where the Project will permanently fill or otherwise result in a complete loss of wetland function. Table 3-2 presents a summary of permanent impacts (within the Redmond portion of the study area) that will result from the Project. These impacts will be mitigated through a Keller Farm Mitigation Bank credit purchase.

Table 3-2. Permanent Wetland Fill/grade Impacts

Wetland ID	Wetland Size (acres)	Affected Cowardin Class[a]	Impact Size (acres)	Source of Impact
WKC-3 (Redmond portion of study area)	0.231	PEM, PSS	0.231[b]	Placement of fill within the retaining walls for the guideway and an approximately 10-foot-wide area on the south side of the guideway to facilitate future maintenance access.
WRE-2	0.074	PSS	0.074	Placement of fill for the guideway.
WRE-5	>10	PFO, PSS	0.075	Excavation of soils to remove the existing railroad crossing and restore and enhance the stream channel and floodplain area, including associated riparian wetlands. Placement of fill for columns and shafts associated with the Bear Creek crossing structure and East Lake Sammamish Trail pedestrian bridge. There will be fill for the trail prism, and access areas under the elevated guideway.
WRE-6	0.430	PFO, PSS	0.052	Excavation of soils to remove the existing railroad crossing and restore and enhance the stream channel and floodplain area, including associated riparian wetlands. Placement of fill for columns and shafts associated with the Bear Creek crossing structure and East Lake Sammamish Trail pedestrian bridge. There will be fill for the trail prism, and access areas under the elevated guideway.
WRE-8	1.010	PFO, PSS	0.506	Placement of fill within the wetland to provide construction staging and access to construct the elevated guideway, column, shaft for the elevated guideway, and trail realignment for the connector trail.

PEM = palustrine emergent

PSS = palustrine scrub-shrub

PFO = palustrine forested

[a] Classification of Wetlands and Deepwater Habitats of the United States (FGDC 2013).

[b] Impacts occurring to the portion of Wetland WKC-3 located within unincorporated King County will be mitigated through a permittee-responsible project in Marymoor Park.

3.2.2 Long-Term Temporary

Long-term temporary impacts will occur where construction will disturb non-woody vegetation for more than 1 year, or where woody vegetation is temporarily impacted for any time period. Table 3-3 presents a summary of these temporary impacts. Following completion of the work that created the temporary impacts, the affected areas will be restored. All temporary fill will be removed, the existing subgrade prepared, and existing surface and groundwater flow restored by recontouring the work area. The RZC does not require additional mitigation to compensate for temporal impacts to wetland functions resulting from temporary impacts. However, per Corps and Ecology requirements, long-term temporary impacts will be mitigated through a Keller Farm Mitigation Bank credit purchase.

Table 3-3. Long-Term Temporary Wetland Impacts

Wetland ID	Wetland Size (acres)	Affected Cowardin Class[a]	Impact Size (acres)	Source of Impact
WRE-4	0.078	PEM	0.078	Placement of temporary fill to provide staging areas and construction access for the Sammamish River crossing structure.
WRE-5	>10	PFO, PSS	1.178	Placement of temporary fill within the wetland to provide construction staging and access to construct the Bear Creek crossing structure, trail prism, and SR 520 ramp revisions.
WRE-6	0.430	PFO, PSS	0.186	Placement of temporary fill within the wetland to provide construction staging and access to construct the elevated track, column and shaft construction for the elevated track, and trail realignment for the connector trail.

PEM = palustrine emergent
PSS = palustrine scrub-shrub
PFO = palustrine forested
[a] Classification of Wetlands and Deepwater Habitats of the United States (FGDC 2013).

3.2.3 Short-Term Temporary

Short-term temporary impacts will occur where construction will disturb existing non-woody vegetation for a duration of less than 1 year. There are no short-term temporary wetland impacts that will occur within Redmond city limits.

3.2.4 Permanent Vegetation Conversion

Permanent vegetation conversion impacts will occur where wetland forest habitat is permanently converted to scrub-shrub or emergent habitat, but the total wetland area will not decrease, there is no permanent fill, and permanent hydrological impacts are avoided. Table 3-4 presents a summary of permanent vegetation conversion impacts resulting from the Project. The RZC does not require additional mitigation to compensate for impacts to wetland functions resulting from permanent vegetation conversion impacts. However, per Corps and Ecology requirements, permanent vegetation conversion impacts will be mitigated through a Keller Farm Mitigation Bank credit purchase.

Table 3-4. Permanent Wetland Vegetation Conversion Impacts

Wetland ID	Wetland Size (acres)	Affected Cowardin Class[a]	Impact Size (acres)	Source of Impact
WRE-5	>10	PFO, PSS	0.023	Conversion of forest habitat to scrub-shrub or emergent habitat, due to installation of the Bear Creek crossing structure.

PSS = palustrine scrub-shrub
PFO = palustrine forested
[a] Classification of Wetlands and Deepwater Habitats of the United States (FGDC 2013).

3.2.5 Permanent Wetland Buffer

Permanent wetland buffer impacts will occur where the Project will permanently fill or clear wetland buffer areas. Table 3-5 presents a summary of permanent wetland buffer impacts resulting from the Project. These impacts will be mitigated through a Keller Farm Mitigation Bank credit purchase. Mitigation for permanent wetland buffer impacts is required by the City of Redmond (RZC 12.63.010), but is not required by Ecology or the Corps.

Table 3-5. Permanent Wetland Buffer Impacts

Wetland ID	Wetland Category [a]	Wetland Buffer Width (feet) [b]	Impact Size (acres)	Source of Impact
WKC-3 (Redmond portion of study area)	III	125	0.061	Placement of fill within the wetland buffer for guideway alignment.
WRE-4	III	80	0.029	Placement of fill within the wetland buffer for guideway alignment.
WRE-5	I	150	0.259	Placement of fill within wetland buffer for pedestrian bridge.
WRE-6	I	150	0.206	Placement of fill within wetland buffer for pedestrian bridge.
WRE-8	II	150	0.269	Placement of fill within wetland buffer for guideway columns.

[a] Washington State Wetland Rating System for Western Washington (Hruby 2014).
[b] Wetland buffers widths assigned according to RZC 21.64.030.B.

3.3 Affected Wetland Functions

Project impacts will result in alterations to the functions provided by these wetlands. These functional changes are described, by wetland, in the paragraphs below.

3.3.1 Wetland WKC-3

The portion of Wetland WKC-3 within the Redmond city limits is located in the SR 520 right-of-way and provides lower levels of water quality, hydrologic, and habitat functions, as compared to the portion of the wetland to the south, in Marymoor Park (King County). The portion of Wetland WKC-3 within the Redmond study area is composed of Himalayan blackberry and some common roadside grasses; therefore, its wildlife habitat is very limited and of lower quality. Functional loss will occur where the wetland is filled and vegetation converted, thus modifying some of the attributes (water storage volume, area and vegetation for water quality treatment, habitat area, and features).

3.3.2 Wetland WRE-2

Wetland WRE-2 is located at the toe of a steep slope east of SR 520, north of NE 60th Street. The entire 0.074-acre area of Wetland WRE-2 will be permanently filled, thus eliminating the moderate level of water quality functions as well as the low levels of hydrology and habitat functions the wetland provides.

3.3.3 Wetland WRE-4

Wetland WRE-4 is in a linear depression positioned in the SR 520 interchange with West Lake Sammamish Parkway NE. The entire 0.078-acre area of Wetland WRE-4 will be filled for up to 2 years for construction access. This will eliminate the moderate water quality and hydrologic functions and low level of habitat functions provided by the wetland. Wetland functions will be restored after construction. A drainage pipe will be installed within the fill to maintain conveyance during construction.

3.3.4 Wetland WRE-5

Wetland WRE-5 is a Bear Creek riparian wetland located south of the abandoned railway corridor. The wetland will have a small area of permanent fill compared to its overall size (less than 0.1 acre of impact to wetland over 10 acres in size), as well as areas of long-term (1.178 acres) impacts. Temporary impacts will occur through placement of temporary fill to provide staging and access to construct the Bear Creek crossing structure, trail prism, SR 520 ramp revisions. Bear Creek restoration activities will also result in temporary impacts.

Given the relatively small area of permanent fill, the Project will minimally reduce the functions provided by this wetland when project work is completed. The functions provided by this wetland will be temporarily reduced during construction due to the removal of vegetation and alterations to ground elevations. Wetland WRE-5 provides very high water quality and hydrologic functions and moderate habitat functions. Although the wetland will be permanently and temporarily altered, this area will be part of a larger restoration effort of the Bear Creek riparian corridor following construction. The restoration plan will attempt to maintain or improve these functions compared to the current conditions by adding and enhancing features (e.g., side channels and flood bench wetlands). Temporary impacts will minimally reduce wetland functions until they are restored after construction is complete.

3.3.5 Wetland WRE-6

Wetland WRE-6 is a Bear Creek riparian wetland located north of the abandoned railway corridor. The wetland will have approximately 10 percent of its area (0.052 acre) permanently affected by the Project. Long-term temporary impacts (0.186 acre) will also occur. Temporary impacts will occur through construction staging and access to construct the elevated track, column and shaft construction for the elevated track, and trail realignment for the connector trail. Bear Creek restoration activities will also result in temporary impacts.

As a result of permanent impacts, the Project will reduce the functions provided by this wetland when completed. A temporary reduction in wetland functions during construction will occur due to the removal of vegetation and alterations to ground elevations. Wetland WRE-6 currently provides very high water quality and hydrologic functions and moderate habitat functions, although these functions are limited (as compared to Wetland WRE-5) due to the relatively small size (0.43 acre) of the wetland. Although Wetland WRE-6 will be permanently and temporarily altered, this area will be part of a larger restoration effort of the Bear Creek riparian corridor following construction. The restoration plan will attempt to maintain or improve these functions compared to the current conditions by adding and enhancing features (e.g., side channels and flood bench wetlands). Temporary impacts will minimally reduce wetland functions until they are restored after construction is complete.

3.3.6 Wetland WRE-8

Wetland WRE-8 is a forested wetland located on either side of the Redmond Connector Trail. The area to the south of the trail will have approximately half of its area (0.506 acre) permanently affected by the Project as a result of relocating the existing trail and installing guideway piers in the wetland, which will mainly eliminate areas of remnant wetland that are cut off from the larger wetland and create more remnant areas. The low clearance of the guideway (between 13 feet and 22 feet) in this area will preclude the re-establishment of forested and full-height scrub-shrub wetland vegetation. In addition, there will be fill material placed in the wetland to realign the Redmond Central Connector trail and to accommodate stormwater facilities. Moderate water quality functions will be reduced due to the loss of wetland vegetation, although some function will remain because half of the vegetation will be retained. The wetland's moderate habitat functions will be reduced due to vegetation loss. Due to the permanent vegetation conversion and overall reduction of function to the southern portion of Wetland WRE-8, this section is considered a total take.

4. WETLAND MITIGATION BANK USE

4.1 Site Selection Rationale

The City of Redmond requires all wetlands affected within Redmond city limits to be mitigated for within the city limits (RZC 21.64.010[L][2][i]). There is inadequate space in the immediate project vicinity to provide the required wetland mitigation and protective buffers. Furthermore, the 2008 Compensatory Mitigation for Losses of Aquatic Resources, Final Rule (Corps 2008) places using a mitigation bank at the top of the preference hierarchy for compensatory mitigation options in part because large consolidated mitigation projects with regulatory oversight reduce the potential risk of further temporal loss and restoration failures that is sometimes associated with permittee-responsible mitigation. Additionally, large consolidated mitigation projects such as mitigation banks are situated in high priority restoration areas within a watershed and can often provide greater ecological uplift to wetland resources as well as greater habitat connectivity for wetland- and aquatic-dependent plants and animals. Therefore, Sound Transit proposes to purchase credits from the Keller Farm Mitigation Bank for compensatory mitigation for wetland impacts within Redmond city limits associated with the Project. The project corridor is within the service area of the Keller Farm Mitigation Bank and approximately 0.5 mile from of the proposed bank site location (Habitat Bank, LLC 2015).

The Keller Farm Mitigation Bank is 75.2 acres in size and is located near the intersection of Avondale Road and NE Union Hill Road. The Keller Farm was claimed by Morris Keller in 1889 and used as a homestead and dairy farm until the 1980s. Prior to settlement, the site consisted of wetlands and other aquatic areas mixed with riparian uplands and hydrologically connected to Bear, Evans, and Perrigo creeks. The land was used primarily for row crops until the Keller Farm property was sold to the City of Redmond in 2015 for preservation of the site and development of a mitigation bank project. Bear Creek flows through the property and was historically rerouted and used for log transportation. Perrigo Creek also flows through the property and was rerouted to directly parallel Avondale Road. Perrigo Creek currently drains into Bear Creek in the western corner of the site. The floodplain of these creeks was ditched and tiled for farm use. The confluence of Evans Creek with Bear Creek is adjacent to the property and just upstream from the southeast corner.

The City of Redmond's Watershed Management Plan designated Bear Creek as a "Highest Restoration Watershed" (Herrera 2013). The Watershed Management Plan focuses on landscape and ecological principles and outlines the City of Redmond's commitment to rehabilitating natural resources within the next 50 to 100 years. High Restoration Watersheds such as Bear Creek are anticipated to be fully rehabilitated by 2060. The Keller Farm site has been identified in numerous watershed planning documents throughout the last 3 decades as having the potential for significant ecological lift and rehabilitation within the Bear Creek Basin that could benefit the entire watershed. Currently the site is extensively ditched and soils have been tilled over the past century. Invasive species such as reed canarygrass, Japanese knotweed, and Himalayan blackberry overrun the site, and there is very little native tree or shrub cover present.

The Keller Farm Mitigation Bank design goals were developed as part of the Project Prospectus (Habitat Bank, LLC 2015) and Basis of Design Report (Shannon and Wilson Inc. 2018). The design goals are consistent with Ecology, Corps, and U.S. Environmental Protection Agency guidelines for establishing mitigation bank goals and criteria, as well as with Bear Creek Basin restoration planning efforts and WRIA 8 restoration goals as established by the WRIA 8 Salmon Recovery Council. Wetland and habitat restoration goals on this mitigation bank site were developed to address the limiting factors in the watershed related to the loss of wetland hydrology, the loss of habitat and vegetation communities, and

the manipulation of topography affecting wetlands, floodplain, and stream habitat conditions as well as anadromous fish species, including threatened Chinook salmon. The site-specific goals and objectives include the following:

- Permanently protect ecosystem functions at the mitigation bank by implementing the Instrument and executing a conservation easement with permanent funding for site stewardship.
- Re-establish wetland hydrology and varying wetland hydroperiods across the site by disabling farm ditches and drainage tiles and targeted grading.
- Create additional habitat area that supports wetland-dependent organisms.
- Increase habitat structure and diversity on the mitigation bank site over existing conditions.
- Re-establish wetland vegetation and wetland habitat communities across the site.
- Remove and control invasive plant species and reintroduce native vegetation.
- Plant native trees, shrubs, and herbaceous species to re-establish a mosaic of habitat communities and increase habitat structure, complexity, and function.
- Improve access for aquatic organisms to floodplain wetland and aquatic areas.
- Enhance and create off-channel rearing and refuge habitat for salmonids within the floodplain streams and deeper backwater areas connected to Bear Creek.
- Reconnect Bear Creek to the floodplain and improve floodplain functions on the mitigation bank site, including attenuation of flood flows, reductions in peak flood flows, food web and organic material support and transport, and refuge habitat for fish and wildlife during flood events.
- Establish a connection point for the future relocation of Perrigo Creek through the adjacent parcel north of the mitigation bank site.
- Re-establish and rehabilitate stream channel habitat in the floodplain through grading and addition of large woody debris.
- Create pool habitat and increase channel habitat complexity.
- Increase shading and cover of streams on the mitigation bank site over existing conditions.

4.1.1 Wetland Functions Provided at Wetland Mitigation Bank

The following wetland functions are described based on background information presented in the Habitat Bank, LLC, 2015 Keller Farm Mitigation Bank Project Prospectus:

Water Quality

Bear Creek and Evans Creek are currently listed on Ecology's 303(d)list for failure to meet bioassessment state standards. Both streams are also currently listed as Category 4A waters for failure to meet dissolved oxygen, temperature, and bacteria standards (Ecology 2018). In June 2008, Ecology began a TMDL for the Bear-Evans watershed to address these dissolved oxygen, temperature, and bacteria issues. During the 2008 Water Quality Assessment, Ecology revised the impaired listings from Category 5 to Category 4a (Ecology 2011). Removing ditches and reconnecting groundwater to Bear Creek will increase dissolved oxygen and base flows to the creek. Increased riparian vegetation will also help cool the stream and potentially reduce bacteria growth.

The tilled topsoil layer of the site will be ripped out at around a depth of 14 inches to break up the plow layer. Final grading will add microdepressions to create a wetland mosaic. This also allows surface water to pool in depressions and settle out sediments and heavy metals while recharging groundwater.

Wetland re-establishment will extend all the way up to Avondale Road and intercept stormwater runoff from a major roadway, thus improving surface water quality within highly developed WRIA 8.

Hydrology

Restoring Bear Creek and Perrigo Creek with their historical floodplains and re-establishing 63 acres of wetland will greatly increase the surface water storage capacity of the site and upstream from the project corridor. Diverting water that would otherwise flow down Bear Creek will reduce downstream flooding after storm surges.

Habitat

The Keller Farm Mitigation Bank will re-establish and rehabilitate existing and former wetlands on site, as well as provide off-channel rearing and refuge habitat for resident and anadromous fish species. . In addition to the site being within a Highest Restoration Watershed in WRIA 8, it is designated as a Core Chinook area by the Chinook Salmon Conservation Plan (Salmon Recovery Council 2005). Bear Creek also provides habitat for cutthroat and resident trout and coho, sockeye, steelhead, and kokanee salmon. Improving fish habitat is one of the main focuses of the mitigation bank site. Planting the riparian corridor will provide vegetation overhang and cool the streams as well as provide a food source from falling insects. Large woody debris and off-channel habitat will provide stream complexity and rearing/refuge habitat for fish.

Removing the invasive Himalayan blackberry, Japanese knotweed, and giant hogweed and planting a variety of native vegetation will increase the species diversity and structural diversity of the site. A mosaic of different wetland hydroperiods and vegetation classes will greatly increase habitat potential and wildlife diversity. The large size of the site can support healthy wildlife populations and ecosystems with less edge habitat compared to smaller mitigation sites. The Keller Farm Mitigation Bank directly abuts a WSDOT mitigation site and Bear Creek Park, so therefore will provide habitat connectivity for wetland-dependent wildlife, including native amphibians, small mammals, song birds, birds of prey, and migratory waterfowl.

Summary of Restoration Actions at the Keller Farm Mitigation Bank

The proposed mitigation bank project restoration actions have the potential to greatly improve the existing conditions of wetlands, streams, and fish and wildlife habitat within the bank site. Restoration actions will rehabilitate 7.9 acres of existing wetland habitats while re-establishing approximately 51.1 acres of wetlands. The existing 7,114 linear feet (1.7 acres) of existing ditched tributary streams will be rehabilitated, and approximately 5,162 linear feet (2.6 acres) of stream channel will be added.

Enhanced connections with the Bear Creek floodplain will be established, thus increasing the range of flow conditions where Bear Creek flows will contribute to hydrologic support of floodplain wetlands and streams. These connections will also allow fish access to the re-established wetlands and stream channels in the floodplain. The City of Redmond hopes to implement the Bear Creek Habitat Restoration Plan in the channel and riparian buffer corridor of Bear Creek adjacent to the mitigation bank; this will provide further habitat for anadromous and resident fish in Bear Creek.

Post-construction, the mitigation bank site will consist of a mosaic of uplands, stream channel, and forested, scrub-shrub, and emergent wetlands and provide improved habitat for regionally important salmonid populations. Post-project conditions will provide numerous functional benefits over existing

conditions, including recharging the local groundwater aquifer, increasing floodplain wetland groundwater storage, providing cooling of groundwater through soil heat adsorption of surface waters, and delaying release of cooler groundwater to the floodplain streams later in the spring and summer when stream temperatures are highest. Plantings in the wetlands and adjacent to Bear Creek and the floodplain streams will also help to moderate summer stream water temperatures and improve habitat functions for wetland-dependent fish and wildlife.

4.1.2 Wetland Functions Not Provided at Wetland Mitigation Bank

Based upon an analysis of project-related wetland functions, impacts, and information provided by the mitigation bank proponent regarding wetland functions that will be provided at the bank (Habitat Bank, LLC 2015), Sound Transit has concluded that the Keller Farm Mitigation Bank site will adequately compensate for all wetland functions in equal or greater amounts.

4.2 Proposed Mitigation Credits

The Keller Farm Mitigation Bank proponent (Habitat Bank, LLC) provided Sound Transit with details on the upcoming Mitigation Bank Instrument (MBI) to be used for calculating bank credits. The upcoming MBI will provide the recommended credit amount according to impact area based on the functional category of the wetland, as presented in Table 4-1.

Table 4-1. Credits Recommended for Wetland Impacts

Impact Type	Credit Recommended per Impact Area
Permanent: Category I Wetland	1.5:1
Permanent: Category II Wetland	1.2:1
Permanent: Category III Wetland	1:1
Permanent: Category IV Wetland	0.85:1
Permanent: Wetland Buffer	0.3:1
Permanent: Vegetation Conversion	Calculated at one-quarter of the permanent impact ratio where mitigation is already proposed for temporary impacts. For standalone vegetation conversion impacts with no associated temporary impacts, mitigation is calculated at one-half of the permanent impact ratio.
Temporary: Long-Term	Calculated at one-quarter of the permanent impact ratio.

Sound Transit proposes to purchase a total of 1.512 bank credits from the Keller Farm Mitigation Bank to compensate for permanent and long-term temporary impacts to wetlands, permanent vegetation conversion impacts to wetlands, and permanent wetland buffer impacts within Redmond city limits. Table 4-2 provides the wetland category and impact area with the credit ratio and subsequent credit total.

Table 4-2. Proposed Mitigation Bank Credits at Keller Farm Mitigation Bank

Wetland Name	Impact Area	Wetland Category	Credit Ratio	Credit Total
		Permanent Wetland Impact		
WKC-3 (Redmond portion of study area)	0.231	III	1	0.231
WRE-2	0.074	IV	0.85	0.063
WRE-5	0.075	I	1.5	0.113
WRE-6	0.052	I	1.5	0.078
WRE-8	0.506	II	1.2	0.607
Total	**0.938**			**1.092**
		Long-Term Temporary Impacts		
WRE-4	0.078	III	0.25	0.020
WRE-5	0.317[a]	I	0.375	0.119
WRE-6	0.168	I	0.375	0.070
Total	**0.460**			**0.209**
		Permanent Vegetation Conversion Impacts		
WRE-5	0.023	I	0.375	0.009
Total	**0.023**			**0.009**
		Permanent Wetland Buffer Impact		
WKC-3 (Redmond portion)	0.061	III	0.3	0.018
WRE-4	0.029	III	0.3	0.009
WRE-5	0.259	I	0.3	0.078
WRE-6	0.206	I	0.3	0.062
WRE-8	0.269	II	0.3	0.081
Total	**0.824**			**0.248**
			GRAND TOTAL	**1.558**

[a] The total long-term temporary impact to WRE-5 is 1.178 acres. However, 0.861 acre of this total will result from mitigation actions; additional mitigation for temporal impacts to this area is not required.

4.2.1 Credit Purchase or Transfer Timing

Construction of the Project is scheduled to begin in 2020 and finish in 2023. Use of the Keller Farm Mitigation Bank for compensatory mitigation is contingent on the bank being certified before Project-related wetland impacts occur within Redmond city limits. The mitigation bank proponent and the City of Redmond have stated that the bank is expected to be certified in 2019. Proof of credit purchase will be provided to the Corps, Ecology, and the City of Redmond before any wetlands are affected by the Project. If bank certification does not occur by the start of project construction, Sound Transit will formulate an alternative mitigation strategy before any wetlands are impacted.

5. REFERENCES

Brinson, M. M.1993. A hydrogeomorphic classification for wetlands. East Carolina University. Greenville, North Carolina.

Environmental Laboratory. 1987. Corps of Engineers Wetland Delineation Manual.

Federal Geographic Data Committee FGDC (FGDC). 2013. Classification of Wetlands and Deepwater Habitats of the United States. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington, D.C.

Habitat Bank, LLC. 2015. Keller Farm Mitigation Bank Project Prospectus. Kirkland, Washington.

Herrera Environmental Consultants, Inc. (Herrera). 2013. City of Redmond Citywide Watershed Management Plan. Redmond, Washington. Prepared for City of Redmond Public Works, Natural Resources Division.

Hruby, T. 2004. Washington State Wetland Rating System for Western Washington. Washington State Department of Ecology Publication Number 04-06-025, published August 2004.

Hruby, T. 2014. Washington State Wetland Rating System for Western Washington. Washington State Department of Ecology Publication Number 04-06-029, published October 2014.

King County. 2000. Declaration of Covenant for Marymoor Park Property.

Parametrix. 2019. Downtown Redmond Link Extension: City of Redmond Critical Areas Report. Prepared for Central Puget Sound Regional Transit Authority (Sound Transit). Seattle, Washington.

Salmon Recovery Council Lake Washington/Cedar/Sammamish Watershed (Salmon Recovery Council). July 2005. Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan.

Shannon and Wilson, Inc. 2018. Basis of Design Report (Revised): Keller Farm Mitigation Bank. Seattle, WA

U.S. Army Corps of Engineers (Corps). 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region. U.S. Army Corps of Engineers Engineer Research and Development Center, Vicksburg, Mississippi.

U.S. Army Corps of Engineers (Corps). 2008. Compensatory Mitigation for Losses of Aquatic Resources, Final Rule. 33 C.F.R. Part 332.

Washington State Department of Ecology (Ecology). 2011. Bear-Evans Watershed Temperature, Dissolved Oxygen and Fecal Coliform Bacteria Total Maximum Daily Load; Water Quality Implementation Plan. Washington State Department of Ecology Publication No. 11-10-024. Bellevue, Washington.

Washington State Department of Ecology (Ecology). 2018. Washington State Water Quality Atlas. Available at https://fortress.wa.gov/ecy/waterqualityatlas/StartPage.aspx. Accessed August 2018.

Appendix N

Mitigation Planting List

Species	Common Name	Plant stock size	Spacing	Planting Location					
				Upland Buffer	***Upland Riparian***	***Riparian Wetland***	***Depressional Wetland***	***Upland Areas near tracks (height restriction)***	***Wetland Areas near Track (height restriction)***
Trees									
Abies grandis	Grand fir	1 gallon	12 ft on ctr	x	x				
Acer macrophyllum	Bigleaf maple	1 gallon	12 ft on ctr	x	x				
Alnus rubra	Red alder	1 gallon	12 ft on ctr	x	x	x	x		
Frangula purshiana	Cascara	1 gallon	12 ft on ctr	x	x			x	
Fraxinus latifolia	Oregon Ash	1 gallon	12 ft on ctr		x	x	x		
Picea sitchensis	Sitka spruce	1 gallon	12 ft on ctr	x	x				
Populus balsamifera	Cottonwood	1 gallon	12 ft on ctr	x	x	x	x		
Prunus emarginata	Bitter cherry	1 gallon	12 ft on ctr	x				x	
Pseudotsuga menziesii	Douglas-fir	1 gallon	12 ft on ctr	x					
Salix lucida ssp. Lasiandra	Pacific willow	Stake	12 ft on ctr		x	x	x		x
Thuja plicata	Western redcedar	1 gallon	12 ft on ctr	x	x				
Tsuga heterophylla	Western hemlock	1 gallon	12 ft on ctr	x	x				
Shrubs									
Acer circinatum	Vine maple	1 gallon	6 ft on ctr	x	x			x	
Amelanchier alnifolia	Service berry	1 gallon	6 ft on ctr	x	x			x	
Cornus sericea	Red-twig dogwood	Stake	6 ft on ctr		x	x	x		x
Corylus cornuta	beaked hazelnut	1 gallon	6 ft on ctr	x	x			x	
Crataegus douglasii	Black hawthorn	1 gallon	6 ft on ctr		x	x	x		x
Gaultheria shallon	Salal	1 gallon	6 ft on ctr	x				x	
Holodiscus discolor	Oceanspray	1 gallon	6 ft on ctr	x				x	
Lonicera involucrata	Twinberry	1 gallon	6 ft on ctr		x	x	x		x
Malus fusca	Pacific crabapple	1 gallon	6 ft on ctr		x	x			x
Oemleria cerasiformis	Oso berry	1 gallon	6 ft on ctr	x				x	
Philadelphus lewisii	Mock orange	1 gallon	6 ft on ctr	x				x	
Physocarpus capitatus	Ninebark	1 gallon	6 ft on ctr	x	x	x			x
Ribes sanguineum	Red currant	1 gallon	6 ft on ctr	x	x			x	
Rubus parviflora	Thimbleberry	1 gallon	6 ft on ctr	x	x	x		x	

Rubus spectabilis	Salmonberry	1 gallon	6 ft on ctr		x	x			x
Salix scouleriana	Scouler's willow	Stake	6 ft on ctr			x	x		x
Salix sitchensis	Sitka willow	Stake	6 ft on ctr			x	x		x
Sambucus racemosa	Red elderberry	1 gallon	6 ft on ctr	x	x			x	
Symphoricarpus albus	Snowberry	1 gallon	6 ft on ctr	x	x			x	
Grasses and Forbs									
Asarum caudatum	Wild ginger	4" pot or BR	3 ft on ctr	x					
Camassia quamash	Camas	bulb	patches w bulbs planted 6" on ctr				x	x	x
Carex obnupta	Slough sedge	plug	1 ft on ctr			x	x		
Carex obnupta	Slough sedge	seed	10lbs/acre			x	x		
Deschampia cespitosa	Tufted hairgrass	plug	1 ft on ctr			x	x		
Deschampia cespitosa	Tufted hairgrass	seed	8lbs/acre			x	x		
Elymus glaucus	Wild rye	plug	1 ft on ctr	x	x			x	
Elymus glaucus	Wild rye	seed	10lbs/acre	x	x			x	
Glyceria elata	Manna grass	plug	1 ft on ctr			x	x		x
Glyceria elata	Manna grass	seed	12lbs/acre			x	x		x
Juncus ensifolius	Dagger-leaf rush	seed	8lbs/acre			x	x		x
Lysichiton americanum	Skunk cabbage	4" pot or BR	3 ft on ctr			x	x		x
Mentha arvensis	Field mint	4" pot or BR	3 ft on ctr			x	x	x	x
Oenanthe sarmentosa	Wate parsley	4" pot or BR	3 ft on ctr			x	x		x
Polystichum munitum	Sword fern	4" pot or BR	3 ft on ctr	x				x	
Scirpus microcarpus	Small-fruited bulrush	plug	1 ft on ctr			x	x		x
Stachys chamissonis	Hedge nettle	4" pot or BR	3 ft on ctr	x				x	x
Symphotrichum subspicatum	Douglas aster	4" pot or BR	3 ft on ctr	x	x		x		
Tolmiea menziesii	Piggy-back plant	4" pot or BR	3 ft on ctr	x	x	x			x
Urtica diocia	Stinging nettle	4" pot or BR	3 ft on ctr	x	x	x	x	x	x

Appendix O

Bear Creek Conceptual Design Drawings

SOUNDTRANSIT
CENTRAL PUGET SOUND REGIONAL TRANSIT AUTHORITY

DOWNTOWN REDMOND LINK EXTENSION (DRLE)

RTS TO DOWNTOWN REDMOND

BEAR CREEK CROSSING AND RESTORATION

CONCEPTUAL DESIGN DRAWINGS
FEBRUARY 1, 2019

INDEX OF DRAWINGS

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PRELIMINARY
NOT FOR CONSTRUCTION

Xrefs:
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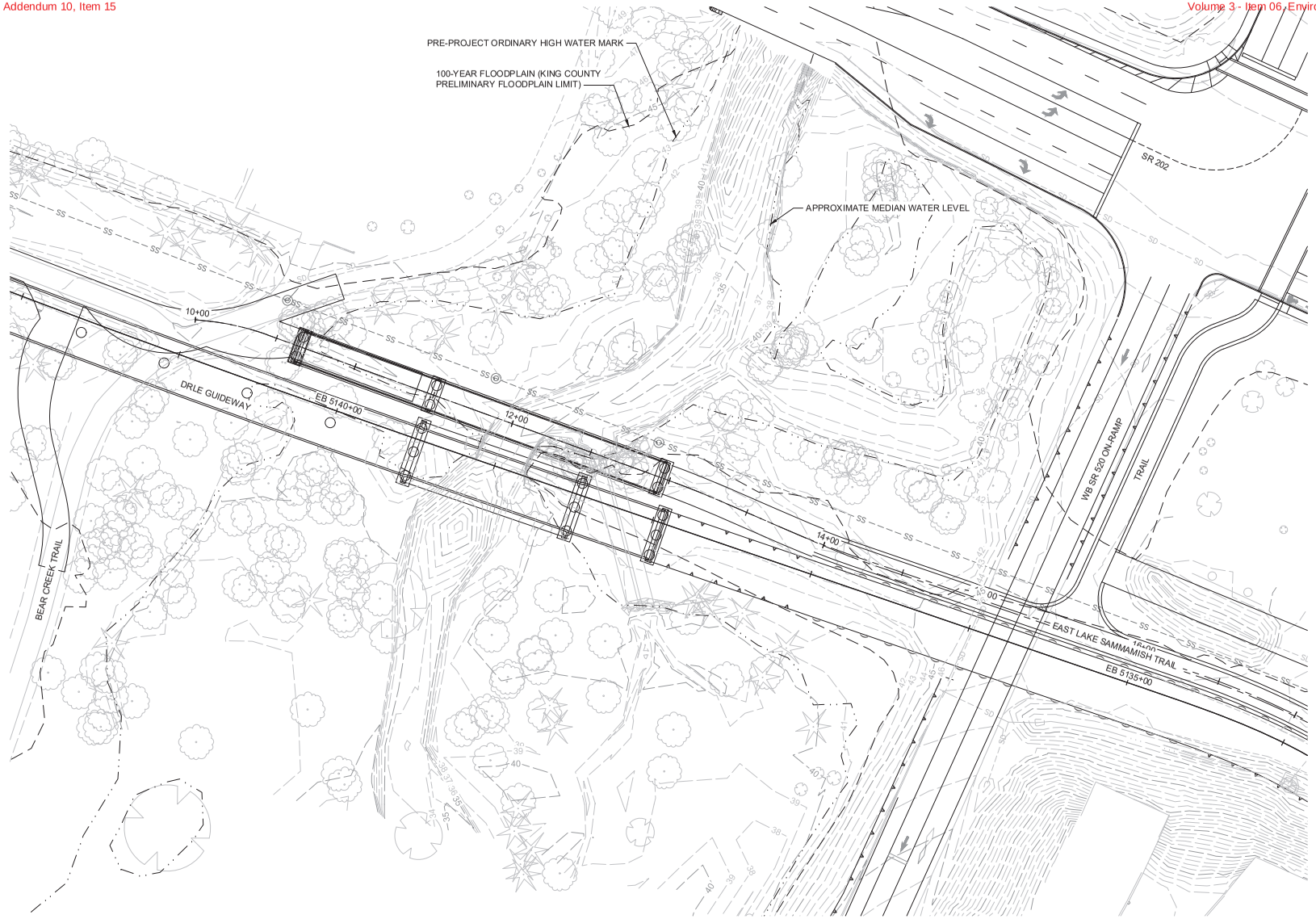

LEGEND

- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- ORDINARY HIGH WATER MARK
- 100-YEAR FLOODPLAIN LIMIT (KING COUNTY PRELIMINARY FLOODPLAIN)

N

30 15 0 30 60
SCALE IN FEET

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	PF	BP	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: P. FENDT
DRAWN BY: T. NABOURS
CHECKED BY: B. PHILLIPS
APPROVED BY: B. PHILLIPS

PAUL S. FENDT — STATE OF WASHINGTON — 37893 — REGISTERED PROFESSIONAL ENGINEER

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SUBMITTED BY: | DATE: | REVIEWED BY: | DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=30'
FILENAME: PLANS_BEARCREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
REFERENCE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
EXISTING SITE CONDITIONS

DRAWING No.: CDD100
LOCATION ID:
SHEET No.: 1
REV:

01/31/19 | 7:46 AM | TNLEFJ
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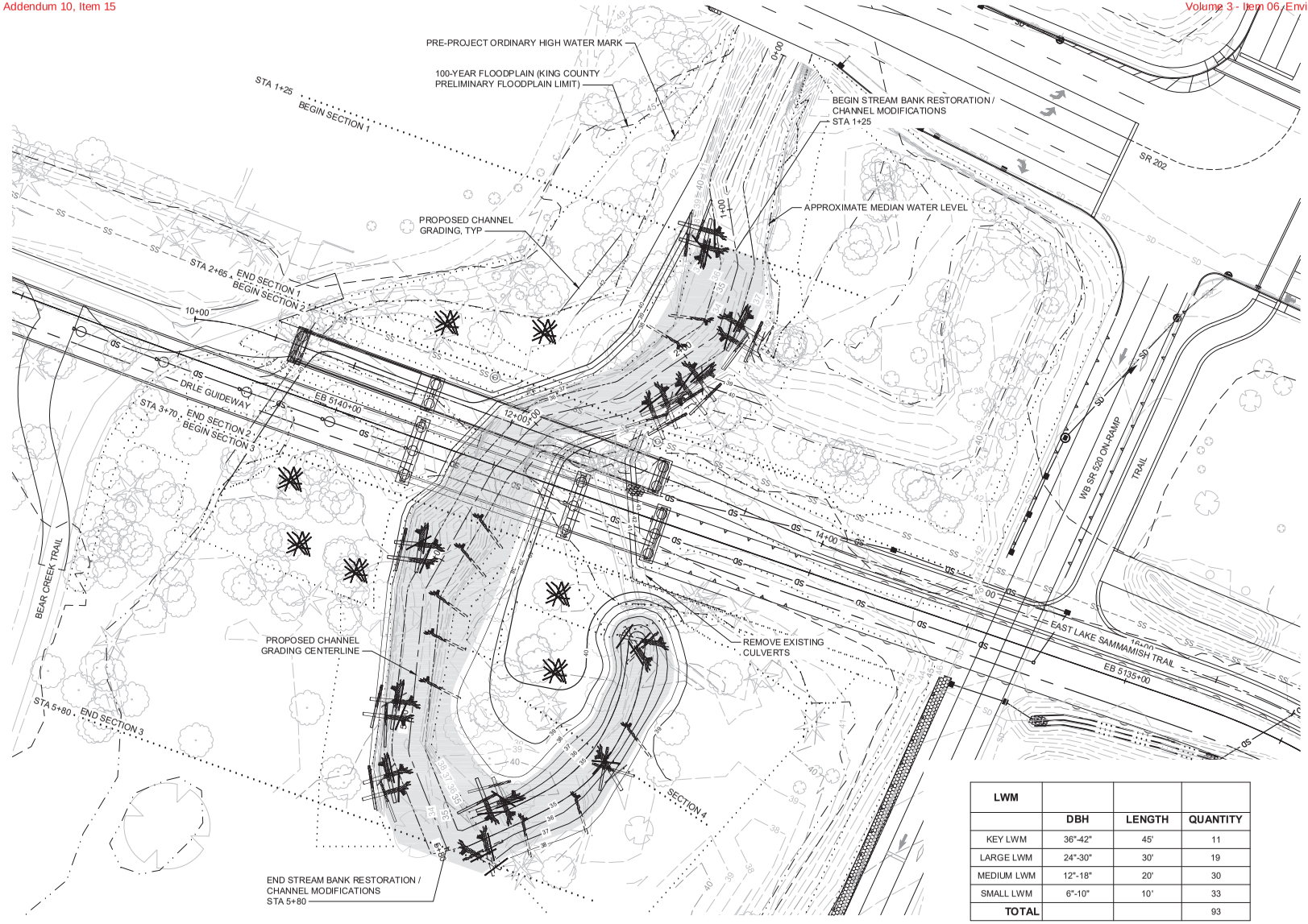

LEGEND

- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- TYPICAL SECTION BOUNDARY
- ORDINARY HIGH WATER MARK
- 100-YEAR FLOODPLAIN LIMIT (KING COUNTY PRELIMINARY FLOODPLAIN)
- MEDIAN WATER ELEVATION AREA

LARGE WOODY MATERIAL (LWM) NOTES:

LOG JAM A:

1 KEY WITH ROOT WAD
1 LARGE WITH ROOT WAD
1 MEDIUM
3 SMALL

LOG JAM B:

1 KEY WITH ROOT WAD
2 LARGE WITH ROOT WAD
2 MEDIUM
3 SMALL

LOG JAM C:

1 KEY WITH ROOT WAD
2 MEDIUM
3 SMALL

DEBRIS PILE:

VARIOUS LWM
15'L X 15'W X 3'H
MIN PILE

SINGLE PIECE WITH ROOT WAD:

1 MEDIUM

NOTES:

1. TOTAL WOOD SHALL NOT VARY FROM NUMBERS INDICATED.
2. LARGE WOODY MATERIAL SHALL BE PLACED TO EXTEND A MINIMUM OF 1/3 INTO THE ACTIVE CHANNEL BOTTOM.
3. REMOVE ALL ANGULAR ROCK, CONCRETE OR ASPHALT DEBRIS AND OTHER RUBBLE STA 1+25 TO STA 5+80.
4. ALL WORK SHALL COMPLY WITH CITY OF REDMOND STORMWATER TECHNICAL NOTEBOOK REQUIREMENTS.
5. SEE TYPICAL SECTIONS SHEETS FOR CROSS-SECTIONS 1 THROUGH 4.

LWM			
	DBH	LENGTH	QUANTITY
KEY LWM	36"-42"	45'	11
LARGE LWM	24"-30"	30'	19
MEDIUM LWM	12"-18"	20'	30
SMALL LWM	6"-10"	10'	33
TOTAL			93

N

30 15 0 30 60
SCALE IN FEET

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LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=30'
FILENAME: PLANS_BEARCREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
PRESCRIPTIVE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
SITE LAYOUT

DRAWING No.: CDD101
LOCATION ID:
SHEET No.: 2
REV:

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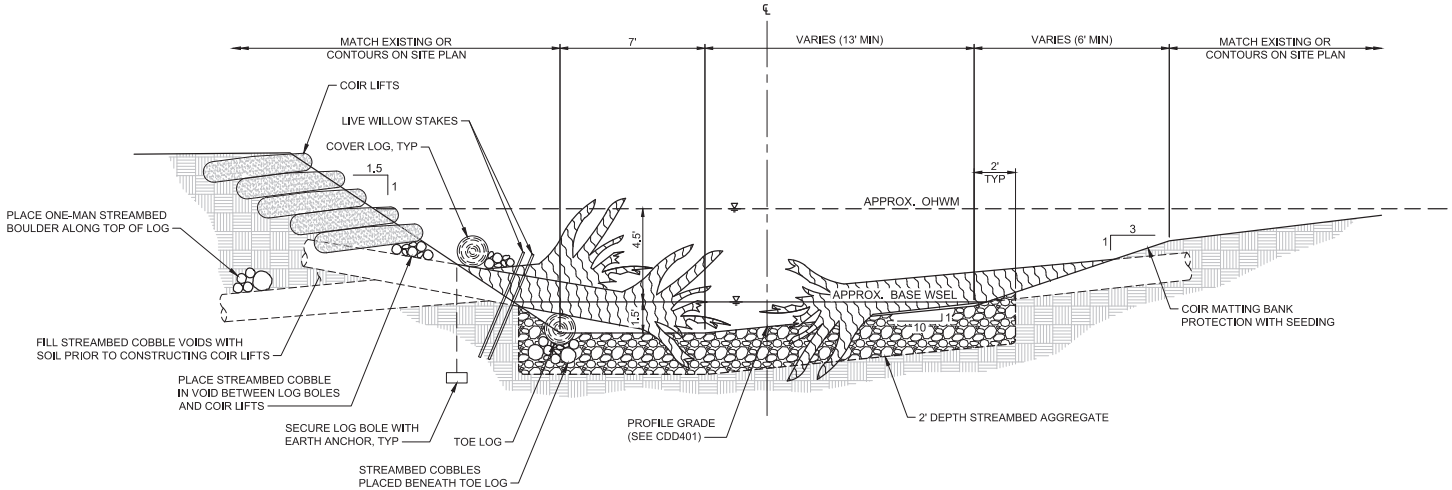
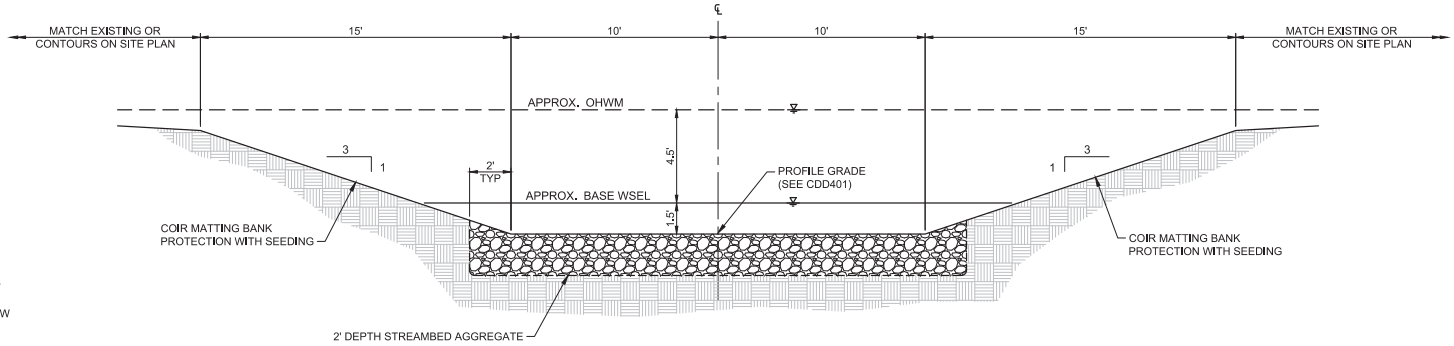


CHANNEL SECTION 1 CDD101
NOT TO SCALE



CHANNEL SECTION 2 CDD101
NOT TO SCALE

NOTES:

1. TOTAL WOOD SHALL NOT VARY FROM NUMBERS INDICATED.
2. SEE PLANTING PLAN FOR LANDSCAPE REQUIREMENTS.
3. PROVIDE 1 FOOT DEPTH STREAMBED AGGREGATE BENEATH CHANNEL BOTTOM.
4. PROVIDE GRAVEL PROTECTION FOR ALL SLOPES LESS THAN 3:1 BELOW APPROXIMATE BASE WATER SURFACE ELEVATION.
5. PROVIDE COIR MATTING BANK PROTECTION FOR SLOPES 3:1 OR LESS ABOVE APPROXIMATE BASE WATER SURFACE ELEVATION. SEED BELOW MATTING AND ANCHOR WITH WOOD STAKES.
6. PROVIDE 1 FOOT COIR LIFTS FOR SOIL STABILIZATION ON ALL SLOPES STEEPER THAN 3:1.

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	PF	BP	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: P. FENDT
DRAWN BY: T. NABOURS
CHECKED BY: B. PHILLIPS
APPROVED BY: B. PHILLIPS

PAUL S. FENDT, STATE OF WASHINGTON, 39910, REGISTERED PROFESSIONAL ENGINEER

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LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: NTS
FILENAME: PLANS_BEARCREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
PRESCRIPTIVE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
TYPICAL CHANNEL SECTIONS

DRAWING No.: CDD201
LOCATION ID:
SHEET No.: 3
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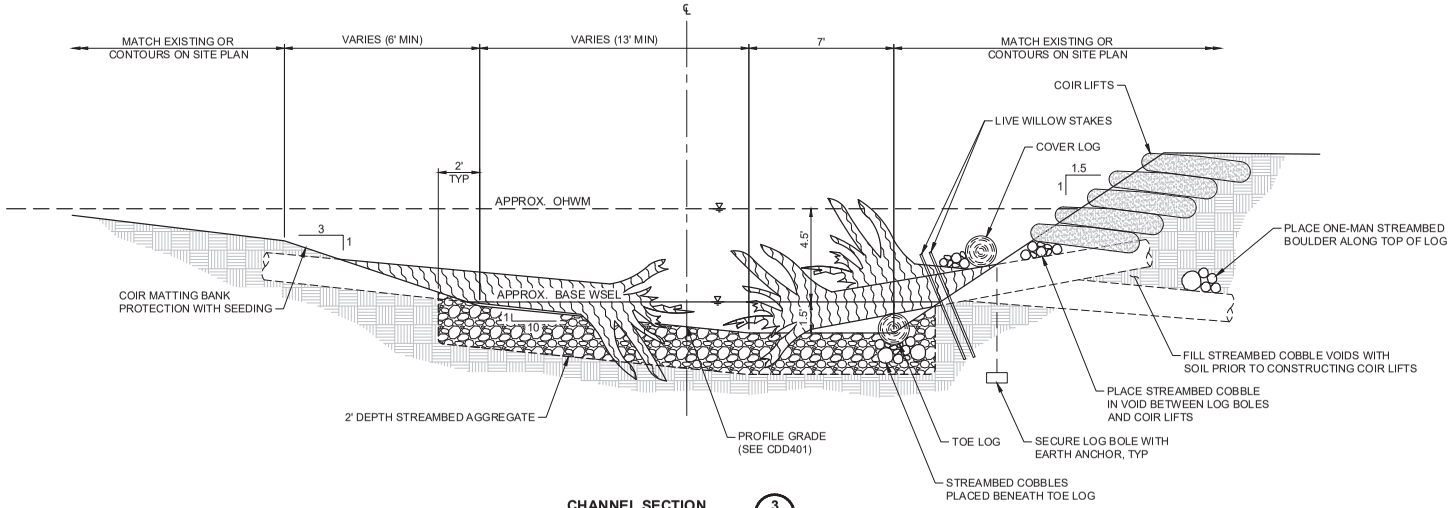
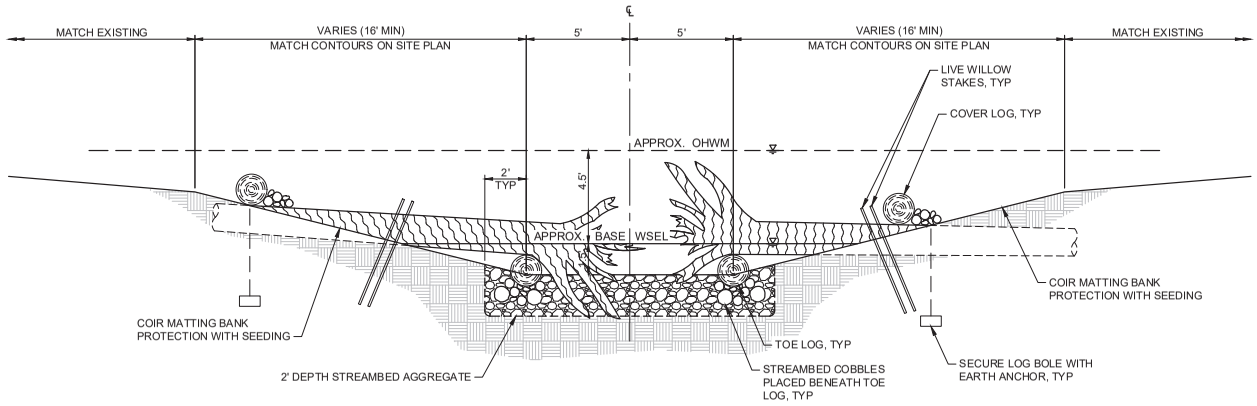


CHANNEL SECTION 3 CDD101
NOT TO SCALE



BACKWATER CHANNEL SECTION 4 CDD101
NOT TO SCALE

NOTES:

1. TOTAL WOOD SHALL NOT VARY FROM NUMBERS INDICATED.
2. SEE PLANTING PLAN FOR LANDSCAPE REQUIREMENTS.
3. PROVIDE 1 FOOT DEPTH STREAMBED AGGREGATE BENEATH CHANNEL BOTTOM.
4. PROVIDE GRAVEL PROTECTION FOR ALL SLOPES LESS THAN 3:1 BELOW APPROXIMATE BASE WATER SURFACE ELEVATION.
5. PROVIDE COIR MATTING BANK PROTECTION FOR SLOPES 3:1 OR LESS ABOVE APPROXIMATE BASE WATER SURFACE ELEVATION. SEED BELOW MATTING AND ANCHOR WITH WOOD STAKES.
6. PROVIDE 1 FOOT COIR LIFTS FOR SOIL STABILIZATION ON ALL SLOPES STEEPER THAN 3:1.

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	PF	BP	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: P. FENDT
DRAWN BY: T. NABOURS
CHECKED BY: B. PHILLIPS
APPROVED BY: B. PHILLIPS

PAUL S. FENDT, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER

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LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: NTS
FILENAME: PLANS_BEARCREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
PRESCRIPTIVE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
TYPICAL CHANNEL SECTIONS

DRAWING No.: CDD202
LOCATION ID:
SHEET No.: 4
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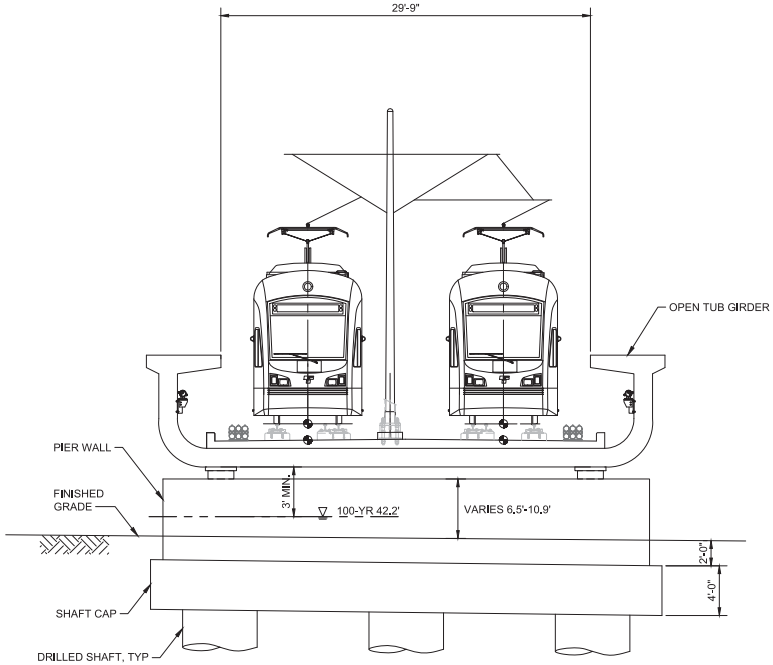
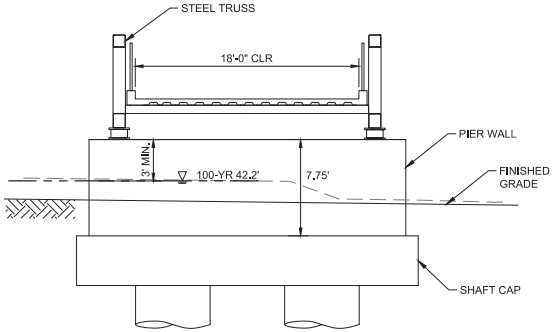
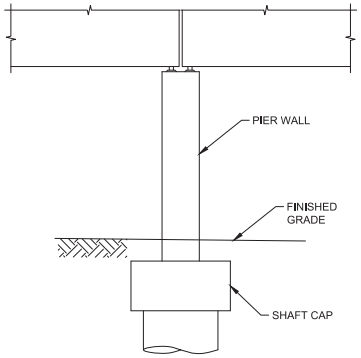


ELEVATED GUDEWAY SECTION M-1 CDD301
SCALE: 1" = 5'



PEDESTRIAN BRIDGE SECTION ABUTMENT AND INTERMEDIATE PIER M-2 CDD301
SCALE: 1" = 5'



PEDESTRIAN BRIDGE SECTION INTERMEDIATE PIER M-3 CDD301
SCALE: 1" = 5'

GENERAL NOTES:

1. SECTION SHOWN FOR PERMITTING PURPOSES. SECTION USED FOR CONSTRUCTION MAY DIFFER.

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	PF	BP	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: P. FENDT
DRAWN BY: T. NABOURS
CHECKED BY: B. PHILLIPS
APPROVED BY: B. PHILLIPS

STATE OF WASHINGTON PAUL S. FENDT 39916 REGISTERED PROFESSIONAL ENGINEER

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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=5'
FILENAME: PLANS_BEARCREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
REFERENCE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
TYPICAL GUIDEWAY SECTIONS

DRAWING No.: CDD203
LOCATION ID:
SHEET No.: 5
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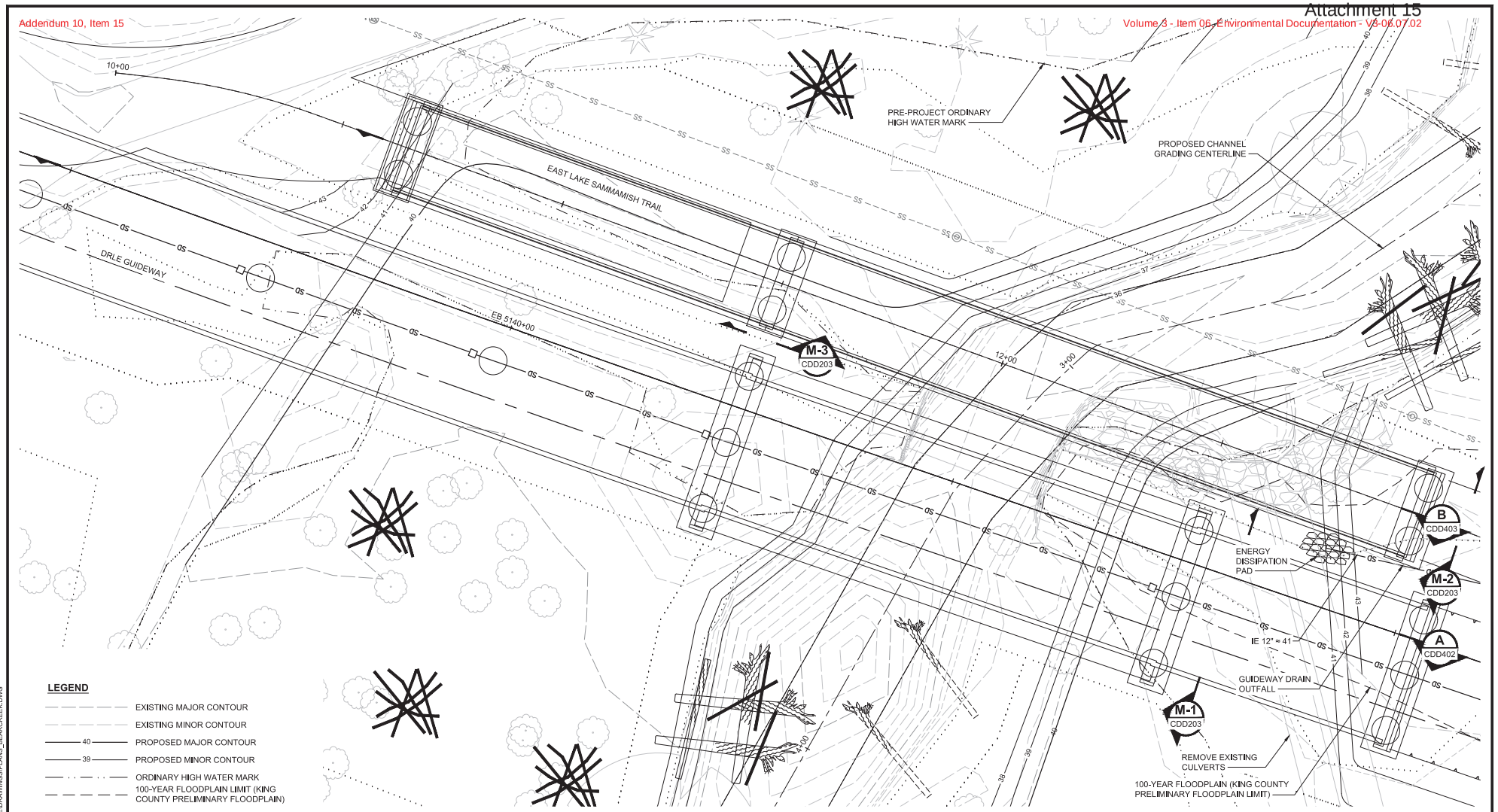

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	PF	BP	BP	ADDENDUM #6 - NEW SHEET

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LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=10'
FILENAME: PLANS_BEARCREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
REFERENCE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
PLAN DETAIL

DRAWING No.: CDD301
LOCATION ID:
SHEET No.: 6
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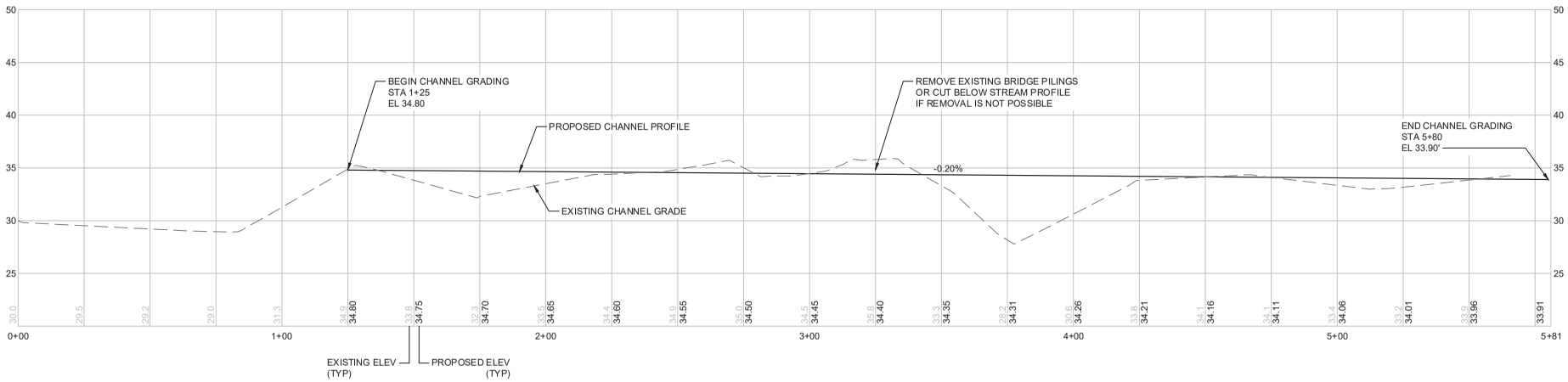

BEAR CREEK CHANNEL PROFILE
SCALE: (H: 1"=20', V: 1"=5')

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	PF	BP	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: P. FENDT
DRAWN BY: T. NABOURS
CHECKED BY: B. PHILLIPS
APPROVED BY: B. PHILLIPS

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SUBMITTED BY: | DATE: | REVIEWED BY: | DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: H: 1"=20', V: 1"=5'
FILENAME: PLANS_BEARCREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
PRESCRIPTIVE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
BEAR CREEK CHANNEL PROFILE

DRAWING No.: CDD401
LOCATION ID:
SHEET No.: 7
REV:

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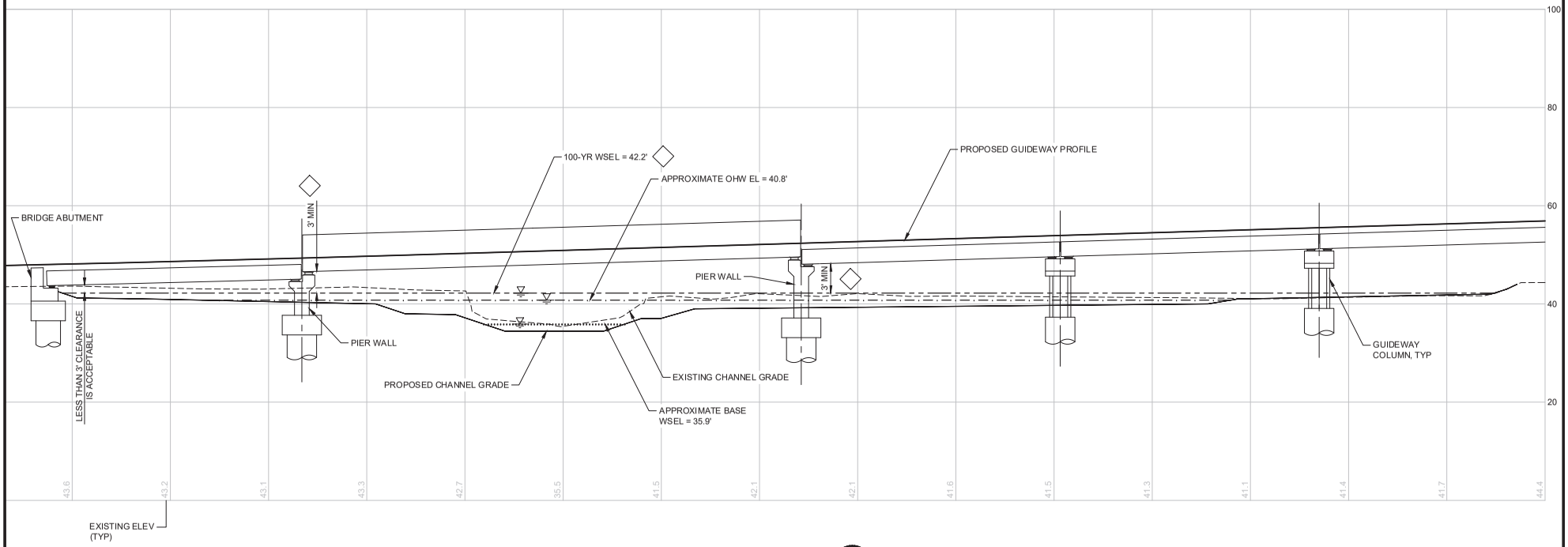

BEAR CREEK CHANNEL SECTION

SCALE: 1'=10'

A
CDD301

STA 3+35

GENERAL NOTES:

1. SECTION SHOWN FOR PERMITTING PURPOSES. SECTION USED FOR CONSTRUCTION MAY DIFFER.
2. PRESCRIPTIVE/REFERENCE DRAWINGS INCLUDE BOTH PRESCRIPTIVE AND REFERENCE INFORMATION. UNLESS OTHERWISE NOTED ON THE DRAWINGS, ITEMS MARKED WITH A DIAMOND ◇ ARE PRESCRIPTIVE. THE REST OF THE CONTENTS OF THE DRAWING ARE REFERENCE.

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
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LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1'=10'
FILENAME: PLANS_BEARCREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
PRESCRIPTIVE/REFERENCE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
BEAR CREEK CHANNEL SECTION

DRAWING No.: CDD402
LOCATION ID:
SHEET No.: 8
REV:

01/31/19 | 8:43 AM | TYLERJ
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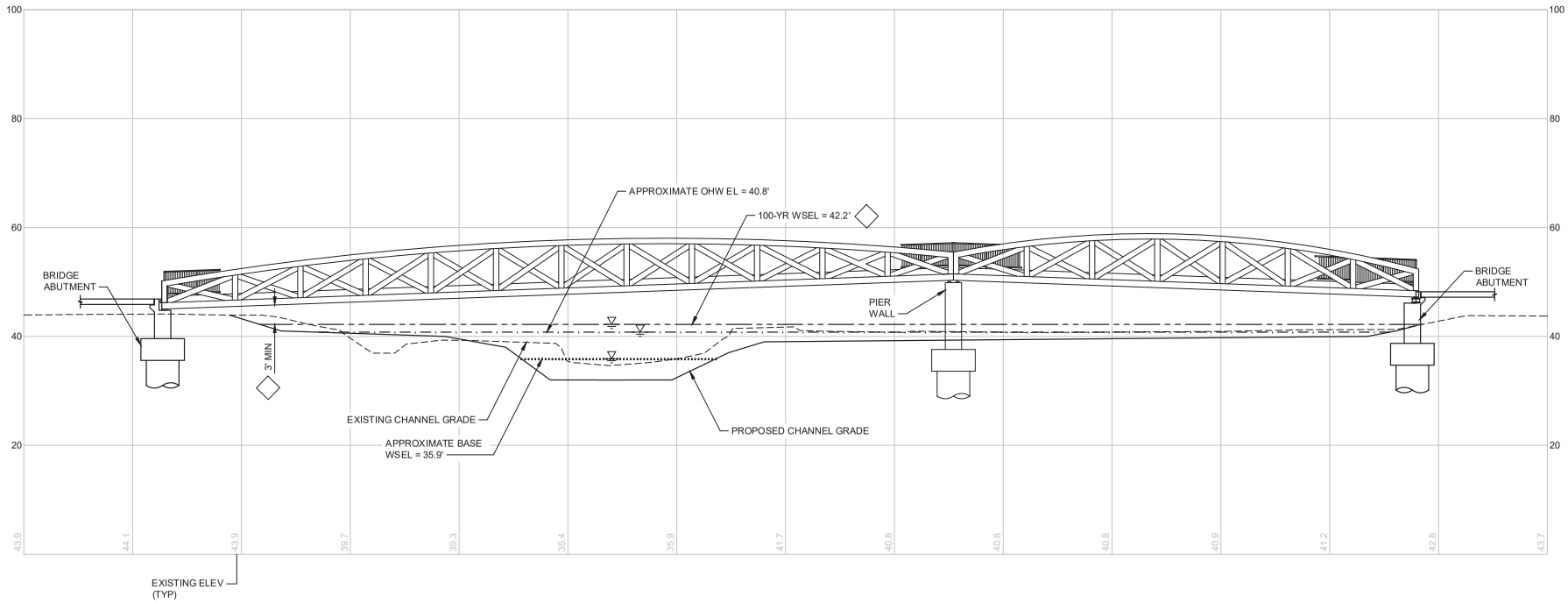

PEDESTRIAN BRIDGE SECTION B CDD301
SCALE: 1'=10'
STA 3+05

GENERAL NOTES:

1. SECTION SHOWN FOR PERMITTING PURPOSES. SECTION USED FOR CONSTRUCTION MAY DIFFER.
2. PRESCRIPTIVE/REFERENCE DRAWINGS INCLUDE BOTH PRESCRIPTIVE AND REFERENCE INFORMATION. UNLESS OTHERWISE NOTED ON THE DRAWINGS, ITEMS MARKED WITH A DIAMOND ◇ ARE PRESCRIPTIVE. THE REST OF THE CONTENTS OF THE DRAWING ARE REFERENCE.

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Parametrix
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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1'=10'
FILENAME: PLANS_BEARCREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
PRESCRIPTIVE/REFERENCE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
PEDESTRIAN BRIDGE SECTION

DRAWING No.: CDD403
LOCATION ID:
SHEET No.: 9
REV:

01/31/19 | 8:44 AM | TYLERJ
C:\USERS\TYLERJ\DOCUMENTS\FILESHAREPOINT\DRAWINGS\PLANS_BEARCREEK.DWG

Xrefs:
RLE-GB-TB22x34
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xRLE-L90-SEP100
xRLE-L90-SWP100
xRLE-L90-CCN100
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xRLE-L95-VG
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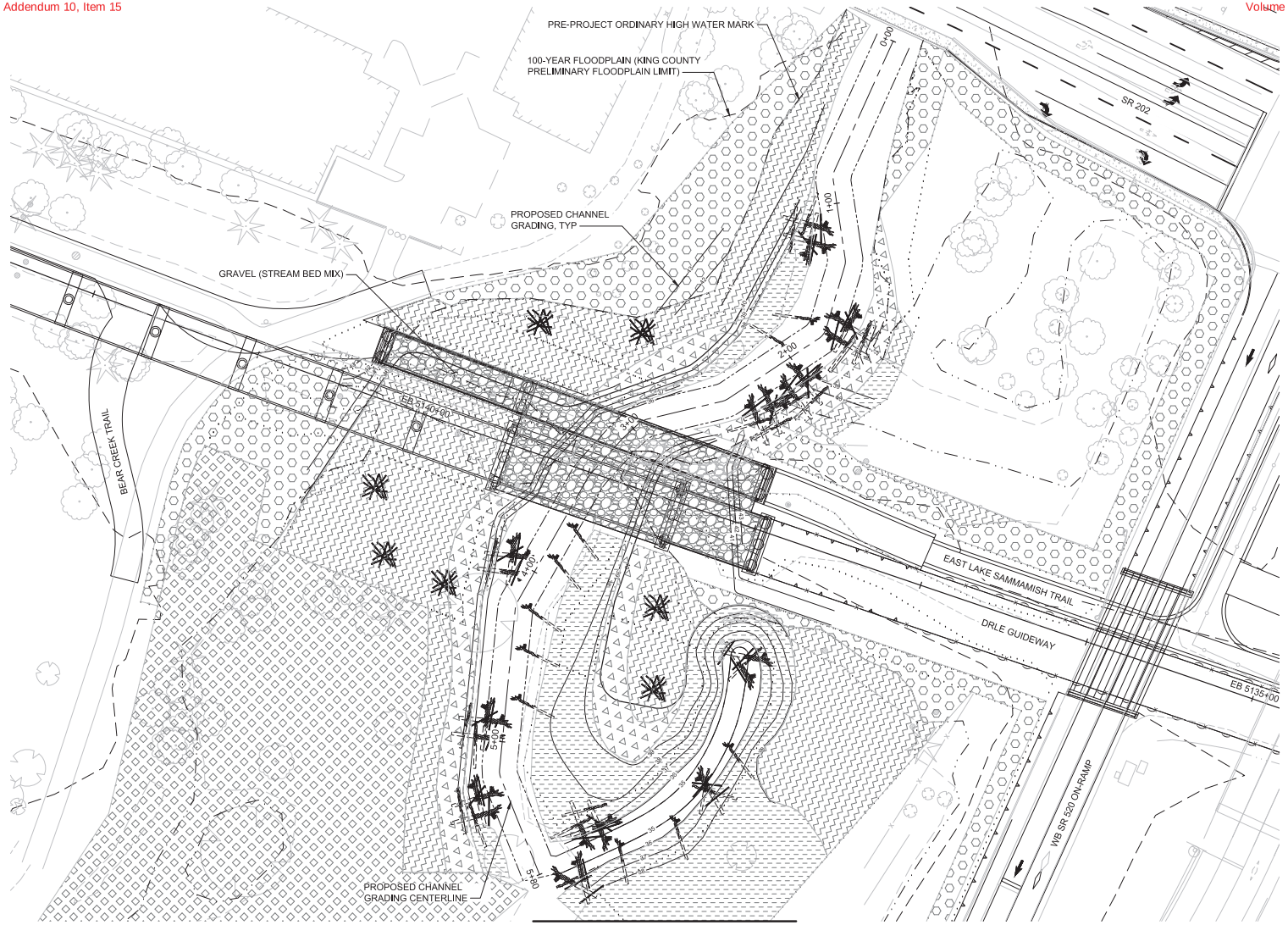

SEE DWG CDD502

PLANTING LEGEND

- ZONE V - RIPARIAN ENHANCEMENT
- ZONE W - UPLAND BUFFER
- ZONE X - RIPARIAN FOREST
- ZONE Y - STREAM BANK
- ZONE Z - RIPARIAN TERRACE
- GRAVEL (STREAM BED MIX)

NOTES:

1. PLANTING CLEARANCE: TREES SHALL BE PLANTED NO CLOSER THAN 15 FEET FROM TRAILS, ROADS AND SIGNS. TREES SHALL BE PLANTED SO THAT AT MATURITY THE DRIPLINE OR BRANCHES ARE NO CLOSER THAN 15-FEET FROM SOUND TRANSIT GUIDEWAYS. COTTONWOOD TREES SHALL BE PLANTED NO CLOSER THAN 70 FEET FROM HIGHWAYS. LARGE NATIVE SHRUBS SHALL BE PLANTED NO CLOSER THAN 10-FEET FROM TRAILS AND ROADS.

N

30 15 0 30 60
SCALE IN FEET

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	JS	BP	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: J. SWENSON
DRAWN BY: J. SWENSON
CHECKED BY: B. PHILLIPS
APPROVED BY: B. PHILLIPS

STATE OF WASHINGTON — JENS SCHUBERT SWENSON — NO. 956 EXP. 10/31/2019 — LANDSCAPE ARCHITECT

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=30'
FILENAME: BEAR_CREEK_PLANTING
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
PRESCRIPTIVE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
LANDSCAPE PLAN

DRAWING No.: CDD501
LOCATION ID:
SHEET No.: 10
REV:

01/31/19 | 10:30 AM | ITOP
C:\USERS\ITOP\DOCUMENTS\SHAREPOINT TARGET\RLE\DRAWINGS\BEAR_CREEK_PLANTING.DWG

Xrefs:
RLE-GB-TB22x34
xRLE-L90-CRP100
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xRLE-L90-CCN100
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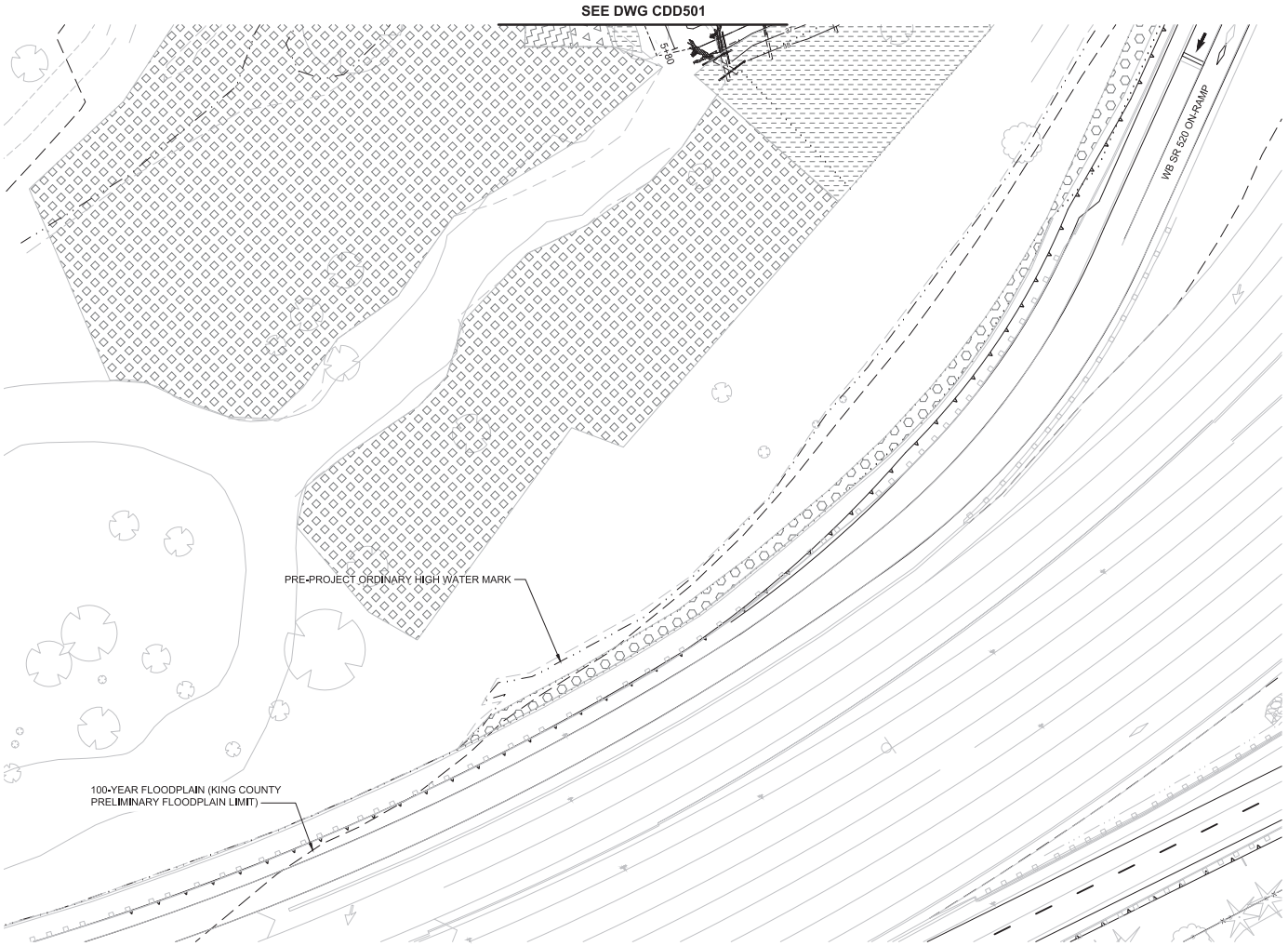

PLANTING LEGEND

- ZONE V - RIPARIAN ENHANCEMENT
- ZONE W - UPLAND BUFFER
- ZONE X - RIPARIAN FOREST
- ZONE Y - STREAM BANK
- ZONE Z - RIPARIAN TERRACE
- GRAVEL (STREAM BED MIX)

NOTES:

1. PLANTING CLEARANCE: TREES SHALL BE PLANTED NO CLOSER THAN 15 FEET FROM TRAILS, ROADS AND SIGNS. TREES SHALL BE PLANTED SO THAT AT MATURITY THE DRIPLINE OR BRANCHES ARE NO CLOSER THAN 15-FEET FROM SOUND TRANSIT GUIDEWAYS. COTTONWOOD TREES SHALL BE PLANTED NO CLOSER THAN 70 FEET FROM HIGHWAYS. LARGE NATIVE SHRUBS SHALL BE PLANTED NO CLOSER THAN 10-FEET FROM TRAILS AND ROADS.

N

30 15 0 30 60
SCALE IN FEET

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	JS	BP	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: J. SWENSON
DRAWN BY: J. SWENSON
CHECKED BY: B. PHILLIPS
APPROVED BY: B. PHILLIPS

STATE OF WASHINGTON — JENNIFER BUBEAR PENSON — 46256 EXP. 10/31/2019 — LANDSCAPE ARCHITECT

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=30'
FILENAME: BEAR_CREEK_PLANTING
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
PRESCRIPTIVE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
LANDSCAPE PLAN

DRAWING No.: CDD502
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REV:

01/31/19 | 10:34 AM | ITOP
C:\USERS\ITOP\DOCUMENTS\SHAREPOINT TARGETFILE\DRAWINGS\BEAR_CREEK_PLANTING.DWG

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xRLE-L95-VWG
xRLE-L95-VSF
xRLE-GS-VSF
xRLE-GS-VFP

PLANTING SCHEDULE — WETLAND MITIGATION AREA AND WETLAND ENHANCEMENT AREA PLANTS

SCIENTIFIC NAME	COMMON NAME	QTY**	SIZE	SPACING	NOTES
ZONE V - RIPARIAN ENHANCEMENT					
TREES					
Acer macrophyllum	Big leaf maple	10%	1 GAL.	12' O.C.	
Thuja plicata	Western redcedar	10%	1 GAL.	12' O.C.	
Tsuga heterophylla	Western hemlock	10%	1 GAL.	12' O.C.	
Pseudotsuga menziesii	Douglas fir	10%	1 GAL.	12' O.C.	
Fraxinus latifolia	Oregon ash	10%	1 GAL.	12' O.C.	
ZONE W - UPLAND BUFFER					
TREES					
Acer macrophyllum	Big leaf maple	10%	1 GAL.	6' O.C.	
Picea sitchensis	Sitka spruce	10%	1 GAL.	6' O.C.	
Thuja plicata	Western redcedar	10%	1 GAL.	6' O.C.	
Tsuga heterophylla	Western hemlock	10%	1 GAL.	6' O.C.	
Pseudotsuga menziesii	Douglas fir	10%	1 GAL.	6' O.C.	
SHRUBS					
Corylus cornuta	Hazelnut	5%	1 GAL.	3' O.C.	
Acer circinatum	Vine maple	5%	1 GAL.	3' O.C.	
Rubus spectabilis	Salmonberry	10%	1 GAL.	3' O.C.	
Rosa pisocarpa	Cluster rose	10%	1 GAL.	3' O.C.	
Symphoricarpos albus	Snowberry	10%	1 GAL.	3' O.C.	
Lonicera involucrate	Twinberry	10%	1 GAL.	3' O.C.	
ZONE X - RIPARIAN FOREST					
TREES					
Fraxinus latifolia	Oregon ash	10%	1 GAL.	6' O.C.	
Picea sitchensis	Sitka spruce	10%	1 GAL.	6' O.C.	
Thuja plicata	Western redcedar	10%	1 GAL.	6' O.C.	
Malus fusca	Western crab apple	10%	1 GAL.	6' O.C.	
Salix lucida ssp. Lasiandra	Pacific Willow	10%	1 GAL.	6' O.C.	
SHRUBS					
Cornus sericea	Redtwig dogwood	5%	1 GAL.	3' O.C.	
Physocarpus capitatus	Pacific ninebark	10%	1 GAL.	3' O.C.	
Rubus spectabilis	Salmonberry	10%	1 GAL.	3' O.C.	
Rosa pisocarpa	Cluster rose	10%	1 GAL.	3' O.C.	
Symphoricarpos albus	Snowberry	5%	1 GAL.	3' O.C.	
Lonicera involucrate	Twinberry	10%	1 GAL.	3' O.C.	
ZONE Y - STREAM BANK					
TREES					
Salix lucida ssp. Lasiandra	Pacific Willow	10%	Live Stake	1.5' O.C.	
SHRUBS					
Cornus sericea	Redtwig dogwood	10%	1 GAL.	3' O.C.	
Physocarpus capitatus	Pacific ninebark	10%	1 GAL.	3' O.C.	
Rubus spectabilis	Salmonberry	10%	1 GAL.	3' O.C.	
Rosa pisocarpa	Cluster rose	10%	1 GAL.	3' O.C.	
Cornus sericea	Redtwig dogwood	15%	Live Stake	1.5' O.C.	
Salix sitchensis	Sitka willow	15%	Live Stake	1.5' O.C.	
Salix hookeriana	Hooker's willows	15%	Live Stake	1.5' O.C.	
ZONE Z - RIPARIAN TERRACE					
TREES					
Salix lucida ssp. Lasiandra	Pacific Willow	10%	Live Stake	1.5' O.C.	
SHRUBS					
Cornus sericea	Redtwig dogwood	30%	Live Stake	1.5' O.C.	
Salix sitchensis	Sitka willow	30%	Live Stake	1.5' O.C.	
Salix hookeriana	Hooker's willows	30%	Live Stake	1.5' O.C.	

** WHERE PERCENTAGES ARE SHOWN, THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE PLANT QUANTITIES REQUIRED TO COVER THE PLANTING AREAS WITH THE LAYOUT AND SPACING NOTED IN THE DETAILS.

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	JS	BP	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: J. SWENSON
DRAWN BY: J. SWENSON
CHECKED BY: B. PHILLIPS
APPROVED BY: B. PHILLIPS

STATE OF WASHINGTON — JESSE SCHUBERT WINN — No. 56 EXP. 10/31/19 — LICENSED PE & RLA

Parametrix — ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=30'
FILENAME: BEAR_CREEK_PLANTING
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
PRESCRIPTIVE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
PLANT SCHEDULE AND NOTES

DRAWING No.: CDD503
LOCATION ID:
SHEET No.: 12
REV:

01/30/19 | 5:47 PM | TYLERJ
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Xrefs:
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xRLE-L90-CCN100
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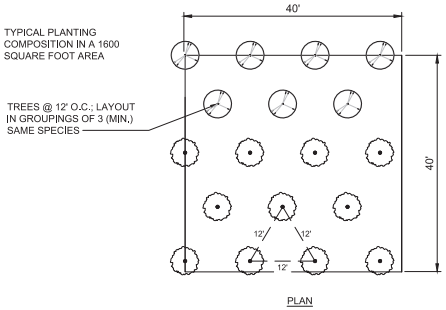
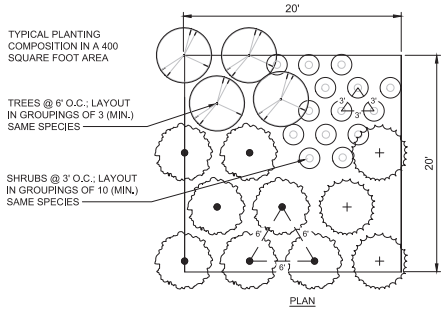
xRLE-GS-VFP



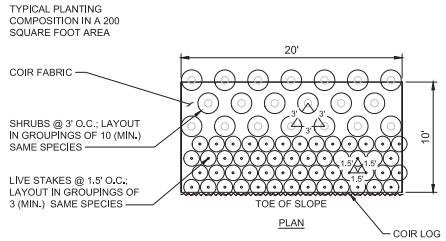
TREAT AND REMOVE INVASIVE PLANTS. PROVIDE IMPORTED PLANT MATERIAL PER SPECIES, SIZE, AND SPACING SHOWN TO VEGETATE UNVEGETATED AREAS. ADJUST PLANT MATERIALS PER EXISTING NATIVE PLANTS. MINIMUM NUMBER TOTAL TREES SHALL BE 430 WITHIN ALL ZONE V AREAS.

ZONE V PLANTING LAYOUT
SCALE: NTS



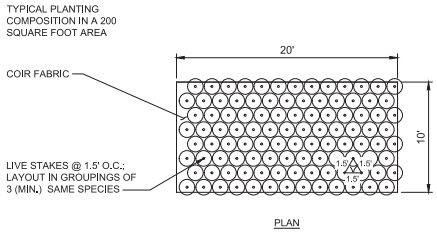
PROVIDE IMPORTED PLANT MATERIALS PER THE SPECIES, SIZE, AND SPACING SHOWN TO VEGETATE 100% AREA OF PLANTING ZONE.

ZONES W AND X PLANTING LAYOUT
SCALE: NTS



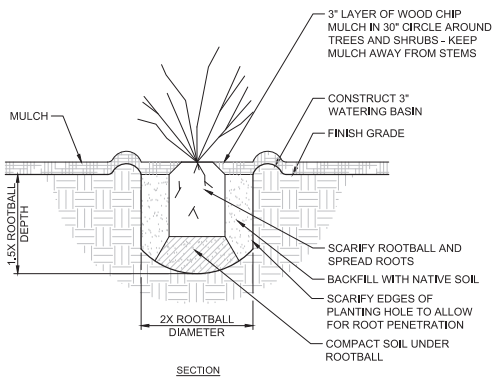
PROVIDE IMPORTED PLANT MATERIALS PER THE SPECIES, SIZE, AND SPACING SHOWN TO VEGETATE 100% AREA OF PLANTING ZONE.

ZONE Y PLANTING LAYOUT
SCALE: NTS

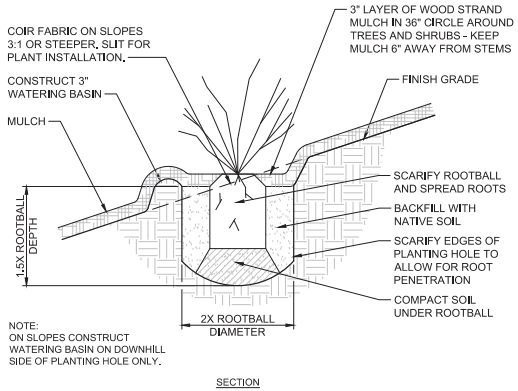


PROVIDE IMPORTED PLANT MATERIALS PER THE SPECIES, SIZE, AND SPACING SHOWN TO VEGETATE 100% AREA OF PLANTING ZONE.

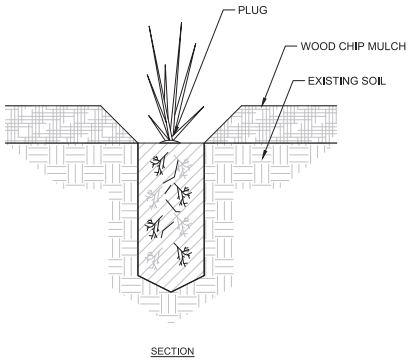
ZONE Z PLANTING LAYOUT
SCALE: NTS



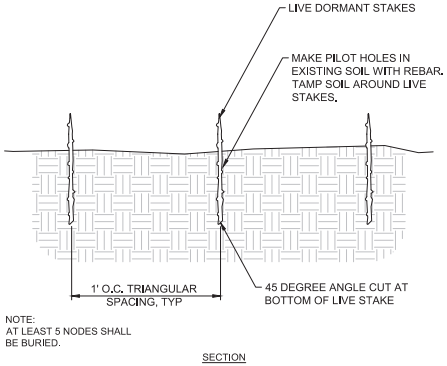
TYPICAL TREE / SHRUB CONTAINER PLANTING
SCALE: NTS



TYPICAL TREE / SHRUB CONTAINER PLANTING ON SLOPE
SCALE: NTS



TYPICAL PLUG PLANTING
SCALE: NTS



TYPICAL LIVE STAKE PLANTING
SCALE: NTS

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	JS	BP	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: J. SWENSON
DRAWN BY: J. SWENSON
CHECKED BY: B. PHILLIPS
APPROVED BY: B. PHILLIPS

STATE OF WASHINGTON — JENS SCHUBERT SWENSON — LANDSCAPE ARCHITECT

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: | DATE: | REVIEWED BY: | DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=30'
FILENAME: BEAR_CREEK_PLANTING
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
PRESCRIPTIVE
CIVIL
BEAR CREEK CROSSING AND RESTORATION
LANDSCAPE DETAILS

DRAWING No.: CDD504
LOCATION ID:
SHEET No.: 13
REV:

01/31/19 | 1:00 PM | ITOP
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xRLE-L90-SWP100
xRLE-L90-RPP100
xRLE-E29-ASP100
xRLE-L95-VSF
xRLE-G5-VSF
RL 175 Easements
xRLE-L90-CLP200
RLE-G8-TB22x34
xRLE-L90-CCN100

CONSTRUCTION SEQUENCING (IN-WATER WORK)

FISH WINDOW - JULY 1ST TO SEPTEMBER 15TH

YEAR 1: FISH WINDOW TASKS
- Remove existing bridge
- Grading of stream under bridges
- Construct fill and sheet piles

YEAR 1: AFTER FISH WINDOW TASKS
- Construct shafts and columns

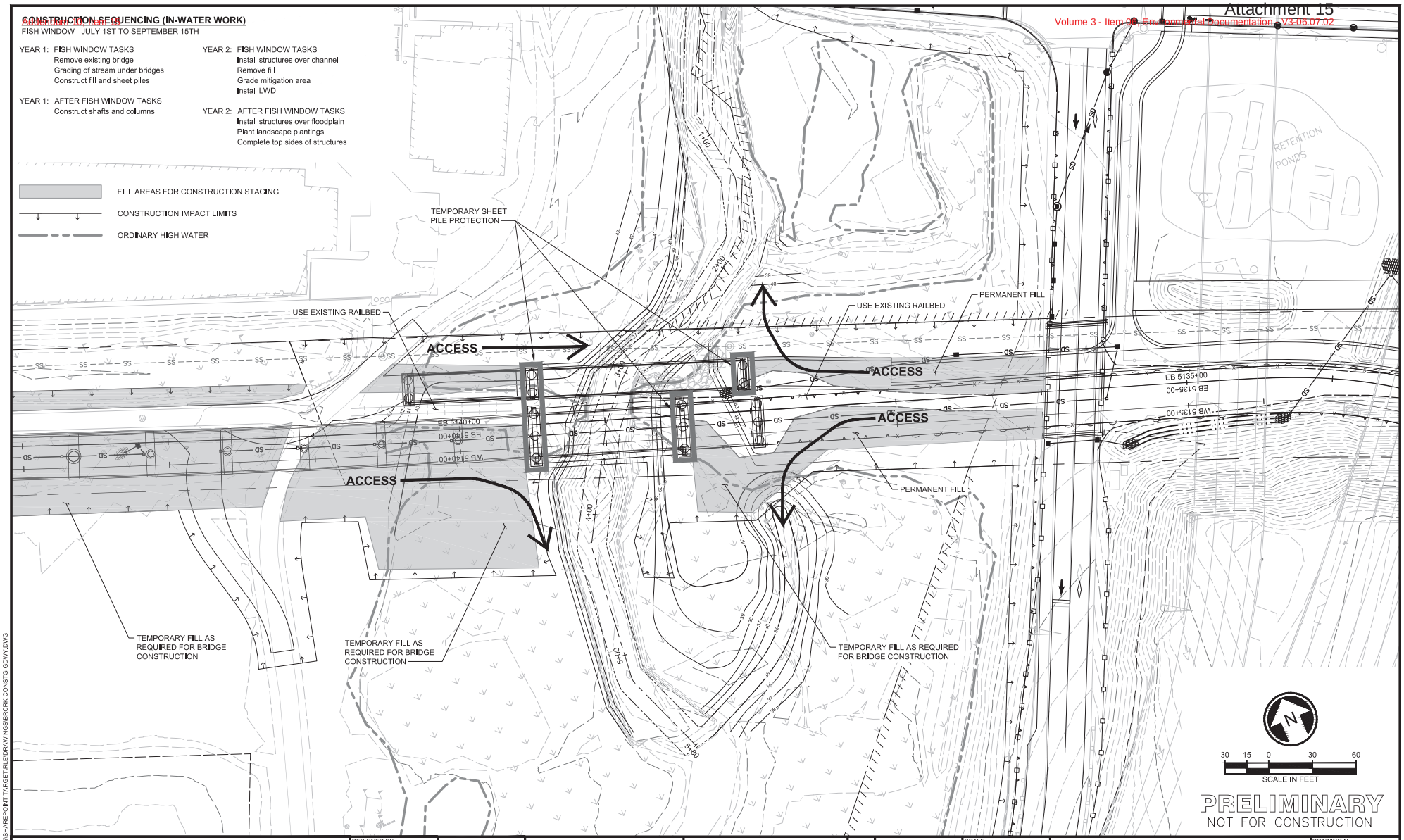
YEAR 2: FISH WINDOW TASKS
- Install structures over channel
- Remove fill
- Grade mitigation area
- Install LWD

YEAR 2: AFTER FISH WINDOW TASKS
- Install structures over floodplain
- Plant landscape plantings
- Complete top sides of structures

FILL AREAS FOR CONSTRUCTION STAGING

CONSTRUCTION IMPACT LIMITS

ORDINARY HIGH WATER



PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	BP	MS	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: B. PHILLIPS
DRAWN BY: P. ITO
CHECKED BY: M. STUMPF
APPROVED BY: B. PHILLIPS

BRAD FREDERICK PHILLIPS, STATE OF WASHINGTON, 38786, REGISTERED PROFESSIONAL ENGINEER

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ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=30'
FILENAME: BRCRK-CONSTG-GDWY
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
REFERENCE

BEAR CREEK CROSSING AND RESTORATION
CONSTRUCTION STAGING - GUIDEWAY

DRAWING No.: CDD601
LOCATION ID:
SHEET No.: 14
REV:

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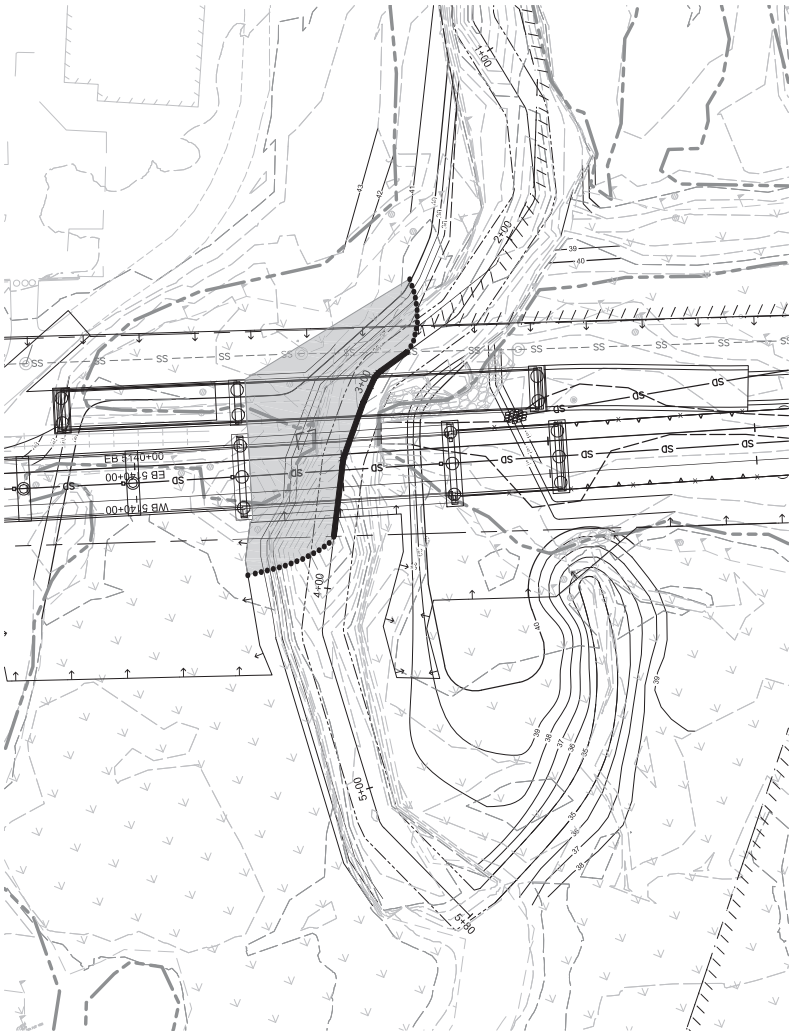
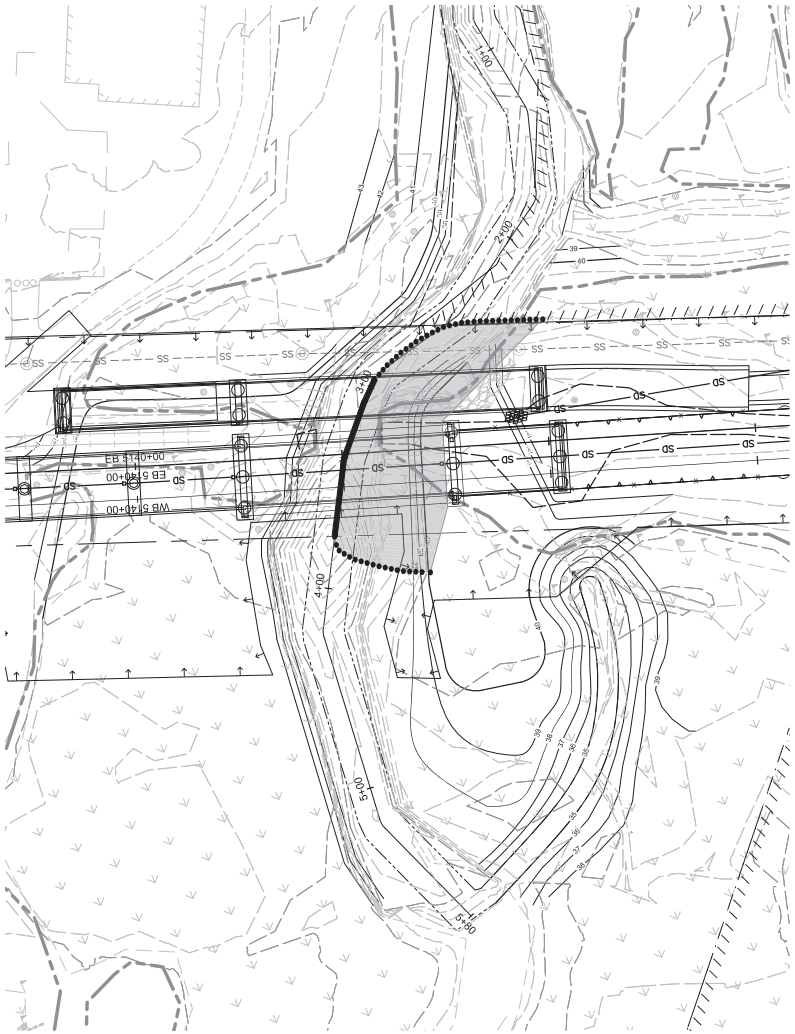


YEAR 1 - PHASE 1



YEAR 1 - PHASE 2

NOTES

1. CONSTRUCTION AREA DENOTES APPROXIMATE WORK AREA UNDER THE ORDINARY HIGH WATER THAT CAN BE DISTURBED DURING THE ALLOWABLE FISH WINDOW.
2. THE ALLOWABLE FISH WINDOW IS JULY 1ST TO SEPTEMBER 15TH. IF REGULATED FISH ARE FOUND PRIOR TO SEPTEMBER 15TH, WASHINGTON DEPARTMENT OF FISH & WILDLIFE MAY REQUIRE TERMINATION OF WORK.
3. ALL DISTURBED AREAS SHALL BE STABILIZED AT THE END OF THE FISH WINDOW.
4. THE DESIGN OF THE TEMPORARY SHORING SHALL PROVIDE FOR STREAM FLOWS UP TO 130 CFS.

LEGEND

- CONSTRUCTION AREA
- CONSTRUCTION IMPACT LIMITS
- ORDINARY HIGH WATER
- SHEET PILE
- SAND BAG WALL

N

30 15 0 30 60
SCALE IN FEET

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	BP	MS	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: B. PHILLIPS
DRAWN BY: P. ITO
CHECKED BY: M. STUMPF
APPROVED BY: B. PHILLIPS

BRAD FREDERICK PHILLIPS, STATE OF WASHINGTON, 38916, REGISTERED PROFESSIONAL ENGINEER

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: | DATE: | REVIEWED BY: | DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=30'
FILENAME: BRCRK-CONSTG-CREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
REFERENCE
BEAR CREEK CROSSING AND RESTORATION
CONSTRUCTION STAGING - BEAR CREEK
YEAR 1 - PHASES 1 & 2

DRAWING No.: CDD602
LOCATION ID:
SHEET No.: 15
REV:

01/31/19 | 10:08 AM | ITOP
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xRLE-L90-RPP100
xRLE-E29-ASP100
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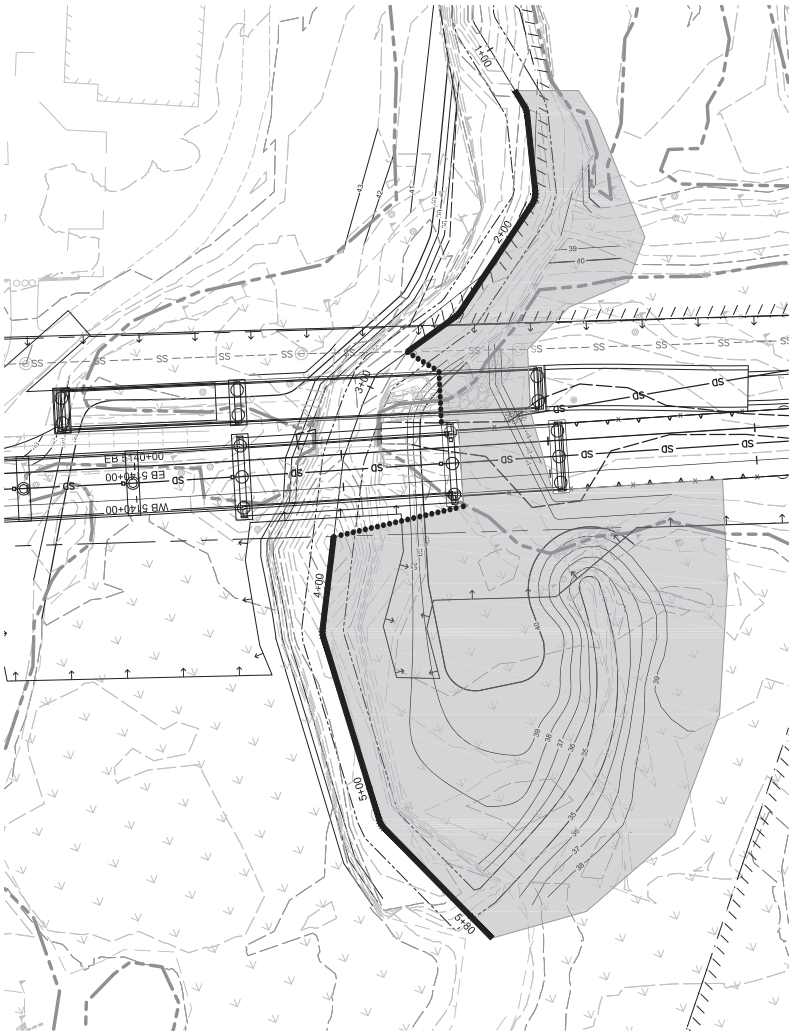
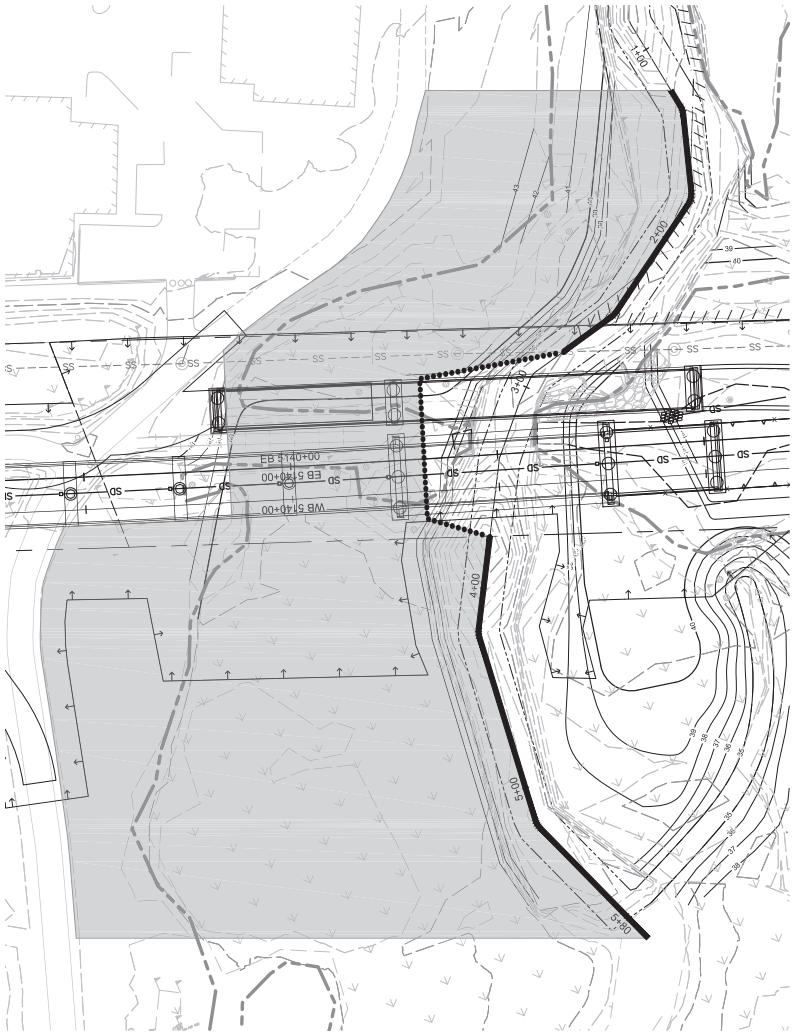


YEAR 2 - PHASE 1



YEAR 2 - PHASE 2

NOTES

1. CONSTRUCTION AREA DENOTES APPROXIMATE WORK AREA UNDER THE ORDINARY HIGH WATER THAT CAN BE DISTURBED DURING THE ALLOWABLE FISH WINDOW.
2. THE ALLOWABLE FISH WINDOW IS JULY 1ST TO SEPTEMBER 15TH. IF REGULATED FISH ARE FOUND PRIOR TO SEPTEMBER 15TH, WASHINGTON DEPARTMENT OF FISH & WILDLIFE MAY REQUIRE TERMINATION OF WORK.
3. ALL DISTURBED AREAS SHALL BE STABILIZED AT THE END OF THE FISH WINDOW.
4. THE DESIGN OF THE TEMPORARY SHORING SHALL PROVIDE FOR STREAM FLOWS UP TO 130 CFS.

LEGEND

- CONSTRUCTION AREA
- CONSTRUCTION IMPACT LIMITS
- ORDINARY HIGH WATER
- SHEET PILE
- SAND BAG WALL

N

30 15 0 30 60
SCALE IN FEET

PRELIMINARY
NOT FOR CONSTRUCTION

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION
	02/01/2019	BP	MS	BP	ADDENDUM #6 - NEW SHEET

DESIGNED BY: B. PHILLIPS
DRAWN BY: P. ITO
CHECKED BY: M. STUMPF
APPROVED BY: B. PHILLIPS

BRAD FREDERICK PHILLIPS, STATE OF WASHINGTON, 38916, REGISTERED PROFESSIONAL ENGINEER

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SUBMITTED BY: | DATE: | REVIEWED BY: | DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1"=30'
FILENAME: BRCRK-CONSTG-CREEK
CONTRACT No.:
DATE: 01/31/2019

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND
REFERENCE
BEAR CREEK CROSSING AND RESTORATION
CONSTRUCTION STAGING - BEAR CREEK
YEAR 2 - PHASES 1 & 2

DRAWING No.: CDD603
LOCATION ID:
SHEET No.: 16
REV:

01/31/19 | 10:11 AM | ITOP
C:\USERS\ITOP\DOCUMENTS\SHAREPOINT TARGETFILE\DRAWINGS\BRCRK-CONSTG-CREEK.DWG

Downtown Redmond Link Extension SEPA Compliance

Environmental compliance pursuant to the State Environmental Policy Act (SEPA) for the Downtown Redmond Link Extension (DRLE) was completed with the East Link Project Final Environmental Impact Statement (EIS) issued in July 2011 and the Downtown Redmond Link Extension SEPA Addendum issued August 31, 2018. The Federal Transit Administration (FTA) and Federal Highway Administration (FHWA) issued a Record of Decision (ROD) for the project on November 16, 2011 and November 17, 2011, respectively. FTA approved a National Environmental Policy Act (NEPA) Re-evaluation on August 29, 2018. The NEPA process is complete.

The 2011 East Link Extension Final EIS and the ROD can be found at the following link:

https://www.soundtransit.org/get-to-know-us/documents-reports/east-link-final-environmental-impact-statement-executive-summary

The 2018 DRLE SEPA Addendum, can be found at the following link:

https://www.soundtransit.org/get-to-know-us/documents-reports/downtown-redmond-link-extension-2018-sepa-addendum-to-east-link

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719 2ND AVENUE, SUITE 200 | SEATTLE, WA 98104 | P 206.394.3700

MEMORANDUM

DATE:	February 6, 2019
TO:	Ellie Ziegler, Sound Transit
FROM:	Michael Hall
SUBJECT:	City of Redmond Shoreline Jurisdiction Tree Protection Plan
PROJECT NAME:	Downtown Redmond Link Extension

This Tree Protection Plan is intended to summarize the Downtown Redmond Link Extension Project's (Project) compliance with the City of Redmond's (City) tree protection requirements as provided in the Redmond Zoning Code (RZC) Chapter 21.72. This plan provides information about sources, methodology, and regulatory requirements for trees within the project vicinity that are located within the City's shoreline jurisdiction. A proposed tree replacement strategy is also summarized in this plan.

Information on tree size, species, and condition data were obtained from the arborist's report developed for the Project (Attachment A); the report also describes the methodology used to rate each tree in the project area. Details on the individual trees within City shoreline jurisdiction are listed in the Tree Table (Attachment B). Maps showing the location of trees to be retained, impacted, and removed are included as Attachment C.

City Tree Protection Plan reporting requirements state that the Tree Table accompanying a Tree Protection Plan should list only those trees larger than 6 inches in diameter at breast height (dbh). Because construction permit applications are expected to be submitted approximately 2 years after the tree survey was conducted (in 2018), the Tree Table includes all trees evaluated during the arborists' field reviews, regardless of dbh.

Each tree was assigned to one of the following categories (as specified in the City's Guidelines for Demonstrating Conformance with Tree Protection Standards), based on its location relative to the critical areas disturbance line and the Bear Creek restoration work area:

- Removed (The tree will be cut down or removed from the site.)
- Impacted (The tree will be left standing, but ground disturbance will take place within 5 feet of the tree's dripline.)
- Retained (The tree will be left standing, and no ground disturbance will take place within 5 feet of the tree's dripline.)

Entries in the Replacement Exemption field of the Tree Table are based on the arborist's evaluations of tree vigor and structure. Trees evaluated as "Poor" or "Dead/Dying" in either vigor or structure (or both) are considered to meet the RZC definition of unhealthy and/or hazardous trees.

According to RZC 21.78, a Hazardous Tree is a "*tree that is dead, or is so affected by a significant structural defect or disease, that falling or failure appears imminent, or a tree that impedes safe vision or traffic flow, or that otherwise currently poses a threat to life or property*."

According to RZC 21.72.080(B), no tree replacement is required for trees that are hazardous, dead, diseased, injured, or in a declining condition with no reasonable assurance of regaining vigor. It was assumed for this analysis that trees identified as “Hazard tree,” “Dead/Dying,” or “Poor structure” in the Replacement Exemption field will not need to be replaced.

RZC 21.68.110(A)(2) specifies special replacement ratios for significant trees that are removed within shoreline jurisdiction. For trees between 6 and 9 inches dbh, the replacement ratio is two new trees for every tree removed. For each additional 3 inches dbh above 6 inches dbh, one additional replacement tree shall be planted, with a maximum of six replacement trees.

According to RZC 21.72.090(B)(2), if more than 65 percent of the trees on a site are removed, tree replacement shall be at a minimum of three trees for each significant tree removed.

Values in the Replacement Trees field in the Tree Table reflect the above requirements. A value of “N/A” indicates a tree that is not slated for removal.

A total of 299 trees were tagged and rated within the City’s shoreline jurisdiction; 69 of which were determined to be unhealthy and/or hazardous. The results of the tree analysis for the “healthy” trees, as detailed in the Tree Table, are summarized in Table 1.

Table 1. Tree Table Analysis Summary

Tree Type	Removal	Impacted	Retained*	Total
Landmark (>30” dbh)	0 0% (of all trees)	2 1% (of all trees)	0 0% (of all trees)	2 1% (of all trees)
Significant (6” to 30” dbh)	158 69% (of all significant trees)	37 16% (of all significant trees)	35 15% (of all significant trees)	230 99% (of all trees)
Totals	158 68% (of all trees)	39 17% (of all trees)	35 15% (of all trees)	232 N/A
Replacement Trees	514	N/A	N/A	514

* “Impacted” trees will also be retained, but are not included in the “retained” column per City reporting requirements.

Sound Transit has identified three areas within City shoreline jurisdiction along Bear Creek where replacement trees will be planted; see the attached tree replacement figure (Attachment D). The three areas total approximately 2.3 acres in area and are either composed of invasive herbaceous or woody vine species (i.e., reed canarygrass and Himalayan blackberry) and/or will be temporarily cleared for construction access and staging. Based upon approximately 75 percent coverage of trees planted 12-feet on-center using triangle spacing, the identified tree replacement areas could accommodate installation of 590 trees. Therefore, these areas will conservatively accommodate the anticipated 514 trees that Sound Transit is required to install within City shoreline jurisdiction.

The design-build contractor will evaluate the anticipated tree removal requirements during final design and will develop a final tree retention, protection, and replacement plan based on their proposed construction methods. The total number of trees to be removed may be reduced if the Contractor’s approach reduces the extent of anticipated clearing required for construction access or staging areas. Tree removal will also be avoided if the contractor determines that some trees may be pruned in lieu of full removal.

Attachment A

Arborist Report

Downtown Redmond Link Extension
Tree Mitigation Report

September 17, 2018

Prepared for

Central Puget Sound Regional Transit Authority
401 S. Jackson Street
Seattle, WA 98104

Prepared by

Parametrix
719 2nd Avenue, Suite 200
Seattle, WA 98104
T. 206.394.3700 F. 1.855.542.6353
www.parametrix.com

Swift Company
3131 Western Ave, M423
Seattle, WA 98121
T. 206.632.2038
www.swiftcompany.com

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1. DATA SUMMARY

1.1 Introduction

When the 3+ miles of above-ground light rail track is constructed for the Downtown Redmond Link Extension (DRLE), many mature trees will be removed from the Washington State Department of Transportation (WSDOT) State Route 520 right-of-way, King County's Marymoor Park, and within the City of Redmond. All three jurisdictions have policy statements regarding tree removal and each jurisdiction has different approaches for the replacement of trees removed in the course of construction. The following is a summary of the estimated tree removal levels, documented expectations for tree replacement in each of the three primary jurisdictions, and an estimate of tree replacement mitigation levels needed to meet the requirements. A list of the Codes referenced is included in the Appendix.

1.2 Tree Assessment

The identification of trees within the project area is based upon an extensive field survey and tree hazard assessment undertaken by Urban Forestry Services, Inc. (UFS) during Preliminary Engineering, based upon the guideway alignment the DRLE Preliminary Engineering Contract Drawings (August, 2018). Trees that are in the vicinity of the current assumed Project Impact Area were cataloged and assessed to be able to address jurisdictional mitigation requirements. Refer to the Tree Assessment Summary Report (September, 2018) by UFS for a full summary of extents of trees surveyed, definition of risk categories, and other information associated with identification and assessment of tree resources. The tree data collected has been entered into the Redmond Link Tree Inventory Database, a GIS web application that allows the user to access specific tree information or to filter data into useful categories:

http://parametrix.maps.arcgis.com/apps/webappviewer/index.html?id=5fdc0dfd98d7467f866d47af0b61ebe1

1.3 Assessment Categories

For the purposes of this document, the **Low Estimate** encompasses trees that will be required to be removed for the light rail construction and safe operations. This tree count is comprised of two tree removal categories defined in the GIS web application. **Category 1** trees are those that will be removed within the width of the guideway plus a 15' vegetation clear zone to each side of the track. Any tree that has a portion of its trunk or Interior Critical Root Zone (ICRZ) within this site area is categorized as a 'Category 1 tree – Removal Required'. See DCM Chapter 10 for a description of the vegetation clear zone and the Tree Assessment Summary Report for a description of the ICRZ. '**Category 2**- Removal Required' trees are those trees outside of the vegetation clear zone that will need to be removed. Trees are grouped in this category for several reasons:

- The tree is a species that has a natural propensity to fail (such as cottonwoods and alders);
- A tree where direct impact to the root system does not fall into being a Category 1 tree but surrounding construction, including removal of neighboring trees, make the trees more apt to fail; or
- A tree whose form, height or condition are not inherently hazardous but, in proximity to the rail line, creates a risk to operations. See the Tree Assessment Summary Report for a detailed description of risk determination factors.

The **High Estimate** takes the number of trees required to be removed (Low Estimate) and adds in all of the trees within property currently planned to be accessible to the Contractor through right-of-way acquisitions, temporary construction easements, and other temporary and permanent real estate property agreements. Assuming that the Contractor uses all of this available space, any tree that has its trunk or ICRZ extending into this zone is categorized as a '**Category 3** Tree – Potential Removal' (trees in this zone that are already categorized as Category 2 are not double counted).

Category 4 trees are defined as those that require pruning for safe retention or will need to be removed. The Contractor and Project Arborist are given the option to prune or remove the tree, according to the specific needs of the construction plan.

The two categories of required removals (**Category 1 + Category 2**) identify the lowest level of anticipated tree removal (**Low Estimate**). Adding the potential tree removals (**Category 3 + Category 4**) to this number indicates the highest level of tree impact currently anticipated (**High Estimate**).

Category 5 trees, those that recommended for maintenance pruning but pose no risk to the light rail operation, are not included in these removal counts.

1.4 Scope of Report

Tree removal numbers noted in this document compare the number of trees that can reliably be predicted to be removed within a minimal project impact area to the potential impacts of removing all trees within an extended project impact area. This allows the Preliminary Engineering team to present a range in the number of trees that will need to be removed for construction. These numbers may be increased or decreased including, but not limited to, the following reasons:

- Revisions to the Preliminary Engineering design or construction parameters. If the design or construction needs change, and consequently cause revisions to the project impact areas, the number of impacted trees is likely to change.
- Refinement of area needed for construction use. The contractor may choose to protect trees within the estimated project impact area to reduce mitigation requirements.

Before any site work begins, a Tree and Vegetation Protection Plan is required, in accordance with Spec 01 56 39, to clearly identify trees to be removed, trees to be protected and to define tree protection measures needed to ensure trees to remain are not impacted adversely by construction. The Contractor will be required to provide tree replacement mitigation for all healthy trees removed, whether intentional or not, in accordance with jurisdictional requirements. For each jurisdiction, the estimated removal and mitigation requirements are outlined. All calculations for tree mitigation are based on local regulations as of May, 2018. Jurisdictional mitigation requirements may change over time and any final tree mitigation plans will need to comply with current requirements.

1.5 Limitations

Although this report provides estimated tree removal and corresponding tree replacement mitigation numbers, it is beyond the scope of this study to determine where the mitigation trees may be planted. Due to the constrained linear limits of the project and the requirements for clear zones for the both the rail line and WSDOT operations, there may not be sufficient available area within the boundaries of the project to fulfill the tree mitigation requirements. Potential areas for tree planting mitigation have been provided by WSDOT (see Letter of Concurrence/WSDOT Roadside Restoration Expectations document) and King County (see King County Tree Mitigation Plan) to assist the Contractor in proposing mitigation plans for approval. Final mitigation plans, including locations and maintenance / warranty agreements, are the responsibility of the Contractor to be confirmed with each affected jurisdiction.

Finally, this report does not attempt to outline or propose any tree replacement mitigation related to incursions and impacts on critical areas (wetlands, critical slopes, wildlife habitat, geologic hazard, etc.). Tree removal and mitigation efforts will be guided by critical area studies conducted by appropriate specialists, and the regulations and permitting of the relevant governing body.

2. MITIGATION CALCULATIONS

2.1 WSDOT

WSDOT's tree replacement policy is based on removing vegetation only for highway purposes. The Roadside Manual stipulates that where a project (or entity) disturbs the roadside, the project (or entity) is responsible for restoring the disturbed area to the ecosystem appropriate to the location and the applicable roadside zone.

WSDOT approaches tree replacement mitigation in a manner closely aligned with land restoration practices, which replace a lost mature plant with more plants of a smaller size to encourage natural succession in the new plant community. To minimize loss of tree canopy cover, vegetation replacement ratios apply. For WSDOT Category 2 vegetation (moderate-sized conifer and late-successional species trees, between 4 - 30 inch Diameter at Breast Height (DBH)), the replacement value is a ratio of one 1-gallon replacement tree for each one inch of tree trunk DBH removed. This requirement does not require mitigation for early-successional tree species that are typically short-lived, like alder and poplar. For WSDOT Category 1 vegetation (mature, old-growth or heritage trees greater than 30 inch DBH), a ratio of six 1-gallon sized trees for every one inch of Category 1 tree trunk DBH removed is required. For WSDOT Category 3 vegetation (small trees less than 4 inch DBH), the replacement ratio is 1:1, using a mix of trees and shrubs to match the character of the trees removed. WSDOT Category 3 vegetation has not been quantified for this report as it is assumed that the opportunity to replace this vegetation can occur within the general restoration plantings proposed with this project.

WSDOT preference is that tree canopy loss is mitigated within the area disturbed by the project. If this is not achievable, the next options for location of mitigation plantings are to plant within the WSDOT ROW in areas outside of the disturbed limits but within the same highway corridor or within WSDOT ROW on another highway within the same region. DRLE will have limited opportunities to accommodate replacement tree plantings within the area impacted by the Project. See the WSDOT Roadside Restoration Expectations document for identification of potential mitigation planting areas. A Plant Establishment Agreement for three years of maintenance is typically required for any mitigation plantings on WSDOT property, in accordance with the Roadside Policy Manual.

Sound Transit and WSDOT have come to an agreement to modify the stated policy on tree replacement quantities for the DRLE project. Sound Transit has agreed to direct the Contractor to plant larger sized trees (5 gal. size); in return, WSDOT has agreed to an associated reduction in the number of trees required to be planted by a factor of 4 (75%).

Sound Transit and WSDOT have also come to an agreement to modify the stated policy on length of warranty and maintenance. Sound Transit has agreed to provide additional years of plant maintenance and WSDOT has agreed to an associated reduction in the number of trees required to be planted. For every 1 year of maintenance (past the required three years), WSDOT will allow a 5% reduction in the number of trees required to be planted. The Contractor will be responsible for providing 2 years warranty and maintenance on all landscape areas within the WSDOT ROW, including all tree replacement plantings. Sound Transit will then pay WSDOT to perform maintenance on these areas for the following 11 years (13 years maintenance total). In return, WSDOT will allow a 50% reduction (5% for each of 10 years) in the number of tree required to be planted. Refer to the Project Requirements and to the WSDOT Roadside Restoration Expectations document for further information.

DRLE Preliminary Engineering - WSDOT Estimated Tree Removals and Replacement Mitigation

	Estimated Tree Removals Total (a)	Estimated Tree Removals Excluding Early Successional, Dead/Dying, & Imminent Threat Trees (b)	Category 1 Estimated Tree Removals (qty) (c)	Category 1 DBH inches of trees removed of trees (c)	Category 1 Number of Replacement 1-gal trees (c)	Category 2 Estimated Tree Removals (qty) (d)	Category 2 DBH inches of trees removed (d)	Category 2 Number of Replacement 1-gal trees (d)	**Total** Number of Replacement Using 1-gal Trees (c+d)	**Total** Number of Replacement Using 5-gal Trees(e)	**Total** Number of Replacements with Extended Plant Establishment (f)
Low Estimate (g)	1025	810	18	648.3	3890	791	6331	6331	10221	2555	1278
High Estimate (h)	1069	850	22	730.8	4385	829	6648	6648	11033	2758	1379

Calculation Notes: (a) Tree removals are based on current Project Impact Area provided by Parametrix and tree inventory provided by Urban Forestry Services, August 22, 2018.
(b) Early successional tree species include alder, cottonwood, and Lombardy poplar; Imminent Threat trees per UFS tree hazard assessment survey.
(c) For Category 1 vegetation (trees >30 inch DBH), the replacement value is six 1-gallon replacement trees for each DBH inch removed.
(d) For Category 2 vegetation (trees 4-30 inch DBH), the replacement value is one 1-gallon replacement tree for each DBH inch removed.
(e) Refer to Sound Transit Letter of Concurrence with WSDOT. 5-gal trees shall be planted for an associated reduction (by a factor of 4) in the number of replacement trees required.
(f) Refer to Sound Transit Letter of Concurrence with WSDOT. 10 additional years of plant establishment will be provided by Sound Transit for an associated reduction (of 50%) in the number of replacement trees required.
(g) Total tree removals within track alignment, 15' vegetative clear zone, and hazard trees.
(h) Total potential tree removals within track alignment, 15' vegetative clear zone, hazard trees, and all contruction access and construction laydown easement areas.

General Notes: 1. All calculations for tree mitigation based on current WSDOT Roadside Manual. Mitigation requirements may change over time and any final tree mitigation plans will need to comply with current jurisdictional requirements.
2. Due to overlap in data categories quantities may not total evenly.

Figure 1. WSDOT Estimated Tree Removals and Replacement Mitigation

2.2 King County

King County defines a significant tree as an existing healthy tree that is not a hazard tree and that is a minimum of twelve inches DBH for deciduous trees or eight inches DBH for evergreen trees. A significant tree may be credited as two trees if: the tree is greater than eighteen inches DBH; is located in a grouping of at least five trees with canopies that touch or overlap; provides energy savings through winter wind protection or summer shading as a result of its location relative to buildings; belongs to a unique or unusual species; is located within twenty-five feet of any critical area or required critical area buffers; or the tree is listed on a historical register.

A significant tree to be replaced by a new replacement tree shall be assigned a diameter of twelve inches. If using replacement trees measuring three inches caliper or greater, one-half inch caliper of replacement tree shall be provided for each one inch DBH of significant tree removed. If using replacement trees measuring less than three inches caliper, one inch caliper of replacement tree shall be provided for each one inch DBH of significant tree removed.

If tree replacement cannot be fulfilled on the impacted site, King County may request trees be located in alternate locations to protect or enhance wildlife habitat. See King County Tree Mitigation Plan for identification of potential mitigation planting areas.

King County requires a 2 year warranty and maintenance period on any plantings.

DRLE Preliminary Engineering - King County Estimated Tree Removals and Replacement Mitigation

	Estimated Tree Removals in King County Jurisdiction (a)	Estimated Significant Tree Removals Excluding Non-Significant Trees, Dead/Dying/ Hazardous Trees and Tree Removals in Critical Areas (b)(c)(d)	Significant Tree Removals Type 1 (e)	Type 1 Replacement Cal. Inches (f)	Significant Tree Removals Type 2 (g)	Type 2 Replacement Cal. Inches (h)	Total Replacement Cal. Inches (f+h)	Number of Replacement Trees Required if Trees 3" Cal. or greater are Used (i)	Number Replacement Trees Required if Trees < 3" Cal. Are Used (i)
Low Estimate (j)	139	24	9	108	16	384	492	246	492
High Estimate (k)	245	38	20	240	19	456	696	348	696

Calculation Notes:
(a) Tree removals are based on current Project Impact Area provided by Parametrix and tree inventory provided by Urban Forestry Services, August 22, 2018.
(b) Significant trees as defined by King County Code 21A.06.1167 as any conifer tree with a DBH of 8 inches or greater, or any deciduous tree with a DBH of 12 inches or
(c) Per King County Code 16.82.156C, dying, diseased, and hazardous trees are excluded from significant tree calculation; non-significant trees do not have a replacement
(d) Tree replacement within critical areas are mitigated under separate permits.
(e) Type 1 trees are significant trees with 12-17 inch DBH for deciduous trees, 8-17 inch DBH for conifers.
(f) Type 1 significant trees have a replacement value of 12 inches caliper.
(g) Type 2 trees are significant trees with 18 inch DBH or greater.
(h) Type 2 significant trees have a replacement value of 24 inches caliper
(i) Per King County Code 16.82.156.E.2, if replacement trees are 3 inch caliper or greater, 1/2 inch caliper replacement is required for every 1 inch DBH of Significant Tree
(j) Total tree removals within track alignment, 15' vegetative clear zone, and hazard trees.
(k) Total potential tree removals within track alignment, 15' vegetative clear zone, hazard trees, and all contruction access and construction laydown easement areas.

General Notes:
1. All calculations for tree mitigation based on current King County Municipal Code. Mitgation requirements may change over time and any final tree mitigation plans will need to comply with current jurisdictional requirements.
2. Due to overlap in data categories quantities may not total evenly.
3. King County may count a significant tree as two trees if the tree is within a grouping of 5 or more trees, provides energy savings, belongs to a unique species, or is on an historial register. This level of detailed information was not collected for this project so these potential additional replacement trees were not quantified in the study.

Figure 2. King County Estimated Tree Removals and Replacement Mitigation

2.3 City of Redmond

General site development standards in the City of Redmond Zoning Code note that site improvements shall be designed to protect trees on site, especially stands of healthy trees, trees with habitat or slope stabilization function, or trees at the perimeter of a property that serve a screening function. The City may require trees designated to be protected within the development permitting process to be permanently protected by being noted on the deed or binding site plan.

The City defines a Significant Tree as any healthy tree six inches DBH or any tree four inches DBH that, after considering its age, height, value, or function, is determined to be a significant tree or tree stand. A Landmark Tree is any healthy tree over thirty inches DBH. To remove a healthy Landmark Tree, an International Society of Arborists (ISA) Tree Evaluation Form and a Tree Removal Exception Request form must be completed.

For each Significant Tree removed, one replacement tree must be planted. Landmark Trees removed shall be replaced with three new trees. Minimum sizes for replacement trees are 2-1/2 inch caliper for deciduous trees or 6 foot height for conifers. It is preferable for the tree to be planted on the site where it is removed but alternative planting areas could include City or County-owned opens space, parks or Native Growth Protection Areas. No replacement trees are required for hazardous, dead or diseased trees that are removed.

For any development projects that identify Significant Trees within or adjacent to the work impact zone, a tree protection and replacement plan must be submitted to the City. In order to adequately protect trees near a construction zone, tree protection barriers must be placed at least 5’ outside the dripline of the tree.

The City has created a set of supplemental standards for tree preservation and replacement within the Marymoor Design district near the SE Redmond Station. Redevelopment must include enough tree plantings to provide 15% canopy coverage of the site within 10 years of completion. The plans can utilize existing trees to remain, replacement trees and street trees to meet the requirements.

The City of Redmond requires a 1 year warranty and maintenance period on any plantings.

DRLE Preliminary Engineering - City of Redmond Estimated Tree Removals and Replacement Mitigation

	Estimated Tree Removals within City of Redmond (COR) (a)	Estimated Significant Tree Removals Excluding Non-Significant Trees, Dead/Dying, Hazardous Trees, & Invasive Species (b)	Significant Tree Removals 6"-30" (c)	Tree Replacements for Significant Trees (d)	Landmark Tree Removals (e)	Tree Replacements for Landmark Trees (f)	Potential Significant Tree Removals 4"-6" (g)	COR Replacement Tree Totals (j)	
								Low Replacement Estimate (h)	High Replacement Estimate (i)
Low Estimate (k)	810	620	592	592	17	51	106	643	749
High Estimate (l)	1125	884	844	844	30	90	155	934	1089

Calculation Notes:
(a) Tree removals are based on current Project Impact Area provided by Parametrix and tree inventory provided by Urban Forestry Services, August 22, 2018. Calculation includes trees owned by the COR and on private properties within the COR jurisdiction.
(b) Trees with a DBH of less than 6 inch are considered Non-Significant per COR RZC 21.78. Dead, dying, or hazardous trees are excluded from tree replacement calculation per COR RZC 21.72.080.B.
(c) Significant trees are defined by COR RZC 21.78 as trees with a DBH of 6 inches or greater.
(d) Significant trees require 1:1 replacement per COR RZC 21.72.080.B.
(e) Landmark trees are defined as trees with DBH of 30 inches or greater per COR RZC 21.72.080.B.
(f) Landmark trees require 3:1 replacement per COR RZC 21.78.080.B.
(g) Trees with 4-6 inch DBH require COR review to determine appropriate classification.
(h) Tree Replacements for Significant and Landmark Trees, assuming no replacement for trees of 4-6 inch DBH removed (d+f).
(i) Tree Replacements for Significant and Landmark Trees, assuming 1:1 replacement for all trees of 4-6 inch DBH removed (d+f+g).
(j) Replacement Trees to be 2-1/2 inch caliper minimum for deciduous trees, 6 foot height minimum for evergreen trees per COR RZC 21.72.080.C.
(k) Total tree removals within track alignment, 15' vegetative clear zone, and hazard trees.
(l) Total potential tree removals within track alignment, 15' vegetative clear zone, hazard trees, and all contruction access and construction laydown easement areas.

General Notes:
1. All calculations for tree mitigation based on current City of Redmond Municipal Code. Mitigation requirements may change over time and any final tree mitigation plans will need to comply with current jurisdictional requirements.
2. Due to overlap in data categories quantities may not total evenly.

Figure 3. City of Redmond Estimated Tree Removals and Replacement Mitigation

3. SUMMARY

This set of mitigation calculations presents a comparison of the minimum and the maximum amount of trees that can predicted to be removed for the DRLE project, using the Preliminary Engineering plans as a basis. It is anticipated that the Contractor will be able to use these estimates to begin to understand the scope of tree removal and to quantify the mitigation that each jurisdiction will require for removal of these resources. The expectation is that, as more detailed plans for construction access and laydown are completed, a more concise plan for tree preservation, tree removal and replacement mitigation will be determined by the Contractor.

Trees to be protected and those to be removed will be identified and tracked on the Tree and Vegetation Protection Plan, as required in spec section 015639, as well as with the GIS web application. At the completion of the project, the Contractor will update and confirm the tree inventory and turn over the updated GIS file to Sound Transit in accordance with the Project Requirements. Sound Transit will use the GIS application to create a basis for a long-term tree management plan for vegetation maintenance. Creating a plan for monitoring, assessing and removal of hazard trees allows Sound Transit to be able to retain healthy, mature trees in the vicinity of the light rail line while reducing the risks to safe rail operation.

Trees are important natural resources. They provide environmental benefits (cleaning the air, providing shade, reducing stormwater runoff), personal benefits (increased health benefits) and community benefits (increasing property values, enhancing outdoor use areas). Established, mature trees have better soil holding capacity to prevent runoff, provide more shade, and sequester more carbon dioxide than younger, smaller trees so there is value in retaining larger trees along the Project. Potential strategies for protecting and retaining mature trees along the alignment include planning ahead for installation of tree protection measures during construction, use of sensitive construction methods around existing trees, and ensuring all site staff are educated on the intentions and the requirements of the tree protection measures.

APPENDIX A

Jurisdictional codes relating to tree protection, removal and mitigation

WSDOT
Roadside Policy Manual, M 3110.03
Roadside Manual, M 25-30

King County
Title 21 A Zoning
Title 16 Clearing and Grading

City of Redmond
Redmond Zoning Code (Redmond Municipal Code Title 21)

Attachment B

Tree Table

Downtown Redmond Link Extension:
City of Redmond Shoreline Jurisdiction Tree Table
2/5/2019

Tag Number	Species	DBH	Health	Comments	Replacement Exemption	Replacement Trees	Proposed Action
4002	Incense cedar	5	Fair to Good			3	Remove
4003	Incense cedar	4	Fair			3	Remove
4004	Incense cedar	4	Fair to Good			3	Remove
4007	Incense cedar	4	Fair to Good			3	Remove
4008	Incense cedar	4.5	Fair	Bowed trunk		3	Remove
4009	Incense cedar	5	Fair to Good			3	Remove
4016	Incense cedar	4	Fair			3	Remove
4017	Incense cedar	4	Fair to Good			3	Remove
4018	Incense cedar	4.5	Fair to Good			3	Remove
4019	Incense cedar	4	Fair to Good			3	Remove
4020	Incense cedar	4.5	Fair to Good			3	Remove
4021	Incense cedar	5.5	Fair to Good			3	Remove
4022	Incense cedar	4.5	Fair to Good			3	Remove
4027	Incense cedar	4	Fair	Multiple top with three codominant leaders.		3	Remove
5059	Black cottonwood	26	Fair	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5060	Black cottonwood	14.5	Fair	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5061	Black cottonwood	22	Fair	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5062	Scouler's willow	13	Dying/Dead	Remove due to risk of branch and crown failure. Large sections of dead codominant leaders and significant dead branches, trunk decay. Multiple trunks.	Hazard Tree	0	Remove
5063	Black cottonwood	20	Fair to Good	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5063.1	Black cottonwood	13	Fair to Good	Remove due to risk of branch and crown failure. Tree leans to northeast.	Hazard Tree	0	Remove
5063.2	Scouler's willow	10	Dying/Dead	Remove due to risk of branch and crown failure. Broken/hanging branches. Tree is dead. Multiple trunks.	Hazard Tree	0	Remove
5064	Black cottonwood	27	Fair	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5065	Black cottonwood	25.5	Fair to Good	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5066	Red alder	14	Poor	Remove due to risk of branch and crown failure. Tree is in decline, with a dead central crown, significant dead branches, and significant dead codominant trunk. Multiple trunks.	Hazard Tree	0	Remove
5067	Black cottonwood	14.5	Fair	Remove due to risk of branch and crown failure. Tree leans to north, and main trunk has a kink and offset crown.	Hazard Tree	0	Remove
5068	Black cottonwood	19	Fair to Good	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5069	Black cottonwood	15	Fair to Good	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5070	Black cottonwood	15.5	Fair to Good	Remove due to risk of branch and crown failure. Two codominant trunks, forked at ground level.	Hazard Tree	0	Remove
5071	Black cottonwood	14	Fair	Remove due to risk of branch and crown failure. Rooted on the edge of the stream bank. Severe lean to north.	Hazard Tree	0	Remove
5072	Scouler's willow	4.5	Poor	Declining health, crown failure on the north side of tree. Significant dead codominant trunk and branches. Multiple trunks.	Dead/Diseased	0	Remove
5073	Black cottonwood	19	Fair to Good	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5074	Black cottonwood	9.5	Fair	Remove due to risk of branch and crown failure. Rooted in armored stream bank, bowed trunk, poor taper, leaning north.	Hazard Tree	0	Remove
5075	Red alder	5.5	Fair to Good	Tree leans southeast.		3	Remove
5075.1	Red alder	4	Fair	Tree leans west, over stream, due to previous failure.		3	Remove

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5076	Scouler's willow	4	Poor to Fair	Branch dieback and large sections of dead crown. Multiple trunks.		3	Remove
5077	Douglas fir	10.5	Fair			3	Remove
5078	Douglas fir	12.5	Fair to Good	Animal injury to lower trunk.		4	Remove
5079	Sitka spruce	11	Fair to Good	Animal injury to lower trunk.		3	Remove
5080	Douglas fir	14	Fair	Animal injury to lower trunk.		4	Remove
5081	Sitka spruce	5.5	Fair to Good			3	Remove
5082	Scouler's willow	12	Dying/Dead	Remove due to risk of crown failure. Significant dead branches and codominant stem, large sections of dead crown, trunk decay.	Hazard Tree	0	Remove
5083	Pacific willow	14	Fair	Significant codominant trunk and crown felled by beaver. Trunk tear-out wound. Multiple trunks.		4	Remove
5084	English hawthorn	4	Fair	Self-corrected lean to northwest. Currently stable. Multiple trunks.		3	Remove
5085	Ash	6	Fair	Multiple trunks, including dead codominant leaders.		3	Remove
5086	Orgeon ash	9.8	Fair to Good	Two codominant trunks, forking at ground level.		3	Remove
5087	Red alder	10.5	Fair	Risk of crown failure.		3	Remove
5088	Scouler's willow	7	Fair	Vertical crack, fracturing of codominant trunks, failed leaders. Root and soil crack. Multiple trunks.	Poor structure	0	Remove
5089	Scouler's willow	6	Fair	Multiple trunks.		3	Remove
5090	Orgeon ash	8.6	Fair	Two codominant leaders, stable structure. Wet soils in area.		3	Remove
5091	Red alder	5.3	Fair to Good			3	Remove
5092	European white birch	6	Fair			3	Remove
5093	European white birch	6.5	Fair to Good	Extreme sweep to the lower trunk, having failed to the east in the past.		3	Remove
5094	Red alder	7.8	Fair			3	Remove
5095	Red alder	7	Poor to Fair	Slightly suppressed by surrounding canopy.		3	Remove
5096	Red alder	7.8	Fair			3	Remove
5097	Pacific sunset maple	9	Fair to Good			3	Remove
5098	Pacific sunset maple	5.8	Fair	Multiple attachments at a single point on the trunk, with tight angles and included bark with seams between the trunks; typically a weak structure.		3	Remove
5099	Pacific sunset maple	6.2	Fair	Multiple attachments at a single point on the trunk, with tight angles and included bark with seams between the trunks; typically a weak structure.		3	Remove
5100	Pacific sunset maple	10.5	Fair			3	Remove
5101	Pacific sunset maple	11.7	Fair to Good	Codominant branches with poor structure		3	Remove
5102	Red alder	8	Fair	Swept lower trunk due to past failure.		3	Remove
5103	Scouler's willow	4	Fair	Multiple trunks.		3	Remove
5104	Red alder	8.8	Fair	Risk of crown failure.		3	Remove
5105	Red alder	9.7	Fair	Remove due to risk of crown failure. Cracked and decayed trunk.	Poor structure	0	Remove
5106	Scouler's willow	10	Fair	Prune and monitor. Codominant leaders have failed, leaving tear-out wounds. Trunks bow to west. Crown contains dead and lodged branches. Multiple trunks.		3	Remove
5107	Red alder	11	Poor	Remove due to risk of crown failure. Large sections of dead crown, significant dead branches.	Hazard Tree	0	Remove
5108	**Ash**	**42**	Poor	Cut to create a wildlife tree. Extensive pockets and columns of decay in the primary trunk. Catastrophic crown failure. Significant dead branches and codominant trunk.	Dead/Diseased	0	Remove

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5109	Orgeon ash	5	Fair	The upper crown is being impacted by the crown of tree no.5110.		3	Remove
5110	European white birch	14.5	Fair	Tree has failed in the past, but has regrown and formed two codominant leaders.	Poor structure	0	Remove
5121	Black cottonwood	16	Fair to Good	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5122	Black cottonwood	14	Fair to Good	Remove due to risk of branch and crown failure	Hazard Tree	0	Remove
5129	Douglas fir	21	Fair to Good			N/A	Impacted
5130	Douglas fir	17	Fair to Good			N/A	Impacted
5131	Orgeon ash	11.5	Fair	Remove due to risk of branch and crown failure. Multiple trunks with longitudinal decay and failed codominant leaders. Large sections of dead crown, significant dead branches.	Hazard Tree	0	Remove
5132	Douglas fir	11	Fair	Remove due to risk of branch and crown failure. Self-corrected lean.	Hazard Tree	0	Remove
5200	Black cottonwood	24	Fair to Good	Remove due to risk of branch and crown failure. Significant dead branches.	Hazard Tree	0	Remove
5553	Incense cedar	4.3	Fair to Good			N/A	Retain
5554	Incense cedar	4.4	Fair to Good			3	Remove
5555	Incense cedar	4.5	Fair to Good			3	Remove
5556	European white birch	3.4	Poor	Decline in crown foliage density, branch dieback.	Dead/Diseased	0	Remove
5565	Cleveland select pear	8.1	Fair to Good	Many surface roots, lean toward northwest.		3	Remove
5566	Cleveland select pear	8.2	Fair	Surface roots.		3	Remove
5567	Cleveland select pear	8.3	Fair	Leans northwest.		N/A	Retain
5568	Cleveland select pear	8.1	Fair to Good	Many surface roots, slight lean toward northeast.		N/A	Retain
5569	Cleveland select pear	8.5	Fair			N/A	Retain
5571	Red alder	16	Fair	Portion of crown overhangs highway bridge over the Sammamish River.		5	Remove
5572	Red alder	10.3	Fair	Lean toward southwest, appears stable.		3	Remove
5573	Red alder	17.3	Fair			5	Remove
5574	Black cottonwood	14.3	Fair to Good			4	Remove
5921	Black cottonwood	29.6	Fair to Good			6	Remove
5922	Black cottonwood	24.6	Fair to Good			6	Remove
5923	Black cottonwood	23.2	Fair	Leans toward south. Narrow crown relative to surrounding trees. Partially occluded injury with moderate decay on lower trunk.		N/A	Impacted
5924	Black cottonwood	19.7	Fair	Catastrophic trunk failure approximately 30 feet above ground. Decay likely at failure point. New leader at failure point, growing at 20-degree angle northeast. Over-extended branches with poor taper.		N/A	Impacted
6996	Western red cedar	6.7	Fair			3	Remove
6999	English hawthorn	7.7	Fair	33-degree lean to south. Significant dead branches. Multiple trunks.		3	Remove
7000	Pacific sunset maple	12.8	Fair to Good	Non-native, planted cultivar.		4	Remove
9082	English hawthorn	7.1	Fair to Good	Multiple trunks.		3	Remove
9096	Pacific sunset maple	11.7	Fair to Good	Non-native, planted cultivar.		3	Remove
9097	Western crabapple	7.5	Fair	Multiple codominant trunks with poor structure.		3	Remove
9098	Pacific willow	6.2	Fair	Bend and bow in the lower trunk. Crown is half-smothered by Himalayan blackberries.		3	Remove
9099	Pacific sunset maple	11.7	Fair to Good	Non-native, planted cultivar.		3	Remove
9100	Douglas fir	11.2	Fair			3	Remove
9101	Western red cedar	6.7	Fair			3	Remove

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9102	Bitter cherry	5.3	Fair	Approximately 30-degree lean toward Bear Creek Trail. Unstable trunk. Decline in crown foliage density.		3	Remove
9103	Red alder	11.9	Poor	Significant dead branches and codominant trunk. Over-extended branches with poor taper. Large sections of dead crown. Canker or foliar disease in branches.	Dead/Diseased	0	Remove
9105	Pacific sunset maple	8.6	Fair to Good	Non-native, planted cultivar.		3	Remove
9106	Western red cedar	8.5	Fair to Good	Bowed trunk, correcting a lean.		3	Remove
9107	Red alder	8.8	Fair to Good			3	Remove
9108	Red alder	5.6	Fair to Good	Trunk has poor taper.		3	Remove
9109	Red alder	11.4	Fair			3	Remove
9110	Red alder	8.7	Fair to Good			3	Remove
9111	Red alder	4.4	Poor to Fair	Trunk has poor taper.		3	Remove
9112	Red alder	5.9	Fair	Trunk has poor taper.		3	Remove
9113	Red alder	11.2	Fair to Good			3	Remove
9114	Red alder	12.4	Fair to Good			4	Remove
9116	Red alder	8.8	Fair	Minor injuries on lower trunk.		3	Remove
9117	Red alder	8.3	Fair	Minor injuries on lower trunk.		3	Remove
9118	Orgeon ash	8.7	Fair to Good			3	Remove
9119	Sitka spruce	4.7	Fair	Beaver damage affecting more than 30% of circumference at the base.		3	Remove
9120	Cascara	4.9	Fair to Good			3	Remove
9134	Red alder	13.4	Poor	Dead top. Upper crown has begun to fail, with dead crown parts failing out. Tree appears to be in decline.	Poor structure	N/A	Impacted
9135	Red alder	7.4	Poor	Dead top. Upper crown has begun to fail, with dead crown parts failing out. Tree appears to be in decline.	Poor structure	N/A	Impacted
9136	Red alder	9.8	Fair			N/A	Impacted
9137	Red alder	7.7	Fair			N/A	Impacted
9138	Red alder	9.3	Fair			N/A	Impacted
9139	Red alder	6.9	Dying/Dead	Dead.	Dead/Diseased	N/A	Impacted
9140	Red alder	11.5	Fair	Weak codominant trunk structure with a seam and included bark. Decay at site of past trunk failure approximately 10 feet above ground. New leaders arising from below failure site.		3	Remove
9141	Red alder	12.9	Poor	Dead top. Upper crown has begun to fail, with dead crown parts failing out. Tree appears to be in decline.	Dead/Diseased	0	Remove
9236	Black cottonwood	8	Fair to Good	Multiple trunks.		N/A	Retain
9237	Western crabapple	4	Fair			3	Remove
9238	Orgeon ash	4	Fair to Good			3	Remove
9242	Red alder	6.2	Poor	Decline in crown foliage density. Branch dieback. Trunk has poor taper.	Poor structure	N/A	Impacted
9243	Douglas fir	8.9	Fair			N/A	Impacted
9244	Douglas fir	7.2	Fair			N/A	Impacted
9245	Scouler's willow	10	Poor to Fair	Trunk tear-out wound, containing decay. Large sections of dead crown. Significant dead branches.	Poor structure	N/A	Impacted
9246	Paper birch	8.7	Dying/Dead		Dead/Diseased	N/A	Retain
9247	Paper birch	15.7	Dying/Dead	Large sections of dead crown. Significant dead branches.	Dead/Diseased	N/A	Impacted

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9248	Scouler's willow	15.2	Poor to Fair	Large sections of dead crown. Significant dead branches. Trunk tear-out wound, containing decay.	Poor structure	0	Remove
9249	Bigleaf maple	6.4	Fair	Approximately 8-degree lean to northeast. Multiple trunks.		3	Remove
9250	Bigleaf maple	14.4	Fair to Good	Occluded basal injury.		N/A	Impacted
9251	Scouler's willow	9.8	Poor	Trunk decay. Large sections of dead crown. Significant dead branches.	Poor structure	N/A	Retain
9252	Black cottonwood	19.7	Fair	Over-extended branches with poor taper.		N/A	Impacted
9253	English hawthorn	3.8	Fair			N/A	Impacted
9254	Paper birch	6.6	Fair			N/A	Impacted
9255	Orgeon ash	7	Fair	Trunk has poor taper.		N/A	Impacted
9256	Paper birch	4.5	Fair	Suppressed.		3	Remove
9257	Paper birch	5.8	Fair	Slightly suppressed.		3	Remove
9258	Black cottonwood	25.5	Fair	Significant dead branches. Over-extended branches with poor taper. Multiple trunks.		6	Remove
9259	Scouler's willow	9.8	Poor to Fair	Decline in crown foliage density. Significant dead branches. Trunk tear-out wound, containing decay. Leaning and unstabel trunk.	Poor structure	N/A	Impacted
9260	Scouler's willow	9.3	Poor	Large sections of dead crown. Significant dead branches. Significant dead codominant trunk. Trunk tear-out wound, containing decay.	Poor structure	N/A	Retain
9261	Scouler's willow	8.7	Poor to Fair	Trunk tear-out wound, containing decay. Broken and/or hanging branches. Large sections of dead crown. Branch dieback.	Poor structure	N/A	Retain
9262	Scouler's willow	5.8	Fair	Approximately 42-degree lean to southeast.		N/A	Retain
9263	Scouler's willow	3.9	Fair	Approximately 56-degree lean to southeast. No sign of recent instability.		N/A	Retain
9264	Scouler's willow	7.8	Fair	Approximately 24-degree lean to southeast.		N/A	Retain
9265	Scouler's willow	5.7	Fair			N/A	Retain
9266	Sitka spruce	9.3	Fair			N/A	Retain
9267	Scouler's willow	5.5	Fair	Dramatic lean to northeast, with trunk bowed to a horizontal position 5 feet above ground.		N/A	Retain
9268	Black cottonwood	12	Fair to Good	Trunk has poor taper.		N/A	Retain
9269	Scouler's willow	6.7	Fair	Multiple trunks.		N/A	Retain
9270	Scouler's willow	4	Fair			N/A	Retain
9271	Black cottonwood	8.5	Fair to Good			N/A	Retain
9272	Orgeon ash	4.3	Fair			N/A	Retain
9273	English hawthorn	5.1	Dying/Dead	Large sections of dead crown. Significant dead branches. Multiple trunks.	Dead/Diseased	N/A	Retain
9274	Black cottonwood	14.8	Fair to Good	Over-extended branches with poor taper.		N/A	Retain
9275	Black cottonwood	17	Fair to Good	Over-extended branches with poor taper.		N/A	Retain
9276	Scouler's willow	5.7	Fair to Good			N/A	Retain
9277	Orgeon ash	8.9	Fair	Multiple trunks.		3	Remove
9278	Scouler's willow	5.8	Fair	Multiple trunks.		3	Remove
9279	Red alder	8.2	Fair	Trunk scarring with exposed wood and response growth on the lower trunk.		3	Remove
9282	Scouler's willow	4	Fair	Lean to north. Multiple trunks.		N/A	Impacted
9283	Scouler's willow	7.5	Fair	Multiple failed leaders. Broken and/or hanging branches. Over-extended branches with poor taper. Multiple trunks.		N/A	Impacted
9284	Western crabapple	3	Fair	Multiple trunks.		N/A	Impacted

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9285	Scouler's willow	3.3	Fair	Approximately 38-degree lean to northeast. Multiple trunks.		3	Remove
9286	Red alder	8.5	Dying/Dead	Decay in trunk, unstable lean.	Dead/Diseased	0	Remove
9287	Sitka spruce	10.7	Fair to Good	Basal injury with exposed wood. Surface roots present.		3	Remove
9288	Red alder	4.9	Dying/Dead	Large sections of dead crown. Broken and/or hanging branches.	Dead/Diseased	0	Remove
9289	Sitka spruce	8.5	Fair to Good			3	Remove
9290	Scouler's willow	5	Poor	Large sections of dead crown. Branch dieback. Multiple trunks.	Dead/Diseased	0	Remove
9291	Scouler's willow	4	Fair	Multiple trunks.		3	Remove
9293	Orgeon ash	6.3	Fair to Good	Multiple trunks.		3	Remove
9294	Sitka spruce	10.3	Fair	Basal scar with exposed wood.		3	Remove
9295	Scouler's willow	5.3	Dying/Dead	Failed tree.	Dead/Diseased	0	Remove
9296	Sitka spruce	8.5	Fair to Good			N/A	Impacted
9297	Sitka spruce	5.5	Fair			3	Remove
9298	Sitka spruce	5	Fair to Good			3	Remove
9299	Pacific willow	24	Poor to Fair	Has suffered multiple failures over multiple years. Cracked and decayed trunk. Root movement and/or lift. Significant dead branches. Broken and/or hanging branches. Large sections of dead crown. Multiple trunks.		6	Remove
9300	Sitka spruce	7	Fair			3	Remove
9301	Red alder	8.7	Poor	Large sections of dead crown. Significant dead branches. Broken and/or hanging branches.	Dead/Diseased	0	Remove
9302	Scouler's willow	4	Poor to Fair			3	Remove
9303	Sitka spruce	4.7	Fair			3	Remove
9304	Western crabapple	4.7	Fair	Multiple trunks.		3	Remove
9305	Pacific willow	12.3	Fair	Trunk decay. Decline in crown foliage density. Significant dead branches. Multiple trunks.		4	Remove
9306	Pacific willow	19	Poor	Regrowing from fractured remains of previously failed trunk. Large sections of dead crown. Broken and/or hanging branches. Significant dead branches. Trunk decay present.	Dead/Diseased	0	Remove
9306	Pacific willow	19	Poor	Regrowing from fractured remains of previously failed trunk. Large sections of dead crown. Broken and/or hanging branches. Significant dead branches. Trunk decay present.	Dead/Diseased	0	Remove
9307	Sitka spruce	4.7	Fair to Good			3	Remove
9309	Scouler's willow	6.3	Fair	Trunk has poor taper.		3	Remove
9310	Scouler's willow	6.2	Poor to Fair	Decline in crown foliage density. Broken and/or hanging branches.		3	Remove
9311	Pacific willow	14.2	Fair to Good	50% of the trunk diameter has been cut away by beaver. Decay present.	Poor structure	0	Remove
9312	Red alder	16	Fair to Good			5	Remove
9313	Pacific willow	6.8	Fair	Multiple trunks.		3	Remove
9314	Pacific willow	5.7	Fair			3	Remove
9315	Scouler's willow	4.8	Fair			3	Remove
9316	Scouler's willow	5.3	Fair	Approximately 42-degree lean to northwest.		3	Remove
9317	Western red cedar	6	Fair to Good			3	Remove
9318	Red alder	6	Fair to Good			3	Remove

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Tag Number	Species	DBH	Health	Comments	Replacement Exemption	Replacement Trees	Proposed Action
9319	Red alder	5.4	Poor	Substantial decay in long trunk cavity. Large sections of dead crown. Significant dead branches. Multiple trunks.	Dead/Diseased	0	Remove
9320	Orgeon ash	18.3	Fair	Significant dead branches. Broken and/or hanging branches. Trunk tear-out wound, containing decay.		6	Remove
9321	Scouler's willow	4.7	Fair to Good	Tree group.		3	Remove
9322	Scouler's willow	4.7	Fair	Tree group.		3	Remove
9323	Scouler's willow	4.3	Fair to Good	Tree group.		3	Remove
9324	Pacific willow	3.9	Dying/Dead	This tree has failed entirely. Multiple trunks.	Dead/Diseased	0	Remove
9325	Scouler's willow	4.7	Fair			3	Remove
9326	Orgeon ash	6.9	Fair to Good			3	Remove
9327	Scouler's willow	4.7	Dying/Dead	Snag--partially failed. Significant dead codominant trunk. Large sections of dead crown. Significant dead branches. Broken and/or hanging branches.	Dead/Diseased	0	Remove
9328	Scouler's willow	4.7	Fair to Good			3	Remove
9329	Scouler's willow	4.7	Fair to Good			3	Remove
9330	Scouler's willow	4.8	Fair	Tree has rotated in the soil and split at the base. Approximately 70- to 75-degree lean to northwest. Multiple trunks.		3	Remove
9331	Scouler's willow	4.7	Fair	Partially failed. Approximately 70-degree lean to north-northwest.		3	Remove
9332	Scouler's willow	10.3	Fair	Partially failed. Approximately 70-degree lean to north-northwest.		3	Remove
9333	Orgeon ash	5.3	Fair			N/A	Retain
9334	Orgeon ash	4.9	Fair			N/A	Impacted
9335	Sitka spruce	4.6	Fair	Suppressed by overhead branches.		N/A	Impacted
9336	Scouler's willow	5.1	Fair	Multiple trunks.		3	Remove
9337	Red alder	9.5	Fair			3	Remove
9338	Scouler's willow	5.3	Fair	Partially laid across the ground due to past failure. Approximately 78-degree lean to northeast.		3	Remove
9339	Pacific willow	4.2	Fair	Approximately 44-degree lean to east.		3	Remove
9340	Scouler's willow	5.5	Fair to Good	Approximately 25-degree lean to south. Broken and/or hanging branches.		3	Remove
9341	Scouler's willow	5.8	Fair			3	Remove
9342	Scouler's willow	7.4	Fair			3	Remove
9343	Scouler's willow	5.8	Fair			3	Remove
9344	Orgeon ash	11.5	Fair to Good	Multiple trunks.		3	Remove
9345	Orgeon ash	6.7	Fair	Stable codominant trunk structure.		N/A	Impacted
9346	Red alder	10	Fair			3	Remove
9347	Red alder	8	Poor to Fair			3	Remove
9403	Black cottonwood	21	Fair	Basal injury from beaver activity. Over-extended branches with poor taper.		N/A	Impacted
9404	Pacific willow	11.3	Fair	Multiple failed leaders. Injuries and exposed wood on lower trunk; no decay. Located in a seasonally flooded area. Broken and/or hanging branches. Multiple trunks.		N/A	Retain
9405	Black cottonwood	25	Fair	Beaver damage to exposed roots; no decay visible. Over-extended branches with poor taper.		N/A	Impacted
9406	Orgeon ash	8.7	Fair	At margin of seasonally wet area. Significant dead branches.		N/A	Retain
9407	Black cottonwood	23	Fair to Good	Over-extended branches with poor taper. Multiple trunks.		N/A	Impacted

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9408	Black cottonwood	26.4	Fair to Good	Over-extended branches with poor taper.		N/A	Impacted
9409	Black cottonwood	11.7	Fair to Good	Swept lower trunk with occluded injury.		N/A	Impacted
9410	Orgeon ash	11.9	Fair	Multiple trunks.		N/A	Impacted
9411	Pacific willow	10.5	Poor to Fair	Leaders have failed in the past. Located in seasonally wet area. Broken and/or hanging branches. Branch dieback.	Poor structure	N/A	Retain
9412	Orgeon ash	9.5	Dying/Dead	Large sections of dead crown. Significant dead branches. Broken and/or hanging branches. Multiple trunks.	Dead/Diseased	N/A	Impacted
9413	Scouler's willow	7	Fair	Slight lean to north. Multiple trunks.		3	Remove
9414	Scouler's willow	17.5	Poor to Fair	Basal cavity containing decay. Significant dead branches. Multiple trunks.		5	Remove
9415	Pacific willow	15.5	Fair	Located in seasonally wet area. Significant dead branches.		N/A	Retain
9416	Red alder	16.8	Fair to Good			N/A	Retain
9417	Red alder	16.7	Fair	Failed upper leader.		N/A	Retain
9418	Pacific willow	6.8	Fair	Approximately 35-degree lean to northeast. Located in seasonally flooded area. Broken and/or hanging branches.		N/A	Retain
9419	Pacific willow	11.5	Poor to Fair	Basal cavity with decay. Approximately 32-degree lean to northeast. Located in seasonally flooded area. Broken and/or hanging branches.	Poor structure	N/A	Retain
9420	Red alder	14	Fair	Multiple trunks.		N/A	Retain
9421	English hawthorn	14.3	Fair to Good	Multiple trunks.		N/A	Retain
9422	Orgeon ash	19.8	Fair	Significant dead branches. Large sections of dead crown. Multiple trunks.		N/A	Retain
9423	Orgeon ash	17.9	Fair	Approximately 22-degree lean to northeast. Significant dead branches.		N/A	Retain
9424	Orgeon ash	15.4	Fair	Approximately 22-degree lean to northeast. Significant dead branches. Multiple trunks.		N/A	Retain
9425	Orgeon ash	15.8	Fair			N/A	Retain
9426	Orgeon ash	23.3	Fair to Good	Significant crack in codominant trunks, with seam and rib; decay likely. Significant dead branches.	Poor structure	N/A	Retain
9427	Orgeon ash	6.3	Poor	Consists of remaining trunk and regrowth from previously failed tree.	Poor structure	N/A	Retain
9428	Orgeon ash	6.2	Fair			N/A	Retain
9429	Orgeon ash	14	Poor to Fair	Regrowth from previous failure of mid- to upper trunk and crown.	Poor structure	N/A	Impacted
9430	Orgeon ash	8.9	Dying/Dead	Large sections of dead crown. Broken and/or hanging branches. Significant dead branches. Multiple trunks.	Dead/Diseased	N/A	Impacted
9431	Orgeon ash	21.5	Fair	Significant dead branches. Multiple trunks.		6	Remove
9432	Orgeon ash	15.5	Poor to Fair	Significant dead branches. Broken and/or hanging branches.		N/A	Impacted
9433	Orgeon ash	19.5	Dying/Dead	Large sections of dead crown. Significant dead codominant trunk. Significant dead, broken, and/or hanging branches. Multiple trunks.	Dead/Diseased	0	Remove
9434	English hawthorn	6.9	Fair to Good			3	Remove
9435	Pacific willow	10.4	Fair	Codominant branches with poor structure. Trunk has poor taper. Significant dead branches. Over-extended branches with poor taper. Multiple trunks.		3	Remove
9436	Scouler's willow	5.7	Fair to Good	Multiple injuries at the base, decay developing in lower 3 feet of trunk. Large codominant leader has failed toward the southwest. Multiple trunks.	Poor structure	0	Remove
9437	Black cottonwood	14.3	Fair to Good	All four trunks developed from a single lower trunk that is laid flat across the ground. 7-degree lean to north. Over-extended branches with poor taper. Trunk has poor taper. Multiple trunks.		4	Remove

Downtown Redmond Link Extension:
City of Redmond Shoreline Jurisdiction Tree Table
2/5/2019

Tag Number	Species	DBH	Health	Comments	Replacement Exemption	Replacement Trees	Proposed Action
9438	Bitter cherry	12.5	Fair to Good	Lower trunk obscured by English ivy, up to height of 20 to 25 feet. Over-extended branches with poor taper.		4	Remove
9439	Scouler's willow	10.7	Fair	Multiple trunks growing from leaning lower trunk of partially failed tree. Unstable. Multiple trunks.		3	Remove
9440	English hawthorn	5.9	Fair			3	Remove
9602	Orgeon ash	10.7	Fair			3	Remove
9603	Orgeon ash	25.3	Fair	Heavily decayed trunk with partially failed codominant trunks and large cavities in the primary trunk. Large sections of dead crown. Significant dead branches. Broken and/or hanging branches. Multiple trunks.	Poor structure	0	Remove
9604	Orgeon ash	6.3	Poor	Approximately 18-degree lean to southeast. Large cavities in soil under tree from river flow erosion. Large sections of dead crown. Root movement and/or lift. Significant dead branches. Over-extended branches with poor taper. Multiple trunks.	Dead/Diseased	0	Remove
9605	Orgeon ash	10.2	Fair	River flow erosion has undermined root soil. Significant dead branches. Decline in crown foliage density.		3	Remove
9606	Orgeon ash	13.5	Poor to Fair	River flow erosion has undermined root system. Decline in crown foliage density. Significant dead branches. Multiple trunks.		4	Remove
9607	Orgeon ash	23.8	Poor	Most of crown and trunk has failed, with subsequent crown regrowth. Significant dead codominant trunk. Trunk tear-out wound, containing decay. Codominant branches with poor structure.	Dead/Diseased	0	Remove
9608	Orgeon ash	10.5	Fair	Approximately 26-degree lean to north-northeast. Root system undermined by river flow erosion.		3	Remove
9609	Orgeon ash	14	Fair	Approximate 38-degree lean over river. Root system undermined by river flow erosion. Unstable trunk. Significant dead branches. Soil subsidence around roots.		4	Remove
9610	English hawthorn	10	Fair to Good	Lower trunk sections covered in English ivy. Over-extended branches with poor taper. Multiple trunks.		3	Remove
9611	Black cottonwood	14.9	Fair to Good	Severely swept lower trunk, a portion of which is lying on the soil surface and appears to have rooted.		N/A	Impacted
9612	Black cottonwood	6.9	Fair	Three codominant trunks, appraently stable. Trunk taper is low, increasing susceptibility to failure in prevailing winds if exposed. Multiple trunks.		N/A	Impacted
9613	Black cottonwood	8.5	Fair	Trunk has poor taper.		N/A	Impacted
9614	Black cottonwood	11.6	Fair	Swept lower trunk. Signs of root movement indicate potential instability in wet soil conditions.		N/A	Impacted
9615	Norway maple	4.7	Fair	Multiple decay points on trunk, including two long cavities. Large sections of dead crown. Significant dead branches.	Poor structure	0	Remove
9616	Western red cedar	5.3	Fair	Injuries from beaver activity, including open wound.		3	Remove
9617	Black cottonwood	7	Fair	Approximately 23-degree lean to northeast. Surface roots. Trunk has poor taper. Long-term retention not recommended.		N/A	Impacted
9618	Orgeon ash	10.9	Fair	Multiple trunks.		3	Remove
9619	Orgeon ash	19	Fair			6	Remove
9620	Black cottonwood	7	Fair	Connected through root grafting with #9621. Appears stable despite root lift and swept lower trunk.		N/A	Impacted

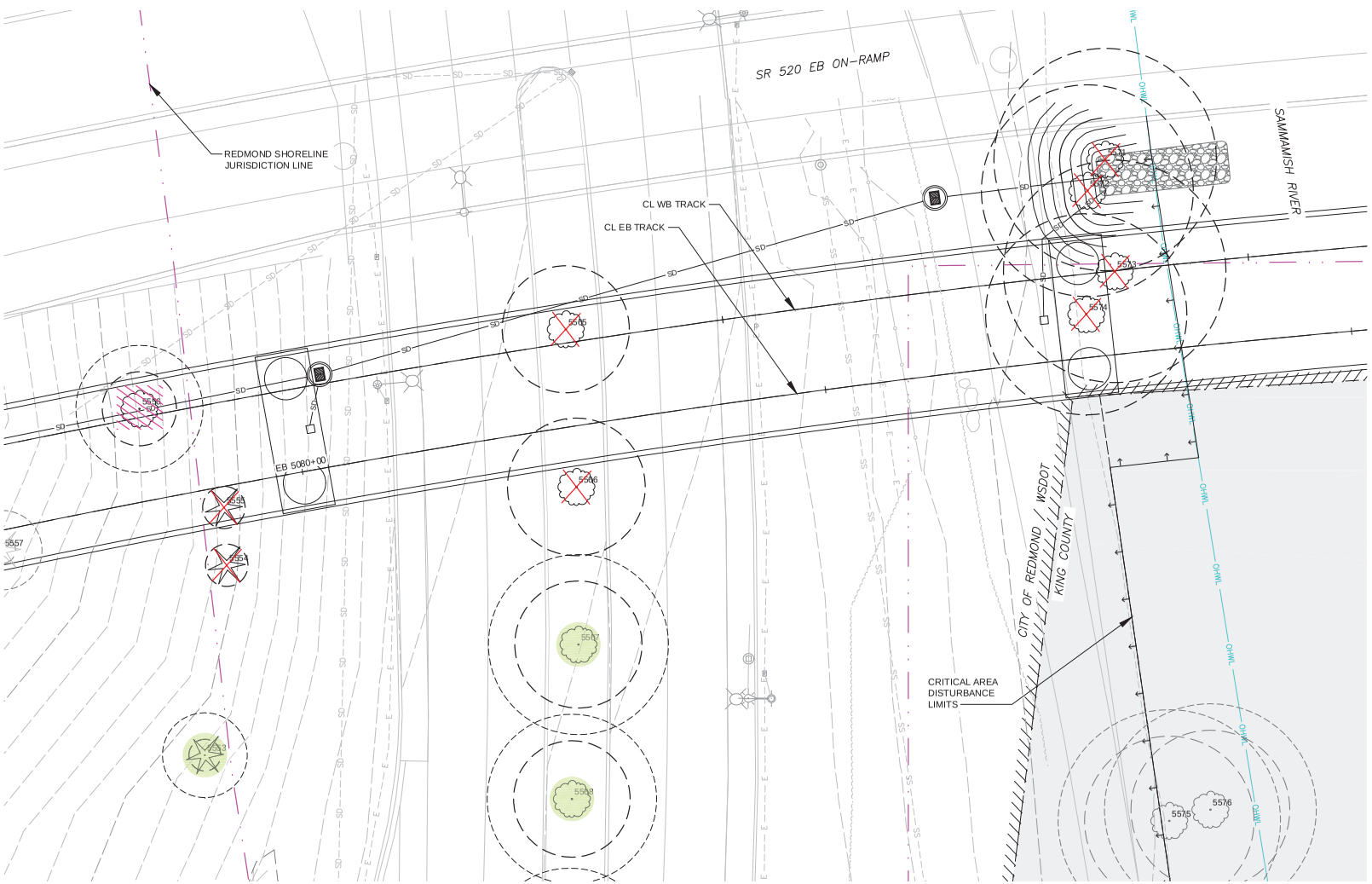
Downtown Redmond Link Extension:
City of Redmond Shoreline Jurisdiction Tree Table
2/5/2019

Tag Number	Species	DBH	Health	Comments	Replacement Exemption	Replacement Trees	Proposed Action
9621	Black cottonwood	9	Fair	Connected through root grafting with #9620. Appears stable despite root lift.		N/A	Impacted
9622	Black cottonwood	7.7	Fair	Surface roots, with raised trunk base and structural roots off the ground. Significant lean toward Redmond Way. Trunk has poor taper.		N/A	Retain
9623	**Black cottonwood**	**43**	Fair to Good	Over-extended branches with poor taper.		N/A	Impacted
9624	**Black cottonwood**	**31.7**	Fair to Good	Three codominant trunks, with arching and open crown and exposure to prevailing winds. Over-extended branches with poor taper.		N/A	Impacted
9625	Black cottonwood	20.4	Fair to Good	Asymmetrical and codominant crown with #9623. Over-extended branches with poor taper.		N/A	Retain
9626	English hawthorn	7	Fair to Good	Multiple trunks.		3	Remove
9627	Red alder	10.5	Fair to Good	Tree consists of multiple leaders from previously failed base. Multiple trunks.		3	Remove
<No Tag>	Kwanzan cherry	4.7	Fair	Trunk has stable but tight codominant at a height of approximately 3-feet, which may increase susceptibility to trunk failure in the future. Multiple trunks.		3	Remove

Attachment C

Drawings and Maps

SE 1/4, SEC. 11, T.25N. R.5E. W.M.



LEGEND

- 5'-0" DRIPLINE OFFSET
- DRIPLINE
- TREE ID
- TREE WITHIN CITY SHORELINE JURISDICTION
- TREE OUTSIDE CITY SHORELINE JURISDICTION
- CONIFEROUS TREE
- DECIDUOUS TREE
- SIGNIFICANT TREE TO BE REMOVED
- LANDMARK TREE TO BE REMOVED
- SIGNIFICANT TREE TO BE IMPACTED
- LANDMARK TREE TO BE IMPACTED
- SIGNIFICANT TREE TO BE RETAINED
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- UNHEALTHY / HAZARDOUS TREE

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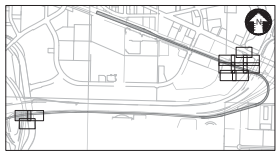

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CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: **L90-TP001**
LOCATION ID:
SHEET No.: 1
REV:

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xRLE-G95-Rdmd-SJB
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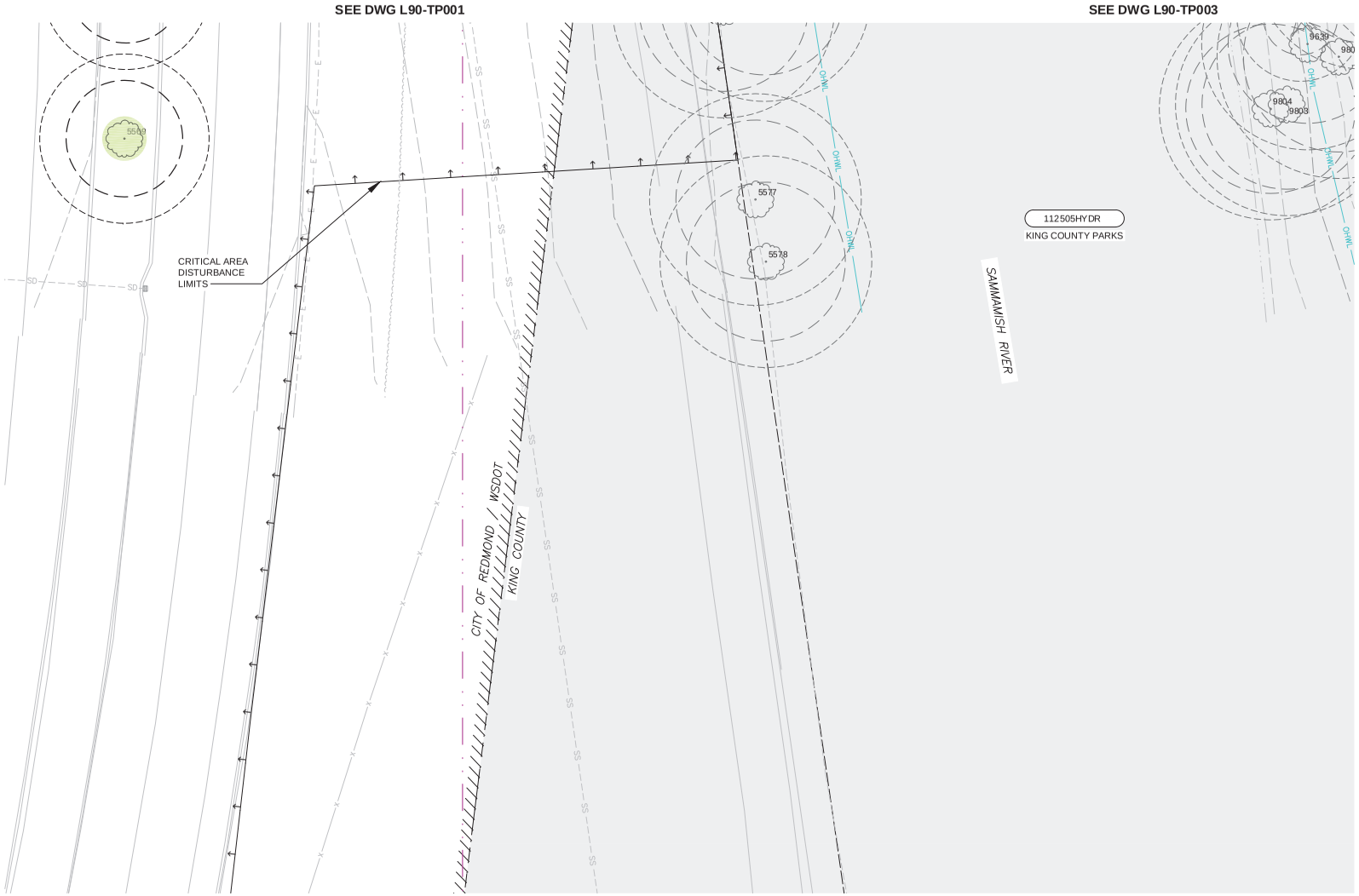
SE 1/4, SEC. 11, T.25N. R.5E. W.M.



LEGEND

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- DRIPLINE
- TREE ID
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- TREE OUTSIDE CITY SHORELINE JURISDICTION
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- SIGNIFICANT TREE TO BE RETAINED
- LANDMARK TREE TO BE RETAINED
- UNHEALTHY / HAZARDOUS TREE

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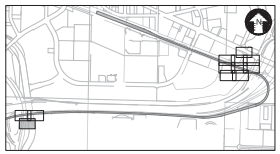

KEY MAP

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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP002
LOCATION ID:
SHEET No.: 2
REV:

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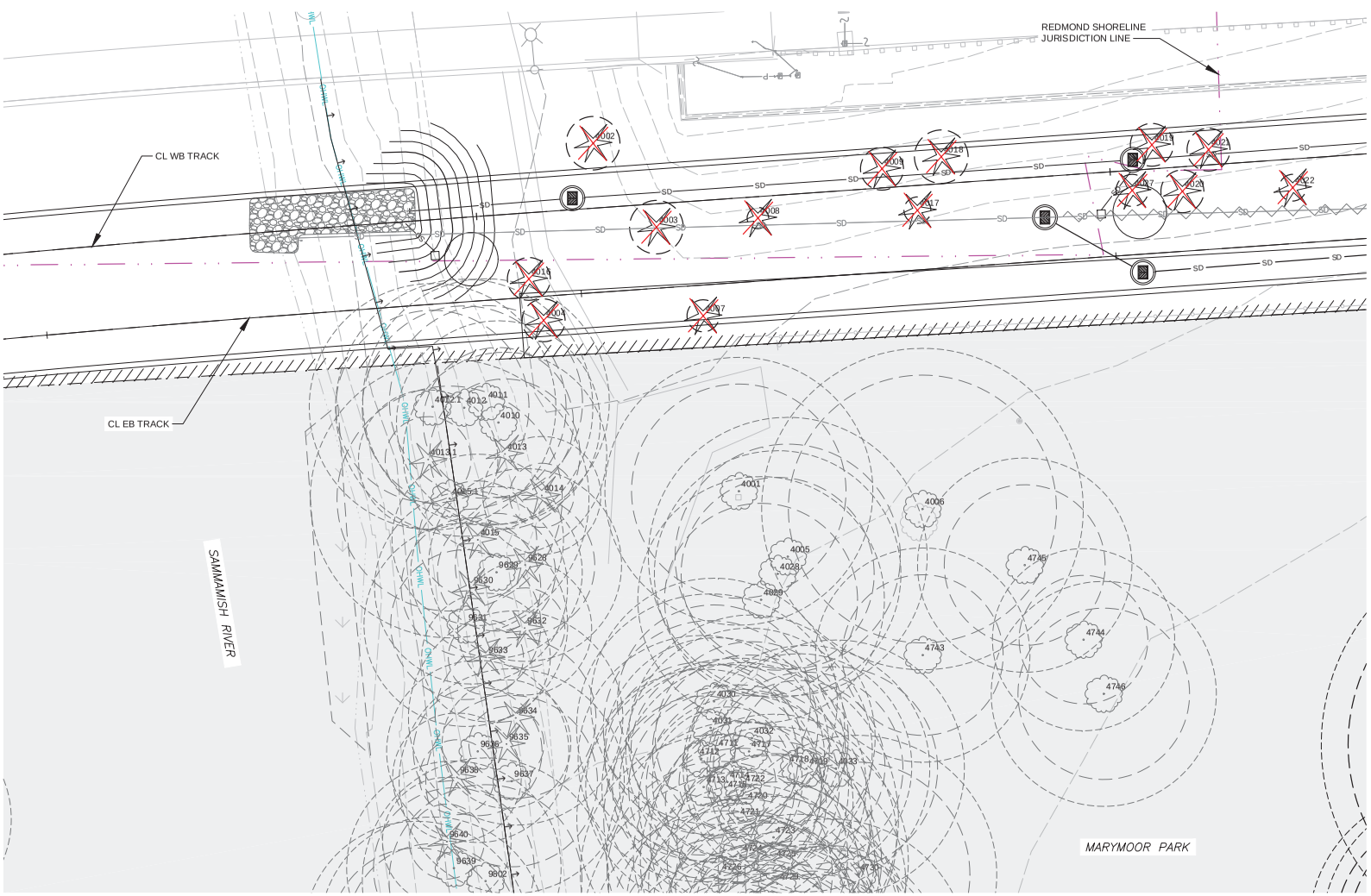

SEE DWG L90-TP001

SEE DWG L90-TP002

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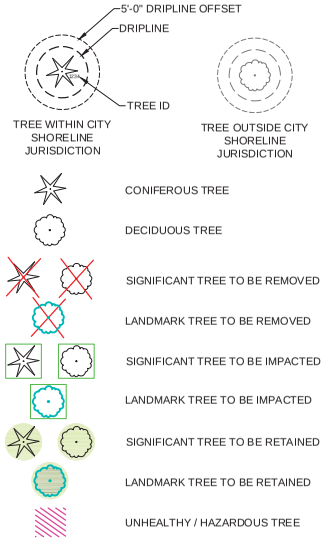

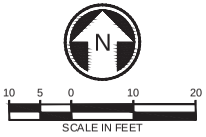

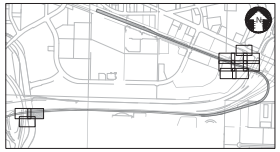

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SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP003
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SHEET No.: 3
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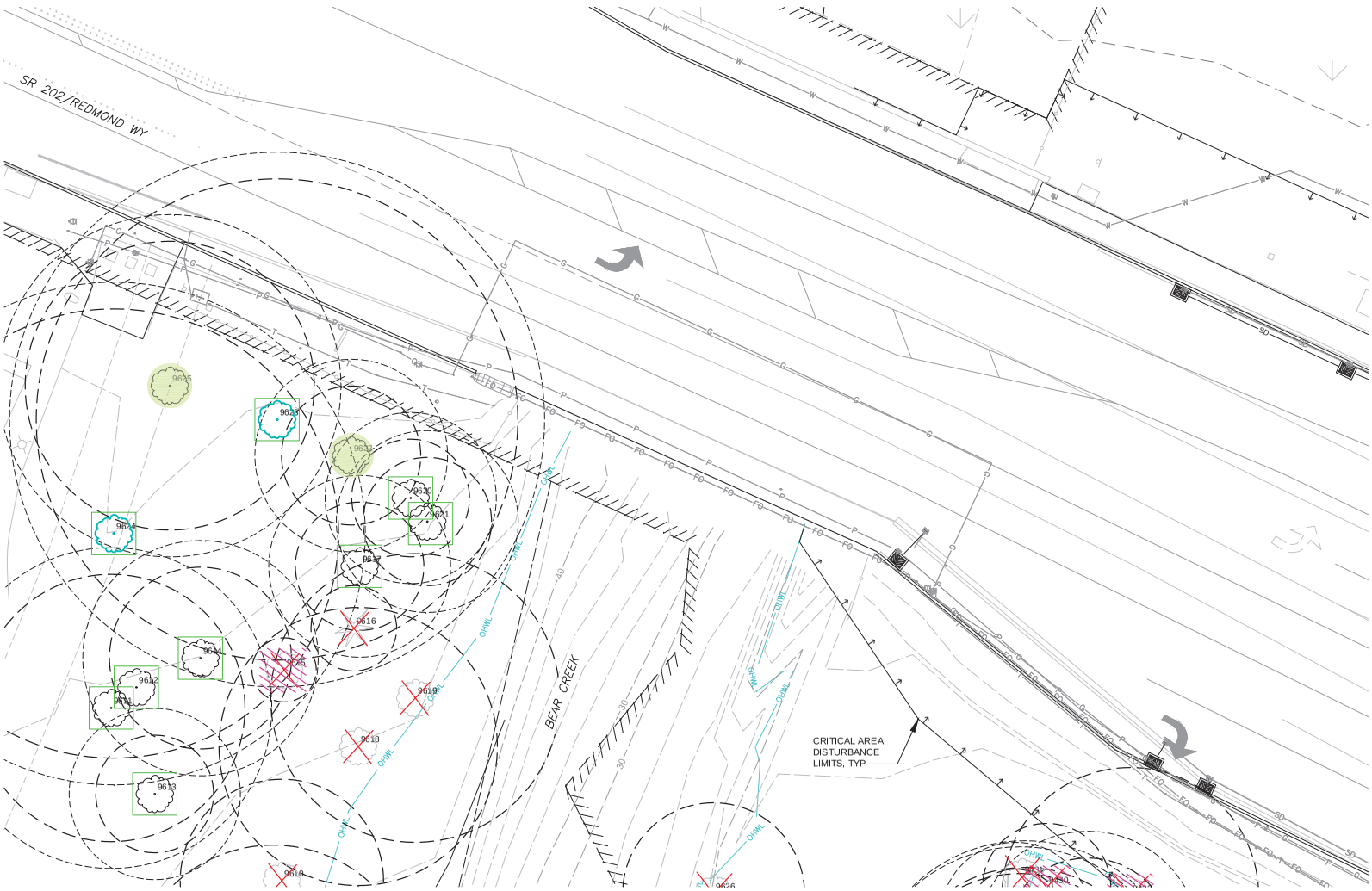

LEGEND

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- TREE OUTSIDE CITY SHORELINE JURISDICTION
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- DECIDUOUS TREE
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- SIGNIFICANT TREE TO BE IMPACTED
- LANDMARK TREE TO BE IMPACTED
- SIGNIFICANT TREE TO BE RETAINED
- LANDMARK TREE TO BE RETAINED
- UNHEALTHY / HAZARDOUS TREE

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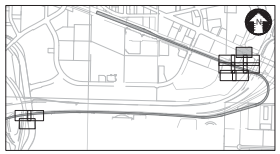

KEY MAP

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SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP004
LOCATION ID:
SHEET No.: 4
REV:

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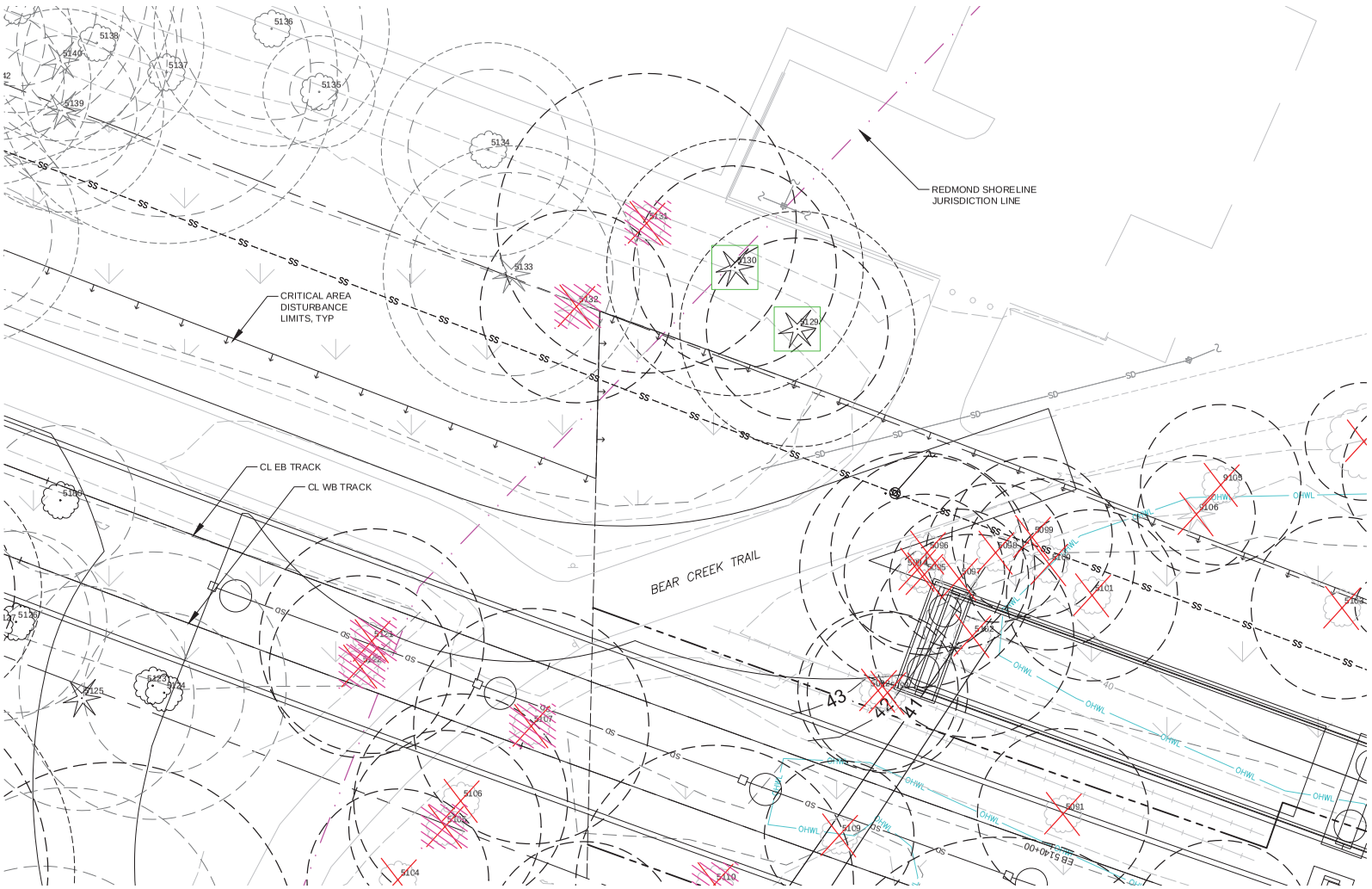

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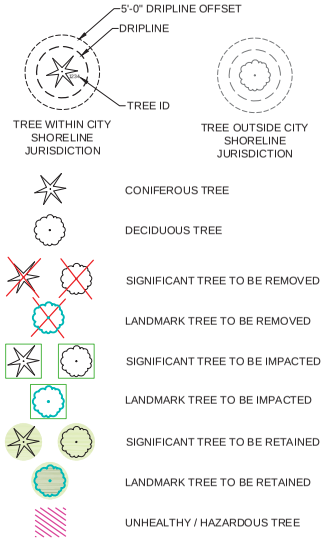

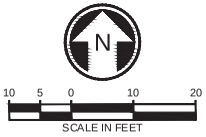

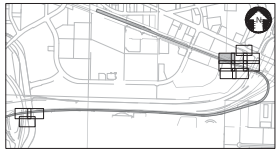

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CONCEPTUAL DESIGN

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APPROVED BY:

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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP005
LOCATION ID:
SHEET No.: 5
REV:

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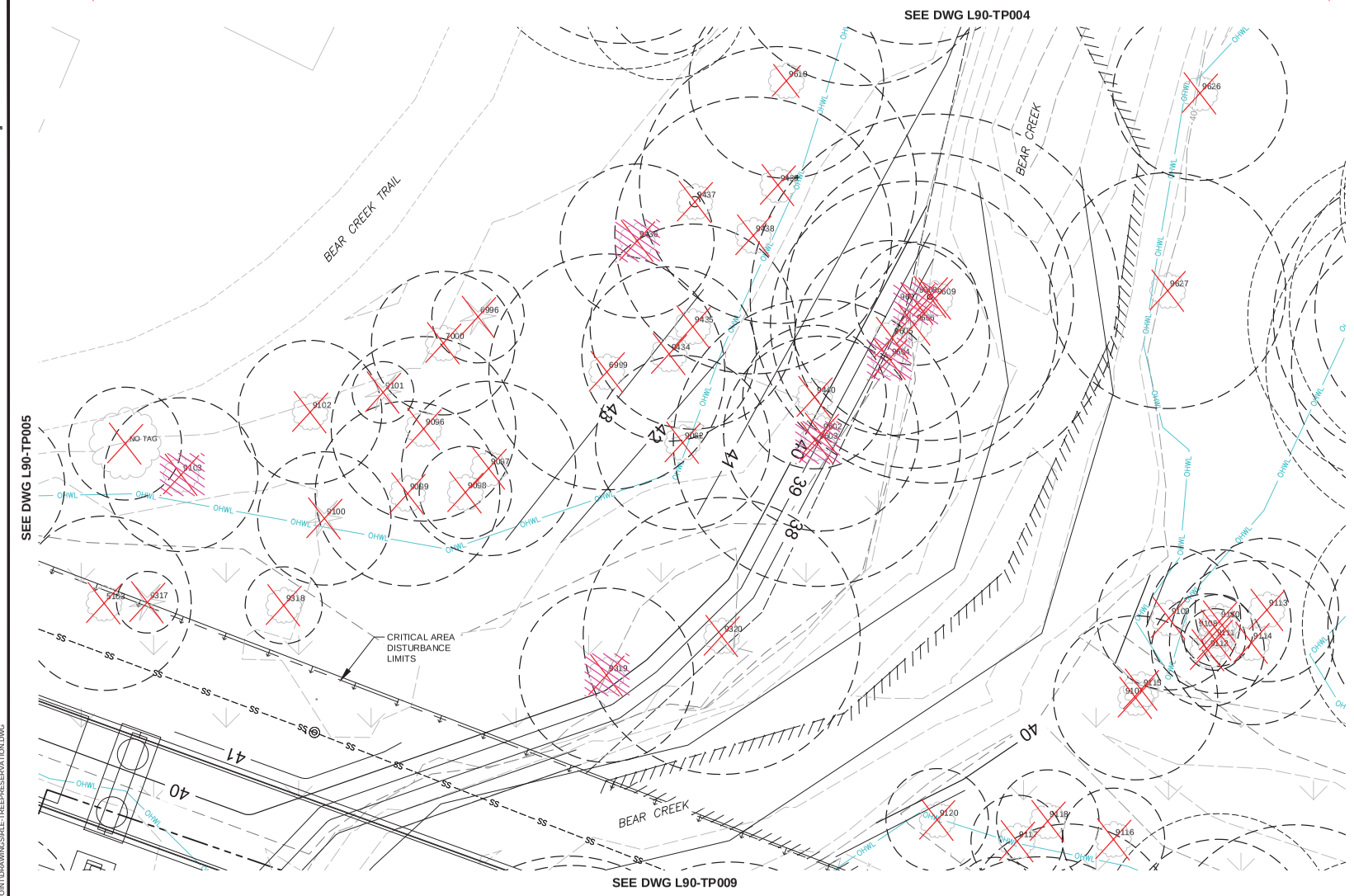

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- 5'-0" DRIPLINE OFFSET
- DRIPLINE
- TREE ID
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- TREE OUTSIDE CITY SHORELINE JURISDICTION
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- DECIDUOUS TREE
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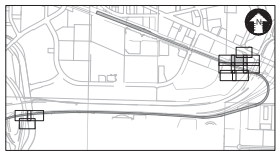
- LANDMARK TREE TO BE REMOVED
- SIGNIFICANT TREE TO BE IMPACTED
- LANDMARK TREE TO BE IMPACTED
- SIGNIFICANT TREE TO BE RETAINED
- LANDMARK TREE TO BE RETAINED
- UNHEALTHY / HAZARDOUS TREE

N

10 5 0 10 20

SCALE IN FEET



KEY MAP

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP006
LOCATION ID:
SHEET No.: 6
REV:

Xrefs:
RLE-GB-TB22x34
xRLE-L90-SEP100
xRLE-L90-CRP100
xRLE-L90-XAP100
xRLE-L90-CDP100
xRLE-G5-VSF
xRLE-L95-VSF
xRLE-L90-VSF
xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-G5-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-CLP200
xRLE-L90-VRX
xRLE-L90-RHP100
key-map-permits
xRLE-G5-CriticalAreas
xRLE-G5-Rdmd-SJB
xRLE-L95-VVG
xRLE-L90-VVG
xTreePlan_Data

02/01/19 | 4:15 PM | TYLERJ
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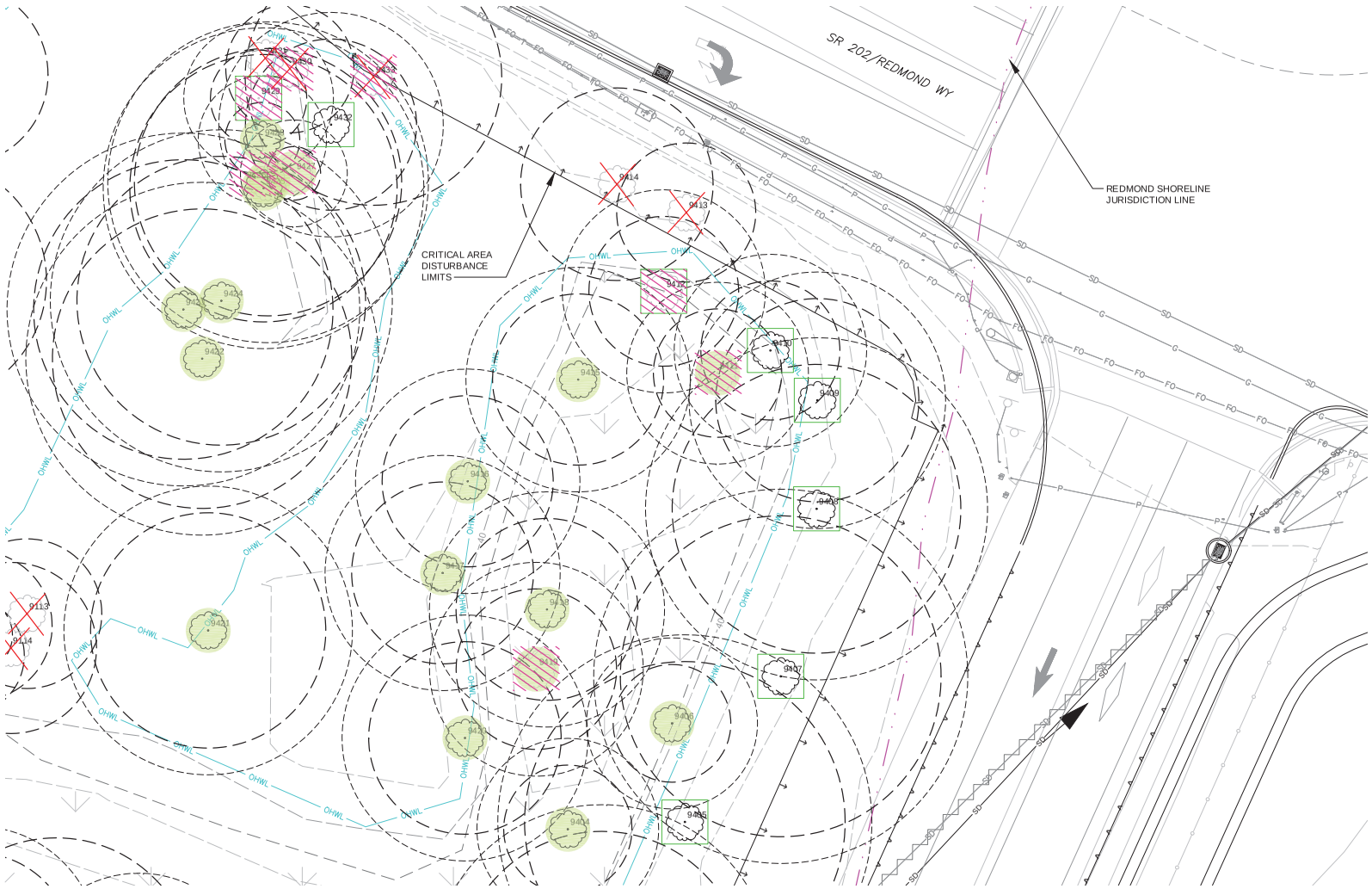
SEE DWG L90-TP004

SEE DWG L90-TP006

SEE DWG L90-TP010



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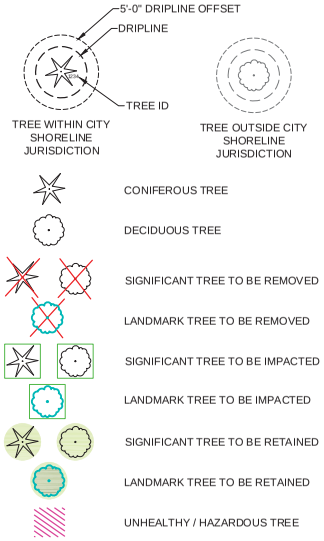

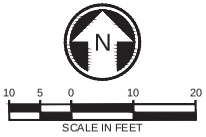

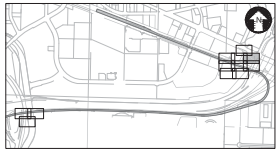

KEY MAP

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xRLE-L90-VSF
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xRLE-L95-VUT
xRLE-G5-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-CLP200
xRLE-L90-VRX
xRLE-L90-RHP100
key-map-permits
xRLE-G5-CriticalAreas
xRLE-G5-Rdmd-SJB
xRLE-L95-VVG
xRLE-L90-VVG
xTreePlan_Data

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CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

Parametrix
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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP007
LOCATION ID:
SHEET No.: 7
REV:

Xrefs:
RLE-GB-TB22x34
xRLE-L90-SEP100
xRLE-L90-CRP100
xRLE-L90-XAP100
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xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-G5-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-CLP200
xRLE-L90-WRX
xRLE-L90-RHP100
key-map-permits
xRLE-G5-CriticalAreas
xRLE-G5-Rdmd-SJB
xRLE-L95-VVG
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xTreePlan_Data

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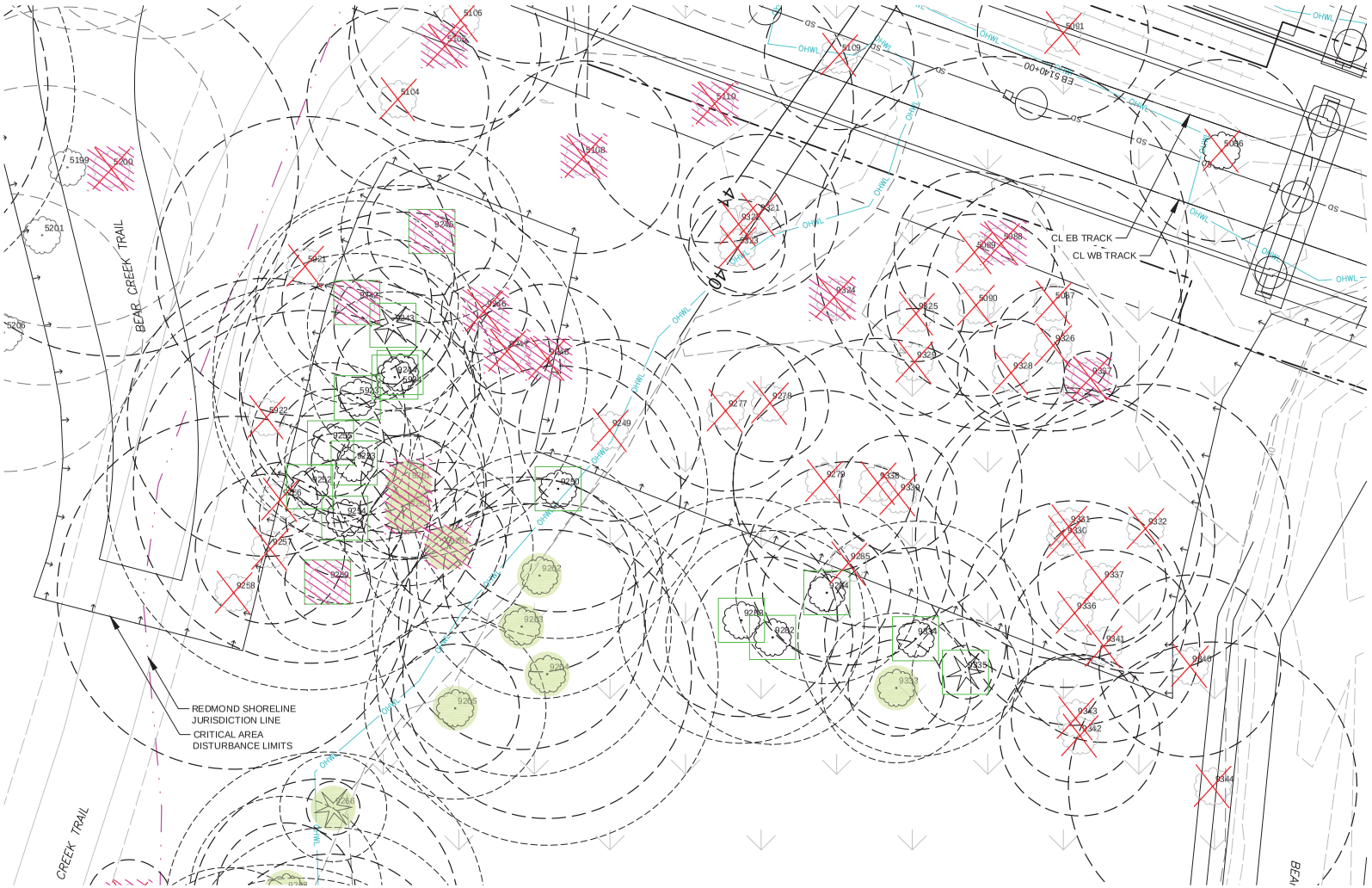
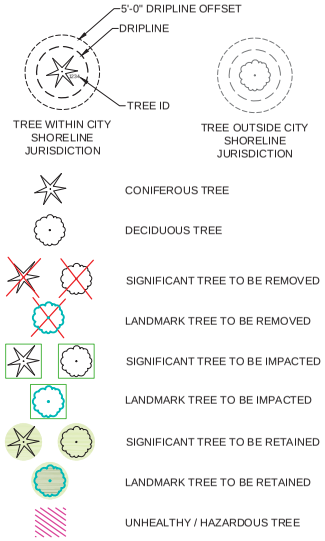
SEE DWG L90-TP005



SEE DWG L90-TP009

SEE DWG L90-TP011

LEGEND



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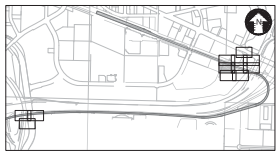

KEY MAP

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

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LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP008
LOCATION ID:
SHEET No.: 8
REV:

02/01/19 | 4:20 PM | TYLER3
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Xrefs:
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xRLE-L90-SEP100
xRLE-L90-CRP100
xRLE-L90-XAP100
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xRLE-L90-VSF
xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-G5-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-CLP200
xRLE-L90-VRX
xRLE-L90-RHP100
key-map-permits
xRLE-G5-CriticalAreas
xRLE-G5-Rdmd-SJB
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xRLE-L90-VVG
xTreePlan_Data

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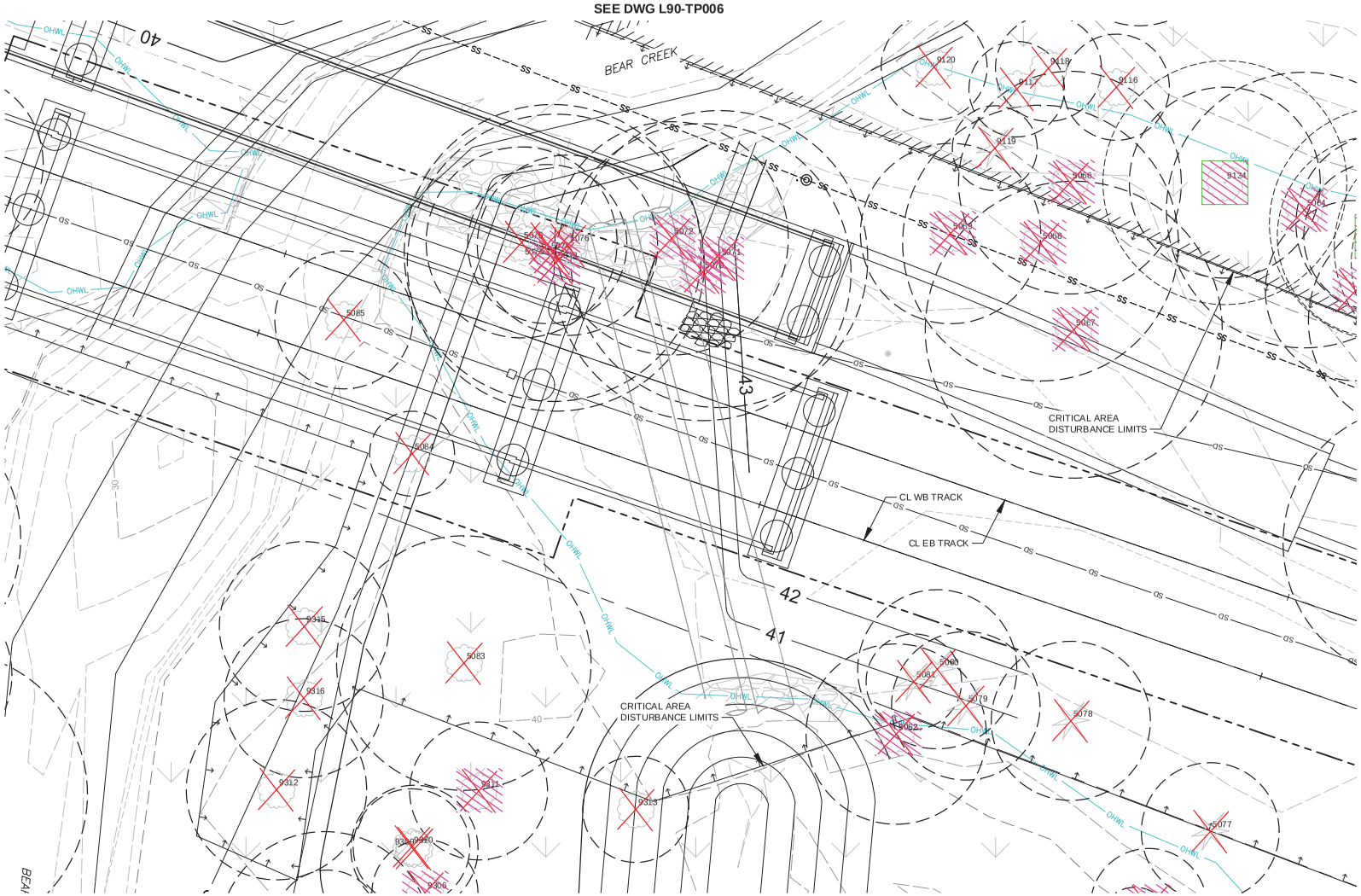

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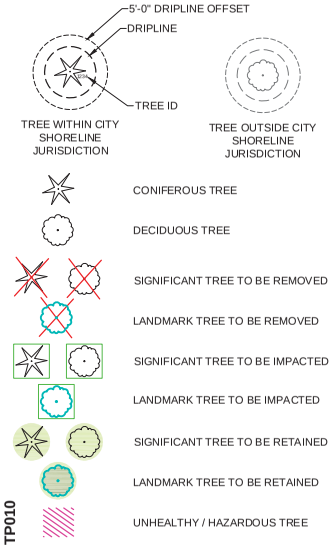

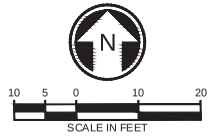

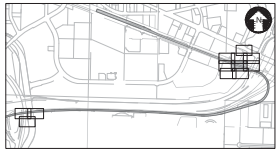

KEY MAP

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DESIGNED BY:
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CHECKED BY:
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ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP009
LOCATION ID:
SHEET No.: 9
REV:

02/01/19 | 4:22 PM | TYLERJ
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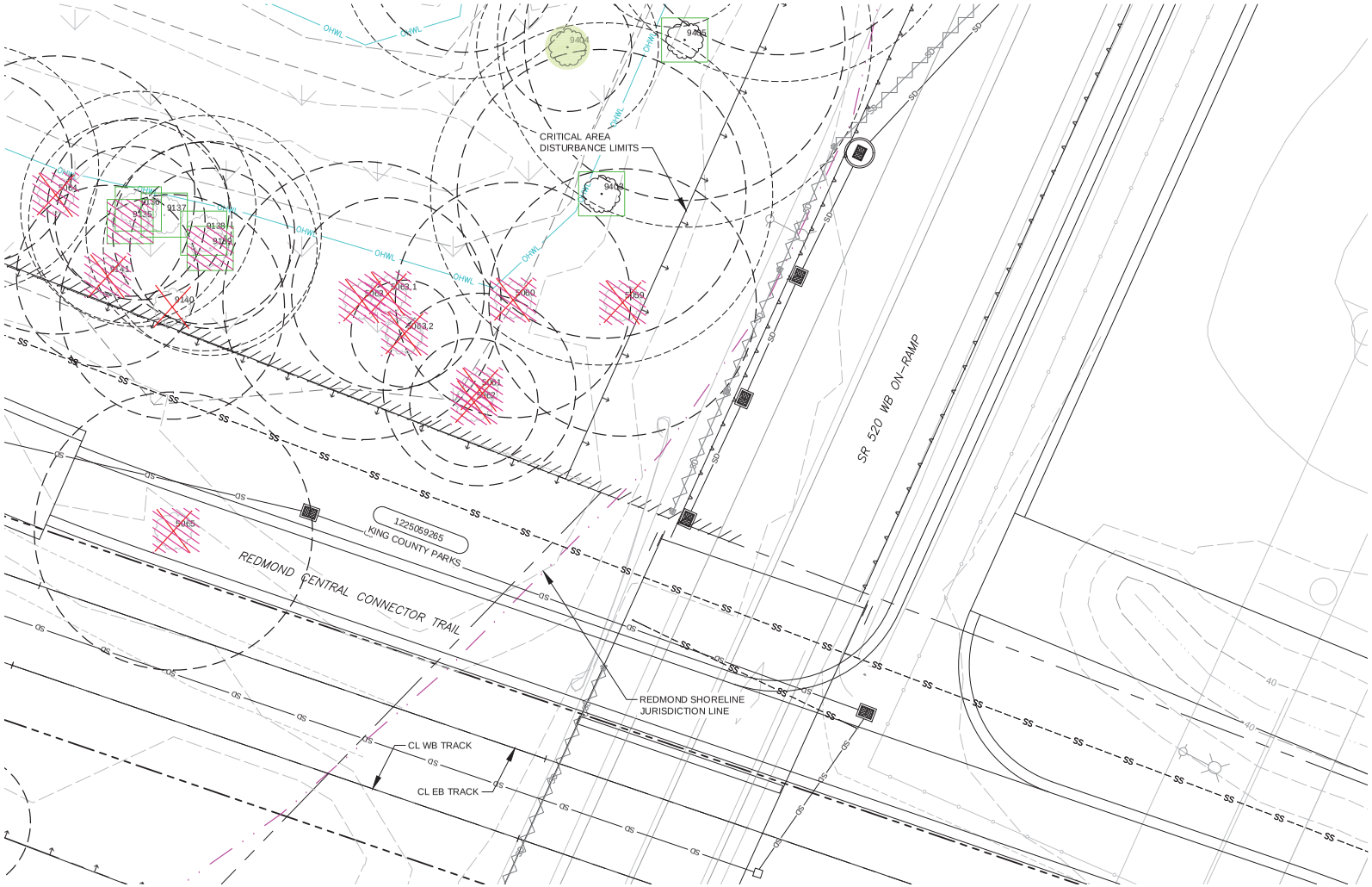
SEE DWG L90-TP007

SEE DWG L90-TP009



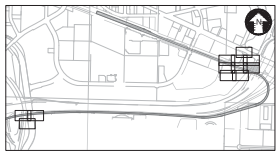
LEGEND

- 5'-0" DRIPLINE OFFSET
- DRIPLINE
- TREE ID
- TREE WITHIN CITY SHORELINE JURISDICTION
- TREE OUTSIDE CITY SHORELINE JURISDICTION
- CONIFEROUS TREE
- DECIDUOUS TREE
- SIGNIFICANT TREE TO BE REMOVED
- LANDMARK TREE TO BE REMOVED
- SIGNIFICANT TREE TO BE IMPACTED
- LANDMARK TREE TO BE IMPACTED
- SIGNIFICANT TREE TO BE RETAINED
- LANDMARK TREE TO BE RETAINED
- UNHEALTHY / HAZARDOUS TREE

N

10 5 0 10 20

SCALE IN FEET



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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP010
LOCATION ID:
SHEET No.: 10
REV:

Xrefs:
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xRLE-L90-SEP100
xRLE-L90-CRP100
xRLE-L90-XAP100
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xRLE-L95-VSF
xRLE-L90-VSF
xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-G5-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-CLP200
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xRLE-L90-RHP100
key-map-permits
xRLE-G5-CriticalAreas
xRLE-G5-Rdmd-SJB
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xTreePlan_Data

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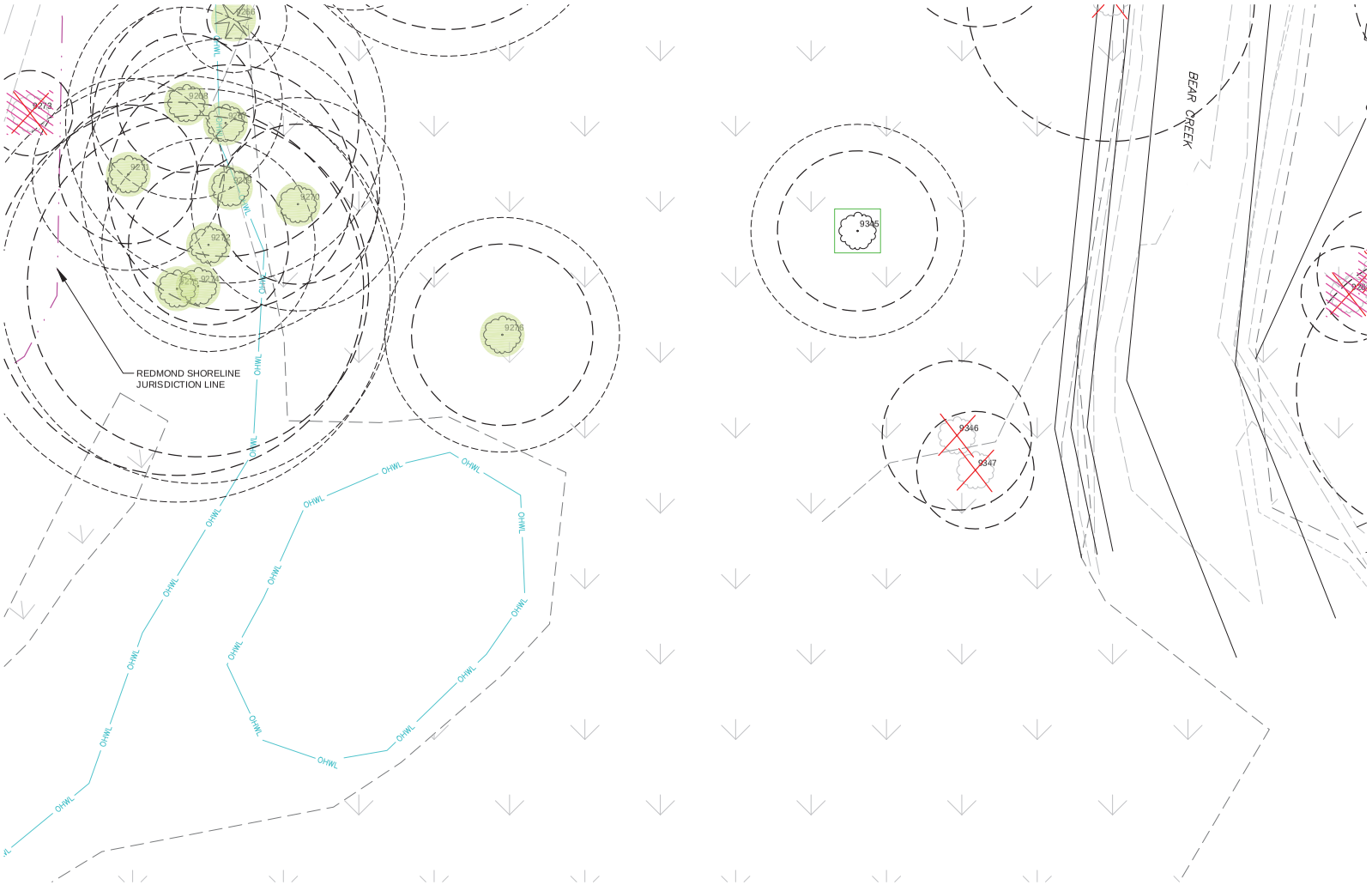
SEE DWG L90-TP008



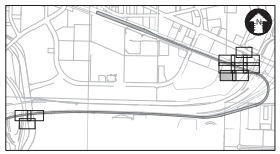
LEGEND

- 5'-0" DRIPLINE OFFSET
- DRIPLINE
- TREE ID
- TREE WITHIN CITY SHORELINE JURISDICTION
- TREE OUTSIDE CITY SHORELINE JURISDICTION
- CONIFEROUS TREE
- DECIDUOUS TREE
- SIGNIFICANT TREE TO BE REMOVED
- LANDMARK TREE TO BE REMOVED
- SIGNIFICANT TREE TO BE IMPACTED
- LANDMARK TREE TO BE IMPACTED
- SIGNIFICANT TREE TO BE RETAINED
- LANDMARK TREE TO BE RETAINED
- UNHEALTHY / HAZARDOUS TREE

N

10 5 0 10 20

SCALE IN FEET



KEY MAP

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xRLE-L90-VSF
xRLE-E29-ASP100
xRLE-L95-VUT
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xRLE-L90-VRX
xRLE-L90-RHP100
key-map-permits
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CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

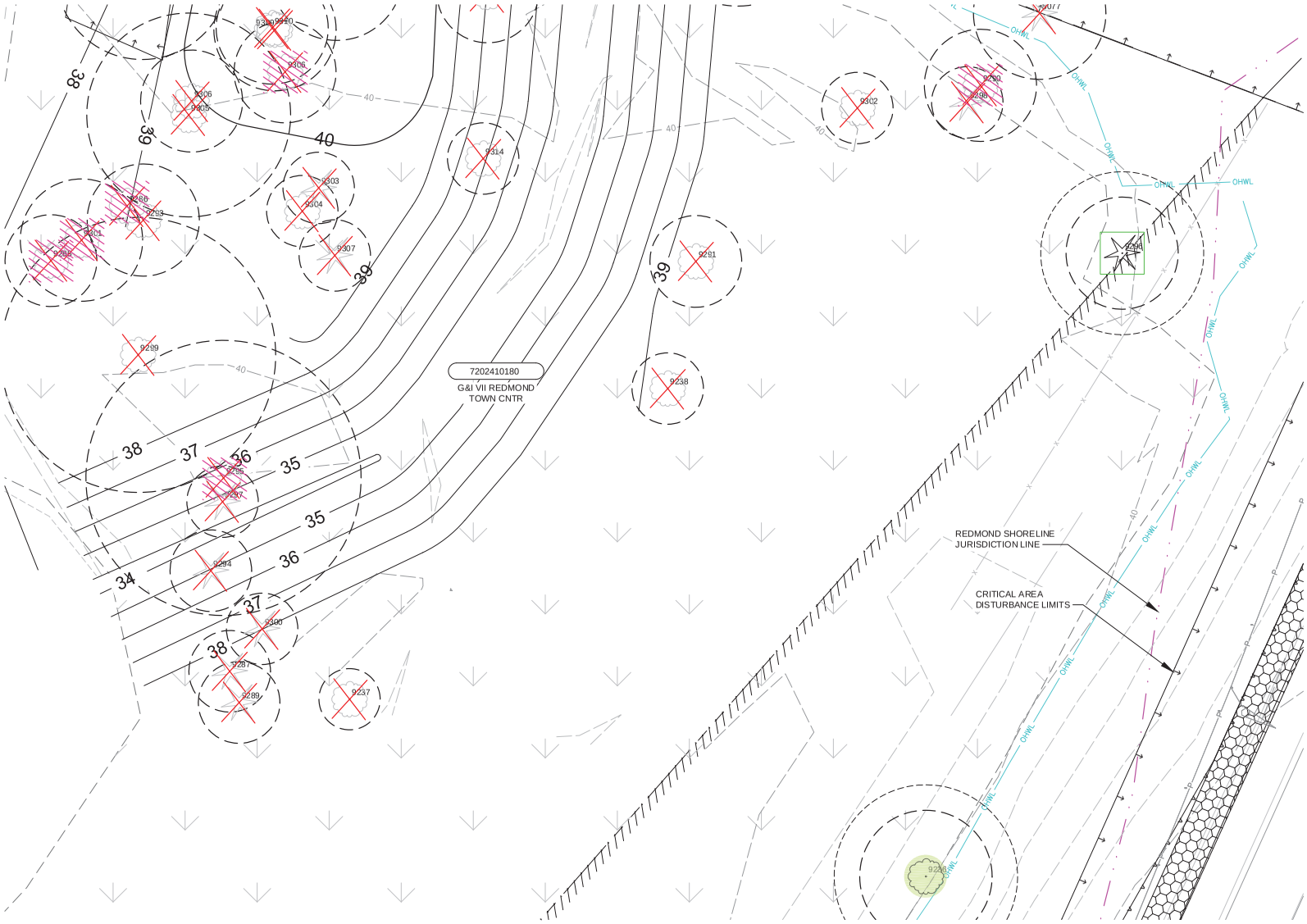
CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP011
LOCATION ID:
SHEET No.: 11
REV:

SE 1/4, SEC. 11, T.25N. R.5E. W.M.

SEE DWG L90-TP009

SEE DWG L90-TP011



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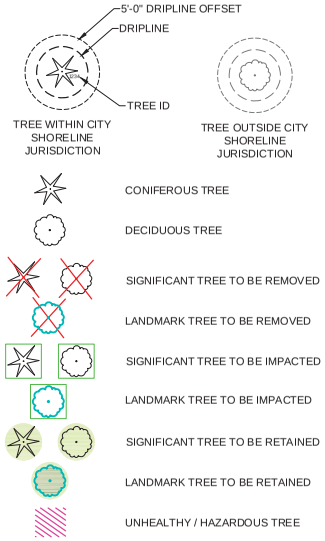

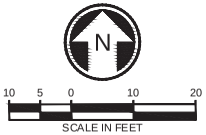

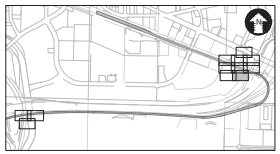

KEY MAP

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

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APPROVED BY:

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-TREEPRESERVATION
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE JURISDICTION
TREE PRESERVATION PLAN

DRAWING No.: L90-TP012
LOCATION ID:
SHEET No.: 12
REV:

Xrefs:
RLE-GB-TB22x34
xRLE-L90-SEP100
xRLE-L90-CRP100
xRLE-L90-XAP100
xRLE-L90-CDP100
xRLE-G5-VSF
xRLE-L95-VSF
xRLE-L90-VSF
xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-G5-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-CLP200
xRLE-L90-WRX
xRLE-L90-RHP100
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xRLE-G5-Redmd-SJB
xRLE-L95-VVG
xRLE-L90-VVG
xTreePlan_Data

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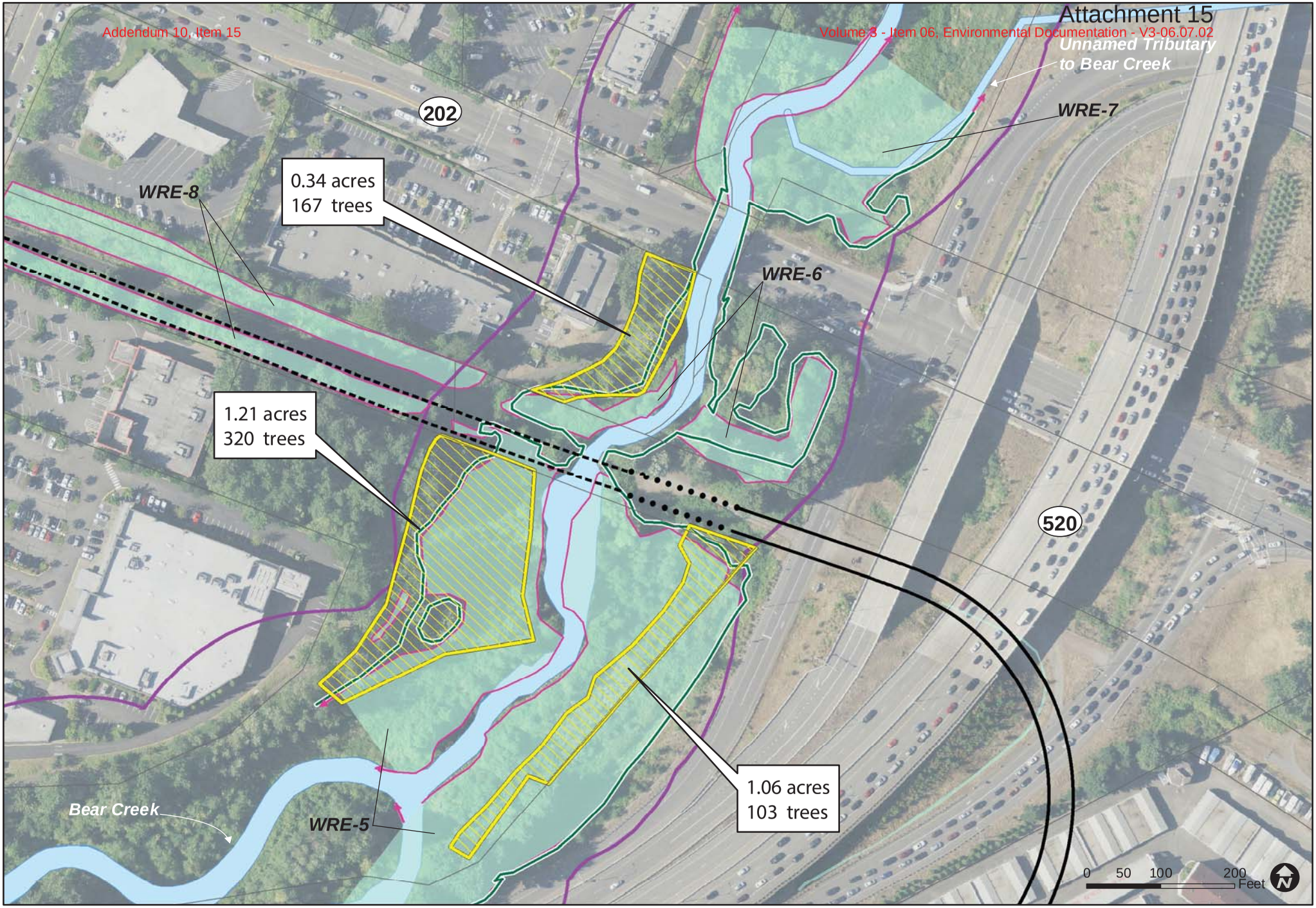
Attachment D

Tree Replacement Figure

Attachment 15



*Source: USGS, City of Redmond, King County, Parametrix

Alignment
- At-Grade
- Elevated
- Retained Cut/Fill

- Parcel
- Tree Replacement Areas
- Shoreline Jurisdiction

- Wetland
- OHWM

Redmond Tree Replacement Areas
Downtown Redmond Link Extension

Xrefs:
RLE-GB-TB22x34
xRLE-L90-SEP100
xRLE-L90-SWP100
xRLE-L90-CRP100
xRLE-L90-KAP100
xRLE-L90-CDP100
xRLE-GIS-VSF
xRLE-L95-VSF
xRLE-L90-VSF
xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-GIS-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-VRX
xRLE-L90-RHP100
xRLE-GIS-VFP
key-map-permits
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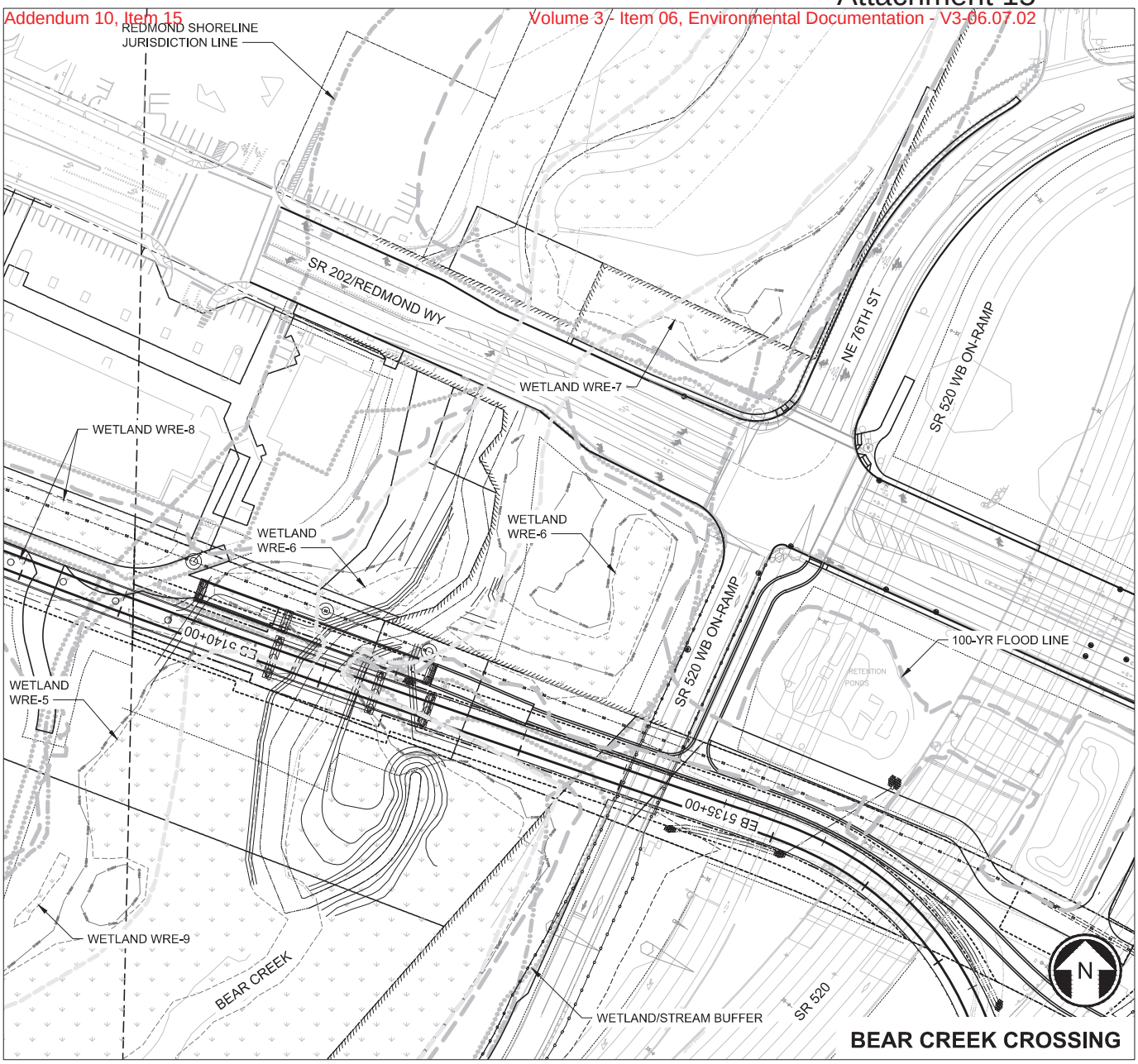
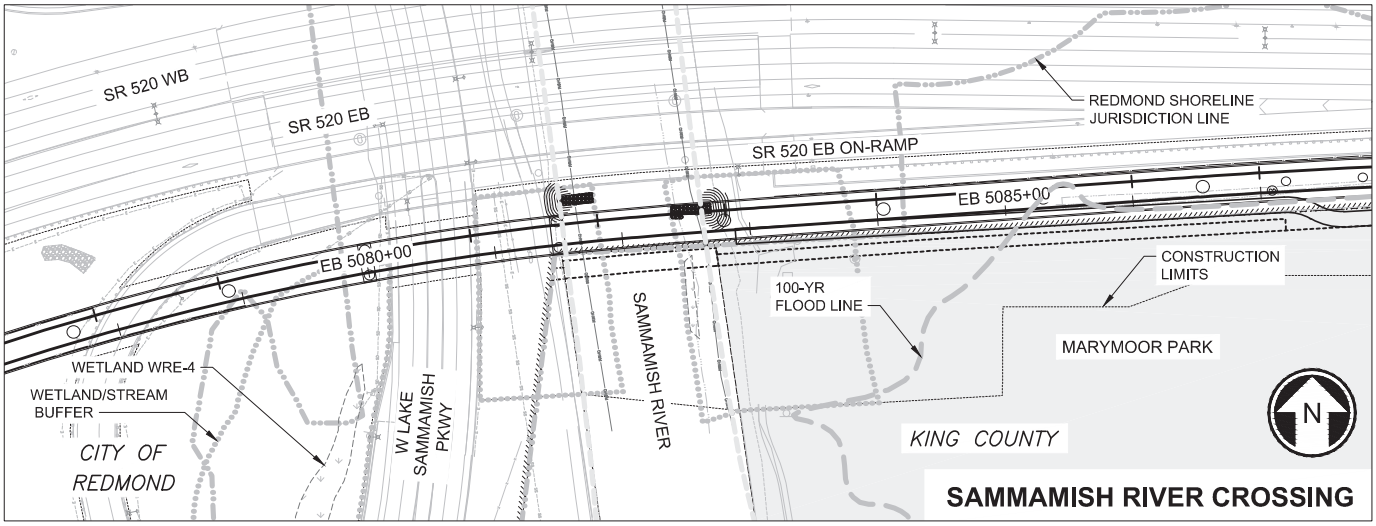


BEAR CREEK CROSSING



SAMMAMISH RIVER CROSSING

02/18/19 | 4:44 PM | ITOP
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SOUNDTRANSIT

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DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
REDUCED SITE DEVELOPMENT PLAN

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES
1019 39TH AVENUE SE, SUITE 100 | PUYALLUP, WA 98374 | P 253.604.6600

TECHNICAL MEMORANDUM

DATE:	January 29, 2019
TO:	Ellie Ziegler, Sound Transit
FROM:	Dallas Dimock, Parametrix
SUBJECT:	Proposed Lighting within City of Redmond Shoreline Jurisdiction
CC:	Benn Burke and Adam Merrill, Parametrix

PROJECT SUMMARY

Project Description

This memorandum was prepared to describe existing and proposed lighting within City of Redmond (City) shoreline jurisdiction for the Downtown Redmond Link Extension Project (Project). The Project will include new light rail bridges over the Sammamish River and Bear Creek. A new pedestrian bridge will also be installed over Bear Creek. The Project will not introduce any new lighting within City shoreline jurisdiction of the Sammamish River, but will likely introduce new lighting within City shoreline jurisdiction of Bear Creek. This memo demonstrates compliance with Redmond Zoning Code (RZC) 21.68 Shoreline Master Program, Section 21.68.120 (Lighting Within Shoreline Jurisdiction).

Existing Lighting

The existing lighting within City shoreline jurisdiction of Bear Creek is located along State Route (SR) 202 (Redmond Way), NE 76th Street, and the SR 520 westbound on-ramp, as shown in Attachment 1.

Proposed Lighting

The proposed lighting would involve potentially replacing the existing lighting along SR 202 (Redmond Way), NE 76th Street, and the SR 520 westbound on-ramp only where the existing lighting will be disturbed by roadway improvements. For pedestrian safety, lighting will also likely be installed along the East Lake Sammamish Trail and the Redmond Central Connector Trail. If lighting is to be installed on the new pedestrian bridge over Bear Creek, the lighting will be designed to point upwards, away from the creek. No lighting will be installed on the new light rail bridges over the Sammamish River and Bear Creek.

LIGHTING DESIGN PARAMETERS

Design Standards

The lighting design for this Project will be based on the following documents:

- WSDOT Special Provisions
- WSDOT Amendments to the Standard Specifications
- WSDOT Standard Specifications
- WSDOT Design Manual
- WSDOT Standard Plans

- WSDOT Traffic Manual
- WSDOT Northwest Region Illumination and Signal Details
- AASHTO A Policy on Geometric Design of Highways and Streets, 5th Edition, 2004
- City of Redmond Special Provisions
- City of Redmond Illumination Design Manual
- City of Redmond Standard Specifications and Details
- City of Redmond Traffic Signal Design Manual
- King County 2016 Road Design and Construction Standards

Design Areas

The lighting design areas in the project limits are assumed to include SR 202 (Redmond Way), NE 76th Street, and SR 520 westbound on-ramp roadways as well as the SR 202 and SR 520 westbound on-ramp/NE 76th Street intersection. The East Lake Sammamish Trail and the Redmond Central Connector Trail are also included in the design area. These lighting design areas are shown in Attachment 1.

Lighting Standards

According to the January 2018 Downtown Redmond Link Extension SEPA Addendum, Appendix F Biological Assessment, "*Neither construction nor operation of the Downtown Redmond Link Extension is expected to result in any increases in nighttime illumination of fish-bearing waters (which could increase the risk of predation on juvenile salmonids). If any construction activity occurs at night, temporary lights will be directed away from fish-bearing waters to prevent interference with fish behavior patterns. During operation, the tracks will have no overhead lighting and the train headlights will be directed parallel to the tracks. Lighting at light rail stations is not expected to result in any adverse effects because no stations are proposed within 200 feet of surface-flowing streams that are known or expected to support ESA-listed fish*."

According to the RZC Section 21.68.120 (Lighting Within Shoreline Jurisdiction), there are four specific requirements that need to be met. The four specific requirements are listed below:

A. *Lighting plans shall be submitted with development proposals to demonstrate how the lighting plan proposal complies with the City's "dark side" policies.*

B. *Lighting shall be designed and constructed to minimize glare and prevent glare and light from intruding on neighboring properties.*

C. *Lighting for active outdoor recreational uses shall not be illuminated by artificial light from 10:00 p.m. to 8:00 a.m. Lighting shall incorporate cutoff shields and be mitigated through native conifer screening plantings.*

D. *See RZC 21.34, Lighting Standards, for additional Citywide lighting standards.*

Active outdoor recreational facilities are not proposed as part of the Project; therefore, Requirement C does not apply. The Project Design-Builder will meet requirements A, B, and D if they propose to locate new or replacement lighting within City shoreline jurisdiction of Bear Creek.

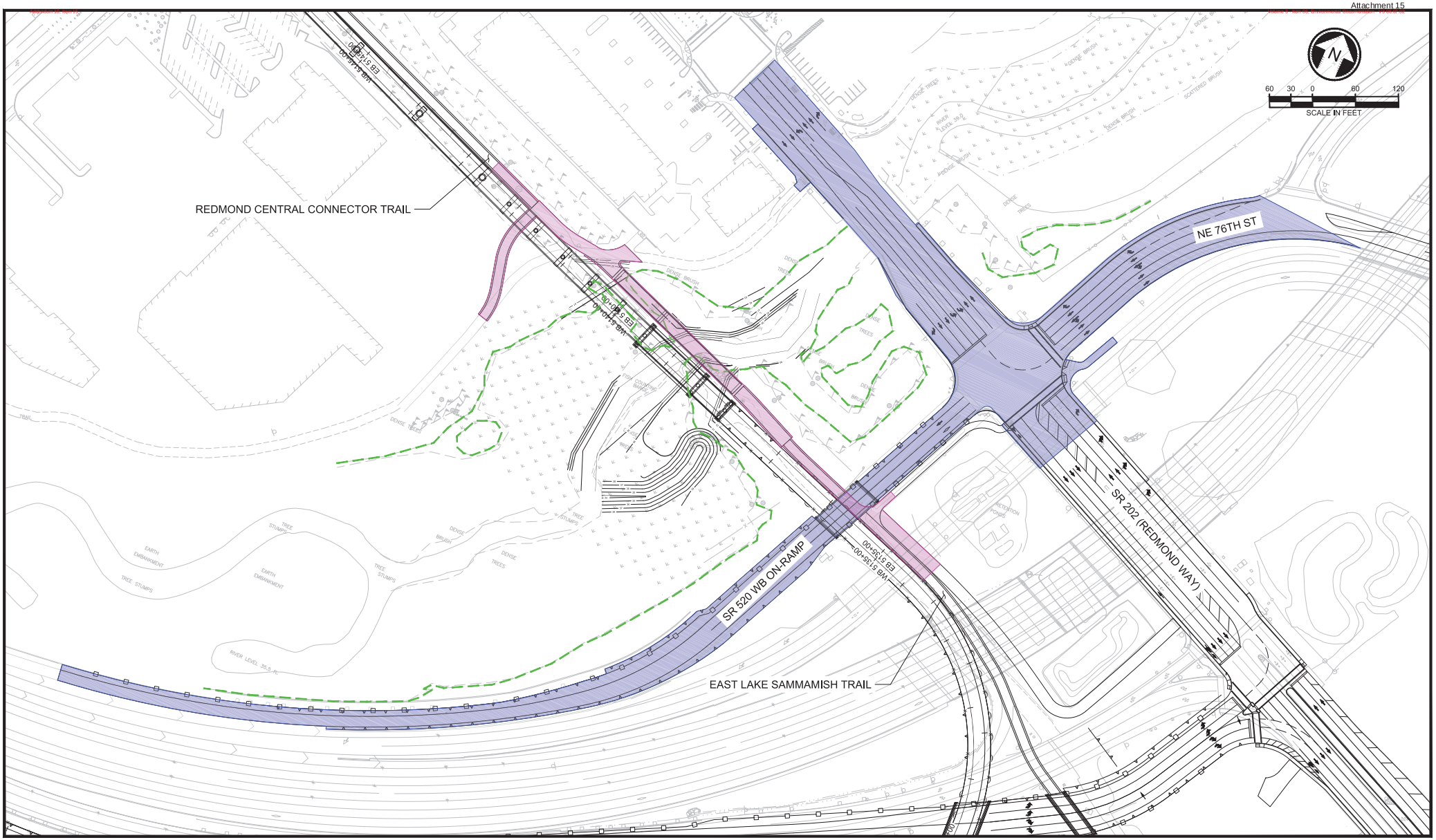
Conclusion

The Project will include new light rail bridges over the Sammamish River and Bear Creek with no proposed lighting. Existing lighting along SR 202 (Redmond Way), NE 76th Street, and the SR 520 westbound on-ramp may be replaced, but only where the existing lighting will be disturbed by roadway improvements. A new pedestrian bridge will be installed over Bear Creek with the possibility of up-lighting to improve pedestrian safety, but the

lighting will be designed in such a way that it shall have no impact on the fish-bearing waters of Bear Creek. The Design-Builder shall follow the standards and provisions listed in this memorandum for all proposed lighting within City of Redmond shoreline jurisdiction to comply with the RZC.

Attachment

Attachment 1 – Conceptual Lighting Plan: Bear Creek Vicinity



LEGEND

- EXISTING LIGHTING AREA TO BE REPLACED
- POTENTIAL NEW LIGHTING AREA
- BEAR CREEK ORDINARY HIGH WATER MARK

SOUNDTRANSIT

CONCEPTUAL LIGHTING PLAN: BEAR CREEK VICINITY

ATTACHMENT 1

DOWNTOWN REDMOND LINK EXTENSION

10/31/18

Xrefs:
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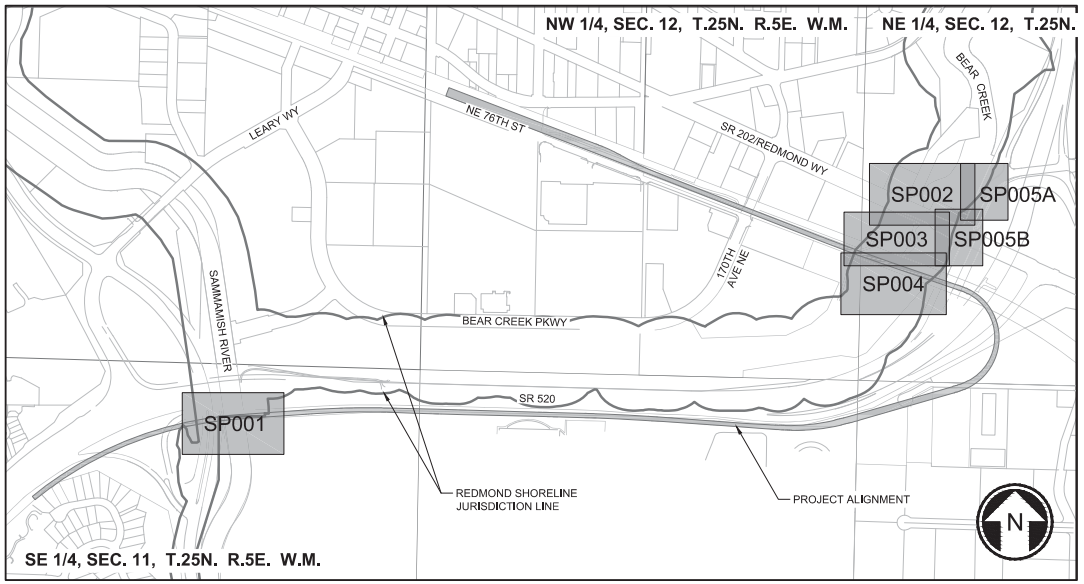

GENERAL INFORMATION

a. LEGAL DESCRIPTION: N/A

PARCEL NUMBERS: SEE PLAN SHEETS FOR PARCEL NUMBERS

b. PROPOSED UBC CONSTRUCTION TYPE: N/A

c. SITE SIZE (GROSS AND NET): N/A

d. DWELLING UNITS ALLOWED & PROPOSED (RESIDENTIAL): N/A

e. GROSS FLOOR AREA ALLOWED & PROPOSED (NON-RESIDENTIAL): N/A

f. OPEN SPACE/LANDSCAPING REQUIRED & PROVIDED: N/A

g. IMPERVIOUS SURFACE ALLOWED & PROPOSED: N/A

h. PARKING REQUIRED AND PROVIDED: N/A

i. BUILDING HEIGHT ALLOWED AND PROPOSED: N/A

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CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

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DRAWN BY:
CHECKED BY:
APPROVED BY:

Parametrix
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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: NTS
FILENAME: RLE-SHRPRMT-COR-SP
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT

SITE PLAN - COVER SHEET

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LOCATION ID:
SHEET No.: 1
REV:

SE 1/4, SEC. 11, T.25N. R.5E. W.M.

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xRLE-E29-ASP100
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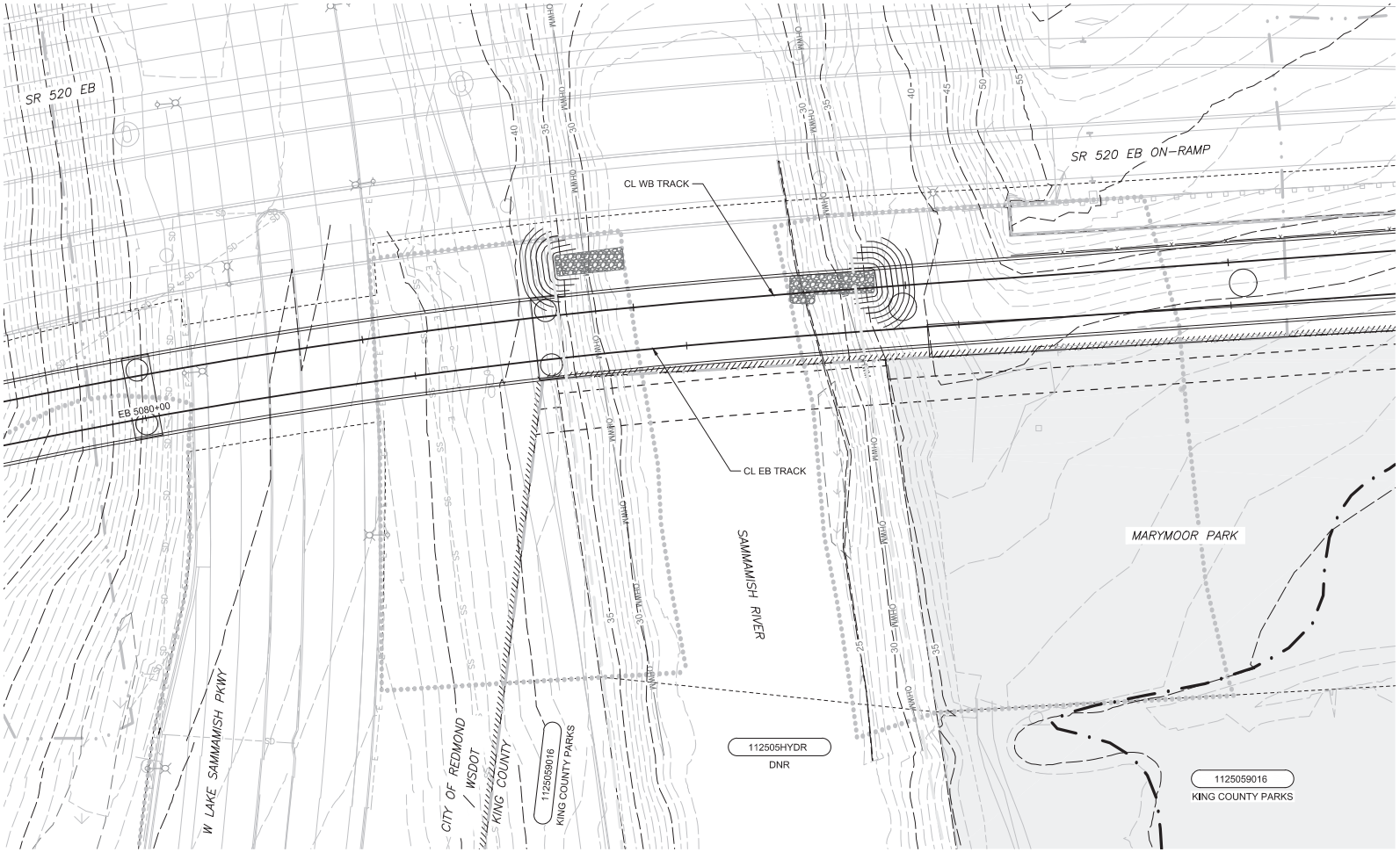

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- 1/4 SECTION LINE
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- TEMPORARY CONSTRUCTION EASEMENT
- PROPERTY LINE
- EXISTING EASEMENT LINE
- PROPOSED EASEMENT LINE
- EXISTING CONTOUR LINES (40)
- PROPOSED CONTOUR LINES (40, 38)
- BALLAST WALL
- RETAINING WALL
- FENCE
- GUARDRAIL / CONCRETE BARRIER
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- 100-YEAR FLOOD LINE
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- WETLAND BOUNDARY
- ORDINARY HIGH WATER MARK (OHWM)
- WETLAND AND OHWM BUFFER
- UNINCORPORATED KING COUNTY
- WETLAND

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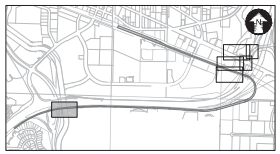

KEY MAP

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SOUNDTRANSIT

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DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
SAMMAMISH RIVER
SITE PLAN - SHEET 1 OF 1

DRAWING No.: L90-SP001
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LEGEND

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- ORDINARY HIGH WATER MARK (OHWM)
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- WETLAND

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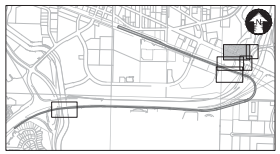

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SOUNDTRANSIT

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CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
SITE PLAN - SHEET 1 OF 4

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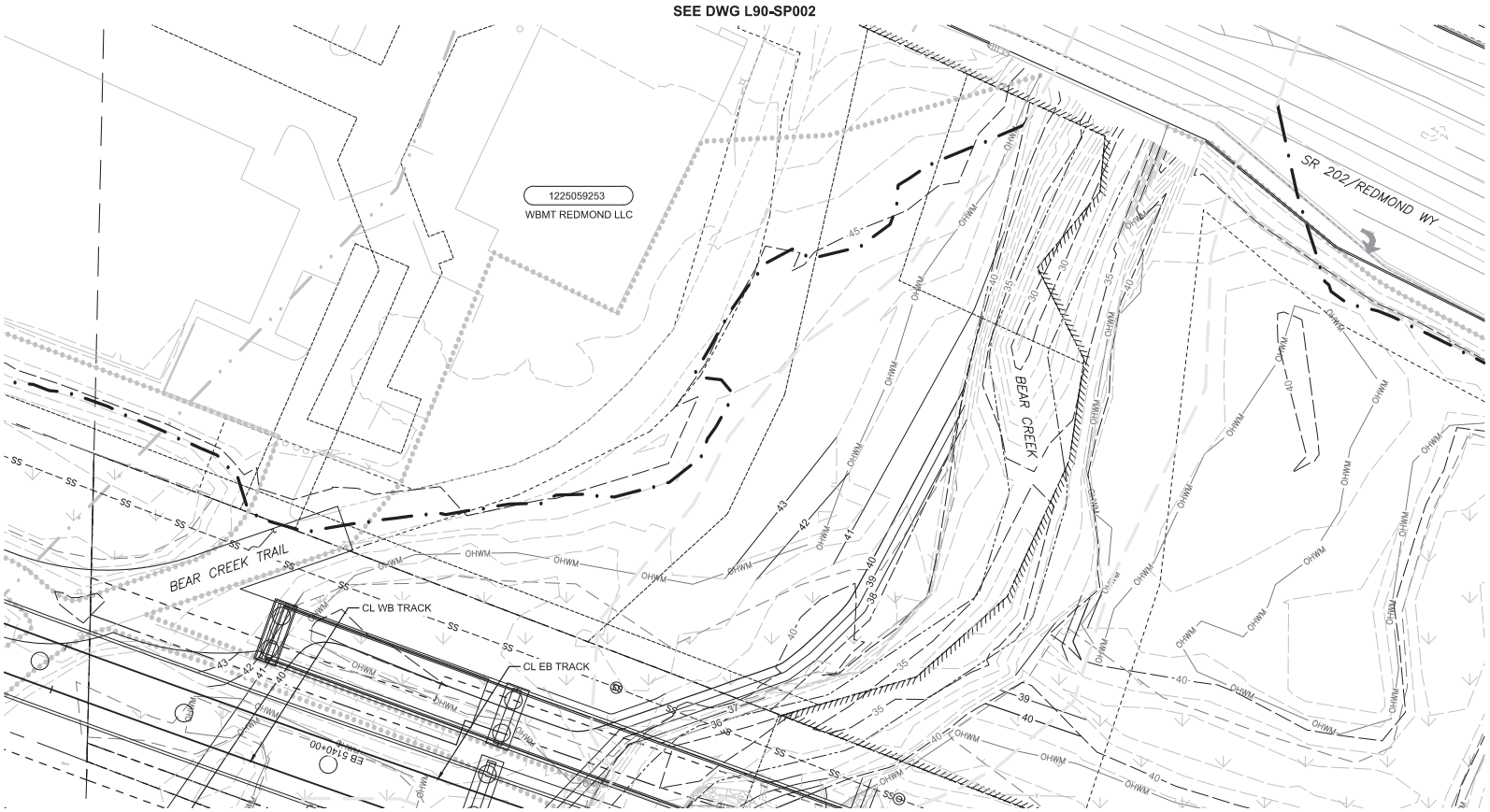

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- UNINCORPORATED KING COUNTY
- WETLAND

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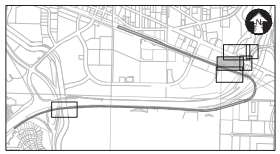

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CONTRACT No.: CN 0148-18
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DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
SITE PLAN - SHEET 2 OF 4

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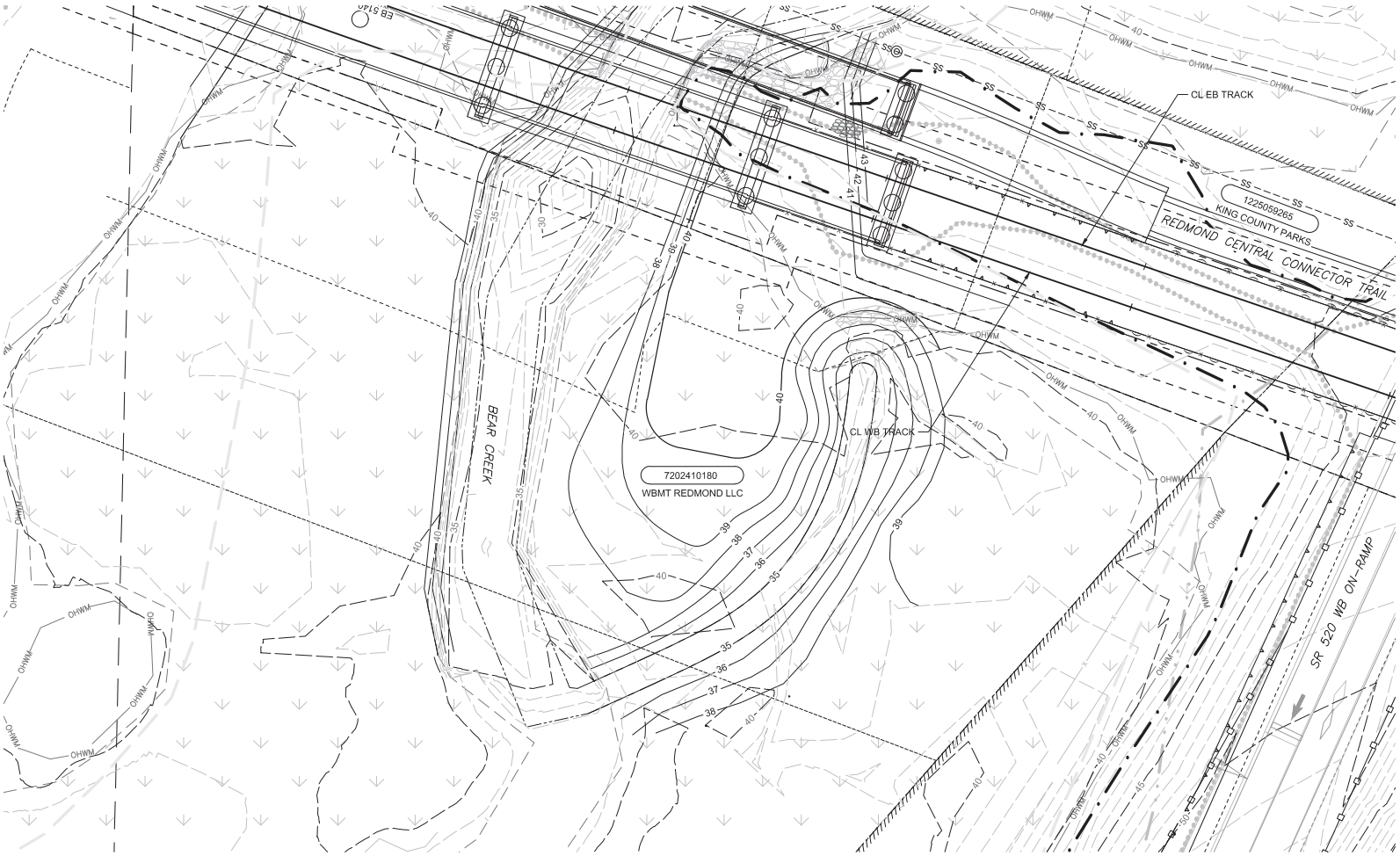

LEGEND

- SECTION LINE
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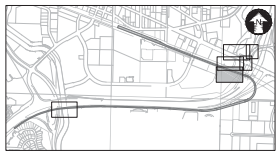

KEY MAP

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Parametrix
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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-SP
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
SITE PLAN - SHEET 3 OF 4

DRAWING No.: L90-SP004
LOCATION ID:
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key-map-permits
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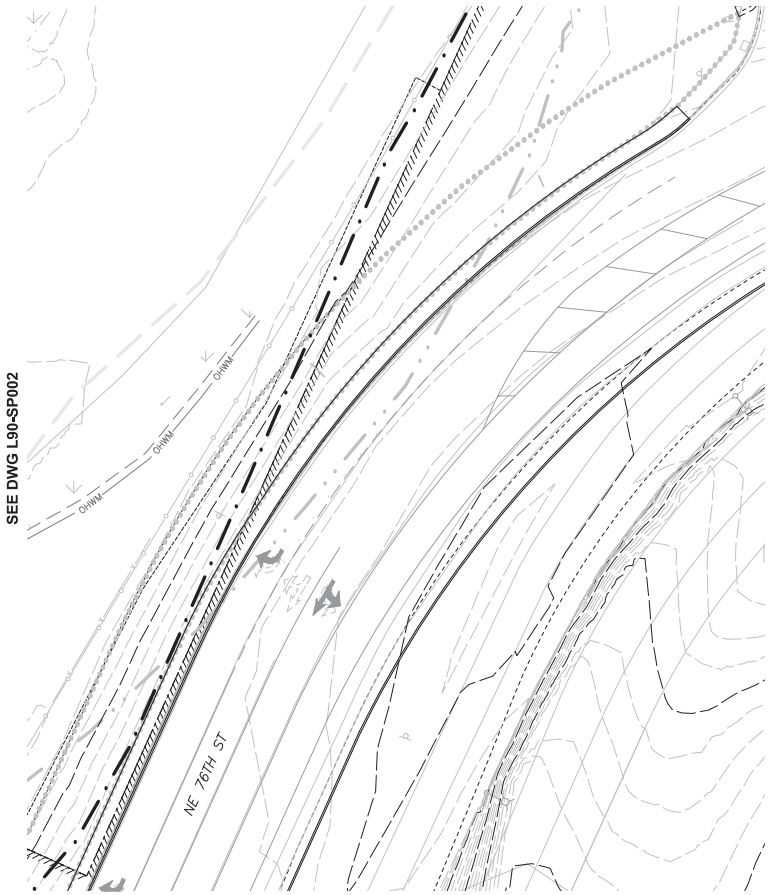

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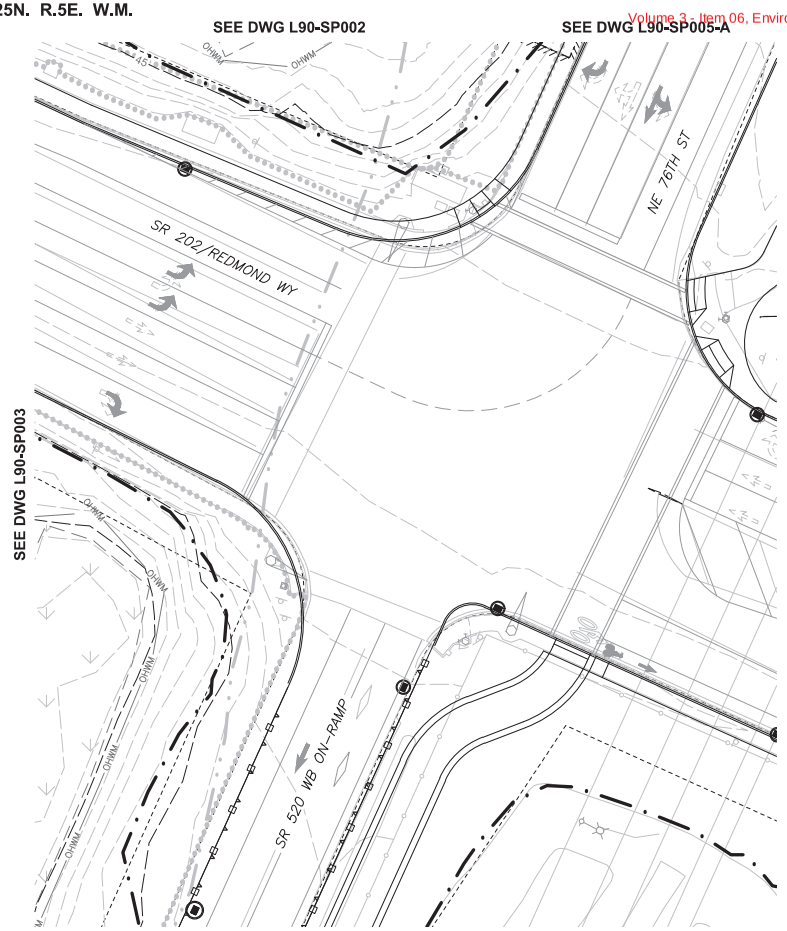

PLAN SP005-B

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- WSDOT RIGHT-OF-WAY
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- PROPERTY LINE
- EXISTING EASEMENT LINE
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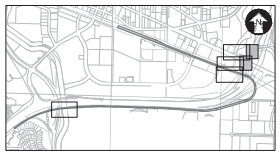

KEY MAP

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No.	DATE	DSN	CHK	APP	REVISION

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APPROVED BY:

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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-SP
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
SITE PLAN - SHEET 4 OF 4

DRAWING No.: L90-SP005
LOCATION ID:
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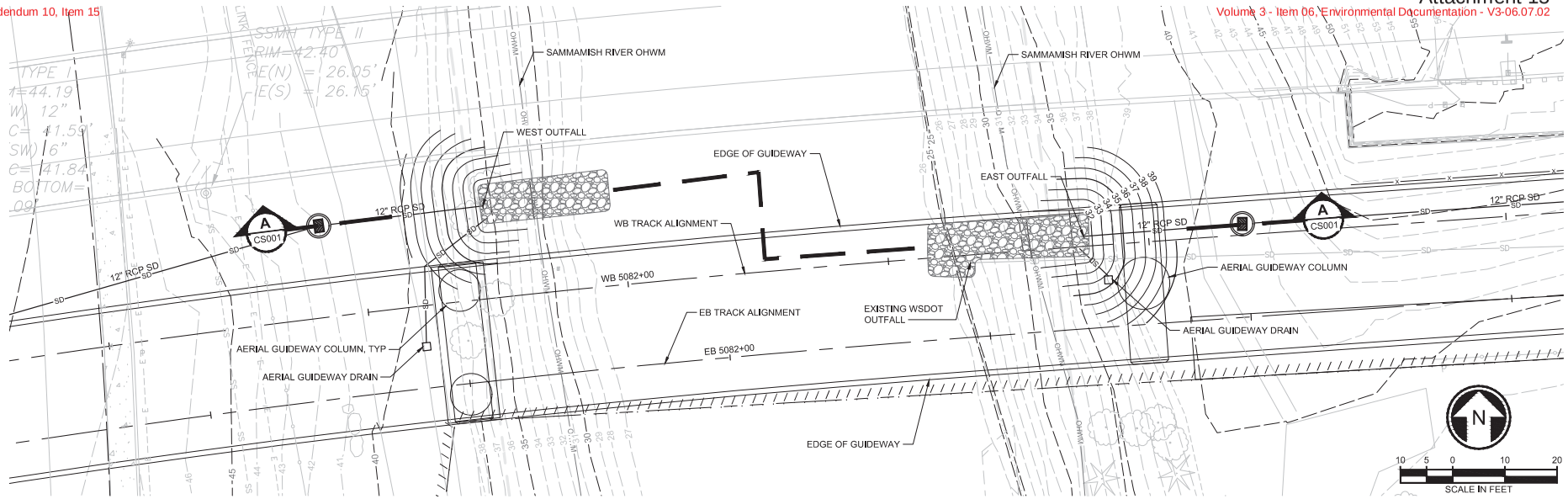

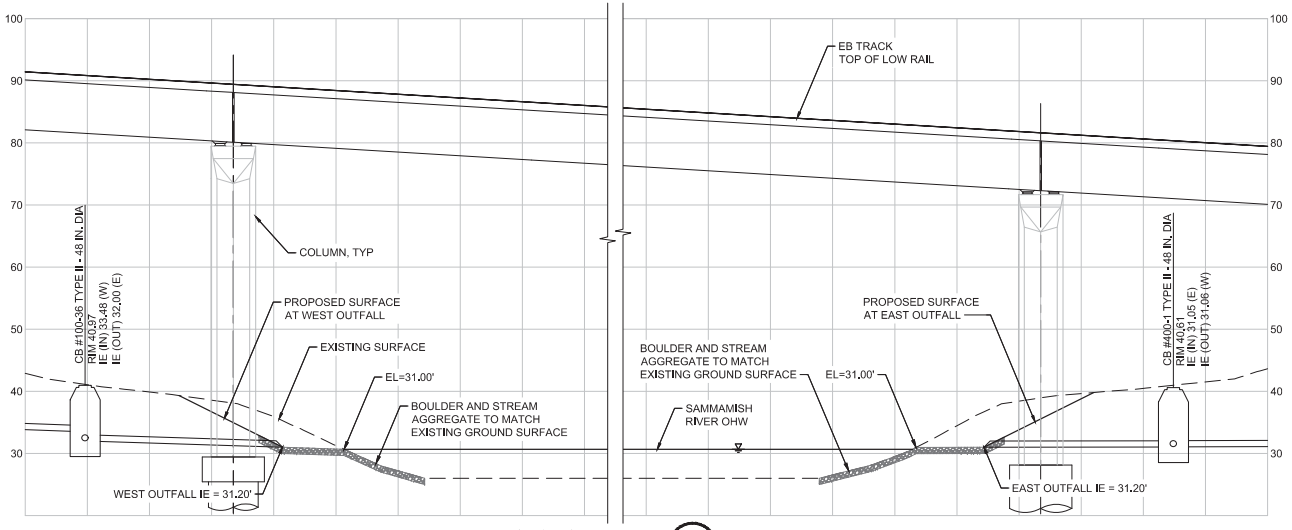

SECTION A
SCALE: 1" = 10'

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-SHRPRMT-COR-SECT
CONTRACT No.:
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTC TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
SAMMAMISH RIVER
CROSS-SECTION - SHEET 1 OF 1

DRAWING No.: **L90-CS001**
LOCATION ID:
SHEET No.: 7
REV:

02/19/19 | 11:31 AM | ITOP
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Xrefs:
RLE-GB-TB22x34
xRLE-L90-SEP100
xRLE-L90-SWP100
xRLE-L95-WG
xRLE-L95-VSF
xRLE-L95-VUT
xRLE-L90-WG
xRLE-L90-VSF
xRLE-L90-VUT
xRLE-L90-WRX
xRLE-G5-VFP
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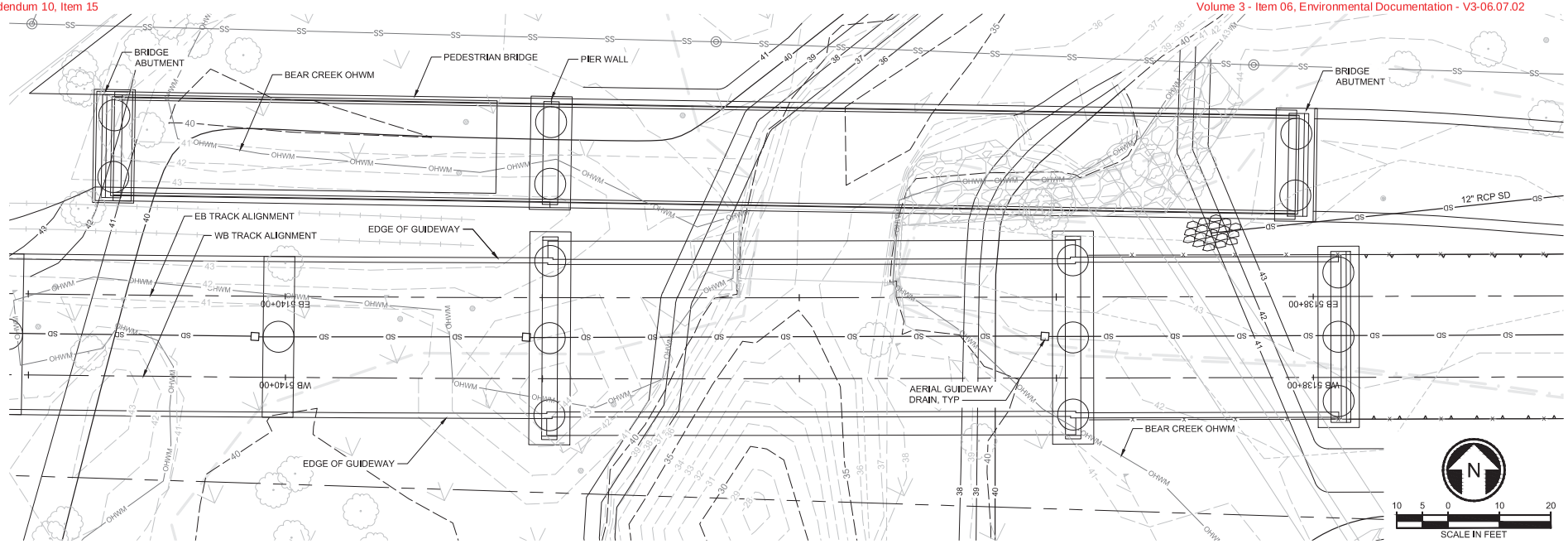

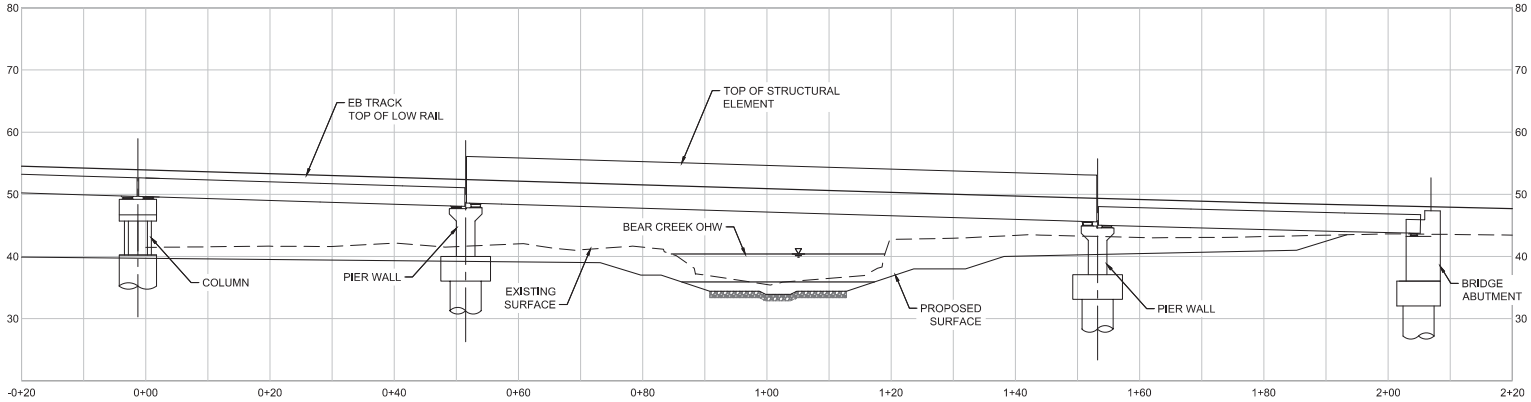

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 10'
FILENAME: RLE-SHRPRMT-COR-SECT
CONTRACT No.:
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTC TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
CROSS-SECTION - SHEET 1 OF 1

DRAWING No.: L90-CS002
LOCATION ID:
SHEET No.: 8
REV:

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Xrefs:
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xRLE-L90-CRP100
xRLE-L90-KAP100
xRLE-L90-CDP100
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xRLE-L95-VSF
xRLE-L90-VSF
xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-G25-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-VRX
xRLE-L90-RHP100
xRLE-G25-VFP
key-map-permits
xRLE-G25-CriticalAreas
xRLE-G25-Rdmd-SJR
xRLE-L90-CCN100
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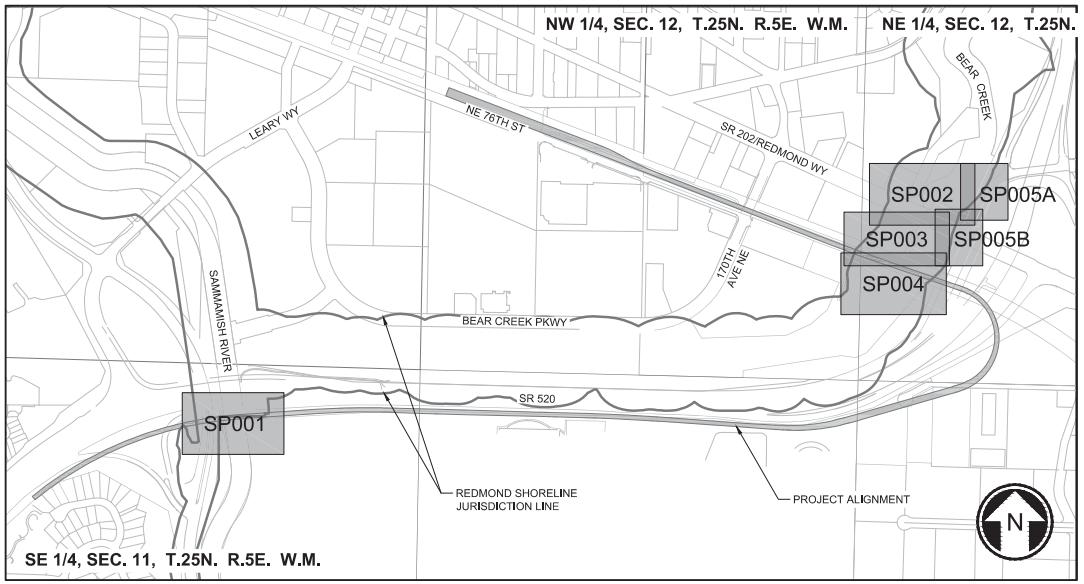

GENERAL INFORMATION

a. LEGAL DESCRIPTION: N/A

PARCEL NUMBERS: SEE PLAN SHEETS FOR PARCEL NUMBERS

b. PROPOSED UBC CONSTRUCTION TYPE: N/A

c. SITE SIZE (GROSS AND NET): N/A

d. DWELLING UNITS ALLOWED & PROPOSED (RESIDENTIAL): N/A

e. GROSS FLOOR AREA ALLOWED & PROPOSED (NON-RESIDENTIAL): N/A

f. OPEN SPACE/LANDSCAPING REQUIRED & PROVIDED: N/A

g. IMPERVIOUS SURFACE ALLOWED & PROPOSED: N/A

h. PARKING REQUIRED AND PROVIDED: N/A

i. BUILDING HEIGHT ALLOWED AND PROPOSED: N/A

02/19/19 | 11:46 AM | ITOP
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CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
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Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: NTS
FILENAME: RLE-SHRPRMT-COR-SP
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT

SITE PLAN - COVER SHEET

DRAWING No.: L90-SP000
LOCATION ID:
SHEET No.: 1
REV:

SE 1/4, SEC. 11, T.25N. R.5E. W.M.

Xrefs:
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xRLE-L90-SEP100
xRLE-L90-SWP100
xRLE-L90-CRP100
xRLE-L90-KAP100
xRLE-L90-CDP100
xRLE-G05-VSF
xRLE-L95-VSF
xRLE-L90-VSF
xRLE-G05-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-WRX
xRLE-L90-RHP100
xRLE-G05-VFP
key-map-permits
xRLE-G05-CriticalAreas
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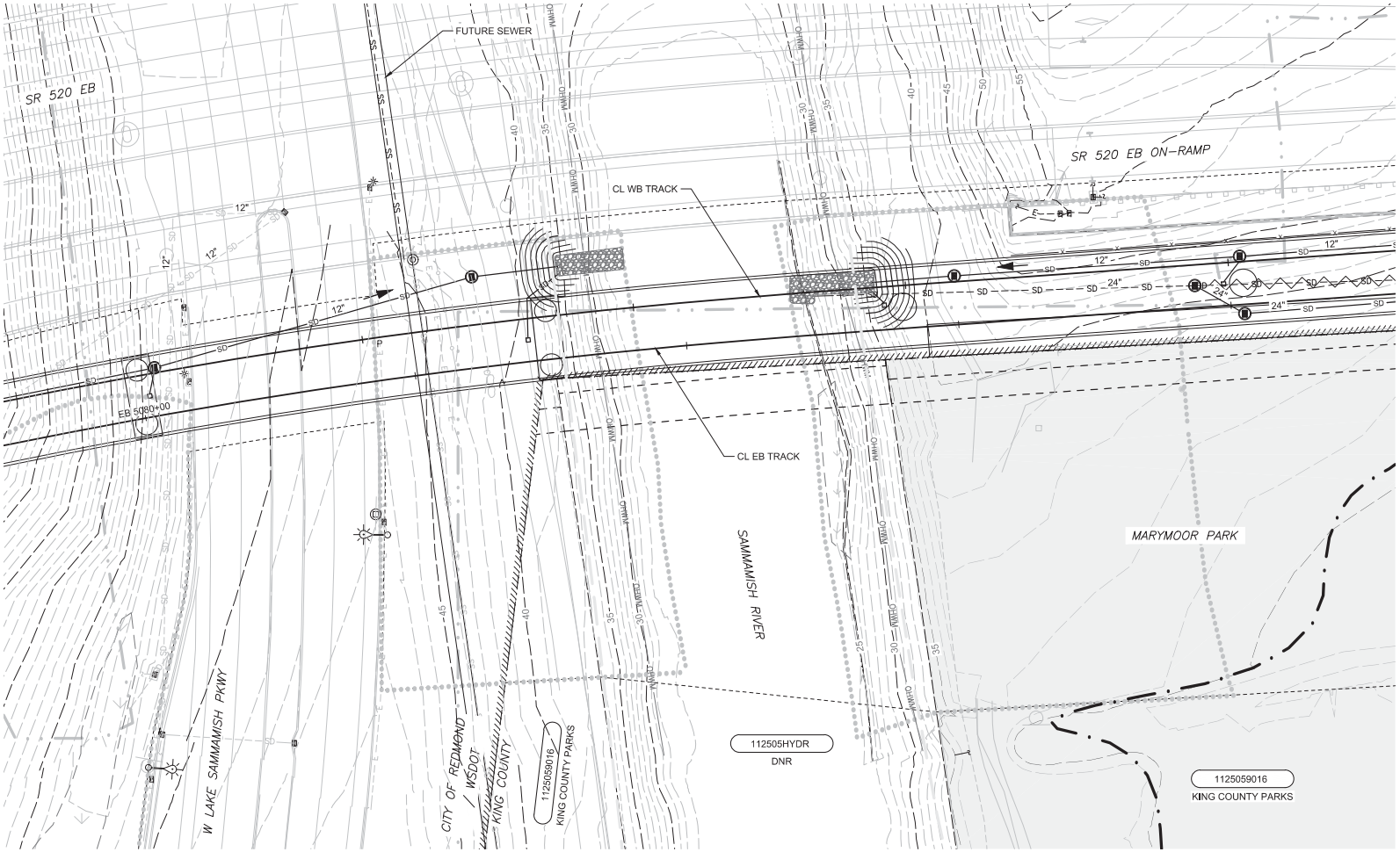
xRLE-L90-CCN100



LEGEND

- SECTION LINE
- 1/4 SECTION LINE
- WSDOT RIGHT-OF-WAY
- TEMPORARY CONSTRUCTION EASEMENT
- PROPERTY LINE
- EXISTING EASEMENT LINE
- PROPOSED EASEMENT LINE
- EXISTING CONTOUR LINES
- PROPOSED CONTOUR LINES
- BALLAST WALL
- RETAINING WALL
- FENCE
- GUARDRAIL / CONCRETE BARRIER
- FLOODWAY BOUNDARY
- 100-YEAR FLOOD LINE
- REDMOND SHORELINE JURISDICTION LINE
- WETLAND BOUNDARY
- ORDINARY HIGH WATER MARK (OHWM)
- WETLAND AND OHWM BUFFER
- UNINCORPORATED KING COUNTY
- WETLAND

NOTES:

1. NO PROPOSED WATER FACILITIES LIE WITHIN THE SHORELINE JURISDICTION AREA.
2. NO PROPOSED SEWER FACILITIES LIE WITHIN THE SHORELINE JURISDICTION AREA.

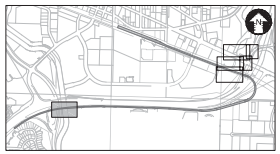
UTILITY LEGEND

- EXISTING FIBEROPTIC
- EXISTING GAS
- EXISTING POWER
- EXISTING SANITARY SEWER
- EXISTING STORM DRAIN
- EXISTING TELEPHONE
- EXISTING WATER
- REMOVE EXISTING STORM DRAIN
- PROPOSED FIBEROPTIC
- PROPOSED STORM DRAIN
- EXISTING ELECTRICAL JUNCTION BOX
- EXISTING GAS VALVE
- EXISTING LIGHT POLE
- EXISTING STORM DRAIN CATCH BASIN
- EXISTING SANITARY SEWER MANHOLE
- EXISTING TELEPHONE JUNCTION BOX
- PROPOSED STORM DRAIN CATCH BASIN
- PROPOSED FIBEROPTIC VAULT

N

20 10 0 20 40

SCALE IN FEET



KEY MAP

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-UTIL
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
SAMMAMISH RIVER
UTILITY PLAN - SHEET 1 OF 1

DRAWING No.: L90-UP001
LOCATION ID:
SHEET No.: 9
REV:

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Xrefs:
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xRLE-L90-KAP100
xRLE-L90-CDP100
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xRLE-L95-VSF
xRLE-L90-VSF
xRLE-G5-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-WRX
xRLE-L90-RHP100
xRLE-G5-VTF
key-map-permits
xRLE-G5-CriticalAreas
xRLE-G5-Rdmd-SJB
xRLE-E29-ASP100
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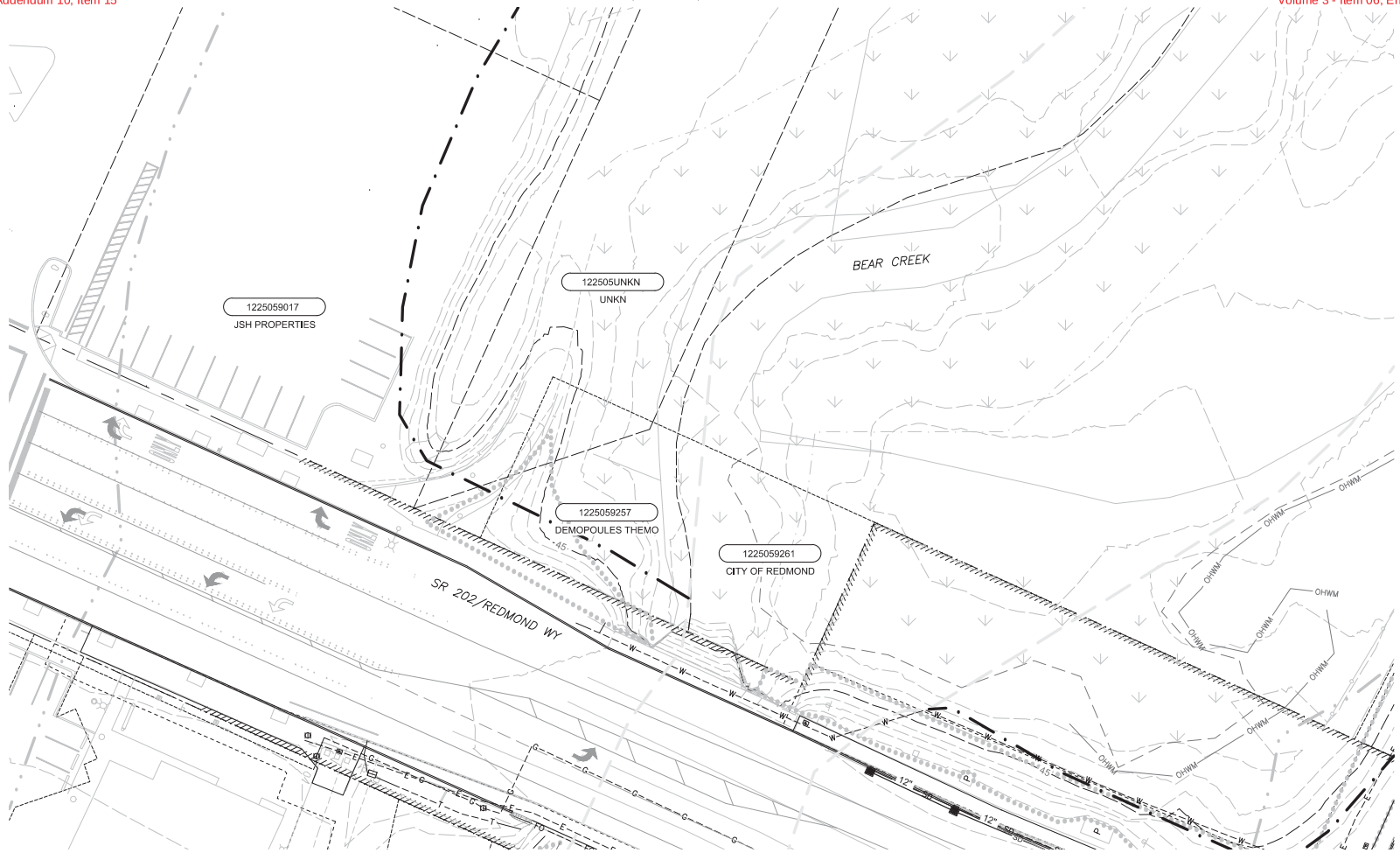
xRLE-L90-CON100

NE 1/4, SEC. 12, T.25N. R.5E. W.M.



LEGEND

- SECTION LINE
- 1/4 SECTION LINE
- WSDOT RIGHT-OF-WAY
- TEMPORARY CONSTRUCTION EASEMENT
- PROPERTY LINE
- EXISTING EASEMENT LINE
- PROPOSED EASEMENT LINE
- EXISTING CONTOUR LINES (40)
- PROPOSED CONTOUR LINES (40, 38)
- BALLAST WALL
- RETAINING WALL
- FENCE
- GUARDRAIL / CONCRETE BARRIER
- FLOODWAY BOUNDARY
- 100-YEAR FLOOD LINE
- REDMOND SHORELINE JURISDICTION LINE
- WETLAND BOUNDARY
- ORDINARY HIGH WATER MARK (OHWM)
- WETLAND AND OHWM BUFFER
- UNINCORPORATED KING COUNTY
- WETLAND

NOTES:

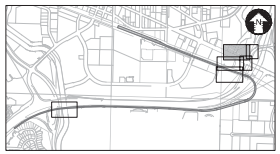
1. NO PROPOSED WATER FACILITIES LIE WITHIN THE SHORELINE JURISDICTION AREA.
2. NO PROPOSED SEWER FACILITIES LIE WITHIN THE SHORELINE JURISDICTION AREA.

UTILITY LEGEND

- EXISTING FIBEROPTIC
- EXISTING GAS
- EXISTING POWER
- EXISTING SANITARY SEWER
- EXISTING STORM DRAIN
- EXISTING TELEPHONE
- EXISTING WATER
- REMOVE EXISTING STORM DRAIN
- PROPOSED FIBEROPTIC
- PROPOSED STORM DRAIN
- EXISTING ELECTRICAL JUNCTION BOX
- EXISTING GAS VALVE
- EXISTING LIGHT POLE
- EXISTING STORM DRAIN CATCH BASIN
- EXISTING SANITARY SEWER MANHOLE
- EXISTING TELEPHONE JUNCTION BOX
- PROPOSED STORM DRAIN CATCH BASIN
- PROPOSED FIBEROPTIC VAULT

N

20 10 0 20 40
SCALE IN FEET



KEY MAP

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-UTIL
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
UTILITY PLAN - SHEET 1 OF 4

DRAWING No.: L90-UP002
LOCATION ID:
SHEET No.: 10
REV:

02/19/19 | 10:53 AM | ITOP
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Xrefs:
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xRLE-L90-KAP100
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xRLE-L95-VSF
xRLE-L90-VSF
xRLE-G05-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-WRX
xRLE-L90-RHP100
xRLE-G05-VFP
key-map-permits
xRLE-G05-CriticalAreas
xRLE-G05-Rdmd-SJB
xRLE-E29-ASP100
xRLE-L90-UCP100
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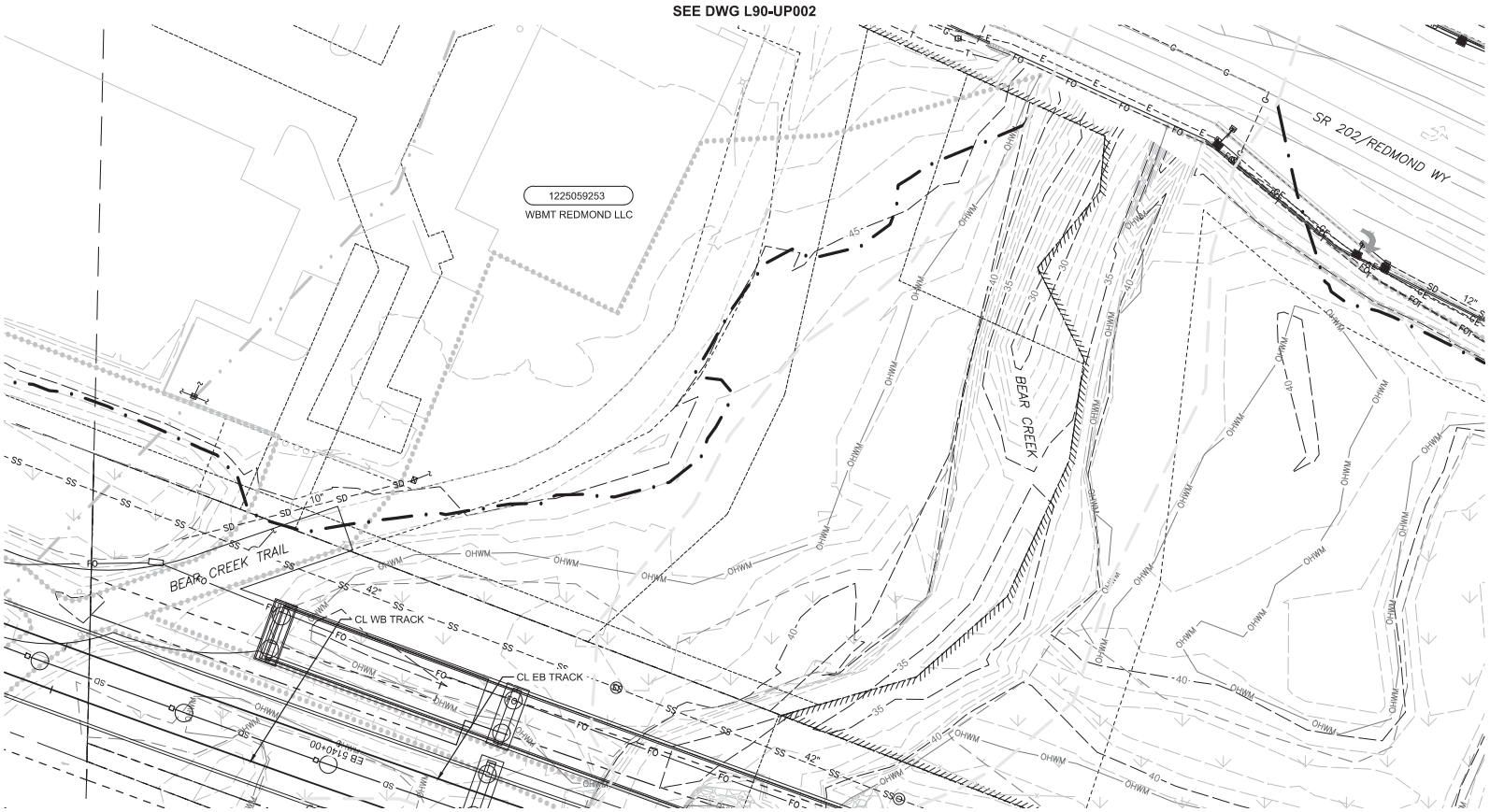
xRLE-L90-CCN100

NE 1/4, SEC. 12, T.25N. R.5E. W.M.



LEGEND

- SECTION LINE
- 1/4 SECTION LINE
- WSDOT RIGHT-OF-WAY
- TEMPORARY CONSTRUCTION EASEMENT
- PROPERTY LINE
- EXISTING EASEMENT LINE
- PROPOSED EASEMENT LINE
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- FLOODWAY BOUNDARY
- 100-YEAR FLOOD LINE
- REDMOND SHORELINE JURISDICTION LINE
- WETLAND BOUNDARY
- ORDINARY HIGH WATER MARK (OHWM)
- WETLAND AND OHWM BUFFER
- UNINCORPORATED KING COUNTY
- WETLAND

NOTES:

1. NO PROPOSED WATER FACILITIES LIE WITHIN THE SHORELINE JURISDICTION AREA.
2. NO PROPOSED SEWER FACILITIES LIE WITHIN THE SHORELINE JURISDICTION AREA.

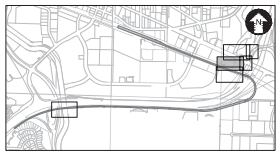
UTILITY LEGEND

- EXISTING FIBEROPTIC
- EXISTING GAS
- EXISTING POWER
- EXISTING SANITARY SEWER
- EXISTING STORM DRAIN
- EXISTING TELEPHONE
- EXISTING WATER
- REMOVE EXISTING STORM DRAIN
- PROPOSED FIBEROPTIC
- PROPOSED STORM DRAIN
- EXISTING ELECTRICAL JUNCTION BOX
- EXISTING GAS VALVE
- EXISTING LIGHT POLE
- EXISTING STORM DRAIN CATCH BASIN
- EXISTING SANITARY SEWER MANHOLE
- EXISTING TELEPHONE JUNCTION BOX
- PROPOSED STORM DRAIN CATCH BASIN
- PROPOSED FIBEROPTIC VAULT

N

20 10 0 20 40

SCALE IN FEET



KEY MAP

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-UTIL
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
UTILITY PLAN - SHEET 2 OF 4

DRAWING No.: L90-UP003
LOCATION ID:
SHEET No.: 11
REV:

02/19/19 | 10:54 AM | ITOP
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Xrefs:
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xRLE-L90-KAP100
xRLE-L90-CDP100
xRLE-G05-VSF
xRLE-L95-VSF
xRLE-L90-VSF
xRLE-G05-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-WRX
xRLE-L90-RHP100
xRLE-G05-VTP
key-map-permits
xRLE-G05-CriticalAreas
xRLE-G05-Rdmd-SJB
xRLE-E29-ASP100
xRLE-L90-UCP100
xRLE-L95-VUT
xRLE-L90-CON100

NE 1/4, SEC. 12, T.25N. R.5E. W.M.

SEE DWG L90-UP003

LEGEND

- SECTION LINE
- 1/4 SECTION LINE
- WSDOT RIGHT-OF-WAY
- TEMPORARY CONSTRUCTION EASEMENT
- PROPERTY LINE
- EXISTING EASEMENT LINE
- PROPOSED EASEMENT LINE
- EXISTING CONTOUR LINES (40)
- PROPOSED CONTOUR LINES (40, 38)
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- RETAINING WALL
- FENCE
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- REDMOND SHORELINE JURISDICTION LINE
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- WETLAND AND OHWM BUFFER
- UNINCORPORATED KING COUNTY
- WETLAND

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2. NO PROPOSED SEWER FACILITIES LIE WITHIN THE SHORELINE JURISDICTION AREA.

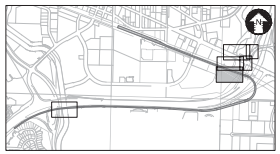
UTILITY LEGEND

- EXISTING FIBEROPTIC
- EXISTING GAS
- EXISTING POWER
- EXISTING SANITARY SEWER
- EXISTING STORM DRAIN
- EXISTING TELEPHONE
- EXISTING WATER
- REMOVE EXISTING STORM DRAIN
- PROPOSED FIBEROPTIC
- PROPOSED STORM DRAIN
- EXISTING ELECTRICAL JUNCTION BOX
- EXISTING GAS VALVE
- EXISTING LIGHT POLE
- EXISTING STORM DRAIN CATCH BASIN
- EXISTING SANITARY SEWER MANHOLE
- EXISTING TELEPHONE JUNCTION BOX
- PROPOSED STORM DRAIN CATCH BASIN
- PROPOSED FIBEROPTIC VAULT

N

20 10 0 20 40

SCALE IN FEET



KEY MAP

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-UTIL
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
UTILITY PLAN - SHEET 3 OF 4

DRAWING No.: L90-UP004
LOCATION ID:
SHEET No.: 12
REV:

02/19/19 | 10:56 AM | ITOP
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NE 1/4, SEC. 12, T.25N. R.5E. W.M.

Xrefs:
RLE-GB-TB22x34
xRLE-L90-SEP100
xRLE-L90-SWP100
xRLE-L90-CRP100
xRLE-L90-KAP100
xRLE-L90-CDP100
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xRLE-L95-VSF
xRLE-L90-VSF
xRLE-G5-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-WRX
xRLE-L90-RHP100
xRLE-G5-VFP
key-map-permits
xRLE-G5-CriticalAreas
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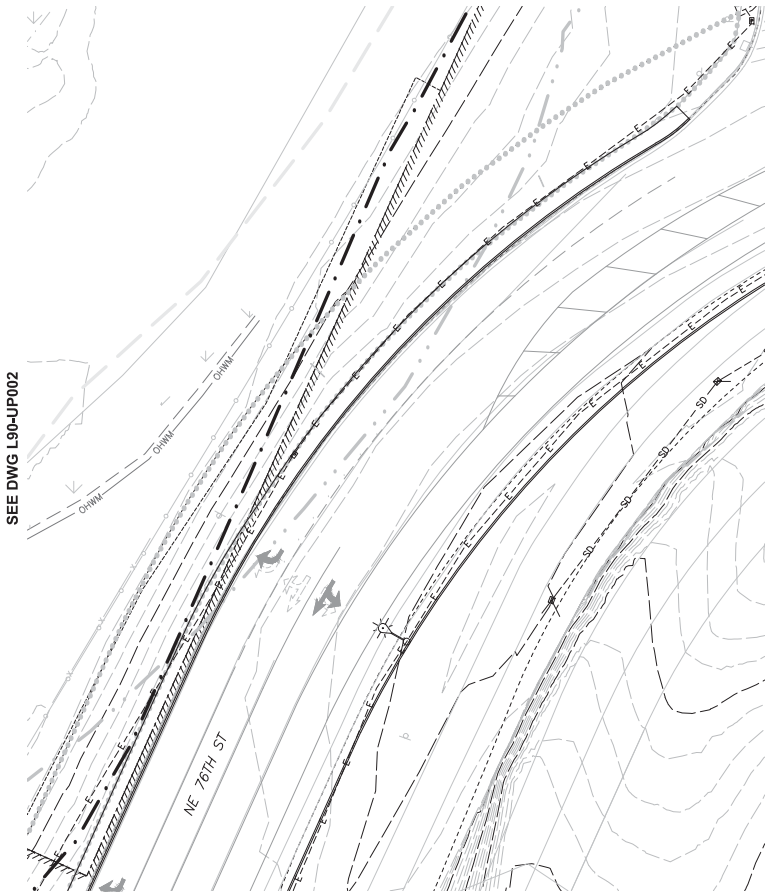
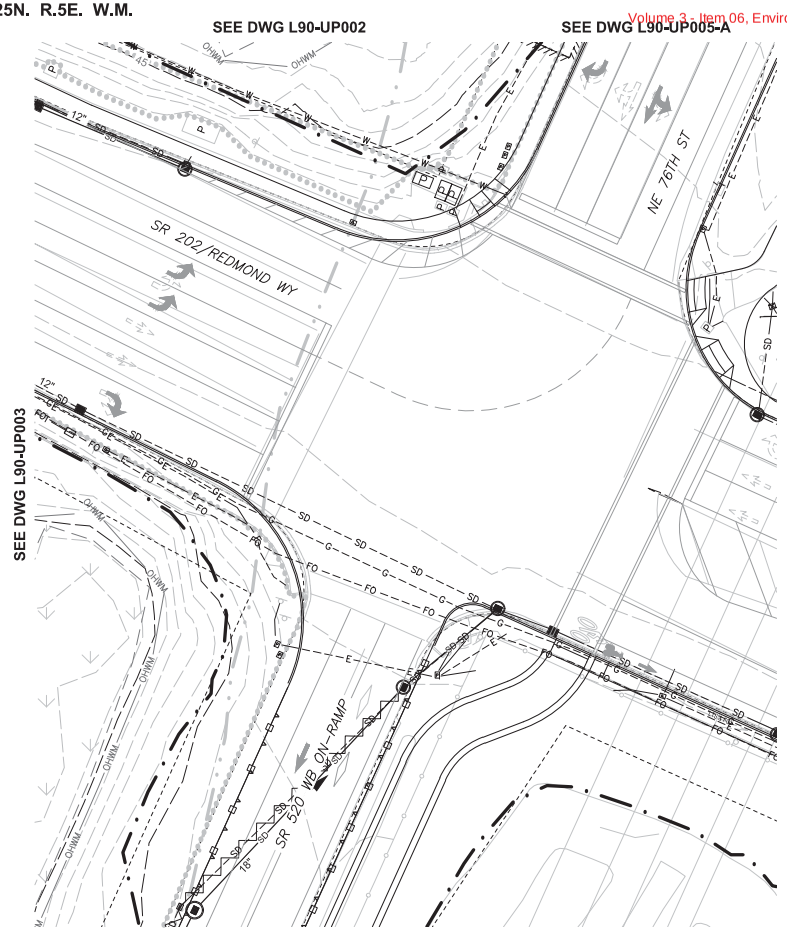
xRLE-L90-CON100



PLAN UP005-A



PLAN UP005-B

LEGEND

- SECTION LINE
- 1/4 SECTION LINE
- WSDOT RIGHT-OF-WAY
- TEMPORARY CONSTRUCTION EASEMENT
- PROPERTY LINE
- EXISTING EASEMENT LINE
- PROPOSED EASEMENT LINE
- EXISTING CONTOUR LINES (40)
- PROPOSED CONTOUR LINES (40, 38)
- BALLAST WALL
- RETAINING WALL
- FENCE
- GUARDRAIL / CONCRETE BARRIER
- FLOODWAY BOUNDARY
- 100-YEAR FLOOD LINE
- REDMOND SHORELINE JURISDICTION LINE
- WETLAND BOUNDARY
- ORDINARY HIGH WATER MARK (OHWM)
- WETLAND AND OHWM BUFFER
- UNINCORPORATED KING COUNTY
- WETLAND

NOTES:

1. NO PROPOSED WATER FACILITIES LIE WITHIN THE SHORELINE JURISDICTION AREA.
2. NO PROPOSED SEWER FACILITIES LIE WITHIN THE SHORELINE JURISDICTION AREA.

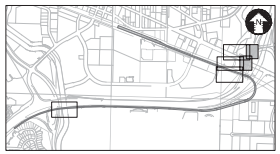
UTILITY LEGEND

- EXISTING FIBEROPTIC
- EXISTING GAS
- EXISTING POWER
- EXISTING SANITARY SEWER
- EXISTING STORM DRAIN
- EXISTING TELEPHONE
- EXISTING WATER
- REMOVE EXISTING STORM DRAIN
- PROPOSED FIBEROPTIC
- PROPOSED STORM DRAIN
- EXISTING ELECTRICAL JUNCTION BOX
- EXISTING GAS VALVE
- EXISTING LIGHT POLE
- EXISTING STORM DRAIN CATCH BASIN
- EXISTING SANITARY SEWER MANHOLE
- EXISTING TELEPHONE JUNCTION BOX
- PROPOSED STORM DRAIN CATCH BASIN
- PROPOSED FIBEROPTIC VAULT

N

20 10 0 20 40

SCALE IN FEET



KEY MAP

CONCEPTUAL DESIGN

No.	DATE	DSN	CHK	APP	REVISION

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-UTIL
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
UTILITY PLAN - SHEET 4 OF 4

DRAWING No.: L90-UP005
LOCATION ID:
SHEET No.: 13
REV:

02/19/19 | 10:59 AM | ITOP
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xRLE-L90-CRP100
xRLE-L90-KAP100
xRLE-L90-CDP100
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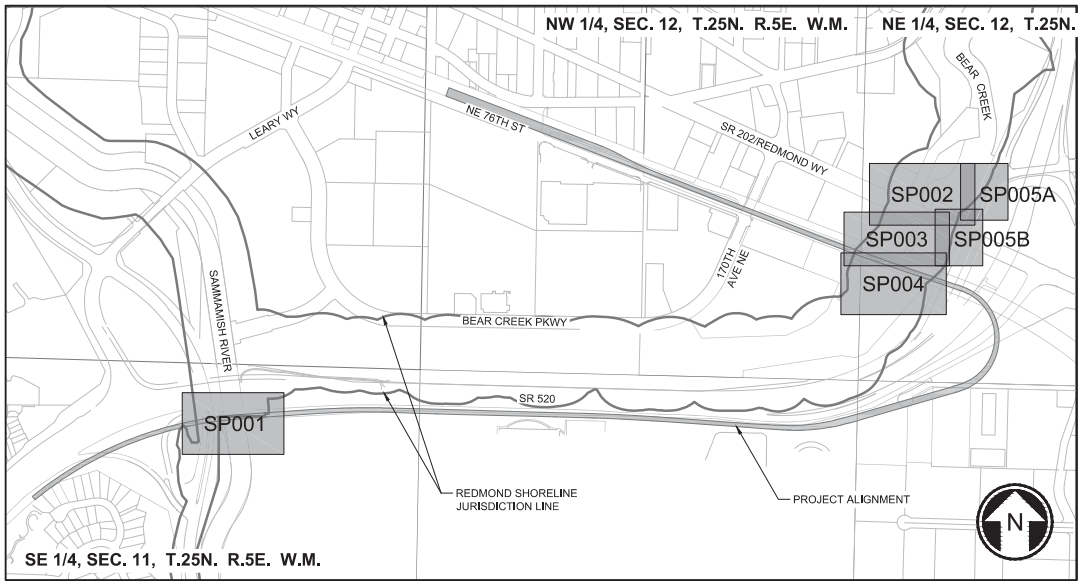
xRLE-L95-VSF
xRLE-L90-VSF
xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-G25-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-VRX
xRLE-L90-RHP100
xRLE-G25-VFP
key-map-permits
xRLE-G25-CriticalAreas
xRLE-G25-Rdmd-SJR
xRLE-L90-CCN100
RLE-GB-TB-Figures-8x11



GENERAL INFORMATION

a. LEGAL DESCRIPTION: N/A

PARCEL NUMBERS: SEE PLAN SHEETS FOR PARCEL NUMBERS

b. PROPOSED UBC CONSTRUCTION TYPE: N/A

c. SITE SIZE (GROSS AND NET): N/A

d. DWELLING UNITS ALLOWED & PROPOSED (RESIDENTIAL): N/A

e. GROSS FLOOR AREA ALLOWED & PROPOSED (NON-RESIDENTIAL): N/A

f. OPEN SPACE/LANDSCAPING REQUIRED & PROVIDED: N/A

g. IMPERVIOUS SURFACE ALLOWED & PROPOSED: N/A

h. PARKING REQUIRED AND PROVIDED: N/A

i. BUILDING HEIGHT ALLOWED AND PROPOSED: N/A

02/19/19 | 11:46 AM | ITOP
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CONCEPTUAL DESIGN

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DESIGNED BY:
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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: NTS
FILENAME: RLE-SHRPRMT-COR-SP
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT

SITE PLAN - COVER SHEET

DRAWING No.: L90-SP000
LOCATION ID:
SHEET No.: 1
REV:

SE 1/4, SEC. 11, T.25N. R.5E. W.M.

Xrefs:
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xRLE-L90-CDP100
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xRLE-L90-VSF
xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-G05-VUT
xRLE-L90-VUT
xRLE-E29-LPP100
xRLE-E31-LPP100
xRLE-L90-VRX
xRLE-L90-RHP100
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xRLE-G05-Rdmd-SJR
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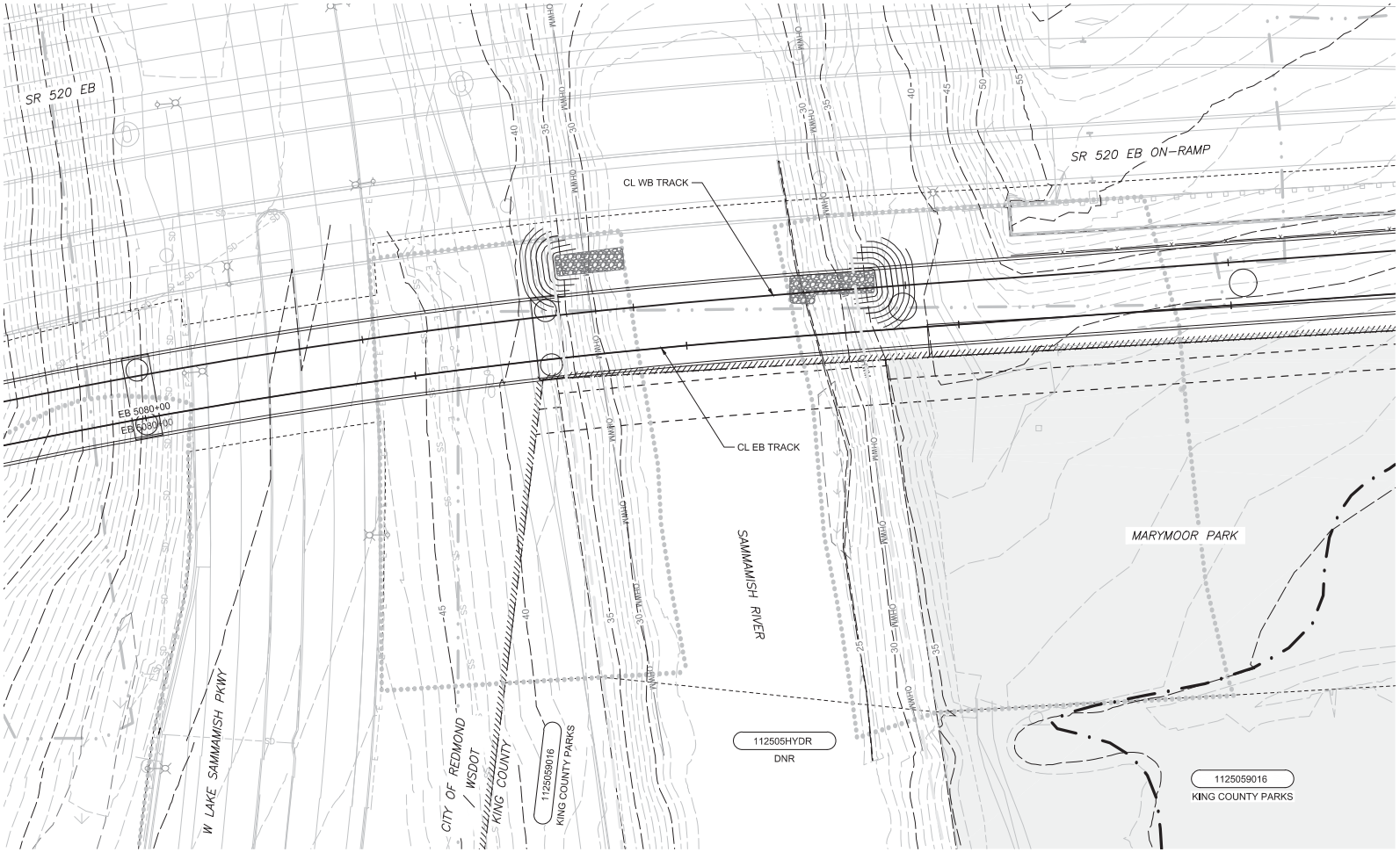


LEGEND

- SECTION LINE
- 1/4 SECTION LINE
- WSDOT RIGHT-OF-WAY
- TEMPORARY CONSTRUCTION EASEMENT
- PROPERTY LINE
- EXISTING EASEMENT LINE
- PROPOSED EASEMENT LINE
- 40 — EXISTING CONTOUR LINES
- 40 / 38 — PROPOSED CONTOUR LINES
- BALLAST WALL
- RETAINING WALL
- FENCE
- GUARDRAIL / CONCRETE BARRIER
- FLOODWAY BOUNDARY
- 100-YEAR FLOOD LINE
- REDMOND SHORELINE JURISDICTION LINE
- WETLAND BOUNDARY
- OHWM — ORDINARY HIGH WATER MARK (OHWM)
- WETLAND AND OHWM BUFFER
- UNINCORPORATED KING COUNTY
- WETLAND

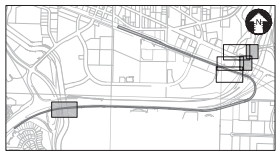
NOTES:

1. NO PROPOSED ROADWAY RECONSTRUCTION LIES WITHIN THE SHORELINE JURISDICTION AREA.
2. NO PROPOSED RETAINING WALLS OR ROCKERIES > 8' LIE WITHIN THE SHORELINE JURISDICTION AREA.

N

20 10 0 20 40

SCALE IN FEET



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LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

DATE:

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-GRAD
CONTRACT No.: CN 0148-18

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
SAMMAMISH RIVER
GRADING PLAN - SHEET 1 OF 1

DRAWING No.: L90-GP001
LOCATION ID:
SHEET No.: 14
REV:

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xRLE-L95-VSF
xRLE-L90-VSF
xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-G25-VUT
xRLE-L90-VUT
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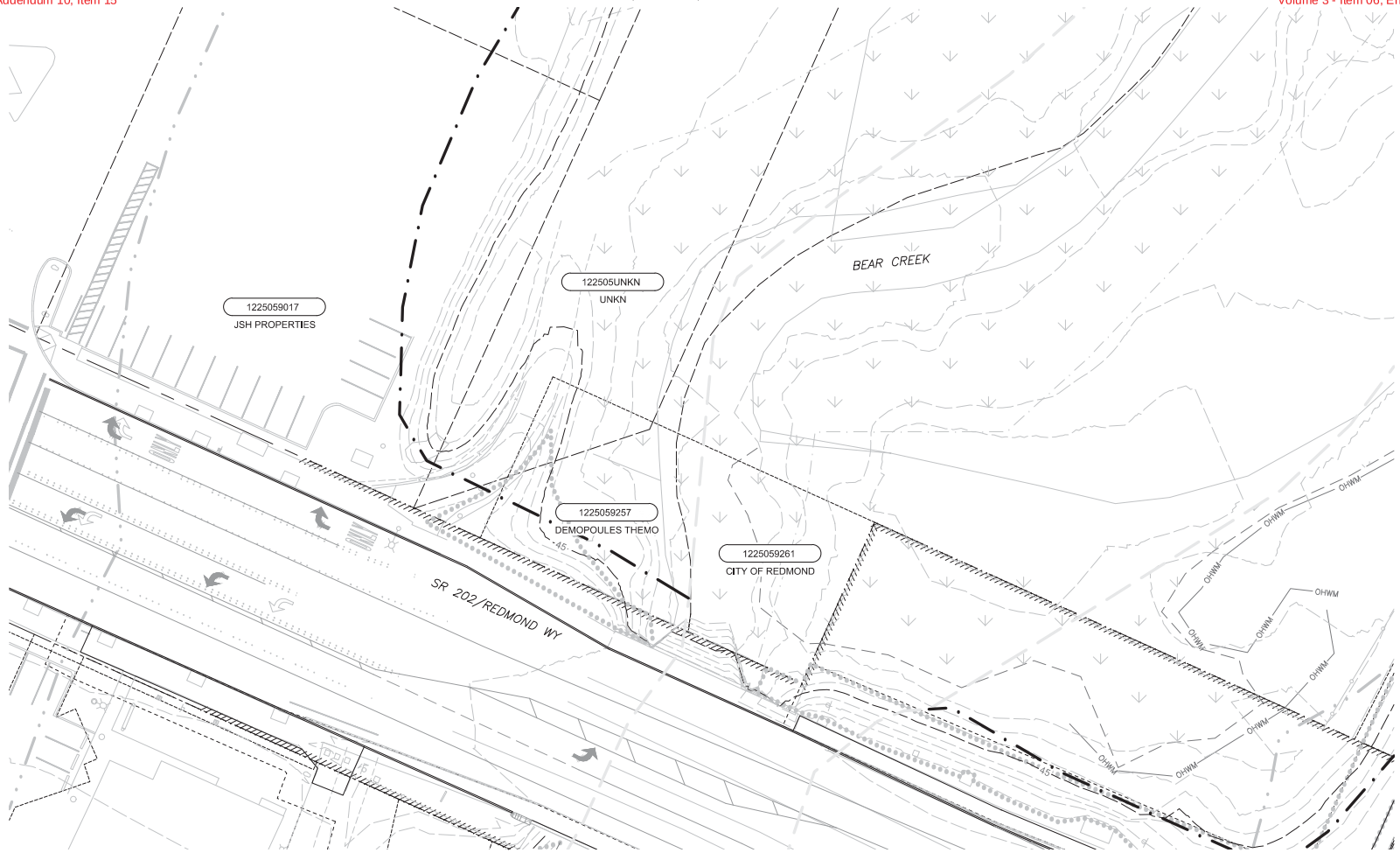
xRLE-E31-LPP100
xRLE-L90-VRX
xRLE-L90-RHP100
xRLE-G25-VFP
key-map-permits
xRLE-G25-CriticalAreas
xRLE-G25-Rdmd-SJB
xRLE-L90-CCN100

NE 1/4, SEC. 12, T.25N. R.5E. W.M.



SEE DWG L90-GP005

LEGEND

- SECTION LINE
- 1/4 SECTION LINE
- WSDOT RIGHT-OF-WAY
- TEMPORARY CONSTRUCTION EASEMENT
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- WETLAND

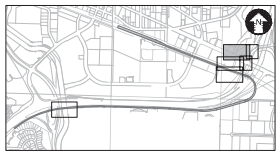
NOTES:

1. NO PROPOSED ROADWAY RECONSTRUCTION LIES WITHIN THE SHORELINE JURISDICTION AREA.
2. NO PROPOSED RETAINING WALLS OR ROCKERIES > 8' LIE WITHIN THE SHORELINE JURISDICTION AREA.

N

20 10 0 20 40

SCALE IN FEET



KEY MAP

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SOUNDTRANSIT

DATE:

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-GRAD
CONTRACT No.: CN 0148-18

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
GRADING PLAN - SHEET 1 OF 4

DRAWING No.: L90-GP002
LOCATION ID:
SHEET No.: 15
REV:

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NE 1/4, SEC. 12, T.25N. R.5E. W.M.

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xRLE-E29-ASP100
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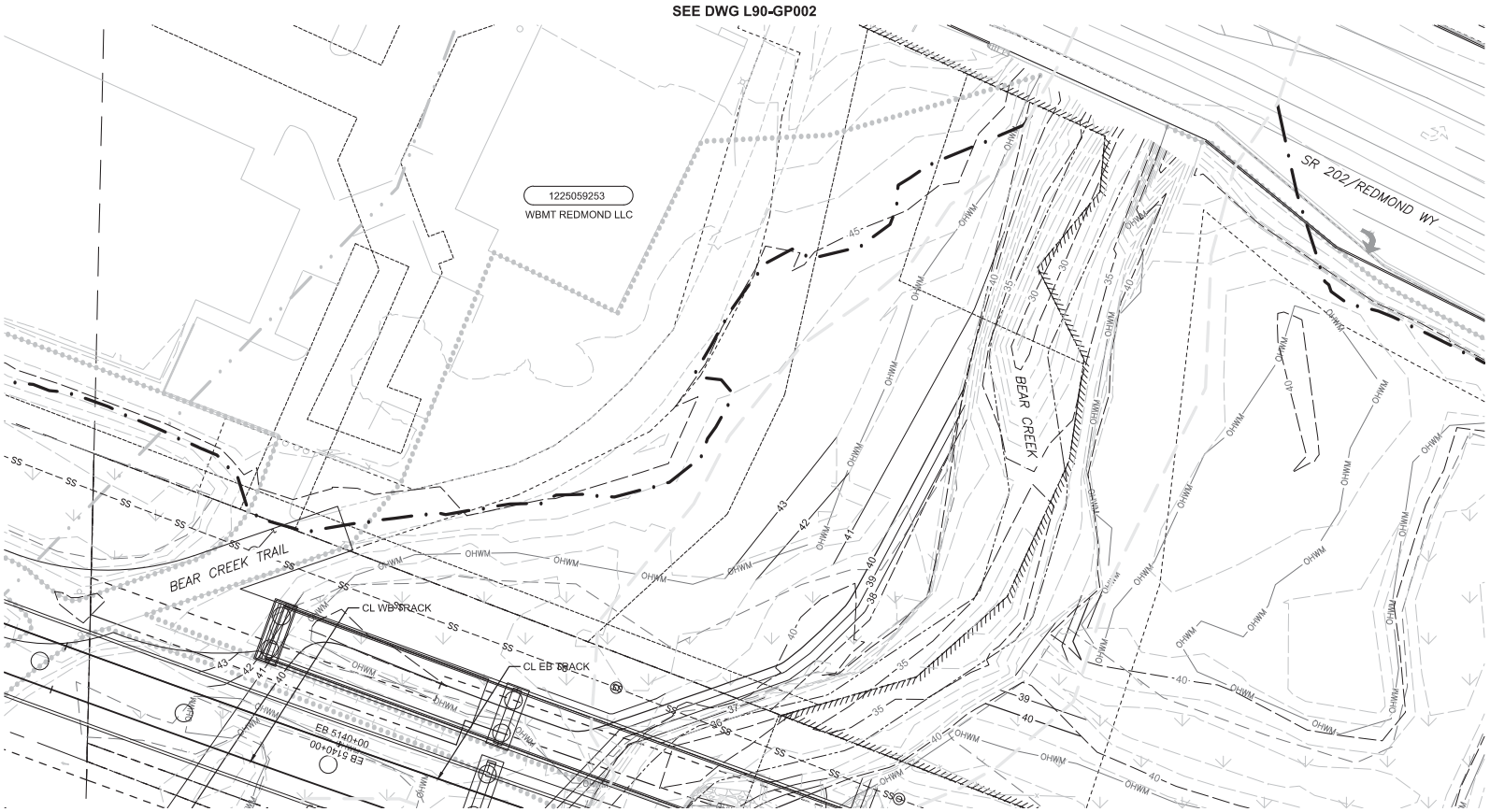

LEGEND

- SECTION LINE
- 1/4 SECTION LINE
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- TEMPORARY CONSTRUCTION EASEMENT
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NOTES:

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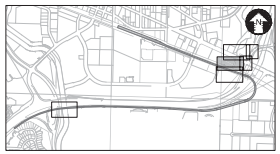
N

20 10 0 20 40
SCALE IN FEET



KEY MAP

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SOUNDTRANSIT

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-GRAD
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
GRADING PLAN - SHEET 2 OF 4

DRAWING No.: L90-GP003
LOCATION ID:
SHEET No.: 16
REV:

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NE 1/4, SEC. 12, T.25N. R.5E. W.M.

SEE DWG L90-GP003

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xRLE-G25-VUT
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xRLE-L90-RHP100
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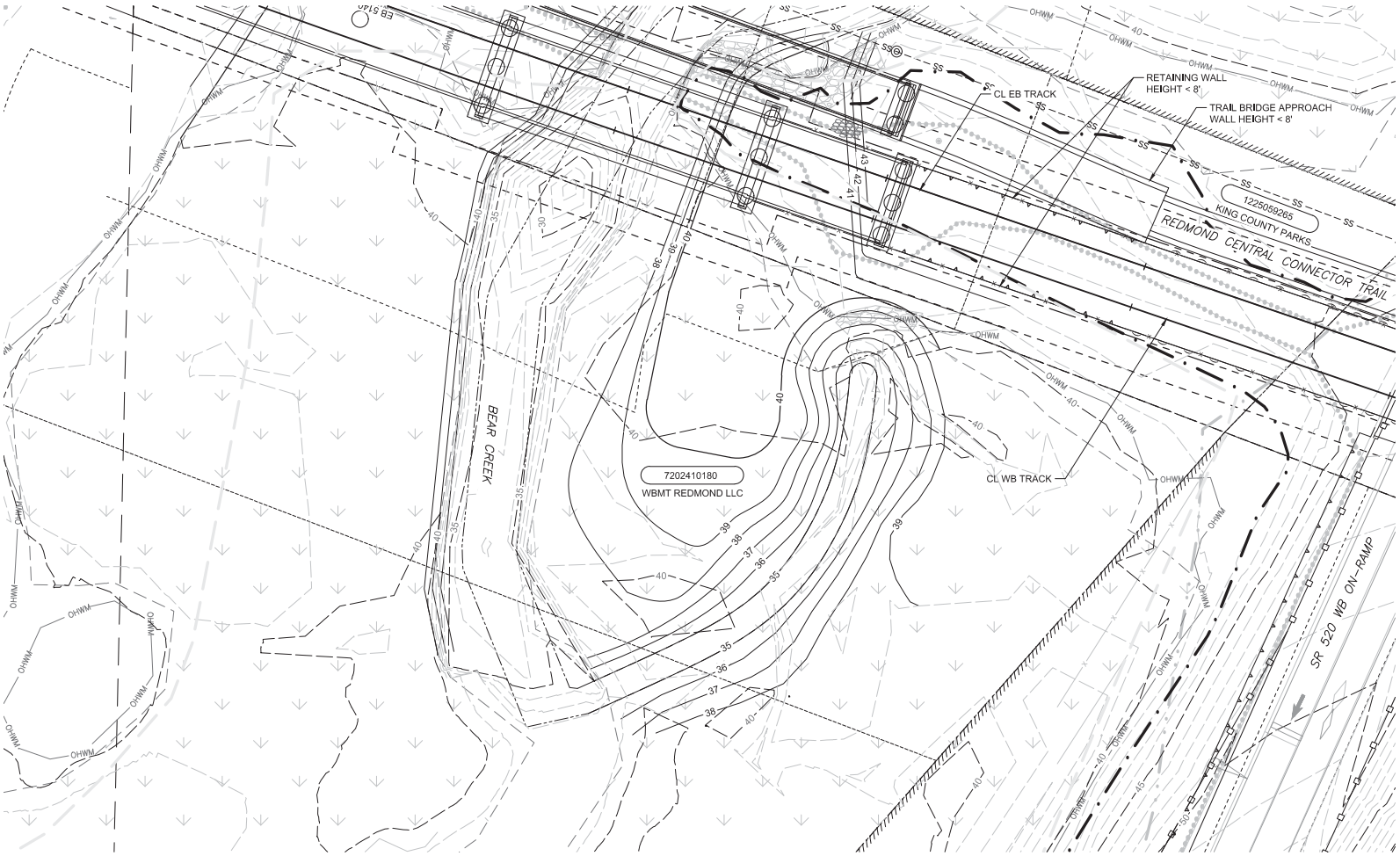

LEGEND

- SECTION LINE
- 1/4 SECTION LINE
- WSDOT RIGHT-OF-WAY
- TEMPORARY CONSTRUCTION EASEMENT
- PROPERTY LINE
- EXISTING EASEMENT LINE
- PROPOSED EASEMENT LINE
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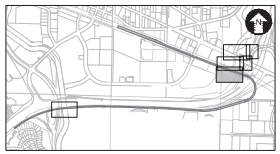
N

20 10 0 20 40

SCALE IN FEET



KEY MAP

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SUBMITTED BY: DATE: REVIEWED BY: DATE:

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-GRAD
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
GRADING PLAN - SHEET 3 OF 4

DRAWING No.: L90-GP004
LOCATION ID:
SHEET No.: 17
REV:

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xRLE-E29-ASP100
xRLE-L95-VUT
xRLE-G5-VUT
xRLE-L90-VUT
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xRLE-E31-LPP100
xRLE-L90-VRX
xRLE-L90-RHP100
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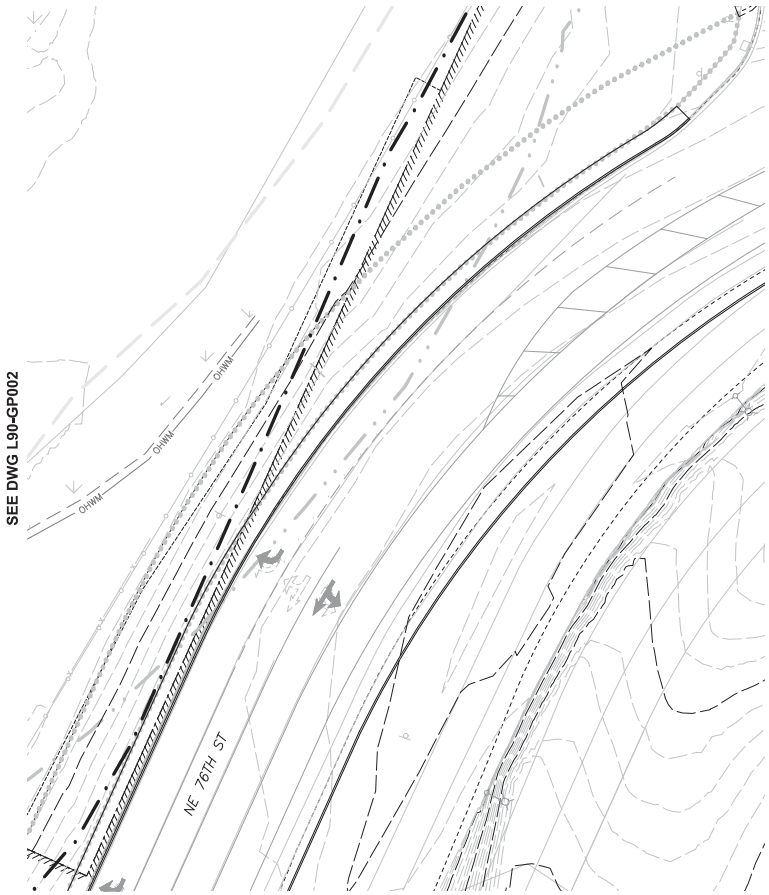
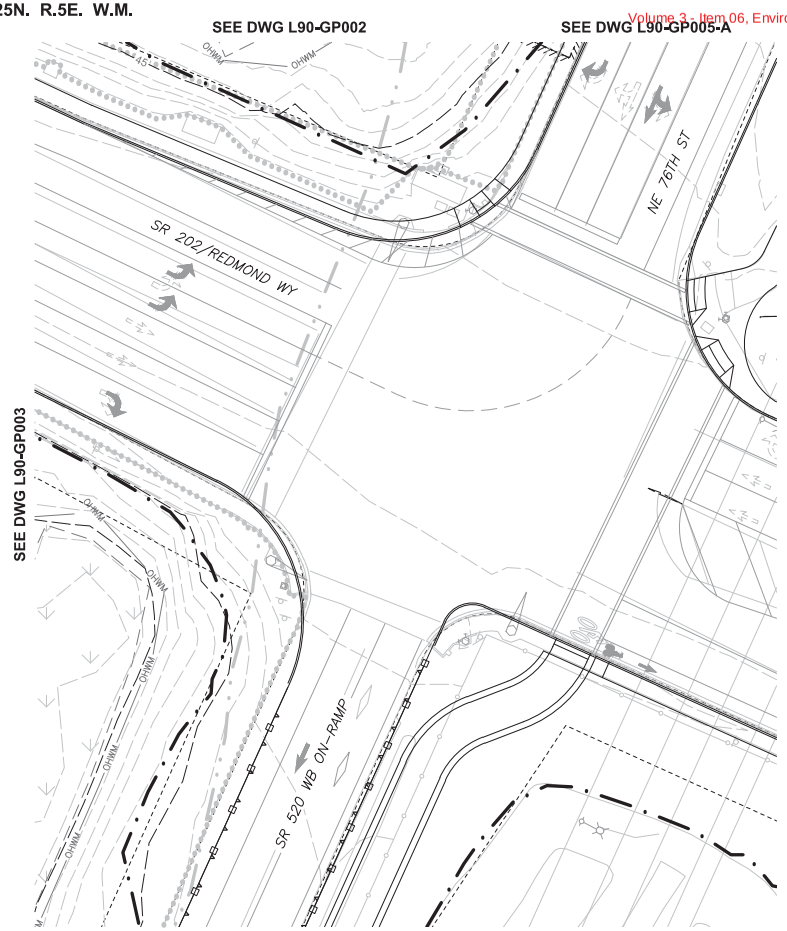


PLAN GP005-A



PLAN GP005-B

LEGEND

- SECTION LINE
- 1/4 SECTION LINE
- WSDOT RIGHT-OF-WAY
- TEMPORARY CONSTRUCTION EASEMENT
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NOTES:

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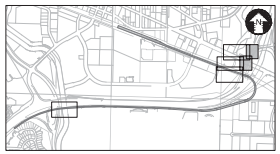
2. NO PROPOSED RETAINING WALLS OR ROCKERIES > 8' LIE WITHIN THE SHORELINE JURISDICTION AREA.

N

20 10 0 20 40
SCALE IN FEET



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SOUNDTRANSIT

SCALE: 1" = 20'
FILENAME: RLE-SHRPRMT-COR-GRAD
CONTRACT No.: CN 0148-18
DATE:

DOWNTOWN REDMOND LINK EXTENSION
RTS TO DOWNTOWN REDMOND

CITY OF REDMOND SHORELINE PERMIT
BEAR CREEK
GRADING PLAN - SHEET 4 OF 4

DRAWING No.: L90-GP005
LOCATION ID:
SHEET No.: 18
REV:

02/19/19 | 10:42 AM | ITOP
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