APPENDIX B

APPENDIX B

Seismic Shear Wave Velocity Tests

Seismic shear wave velocity profiling of the subsurface materials at the project site was performed using Seismic Cone Penetration Testing (SCPT) equipment. The purpose of the seismic shear wave velocity profiling of the subsurface materials was to analyze the seismic design considerations for the project. Shear wave velocity testing using seismic cone penetration testing equipment was performed at two selected boring locations, designated as [B-7(SW)] and [B-13(SW)], as shown on the Overall Site Plan (Plate 2) and the Individual Site Plans (Plates 3.1 and 3.2). The seismic shear wave velocity profiling was performed at various depths extending to maximum depths of about 122.5 and 121.4 feet below the existing ground surface for [B-7(SW)] and [B-13(SW)], respectively.

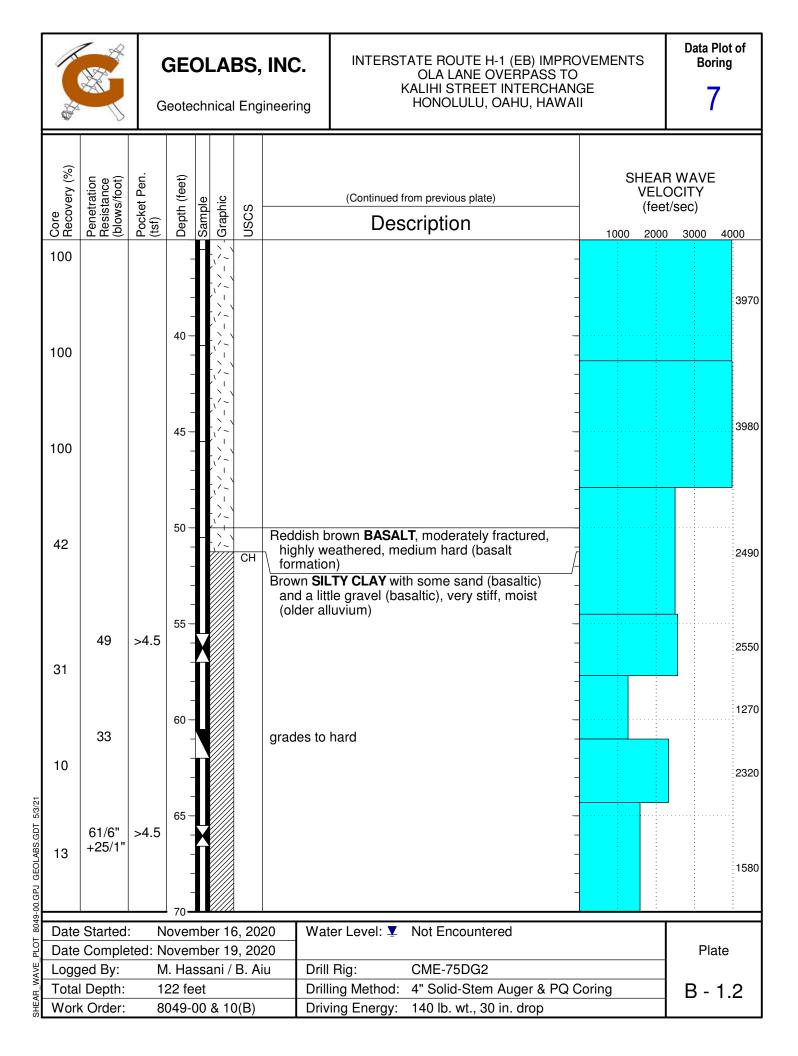
To conduct the seismic shear wave velocity test in the boring, the test boring was advanced utilizing rotary coring methods to the maximum depth of the boring. A log of the materials encountered in the boring is presented in the Logs of Borings in Appendix A. After the boring was advanced to the maximum depth of the borehole, the bored hole was backfilled with 0.25-inch diameter coated bentonite pellets. The temporary casing from the coring operations was used as a tremie pipe to place the bentonite pellets starting from the bottom and advancing upward. When the bentonite pellets are in contact with the groundwater in the borehole, the pellets begin to slowly hydrate. As the bentonite pellets hydrate, they swell and soften. The probe was then pushed through the softened bentonite column extending to depths of about 122.5 and 121.4 feet below the existing ground surface using seismic cone testing equipment (SCPT).

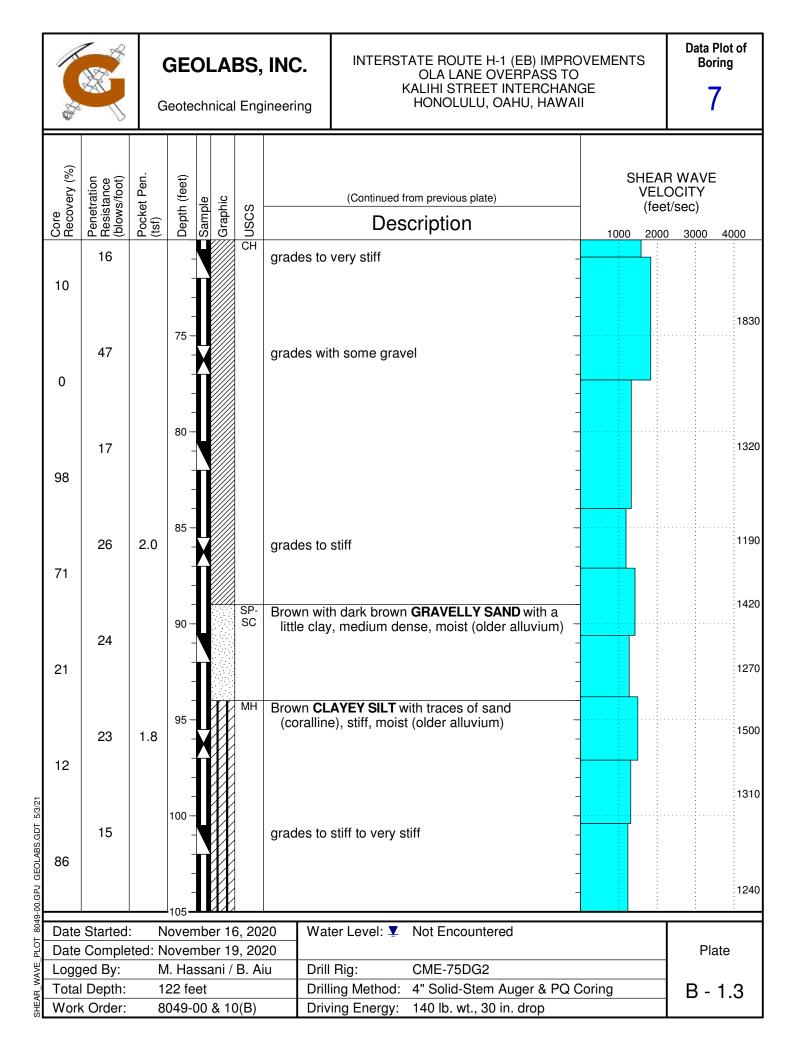
The seismic shear wave velocity test consists of hydraulically pushing a 10-ton steel electronic subtraction cone with an apex angle of 60 degrees and a projected surface area of 1.55 square inches (10 square centimeters) into the bored hole. The cone carries a uniaxial horizontal accelerator geophone to detect the arrival of a shear wave generated and propagated from the ground surface. The seismic measurements were made when the SCPT had stopped and a shear wave was sent into the subsurface. A shear wave was generated at the surface by striking a loaded plate with a switched hammer. The propagation time of the wave from the hammer blow to the cone was measured at each discrete depth interval. The vector difference of these depths divided by the time difference for the shear wave to arrive at the various depths provided the average shear wave velocity over the depth interval.

The seismic shear wave velocities measured, and the weighted average seismic shear wave velocity calculated for the top 100 feet of the soil profile at the boring locations are presented on Plates B-1.1 through B-2.6 in Appendix B. The weighted average shear wave velocity was calculated based on the average shear wave velocity method described in Table C3.10.3.1-1 (Steps for Site Classification) of the AASHTO 2020 LRFD Bridge Design Specifications, 9th Edition.

No.						-	INC.		ATE ROUTE H-1 (E OLA LANE OVER ALIHI STREET INT HONOLULU, OAH	PASS TO ERCHAN	GE	S		Plot of oring 7
Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	ple	hic	S		Approximate Elevation	e Ground Surface (feet): 41.5 *		s		t WAV OCITY /sec)	E
Core Reco	Pene Resis (blow	Pock (tsf)	Deptl	Sample	Graphic	nscs		Des	cription		1000	2000	3000	4000
	65		-					PHALTIC CO	NCRETE), dense, moist (fill)					820
			-	X)000					-				660
	9		-			СН	Yellowish stiff, moi		CLAY with some s	and, -				610
100	12/0" Ref.		5-	Ħ	· · · · ·				y to moderately frac ery hard (basalt forn					
			-							-			_	1510
100			- 10 – -				grades to	closely to mo	derately fractured	-	-			2440
			-							-				1830
100			15 - -				grades to	massive		-		· · · ·		1240
100			- - 20 - -							-				
100			- - 25 -							-	-			4700
100			- - 30 -							-				4710
			-		\ \					-				
Date	Started	: N	over	nbe	er 16	6, 20	20 Wat	ter Level: 🗴	Not Encountered					
	Comple	eted: N	over	nbe	er 19	9, 20	20						Ρ	late
	ed By: Depth:		I. Ha 22 fe		ni /	B. Ai		I Rig: ling Method:	CME-75DG2 4" Solid-Stem Aug	er & PQ (Corina		R-	1.1
	Order:		049-0		& 10	D(B)		/ing Energy:	140 lb. wt., 30 in. c		3		- 0	1.1

SHEAR_WAVE_PLOT 8049-00.GPJ GEOLABS.GDT 5/3/21

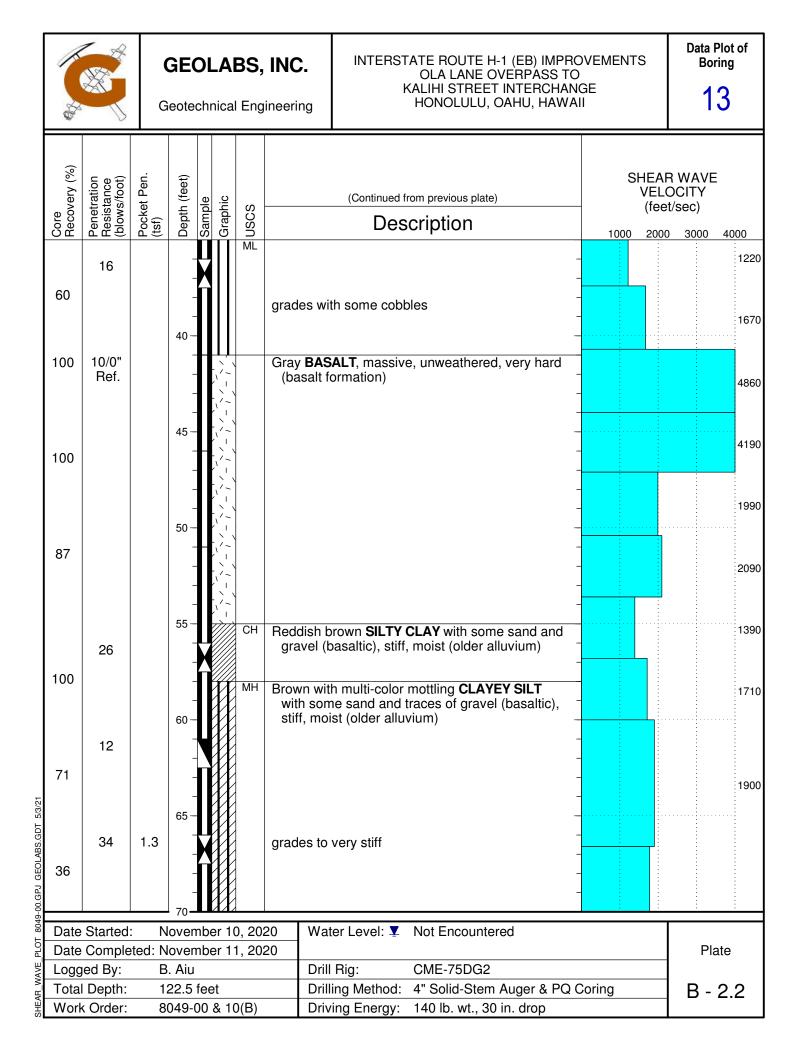


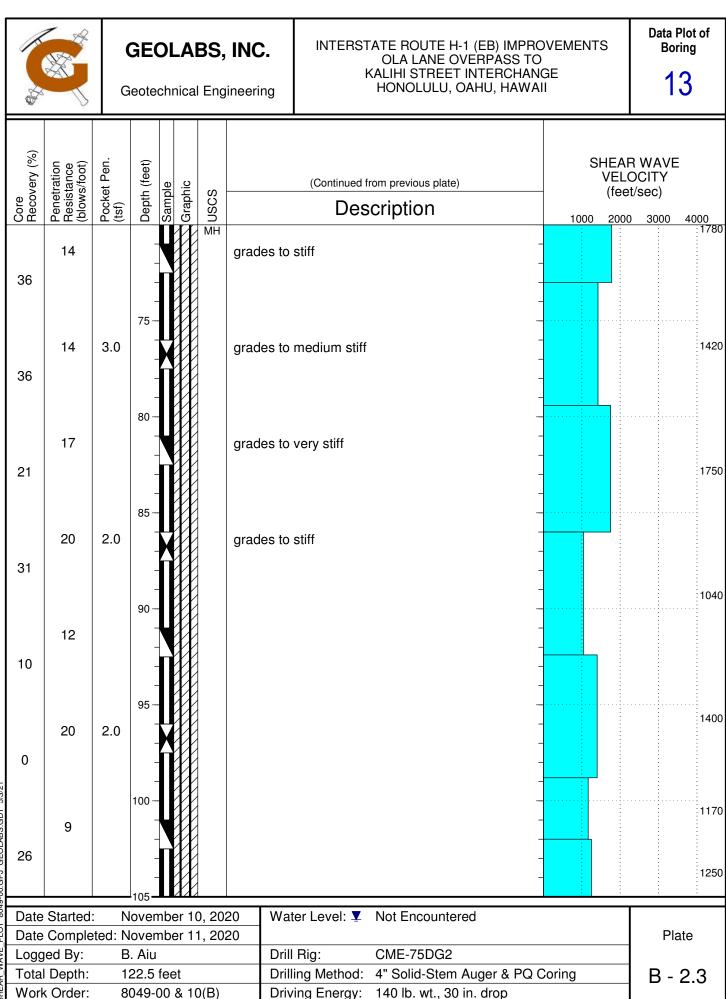


	GEOLABS, INC Geotechnical Engineerin								INTERSTATE ROUTE H-1 (EB) IMPROVEMENTS OLA LANE OVERPASS TO KALIHI STREET INTERCHANGE HONOLULU, OAHU, HAWAII			ITS	Data Plot of Boring 7		
	Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample Graphic	USCS			rom previous plate)				R WAV DCITY t/sec)	Ξ	
	Core Reco	Per Res (blc	Poc (tsf)	Dep	Sar Gra	NSU		Des	cription		1000	2000	3000	4000	
	71	14	1.5	- - - 110 -		MH	grades to grades to	o medium stiff o stiff		-					
	0	10								-]		1150	
	100	27	1.8											1270	
SHEAR_WAVE_PLOT 8049-00.GPJ GEOLABS.GDT 5/3/21		12					Boring te	erminated at 1	22 feet					1110	
1049-0	Det	0.1		-140-		- 		alan Laurah 💻	Net Descustered						
.OT 8		Started			nber 1			ater Level: 🗴	Not Encountered				Р	late	
/E_PL		Comple			nber I ssani /			ll Rig:	CME-75DG2				Р	ale	
WAV		I Depth:		л. па 22 fe		ы. А		Iling Method:		r & DO O	oring		П		
-TEAR		k Order:			00 & 1	0(R)		ving Energy:	140 lb. wt., 30 in. dr		Jung		В-	1.4	
ŝ		Cidel.	0	0-10-1		J(D)		my Lieryy.	1 TO 10. WL., 50 III. UI	<u>ч</u> ч					

A A A A A A A A A A A A A A A A A A A						-	INC.	ĸ	ATE ROUTE H-1 OLA LANE OVI ALIHI STREET II HONOLULU, OA	ERPÁSS TO NTERCHANO	ЭE	S	Во	Plot of oring
Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	ple	ohic	S			Ground Surface (feet): 69 *)	SHEAR WAVE VELOCITY (feet/sec)			Ē
Core	Pene Resi (blov	Pock (tsf)	Dept	Sample	Graphic	NSCS			cription		1000	2000	3000	4000
	15/6" +50/1" 20		-			СН			n a little sand (ba very stiff to hard,					1060
88 73	50/4"		- 5 - -	-				ely weathered	CIA , closely fracti I, medium hard t					3240 3270
90			- 10-	11			-	moderately fra		-				
			- - 15-						ractured, slightly (basalt formatior					3130
100			-				grades to grades to	massive unweathered		-				4250
100			20							 				5930
88			- 25 -						orown silty clay l	ocally - - -				6130
			- - 30			ML		slightly fractur	with some sand	- - - k				5880
17									older alluvium)	- - -				1000
Date	Started:	N	oven	nbe	r 10), 202	20 Wat	ter Level: 🗴	Not Encountere	d				
1	Comple	ted: N	oven	nbe			20						PI	ate
	ed By: Depth:		. Aiu 22.5					3	CME-75DG2 4" Solid-Stem A		oring		П	0 1
	Order:		22.5)49-()(B)		-	140 lb. wt., 30 ir	-	onng		В-	2.1

SHEAR_WAVE_PLOT 8049-00.GPJ GEOLABS.GDT 5/3/21





SHEAR_WAVE_PLOT 8049-00.GPJ GEOLABS.GDT 5/3/21

10 10 SM Brown with gray mottling SILTY SAND (BASALTIC) with traces of gravel (basaltic), medium dense, moist (older alluvium) 53 12 40 115 68 24 ML Brown with multi-color mottling SANDY SILT, stiff, moist (older alluvium) 140						-	, INC.		ATE ROUTE H-1 (EE OLA LANE OVERF (ALIHI STREET INTE HONOLULU, OAHU	PÁSS TO ERCHANGE		S	Bo	Plot of oring
10 25 2.0 Image: Simple state st	Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample Graphic	USCS						VELC (feet/	CITY (sec)	
19 10 (BASALTIC) with traces of gravel (basaltic), medium dense, moist (older alluvium) 53 12 40 115 68 40 115 115 115 9 10 M. Brown with multi-color mottling SANDY SILT, stiff, moist (older alluvium) 15 9 120 M. Brown with multi-color mottling SANDY SILT, stiff, moist (older alluvium) 15 9 120 Boring terminated at 122.5 feet 15 Date Started: November 10, 2020 Water Level: Y. Not Encountered Plate Logged By: B.Aiu Drill Rig: CME-75DG2 Plate Total Depth: 122.5 feet Drilling Method: 4' Solid-Stem Auger & PQ Coring B - 2,4				-						-				148
40 40 ML Brown with multi-color mottling SANDY SILT, stiff, moist (older alluvium) 140 9 9 Boring terminated at 122.5 feet 151 125 125 Boring terminated at 122.5 feet 151 130 131 135 135 130 135 135 135 131 135 135 136 132 135 135 135 133 135 135 135 136 135 135 135 135 135 135 135 136 135 135 135 137 138 135 135 138 135 135 135 139 135 135 135 139 135 135 135 139 135 135 135 139 135 135 135 139 135 135 135 139 135 135 135 139 135 135 135 </td <td>12</td> <td>19</td> <td></td> <td>- 110</td> <td></td> <td>SM</td> <td>(BASAL</td> <td>.TIC) with trac</td> <td>es of gravel (basaltio</td> <td>s), – - -</td> <td></td> <td></td> <td></td> <td>53(</td>	12	19		- 110		SM	(BASAL	.TIC) with trac	es of gravel (basaltio	s), – - -				53(
9 Image: Started: November 10, 2020 Water Level: Y Not Encountered Plate Date Started: November 11, 2020 Logged By: B. Aiu Drill Rig: CME-75DG2 Plate Total Depth: 122.5 feet Drilling Method: 4" Solid-Stem Auger & PQ Coring B - 2.4		40		- 115 - -										68 140
Date Started: November 10, 2020 Water Level: Y Not Encountered Plate Date Started: November 11, 2020 Drill Rig: CME-75DG2 Plate Total Depth: 122.5 feet Drill Rig: CME-75DG2 B - 2.4	24	9		- - 120 -		ML	Brown wit stiff, mo	th multi-color ist (older alluv	mottling SANDY SIL vium)	T,				157
Date Started: November 10, 2020 Water Level: Y Not Encountered Date Started: November 11, 2020 Plate Logged By: B. Aiu Drill Rig: CME-75DG2 Total Depth: 122.5 feet Drilling Method: 4" Solid-Stem Auger & PQ Coring B - 2.4				- - - 125 -			Boring te	erminated at 1	22.5 feet	-				
Date Started: November 10, 2020 Water Level: Y Not Encountered Date Started: November 11, 2020 Plate Logged By: B. Aiu Drill Rig: CME-75DG2 Total Depth: 122.5 feet Drilling Method: 4" Solid-Stem Auger & PQ Coring B - 2.4				-	-					-				
Date Started:November 10, 2020 140Water Level: ▼ Not EncounteredPlateDate Completed: November 11, 2020Ditll Rig:CME-75DG2PlateLogged By:B. AiuDrill Rig:CME-75DG2B. AiuTotal Depth:122.5 feetDrilling Method: 4" Solid-Stem Auger & PQ CoringB - 2.4				130	-					-				
Date Started:November 10, 2020Water Level: YNot EncounteredPlateDate Completed: November 11, 2020Drill Rig:CME-75DG2PlateLogged By:B. AiuDrill Rig:CME-75DG2B- 2.4Total Depth:122.5 feetDrilling Method:4" Solid-Stem Auger & PQ CoringB - 2.4				- 135 - -										
Date Completed: November 11, 2020 Plate Logged By: B. Aiu Drill Rig: CME-75DG2 Total Depth: 122.5 feet Drilling Method: 4" Solid-Stem Auger & PQ Coring B - 2.4	Det	Charter						tor Louis T	Not Encountered	_				
Total Depth: 122.5 feet Drilling Method: 4" Solid-Stem Auger & PQ Coring B - 2.4									NOT EUCOUNTELEO				Р	late
	Tota	I Depth:	1	22.5	feet		Dril	lling Method:	4" Solid-Stem Auge		ing		В-	2.4

SHEAR WAVE VELOCITY TEST RESULTS

Interstate Route H-1 (EB) Improvements Ola Lane Overpass to Kalihi Street Interchange Honolulu, Oahu, Hawaii

		B-7		
			Estimated Shear	Average Travel
Depth	Depth	Layer Thickness	Wave Velocity	Time
(From)	(То)	(<i>d</i> _i)	(V _{si})	(d_{i}/V_{si})
(feet)	(feet)	(feet)	(feet/second)	(milliseconds)
0.0	1.0	1.0	824	1.19
1.0	2.0	1.0	655	1.50
2.0	5.2	3.3	613	5.35
5.2	8.5	3.3	1,507	2.18
8.5	11.8	3.3	2,436	1.35
11.8	15.1	3.3	1,833	1.79
15.1	18.2	3.1	1,235	2.52
18.2	21.5	3.3	1,740	1.89
21.5	28.1	6.6	4,696	1.40
28.1	34.8	6.7	4,712	1.43
34.8	41.3	6.6	3,968	1.65
41.3	47.9	6.6	3,977	1.65
47.9	54.5	6.6	2,493	2.63
54.5	57.7	3.3	2,553	1.29
57.7	61.0	3.3	1,267	2.59
61.0	64.3	3.3	2,320	1.41
64.3	70.9	6.6	1,581	4.15
70.9	77.3	6.4	1,834	3.49
77.3	84.0	6.7	1,324	5.08
84.0	87.1	3.1	1,188	2.62
87.1	90.6	3.4	1,421	2.42
90.6	93.8	3.3	1,270	2.58
93.8	97.1	3.3	1,496	2.19
97.1	100.4	3.3	1,311	2.50
100.4	107.1	6.7	1,237	5.44
107.1	113.5	6.4	1,145	5.59
113.5	120.2	6.7	1,265	5.32
120.2	122.5	2.3	1,109	2.07
TOTAL		122.5		75.28
tandard Weighted	Average		2,145	feet/second
computed V _{s100'} Usi	-	1,628	feet/second	

SHEAR WAVE VELOCITY TEST RESULTS

Interstate Route H-1 (EB) Improvements Ola Lane Overpass to Kalihi Street Interchange Honolulu, Oahu, Hawaii

		B-13		
			Estimated Shear	Average Travel
Douth	Douth	Lever Thielmese	Estimated Shear	Average Travel
Depth	Depth	Layer Thickness	Wave Velocity	Time
(From)	(То)	(d _i)	(V _{si})	(d _i /V _{si})
(feet)	(feet)	(feet)	(feet/second)	(milliseconds)
0.0	2.3	2.3	1,061	2.16
2.3	5.6	3.3	3,238	1.01
5.6	8.7	3.1	3,272	0.95
8.7	15.1	6.4	3,130	2.04
15.1	18.4	3.3	4,252	0.77
18.4	21.5	3.1	5,932	0.53
21.5	24.6	3.1	5,976	0.52
24.6	27.7	3.1	6,126	0.51
27.7	31.0	3.3	5,883	0.56
31.0	34.3	3.3	1,001	3.28
34.3	37.4	3.1	1,216	2.56
37.4	40.7	3.3	1,669	1.97
40.7	44.0	3.3	4,864	0.67
44.0	47.1	3.1	4,187	0.74
47.1	50.4	3.3	1,990	1.65
50.4	53.6	3.3	2,094	1.57
53.6	56.8	3.1	1,392	2.24
56.8	60.0	3.3	1,712	1.92
60.0	66.6	6.6	1,902	3.45
66.6	73.0	6.4	1,778	3.60
73.0	79.4	6.4	1,419	4.51
79.4	86.0	6.6	1,747	3.76
86.0	92.4	6.4	1,042	6.14
92.4	98.8	6.4	1,398	4.58
98.8	102.0	3.3	1,166	2.81
102.0	105.3	3.3	1,251	2.62
105.3	108.6	3.3	1,476	2.22
108.6	111.9	3.3	528	6.21
111.9	115.0	3.1	675	4.62
115.0	118.3	3.3	1,395	2.35
118.3	121.4	3.1	1,565	1.99
TOTAL		121.4		74.52
tandard Weighted	Average		2,337	teet/second
omputed V _{s100'} Usi	-		1,629	feet/second
- In 1999 - 1990 - 1990	0.2210.000		_, = = = = = = = = = = = = = = = = = = =	