Geotechnical Engineering Report
Freeway Basin and Outlet Conduit
Pima 3 Basins Project
Loop 101- Scottsdale Road to Union Hills Drive
Hayden Road - Loop 101 to Bell Road
Scottsdale, Arizona
R.A.M. Project No. G02281

For:
Stantech Consulting
7776 Pointe Parkway West, Suite 290
Phoenix, Arizona 85044

♦♦♦

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Stantech Consulting
7776 Pointe Parkway West, Suite 290
Phoenix, Arizona 85044

May 27, 1998

Attention: Chuck Gopperton, P.E.

Subject: Geotechnical Engineering Report
Freeway Basin and Outlet Conduit
Pima 3 Basins Project
Loop 101 - Scottsdale Road to Union Hills Drive
Hayden Road - Loop 101 to Bell Road
Scottsdale, Arizona

R.A.M. Project No. G02281

Attached to this letter is the Geotechnical Engineering Report for the Freeway Basin and Outlet Conduit project to be located in Scottsdale, Arizona.

The project will include a linear collection/retention basin and an outlet conduit. The existing pavement will be replaced where encountered. The results of our field exploration; laboratory testing; and engineering analysis, evaluation and recommendations are presented in the report.

The following is a brief summary of selected recommendations.

A. Foundations:
- Use mat foundations or spread footings for inlet/outlet structures.
- Support on native site soils as recommended herein.
- See report for allowable bearing capacities for various foundation depths and types.

B. Site Soils:
- Use as fill in all areas.

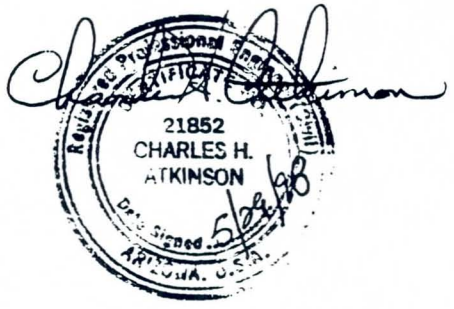
C. Replacement Pavement:
- If existing pavements are to be replaced in kind, then the minimum section should be 5 or 3 inches of asphalt concrete on 9 or 6 inches of base material in the area of Test Borings 13 and 15, respectively.
- If based on City of Scottsdale design procedure, a pavement section of 2 or 3 inches of asphalt concrete on 9 or 12 inches of base material is required for local streets classification or major collector, respectively.

The attached report was prepared based on project and site data available at this time and was prepared in a manner and to the standards of the local geotechnical engineering practice. Our services did not include evaluations for the presence of hazardous materials, for area subsidence resulting from groundwater withdrawal or other geologic hazards.

Respectfully submitted,

RICKER, ATKINSON, MCBEE & ASSOCIATES, INC.

By: Kenneth L. Ricker, P.E.



Reviewed by: Charles H. Atkinson, P.E.

/nk
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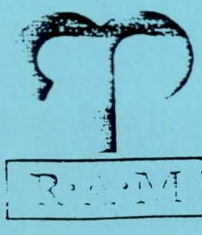


INTRODUCTION

This report presents the results of our geotechnical engineering services for the proposed Freeway Basin and Outlet Conduit project in Scottsdale, Arizona. The scope of our services included performing a field exploration program, laboratory analysis and geotechnical engineering evaluation, analysis and recommendations. The geotechnical recommendations presented herein consist of foundation design, pavement design, site development, material suitability and requirements, site preparation and grading procedures. We would be pleased to discuss with you any additional recommendations you may require. In addition, we are available to review project specifications and plans for conformance with our recommendations at no charge to you.

This firm should be notified for additional evaluation and recommendations should the facility design parameters (location, type, size, structural loads), site use or conditions encountered during construction differ from those presented herein.

PROPOSED CONSTRUCTION

The Freeway Basin and Outlet Conduit project will include a linear collection/retention basin located on the north side of the Loop 101 Freeway (future) between Scottsdale Road and Union Hills Drive (future). The basin will have relatively steep side slopes with a trapazoidal cross-section, will be lined with gunite or concrete, will be up to 20 feet deep with some planters or benches in the sides of the basin and will drain to an outlet conduit located along Hayden Road (future). The basin will be approximately 1.5 miles long. The outlet conduit will flow the alignment of Hayden Road from the basin south to just south of Bell Road where it will discharge into the Tournament Players Club retention area. The outlet conduit will be either a double-barrel box culvert or twin-pipes (concrete or metal). The outlet conduit will be up to 20 feet deep.

SITE CONDITIONS

The Freeway Basin is native desert land adjacent and parallel to the north side of Loop 101 Freeway (future). The surface slopes downward to the south-southwest with numerous small to medium size washes. The area contains a sparse to moderate growth of desert plants. The Outlet Conduit follows

the alignment of Hayden Road which is a dirt road in the north end and central part of the outlet conduit and a paved road in the remainder. The entire project is in Scottsdale, Arizona.

FIELD EXPLORATIONS

Subsurface conditions at the detention basin were explored by drilling ten test borings (1 to 10) to depths of 25.0 to 26.0 feet and the outlet conduit was explored by drilling six test borings (11 to 16) to depths of 25.0 to 25.5 feet as shown on the Site Plans in Appendix A. The test borings were drilled with a CME 75 drill rig using 7-inch diameter, hollow-stem augers. The drilling equipment and crew were provided by D & S Drilling, Inc. The test boring locations were determined in the field by a technician from our firm who also directed the drill crew. During the field explorations, representative disturbed and undisturbed samples were obtained, the test borings logged and soils field classified by our technician. The relatively undisturbed samples were obtained by driving a 3-inch diameter, ring-lined, open-end sampler into the soil with a 140-pound hammer dropping 30 inches. The results of the field explorations are presented in Appendix A.

LABORATORY ANALYSIS

Representative samples obtained during the field exploration were subjected to the following laboratory tests.

Type of Test	Type of Sample	Number of Samples Tested
Direct Shear	Undisturbed	4
Percent Passing No. 200 Sieve and Atterberg Limits	Representative	32
Remolded Swell Potential	Representative	3
Standard Proctor	Representative	6
Moisture Content/Dry Density*	Undisturbed (Ring)	36
Moisture Content	Split-Spoon /Disturbed Ring	23

*Reported on the test boring logs

The results of the laboratory testing are presented in Appendix B.

SUBSURFACE CONDITIONS

The subsurface conditions encountered at the test boring locations were relatively uniform. Soils encountered for the full depth of exploration (25 to 26 feet) were clayey sands and silty to clayey gravelly sands. This deposit was moderately loose to depths of 3 feet, contained low to medium plasticity fines, contained variable light to heavy cementation below 4 feet and contained occasional lenses of silty sand, sand and sandy clay. In Test Borings 13 and 15 the surface soils were overlain by 5.0 and 3.0 inches of asphalt concrete on 9.0 and 6.0 inches of base material, respectively. The soil moisture was described as nearly dry. At the time of field explorations for the project no groundwater was encountered in our test borings. Groundwater at the sites is relatively deep and will not influence construction.

FOUNDATION DESIGN RECOMMENDATIONS

Foundations:

The proposed inlet and outlet structures may be supported on shallow spread footings and/or mat foundations founded on native undisturbed site soils. Foundations thus founded may be designed using the following allowable bearing pressures:

Foundation Depth Below			
Existing Grade (feet)	Finished Grade* (feet)	Bearing Material	Allowable Bearing Pressure (psf)
0 to 4	0	Undisturbed	700
4 to 20	0	Undisturbed	1500
0 to 4	1.5	Undisturbed	1000
4 to 20	1.5	Undisturbed	2500

*Lowest adjacent finished grade within 5 feet of the facility.

All foundation excavations should be reviewed by the geotechnical engineer prior to placing reinforcement steel. Foundation bearing surfaces should not contain fills, loose or soft soils or debris. Where encountered these materials must be removed and replaced with compacted fill or lean concrete. Structural loads for the above footings should not exceed 5 kips per linear foot for walls and 70 kips for columns. A modulus of subgrade reaction of 300 pci for site soils may be used in design of mat foundations.

The allowable bearing capacity should be applied to maximum, design dead plus live loads and may be increased by one-third when considering temporary loads such as transient wind or seismic loads. A one-third increase may also be used for toe pressures due to eccentric or lateral loadings, assuming the entire footing bearing surface remains in compression. The weight of the footing concrete below grade may be neglected in dead load computations. The recommended minimum footing widths are 2.0 and 1.33 feet for isolated columns and continuous wall footings, respectively.

The estimated total and differential foundation settlements for the loading conditions described above are less than 1/2 inch if soils below footing level remain at or below the construction moisture content. Some additional post-construction, differential settlement could occur if bearing soils become wet after construction. Therefore, continuous footings and stem walls should be reinforced and masonry walls constructed with properly designed reinforcement and with frequent expansion/contraction joints. Positive drainage away from the perimeter of the facility is essential to minimize the potential for moisture infiltration into bearing soils.

Lateral Earth Pressures:

The following tabulation presents the recommended lateral earth pressures and base friction values which should be used in the lateral design of footings and retaining walls. The lateral pressures are equivalent fluid pressures for average anticipated conditions.

Backfill Pressures:

Unrestrained walls----------	30 psf/ft
Restrained walls----------	55 psf/ft

Passive Pressures:
Continuous---------- 250 psf/ft
Coefficient of Base Friction:
Concrete to soil---------- 0.40

The above equivalent fluid pressures are for vertical walls with horizontal backfills and do not include temporary loads imposed by compaction equipment or permanent loads resulting from backfill swell pressures or surcharge loads. All retaining walls should contain weep holes to reduce the potential for the buildup of hydrostatic pressures.

PAVEMENT DESIGN RECOMMENDATIONS

Replacement Pavements:

The City of Scottsdale design criteria was used in developing a pavement section for replacement pavements. Two options are available for the pavement replacement areas.

1. Replace in kind: Based on the existing sections, minimum thickness should be 5.0 and 3.0 inches of asphalt concrete on 9.0 and 6.0 inches of base material along Hayden Road in the north central part (Test Boring 13) and the south end (Test Boring 15), respectively.

2. Design section: Based on the City of Scottsdale procedures for local street classifications and for major collector streets, the thickness should be 2.0 and 3.0 inches of asphalt concrete on 9.0 and 12.0 inches of base material, respectively.

It is recommended that the City of Scottsdale select the best opinion based on the current roadway conditions, projected traffic and planned future improvements.

The asphalt concrete mix used shall be EVAC 19mm (medium traffic). The upper 4 inches of base material shall be MAG Aggregate Base and the remainder may be MAG Select. All pavement sections should be constructed in accordance with MAG Specifications (1998) as modified by the City of Scottsdale.

The above sections are minimal and should function well with periodic maintenance (seal coats, overlays or patching) where proper drainage is provided and maintained. Should moisture penetrate the subgrade soils or ponding occur on or adjacent to the pavement section, increased maintenance and a significant reduction in pavement life could occur. Therefore, good surface drainage on and adjacent to the pavement is essential for achieving the desired pavement life.

SITE DEVELOPMENT RECOMMENDATIONS

Subsurface Wall Backfills:

On-site soils may be used as backfill against retaining walls and subsurface walls. All fill placed against the subsurface walls should be mechanically compacted to the densities described in the "Site Preparation and Grading Procedures" part of this report. Water jetting or flooding of backfill zones must be avoided.

Sidewalks, stairways, retaining walls, fences, planters, pavements, underground utilities and other elements founded on or in the backfill zone may undergo some differential movements with respect to the structures and undisturbed areas. The amount of movement can be limited by properly placing and compacting the backfill zone. However, even properly placed backfill may undergo post-compaction settlement equivalent to 1/4 to 1/2 percent of the backfill height. Therefore, those elements which are on or in the backfill zone should be structurally supported on the facility wall and the nearby undisturbed soils or an allowance made for differential movements of the elements in the backfill zone.

Surface Drainage:

Most soils will undergo some degree of volume change as the result of wetting. The degree of volume change will depend on the type of soil, swell potential, natural soils structure or degree of compaction (if a fill). These volume changes could result in movements in overlying facilities and non-structure elements including sidewalks, planters, retaining walls, floor slabs, etc. Therefore, good site and surface drainage away from these elements is required. In addition, water should not be allowed to pond within 10 feet of the facilities or other elements which are sensitive to

movements. The exterior footing excavation backfill must be well compacted to minimize the possibility of moisture infiltration through this zone.

Excavatability:

The excavatability of site materials is difficult to evaluate based only on the exploration equipment used during this design report. Therefore, we recommend that the contractor evaluate the excavatability of site materials by performing test excavations with the size and type of equipment the contractor plans on using at the site. For design purposes the following paragraph presents our best analysis as to the excavatability of site soils.

The near surface soils can probably be removed with conventional excavating equipment. Excavations penetrating the heavily cemented deposits will be slower and more difficult to accomplish. OSHA requires all excavations over five feet in depth, in which personnel are to enter, be either braced or sloped in accordance with OSHA regulations.

Earthwork Factors:

Earthwork losses due to ground height losses and shrinkage were estimated based on past experiences in the area and limited test data. The materials encountered at the site were of low to medium density. The estimated ground height losses due to subgrade compaction are as follows for previously ungraded areas:

*Ground Height Loss at Given Percent Compaction	
95%	100%
1.0" to 2.0"	1.5" to 2.5"

* Based on maximum dry density obtained by ASTM D698, dry densities obtained from samples, and achieving an 8-inch deep compacted zone without stripping natural surface zones. These values do not include recompaction of zone disturbed by demolition or previous site usage.

The estimated shrinkage losses from cut to fill zones are as follows for naturally occurring soils. Where existing fills are reconditioned considerable shrinkage to some gain in material is expected:

*Estimated Percent Shrinkage at Given Percent Compaction

Depth of Excavation	95%	100%	105%
0 to 4 feet	20%± 2%	25% ± 2%	30% ± 2%
4 to 20 feet	13%± 2%	18% ± 2%	23% ± 2%

*Based on maximum dry density obtained by ASTM D698 and dry densities obtained from samples for natural undisturbed soils from the near surface zone, and local experience.

Our experience with earthwork losses has generally indicated that subgrades and fill zones compacted to a minimum value of 95% of maximum dry density (ASTM D698) result in losses comparable to 100% compaction (similarly for 90% minimum use 95% and for 100% minimum use 105%). These estimates do not include compaction to greater depths than assumed, losses due to wind or wastage, over-excavation, etc. These values do not include recompaction of zones disturbed by demolition or previous site usage.

Workability:

Wetting site soils such that moisture contents are at or above optimum could result in some soil pumping under dynamic loadings such as heavy construction equipment driving over the area. In facility areas, some pumping is not detrimental to foundations provided the specified percent compaction is achieved. However, in flexible pavement areas where pumping has occurred, and in facility areas where severe pumping has damaged subgrade conditions, the area should be allowed to dry until soils are workable without pumping, or the wetted areas removed and replaced with drier site soils.

Basin Slopes:

The proposed basin slopes will be constructed by excavating into the undisturbed soils, shaping the

side slopes to 1H:1V with landscape benches or planters. The side slopes and bottom of the basin will be lined with either gunite or concrete slope paving. The top of the basin will allow for both sheet flow and controlled inlet flows, at washes or other inlet points. The existing native soils below a depth of 4 feet will be stable at the proposed slope of 1H:1V provided a liner is placed and a drainage system installed behind the liner. The upper four feet of native soil will not be stable behind the liner on a permanent cut slope of 1H:1V. To stabilize this zone, these soils should be overexcavated and recompacted to at least 95 percent of the ASTM D698 maximum dry density.

The drainage system should be vertical strip drains placed behind the liner. The strip drains should be connected to weep holes near the bottom of the liner. The strip drain may be a synthetic drainage material such as Duradrain. Where planters are constructed along the slope, the drainage in the planters should be controlled by lining the planter and providing a bottom drain for the liner.

Construction Excavation:

At the time of our field exploration and to the depth explored, no groundwater was observed in the test borings.

1. In excavations, unbraced temporary slopes in the surface soils (0 to 4 feet) should stand at slopes of 1H:1V. Locally, it may be necessary to flatten slopes to 1.5H:1V if very clean, loose sand lenses of significant thickness are encountered. Temporary excavations into the deeper cemented soils (4 to 20 feet) may be constructed at a slope of 1/2H:1V. As an alternative, localized bracing or shoring may be required in areas of caving and lenses.

2. Surface areas behind the crest of excavations should be graded so that surface waters do not pond within 10 feet of the crest, or drain into the temporary or unprotected excavations.

3. Heavy material stockpiles should not be placed within 10 feet of the crest. Similarly, heavy construction equipment should not pass or be parked within 10 feet of the crest.

4. The crest of slopes should be monitored daily for evidence of movement or potential problems.

The design of any bracing systems should be reviewed by a qualified geotechnical engineer. Also, observations should be made by the geotechnical engineer during excavating to evaluate site conditions and determine if modifications are necessary in excavation procedures. If unbraced slopes are utilized, some surface raveling, erosion, and spalling should be expected unless measures are taken to stabilize exposed cut surfaces.

MATERIALS SUITABILITY AND REQUIREMENTS

Site Soils:

The site soils exhibit low to medium plasticity. These soils may be used as fill in all areas.

Imported Soils:

Additional fill and backfill required around the facilities or in exterior slab areas or for use as retaining wall backfills should be imported soils meeting the following requirements:

Maximum Particle Size	6 inches
Maximum Swell Potential	1.5%*

*Based on a sample which is remolded to 95% of the ASTM D698 maximum dry density at a moisture content of 2 percent below optimum, placed under a surcharge load of 100 psf and wetted.

Base Material:

Base material used in pavement areas should conform to the requirements of Maricopa Association of Governments (MAG) Specifications for Aggregate Base (Section 702). Existing asphalt concrete pavement which is milled may be used as base and select materials provided the material meets the requirements of MAG Section 702.

Asphalt Concrete Pavement:

Asphalt concrete pavement materials should conform to the requirements of EVAC Specifications as modified by the City of Scottsdale (Superpave Mixes will be required).

Pipe Bedding:

Material used as pipe bedding should be granular soils which meet the requirements of MAG Specifications as modified by the City of Scottsdale.

SITE PREPARATION AND GRADING PROCEDURES

Facility and Pavement Areas:

Recommendations presented in the previous sections of this report are based upon the following site preparation and grading procedures. Therefore, all earthwork should be accomplished with observation and testing by a qualified technician under the direction of a registered geotechnical/ materials engineer. The following apply to the areas within and extending 5 feet beyond the footprint of facilities, exterior slabs and pavement areas.

1. Clear and grub the site by removing and disposing of all vegetation, debris, rubble and remnants of former developments.

2. Strip the site of any existing fill zones, backfill zones and unstable soils. During stripping observe the surface for evidence of buried debris, vegetation or disturbed materials which will require additional removal. If encountered, these materials should be removed. Areas steeper than 5H to 1V should be benched and any depressions widened to accommodate compaction equipment.

3. In the upper 4 feet of the basin slopes, overexcavate these materials to a depth of 4 feet below existing grade and to a width parallel to the face of the slope of at least 10 feet. Overexcavated materials or other materials from the basin excavation may be used as fill in this area.

4. Prepare the ground surface in fill areas and in areas cut to grade by scarifying, moisture conditioning and compacting the exposed surface soils to a depth of 8 inches. Scarification may be deleted on the subgrade surface in the lined basin area.

5. Moisture condition and place all fill and backfill materials required to achieve specified grades. Fill materials should be moisture conditioned, placed and compacted in horizontal lifts of thicknesses compatible with the compaction equipment being used.

6. Compact subgrade, fill, backfill, subbase fill or base material to the following minimum percent compaction of the ASTM D698 maximum dry density for each lift.

Material	Minimum Percent Compaction
Soil:	
In retention basins	95
Below foundation sections (fill thickness less than 5 feet)	95
Below foundation sections (fill thickness greater than 5 feet)	100
Below concrete slabs (above footings)	90
Against subsurface walls (all other areas not indicated above)	95
Below pavements	95
Base Material:	
Below concrete slabs	95
Below pavements	100
Backfill:*	90

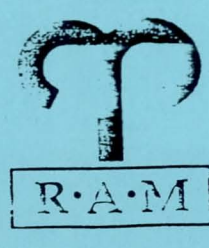
* Outside of facilities and exterior slab.

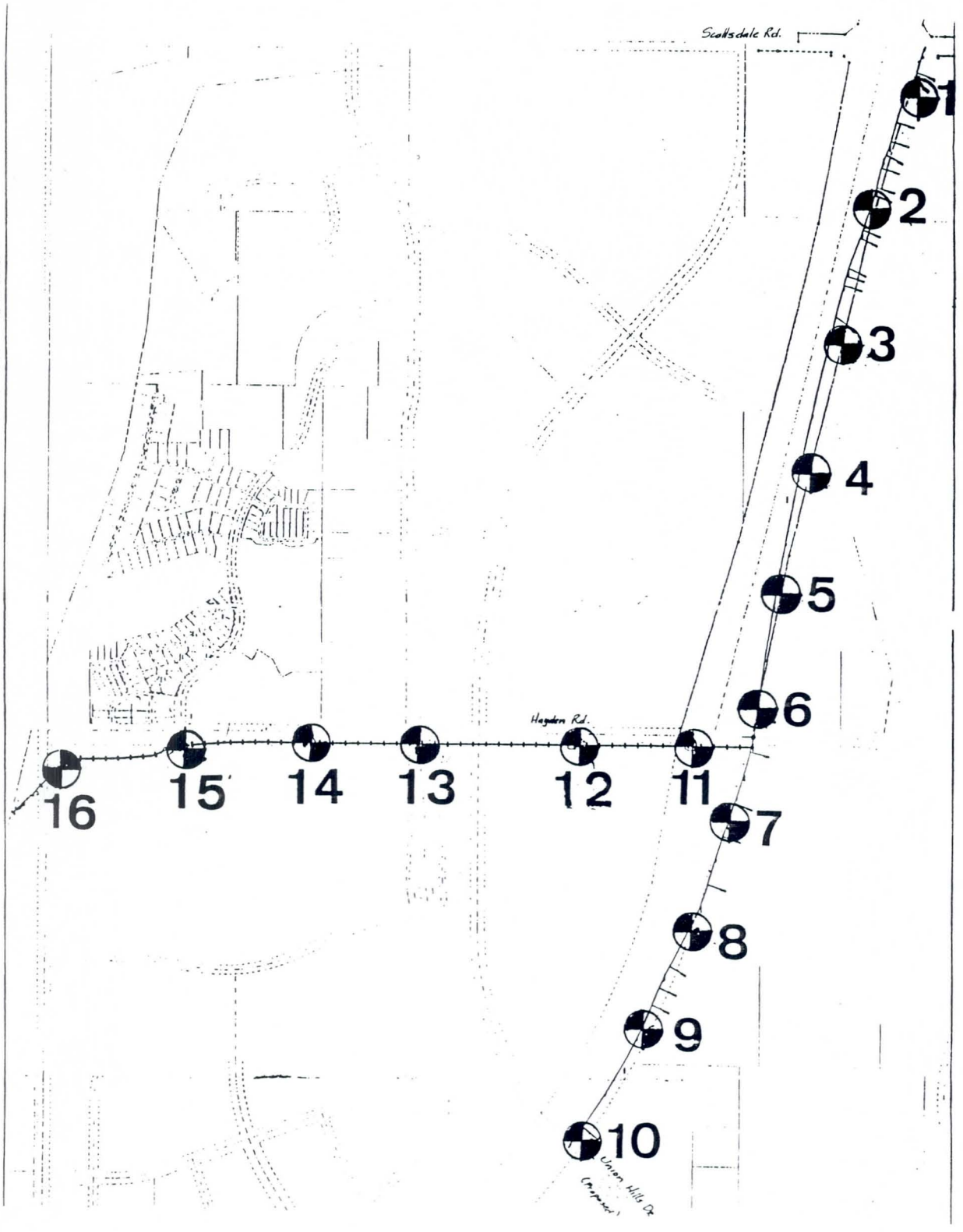
7. The moisture content of soil and base materials at the time of compaction should be:

Type	Area of Use	Moisture Content
On-site	Facility, Exterior Slab, Retention Basins	Optimum plus or minus 3%
On-site	Pavement	2% below optimum or lower
Imported	Facility, Exterior Slab	Optimum plus or minus 3%
Imported	Pavement	2% below optimum or lower
Base Material	Pavement	Optimum plus or minus 3%

8. Any soils which are disturbed or overexcavated by the contractor outside the limits of the plans or specifications should be replaced with materials compacted as specified above.

APPENDIX A
FIELD EXPLORATIONS





Test Boring Location

SITE PLAN

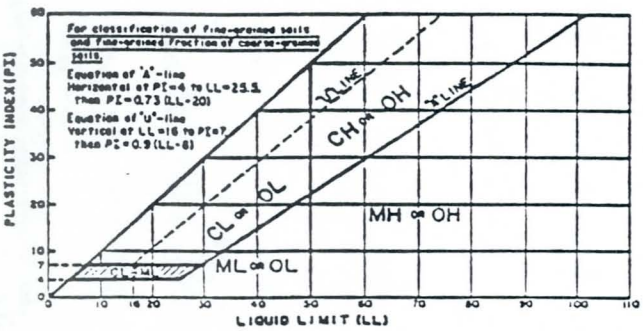
R.A.M. Project No. G02281

LEGEND

CLASSIFICATION OF SOILS

ASTM Designation: D2487-83
(Based on Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests				Soil Classification	
				Group Symbol	Name
COARSE-GRAINED SOILS More than 50% retained on No. 200 Sieve	Gravels More than 50% coarse fraction retained on No. 4 Sieve	Clean Gravels Less than 5% fines	Cu≥4 and 1≤Cc≤3	GW	Well graded gravel
			Cu<4 and/or 1>Cc>3	GP	Poorly graded gravel
		Gravels with Fines More than 12% fines	Fines classify as ML or MH	GM	Silty gravel
			Fines classify as CL or CH	GC	Clayey gravel
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	Cu≥6 and 1≤Cc≤3	SW	Well-graded sand
			Cu<6 and/or 1>Cc>3	SP	Poorly graded sand
		Sands with Fines More than 12% fines	Fines classify as ML or MH	SM	Silty sand
			Fines classify as CL or CH	SC	Clayey sand
FINE-GRAINED SOILS 50% or more passes the No. 200 Sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI>7 and plots on or above "A" line	CL	Lean clay
			PI<4 or plots below "A" line	ML	Silt
		Organic	Liquid Limit - oven dried / Liquid limit - not dried <0.75	OL	Organic clay / Organic silt
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay
			PI plots below "A" line	MH	Elastic silt
		Organic	Liquid limit - oven dried / Liquid limit - not dried <0.75	OH	Organic clay / Organic silt
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor			PT	Peat



TEST BORING LOG DEFINITIONS

Blows per foot using 140 pound hammer with 30 inch free-fall.

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
	C	N/R					

C = Continuous Penetration Resistance (2 inch diameter rod)
N = Standard Penetration Resistance (ASTM D1586)
R = Penetration Resistance (3 inch diameter ring line sampler)

U.S. STANDARD SERIES SIEVE				GRAIN SIZES	CLEAR SQUARE SIEVE OPENINGS		
200	40	10	4	3/4"	3"	12"	
SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

MOISTURE CONDITION (INCREASING MOISTURE →)

DRY — SLIGHTLY DAMP — DAMP (Plastic Limit) — MOIST — VERY MOIST — WELL (SATURATED) (Liquid Limit)

CONSISTENCY CORRELATION		RELATIVE DENSITY CORRELATION	
CLAYS & SILTS	BLOWS/FOOT*	SANDS & GRAVELS	BLOWS/FOOT*
VERY SOFT	0-2	VERY LOOSE	0-4
SOFT	2-4	LOOSE	4-10
FIRM	4-8	MEDIUM DENSE	10-30
STIFF	8-16	DENSE	30-50
VERY STIFF	16-32	VERY DENSE	OVER 50
HARD	OVER 32		

***Number of blows of 140 lb. hammer falling 30" to drive a 2" O.D. (1-3/8" I.D.) split-spoon sampler (ASTM D1586).**

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 1

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SC	Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense to dense below, medium plasticity fines, variable light to heavy cementation below 4 feet, occasional silty sand and sand lenses.
5		26	R	117	2		
10		50/3"	R	*			
15		21	R	NR			
20		50/10"	R	114	2		
25		50/5"	R	*	5		Stopped drilling at 25.5 feet. No Groundwater Observed. NR= No Recovery. *= Sample too disturbed to determine density.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 2

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
5		50/7"	R	108	2	SC	Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense to dense below, medium plasticity fines, variable light to heavy cementation below 4 feet, occasional silty sand and sand lenses.
10		27	R	95	5	CL	Sandy Clay, Trace Gravel; brown, nearly dry, stiff to hard, moderate cementation, medium plasticity.
15		50/8"	R	119	2	SC	Clayey Gravelly Sand; brown, nearly dry, dense, moderate to heavy cementation, medium plasticity fines.
20		50/6"	R	*	1		
25		50/6"	R	120	2		Stopped drilling at 25.5 feet. No Groundwater Observed. *= Sample too disturbed to determine density.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 3

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SC	Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense to dense below, medium plasticity fines, variable light to heavy cementation below 4 feet, occasional silty sand and sand lenses.
5		12	R	107	1		
10		37	R	109	3		
15		50/7"	R	115	5		Increased Plasticity Below 15 Feet.
20		50/5"	R	*	4		
25		27	R	*	1		Stopped drilling at 26 feet. No Groundwater Observed. *= Sample too disturbed to determine density.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 4

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SM/SC	Silty to Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense below, low plasticity fines, variable light to moderate cementation below 4 feet.
5		10	R	117	5		
10		50/4"	R	*	3	SC	Clayey Gravelly Sand; brown, nearly dry, dense, moderate to heavy cementation, medium plasticity fines.
							Loose Gravel Below 12 Feet.
15		50/4"	R	NR			
20		50/4"	R	*	3		
							Stopped drilling at 26 feet.
25		50/8"	R	113	2		No Groundwater Observed.
							NR= No Recovery.
							*= Sample too disturbed to determine density.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 5

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SC	Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense to dense below, medium plasticity fines, variable light to heavy cementation below 4 feet, occasional silty sand and sand lenses.
5		40	R	106	5		
10		50/6"	R	96	6		
15		50/4"	R	*	4		Increased Plasticity Below 15 Feet.
20		50/7"	R	NR			
25							Stopped drilling at 25 feet. No Groundwater Observed. NR = No Recovery. * = Sample too disturbed to determine density.
		50/2"	R	NR			

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 6

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SM/ SC	Silty to Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense below, low plasticity fines, variable light to moderate cementation below 4 feet.
5		50/4"	R	107	4		
10		50/7"	R	115	4	SC	Clayey Gravelly Sand; brown, nearly dry, dense, moderate to heavy cementation, medium plasticity fines.
15		50/8"	R	*	1		
20		50/9"	R	113	3		
25		50/3"	R	NR			Stopped drilling at 25 feet. No Groundwater Observed. NR= No Recovery. *= Sample too disturbed to determine density.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 7

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SM/ SC	Silty to Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense below, low plasticity fines, variable light to moderate cementation below 4 feet.
5		50/8"	R	121	2		
10		50/4"	R	NR			
						SC	Clayey Gravelly Sand; brown, nearly dry, dense, moderate to heavy cementation, medium plasticity fines.
15		50/6"	R	114	2		
20		50/4"	R	NR			
25							Stopped drilling at 25 feet. No Groundwater Observed. NR = No Recovery.
		50/1"	N	NR			

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 8

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SM/ SC	Silty to Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense below, low plasticity fines, variable light to moderate cementation below 4 feet.
5		50/4"	R	114	2		
10		50/4"	R	NR			
						SC	Clayey Gravelly Sand; brown, nearly dry, dense, moderate to heavy cementation, medium plasticity fines.
15		50/3"	N		3		
20		50/1"	N		2		
25		50/2"	N		5		Stopped drilling at 26 feet. No Groundwater Observed. NR = No Recovery.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 9

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SM/SC	Silty to Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense below, low plasticity fines, variable light to moderate cementation below 4 feet.
5		20	R	108	3		
10		50/6"	R	*	5		
15		50/6"	R	*	6	SC	Clayey Gravelly Sand; brown, nearly dry, dense, moderate to heavy cementation, medium plasticity fines.
20		50/10"	R	108	3		
25		50/1"	R	NR			Stopped drilling at 25 feet. No Groundwater Observed. NR= No Recovery. *= Sample too disturbed to determine density.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 10

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SM/SC	Silty to Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense below, low plasticity fines, variable light to moderate cementation below 4 feet.
5		31	R	122	1		
10		50/2"	R	NR			
15		50/8"	R	NR			
20		50/2"	N	NR		SC	Clayey Gravelly Sand; brown, nearly dry, dense, moderate to heavy cementation, medium plasticity fines.
25		50/2"	N		3		Stopped drilling at 25.5 feet. No Groundwater Observed. NR= No Recovery.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 11

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SM/SC	Silty to Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense below, low plasticity fines, variable light to moderate cementation below 4 feet.
5		27	R	103	4		
10		50/4"	R		3		
15		50/8"	R	97	2	SC	Clayey Gravelly Sand; brown, nearly dry, dense, moderate to heavy cementation, medium plasticity fines.
20		50/6"	R	NR			
25		50/6"	R	NR			Stopped drilling at 25.5 feet. No Groundwater Observed. NR= No Recovery.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 12

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SC	Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense to dense below, medium plasticity fines, variable light to heavy cementation below 4 feet, occasional silty sand and sand lenses.
5		50/6"	R	NR			
10		31	R	102	2		
15		50/7"	R	*	1		
20		50/2"	R	NR			
							Stopped drilling at 25 feet.
							No Groundwater Observed.
							NR = No Recovery.
25							*= Sample too disturbed to determine density.
		50/2"	R	NR			

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 13

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							5" Asphalt Concrete on 9" Base Material.
5		31	R	110	3	SC	Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense to dense below, medium plasticity fines, variable light to heavy cementation below 4 feet, occasional silty sand and sand lenses.
10		38	R	119	2		
15		50/4"	R	NR			
20		50/2"	R	NR			
25		50/3"	R	NR			Stopped drilling at 25 feet. No Groundwater Observed. NR = No Recovery.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 14

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SC	Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense to dense below, medium plasticity fines, variable light to heavy cementation below 4 feet, occasional silty sand and sand lenses.
5		20	R	109	3		
10		50/7"	R	116	4		
15		50/8"	R	NR			
20		50/2"	R	NR			
25		50/5"	R	127	3		Stopped drilling at 25.5 feet. No Groundwater Observed. NR = No Recovery.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 15

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							3" Asphalt Concrete on 6" Base Material.
						SC	Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense to depth below, medium plasticity fines, variable light to heavy cementation below 4 feet, occasional silty sand and sand lens.
5		24	R	121	10		
10		50/11"	R	120	2		
15		50	R	117	2		
20		50/6"	R	98	6		
25		50/4"	R	NR			Stopped drilling at 25.5 feet. No Groundwater Observed. NR= No Recovery.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: **Freeway Basin and Outlet Conduit** TEST BORING: 16

Elevation: Not Determined Datum: --- Date: 4-14-98

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SC	Clayey Gravelly Sand; brown, nearly dry, moderately loose to 3 feet, medium dense to dense below, medium plasticity fines, variable light to heavy cementation below 4 feet, occasional silty sand and sand lenses.
5		22	R	104	5		
10		50/5"	R	97	4		
15		50/4"	R	NR			
20		50/6"	R	*	1		
25		50/4"	R	NR			Stopped drilling at 25.5 feet. No Groundwater Observed. NR= No Recovery. *= Sample too disturbed to determine density.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

APPENDIX B
LABORATORY ANALYSIS

LABORATORY TEST RESULTS

Date: 13-May-98

SAMPLE SOURCE: 2 @ 10' - 11'

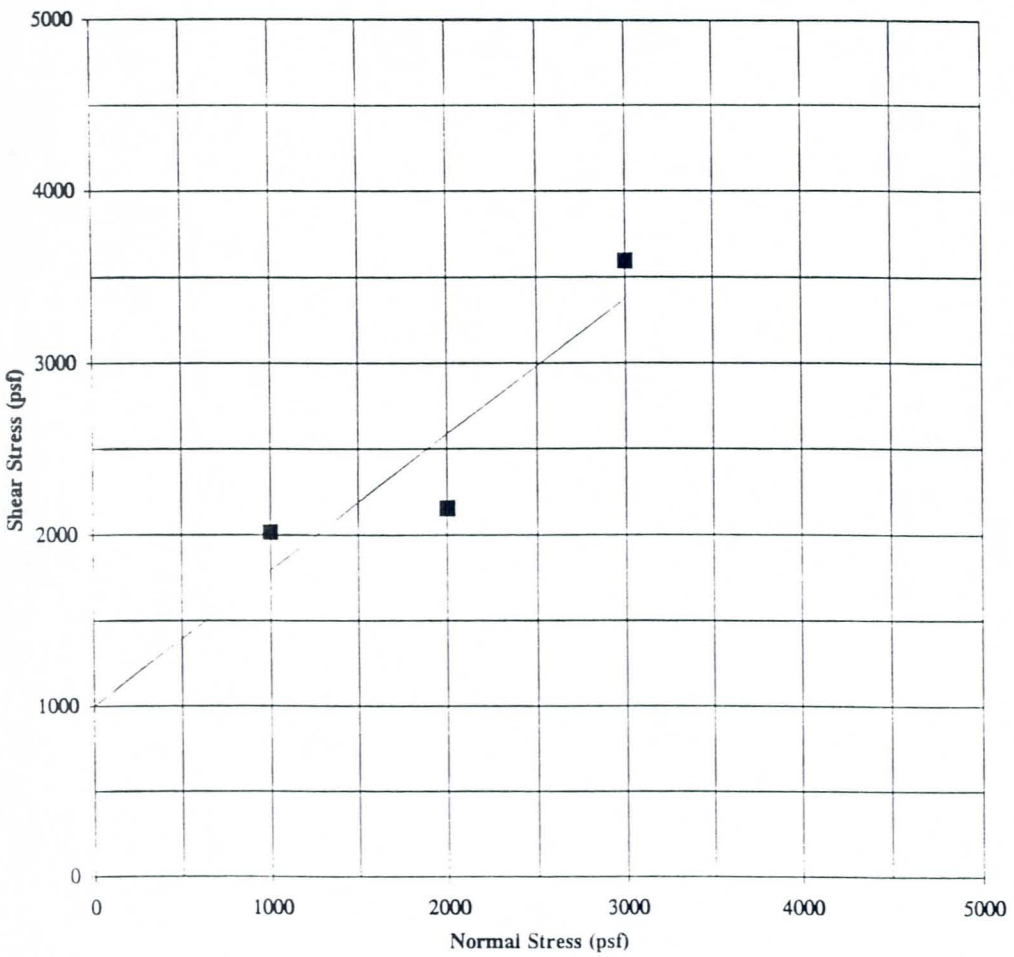
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 95 Moisture Content (%): 5

Cohesion (psf) = 1000 Friction Angle (phi) = 38



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 13-May-98

SAMPLE SOURCE: 4 @ 5' - 6'

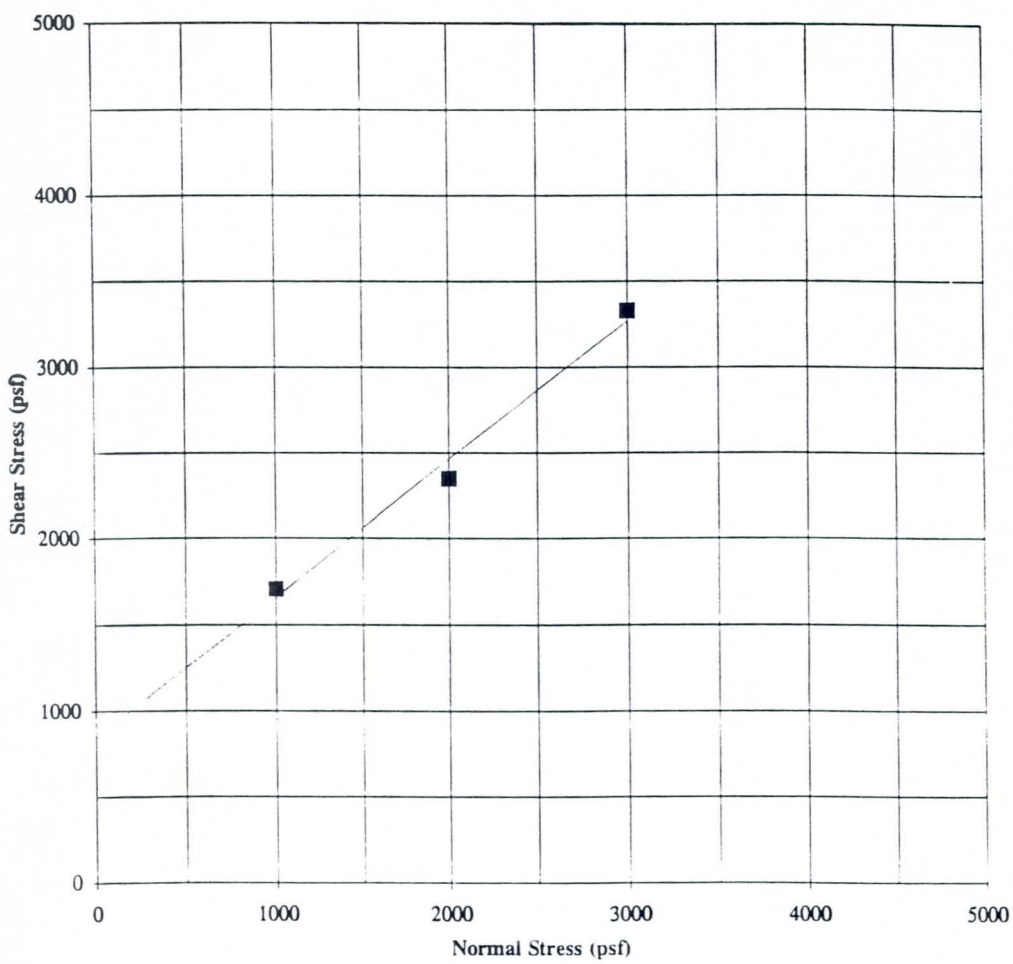
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 117 Moisture Content (%): 5

Cohesion (psf) = 850 Friction Angle (phi) = 39



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 13-May-98

SAMPLE SOURCE: 11 @ 15' - 16'

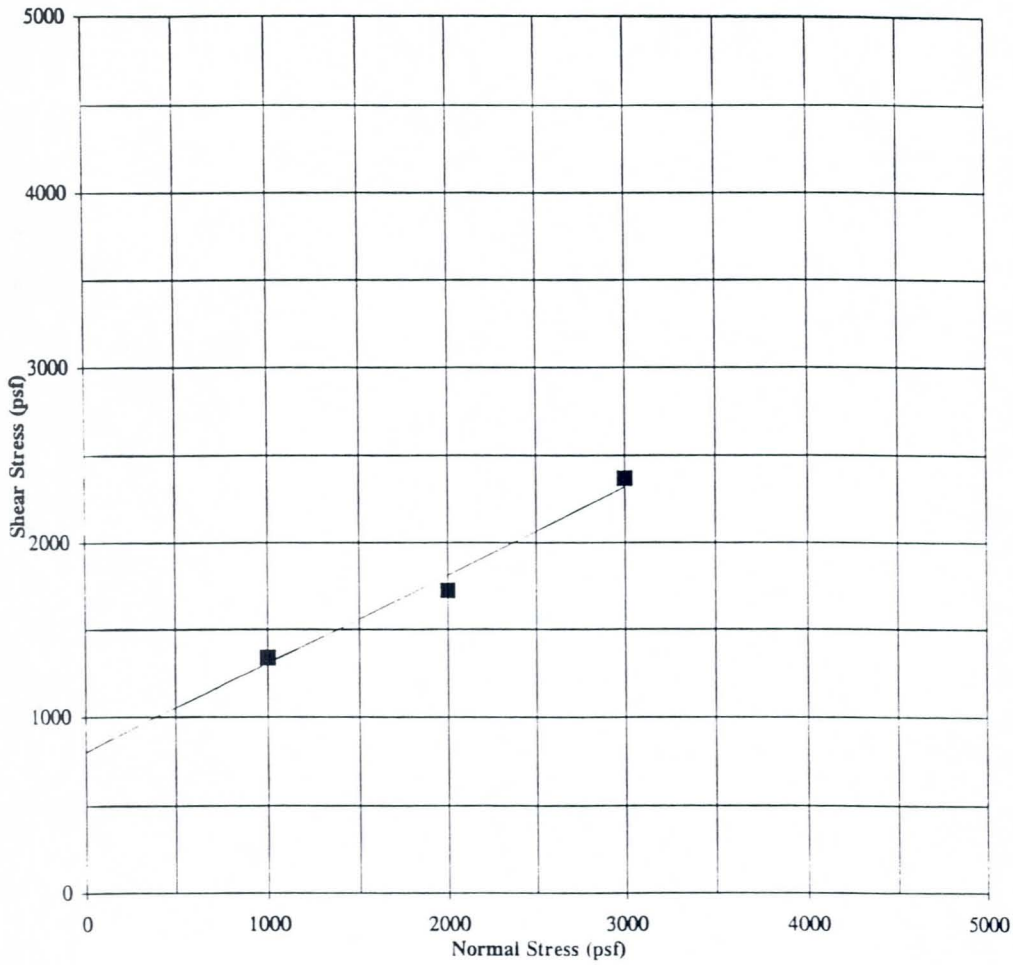
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 97 Moisture Content (%): 2

Cohesion (psf) = 800 Friction Angle (phi) = 27



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 13-May-98

SAMPLE SOURCE: 13 @ 10' - 11'

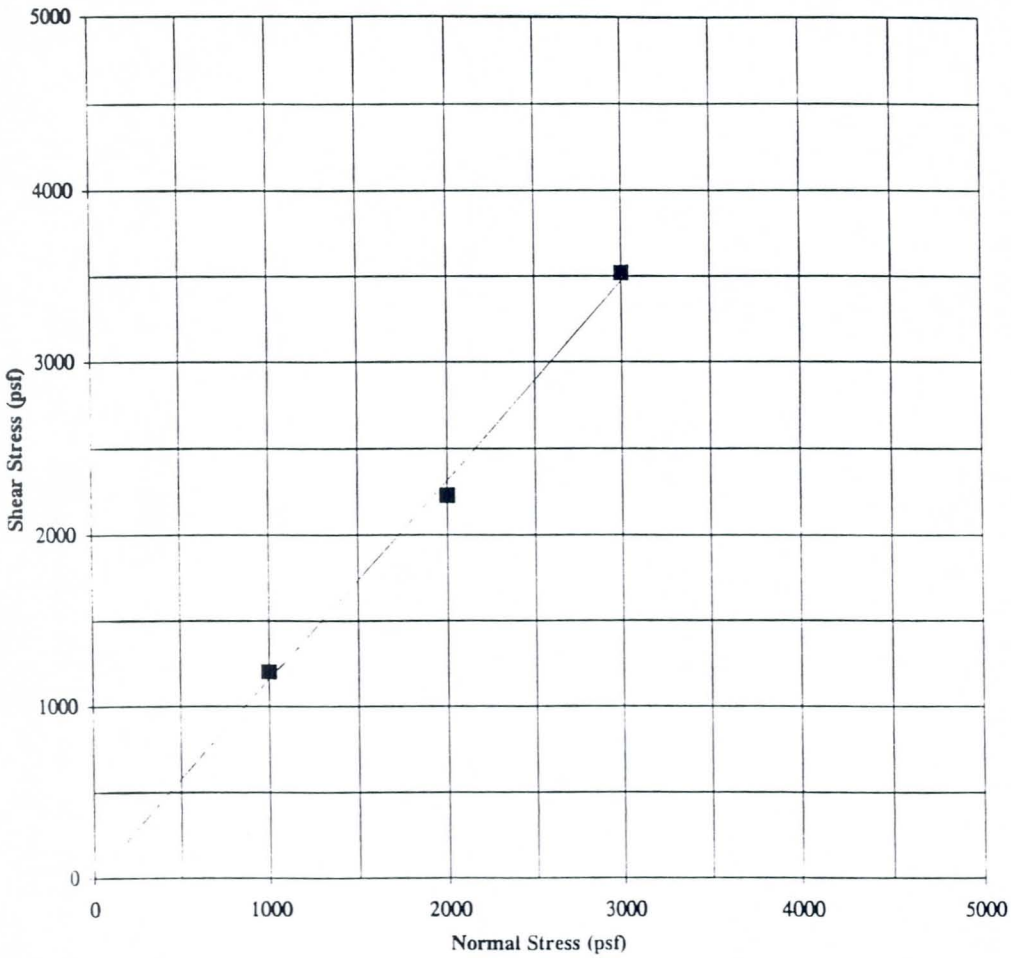
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 119 Moisture Content (%): 2

Cohesion (psf) = 0 Friction Angle (phi) = 49



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 13-May-98

SAMPLE SOURCE: As noted below

TESTING PERFORMED: Percent Passing No. 200 Sieve, Atterberg Limits (ASTM D1140, D4318)

SAMPLED BY: RAM/Miller

RESULTS:

Sample Source	Percent Retained No. 4 Sieve	Percent Passing No. 200 Sieve	Liquid Limit	Plasticity Index
1 @ 5'-10'	18	32	27	7
1 @ 15'-20'	22	15	29	11
2 @ 0'-5'	14	44	28	10
2 @ 10'-15'	3	63	39	21
3 @ 5'-10'	18	27	26	8
3 @ 15'-20'	15	20	42	26
4 @ 0'-5'	12	30	24	5
4 @ 10'-15'	9	34	29	9
5 @ 5'-10'	15	26	26	8
5 @ 15'-20'	14	31	38	20
6 @ 0'-5'	8	24	20	4
6 @ 10'-15'	13	23	29	14
7 @ 5'-10'	13	31	22	5
7 @ 15'-20'	13	29	27	7
8 @ 0'-5'	18	21	20	3
8 @ 10'-15'	16	23	26	9

LABORATORY TEST RESULTS

Date: 13-May-98

SAMPLE SOURCE: As noted below

TESTING PERFORMED: Percent Passing No. 200 Sieve, Atterberg Limits (ASTM D1140, D4318)

SAMPLED BY: RAM/Miller

RESULTS:

Sample Source	Percent Retained No. 4 Sieve	Percent Passing No. 200 Sieve	Liquid Limit	Plasticity Index
9 @ 5'-10'	18	22	21	4
9 @ 15'-20'	14	30	28	10
10 @ 0'-5'	25	13	N/A	Non-Plastic
10 @ 10'-15'	16	22	26	6
11 @ 0'-5'	11	37	25	6
11 @ 5'-10'	11	30	23	3
12 @ 0'-5'	10	44	27	8
12 @ 10'-15'	25	31	36	13
13 @ 0'-5'	29	19	33	17
13@ 15'-20'	17	22	38	21
14 @ 0'-5'	10	42	26	9
14 @ 5'-10'	11	29	24	7
15 @ 0'-5'	11	41	31	13
15 @ 10'-15'	17	29	39	22
16 @ 0'-5'	15	35	27	11
16 @ 15'-20'	7	33	29	12

LABORATORY TEST RESULTS

Date: 13-May-98

SAMPLE SOURCE: As noted below

TESTING PERFORMED: Percent Expansion (ASTM D4546)

SAMPLED BY: RAM/Miller

RESULTS:

Sample Source	Percent Expansion*	Remolded Dry Density (pcf)	Remolded Moisture Content (%)
11 @ 0'-5'	0.3	118	9
13 @ 0'-5'	0.7	123	7
16 @ 0'-5'	0.4	119	8

* Based upon sample remolded to 95% of the estimated maximum dry density at 2% below the estimated optimum moisture content, with a surcharge pressure of 100 psf.

LABORATORY TEST RESULTS

Date: 13-May-98

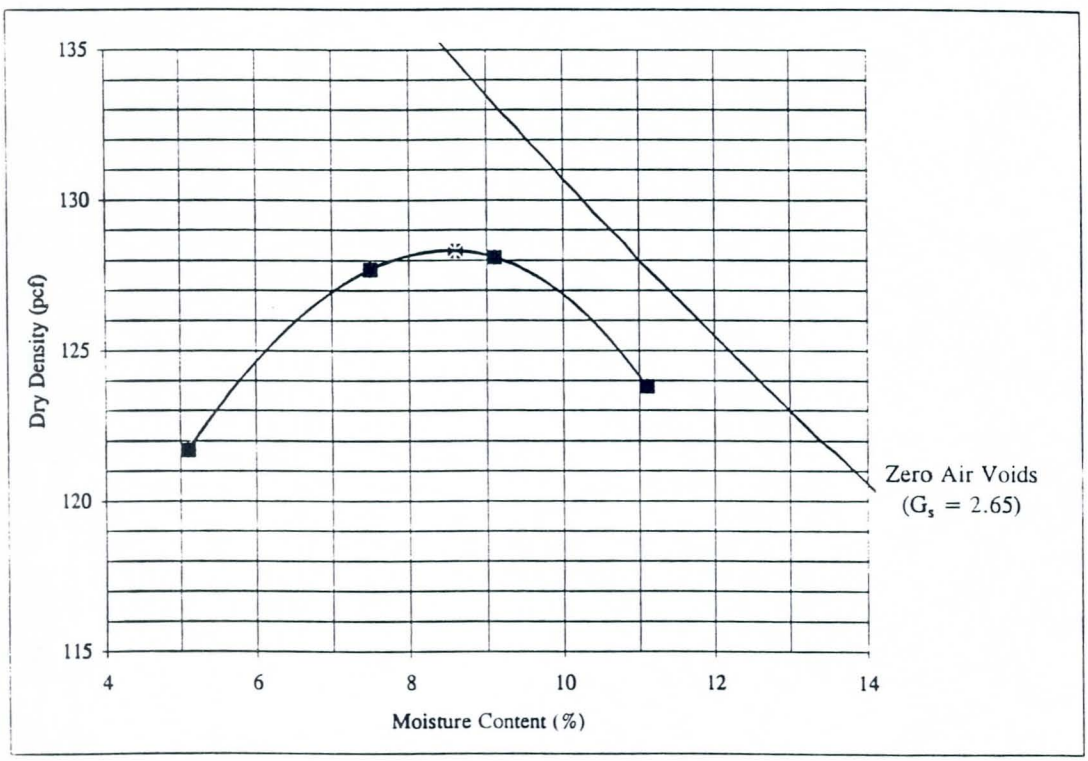
SAMPLE SOURCE: 1 @ 5' - 10'

TESTING PERFORMED Maximum Density-Optimum Moisture Determination (ASTM D698 Method A)

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 128.3 Optimum Moisture (%) = 8.6



LABORATORY TEST RESULTS

Date: 13-May-98

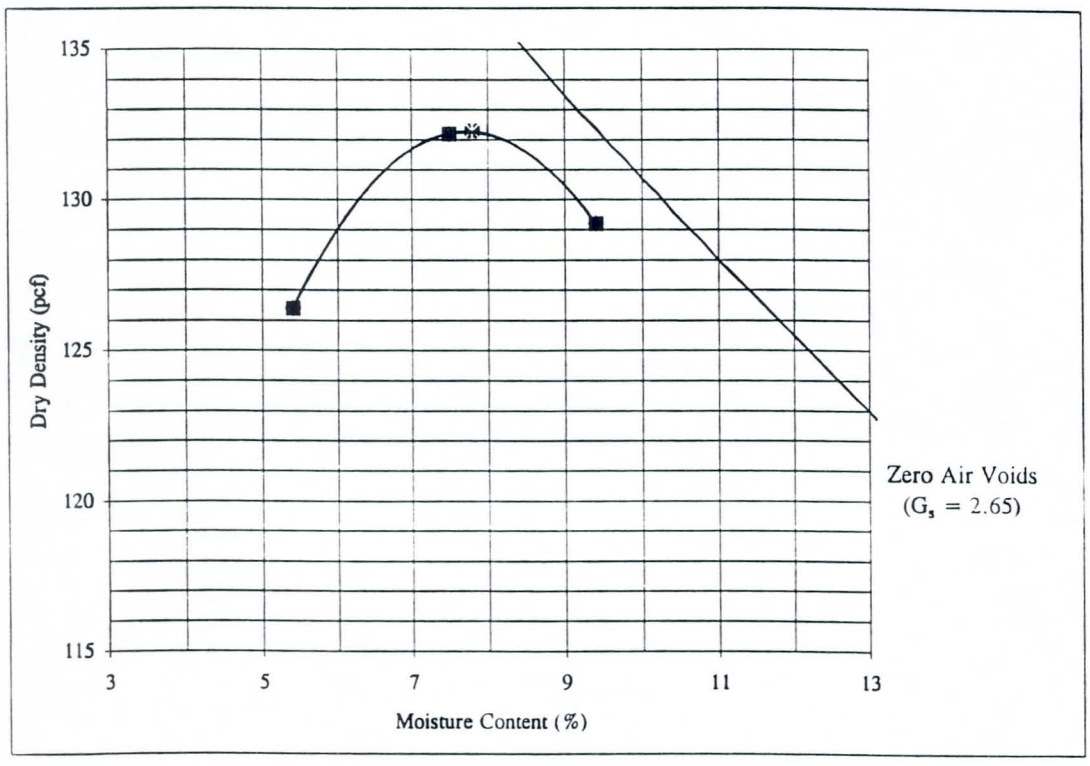
SAMPLE SOURCE: 6 @ 0' - 5'

TESTING PERFORMED Maximum Density-Optimum Moisture Determination (ASTM D698 Method A)

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 132.3 Optimum Moisture (%) = 7.8



LABORATORY TEST RESULTS

Date: 13-May-98

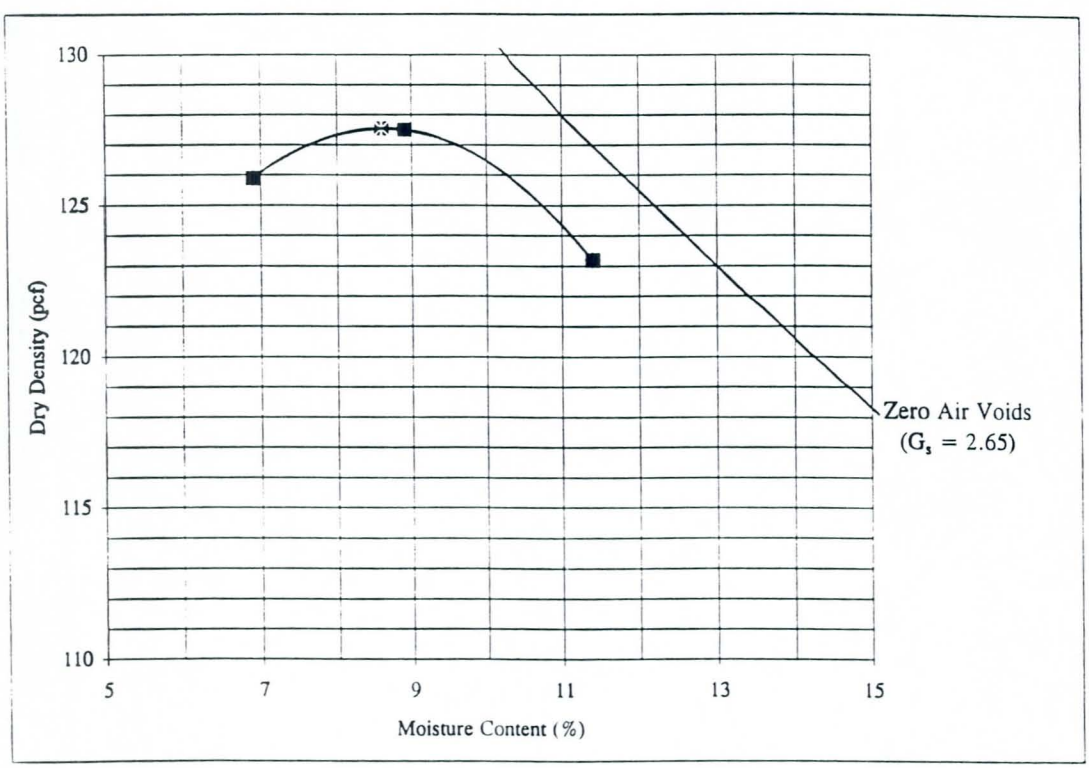
SAMPLE SOURCE: 7 @ 15' - 20'

TESTING PERFORMED Maximum Density-Optimum Moisture Determination (ASTM D698 Method A)

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 127.6 Optimum Moisture (%) = 8.6



LABORATORY TEST RESULTS

Date: 13-May-98

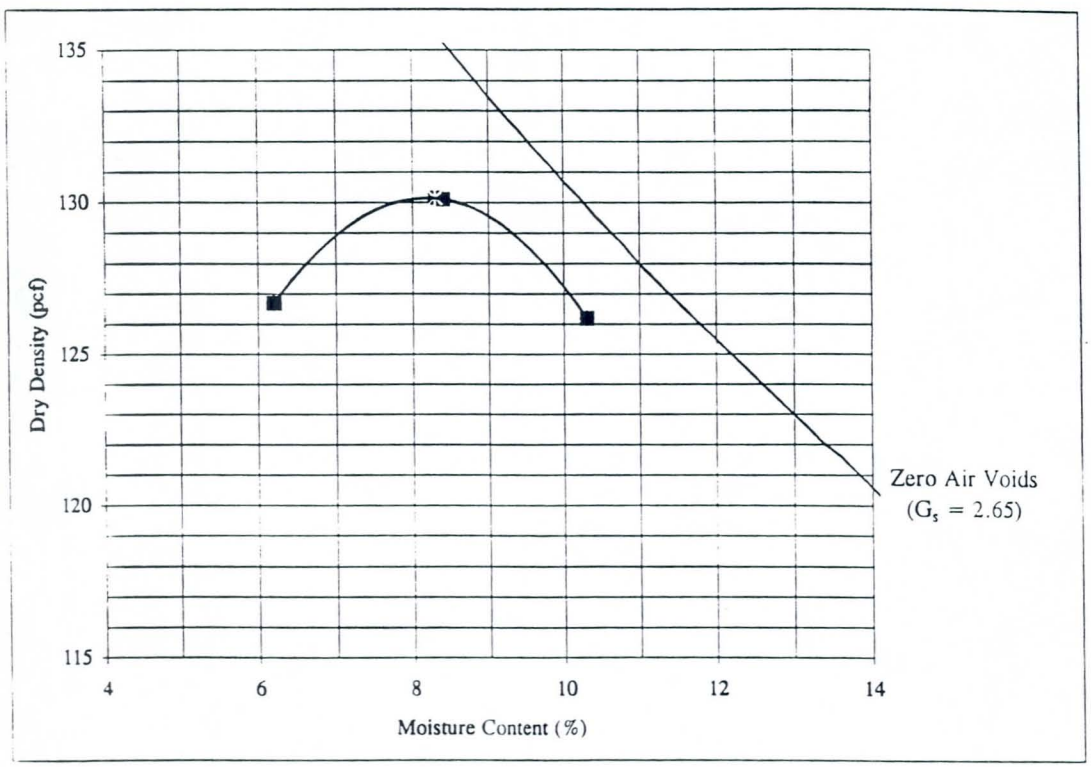
SAMPLE SOURCE: 10 @ 10' - 15'

TESTING PERFORMED Maximum Density-Optimum Moisture Determination (ASTM D698 Method A)

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 130.2 Optimum Moisture (%) = 8.3



LABORATORY TEST RESULTS

Date: 13-May-98

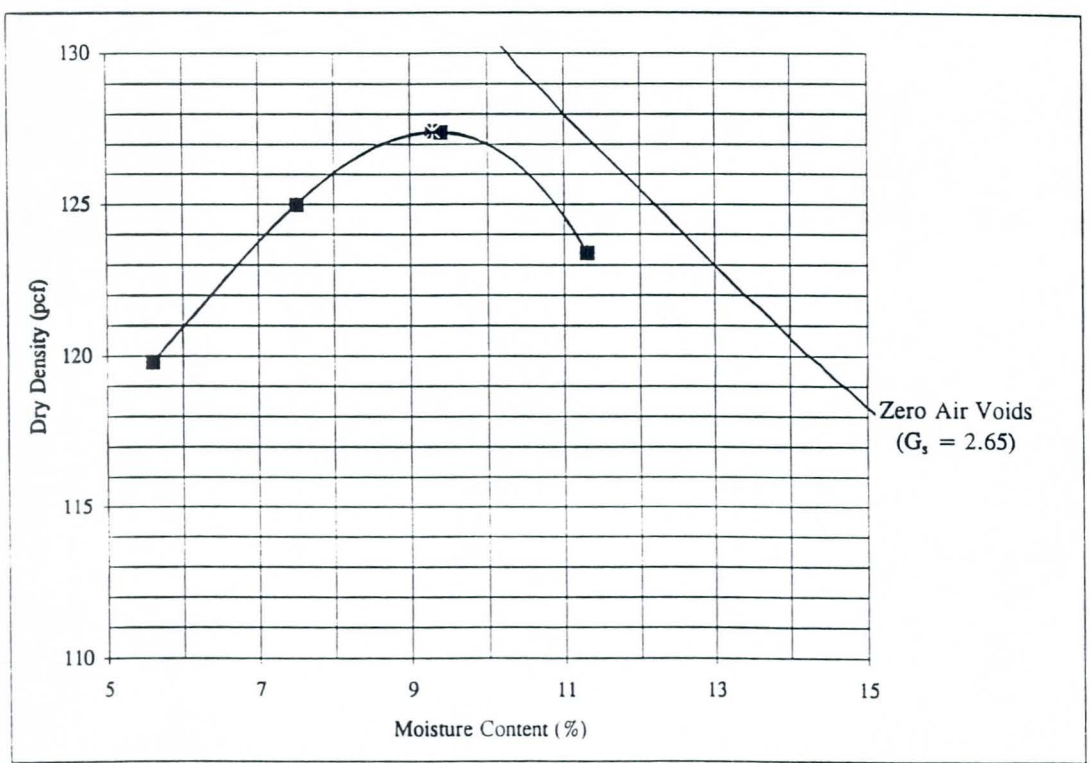
SAMPLE SOURCE: 13 @ 15' - 20'

TESTING PERFORMED Maximum Density-Optimum Moisture Determination (ASTM D698 Method A)

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 127.4 Optimum Moisture (%) = 9.3



LABORATORY TEST RESULTS

Date: 13-May-98

SAMPLE SOURCE: 15 @ 10' - 15'

TESTING PERFORMED Maximum Density-Optimum Moisture Determination (ASTM D698 Method A)

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 125.4 **Optimum Moisture (%) =** 9.1