Western Soil, Inc.
Geotechnical-Environmental-Geological-Material Testing Laboratory

GEOTECHNICAL ENGINEERING REPORT
ON
SUBSURFACE EXPLORATION
FOR
VALLE DE MONTE GRANDE
CABO ROJO, PUERTO RICO

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W stern Soil, Inc

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JULY 31, 2000

INTRODUCTION

A new development consisting of 100 residential single-family lots, park and green areas, and access streets is being proposed by Monte Grande Developer, SE (MGD), on a site in Cabo Rojo, Puerto Rico. On behalf of MGD, René Guerra, PLS, requested a subsurface exploration from this firm to determine the general subsoil conditions underlying the site, and prepare foundation and earthwork recommendations for the future development.

Subsurface exploration and laboratory tests on soil samples were performed by ***Western Soil, Inc.***, under the supervision of an authorized representative, and engineeering analyses were conducted by ***Western Soil, Inc.***, and the undersigned. This geotechnical engineering report presents exploration findings, data interpretation, and the cited recommendations. Construction plans and specifications are being prepared by the engineering office of CRH Asociados.

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SITE LOCATION AND PROJECT DESCRIPTION

The site is located off State Road PR-102, kilometer 22.7 (interior), in the Monte grande Ward, Villa Alegre Sector, of Cabo Rojo, Puerto Rico. A map indicating the approximate site location is shown in **Figure 1** (all figures mentioned in this report are included as **Appendix 1**).

According to a grading plan provided by the designers, also showing the existing topography of the site, the geomorphology of the latter consists basically of sloping ground, with elevations between a high of 34 on the southwest corner and a low of 24 meters, MSL, towards the northeastern corner of the site. Two natural drainage basins run across the site: one towards the northeas5t along the northern half of the site, and the other from southwest-west towards the northeast-east, cutting through the southern half.

As mentioned earlier, the project will comprise a development consisting of 90 residential single-family lots, park and green areas, and access streets. A grading plan dated November 1999, provided by the designers for the preparation of this report and included as **Figure 2**, indicates that cuts are being proposed within the higher areas of the site on the southwestern corner, across a strip to the west and a small hill knob at the mideastern border of the site. On the other hand, fills will be required within practically all the areas covered by the two natural drainage basin systems. Maximum cut depths and fill heights will be approximately between 2 and 3 meters, although as much as 4 to 5 meters of fill will be required toward the northeastern corner of the site. Judging from the existing geomorphology, the development may contemplate cut/fill transitions and some structures could have footings on or near slopes.

SCOPE OF WORK

Field work consisted in drilling four (4) borings. Borings were located with tape measure, using existing boundary limits and topographic features, as shown in **Figure 3**. Office work consisted of reviewing technical literature, interpreting exploration findings, performing geotechnical engineering analyses, and preparing this geotechnical engineering report.

All borings were performed by rotary drilling with hollow-stem augers[1] and samples were recovered continuously to a depth of 6 feet, and in 5-foot intervals from thereon, while performing the Standard Penetration Test (SPT)[2]. Retained samples were transported in glass jars to the laboratory for visual-manual description[3], water content determination[4], and unconfined compression by means of the spring tester or the hand penetrometer.

Measurements of depth to the probable phreatic level were made within the boreholes during drilling. These observations are included in the boring logs. All depths mentioned in this report, unless otherwise specified, are referred to the existing ground surface when drilling was performed. A description of field and laboratory testing procedures used for this work is included in **Appendix 2**. Detailed descriptions of the soils and materials encountered in the borings are shown in the boring logs. These logs show only the subsoil conditions found on the dates and locations indicated in this report. Boring logs are included in **Appendix 3**.

GENERAL SUBSOIL CONDITIONS

According to the borings, limited by the maximum explored depths, subsurface materials consist generally of stiff to very stiff, reddish brown residual silty clays with occasional

relict structures and hard saprolite (completely weathered bedrock) toward the end of the borings.

Groundwater was found during drilling in B-1 and B-2 at a depth of approximately 15 feet. Nevertheless, accurate groundwater levels can only be measured by monitoring one or more observation wells for several days until the water table is fairly stabilized. Furthermore, phreatic levels vary with seasonal and climatic changes throughout the year.

DISCUSSION

As a result of the findings just described, subsoil conditions are considered adequate and satisfactory for supporting the proposed structures on shallow foundations and for placing the expected permanent fill heights without inducing short- or long-term settlements. However, all soft sediments encountered during construction within and along the natural drainage basin systems running across the site should be removed and replaced with the engineered fill recommended in the forthcoming section. If applicable, quantities to be replaced should be determined during construction under the observation of the inspecting geotechnical engineer or representative.

Cut/fill transitions under lots or structures should not be planned as part of the project site design, as these may create long-term foundation problems due to differential settlements that may occur between in situ and fill materials. Furthermore, if footings are proposed near or within slopes, these should be cast at some minimum distance from the face of the slope, as recommended in the next section.

Regarding cuts, conventional equipment may be used for excavating all soils encountered in the borings. Should cuts be deeper than the end-of-boring depths, additional

deeper borings should be drilled before presenting the construction contract to bidders. Lastly, slopes on fill and cut throughout the site should be constructed with angles not exceeding 1V:2H and 1V:1.5H, respectively. One-meter wide berms should be provided for every 5 meters of height, if required.

Construction plans (except a proposed grading plan with existing topography) were not available for the preparation of this report. Therefore, *it is extremely important that final construction plans be furnished to this firm in order to verify and confirm if these recommendations are still applicable or require revision.*

RECOMMENDATIONS

EARTHWORK

1. All earthwork activities should be observed and reviewed by a full-time resident soil technician supervised by this geotechnical firm. These observations should include, but not be limited to, clearing and grubbing, identification and removal of unsuitable materials which may appear during construction, laboratory testing and approval of proposed fill and/or backfill materials, in situ testing of compacted materials for quality control, foundation excavations, cuts and embankment slopes, and evaluation of any unexpected subsoil or groundwater condition found during construction. It is important to understand that the geotechnical firm contracted to inspect the earthwork activities will adopt these recommendations in full, endorsing or disagreeing with this report. Should any changes or ammendments be made to the recommendations presented in this report, the geotechnical engineer or firm revising these should be responsible for the changed or ammended recommendations.

2. Clearing and grubbing of the existing grade is recommended. This activity includes removing and stripping vegetation, topsoil, and extraneous materials (e.g., construction debris, timber, underground and abandoned structures, etc.). A thickness of about 6 to12 inches may be used as an estimate for stripping but actual depths should be determined in the field during construction. Removed, replaced or stripped materials are objectionable as fill or backfill for foundation purposes, but these can be used in passive or landscaped areas where structures nor pavements will be constructed.

3. Once the clearing and grubbing activity is completed, the entire site should be proof-rolled. Any soft pocket of earth materials found during this operation, and deemed to be unsuitable, should be identified, and entirely removed and replaced with engineered fill, as recommended later in this section. However, soft sediments found along the natural drainage basin system should be entirely replaced with the engineered fill recommended in the forthcoming paragraphs. Prior to the placement of the permanent fill, a well-designed drain (e.g., perforated pipe surrounded by clean gravel and filter cloth; i.e., *french drain*) should be installed along the bed of the natural drainage basin and other low areas where water may flow either permanently or during rains, in order to prevent piping under the future embankmwents; thus avoiding foundation instability.

4. Borrow materials for permanent fill or backfill should classify as A-2-4 (AASHTO Soil Classification System) or better. These materials should not contain vegetative or organic matter, nor rocks larger than six (6) inches, and should not exhibit critical expansive potential. In situ soils may be used as fill or backfill, but it is important to bear in mind that residual soils are difficult to work with due to their natural moisture contents.

Therefore, the inspecting geotechnical engineer should establish specific recommendations concerning fill placement and compaction if the in situ residual soils of the area are planned to be used.

5. Permanent fill or backfill materials should be placed in maximum loose lifts of 6 to 8 inches in thickness, depending on the type of fill to be used, and compacted. The selected compaction equipment should be capable of compacting the fill such that the recommended relative compaction is obtained without affecting adjacent structures. Backfill around footings or confined areas, where a large roller does not work efficiently, should be placed in maximum loose lifts of 4 inches. The latter should be carefully compacted with hand-operated, mechanical rammers to prevent unnecessary distress to structural members already constructed.

6. Field compaction of permanent fills or backfills under the structures and pavements should comply with 95 and 90%, respectively, of the maximum dry density obtained in the Modified Proctor Test described in ASTM D 1557-78, 90. Moisture content during compaction should be maintained within -2 and +3% of optimum. As the compaction of each layer progresses, continuous leveling should be performed to assure uniform density.

7. Field density tests should be performed on each layer of compacted permanent fill by the inspecting geotechnical engineer or firm. Additional rolling should be performed if the density test results indicate that the relative compaction is less than that recom-

mended. Scarification and air-drying of the compacted surface may be required before rolling again if the moisture content of the fill is too high.

8. Slopes on fill and cut throughout the site should be constructed with angles not exceeding 1V:2H and 1V:1.5H, respectively. One-meter wide berms should be provided on slopes every 5 meters of height. As soon as embankments and cuts are constructed, exposed slope surfaces should be adequately protected against erosion to prevent surficial failures of the slope face during construction and long term stability problems. Existing sloping ground surfaces on which fill is to be placed should be benched as the fill layers are placed, to maintain vertical reactions and to provide an effective bond between the fill and the natural ground. This may be accomplished by cutting into the natural ground a distance of one meter at vertical intervals of approximately one meter.

9. Regarding cuts, conventional equipment may be used for excavating all soils encountered in the borings. Should cuts be deeper than the end-of-boring depths, additional deeper borings should be drilled before presenting the construction contract to bidders. In any case, all excavations should be performed in accordance with 29 CFR Part 1926, Occupational Safety and Health Standards-Excavations; Final Rule, published by the US Federal Department of Labor, Occupational Safety and Health Administration.

FOUNDATIONS

1. Beam on elastic foundations (or spread footings) should be used for supporting the future structures, and may be designed with allowable modulii of subgrade reaction of 100 (allowable soil bearing capacity of 3,000 psf) on residual soils and saprolite, and 70 kcf

(allowable soil bearing capacity of 2,000 psf) on fills, provided that all soft sediments are replaced with engineered fill and that none of the future structures is constructed on cut/fill transitions.

2. The minimum depth of foundation should be the maximum engrossed thickness of the beams, which are usually under the maximum loaded areas, provided that the bottom of the foundations is adequately protected against internal and external erosion from groundwater seepage and runoff. If spread footings are used for supporting the future structures, a minimum depth of foundation of 2 feet may be used, provided that these are also protected against internal and external erosion.

3. The allowable soil bearing pressure may be increased by 33% for the maximum combination of dead load, live load, and short-term lateral loads.

4. Structures should not be constructed partially on cut and fill; i.e., on cut/fill transitions, to prevent differential settlements which may occur between cut and fill materials, possibly creating distress to the future stuctures. If topographic and property limits restraint a structure from being constructed on partial cut and fill, the proposed area for cut within the structure should be undercut at least 1 meter below the proposed final grade, provided that the difference between the fill thickness under the entire structure is not more than 4 feet.

5. As a result of the existing topography, some structures may be near the edge of slopes. Should this be the case, the minimum setback between the subject structures and the

edge of the slope should be at least H/3 (where H is the height of the slope) but not more than 40 feet.

REFERENCES

(1) ASTM D 1452-80, 90
(2) ASTM D 1586-84
(3) ASTM D 2488-90
(4) ASTM D 2216-90

LIMITATIONS OF THIS REPORT

This report is based on all design concepts, parameters and constraints which have been made known to this firm. The final design may require revision of these recommendations, to confirm their applicability to the new design.

The conclusions and recommendations presented in this report are the result of the best evaluation made by this firm of the stratigraphic properties of soils and rock, as obtained from the four (4) borings drilled for this report, and the corresponding laboratory tests performed in accordance with geotechnical engineering standards. Interpretations and judgments based on these data may differ from actual conditions, since variations in the nature and behavior of subsurface materials may occur within short distances. Therefore, it is important that the inspecting geotechnical firm review footing excavations before footings are cast, in order to make sure that foundation soils are suitable for supporting the footings. Moreover, final grading and foundation plans should be provided to this firm for review, prior to construction bidding, and revision in case recommendations need to be changed.

This document has been prepared specifically for the client and the project addressed herein. Furthermore, it should not be used for a different project at this sites without the written consent of ***Western Soil, Inc.***

Respectfully submitted,

JOSÉ HERNÁNDEZ BENÍTEZ
INGENIERO
LICENCIADO
LIC. #7237
PUERTO RICO

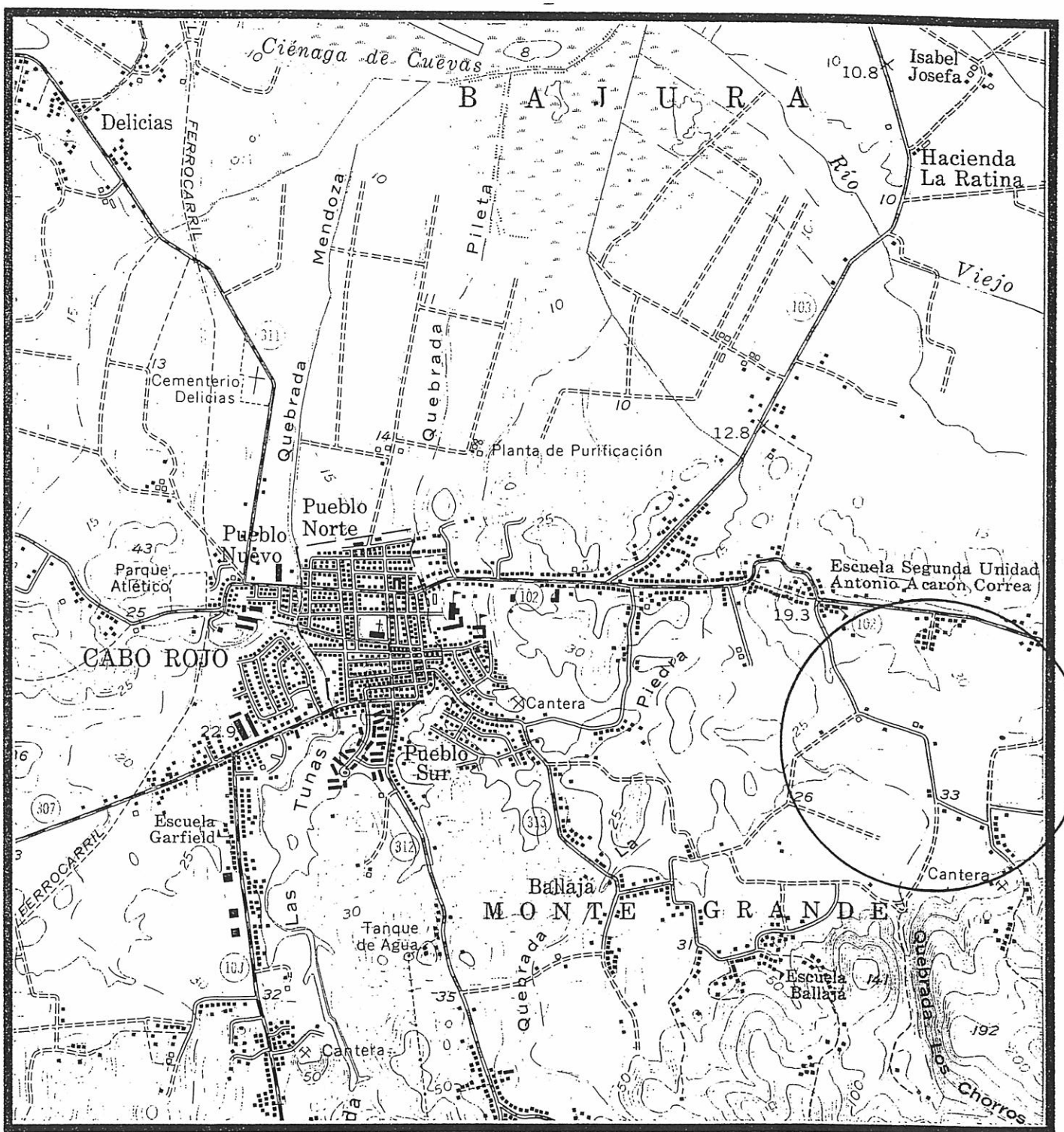
JOSÉ HERNÁNDEZ BENÍTEZ, MECE, PE
CONSULTING GEOTECHNICAL ENGINEER
FOR *WESTERN SOIL, INC.*

MAX LARACUENTE BERNAT,
PRESIDENT, *WESTERN SOIL, INC.*

APPENDIX 1

FIGURES

Western Soil, Inc.



PROJECT NAME	LOCATION
Valles de Monte Grande Reb-Clar, Inc.	PR-102, Km 21.8, Bo. Monte Grande Cabo Rojo, Puerto Rico

FIGURE No. 1 SITE LOCATION MAP

SCALE: 1:20,000

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APPENDIX 2

FIELD AND LABORATORY TESTING PROCEDURES

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DRILLING

Auger Borings. These are performed by turning a hollow-stem auger into the ground a short distance. As the auger advances into the ground, the cuttings 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. Wash borings are performed by advancing 5-foot casings (3-inch in diameter) into the ground with the drop of a 300-lb hammer from a height of 30 inches. The number of blows for every foot of casing penetration is reported in the boring logs. When driving of the casing becomes too difficult, due to the hardness of the soils encountered, and the hole does not cave-in, the boring is advanced without casing by continuously washing out the soils with the drill rods. The color and nature of the soils washed out is observed, examined and recorded to have a general idea of the extent of the soil strata.

Core Borings. Usually performed on rock formations, a core borings are advanced by rotating drill rods, a core barrel and a diamond bit. As the bit cuts into the rock, the rock core is free to move into the inner core barrel head, which is suspended on a swivel. Therefore, the rock core does not follow the rotary motion of the outer core barrel with its bit. Cooling water or a bentonite slurry is circulated through the drill rods and the core barrel. Penetration depends on the length of the core barrel and the quality (amount of joints or fractures) of the

rock. Core runs are longer as rock quality increases. As the core barrel is withdrawn, the core lifter, located inside the diamond bit, wedges itself around the bottom of the rock core, thus permitting it to be pulled free from the underlying rock.

SAMPLING

Standard Penetration Test (ASTM D 1586). Standard Penetration Tests (SPT) are performed by driving a 1.375-in ID X 2-in OD X 18- or 24-in long, split spoon sampler with the drop of a 140-lb hammer from a 30-in height. The number of blows for every 6-in of sampler penetration is recorded, and the number of blows between 6 and 18 inches of penetration is reported as the N-value. Samples are stored and sealed in glass jars for visual classification and other routine laboratory tests. The SPT has been correlated with the consistency of fine-grained soils, and the angle of internal friction or the relative density of sands. Such correlations can be used for preliminary engineering analyses and classification of soil strata of a particular site. For the case of sands, this firm has adopted the recommendations by De Mello, 1971: obtain the angle of internal friction from N-values and overburden pressure to determine the relative density. In the case of fine-grained soils, the correlation of the SPT with the undrained shear strength of medium and stiff silts and clays of low sensitivity have been found to be fairly good. However, in the case of soft silts and clays, the SPT yields poor estimates of the undrained shear strength. Therefore, testing undisturbed samples, and performing other in situ tests (e.g., vane shear, cone penetration, dilatometer, etc.) may be more reliable for these cases.

Undisturbed Sampling. Undisturbed samples are obtained with thin-wall Shelby tube samplers, 2- to 5-in OD by 30-in 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 sample penetrated the sampler. Special care is taken in handling these samples to minimize disturbance.

LABORATORY TESTING

Natural Moisture Content (ASTM D 2216). This is the water content of the in situ soil. It is obtained from either disturbed or undisturbed samples. Basically, about 40 grams of soil is placed in an oven for 24 hours at a temperature of 110° C. The difference in weight between the natural and oven-dried states of the soil, divided by the dry weight of the dry sample, expressed in percentage, is reported as the natural moisture content (w_n).

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 procedures used to determine liquid and plastic limits are described in the referenced ASTM standard.

Unconfined Compression (ASTM D 2166). The best-quality samples recovered during SPT performance are subjected to failure in unconfined compression. These samples are disturbed and the shear strength obtained is usually lower than the "true" in situ strength, depending on the degree of disturbance and the soil sensitivity. Furthermore, increased brittleness of the soil structure results in strength values lower than the in situ undrained strength. Therefore, the unconfined strength value determined from a split spoon sample is only used as index property for classification and identification purposes. If more accurate strength values are required, undisturbed samples are used.

SOIL DESCRIPTION (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 hand; a hard fine-grained soil is difficult to indent with the thumb nail, stiff soils are difficult to indent with the thumb medium soils can be penetrated by moderate thumb pressure, and soft soils are easily penetrated with the thumb. The description of coarse-grained soils (sands and gravels) include size (fine, medium, coarse), and roundness (angular, sub-angular, sub-rounded, rounded, and well-rounded, according to Pettijohn, 1949). 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 clay 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%
Sandy or Gravelly	20 - 35%
And	35 - 50%

The relative density of sands has been also correlated with the SPT as follows:

N-values	Relative Density
0 - 4	very loose
4 - 10	loose

10 - 30	medium
30 - 50	dense
> 50	very dense

These correlations are very approximate, and vary with, among other factors, overburden pressure (Gibbs and Holtz, 1957, and Bazaraa, 1967). Moreover, these are meaningless in soils with a significant amount of gravel or cobbles. The relative amounts of the fine-grained soils is estimated according to the reaction of the soil to dilatancy, shine, dry strength and toughness, with the adjective indicating the less active fraction; i.e., a silty clay behaves more like a clay than a silt. The consistency of cohesive soils has also been correlated to the results of the SPT, as shown below. This correlation, however, is greatly affected by the clay structure and factors such as sensitivity.

Unconfined Compressive Strength (tsf)	N-value	Consistency
< 0.25	< 2	very soft
0.25 - 0.50	2 - 4	soft
0.50 - 1.00	4 - 8	medium
1.00 - 2.00	8 - 15	stiff
2.00 - 4.00	15 - 30	very stiff
> 4.00	> 30	hard

ROCK DESCRIPTION

Geologic features used to describe rock cores are weathering, hardness, joint bedding and foliation spacing, percent recovery, RQD, etc. These are explained in the following tables:

Weathering

Degree	Sample Condition
Fresh	Fresh, bright crystals, few joints may show slight staining. Rock rings under hammer if crystalline.
Very Slight	Generally fresh, joint-stained, some joints may show clay if open, crystals in broken face show clay if open, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Generally fresh, joint-stained and discoloration extends into rock up to 1". Open joints contain clay. In granodiorite rocks, some feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granodiorite rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer, and show significant loss of strength as compared with fresh rock.
Moderately Severe	All rocks, except quartz, discolored or severely stained. In granodiorite rocks, all feldspars are dull and most show kaolinization. Rock shows severe loss of strength and can be excavated with geologist pick. Rock goes "chunk" when struck.
Severe	All rocks, except quartz, discolored or stained. Rock "fabric" clear and evident, but reduced in strengh to strong soil. In granodiorite rocks, all feldspars are kaolinized to some extent.
Very Severe	All rocks, except quartz,

	discolored or stained. Rock "fabric" discernible but mass effectively reduced to "soil," with only fragments of strong rock remaining.
Complete	Rock reduced to "soil." Rock "fabric" not discernible, or discernible only in small scattered locations. Quartz may be present as dikes or stringers.

Hardness

Degree	Sample Conditions
Very Hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows with geologist pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately Hard	Can be scratched with knife or pick. ¼"-deep gouges or grooves can be excavated by hard blow with point of geologist pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16" deep by firm pressure of knife or pick point. Can be excavated in small 1" chips with geologist pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips, several inches in size, by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.

Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces, one inch or more in thickness, can be broken by finger pressure. Can be scratched readily by finger nail.

**For engineering description of rock, not to be confused with Moh's scale for minerals.*

Note: *For specific projects involving only a limited number of rock types, subdivisions or major groupings may be desirable. Numerical or alphabetical subscripts may be used to identify such subdivisions.*

Joint Bedding and Foliation Spacing in Rock. Joint spacing refers to the distance normal to the plane of the joints of a single system, or "set" of joints which are parallel to each other or nearly so. The spacing of each "set" should be described if it is possible to establish.

Spacing	Joints	Bedding & Foliation
< 2"	very close	very thin
2" - 1'	close	thin
1' - 3'	mod. close	medium
3' - 10'	wide	thick
> 10'	very wide	very thick

Core Recovery and Rock Quality Designation (RQD). In addition to the inspection of the rock core, other valuable information to the engineer is the percent recovery, and the rock quality designation (RQD). The percent recovery is defined as:

$$\% \text{ Recovery} = \frac{\text{Length of core sample recovered}}{\text{Length of cored run}}$$

If the core is broken by hauling or by the drilling process (i.e., the fracture surfaces are fresh irregular breaks rather than natural joint surfaces), the fresh broken pieces are fitted together and counted as one piece, provided that they form the required 4-inch length. Some judgement

is necessary. The RQD is expressed in percent for NX or NWM cores as:

$$RQD = \frac{\text{Sum of the lengths of core pieces longer than 4 in}}{\text{Length of run drilled}}$$

The quality of the rock is described as follows:

RQD, %	Description of Rock Quality
0 - 25	very poor
25 - 50	poor
50 - 75	fair
75 - 90	good
90 - 100	excellent

APPENDIX 3

BORING LOGS

WESTERN SOIL, INC.

BORING No. 1	PROJECT: Valles de Monte Grande Monte Grande Ward, Cabo Rojo	DATE: 7/26/2000
EL., M: 30.0		WATER LEVEL, FT (DATE): 15'-00"(7/26/2000)
EQUIPMENT: BK-51HD	DRILLER: JC LOGGER: MV	

(FEET)	LEGEND	SAMPLER	VISUAL-MANUAL SOIL DESCRIPTION	BLOWS/6"	N-VALUE	REC., %	Q_U, TSF	PEN., PSF	W_N, %
		■	Dark yellowish brown, medium silty clay, trace fine sand, some roots, occ. pebbles	1 2 4 6	6	33			45
		■	Reddish yellow, stiff to very stiff silty clay, trace fine sand, occ. pebbles and roots	6 8 12	14	72		3.5	39
		■	Dark yellowish brown, very stiff silty clay, trace fine sand, occ. roots	11 14 8	25	72			37
		■	Reddish brown to orange, stiff to very stiff silty clay, trace fine sand	12 13	25	56			30
		■	As above (Stiff)	4 6 7	13	94			39
		■	Olive brown, medium clayey silt, trace fine sand	2 3 3	6	100		1.0	49
		■	As above (Medium)	2 3 3	6	100		0.75	51

CONTINUES

■ STANDARD SPLIT SPOON

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ESTERN SOIL, INC.

RING No. 1
M: 30.0

PROJECT: Valles de Monte Grande – Monte Grande Ward, Cabo Rojo

DATE: 7/26/2000

IPMENT: BK-51HD DRILLER: JC LOGGER: MV

WATER LEVEL, FT (DATE): 15'-00"(7/26/2000)

LEGEND	SAMPLER	VISUAL-MANUAL SOIL DESCRIPTION	BLOWS/6"	N-VALUE	REC., %	Q_U, TSF	PEN., PSF	W_N, %
	■	As above (Stiff, dark olive gray, white mottles)	3 4 6	10	67			38
	■							
	■							
	■							
	■							

END OF BORING 26'-06"

■ STANDARD SPLIT SPOON

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VESTERN SOIL, INC.

ORING No. 2
L., M: 29.5

PROJECT: Valles de Monte Grande – Monte Grande Ward, Cabo Rojo

DATE: 7/27/2000

QUIPMENT: BK-51HD DRILLER: JC LOGGER: MV

WATER LEVEL, FT (DATE): 15'-00"(7/27/2000)

(FEET)	LEGEND	SAMPLER	VISUAL-MANUAL SOIL DESCRIPTION	BLOWS/6"	N-VALUE	REC., %	Q_U, TSF	PEN., PSF	W_N, %
		■	Dark yellowish brown, medium silty clay, trace fine sand, some tiny roots, occ. pebbles	2 3 4	7	39		1.75	32
		■	As above (Stiff)	6 6 7	13	39		2.5	28
5		■	Dark olive brown, stiff silty clay, trace fine sand, occ. tiny roots and pebbles	5 6 7	13	72		1.75	44
		■	As above (Very stiff)	8 8 11	19	67		2.75	31
0		■	Dark yellowish brown, stiff clayey silt, trace fine sand, occ. pebbles	3 5 7	12	78			50
5		■	As above (Medium, Yellowish brown)	4 3 4	7	100		0.75	51
)		■	As above (Medium to stiff)	2 3 6	9	100			42
5									

CONTINUES

■ STANDARD SPLIT SPOON

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WESTERN SOIL, INC.

BORING NO. 2	PROJECT: Valles de Monte Grande- Monte Grande Ward, Cabo Rojo	DATE: 7/27/2000
EL., M: 29.5		WATER LEVEL, FT (DATE): 15'-00"(7/27/2000)
EQUIPMENT: BK-51HD	DRILLER: JC	LOGGER: MV

DEPTH (FEET)	LEGEND	SAMPLER	VISUAL-MANUAL SOIL DESCRIPTION	BLOWS/6"	N-VALUE	REC., %	Q_U, TSF	PEN., PSF	W_N, %
			As above (Hard, with angular rock fragments, fine gravel size)	32 50 50/3"	100/9"	67			23
30									
35									
40									
45									

END OF BORING 26'-06"

STANDARD SPLIT SPOON

PO BOX 345 MAYAGÜEZ PUERTO RICO 00681 TEL. (787) 832-7612 FAX (787) 832-6360

WESTERN SOIL, INC.

BORING No. 3	PROJECT: Valles de Monte Grande Monte Grande Ward, Cabo Rojo	DATE: 7/27/2000
EL., M: 30.5		WATER LEVEL, FT (DATE): 15'-00"(7/26 2000)
EQUIPMENT: BK-51HD	DRILLER: JC	LOGGER: MV

DEPTH (FEET)	LEGEND	SAMPLER	VISUAL-MANUAL SOIL DESCRIPTION	BLOWS/6"	N-VALUE	REC., %	Q_U, TSF	PEN., PSF	W_N, %
		■	Yellowish brown, medium to stiff silty clay, trace fine sand, some tiny roots, occ. pebbles	1 4 4	8	39		2.75	41
		■	Yellowish brown, stiff to very stiff silty clay, trace fine sand, occ. pebbles	6 6 8	14	50		2.75	40
5		■	As above (Very stiff)	11 10 11	21	89		3.0	40
		■	As above (Very stiff)	10 9 10	19	72		2.75	39
10		■	Olive brown, stiff clayey silt, trace fine sand, occ. pebbles	3 4 5	9	89		2.5	36
15		■	As above (Medium)	2 3 4	7	100		1.5	37
20		■	Grayish brown, hard clayey silt, trace fine sand, occ. pebbles	11 17 33	50	94		0.75	18
25									

END OF BORING 21'-06"

■ STANDARD SPLIT SPOON

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WESTERN SOIL, INC.

BORING NO. 4	PROJECT: Valles de Monte Grande Monte Grande Ward, Cabo Rojo	DATE: 7/27/2000
EL., M: 27.0		WATER LEVEL, FT (DATE): 15'-00"(7/26/2000)
EQUIPMENT: BK-51HD	DRILLER: JC	LOGGER: MV

DEPTH (FEET)	LEGEND	SAMPLER	VISUAL-MANUAL SOIL DESCRIPTION	BLOWS/6"	N-VALUE	REC., %	Q_U, TSF	PEN., PSF	W_N, %
		■	Dark yellowish brown, medium to stiff silty clay, trace fine sand, occ. tiny roots, and pebbles	2 5 5	8	56		4.0	29
		■	As above (Stiff, reddish yellow)	5 6 6	14	61		3.75	36
5		■	Reddish yellow, very stiff silty clay, trace fine sand, occ. pebbles	8 10 13	21	56		3.75	38
		■	As above (Very stiff)	12 13 15	19	83		3.0	34
10		■	As above (Stiff)	4 4 6	9	83		2.25	39
15		■	Gray, medium clayey silt, trace fine sand	3 2 4	7	100		1.5	40
20		■	As above (Very stiff)	5 9 12	50	94			30
25									

END OF BORING 21'-06"

■ STANDARD SPLIT SPOON

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