DETENTION BASIN NO. 5
CITY OF PHOENIX NO. ST-896837

9th Street and Danbury Road
Phoenix, Arizona

Prepared for

Project Engineering Consultants, Ltd.
3130 North 35th Avenue
Suite No. 1
Phoenix, Arizona 85017

THOMAS-HARTIG & ASSOCIATES, INC.
GEOTECHNICAL, MATERIALS TESTING, AND ENVIRONMENTAL CONSULTANTS

THOMAS-HARTIG & ASSOCIATES, INC.

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6 August 1990

Attention: Steven L. Mortensen, P.E.

Project: Detention Basin No. 5
City of Phoenix No. ST-896837
9th Street and Danbury Road
Phoenix, Arizona

Project No. 90-0545

In accordance with your authorization, geotechnical engineering services were performed for the proposed storm water detention basin facilities. The detention basin includes approximately 24 acres and will range from about 6 to 13 feet below existing grade with a low point at Elevation 1377 feet. Inlet and outlet structures, a low flow outlet, a storm drain, a box culvert crossing 12th Street, and improvements to 9th and 12th Streets will be included. The basin will be landscaped for recreational use when empty, and paved parking lots may be added in the future.

Site Description: The site is vacant, undeveloped desert terrain situated between 9th and 12th Streets, approximately 1140 feet north of Bell Road, Phoenix, Arizona. The site is slightly irregular and slopes down to the southeast with an elevation differential of about 9 feet across the property. At the time of test drilling surface vegetation consisted of sparse to moderate growth of desert vegetation including low grass and weeds, bushes, and small trees.

Investigation: Subsurface conditions at the basin were evaluated by five test borings advanced with a CME-55 drill rig using 7-inch diameter, hollow-stem augers. In addition, two field resistivity tests and two shallow percolation tests were conducted, and subgrade soils were sampled from five locations along the alignment of municipal street improvements. During the field exploration, soils encountered were visually classified, and representative soil samples were obtained at selected depths. The results of the tests are attached and test locations are shown on the site plan, also attached.

Representative samples obtained during the test drilling were subjected to the following laboratory analyses:

Test	Sample(s)	Purpose
Compression	Undisturbed (2)	Foundation settlement analyses
Expansion	Compacted subsurface soil (2)	Expansion potential of excavated soils
Percent Passing No. 200 Sieve and Plasticity Index	Representative surface soil (5)	Pavement design criteria
Stabilometer "R" Value	Representative surface soil (1)	Pavement design criteria
pH, Soluble Salts, and Sulfates	Representative surface soil (2)	Corrosion potential
Dry Density and Moisture Content	Undisturbed (10)	In situ density and moisture determination to correlate engineering properties
Agronomy	Representative subsurface soil (4)	Horticultural evaluation

The results of the dry density and moisture content tests are presented on the graphical boring logs, and other test results are tabulated on the attached data sheets. The agronomy test results and Analyst's summary are also appended.

Soil Conditions: As shown on the attached graphical boring logs, the soil profiles at boring locations vary somewhat. The natural site soils were predominantly stratified sandy clay to clayey sand soils of low to medium plasticity and stiff to hard

consistency with random deeper layers of silty sand and gravel, clayey sand and gravel and sand with only traces of silt. The site soils became calcareous with intermittent light to moderate cementation below about 3 to 5 feet. Soils were described as slightly damp, and no groundwater was encountered in the borings during test drilling.

Expansion Potential: Existing site soils are predominantly sandy clay to clayey sand soil deposits which will exhibit low to moderate expansive potentials when compacted. Expansive potentials of fills constructed using these soils are estimated on the order of 1/8 to 3/8 inch per foot of compacted fill below any lightly loaded facilities (concrete slabs, etc.). To reduce (but not eliminate) the compacted soils expansive potentials, these clayey soils should be compacted and maintained at or slightly above optimum moisture content. Non-plastic, silty sands and gravels were encountered below about 16 to 18 feet in several borings. These deeper non-plastic deposits will be essentially non-expansive and would be more suitable than the overlying clayey site soils for structural fills or backfills.

Foundations: Spread or mat foundations based at or below the bottom elevation of the detention basin appear suitable for supporting the various outlet/inlet and culvert structures. However, temporary inundation is likely and could induce some post-construction differential settlements as well as temporarily reduce the bearing capacity of supporting soils. Therefore, structures should be designed to accommodate some differential foundation movements.

The following tabulation presents foundation bearing design recommendations for footings and/or structure base slabs at selected depths. These values have been developed for buoyant conditions. The bearing materials should be either natural undisturbed soils or fill materials compacted as recommended in Parts II and III of this report. However, support of shallow footings on backfills of an adjoining buried structure is not recommended. Recommendations for other foundation conditions are possible and will be considered upon request.

Footing Type	Footing Depth	Allowable Foundation Bearing Pressure	Maximum Foundation Load Walls	Columns
Mat	0.5'	2000 psf	-	-
Mat	1.5'	2500 psf	-	-
Wall or Col.	1.5'	1500 psf	3 klf	20 kips
Wall or Col.	2.5'	2000 psf	5 klf	40 kips

Footing depth refers to the depth of the base of the footing below finish grade which is defined as structure floor level or basin bottom for interior footings or mats, and the lowest adjacent grade (either floor level or outside grade) within 5 feet for perimeter or exterior footings. All footing excavations should be observed by a representative of the geotechnical engineer to evaluate bearing conditions. If disturbed soils or other unsuitable bearing conditions are observed, the bearing level should be either stepped down to penetrate these undesirable materials or the undesirable materials should be removed and be replaced with lean concrete or other materials as directed.

The recommended bearing pressures should be considered allowable maximums for dead plus design live loads, and may be increased by one-third when considering total loads including wind or seismic forces. The weight of the foundation concrete below subgrade may be neglected in dead load computations. Two (2.0) feet and 1.33 feet are recommended as the minimum width of isolated column and continuous footings, respectively, and mats should have a minimum dimension of 8 feet. At locations of grade change between adjoining structures, footings in the higher area should be positioned so that a surface projected downward at 45 degrees from the lower edge of the footing passes below the adjoining walls, foundations, backfills, etc., at the lower level.

Estimated foundation settlements for estimated structural loading conditions are on the order of 1/4 to 3/8 inch provided foundation bearing soils remain at normal moisture conditions. Additional post-construction differential foundation movements of comparable or slightly greater magnitude could be experienced if the natural bearing soils become wet after construction.

Lateral Design Parameters: The following tabulation present recommendations for lateral stability analyses assuming compacted granular backfill. The values do not include compaction forces.

[1]Foundation Toe Pressures	1.33 X allowable
[2]Lateral Backfill Pressures:	
Above Water Level:	
Unrestrained walls	35 psf/ft.
Rigid, permanently braced walls	50 psf/ft.
Below Water Level:	
Unrestrained walls	80 psf/ft.
Rigid, permanently braced walls	92 psf/ft.
[3]Lateral Passive Pressures:	
Above Water Level:	
Continuous walls/footings	250 psf/ft.
Isolated columns/footings	350 psf/ft.
Below Water Level:	
Continuous walls/footings	125 psf/ft.
Isolated column/footings	180 psf/ft.
Coefficient of Base Friction:	
Independent of passive resistance	0.40
In conjunction with passive resistance	0.30

[1]Increase in allowable foundation bearing pressure (previously tabulated) for foundation toe pressures due to eccentric or lateral loading. The entire footing bearing surface should remain in compression.

[2]Equivalent fluid pressures for vertical walls and horizontal backfill surfaces (maximum 12-foot height). Pressures do not include temporary forces imposed during compaction of the backfill, swelling pressures developed by over-compacted clayey backfill, hydrostatic pressures from inundation of backfill, or surcharge loads. Walls should be suitably braced during backfilling to prevent damage and excessive deflection.

[3]Allowable values for confining soils below the base level of the detention basin, or on slopes for forces perpendicularly away from the basin.

Structural Backfills: Backfill behind structure walls should be compacted to density criteria presented later in this report. If backfills are not compacted as recommended, subsidence may result in areas adjoining backfilled subsurface walls or over utilities. Even properly compacted deep backfills may tend to settle

differentially relative to subsurface walls and should not be used for support of adjoining facilities or utilities prone to damage from differential settlements.

Saturation of backfill and development of hydrostatic pressures is possible in below-grade areas due to infiltration of retained water through backfills. Backfills should consist of granular soils which exhibit low expansive potentials, although we recommend a clayey soil blanket at exterior, exposed backfill surfaces to impede water infiltration. Backfill compaction should be accomplished by mechanical methods. Water jetting or flooding of loose, dumped backfills must be prohibited in all structure backfills and in utility trench backfills within 10 feet of the structures.

Municipal Street Pavements: The City of Phoenix has not yet provided classifications for 9th and 12th Streets, adjoining the project, but preliminary evaluations indicate that 9th Street will be a local or residential street and 12th Street a collector. On these bases, 9th Street improvements are established by City of Phoenix Standard Detail P-1102 and 12th Street improvements by Standard Detail P-1103. These details indicate the following minimum pavement section requirements:

Location	Asphalt Concrete Thickness	*Base Course Thickness
9th Street	2.0"	7.0"
12th Street	2.0"	12.0"

*The top 4-inches of base course shall be ABC.
The remainder shall be ABC or select material.

Equivalent, alternative pavement sections may be developed by reducing the base course thickness and increasing the asphalt concrete thickness by a ratio of 3 inches ABC = 1 in A.C.

Material and placement requirements including subgrade preparation shall be in accordance with the Maricopa Association of Governments' Uniform Standard Specifications for Public Works Construction with appropriate City of Phoenix supplements.

Concrete Slab/Mat Foundation Support: Site grading should be accomplished within facility areas as recommended later in this report to provide subgrade support for concrete slabs-on-grade. A minimum 4 inch thickness of well graded sand and gravel (ABC) is recommended beneath all unreinforced, interior slabs-at-grade. In our opinion, base course is not required beneath reinforced concrete mat foundations on natural subgrades at in situ moisture content. Disturbed soils should be removed and either compacted to specified densities or be replaced prior to placement of base course.

Excavation Conditions: The test drilling and field sampling at the site were performed for design purposes. It is not possible to accurately correlate auger drilling results with the ease or difficulty of digging for various types and sizes of excavation equipment. We present the following general comments regarding excavateability for the designers' information with the understanding that they are approximations based only on test boring data. More accurate information regarding excavateability should be evaluated by contractors or other interested parties from test excavations using the intended equipment.

The near surface soils are non-cemented to lightly cemented and can probably be removed with conventional excavating equipment. However, intermittent light to moderate carbonate cementation (caliche) was generally encountered in soils below 3 to 5 feet, and excavations into these cemented soils could be somewhat difficult and require heavy duty ripping equipment or other specialized equipment. Stability problems ranging from slope raveling to caving may occur in excavations which encounter random non-cemented sand and gravel layers. All excavations should be braced or sloped as required to provide personnel safety and satisfy local safety code regulations.

Site Soil Workability: In building areas, the moisture content of existing site soils should be maintained between optimum and optimum plus 3 percent (ASTM D698) during and subsequent to site grading to reduce expansive potentials. At these conditions, some pumping may be experienced under dynamic loading if the compaction is done by very heavy equipment (i.e., loaded scrapers, water-pulls, etc.). We would not consider some pumping detrimental in areas below foundations or floor slabs (i.e. static loading conditions) provided specified

densities are obtained. Lighter compaction equipment and/or drying of wet soils may be used to reduce pumping if this condition becomes severe.

In bituminous paved areas, the moisture content of the subgrade and fill should be maintained at 2 percent below optimum or lower during site grading to reduce the potential for pumping. If moisture contents are higher than this during construction, pumping may occur and cause early pavement failure. Special precautions should be taken to prevent disturbance, equipment mobility problems, and loss of shear strength in the subgrade. These precautions may include spreading and drying to wet soils, removal and replacement of wet soils, construction of temporary gravel roads at channelized traffic areas, and/or use of lighter compaction equipment.

Permanent Slopes: Low cut or fill slopes in site soils (height less than 15 feet) which do not support or adjoin structures, roads, or other facilities should be no steeper than 2:1 (H:V.). The stability of slopes with greater height or which are used for structural support must be analyzed on an individual basis. Subgrade preparation and fill compaction for fill slopes should be performed as recommended in "Fill Materials" and "Site Grading". Fills should be constructed beyond the design slope surface and trimmed to final configuration. Erosion protection will be required for both cut and fill slopes.

Corrosion: The soil resistivity tests did not indicate potentially "hot" (highly corrosive) soils at the existing moisture condition. However, laboratory testing revealed moderate soluble salts concentrations in the site subsurface soils but low concentrations of soluble sulfates. Concrete on or below grade should be made with Type II cement. The soluble salts concentrations do indicate some potential for corrosion of embedded metallic conduit. Therefore, consideration should be given to the use of approved, non-metallic, wrapped, or cathodic protected conduits. Also, special protection may be necessary where dissimilar metals are placed in close proximity or are joined.

Percolation Tests: Two shallow percolation tests were conducted in 12-inch diameter borings at locations shown on the site plan. The test results are attached and show both the percolation rates as measured and adjusted to estimate bottom area seepage as may be more representative for retention basins. Although

moderate percolation rates were measured, compaction or silting of basin surfaces from introduction of turbid water could significantly reduce seepage rates.

Fill Materials: All fill materials should be inorganic soils free of vegetation, debris, organic contaminants and fragments larger than +6 inches in size. Clayey site soils exhibit low to moderate expansion potentials when compacted. These soils may be used in embankment fills, and in fills below structures and concrete slabs; however, in areas below structures and concrete slabs these soils should be compacted at or above optimum moisture content as recommended in "Site Grading". These soils are not recommended for use in retaining wall backfill. Rather, granular soils meeting the requirements tabulated below are recommended.

Any imported fill or backfill materials for use within structure, concrete slab areas, and as retaining wall backfill should conform with the following specification requirements:

Maximum particle size	6 inches*
Maximum percent expansion	1.5**
Maximum percent passing 200 sieve	25***
Maximum plasticity index	5***

*Maximum size may be reduced at engineer's direction to satisfy trenching and landscaping requirements, etc.

**Performed on sample remolded to 95 percent of the maximum ASTM D698 density and 2 percent below optimum moisture under a 100 psf surcharge pressure.

***Materials for structural wall backfill.

Site Grading: The following recommendations are presented for site grading within structure, concrete slab, and pavement areas. These recommended site grading procedures are intended to provide support for structural elements and pavement sections constructed on-grade. Therefore, all phases of earthwork should be performed under observation and testing directed by the geotechnical engineer.

1. Remove vegetation and organic contaminants, subsurface remnants of any former facilities, all surface fills, any backfills, and any unstable soils (loose, disturbed, etc.) from structure and pavement areas. Observe the

cleared surface before and during subsequent scarification for evidences of debris-laden soils, disturbance, or loose zones requiring additional removal.

2. Widen any resulting depressions as necessary to accommodate compaction equipment and provide a level base for placing fill.

3. Scarify, moisture condition and compact exposed surface soils to a minimum 8-inch depth in areas beneath structures, concrete slabs, and pavements.

4. Place backfill or fill materials required to elevate site areas to specified subbase grade. Fill materials should be placed and compacted in horizontal lifts of thicknesses compatible with the compaction equipment used.

5. Compaction of cleaned exposed soil and each lift of backfill, subbase fill, and base course materials should be accomplished to the following density criteria:

Material	Percent Compaction (ASTM D698)
Cleaned Exposed Soil, Backfill, and Subbase Fill:	
Below foundation level:	
Less than 5 feet deep	95 min.
More than 5 feet deep	100 min.
Below concrete slabs above foundation level:	
On-site soils	90 min.
Imported soils	95 min.
Below asphalt paving	95 min.
*Miscellaneous Backfill	90 min.
Base Course:	
Below concrete slabs	95 min.
Below asphalt paving	100 min.

*Utility trench and exterior fill or backfill not intended for utility line, floor slab, foundation or pavement support.

Compaction of exposed site soils or fills of site soils within structure and concrete slab areas should be performed with soils uniformly mixed at a moisture content between optimum and optimum plus 3 percent. Compaction of imported fill soils with low expansive potentials should be accomplished at optimum content ±3 percent in areas beneath structures and exterior concrete slabs. Compaction of subgrade soil and fill material below asphaltic pavement should be accomplished at a moisture content 2 percent below optimum, or lower.

Natural undisturbed soils or compacted soils subsequently disturbed or removed by construction operations should be replaced with materials compacted as specified above.

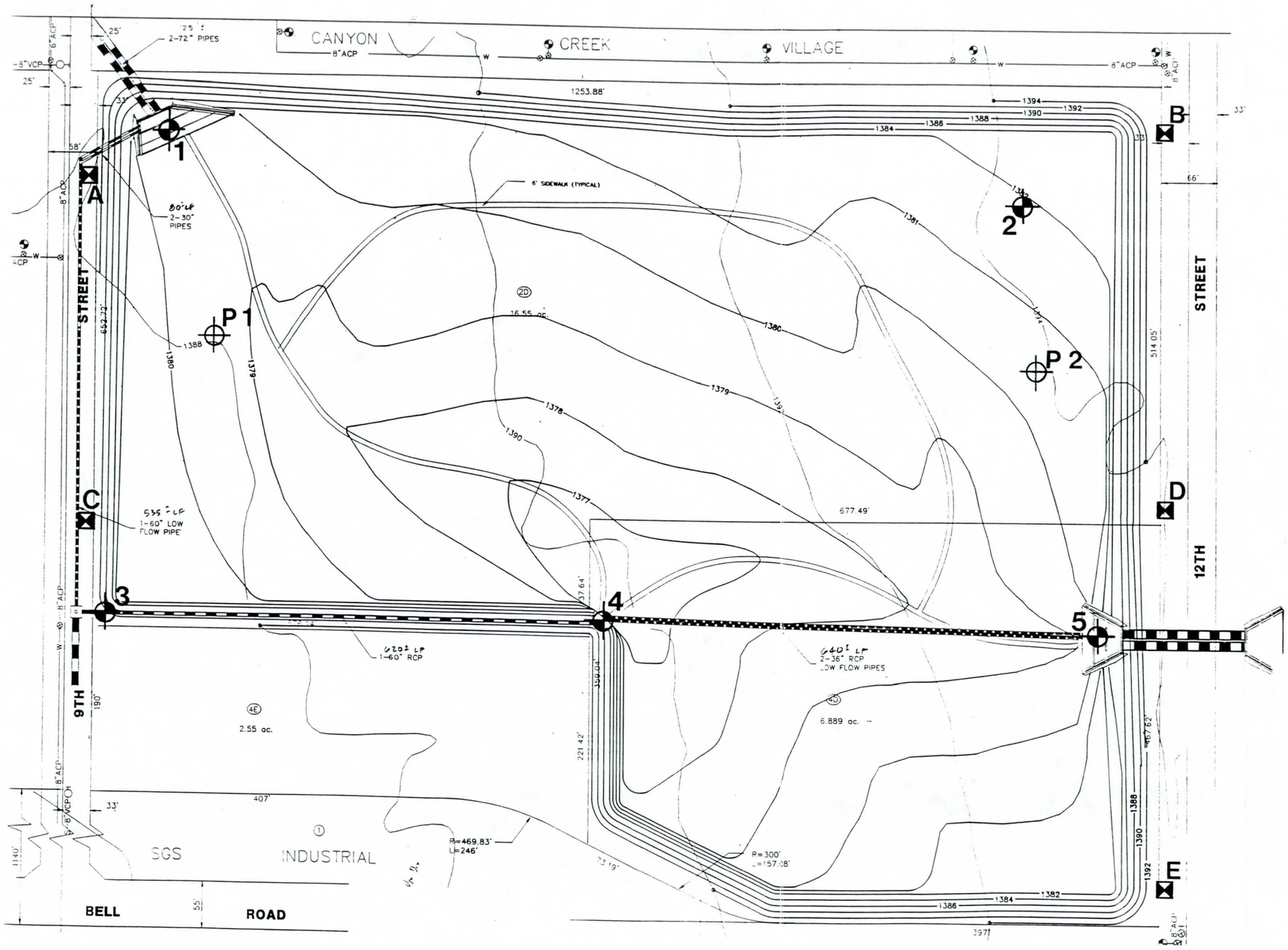
Please call if you have any questions or if we may be of further service.

Respectfully submitted,
THOMAS-HARTIG & ASSOCIATES, INC.

By:_____ Reviewed by:_____
John P. Boyd, P.E. Kenneth E. Ricker, P.E.

/go
Copies to: Addressee (5)

FIELD AND LABORATORY TEST RESULTS



Test Boring Location

Percolation Test Location

Subgrade Sample Location

SITE PLAN

PROJECT NO. 90-0545

THOMAS-HARTIG & ASSOCIATES, INC.

LEGEND

SOIL CLASSIFICATION

COARSE-GRAINED SOIL

More than 50% larger than 200 sieve size

SYMBOL	LETTER	DESCRIPTION	MAJOR DIVISIONS
	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES. LESS THAN 5% - #200 FINES	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size
	GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES. LESS THAN 5% - #200 FINES	
	GM	SILTY GRAVELS. GRAVEL-SAND-SILT MIXTURES. MORE THAN 12% - #200 FINES	
	GC	CLAYEY GRAVELS. GRAVEL-SAND-CLAY MIXTURES. MORE THAN 12% - #200 FINES	
	SW	WELL-GRADED SANDS OR GRAVELLY SANDS. LESS THAN 5% - #200 FINES	SANDS More than half of coarse fraction is smaller than No. 4 sieve size
	SP	POORLY-GRADED SANDS OR GRAVELLY SANDS. LESS THAN 5% - #200 FINES	
	SM	SILTY SANDS. SAND-SILT MIXTURES MORE THAN 12% - #200 FINES	
	SC	CLAYEY SANDS. SAND-CLAY MIXTURES MORE THAN 12% - #200 FINES	

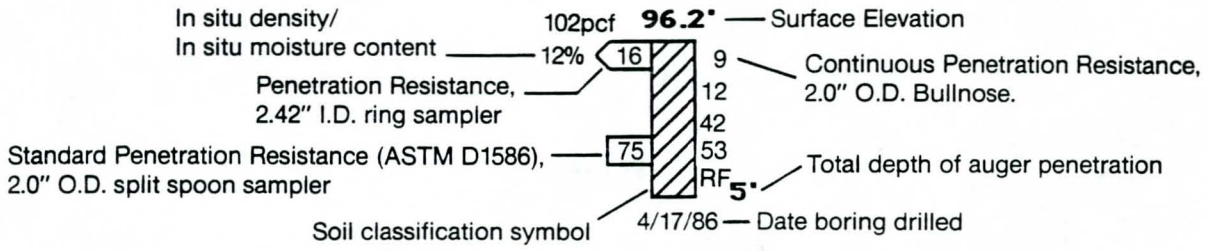
FINE-GRAINED SOIL

More than 50% smaller than 200 sieve size

SYMBOL	LETTER	DESCRIPTION	MAJOR DIVISIONS
	ML	INORGANIC SILTS. ROCK FLOUR. AND FINE SANDY OR CLAYEY SILTS OF LOW TO MEDIUM PLASTICITY	SILTS AND CLAYS Liquid limit less than 50
	CL	INORGANIC CLAYS. GRAVELLY CLAYS. SANDY CLAYS. SILTY CLAYS. AND LEAN CLAYS OF LOW TO MEDIUM PLASTICITY	
	OL	ORGANIC SILTS AND ORGANIC SILT-CLAY MIXTURES OF LOW TO MEDIUM PLASTICITY	
	MH	INORGANIC SILTS. MICACEOUS OR DIATOMACEOUS. AND FINE SANDY OR CLAYEY SILTS OF HIGH PLASTICITY	SILTS AND CLAYS Liquid limit greater than 50
	CH	INORGANIC CLAYS. FAT CLAYS. AND SILTY CLAYS OF HIGH PLASTICITY	
	OH	ORGANIC CLAYS AND ORGANIC SILTS OF MEDIUM TO HIGH PLASTICITY	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

LEGEND FOR GRAPHICAL BORING LOGS:

Log denotes visual approximation unless accompanied by mechanical analysis and Atterberg limits.



PENETRATION RESISTANCE: Blows per foot using 140 lb. hammer with 30" free-fall unless otherwise noted.

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				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 →)

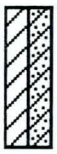
DRY — SLIGHTLY DAMP — DAMP (Plastic Limit) — MOIST — VERY MOIST — WET (SATURATED) (Liquid Limit)

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		

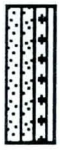
*Number of blows of 140 lb. hammer falling 30" to drive a 2" O.D. (1-3/8" I.D.) split-spoon sampler (ASTM D1586).

Project No. 90-0545

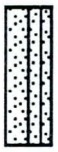
LEGEND OF SOIL TYPES



SANDY CLAY TO CLAYEY SAND (CL/SC); brown to light brown; low to medium plasticity; variable stiff to hard consistency with hardness increasing with increasing depth; intermittent light to moderate cementation (caliche) below about 3 to 5 feet; stratified deposits; some clayey silt (ML-CL) zones near the surface; traces gravel; slightly damp.



SILTY SAND AND GRAVEL (SM/GM); brown to grayish brown; none to low plasticity; medium dense to dense; stratified deposits, poorly graded coarse to fine sands with some silt fines and variable gravel contents; subangular to angular; traces cementation; slightly damp.



SAND TO SILTY SAND (SP/SM); light brown; non-plastic; medium dense; poorly graded coarse to fine sand with silt traces; slightly damp.

CLAYEY SAND AND GRAVEL (SC/GC); brown to light brown; low to medium plasticity; medium dense to dense; stratified deposits; traces to light cementation (caliche); slightly damp.

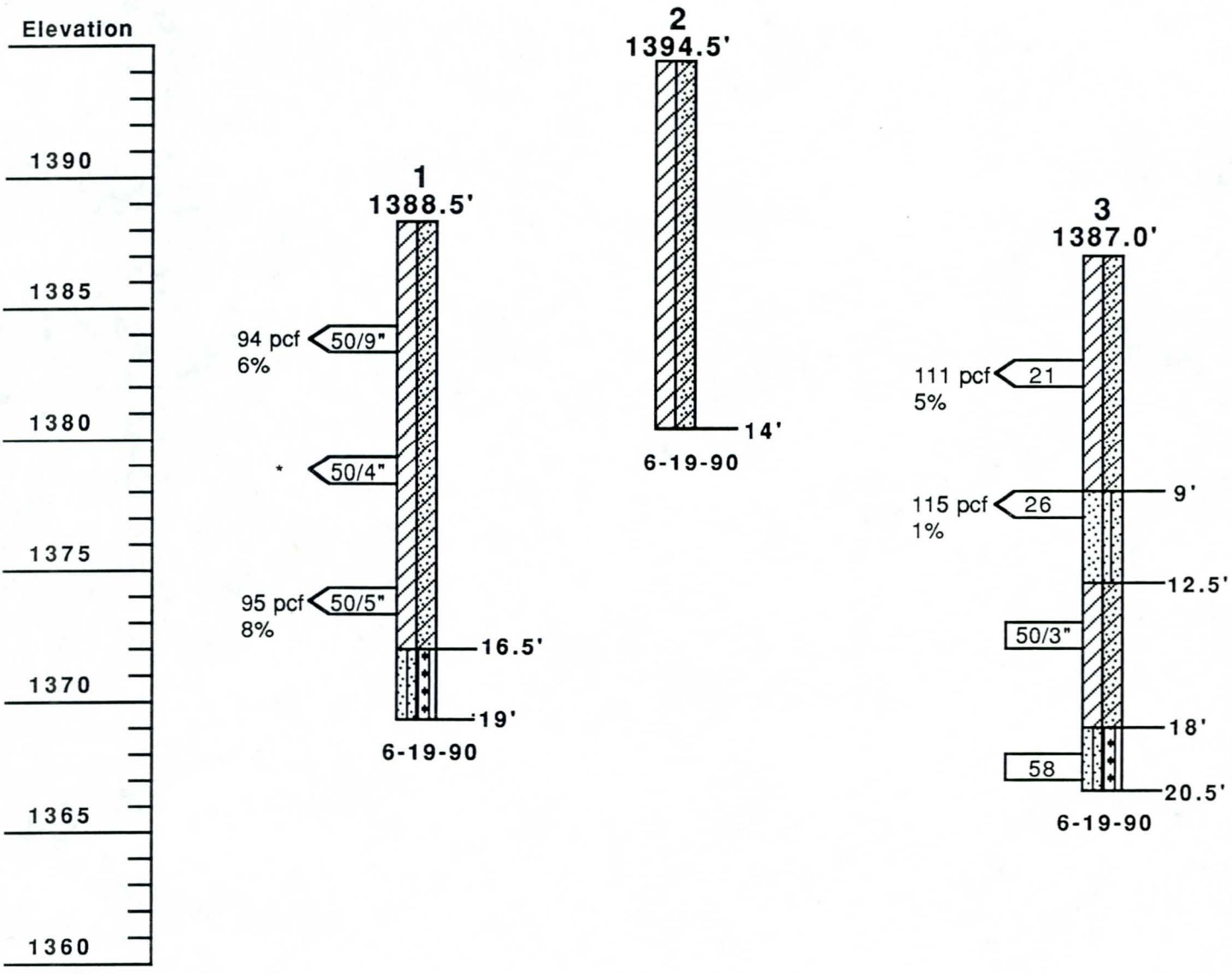
No free groundwater was encountered in any of the borings during drilling.

All borings drilled with 7" diameter hollow stem auger unless otherwise noted.

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

Project No. 90-0545
Thomas-Hartig & Associates

GRAPHICAL BORING LOGS



* Sample too disturbed to determine density.

Surface elevations at test boring locations interpolated from topographic data on preliminary site plan.

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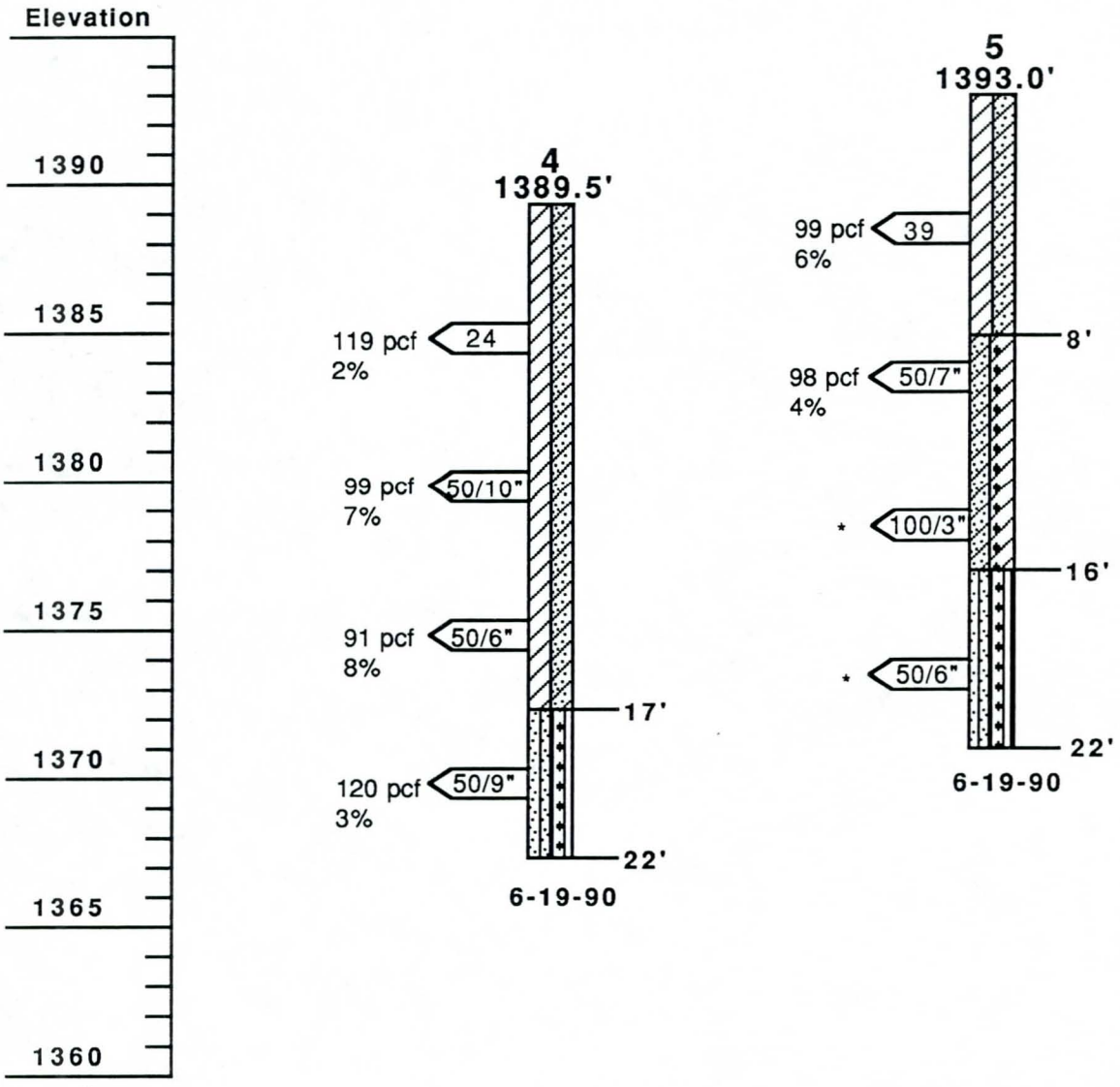

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Thomas-Hartig & Associates

REPORT ON PERCOLATION TESTS

DESCRIPTION: Date: 8-2-90

Location: Noted Below

Material: Surface Soil

Performed By: TH/Stanford

TESTED: Percolation testing after 1 day pre-soaking period.

RESULTS:

Test Boring	Boring Diameter	Boring Depth	Average Water Depth	*Percolation Rate (minutes/inch) Measured	*Adjusted
P-1	12"	5'	12"	6.7	34
P-2	12"	5'	12"	5	25

*Adjusted assuming bottom area seepage only

REPORT ON FIELD RESISTIVITY TESTS

DESCRIPTION: Date: 6-21-90

Location: Noted Below

Material: Subsurface Soil

Performed By: TH/McGrath

TESTED: Field electrical resistivity using the 4-probe method.

RESULTS:

Location	Depth Interval (feet)	Resistivity (ohm-cm)
1	0 - 10	4980
1	0 - 20	6130
2	0 - 10	11490
2	0 - 20	8430

Project No. 90-0545

Thomas-Hartig & Associates, Inc.

REPORT ON LABORATORY TESTS

SAMPLE: Date 6-29-90

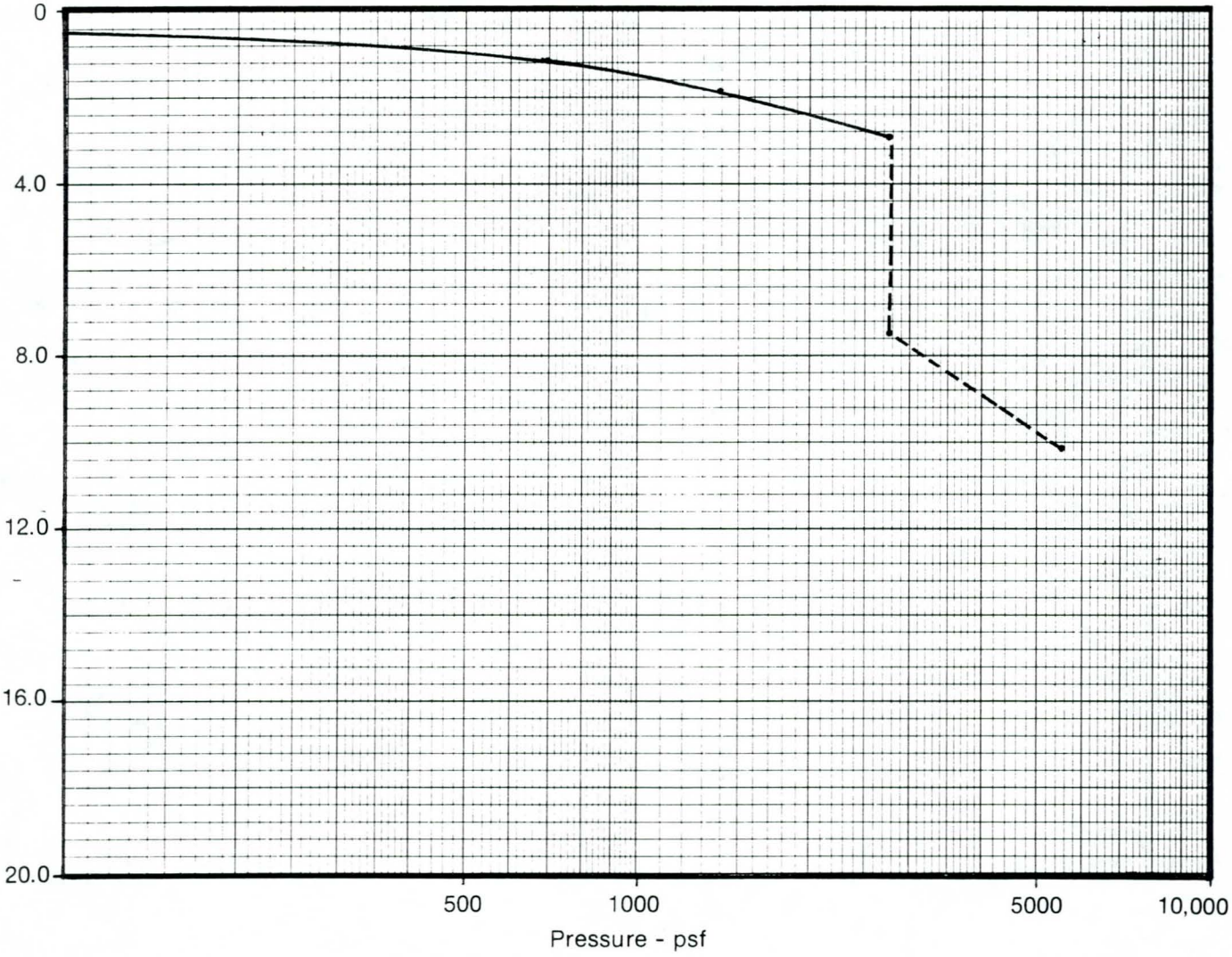
Source Test Boring 1; 14' - 15'

Type Driven Ring Sample; 95 pcf dry density; 8% field moisture

Material Sandy Clay (CL) - Sample desiccated and somewhat disturbed

Sampled By TH/Thompson

TESTED: Compression; test sample soaked at 2770 psf



Project No. 90-0545

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 6-29-90

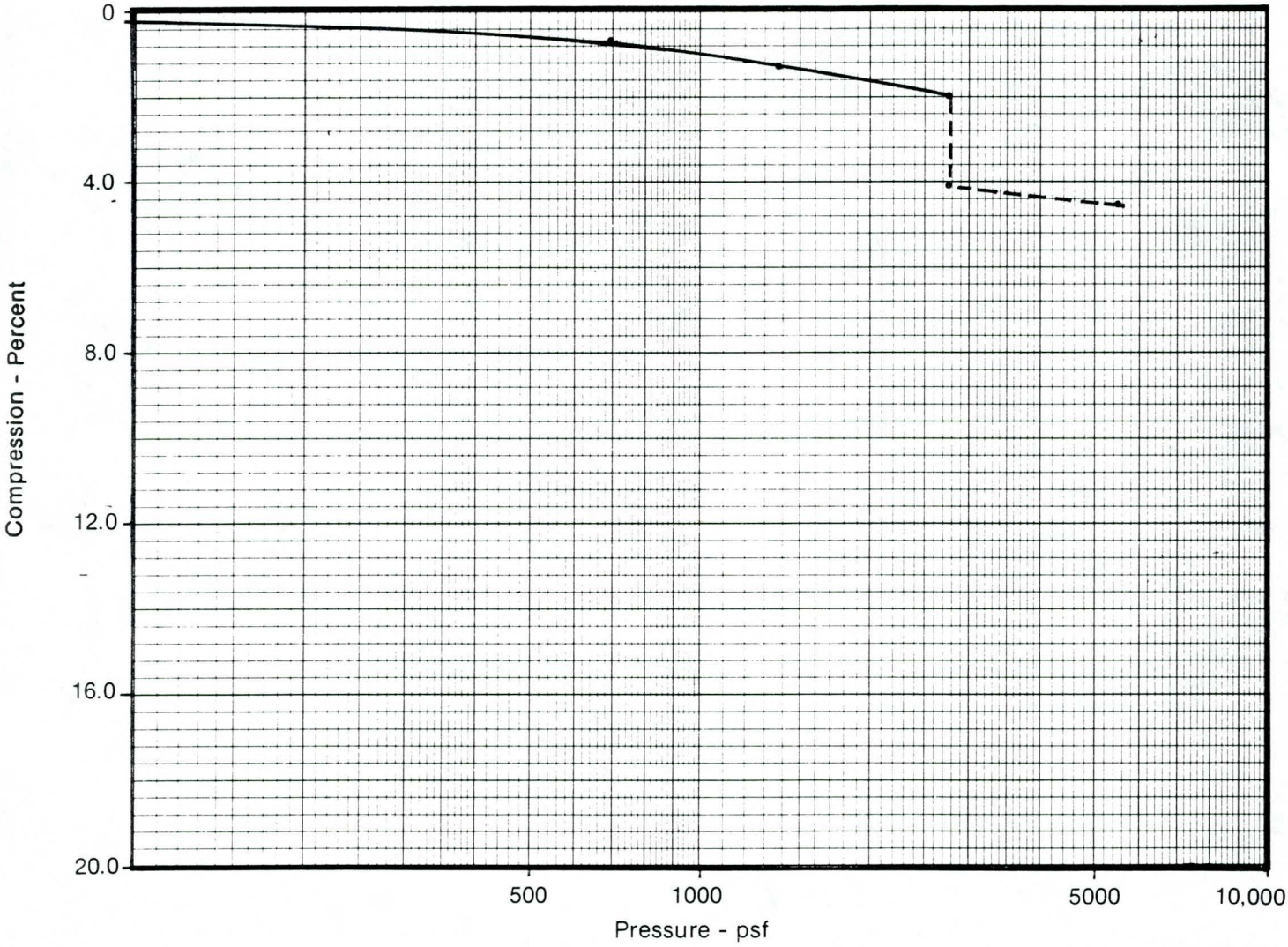
Source Test Boring 4; 19' - 20'

Type Driven Ring Sample; 120 pcf dry density; 3% field moisture

Material Silty Sand and Gravel (SM/GM) - sample somewhat disturbed

Sampled By TH/Thompson

TESTED: Compression; test sample soaked at 2770 psf



Project No. 90-0545

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON REMOLDED EXPANSION TEST

SAMPLE: Date: 7-2-90

Source: Noted Below

Type: Grab Sample

Material: Subsurface Soil

Sampled By: TH/Thompson

TESTED: Percent expansion upon soaking of remolded sample compacted to approximately 95% of the maximum ASTM D698 dry density at approximately 2% less than optimum moisture content.

TEST RESULTS

Sample	Dry Density (pcf)	Initial Moisture (Percent)	Surcharge Pressure (psf)	Expansion Upon Soaking (Percent)
1; 9' -1 0'	96	18	100	0.66
5; 14' - 16'	104	14	100	1.68

REPORT ON % PASSING NO. 200 SIEVE, PLASTICITY INDEX AND STABILOMETER "R" VALUE

SAMPLE: Date: 7-6-90

Source: Noted Below
Type: Grab Sample
Material: Surface Soil
Sampled By: TH/Thompson

TESTED: Percent Passing No. 200 Sieve, Plasticity Index, and Stabilometer "R" Value

TEST RESULTS

Sample	Percent Passing No. 200 Sieve	Plasticity Index	*R Value
A; 0' - 2'	65	15	-
B; 0' - 2'	56	7	-
C; 0' - 2'	53	7	-
D; 0' - 2'	38	20	-
E; 0' - 2'	58	14	24

*Corrected to 300 psi exudation pressure.

Project No. 90-0545
Thomas-Hartig & Associates, Inc.

REPORT ON pH, SOLUBLE SALTS & SULFATES

SAMPLE:

Date: 7-26-90

Source: Noted Below
Type: Grab Sample
Material: Subsurface Soil
Sampled By: TH/Thompson

TESTED: pH, Soluble Salts &Sulfates.

TEST RESULTS

Sample	pH	Soluble Salts (%)	Sulfates Percent
2; 12' - 14'	8.4	0.17	0.024
3; 7' - 9'	8.3	0.17	0.018

Project No. 90-0545

Thomas-Hartig & Associates, Inc.

Laboratory Consultants, Ltd.

5861 South Kyrene, Suite 15 Tempe, Arizona 85283
Telephone (602) 491-9655

SUBMITTED BY: THOMAS-HARTIG
ADDRESS: [illegible]
GROWER:
LAB NO.: 90-545
90S6798

SOIL FERTILITY REPORT

SAMPLE MARKING	1 @ 9-11	CROP	ORNAMENTAL	DATE RECEIVED	6/28/90
		YIELD GOAL	0 N/A	DATE REPORTED	7/6/90

SATURATION PERCENTAGE		SOIL pH	8.8	FREE LIME		ELECTRICAL CONDUCTIVITY mmhos/cm	1.1 L	EXCHANGEABLE SODIUM PERCENTAGE	8.9

LAB TESTS	RESULT		SUGGESTED RECOMMENDATIONS		FERTILIZATION PLAN	
ORGANIC MATTER, %	0.3					lbs/A
ORGANIC NITROGEN	ppm	lbs/A 15		SIDEDRESS		lbs/A
NITRATE - NITROGEN Depth. in. 0 - 12	ppm 5	lbs/A 18		TOPDRESS		lbs/A
				STARTER		lbs/A
				FERTIGATION		lbs/A
AVAILABLE NITROGEN	33		N	5 * lbs/A	TOTAL	lbs/A
AVAILABLE PHOSPHORUS BRAY P1, ppm			P_2O_5	lbs/A	**BROADCAST**	
AVAILABLE PHOSPHORUS BICARBONATE P, ppm	8 L			3 * lbs/A		
EXCHANGEABLE POTASSIUM, ppm	231 H		K_2O	0 * lbs/A		
SULFATE - SULFUR, ppm Depth. in. 0 - 12	100		S	0 * lbs/A		
EXCHANGEABLE MAGNESIUM, ppm	226 M		MgO	0 * lbs/A		
EXCHANGEABLE CALCIUM, ppm	3448 H					
EXCHANGEABLE SODIUM, ppm	444 H					
AVAILABLE ZINC, ppm	0.4 L		Zn	4 ** lbs/A	**STARTER**	
AVAILABLE COPPER, ppm	0.4 H		Cu	0 ** lbs/A		
AVAILABLE IRON, ppm	8.7 H		Fe	0 ** lbs/A		
AVAILABLE MANGANESE, ppm	5.7 H		Mn	0 ** lbs/A		
AVAILABLE BORON, ppm	1.2 H		B	0 ** lbs/A		
LIME REQUIREMENT			Ag - Lime (60% effectiveness)	Tons/A		
GYPSUM REQUIREMENT			Gypsum (100% basis)	Tons/A		

SOIL TEXTURE		% SAND		% SILT		% CLAY	

* = lbs. per 1000 sq. ft. ** = ozs. per 1000 sq. ft

VL = VERY LOW L = LOW M = MEDIUM H = HIGH VH = VERY HIGH

BY: Sharon Murray

PLEASE NOTE SPECIAL COMMENTS ON BACK

Laboratory Consultants, Ltd.

5861 South Kyrene, Suite 15 Tempe, Arizona 85283
Telephone (602) 491-9655

SUBMITTED BY: ADDRESS:	THOMAS-HARTIG
GROWER:	
LAB NO.:	90-545 90S6800

SOIL FERTILITY REPORT

SAMPLE MARKING	2 @ 12-14	CROP	ORNAMENTAL	DATE RECEIVED	6/28/90
		YIELD GOAL	0 N/A	DATE REPORTED	7/6/90

SATURATION PERCENTAGE		SOIL pH	8.4	FREE LIME		ELECTRICAL CONDUCTIVITY mmhos/cm	2.4 M	EXCHANGEABLE SODIUM PERCENTAGE	9.4

LAB TESTS	RESULT		SUGGESTED RECOMMENDATIONS			FERTILIZATION PLAN	
ORGANIC MATTER, %	0.2						lbs/A
ORGANIC NITROGEN	ppm	lbs/A 13		SIDEDRESS			lbs/A
				TOPDRESS			lbs/A
NITRATE - NITROGEN Depth. in. 0 - 12	ppm 36	lbs/A 130		STARTER			lbs/A
				FERTIGATION			lbs/A
AVAILABLE NITROGEN	143		N	2 *	lbs/A	TOTAL	lbs/A
AVAILABLE PHOSPHORUS BRAY P1, ppm			P_2O_5		lbs/A	**BROADCAST**	
BICARBONATE P, ppm	6 L			3 *	lbs/A		
EXCHANGEABLE POTASSIUM, ppm	261 VH		K_2O	0 *	lbs/A		
SULFATE - SULFUR, ppm Depth. in. 0 - 12	52		S	0 *	lbs/A		
EXCHANGEABLE MAGNESIUM, ppm	319 H		MgO	0 *	lbs/A		
EXCHANGEABLE CALCIUM, ppm	3585 H						
EXCHANGEABLE SODIUM, ppm	505 H						
AVAILABLE ZINC, ppm	0.3 L		Zn	4 **	lbs/A	**STARTER**	
AVAILABLE COPPER, ppm	0.6 H		Cu	0 **	lbs/A		
AVAILABLE IRON, ppm	6.8 H		Fe	0 **	lbs/A		
AVAILABLE MANGANESE, ppm	5.1 H		Mn	0 **	lbs/A		
AVAILABLE BORON, ppm	1.6 H		B	0 **	lbs/A		
LIME REQUIREMENT			Ag - Lime (60% effectiveness)		Tons/A		
GYPSUM REQUIREMENT			Gypsum (100% basis)		Tons/A		

SOIL TEXTURE		% SAND		% SILT		% CLAY	

* = lbs. per 1000 sq. ft. ** = ozs. per 1000 sq. ft

VL = VERY LOW L = LOW M = MEDIUM H = HIGH VH = VERY HIGH

BY: Sharon Murray

PLEASE NOTE SPECIAL COMMENTS ON BACK

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Telephone (602) 491-9655

SUBMITTED BY:
ADDRESS: THOMAS-HARTIG

GROWER:
LAB NO.: 90-545
90S6801

SOIL FERTILITY REPORT

SAMPLE MARKING	3 @ 7-9	CROP	ORNAMENTAL	DATE RECEIVED	6/28/90
		YIELD GOAL	0 N/A	DATE REPORTED	7/6/90

SATURATION PERCENTAGE		SOIL pH	8.3	FREE LIME		ELECTRICAL CONDUCTIVITY mmhos/cm	2.6 H	EXCHANGEABLE SODIUM PERCENTAGE	8.6

LAB TESTS	RESULT		SUGGESTED RECOMMENDATIONS			FERTILIZATION PLAN	
ORGANIC MATTER, %	0.1						lbs/A
ORGANIC NITROGEN	ppm	lbs/A				SIDEDRESS	lbs/A
		3				TOPDRESS	lbs/A
NITRATE - NITROGEN Depth. in. 0 - 12	ppm	lbs/A				STARTER	lbs/A
	37	133				FERTIGATION	lbs/A
AVAILABLE NITROGEN	136		N	2 *	lbs/A	TOTAL	lbs/A
AVAILABLE PHOSPHORUS — BRAY P1, ppm					lbs/A	**BROADCAST**	
AVAILABLE PHOSPHORUS — BICARBONATE P, ppm	5 VL		P_2O_5	5 *	lbs/A		
EXCHANGEABLE POTASSIUM, ppm	231 H		K_2O	0 *	lbs/A		
SULFATE - SULFUR, ppm Depth. in. 0 - 12	103		S	0 *	lbs/A		
EXCHANGEABLE MAGNESIUM, ppm	240 M		MgO	0 *	lbs/A		
EXCHANGEABLE CALCIUM, ppm	3748 H						
EXCHANGEABLE SODIUM, ppm	460 H						
AVAILABLE ZINC, ppm	0.3 L		Zn	4 **	lbs/A	**STARTER**	
AVAILABLE COPPER, ppm	0.5 H		Cu	0 **	lbs/A		
AVAILABLE IRON, ppm	9.1 H		Fe	0 **	lbs/A		
AVAILABLE MANGANESE, ppm	4.8 H		Mn	0 **	lbs/A		
AVAILABLE BORON, ppm	1.7 H		B	0 **	lbs/A		
LIME REQUIREMENT			Ag - Lime (60% effectiveness)		Tons/A		
GYPSUM REQUIREMENT			Gypsum (100% basis)		Tons/A		

SOIL TEXTURE		% SAND		% SILT		% CLAY	

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BY: Sharon Murray

PLEASE NOTE SPECIAL COMMENTS ON BACK

Laboratory Consultants, Ltd.

5861 South Kyrene, Suite 15 Tempe, Arizona 85283
Telephone (602) 491-9655

SUBMITTED BY: THOMAS-HARTIG
ADDRESS:

GROWER:
LAB NO.: 90-545
90S6799

SOIL FERTILITY REPORT

SAMPLE MARKING	5 @ 14-16	CROP	ORNAMENTAL	DATE RECEIVED	6/28/90
		YIELD GOAL	0 N/A	DATE REPORTED	7/6/90

SATURATION PERCENTAGE		SOIL pH	8.8	FREE LIME		ELECTRICAL CONDUCTIVITY mmhos/cm	2.2 M	EXCHANGEABLE SODIUM PERCENTAGE	11.4

LAB TESTS	RESULT		SUGGESTED RECOMMENDATIONS		FERTILIZATION PLAN	
ORGANIC MATTER, %	0.1					lbs/A
ORGANIC NITROGEN	ppm	lbs/A 5		SIDEDRESS		lbs/A
NITRATE - NITROGEN Depth. in. 0 - 12	ppm 29	lbs/A 104		TOPDRESS		lbs/A
				STARTER		lbs/A
				FERTIGATION		lbs/A
AVAILABLE NITROGEN	109		N	3 * lbs/A	TOTAL	lbs/A
AVAILABLE PHOSPHORUS BRAY P1, ppm			P_2O_5	lbs/A	**BROADCAST**	
BICARBONATE P, ppm	10 L			3 * lbs/A		
EXCHANGEABLE POTASSIUM, ppm	505 VH		K_2O	0 * lbs/A		
SULFATE - SULFUR, ppm Depth. in. 0 - 12	53		S	0 * lbs/A		
EXCHANGEABLE MAGNESIUM, ppm	322 H		MgO	0 * lbs/A		
EXCHANGEABLE CALCIUM, ppm	3409 H					
EXCHANGEABLE SODIUM, ppm	620 H					
AVAILABLE ZINC, ppm	0.5 L		Zn	4 ** lbs/A	**STARTER**	
AVAILABLE COPPER, ppm	0.6 H		Cu	0 ** lbs/A		
AVAILABLE IRON, ppm	8.5 H		Fe	0 ** lbs/A		
AVAILABLE MANGANESE, ppm	4.5 H		Mn	0 ** lbs/A		
AVAILABLE BORON, ppm	2.4 H		B	0 ** lbs/A		
LIME REQUIREMENT			Ag - Lime (60% effectiveness)	Tons/A		
GYPSUM REQUIREMENT			Gypsum (100% basis)	Tons/A		

SOIL TEXTURE		% SAND		% SILT		% CLAY	

* = lbs. per 1000 sq. ft. ** = ozs. per 1000 sq. ft.

VL = VERY LOW L = LOW M = MEDIUM H = HIGH VH = VERY HIGH

BY: Sharon Murray

PLEASE NOTE SPECIAL COMMENTS ON BACK

Laboratory Consultants, Ltd.

July 9, 1990

Thomas-Hartig & Associates
7031 West Oakland Street
Chandler, Arizona 85226

RE: Soil analysis for Project #90-545; laboratory #90-S-6798 to #90-S-6801

Based on the enclosed reports of analysis, the pH levels are normal for this area, but high enough to affect nutrient availability to plants. To lower to a more desirable range, apply 20 pounds sulfur per 1000 square feet preplant. Incorporate and water in thoroughly.

The salinity levels are high enough to cause foliar burn on established ornamentals/new seedlings and transplants. To reduce, apply a heavy irrigation to leach the excess down and out of the root zone area. Repeat 3 to 4 times.

The exchangeable sodium percentages are approaching a level high enough to cause water permeability problems and/or foliar burn. The sulfur recommended to lower the pH will also reduce the excess sodium.

The organic matter content of these soils is low. To annual beds/planters, apply 20 cubic yards per 1000 square feet nitrogen stabilized organic material to the surface and incorporate into the top 12 inches of soil. A light surface mulch (1/4-1/2 inch deep) will suffice for lawn areas. These applications are not mandatory, but will increase water and nutrient holding capacity and improve soil structure.

Of the nutrients tested, nitrogen, phosphorus, and zinc were found to be deficient. To correct, apply 2 pounds nitrogen, 3 to 5 pounds phosphorus and 1/2 pounds zinc (as sulfate) per 1000 square feet preplant. Incorporate and water in thoroughly. To maintain nitrogen levels, apply 2 pounds nitrogen per 1000 square feet in early February and June to trees and shrubs. To annuals and ground covers (other than turf), apply 1 to 1 1/2 pounds nitrogen per 1000 square feet every 4 to 6 weeks during the active growing season. To lawn areas, apply 1 pound nitrogen per 1000 square feet once per month during the active growing season. Water in applications to incorporate. Phosphorus can be split with nitrogen applications.

5861 South Kyrene, Suite 15 Tempe, Arizona 85283 Telephone (602) 491-9655

If you have any questions or I can be of further assistance, please call at your convenience.

Respectfully submitted.

Sharon Murrey

Sharon Murrey
Analyst

SM:dt