ADVANCED SOIL ENGINEERING

GEOTECHNICAL CONSULTING ENGINEERING
CONCRETE AND MATERIAL TESTING LABORATORIES

ON THE GEOTECHNICAL EXPLORATION PERFORMED AT THE SITE OF THE PROPOSED CORDECO DISCOVERY BAY RESORT & MARINA, ESPINAL WARD, AGUADA, PUERTO RICO

SUBMITTED TO:

AHV & ASSOCIATES

C / O ENG. ANTONIO HERNÁNDEZ VIRELLA

BY:

NELSON MUÑOZ, P.E.

ADVANCED SOIL ENGINEERING
GEOTECHNICAL CONSULTING ENGINEERS

FEBRUARY 18, 2002

P.O. BOX 1313 ISABELA, PR 00662 TEL / FAX: (787) 830 - 0366

ON THE GEOTECHNICAL EXPLORATION PERFORMED AT THE SITE OF THE PROPOSED CORDECO DISCOVERY BAY RESORT & MARINA, ESPINAL WARD, AGUADA, PUERTO RICO

1.0 INTRODUCTION:

This report covers the results of a geotechnical exploration conducted at the site of the proposed Cordeco Discovery Bay Resort & Marina, Espinal Ward, Aguada, Puerto Rico.

The investigation was made following instructions from Eng. Antonio Hernandez Virella from AHV & Associates, property designers and as per accepted boring proposal dated January 11, 2002.

The object of the investigation was to obtain information regarding the existing geologic subsoil conditions at the site of the proposed bay and marina area with the purpose of using the engineering soil data thus obtained in determining the type of foundation required to support the loads of the proposed docks.

This report has been prepared for the exclusive use of the owner, their architects and others involved in the construction and preparation of the plans and specifications of the project.

2.0 SITE LOCATION AND PROJECT DESCRIPTION:

The site of the proposed project is located at the intersection of PR 115 Km. 27.3 and PR 442, Espinal Ward, Aguada, Puerto Rico. According to plans provided to this office, the proposed project considers the construction of a Bay Resort and Marina Complex.

For a proper site location, see attached site location map.

SITE LOCATION MAP

3.0 SCOPE OF INVESTIGATION:

Field Exploration:

The field exploration consisted of drilling eight (8) test borings along the proposed bay and marina area. Test holes were drilled to depths varying from 40.0 to 100.0 ft with a total footage of 400.0 lin. ft.

The borings were performed using the rotary hollow-stem auger technique in accordance with ASTM D 1452. Samples were obtained using the "Standard Penetration Test (SPT)", as specified in ASTM D 1586.

Please refer to **Appendix No. 1 (Boring Location Map)**, for boring location.

4.0 SUBSOIL CONDITIONS:

The general subsoil conditions as disclosed from the test borings drilled at the subject site consist of reddish brown, gray, brownish gray and brown silty clay trace to some sand layer extending to depths varying from 6.0 to 13.0 ft. below existing ground elevation.

The above described layer is resting over a gray and brownish gray sand trace to some silt layer, which extends to depths varying from 40.0 to 80.0 ft.

Underlying the aforementioned stratum and extending to the end of the test holes, the exploratory work shows gray sand some clayey silt layer on boring No.7.

The ground water level of the explored site was encountered at depths varying from 2.0 to 6.0 ft. during the time of our exploratory work.

The above information corresponds to a general description of the subsoil conditions of the area, however, for detailed description regarding the soil profile, field and laboratory test results, please refer to ***Appendix No. 2 (Boring Logs).*** *For detailed description of the procedures followed for the drilling of the test borings and laboratory testing, please refer to* ***Appendix No. 3 (Field and Laboratory Testing Procedures)****.*

5.0 CONCLUSIONS:

The object of the investigation was to obtain information regarding the subsoil conditions at the site of the proposed bay and marina, with the purposed of using this data to evaluate the possibility to develop such complex.

The results of our investigation show that the uppermost 6.0 to 13.0 ft. of the area have a clayey material with a very soft to medium consistency. The liquid limit and plasticity index of this clayey material is 50.7 and 23.3 respectively.

Following the clayey material the exploration work shows gray and brownish gray sand with some silt material, which extends to a depth below 40.0 ft. Occasionally, we find the sandy material with organic matter and traces of clay.

As per information provided to this office, the construction of the marina involves the excavation of approximate 20.0 to 30.0 ft. deep of the material found at the area. We analyzed the characteristics and properties of the sand material and we do not recommend the use of the sand for construction purposes due to the impurities of the material. The Organic Impurities Test shows us that the presence of organic impurities is significant (Darker than Standard) in the sand material.

For the construction of the docks of the marina we recommend the use of driving piles to support the loads of the structures.

6.0 LIMITATION OF THIS REPORT:

The above conclusions are given based on the interpretation of an arbitrary selected, limited number of soil samples rather than a precise knowledge of actual conditions. Subsoil conditions between borings may vary and different conditions that those describe can be encountered.

Respectfully submitted,

ADVANCED SOIL ENGINEERING

NELSON MUÑOZ GONZALEZ
INGENIERO LICENCIADO
LIC.014112
PUERTO RICO

NELSON MUÑOZ, P.E.

File No. 410

February 18, 2002

APPENDIX NO. 1

BORING LOCATION MAP

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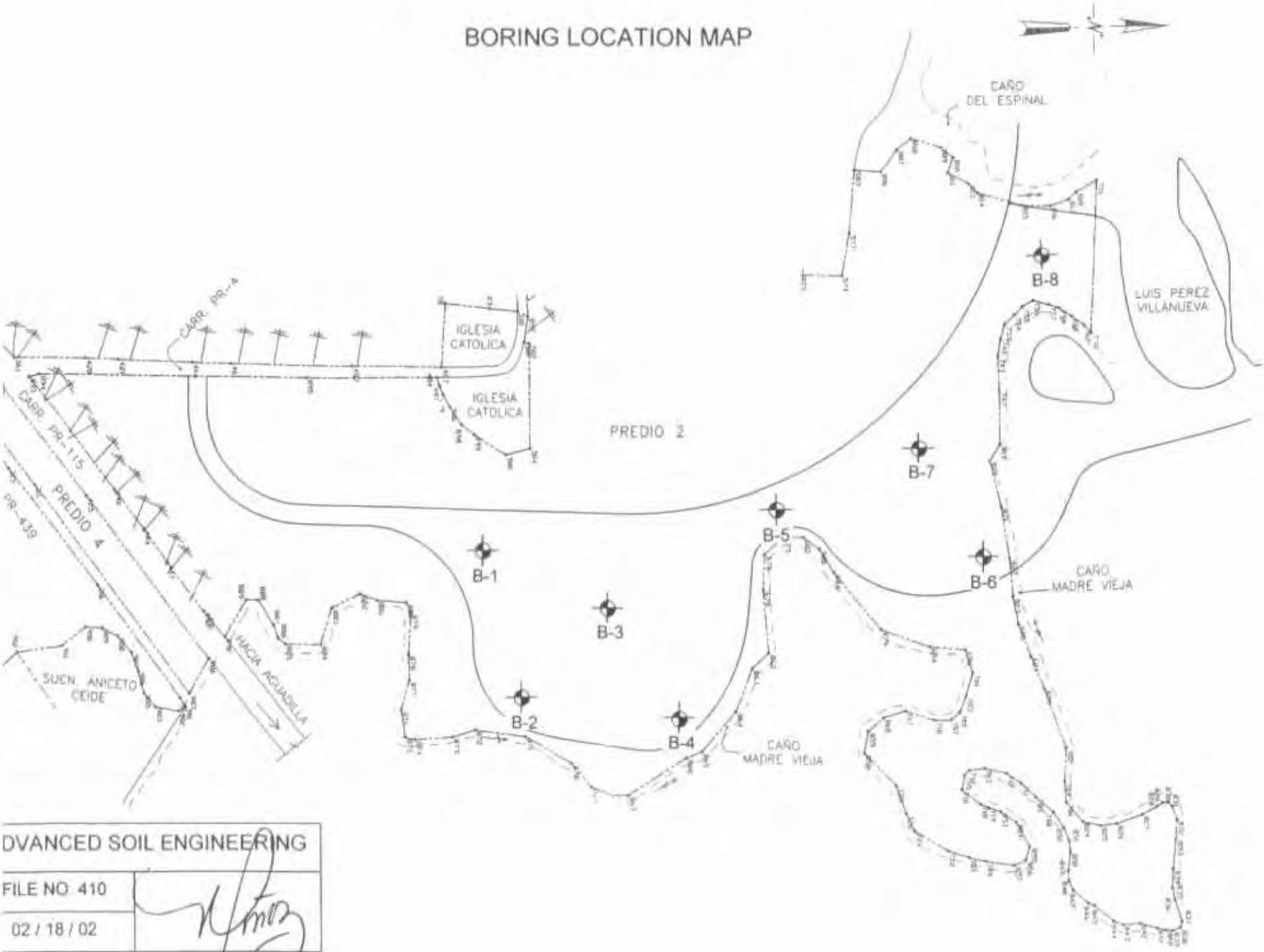
BORING LOCATION MAP



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FILE NO. 410	
02 / 18 / 02	

← BORING LOCATION

APPENDIX NO. 2

BORING LOGS

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P.O. BOX 1313
ISABELA, P.R. 00662
TEL & FAX: 830 - 0366

FILE NO.	BORING NO.
410	1

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/12/02
DATE FINISH: 02/12/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **4.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Brown silty clay			6	27						
			10	40						
Brownish gray silty clay trace sand	5	▼ –	6	67					50.7	23.3
			WH	73						
Gray clayey sand			7	47						
	10									
Gray sand trace silt			20	22						
	15									
			50/5"	23						
	20									
			68	22						
	25									
Brownish gray sand trace silt			59	18						
continue	30									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX

γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

ASE	ADVANCED SOIL ENGINEERING	FILE NO.	BORING NO.
	P.O. BOX 1313 ISABELA, P.R. 00662 TEL & FAX: 830 - 0366	410	1

CLIENT: AHV & ASSOCIATES

PROJECT: CORDECO DISCOVERY BAY & MARINA

LOCATION: ESPINAL WARD, AGUADA

GROUND LEVEL:

DATE STARTED: 02/12/02

DATE FINISH: 02/12/02

BORING TYPE: HOLLOW STEM AUGER GROUND WATER DEPTH: **4.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Brownish gray sand trace silt										
			29	17						
	35									
			34	20						
	40									
END OF BORING										
	45									
	50									
	55									
	60									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES

W = NATURAL MOISTURE CONTENT - %

Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.

Qp = CALIBRATED PENETROMETER READING - T.S.F.

LL = LIQUID LIMIT

PI = PLASTICITY INDEX

γ = ESTIMATED UNIT WEIGHT - P.C.F.

ϕ = ANGLE OF INTERNAL FRICTION - DEGREES

WH = WEIGHT OF HAMMER

ADVANCED SOIL ENGINEERING

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FILE NO.	BORING NO.
410	2

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/12/02
DATE FINISH: 02/12/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **6.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Reddish brown silty clay some sand			9	21						
			4	15						
	5		2	40						
		▼								
			2	47						
Gray silty clay			2	44						
	10									
Gray sand trace silt			19	21						
	15									
			19	21						
	20									
Brownish gray sand trace silt			2	23						
	25									
			77	22						
continue	30									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

ADVANCED SOIL ENGINEERING

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FILE NO.	BORING NO.
410	2

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/12/02
DATE FINISH: 02/12/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH: **6.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Brownish gray sand trace silt										
			14	22						
	35									
			13	26						
	40									
END OF BORING										
	45									
	50									
	55									
	60									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
γ = ESTIMATED UNIT WEIGHT - P.C.F
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

ADVANCED SOIL ENGINEERING

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FILE NO.	BORING NO.
410	3

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/14/02
DATE FINISH: 02/14/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **5.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Reddish brown silty clay some sand			12	23						
			8	23						
	5	▼	2	32						
Gray sandy clay			6	48						
			2	38						
	10									
Gray sand trace silt			4	28						
	15									
			30	20						
	20									
			13	22						
	25									
			22	20						
continue	30									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

ADVANCED SOIL ENGINEERING

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FILE NO.	BORING NO.
410	3

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/14/02
DATE FINISH: 02/14/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **5.0 FT.**

DESCRIPTION	DEPTH FT	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Gray sand trace silt										
			31	18						
	35									
			30	15						
	40									
END OF BORING										
	45									
	50									
	55									
	60									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

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FILE NO.	BORING NO.
410	4

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/13/02
DATE FINISH: 02/13/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **6.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Reddish brown silty clay			6	32						
			12	42						
	5		4	50						
		▼								
			2	57						
			5	49						
	10									
Gray sand some silt			5	35						
	15									
			18	31						
	20									
Brownish gray sand trace silt			16	27						
	25									
			38	23						
continue	30									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

ASE	ADVANCED SOIL ENGINEERING	FILE NO.	BORING NO.
	P.O. BOX 1313 ISABELA, P.R. 00662 TEL & FAX: 830 - 0366	410	4

CLIENT: AHV & ASSOCIATES

PROJECT: CORDECO DISCOVERY BAY & MARINA

LOCATION: ESPINAL WARD, AGUADA

GROUND LEVEL:

DATE STARTED: 02/13/02

DATE FINISH: 02/13/02

BORING TYPE: HOLLOW STEM AUGER GROUND WATER DEPTH : **6.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Brownish gray sand trace silt										
			63	22						
	35									
			41	19						
	40									
END OF BORING										
	45									
	50									
	55									
	60									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES

W = NATURAL MOISTURE CONTENT - %

Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.

Qp = CALIBRATED PENETROMETER READING - T.S.F

LL = LIQUID LIMIT

PI = PLASTICITY INDEX

γ = ESTIMATED UNIT WEIGHT - P.C.F

ϕ = ANGLE OF INTERNAL FRICTION - DEGREES

WH = WEIGHT OF HAMMER

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FILE NO.	BORING NO.
410	5

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/13/02
DATE FINISH: 02/13/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH: **3.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Reddish brown silty clay			8	20						
		▼	9	34						
	5		9	57						
			6	30						
Gray silty clay trace sand			2	51					50.7	23.3
	10									
Gray sand trace silt with organic matter			3	37						
	15									
			6	26						
	20									
Gray sand some silt			13	28						
	25									
			80	17						
continue	30									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX

γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

ASE	ADVANCED SOIL ENGINEERING	FILE NO.	BORING NO.
	P.O. BOX 1313 ISABELA, P.R. 00662 TEL & FAX: 830 - 0366	410	5

CLIENT: AHV & ASSOCIATES

PROJECT: CORDECO DISCOVERY BAY & MARINA

LOCATION: ESPINAL WARD, AGUADA

GROUND LEVEL:

DATE STARTED: 02/13/02

DATE FINISH: 02/13/02

BORING TYPE: HOLLOW STEM AUGER GROUND WATER DEPTH : **3.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Gray sand some silt										
			78	17						
	35									
			90	16						
	40									
END OF BORING										
	45									
	50									
	55									
	60									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX

γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

ADVANCED SOIL ENGINEERING

P.O. BOX 1313
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FILE NO.	BORING NO.
410	6

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/14/02
DATE FINISH: 02/14/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **3.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Brown silty clay			7	37						
Brownish gray silty clay trace sand		▼	4	60					50.7	23.3
	5		3	62						
Light brown sand trace silt			18	17						
			11	18						
	10									
			18	20						
	15									
			35	18						
	20									
			33	16						
	25									
			32	18						
continue	30									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT

γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

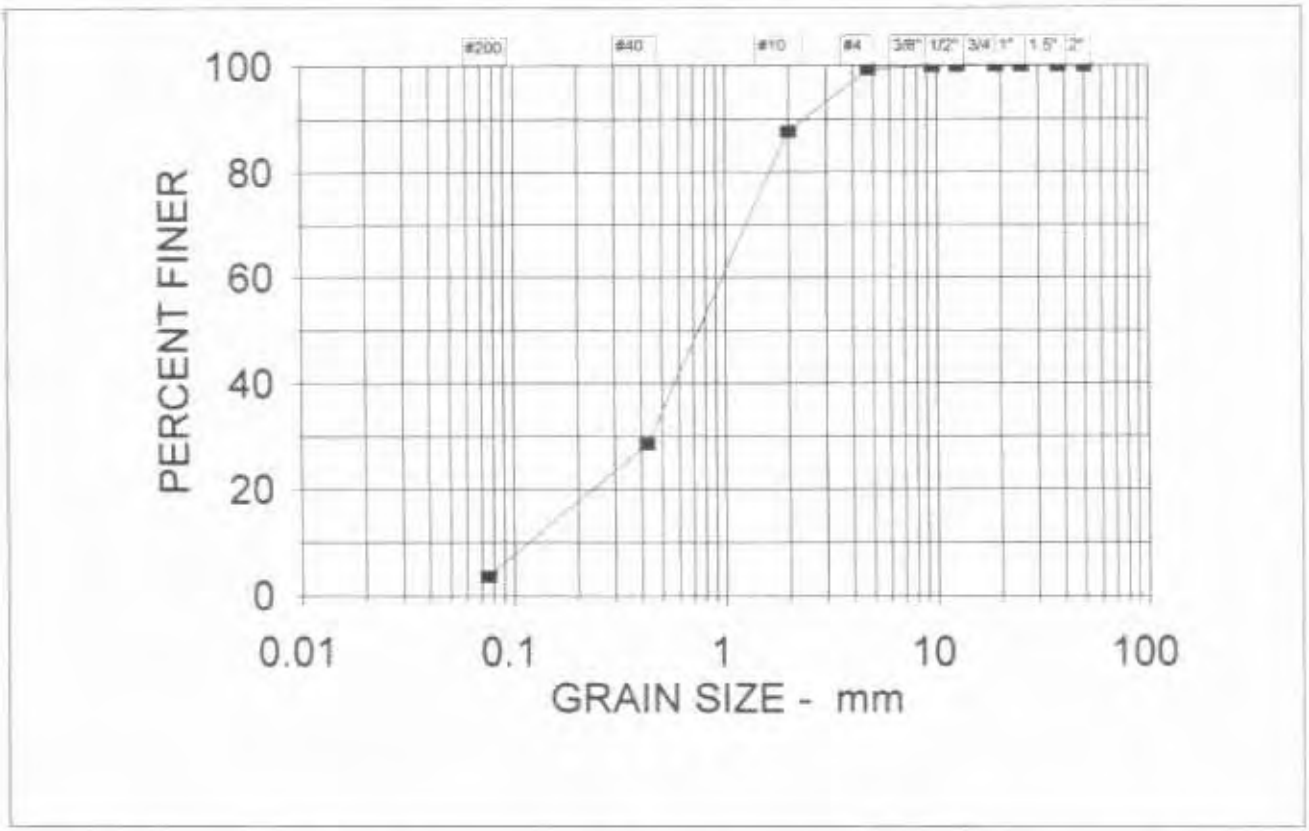
ADVANCED SOIL ENGINEERING

GEOTECHNICAL CONSULTING ENGINEERS
CONCRETE AND MATERIAL TESTING LABORATORIES

P.O BOX 1313
ISABELA, P.R. 00662

TEL. (787) 830-0366
CEL. (787) 376-8636

GRAIN SIZE DISTRIBUTION TEST REPORT



% + 75 mm	% GRAVEL	% SAND	% SILT	% CLAY
0.00	0.63	95.71	3.66	

LL	PI	D85	D60	D50	D30	D15	D10	Cc	Cu
NL	N/P	1.86	0.97	0.74	0.44	0.17	0.12	1.73	8.29

MATERIAL DESCRIPTION	USCS	AASHTO
Gray sand trace silt	SW	A-1-b

Client : AHV & Associates

Project : Cordeco Discovery Bay Resort & Marina, Espinal Ward, Aguada

Location : Boring No.1 (13'-28'), No.2 and No.5 (13'-23')

Remarks:

Tested by : Eduardo Rodríguez

Checked by : Nelson Muñoz, P.E.

Figure No. : 1

Date : February 16, 2002

ASE	ADVANCED SOIL ENGINEERING	FILE NO.	BORING NO.
	P.O. BOX 1313 ISABELA, P.R. 00662 TEL & FAX: 830 - 0366	410	6

CLIENT: AHV & ASSOCIATES

PROJECT: CORDECO DISCOVERY BAY & MARINA

LOCATION: ESPINAL WARD, AGUADA

GROUND LEVEL:

DATE STARTED: 02/14/02

DATE FINISH: 02/14/02

BORING TYPE: HOLLOW STEM AUGER GROUND WATER DEPTH : **3.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Light brown sand trace silt										
			20	16						
	35									
Brownish gray sand trace silt			27	19						
	40									
			40	23						
	45									
			26	22						
	50									
			37	22						
	55									
			39	18						
END OF BORING	60									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
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WH = WEIGHT OF HAMMER

ADVANCED SOIL ENGINEERING

P.O. BOX 1313
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FILE NO.	BORING NO.
410	7

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/15/02
DATE FINISH: 02/15/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **3.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Brown silty clay			9	25						
		▼	6	42						
Brownish gray silty clay trace sand	5		WH	68						
			WH	56						
Gray sand trace silt			3	18						
	10									
			3	20						
	15									
			9	21						
	20									
			17	18						
	25									
Brownish gray sand trace silt			12	20						
continue	30									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

ASE	ADVANCED SOIL ENGINEERING	FILE NO.	BORING NO.
	P.O. BOX 1313 ISABELA, P.R. 00662 TEL & FAX: 830 - 0366	410	7

CLIENT: AHV & ASSOCIATES

PROJECT: CORDECO DISCOVERY BAY & MARINA

LOCATION: ESPINAL WARD, AGUADA

GROUND LEVEL:

DATE STARTED: 02/15/02

DATE FINISH: 02/15/02

BORING TYPE: HOLLOW STEM AUGER GROUND WATER DEPTH : **3.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Brownish gray sand trace silt										
			38	27						
	35									
			16	26						
	40									
			20	23						
	45									
			20	21						
	50									
			29	24						
	55									
			26	29						
continue	60									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES

W = NATURAL MOISTURE CONTENT - %

Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.

Qp = CALIBRATED PENETROMETER READING - T.S.F.

LL = LIQUID LIMIT

PI = PLASTICITY INDEX

γ = ESTIMATED UNIT WEIGHT - P.C.F.

ϕ = ANGLE OF INTERNAL FRICTION - DEGREES

WH = WEIGHT OF HAMMER

ADVANCED SOIL ENGINEERING

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TEL & FAX: 830 - 0366

FILE NO.	BORING NO.
410	7

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/15/02
DATE FINISH: 02/15/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **3.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Brownish gray sand trace silt										
			40	24						
	65									
			36	22						
	70									
			29	23						
	75									
Gray sand some clayey silt			33	29						
	80									
			23	26						
	85									
			26	31						
continue	90									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
γ = ESTIMATED UNIT WEIGHT - P.C.F
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

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FILE NO.	BORING NO.
410	7

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/15/02
DATE FINISH: 02/15/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **3.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Gray sand some clayey silt										
			13	29						
	95									
			26	25						
	100									
END OF BORING										
	105									
	110									
	115									
	120									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX

γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

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FILE NO.	BORING NO.
410	8

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/15/02
DATE FINISH: 02/15/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **2.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Brown silty clay			2	25						
		▼								
Brownish gray silty clay trace sand			2	42						
	5		2	68						
			1	56						
			3	18						
	10									
Gray sand trace silt			30	20						
	15									
			52	21						
	20									
			39	18						
	25									
			45	20						
continue	30									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

ADVANCED SOIL ENGINEERING

P.O. BOX 1313
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TEL & FAX: 830 - 0366

FILE NO.	BORING NO.
410	8

CLIENT: AHV & ASSOCIATES
PROJECT: CORDECO DISCOVERY BAY & MARINA
LOCATION: ESPINAL WARD, AGUADA
GROUND LEVEL:
DATE STARTED: 02/15/02
DATE FINISH: 02/15/02
BORING TYPE: HOLLOW STEM AUGER
GROUND WATER DEPTH : **2.0 FT.**

DESCRIPTION	DEPTH FT.	WATER DEPTH	N VALUE	W	Qu	Qp	γ	ϕ	LL	PI
Brownish gray sand trace silt										
			42	30						
	35									
			38	28						
	40									
END OF BORING										
	45									
	50									
	55									
	60									

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
WH = WEIGHT OF HAMMER

APPENDIX NO. 3

FIELD AND LABORATORY TESTING PROCEDURES

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APPENDIX NO. 3

FIELD AND LABORATORY TESTING PROCEDURES

FIELD TESTING

DRILLING

Auger Borings (ASTM D 1452). These are performed by turning a hollow-stem auger into the ground a short distance. As the auger advances into the ground, the cutting rise to the surface on the auger spirals, although the depth from which the material comes cannot be accurately determined. By using hollow-stem augers, samples can be recovered from the bottom of the auger, thus eliminating the need for driving casings.

Wash Borings. The wash boring process consist of driving a section of 2.5 inches casing into the ground by a drop-hammer operation, as in pile driving. After each length of casing has been driven the earth material inside the casing is cleaned out by a chopping and washing similar to jetting. This is accomplished by flowing water under pressure through rods or pipes which are operated inside the casing. A chisel shaped chopping bit is attached to the end of the rods, and the whole string alternatively is raised and chopped so that the resultant chopping and jetting action loosens the soil. The return flow of water bring the cuttings to the surface.

STANDARD PENETRATION TEST

Standard Penetration Test (SPT) and Split Barrel Sampling (ASTM D 1452). The samples are secured from the bottom of the cleaned hole by a 1.375 inches ID x 24 inches long split spoon samples. With the sampler in, resting on the bottom of the hole, it is driven with the drop of a 140 pounds hammer from a 30 inches height. The number of blows for every 6 inches of sampler penetration is recorded, and the number of blows between 6 and 18 inches of penetration is reported as the N-value. The N-value gives an indication of the consistency of cohesive soils and relative density of granular soils.

Undisturbed Sampling. Undisturbed samples are obtained with thin wall Shelby tube samplers, 3 inches OD by 30 inches long. The sampler is forced into the soil by static force or downward pressure and is pulled out also statically. These samplers are sealed in the field with wax and shipped to the laboratory. Samples are then extruded at the time of testing by pushing in the same direction that the samples penetrated the sampler. Special care is taken in handling these samples to minimize disturbance.

COHESIVE SOILS

N-Values Blows / ft.	Consistency	Unconfined Compressive Strength (tsf)
Less than 2	Very Soft	Less than 0.25
2 - 4	Soft	0.25 - 0.50
4 - 8	Medium	0.50 - 1.00
8 - 15	Stiff	1.00 - 2.00
15 - 30	Very Stiff	2.00 - 4.00
Over 30	Hard	Over 4.00

GRANULAR SOILS

N-Values Blows / ft.	Relative Density
0 - 5	Very Loose
5 - 10	Loose
10 - 30	Medium
30 - 50	Dense
Over 50	Very Dense

LABORATORY TESTING

Natural Moisture (Water) Content (ASTM D 2216). The natural moisture (water) content is determined by finding the quantity of water present in the natural condition and expressing it as a percentage of the dry weight of the solid soil particles of the sample. The water present in the sample is determined by subtracting the weight of the wet soil from the weight of the specimen after been oven dried in an oven at 110 °C for a minimum period of 16 hours.

Atterberg Limits (ASTM D 4318). These limits and related indices are commonly used in geotechnical engineering for soil identification and classification purposes. However, these are also empirically correlated to various parameters which are used for preliminary analyses. The procedure used to determine liquid and plastic limits are described in the referenced ASTM Standard.

Unconfined Compression Test (ASTM D 2166). The cohesive soil specimens obtained from split spoon samples can not be considered as undisturbed samples, nevertheless, the approximate unconfined compressive strength can be easily determined. Unconfined compressive strength tests were performed by subjecting suitable soil samples to axial loads until failure. The compressive strength is defined as the ratio of maximum axial load required to failure to the corrected area and is expressed in units of tons per square feet.

Description and Identification of Soils (ASTM D 2488). The description of soils include the color, type (gravel, sand, silt, clay, organic), consistency (if soil is fine-grained), size and roundness (if soil is coarse-grained) and some other special characteristics which can assist in the identification and classification of the soil. The latter are those recommended for field classification (dilatancy, dry strength, shine and toughness). To approximate the consistency of fine-grained soils (soft, medium, stiff, hard) a simple test is performed with the thumb. The description of coarse-grained soils (sands and gravels) include size (fine, medium, coarse) and roundness (angular, sub-angular, sub-round, round). The relative amount of coarse fractions in fine-grained soils is estimated by placing a representative sample of some 50 grams in a graduated cylinder filled with water. The mix is shaken and allowed to settle. Particles of a size larger than fine sand are visible to the naked eye, while silts and clays are not. In this manner, estimates of the relative amount of the coarse fractions are made and reported as:

Trace	*1 - 10%*
Some	*10 - 20%*
Gravelly, sandy	*20 - 35%*
And	*35 - 50%*

APPENDIX NO. 4

LABORATORY RESULTS

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GEOTECHNICAL CONSULTING ENGINEERS
CONCRETE AND MATERIAL TESTING LABORATORIES

P.O BOX 1313
ISABELA, P.R. 00662

TEL: (787) 830-0366
CEL: (787) 376-8636

GRAIN SIZE DISTRIBUTION TEST DATA

Date : February 16, 2002
Client : AHV & Associates
Project : Cordeco Discovery Bay & Marina, Espinal Ward, Aguada

SAMPLE DATA

Location of sample : Boring No.1 (4'-8'), No.5 (8'-13') and No.6 (2'-6')
Sample description : Brownish gray and gray silty clay trace sand
Fineness Modulus : 0.1
USCS Class : MH Liquid limit : 50.7
AASHTO Class : A-7-6(26) Plasticity index : 23.3

NOTES

Remarks : Tested by : Eduardo Rodriguez

Checked by: Nelson Muñoz, P. E.

Fig. No. : 1

MECHANICAL ANALYSIS DATA

		Initial	After wash
Dry sample and tare	=	126.00	6.31
Tare	=	0.00	0.00
Dry sample weight	=	126.00	6.31
Minus # 200 from wash	=	94.99 %	

Sieve tare method :

Sieve No.	Weight Soil retained	Percent Retained	Combined % Retained	Percent finer
1"	0.00	0.00	0.00	100.00
3/4"	0.00	0.00	0.00	100.00
1/2"	0.00	0.00	0.00	100.00
3/8"	0.00	0.00	0.00	100.00
No. 4	0.00	0.00	0.00	100.00
No. 8	0.04	0.03	0.03	99.97
No. 16	0.18	0.14	0.17	99.83
No. 30	1.16	0.92	1.10	98.90
No. 50	1.09	0.87	1.96	98.04
No. 100	1.58	1.25	3.21	96.79
No. 200	2.26	1.79	5.01	94.99

FRACTIONAL COMPONENTS

% + 75 mm = 0.00 % Gravel = 0.00 % Sand = 5.01 % Finer = 94.99

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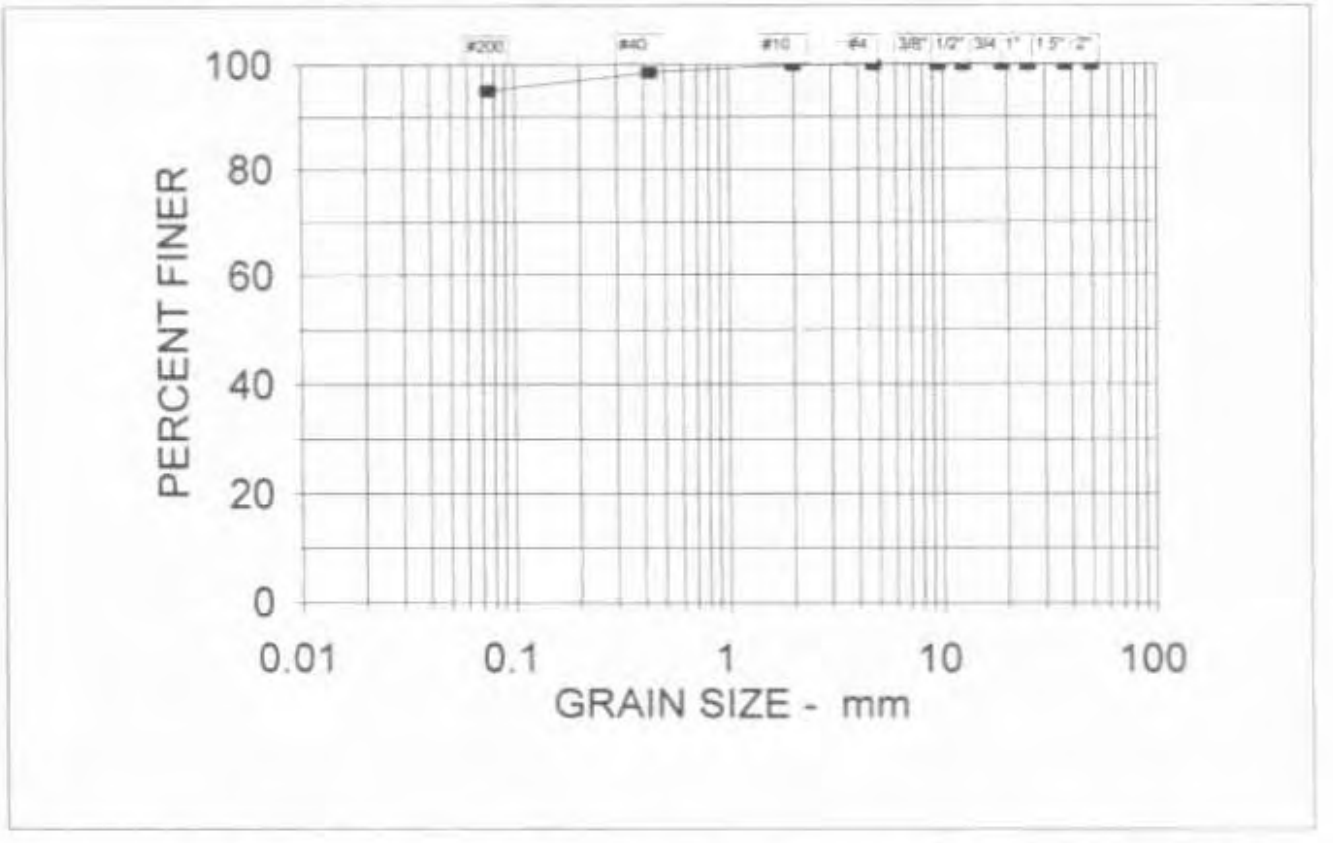
GRAIN SIZE DISTRIBUTION TEST REPORT



% + 75 mm	% GRAVEL	% SAND	% SILT	% CLAY
0.00	0.00	5.01	94.99	

LL	PI	D85	D60	D50	D30	D15	D10	Cc	Cu
50.7	23.3								

MATERIAL DESCRIPTION	USCS	AASHTO
Brownish gray and gray silty clay trace sand	MH	A-7-6(26)

Client : AHV & Associates

Project : Cordeco Discovery Bay Resort & Marina, Espinal Ward, Aguada

Location : Boring No.1 (4'-8'), No.5 (8'-13') and No.6 (2'-6')

Remarks:

Tested by : Eduardo Rodriguez

Checked by : Nelson Muñoz, P.E.

Figure No. : 1

Date : February 16, 2002

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GRAIN SIZE DISTRIBUTION TEST DATA

Date : February 16, 2002
Client : AHV & Associates
Project : Cordeco Discovery Bay & Marina, Espinal Ward, Aguada

SAMPLE DATA

Location of sample : Boring No.1 (13'-28'), No.2 and No.5 (13'-23')
Sample description : Gray sand trace silt
Fineness Modulus : 2.8
USCS Class : SW Liquid limit : N/L
AASHTO Class : A-1-b Plasticity index : N/P

NOTES

Remarks Tested by : Eduardo Rodriguez

Checked by : Nelson Muñoz, P. E.

Fig. No. : 1

MECHANICAL ANALYSIS DATA

		Initial	After wash
Dry sample and tare	=	129.46	124.72
Tare	=	0.00	0.00
Dry sample weight	=	129.46	124.72
Minus # 200 from wash	=	3.66 %	

Sieve tare method :

Sieve No.	Weight Soil retained	Percent Retained	Combined % Retained	Percent finer
1"	0.00	0.00	0.00	100.00
3/4"	0.00	0.00	0.00	100.00
1/2"	0.00	0.00	0.00	100.00
3/8"	0.00	0.00	0.00	100.00
No. 4	0.82	0.63	0.63	99.37
No. 8	10.27	7.93	8.57	91.43
No. 16	39.17	30.26	38.82	61.18
No. 30	28.89	22.32	61.14	38.86
No. 50	24.22	18.71	79.85	20.15
No. 100	13.25	10.23	90.08	9.92
No. 200	8.10	6.26	96.34	3.66

FRACTIONAL COMPONENTS

% + 75 mm = 0.00 % Gravel = 0.63 % Sand = 95.71 % Finer = 3.66

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GRAIN SIZE DISTRIBUTION TEST DATA

Date : February 16, 2002
Client : AHV & Associates
Project : Cordeco Discovery Bay & Marina, Espinal Ward, Aguada

SAMPLE DATA

Location of sample : Boring No.1 ('28-'40), No.2 (23'-40'), No.4 (23'-40') and No.6 (38'-60')
Sample description : Brownish gray sand trace silt
Fineness Modulus : 1.5
USCS Class : SP Liquid limit N/L
AASHTO Class : A-3 Plasticity inde: N/P

NOTES

Remarks Tested by : Eduardo Rodríguez

Checked by: Nelson Muñoz, P. E.

Fig. No. 1

MECHANICAL ANALYSIS DATA

		Initial	After wash
Dry sample and tare	=	774.46	743.29
Tare	=	0.00	0.00
Dry sample weight	=	774.46	743.29
Minus # 200 from wash	=	4.02 %	

Sieve tare method :

Sieve No.	Weight Soil retained	Percent Retained	Combined % Retained	Percent finer
1"	0.00	0.00	0.00	100.00
3/4"	0.00	0.00	0.00	100.00
1/2"	0.00	0.00	0.00	100.00
3/8"	0.00	0.00	0.00	100.00
No. 4	0.51	0.07	0.07	99.93
No. 8	2.16	0.28	0.34	99.66
No. 16	9.18	1.19	1.53	98.47
No. 30	64.13	8.28	9.81	90.19
No. 50	264.89	34.20	44.01	55.99
No. 100	364.46	47.06	91.07	8.93
No. 200	37.96	4.90	95.98	4.02

FRACTIONAL COMPONENTS

% + 75 mm = 0.00 % Gravel = 0.07 % Sand = 95.91 % Finer = 4.02

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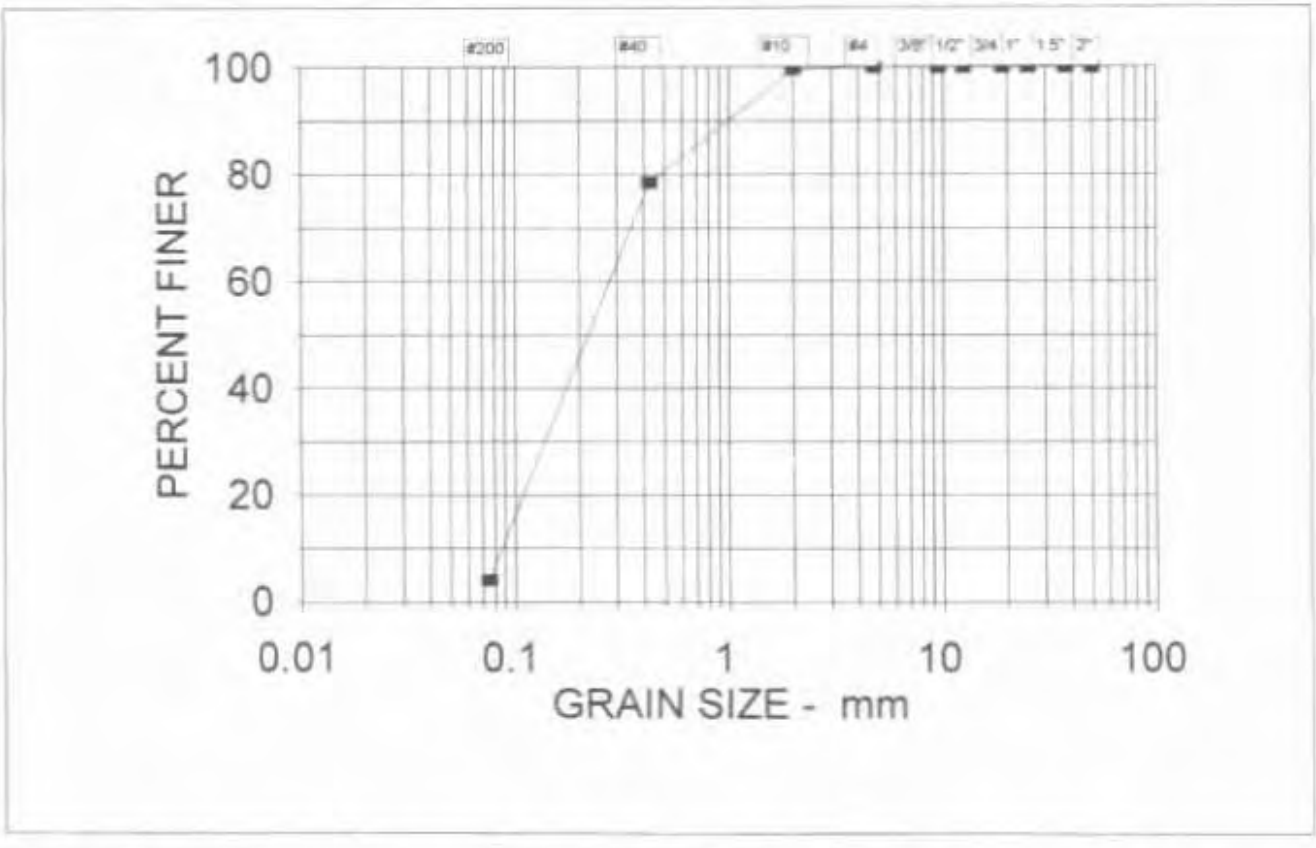

% + 75 mm	% GRAVEL	% SAND	% SILT	% CLAY
0.00	0.07	95.91	4.02	

LL	PI	D85	D60	D50	D30	D15	D10	Cc	Cu
N/L	N/P	0.69	0.28	0.22	0.14	0.10	0.09	0.79	3.20

MATERIAL DESCRIPTION	USCS	AASHTO
Brownish gray sand trace silt	SP	A -3

Client : AHV & Associates

Project : Cordeco Discovery Bay Resort & Marina, Espinal Ward, Aguada

Location : Boring No.1 ('28-'40), No.2 (23'-40'), No.4 (23'-40') and No.6 (38'-60')

Remarks:

Tested by : Eduardo Rodriguez

Checked by : Nelson Muñoz, P.E.

Figure No. : 1

Date : February 16, 2002

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GRAIN SIZE DISTRIBUTION TEST DATA

Date : February 16, 2002
Client : AHV & Associates
Project : Cordeco Discovery Bay & Marina, Espinal Ward, Aguada

SAMPLE DATA

Location of sample : Boring No 3 (13'-40')
Sample description : Gray sand trace silt
Fineness Modulus : 2.0
USCS Class : SW Liquid limit : N/L
AASHTO Class : A-1-b Plasticity index : N/P

NOTES

Remarks : Tested by : Eduardo Rodríguez

Checked by: Nelson Muñoz, P. E.

Fig. No. 1

MECHANICAL ANALYSIS DATA

		Initial	After wash
Dry sample and tare	=	388.40	374.36
Tare	=	0.00	0.00
Dry sample weight	=	388.40	374.36
Minus # 200 from wash	=	3.61 %	

Sieve tare method :

Sieve No.	Weight Soil retained	Percent Retained	Combined % Retained	Percent finer
1"	0.00	0.00	0.00	100.00
3/4"	0.00	0.00	0.00	100.00
1/2"	0.00	0.00	0.00	100.00
3/8"	0.00	0.00	0.00	100.00
No. 4	0.00	0.00	0.00	100.00
No. 8	0.67	0.17	0.17	99.83
No. 16	7.14	1.84	2.01	97.99
No. 30	95.40	24.56	26.57	73.43
No. 50	202.29	52.08	78.66	21.34
No. 100	57.00	14.68	93.33	6.67
No. 200	11.86	3.05	96.39	3.61

FRACTIONAL COMPONENTS

% + 75 mm = 0.00 % Gravel = 0.00 % Sand = 96.39 % Finer = 3.61

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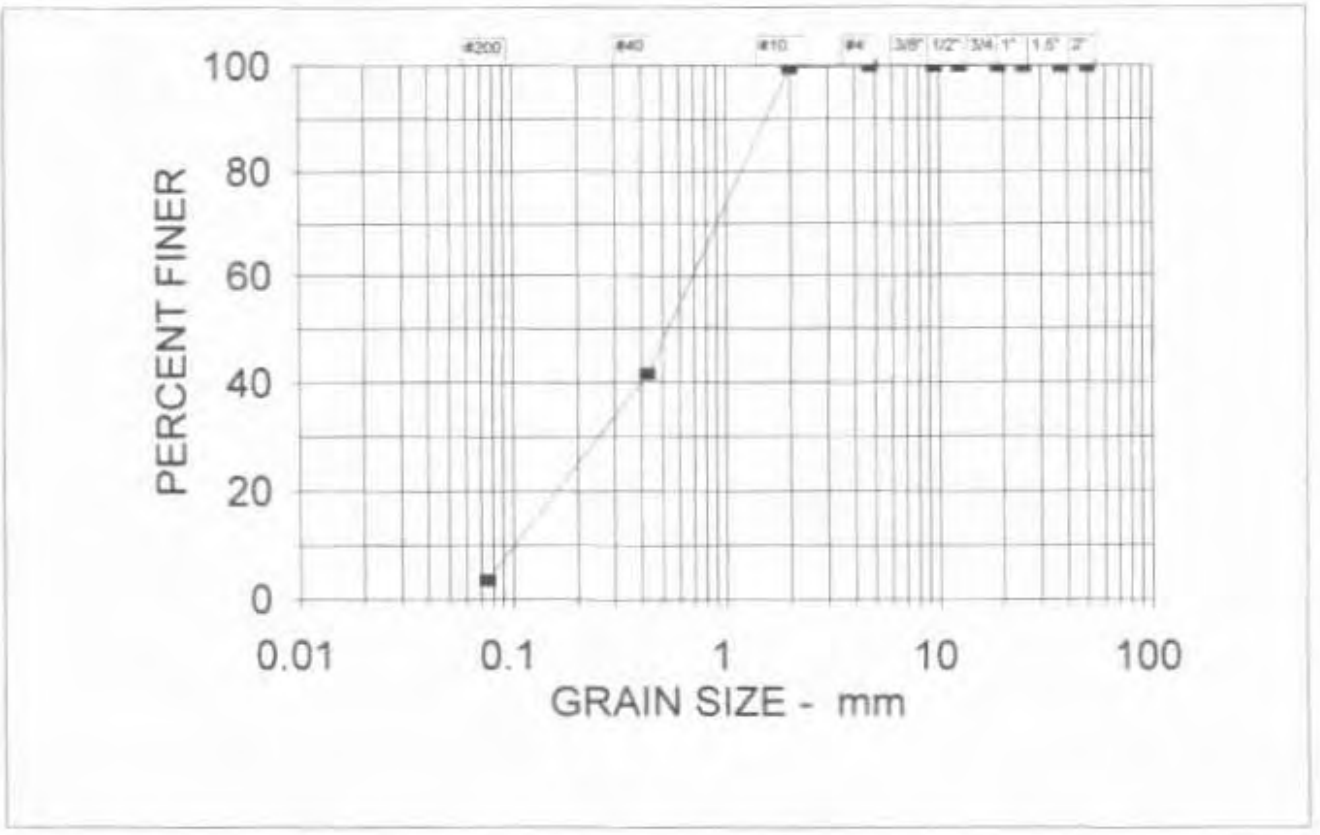

% + 75 mm	% GRAVEL	% SAND	% SILT	% CLAY
0.00	0.00	96.39	3.61	

LL	PI	D85	D60	D50	D30	D15	D10	Cc	Cu
N/L	N/P	1.35	0.69	0.53	0.25	0.13	0.10	0.90	6.91

MATERIAL DESCRIPTION	USCS	AASHTO
Gray sand trace silt	SW	A -1-b

Client : AHV & Associates

Project : Cordeco Discovery Bay Resort & Marina, Espinal Ward, Aguada

Location : Boring No.3 (13'-40')

Remarks:

Tested by : Eduardo Rodriguez

Checked by : Nelson Muñoz, P.E.

Figure No. : 1

Date : February 16, 2002

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GRAIN SIZE DISTRIBUTION TEST DATA

Date : February 16, 2002
Client : AHV & Associates
Project : Cordeco Discovery Bay & Marina, Espinal Ward, Aguada

SAMPLE DATA

Location of sample : Boring No.6 (6'-35')
Sample description : Light brown sand trace silt
Fineness Modulus : 2.2
USCS Class : SW Liquid limit : N/L
AASHTO Class : A-1-b Plasticity inde: N/P

NOTES

Remarks Tested by : Eduardo Rodriguez

Checked by: Nelson Muñoz, P. E.

Fig. No. : 1

MECHANICAL ANALYSIS DATA

		Initial	After wash
Dry sample and tare	=	350.97	335.87
Tare	=	0.00	0.00
Dry sample weight	=	350.97	335.87
Minus # 200 from wash	=	4.30 %	

Sieve tare method :

Sieve No.	Weight Soil retained	Percent Retained	Combined % Retained	Percent finer
1"	0.00	0.00	0.00	100.00
3/4"	0.00	0.00	0.00	100.00
1/2"	0.00	0.00	0.00	100.00
3/8"	0.00	0.00	0.00	100.00
No. 4	1.52	0.43	0.43	99.57
No. 8	3.29	0.94	1.37	98.63
No. 16	16.63	4.74	6.11	93.89
No. 30	115.97	33.04	39.15	60.85
No. 50	132.09	37.64	76.79	23.21
No. 100	58.00	16.53	93.31	6.69
No. 200	8.37	2.38	95.70	4.30

FRACTIONAL COMPONENTS

% + 75 mm = 0.00 % Gravel = 0.43 % Sand = 95.26 % Finer = 4.30

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GEOTECHNICAL CONSULTING ENGINEERS
CONCRETE AND MATERIAL TESTING LABORATORIES

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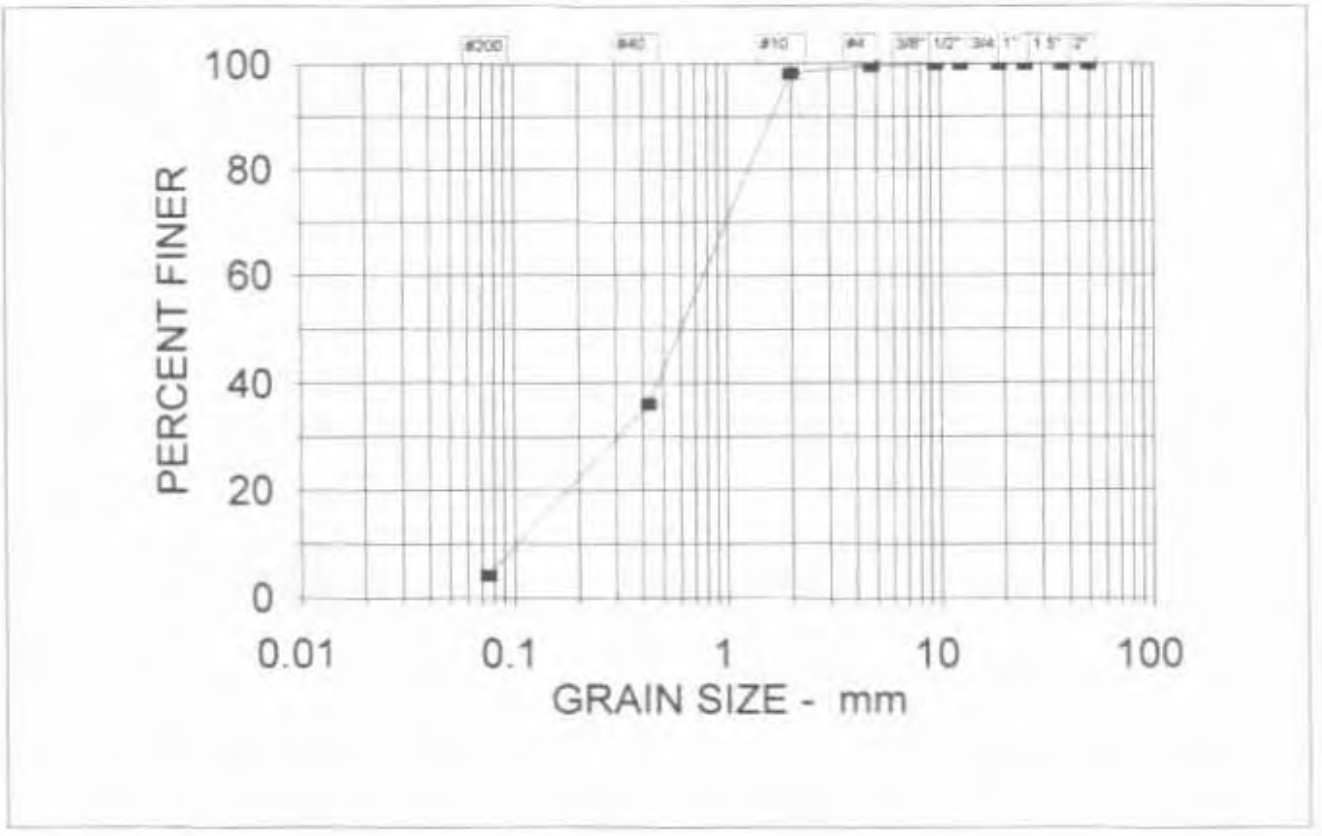
GRAIN SIZE DISTRIBUTION TEST REPORT



% + 75 mm	% GRAVEL	% SAND	% SILT	% CLAY
0.00	0.43	95.26	4.30	

LL	PI	D85	D60	D50	D30	D15	D10	Cc	Cu
N/L	N/P	1.44	0.77	0.60	0.31	0.13	0.10	1.18	7.53

MATERIAL DESCRIPTION	USCS	AASHTO
Light brown sand trace silt	SW	A-1-b

Client : AHV & Associates

Project : Cordeco Discovery Bay Resort & Marina, Espinal Ward, Aguada

Location : Boring No.6 (6'-35')

Remarks:

Tested by : Eduardo Rodriguez

Checked by : Nelson Muñoz, P.E.

Figure No. : 1

Date : February 16, 2002