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Geotechnical Investigation Report
Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

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Scottsdale Road to Hayden Road
Scottsdale, Arizona

Submitted to:

URS Corporation
Phoenix, Arizona

Submitted by:

AMEC Earth & Environmental, Inc.
Tempe, Arizona

August 15, 2006

AMEC Project No. 5-117-001077

Registered Professional Engineer (Civil)
CERTIFICATE NO.
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ERIK H.
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Date Signed 8/15/06
ARIZONA, U.S.A.

August 15, 2006
AMEC Project No. 5-117-001077

URS Corporation
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Attn: Randall Beck, P.E.

Re: Geotechnical Investigation
Indian Bend Road – Scottsdale to Hayden
Scottsdale, Arizona
Scottsdale Project No. S0402
Chandler, Arizona

Submitted herewith are the results of a geotechnical investigation completed by AMEC Earth & Environmental, Inc. (AMEC) for the above referenced project. This report presents the results of test drilling, laboratory testing and engineering analysis. Based on the results of the field investigation and analysis, recommended criteria for site grading, foundation design and pavement design are presented.

Should you have any questions concerning the preliminary recommendations presented in this report, please do not hesitate in contacting us.

Respectfully submitted,

AMEC Earth & Environmental, Inc.

Erik H. Skulstad, P.E.
Geotechnical Engineer

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Reviewed by:

For
Lawrence A. Hansen, Ph.D., P.E.
Senior Vice President

c: Addressee (3)

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1.0 INTRODUCTION

This report presents the results of a geotechnical investigation performed by AMEC Earth & Environmental, Inc. (AMEC) of the site of the proposed realignment and improvements to Indian Bend Road between Scottsdale Road and Hayden Road in Scottsdale, Arizona. The purpose of the investigation was to examine the geotechnical profile beneath the sites of proposed project elements and to evaluate the engineering properties of the subsurface materials. This information was used to provide criteria for the design of foundations and to prepare recommendations related to site grading, excavation and other aspects of the project where soil properties or behavior should be considered.

2.0 PROJECT DESCRIPTION

Details of the project were provided by Randall Beck, P.E. of URS Corporation (URS) and from the Draft Design Concept Report for the Indian Bend Road – Scottsdale to Hayden Road Project prepared by URS. Based on information provided to AMEC it is understood that planned improvements to the alignment include construction to four-lane minor arterial standards with landscaped medians; turn lanes, bike lanes, curb and gutter; a new all-weather crossing of Indian Bend Wash; and new sidewalks. In addition, a new multi-use path is planned along the north side of Indian Bend Road to connect the Indian Bend path system to the McCormick-Stillman Railroad Park.

The existing drop structure, located along the south side of Indian Bend Road, will be relocated north of its existing location at the north right-of-way line of Indian Bend Road. The current configuration of the road allows for flow over the road during flood events. It is understood that the relocated drop structure will be sloped downstream at a 3:1 (horizontal to vertical) angle to the channel bottom. From the toe of the drop structure, a concrete apron sloped at 1 percent will extend to and abut the retaining walls associated with the roadway and concrete arch structures. The concrete apron will continue from the upstream side of the road through the arch structures, abut the retaining walls on the downstream side of the roadway and continue downstream at a slope of about 1 percent for a total distance of about 250 feet. At both ends of the upstream roadway section, the concrete lining will be sloped such that water will drain towards the middle of the channel, where the arch structures will be located.

A proposed storm drain is planned along Indian Bend Road from the west, towards Scottsdale Road. A second storm drain is planned along the east side of the McCormick-Stillman Railroad Park and will extend north and join the main storm drain in Indian Bend Road. Anticipated depths of the storm drains are 10 feet below existing site grade. The storm drains will discharge into the southwest and southeast quadrants of Indian Bend Road and Indian Bend Wash. Additionally, rehabilitation and expansion of the parking lot for the McCormick–Stillman Railroad Park are planned. Expansion of the parking lot is planned along the easternmost portion of the facility in an area currently being used for drainage.

Detailed maps indicating the existing and proposed roadway alignments, as well as proposed structural items related to the project, are provide on the site plans found in Appendix A of this report.

3.0 INVESTIGATION

3.1 Subsurface Exploration

The geotechnical investigation included twenty (20) borings advanced to depths varying between 5 and 30 feet below existing site grades. The site plans in Appendix A depict the locations of the borings. A summary of borings performed for each of the respective design elements is provided below.

Area	Boring(s)	Boring Depths (feet)
Storm Drain / Roadway	B-01 through B-07, inclusive, and B-20 and B-21	Range between 5 and 15 feet
Drop Structure	B-09, B-16, B-19	30 feet
Retaining Walls / Concrete Arch Culverts	B-08, B-10a, B-11, B-12, B-13, B-14, B-15, B-17, B-18	Range between 20 and 25 feet

All borings were advanced using a CME-75 drill rig equipped with 6 5/8-inch O.D. hollow stem auger. Standard penetration testing and open-end drive sampling were performed at selected intervals in the borings. The soils encountered during drilling were continuously examined, visually classified and logged by Karen Anglin of AMEC.

Test borings performed south of Indian Bend Road in Indian Bend Wash required coring of an existing grouted rip-rap apron extending from Indian Bend Road approximately 220 feet south within the main wash channel. Coring through and abandonment of test borings within the apron limits were performed under guidance and supervision of the Flood Control District of Maricopa County (FCDMC). Abandonment of the test borings consisted of a slurry backfill in the upper roughly 10 feet. Excess drill spoils not used for backfill were removed from the site and properly disposed of.

3.2 Laboratory Testing

The moisture content and dry density of selected soil samples were determined. Results of these tests are shown on the boring logs. Sieve analyses and Atterberg limits determinations were performed on selected samples. R-value tests were performed on bulk samples of soil collected from borings advanced within the roadway prism. The results of these tests are presented in Appendix B, along with a brief description of laboratory testing procedures.

4.0 SITE CONDITIONS AND GEOTECHNICAL PROFILE

4.1 Site Conditions

The Indian Bend Road project alignment is located between Scottsdale Road and Hayden Road in Scottsdale, Arizona. Outside Indian Bend Wash the site is predominantly flat. Commercial developments predominate the area west of Indian Bend Wash to Scottsdale Road, with some residential developments located immediately west of the wash. East of Indian Bend Wash the area is primarily residential.

Within Indian Bend Wash there is an existing golf course with two man-made lakes located immediately north of Indian Bend Road. No information regarding the lakes was obtained during our investigation. It is not known whether the lakes are lined, have drains, how they are filled, or how deep they are. Stormwater retention basins and a pedestrian path are located between the golf course and roadway. Immediately south of Indian Bend Road is the existing flood control drop structure. The drop structure is constructed of grouted rip-rap, is approximately twelve (12) feet high and slopes down to the channel bottom at about a 3:1 (horizontal:vertical) slope. At the toe of the drop structure the channel is protected with a concrete apron, which continues downstream approximately 220 feet. The thickness of the rip-rap structure, based on cores obtained at boring locations, is on the order of about 18 to 24 inches. South of the apron structure the channel is unlined and extends south to the Salt River.

4.2 Geotechnical Profile

The subsurface soils encountered at the site, to the full depths of investigation, generally consist of sandy clay and clayey sand mixtures with variable silt and gravel content. The sands are predominantly fine to medium grained, and the clay is generally low to medium in plasticity, with occasional zones of medium to high plasticity.

Soils encountered in test borings performed for roadway and storm drains (Borings B-01 through B-07, inclusive, and B-20 and B-21) were typically moderately firm to firm to the full depths of investigation and were considered to be slightly moist. In test Borings B-04 and B-07 man-made fill was evident in the upper roughly 4 feet. In Boring B-07 large fragments of asphalt, either from man-made fill or from a previous road was encountered at about 4 feet below existing site grade. No traces of asphalt were identified in any of the other borings; however, it is likely that fills will be encountered during construction. The man-made fill encountered appears to have been derived from native, on-site materials.

The soils encountered in retaining wall and concrete arch test borings (Borings B-08, B-10a through B-15, inclusive, and B-17 and B18) were typically moderately firm to very firm in the upper roughly 15 feet, with occasional soft zones in the upper roughly 5 feet, and moist. Below about 15 feet the soils were typically very firm to hard and slightly moist to moist.

The subsurface soils encountered along the proposed crest of the relocated drop structure (Borings B-09, B-16, and B-19) were typically moderately firm to firm in the upper roughly 10 feet with occasional soft zones in the upper roughly 5 to 7 seven feet. Below a depth of about 10 feet the soils increased in firmness to very firm to hard, with depth. The soils encountered in these borings, to the full depths of investigation, were considered to be moist. Increased moisture contents in the near-surface soils at these locations are likely due to the proximity of existing stormwater retention basins. Slightly elevated moisture contents at depth are likely from seepage from the adjacent golf course lakes.

4.3 Groundwater and Soil Moisture Conditions

The site soils, at the time of the investigation, were slightly moist to moist with increasing moisture contents with depth, particularly within test borings performed in the main Indian Bend Wash. The in situ soil moisture contents varied from 2 to 23 percent (of dry weight). No free groundwater was encountered in any of the borings. Based on Hammett and Hearther (1995)*, the regional groundwater table is at a depth of about 265 feet below the surface within the site area. Increased moisture contents encountered within borings along the golf course indicate that some seepage is occurring. Elevated moisture contents in the near-surface soils in this area are likely the result of stormwater retention from rainstorms that occurred within a week prior to the field investigation.

5.0 DISCUSSION AND RECOMMENDATIONS

It is understood that the proposed realigned segment of Indian Bend Road within Indian Bend Wash is planned to be elevated about 13 feet above existing site grade to be approximately level with the portions of Indian Bend Road both east and west of the wash area. The elevated roadway section will be supported on fill between retaining walls spanning the wash and include a series of concrete arch structures to accommodate flows within Indian Bend Wash. It is anticipated that during large rainfall events water will flow upstream of the roadway for some period; however, water is not anticipated to reach the proposed roadway elevation. Based on information provided by URS, it is understood that standard Arizona Department of Transportation (ADOT) cantilever retaining walls will be used.

Spread-type footings bearing at shallow depths relative to existing grade are recommended for support of retaining walls. Recommendations are presented herein for shallow spread-type footings.

Geotechnical recommendations related to the support of retaining walls, allowable bearing pressures, backfill and associated estimated settlements are presented in the following sections. Pavement design recommendations for roadway improvements also are included. In addition, recommendations for trench excavation and backfilling are provided for the proposed storm drains, as are recommendations related to site grading, excavation and other aspects of the project where soil properties or behavior should be considered.

* References are listed in Section 6.0

5.1 Shallow Foundation Design Criteria

Soils encountered along the proposed alignment of retaining walls and at concrete arch structure locations are generally moderately firm to firm in the upper roughly 10 feet with occasional soft zones. Based on in-situ dry densities and moisture contents of the supporting soils, the proposed structures can be supported with the use of spread-type footings with a relatively low degree of calculated risk. Design criteria for shallow spread-type foundations are presented in the following sections.

5.1.1 Design Criteria for Downward Loads

Allowable bearing pressures and immediate settlement estimates for spread footings bearing on native site soils were developed using the results of standard penetration tests (SPT) corrected for overburden pressure and field procedures; methods of estimating elastic settlement for rectangular, rigid footings as presented in Bowles (1982); and estimates of elastic modulus developed using correlations with SPT blow count and typical values for similar soils presented in Bowles (1982) and Kulhawy and Mayne (1990). Estimated settlement of the footings was limited to 1 inch in the computations.

Presented below are recommended uniform allowable bearing pressures as a function of the depth of the footing bottom below existing site grades for use in design of spread-type footings. Subsequent sections of this report present recommended criteria for design of spread footings.

Recommended, Uniform Allowable Bearing Pressures (Dead Plus Live Loads) For Design Of Spread Footings

Structure Location	Minimum Depth Below Existing Grade (feet)	Recommended Allowable Bearing Pressure (Dead + Live Load) (psf)
Footings on Firm Native Soils	5	3,250
Footings on Structure Backfill (minimum 5.0-foot backfill thickness)	---	3,450

It is recommended that all spread footings be founded at a depth of at least five (5.0) feet below the lowest adjacent (existing or finished) grade. The location of the resultant of pressure on the base of footings should be maintained within the middle one-third of the footing. The uniform allowable design bearing pressures presented above may be increased by up to one-third to account for wind or seismic loads. The allowable bearing pressure should account for the depth of embedment of footings; therefore, it is recommended that the weight of any soil directly above the footing, the weight of the structure and the weight of the foundation concrete be summed to calculate footing dimensions according to the recommended allowable pressure. A unit weight of 120 pounds per cubic foot (pcf) should be used to represent the structure backfill soil above the top of footings.

5.1.2 Resistance to Lateral Loads

The passive soil resistance provided by structural fill, placed and compacted in accordance with the recommendations presented in this report, against the edges of spread-type foundations, stem walls and similar vertical foundation elements should be considered as being equal to the forces exerted by a fluid of 300 pounds per cubic foot (pcf) unit weight. A coefficient of friction of 0.40 is recommended for computing the lateral resistance between the bases of foundations and the underlying soils when analyzing lateral loads.

5.1.3 Allowable Uplift Capacity

The allowable uplift capacity of spread-type foundations should be computed as the sum of the footing weight and a prism of soil overlying the footing. The prism to be considered should extend from the top outer edge of the footing to finished grade at an angle of 30 degrees from the vertical. A soil unit weight of 115 pcf is recommended when applying this computational procedure to unfactored uplift loads.

5.1.4 Estimated Settlements

The allowable bearing pressures presented herein were estimated assuming a maximum settlement of 1 inch for soil moisture contents in the existing soils at the time of test drilling. Settlement is anticipated to be immediate and should be essentially complete upon application of the initial live load.

Moisture increases in supporting soils will result in further long-term settlements. If desired, further, more detailed settlement analysis could be performed once loads and footing dimensions are determined.

5.1.5 General Design Criteria

The width of spread-type footings should be in accordance with ADOT specifications relative to wall height for standard cantilever retaining walls and the footings should be founded on relatively undisturbed, native soils or on properly compacted structural backfill.

5.2 Retaining Wall Design

It is understood that standard ADOT cantilever retaining walls will be utilized for the design of the elevated roadway structure. The following sections provide information relative to the design of retaining walls and backfill requirements.

5.2.1 Retaining Wall Backfill

Wall backfill should consist of structure backfill as outlined in Section 203 of the ADOT Standard Specifications (ADOT, 2000); thus, cohesionless backfill parameters of a friction angle of 36 degrees and moist (compacted) unit weight of 120 pcf were assumed in estimating the earth pressures.

A clean, granular, free-draining backfill is recommended to be placed immediately behind the earth-retaining structures. Backfill should meet the following grading requirements when tested in accordance with ASTM D422:

Sieve Size (square openings)	Percent Passing by Dry Weight
6-inch	100
No. 4	30 – 70
No. 200	0 - 5

Where space permits, the free-draining granular backfill should be placed in lifts no thicker than 2.0 feet and mechanically compacted. If the gradation of the fill is generally fine enough to permit testing by conventional means, the fill should be compacted to a density of at least 95 percent of maximum dry density as determined by ASTM D698.

There will be a potential for settlement of roadway fill materials between the retaining walls even if high quality backfill is used. It has been AMEC's experience that settlements on the order of 0.5 to 1.0 percent of the height of the backfill will occur should the backfill experience significant moisture increases. A measure to reduce the risk of settlement includes backfilling with a lean flowable concrete mix that achieves a 28-day compressive strength of 50 to 100 pounds per square inch (psi). This material will be relatively incompressible and can be excavated with normal construction equipment.

Drains, weep holes or other means of drainage should be provided to allow dissipation of hydrostatic buildup between retaining walls, should it occur. Drain holes should only be placed along the downstream side of the roadway. It is assumed that surface drainage of the roadway surfaces will be sufficient to collect and transport surface water and not permit ponding and penetration of runoff into the wall backfill.

5.2.2 Lateral Earth Pressures

The lateral earth pressure acting on retaining walls will depend upon the degree of restraint. Rigid, absolutely restrained walls will be subjected to "at-rest" earth pressures represented by a triangular hydrostatic load diagram of 55 psf per foot of depth for level structure backfill. Rotation or lateral translation of the walls equal to or greater than about 0.001 times the height of the wall will reduce earth pressures to the active state, represented by an equivalent fluid pressure of 35 psf per foot of depth for level backfill. The Rankine earth pressure theory is recommended for use in calculating static lateral earth pressures on retaining walls. For smooth, vertical walls and horizontal backfill, the Rankine active earth pressure can be calculated as:

where:

$$P_a = \frac{1}{2} \gamma H^2 K_a$$

P_a	=	Active Earth Pressure
H	=	Height of Wall
K_a	=	Rankine Active Earth Pressure Coefficient
K_a	=	$\tan^2\left(45 - \frac{\phi}{2}\right)$
φ	=	Angle of Internal Friction, degrees
γ	=	Unit Weight of Fill/Granular Native Soil

A friction angle of 33.25 degrees and a unit weight of 120 pounds per cubic foot are recommended for use in the equation. Earth pressure coefficients for wall configurations other than for vertical, smooth walls with level backfill can be provided upon request. The earth pressures calculated from the equation are actual and should be factored as appropriate to the design condition.

Significantly higher lateral loads on the walls will occur if the backfill materials become saturated. In order to calculate the additional loads, the following equation can be used:

$$P_a = \left(\frac{1}{2} \gamma' H^2 K_a + \frac{1}{2} \gamma_w H_w^2\right)$$

where:

H_w	=	Height of Water
γ_w	=	Unit Weight of Water
γ'	=	Effective Unit Weight ($\gamma - \gamma_w$)

5.3 Site Grading

5.3.1 Surface Preparation

All vegetation and debris should be removed from areas designated for pavements, slabs and structures. Any resulting depressions should be widened as necessary to accommodate compaction equipment and to provide a level base for placing fill. Any areas of excavation deeper than two feet should be benched to provide level areas for placement of fill.

Where spread-type footings for retaining walls are to be used, the existing soils should be excavated to a depth of 5 feet below existing grade or to the depth of proposed base of footings, whichever is deeper. During excavation for the wall footings, a representative of the geotechnical engineer should be present to observe for any loose or soft zones. If loose or soft zones are encountered, they should be removed at the discretion of the geotechnical engineer.

The lateral extent of over excavation should be equal to the depth of fill below the footing for spread footings and 2.0 feet beyond the edges of floor slabs and pavements.

The exposed surfaces upon which fill, exterior slabs or pavements are to be placed should be scarified in the upper six inches, brought to within the range of optimum to plus three percent of optimum moisture content and compacted to at least 95 percent of maximum dry density as determined by ASTM D698.

During compaction of the ground surface, a representative of the geotechnical engineer should be present to observe for any loose or soft zones. If loose or soft zones are encountered, they should be removed at the discretion of the geotechnical engineer.

5.3.2 Structural Fill

All structural fill utilized on the property should be free of vegetation, debris and other deleterious material, and should contain no particles larger than six inches in diameter. All structural fill should be compacted to within the range of optimum to three percent above the optimum moisture content and to a density of at least 95 percent of maximum dry density as determined by ASTM D698.

Structural fill derived from on-site native soils should have no more than 50 percent by weight passing the No. 200 sieve and should have a plasticity index of no more than 15 when tested in accordance with ASTM D4318. The structural fill should be free of vegetation, debris and other deleterious material, and should contain no particles larger than 6 inches in diameter. It appears that most of the on-site soils encountered in the borings will meet the above criteria. However, there are some zones of more clayey soils that will not meet these criteria; thus, blending of soils may be required.

Imported soils to be used as structural fill should be free of vegetation, debris, and other deleterious materials. These soils should contain no particles larger than 6 inches in diameter and should have a gradation that will allow the material to be placed and compacted with no significant voids or nesting.

Imported soils used as structural fill should also conform to the following gradation:

Sieve Size	Percent Passing by Weight
6-inch	100
No. 4	50-100
No. 200	40 (max)

The plasticity index when determined in accordance with ASTM D4318 should not exceed 12.

Fill material should be placed in lifts no thicker than 8 inches where heavy compaction equipment is used. Where hand operated compactors are used, lifts should not exceed 6 inches in thickness. Fill lifts should be of uniform thickness when compacted. All structural fill should be compacted to within the range of one percent below to three percent above the optimum moisture content and to a density of at least 95 percent of maximum dry density as determined by ASTM D698.

Where utility trenches or other excavations are near the foundations, it is recommended that a lean concrete mix be used as backfill to the top of the utilities. The lean concrete should have a minimum 28-day compressive strength of 1,000 psi. This requirement will apply where utility trenches are within the zone bounded by a 45-degree line downward from the outside edge of the foundation.

5.3.3 Granular Base

At least 4 inches of granular base should be placed beneath concrete slabs cast-on grade. Granular base should also be utilized beneath any surface paving. The use a of a granular base for lightly loaded structures will provide a good working surface and aid support of slabs where supporting soils experience an increase in moisture content. Granular base, where used, should meet the following gradation requirements as determined by ASTM D422:

Sieve Size (square openings)	Percent Passing by Weight
1 1/8 inch	100
1/4 inch	38-70
no. 200	0-8

The plasticity index of the fraction of material passing the no. 40 sieve should be nonplastic when tested by ASTM D4318. The coarse aggregate should have a percent of wear, when subjected to the Los Angeles abrasion test (ASTM C131), of no greater than 45. Granular base should be free of excessive vegetation, debris and other deleterious material.

5.4 Excavations and Temporary Cut Slopes

Temporary excavation slopes to depths of 5 feet should be maintained no steeper than 1:1 (horizontal to vertical). All construction loads, such as spoils piles and equipment, should be maintained a distance of at least 10.0 feet from the edge of the excavation. Cut slopes should be observed by the geotechnical engineer during excavation. Some adjustments may be necessary due to isolated wet zones, old fill, other similar conditions. Shoring will be required for vertical cuts.

The perimeter of the excavation should be protected against surface water runoff with berms at the top of the slope or other measures. Severe raveling and rilling of the slopes could occur if impacted by runoff.

It is estimated that typical earthwork equipment can be used for excavation of the site soils. The soils can be ripped for mass excavation with a Caterpillar D8 or larger bulldozer. Trenches can be excavated by typical tractor-mounted backhoes to depths of 10.0 feet, or deeper with an extension boom. Trenches at depths below 15.0 feet may require track-mounted backhoes.

5.5 Seismic Design Parameters

Based on results of our geotechnical field exploration and our understanding of the general soil and geologic conditions underlying the site, it is our opinion that Site Class C is applicable for the above referenced site, as per Table 1615.1.1 (Site Class Definitions) of the 2003 IBC.

5.6 Concrete Slabs Cast-on-Grade

5.6.1 Slab Support

Guidelines relative to site grading for slab and footing support are presented in Section 5.3. These guidelines will result in a subgrade preparation that will provide adequate support for lightly loaded slab-on-grade structures.

In areas where structures are to be constructed on new fill, some long-term settlement, however slight, is likely to occur if the fill material receives a large amount of moisture from a point source. Accordingly, it is recommended that where slabs are supported on grade over fill special construction details be utilized. Specifically, the concrete slabs should be hinged or keyed at the base where they join rigid structures in order to allow slight rotation of the slabs. These measures will reduce the likelihood that such slabs will crack or suffer noticeable separations.

5.6.2 Structural Design of Slabs

Slabs bearing on either structural fill or native soils should be designed using a modulus of subgrade reaction (k) value of 250 pounds per cubic inch.

5.6.3 Moisture Protection of Slabs

Granular base would tend to act as a capillary barrier to moisture, but would not provide a positive barrier against the rise of moisture through the slabs.

5.7 Site Drainage and Moisture Protection

Positive site drainage should be provided during construction and maintained thereafter for long-term performance of foundations. Where possible, asphaltic pavement or concrete slabs should immediately adjoin structures.

Where concrete aprons adjoin retaining walls, and at wall joints, it is recommended that waterproofing be performed with the use of epoxy or other material. Periodic maintenance and possible replacement of waterproofing should be considered in maintenance and operation for the structure.

5.8 Pavements

On-site consideration for conventional asphaltic concrete over granular base for Indian Bend Road and the McCormick – Stillman Railroad Park are provided in Sections 5.8.1. and 5.8.2 respectively. All recommended pavement sections are contingent upon a minimum thickness of 12 inches of compacted subgrade in accordance with the current "Uniform Standard Specifications for Public Works Construction" sponsored and prepared by the Maricopa Association of Governments (MAG), 2004 edition, and the current City of Scottsdale Supplements to MAG.

5.8.1 Indian Bend Road

Pavement design procedures used for roadway pavements are based on the results of R-value, grain-size, Atterberg limits test data, projected traffic volumes, the current City of Scottsdale flexible pavement design outlined in the 2004 Design Standards and Policy Manual (DSPM), and this firm's experience with similar projects.

5.8.1.1 R-Values

Bulk samples of the near-surface site soils were obtained at locations along the roadway alignment. Two samples were tested for laboratory R-values, and four samples were tested to determine the percentage of fines (fraction finer than the no. 200 sieve) and plasticity index. The results of the two laboratory-determined R-values were 21 and 28 with a mean value of 25.0 and a standard deviation of 4.5. Resultant correlated R-values, based on the ADOT Manual (ADOT, 1989) equation using plasticity index and percent passing the no. 200 sieve, resulted in a correlated R-value of 30 with a standard deviation of 12.2. A design R-value of 25.8 was used for pavement analysis.

5.8.1.2 Traffic Volumes

Traffic volume for the roadway section was based on 24-hour counts provided by URS. The data used in the determination of traffic volumes over the life of the structure are presented in the following table:

Design Parameters	Indian Bend Road
Percent Heavy Trucks (%)	4
Percent Buses (%)	2
Percent Passenger Cars (%)	94
Design Period (years)	20
Lane Distribution Factor	0.9
Average Daily Traffic (ADT), Eastbound	14,105
Annual Traffic Growth Rate (%)	2.14%
ESALs (20-year total) through 2020	3,355,000

5.8.1.3 Structural Number

A structural number (SN) for the two sections was determined using the procedure and input parameters presented in the City of Scottsdale DSPM. The structural numbers that resulted from the parameters provided in Section 5.8.2 are presented below.

Roadway Section	Structural Number
Indian Bend Road	3.9

5.8.1.4 Recommended Pavement Section

The following pavement structure achieves the required structural number for this roadway and satisfies the minimum requirements set forth in the Section 5-10 of the City of Scottsdale DSPM for flexible pavement requirements.

Pavement Section	AR (in)	AC (in)	AB (in)
Alternative 1	1	5.5	11

Lift thicknesses for the alternative pavement section are presented in the following table:

Pavement Section	Asphaltic Concrete		Aggregate Base Course	Total Thickness
	AR	AC		
Alternative 1	1" (12.5 gap-graded rubberized asphalt)	1 @ 3" (Base 25 mm Mix) 1 @ 2.5" (A-19 mm Mix)	11"	17.5"

5.8.2 McCormick-Stillman Railroad Park Parking Lot

A visual pavement condition survey was conducted for the parking area of the McCormick-Stillman Railroad Park. In general, the existing pavements are in fair condition with some isolated areas in poor condition.

Minor patching and block cracking were observed over most of the parking area. In localized areas some fatigue related distress was observed, particularly in wheel path areas coincident with areas subject to minor ponding.

Continued cracking should be expected to occur in the future. The cracking can be expected to consist of transverse, longitudinal and block cracking. However, the existing pavement life can be extended through the implementation of a maintenance program or rehabilitation.

Three alternatives are provided in the following sections. The recommendations are for pavement maintenance, rehabilitation and total reconstruction or replacement of the asphaltic pavements. The owner will need to provide input on the value of less cracked pavements versus the total pavement reconstruction costs. If the presence of cracks can be tolerated, partial milling of the asphaltic concrete section may be considered, since adequate structural capacity appears to be provided by the existing pavement sections.

5.8.2.1 Patching

In areas where fatigue related cracking is observed, the pavements should be removed, the subgrade compacted and cleared of any debris if necessary. Areas identified for patching should be defined by the engineer prior to repair, and should be accomplished in accordance with the recommendations presented in Section 5.8.2.4. If saturated or otherwise unsuitable subgrade materials are encountered, the area should be excavated to a depth of 15 inches, a geogrid should be placed at the bottom of the excavation, and the excavation should be backfilled with ABC and compacted in accordance with the recommendations provided in Section 5.3.3.

5.8.2.2 Maintenance Program

The preventative maintenance program recommended should consist of annual crack sealing, fog seals, and patching of areas exhibiting fatigue related distress.

The crack sealing should be accomplished during a cool time of the year, when the cracks are at or near their widest. Cracks greater than ¼-inch wide should be treated by cleaning and sealing. At a minimum, the sealant material should be rubberized asphalt meeting the requirements of ASTM D1190. A low modulus rubberized asphalt meeting the requirements of ASTM D 3405 is preferred.

Every other year a fog seal coat meeting the requirements of MAG (2004) specifications Sections 333 and 713 should be applied. The application rate should be evaluated at the time of application.

5.8.2.3 Pavement Rehabilitation

Either chip sealing of the asphaltic concrete pavements or a mill and overlay project to replace the existing surface pavement course is recommended for a long term method of pavement rehabilitation subsequent to patching of areas exhibiting fatigue related distress.

For chip sealing of the asphaltic concrete pavements, cracking sealing should be performed in accordance with the recommendations provided in Section 5.8.2.2. The chip seal materials quality and construction requirements are provided in Section 5.8.3. Alternatively, a tire rubber modified surface seal can be utilized.

A partial mill and overlay program can be performed on the existing pavements; however, it may result in reflection cracking from the remaining asphaltic concrete pavements. With the partial milling and overlay option, wide cracks (greater than ¼ inch) should be treated prior to constructing the overlay. At a minimum, the cracks should be cleaned out and filled with an asphalt rubber or polymer modified sealant material meeting the requirements stated in Section 5.8.2.2.

5.8.2.4 Pavement Replacement

If desired, total replacement of pavements can be performed. All recommended pavement sections are contingent upon a minimum thickness of 12 inches of compacted subgrade, and all recommended asphaltic concrete pavement sections are contingent upon the application of a seal coat to the finished surface of the asphaltic concrete within a period of one month to a year following new pavement construction. It is our experience that application of a seal coat prior to one month after placement can be detrimental to the curing of newly constructed asphaltic concrete.

The following conventional asphaltic concrete over granular base pavement structures are recommended:

Area	Asphaltic Concrete	Granular Base
Passenger Car Parking and Traffic Lanes	3 inches	6 inches
Heavy Truck Traffic and Loading Areas	3 inches	10 inches

5.8.3 Materials Quality and Construction Requirements

The materials quality and construction requirements should conform to the following sections of the current "Uniform Standard Specifications for Public Works Construction" sponsored and prepared by the Maricopa Association of Governments (MAG), 2004 edition, and the current MCDOT Supplements to MAG.

Item	**Section(s)**
Untreated Base	301 & 702.2
Asphaltic Chip Seal	330
Asphaltic Concrete (Marshall Mix Design)	321 & 710
Subgrade	301
Asphalt Rubber Asphalt Concrete	MCDOT 325

5.9 Seepage Analysis

Two simulated steady-state seepage analyses were performed through the proposed drop structure. The first simulation included an impervious cover material from the drop structure crest to the end of the concrete apron, located downstream of the realigned Indian Bend Road. The second simulation performed was of the exposed cut during construction of the drop structure, a period where no cover would be in place. Both simulations were performed assuming maximum lake water level conditions.

The two dimensional (2D) finite element computer program SEEP/W (Geoslope International, Inc., 2004) was used. SEEP/W is a finite element program that can be used to model the saturated and unsaturated flow of water within porous materials. Analyses were completed using quadrilateral and triangular elements to develop the finite element mesh, and solutions were obtained using four-point integration techniques.

A two layer soil model was developed from borehole data obtained along the proposed crest of the drop structure. A summary of parameters used for the analysis are provided in the table below.

Depth (feet)	Soil Type	Vertical Hydraulic Conductivity, K_h (cm/sec)
0 – 12	Clayey Sand (SC)	$5x10^{-5}$
12 – 30	Sandy Clay (CL)	$1x10^{-5}$

The ratio of the horizontal to vertical hydraulic conductivity (K_h/K_v) was assumed to be 10 for both layers. The hydraulic conductivity values were selected based on AMEC's experience with similar soil types.

The results of the steady state seepage analyses are provided in Appendix C. Results of the analyses indicate an estimated flux of $5.41x10^{-9}$ ft^3/sec/ft for Simulation 1 and $1.68x10^{-8}$ ft^3/sec/ft for Simulation 2. Based on the results of the analyses, it is our opinion that seepage is not a concern given the in situ soil conditions, and that uplift conditions are unlikely to occur.

5.10 Stability Analysis

Static stability analysis of a typical section for the proposed drop structure using the computer program PCSTABL6 (Purdue University, 1999). PCSTABL6 is a software product that uses limit equilibrium theory to compute the factor of safety of earth and rock slopes. The factors of safety presented herein were computed using the Modified Bishop Method of Slices, which is conservative in comparison to solutions obtained by other limit equilibrium methods.

Two alternative analyses were performed for the drop structure section. The first analysis (Alternative 1A) was performed on the downstream section and assumed a fully developed phreatic surface through the embankment. This analysis was complemented by a second analysis (Alternative 1B) for an overflow condition. The third analysis (Alternative 2) was

performed on the upstream side of the drop structure and included a full developed phreatic surface through the embankment and a rapid drawdown scenario. A summary of the analysis results and estimated parameters used for the analyses are provided in the following table. A detailed summary of parameters used for the analyses are provide in the attached output files presented in Appendix D.

Alternative	Upstream/ Downstream	Total Unit Weight (pcf)	Saturated Unit Weight (pcf)	Cohesion Intercept (psf)*	Friction Angle (deg)	Resultant Factor of Safety
1A	Downstream	116	128	500	31	5.7
1B	Downstream	116	128	500	31	5.7
2	Upstream	116	128	500	31	3.8

*A conservative value for cohesion was assumed to represent an increase in moisture contents of the native soils.

The minimum factors of safety for the most critical failure surface were determined for static conditions using the program's search features. The results of stability analyses for the slopes are presented in Appendix D. The analyses indicate that the downstream slope will be stable during construction of the drop structure and that the upstream slope will be stable in the event of a breach and rapid drawdown of lake waters.

6.0 References

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Arizona Department of Transportation Design Manual, 1989

Bowles, J.E., 1982, Foundation Analysis and Design, Third Edition, McGraw-Hill Book Co., New York, New York.

GEO-SLOPE International Ltd., "SEEP/W for finite element seepage analysis", Calgary, Alberta, Canada, 1991-1998.

Hammett, B.A. and Hearther, R.L., 1995, Maps Showing Groundwater Conditions in the Phoenix Active Management Area, Maricopa, Pinal and Yavapai Counties, Arizona – 1992, Department of Water Resources, Hydrologic Maps Series Report Number 27, Phoenix, AZ, July.

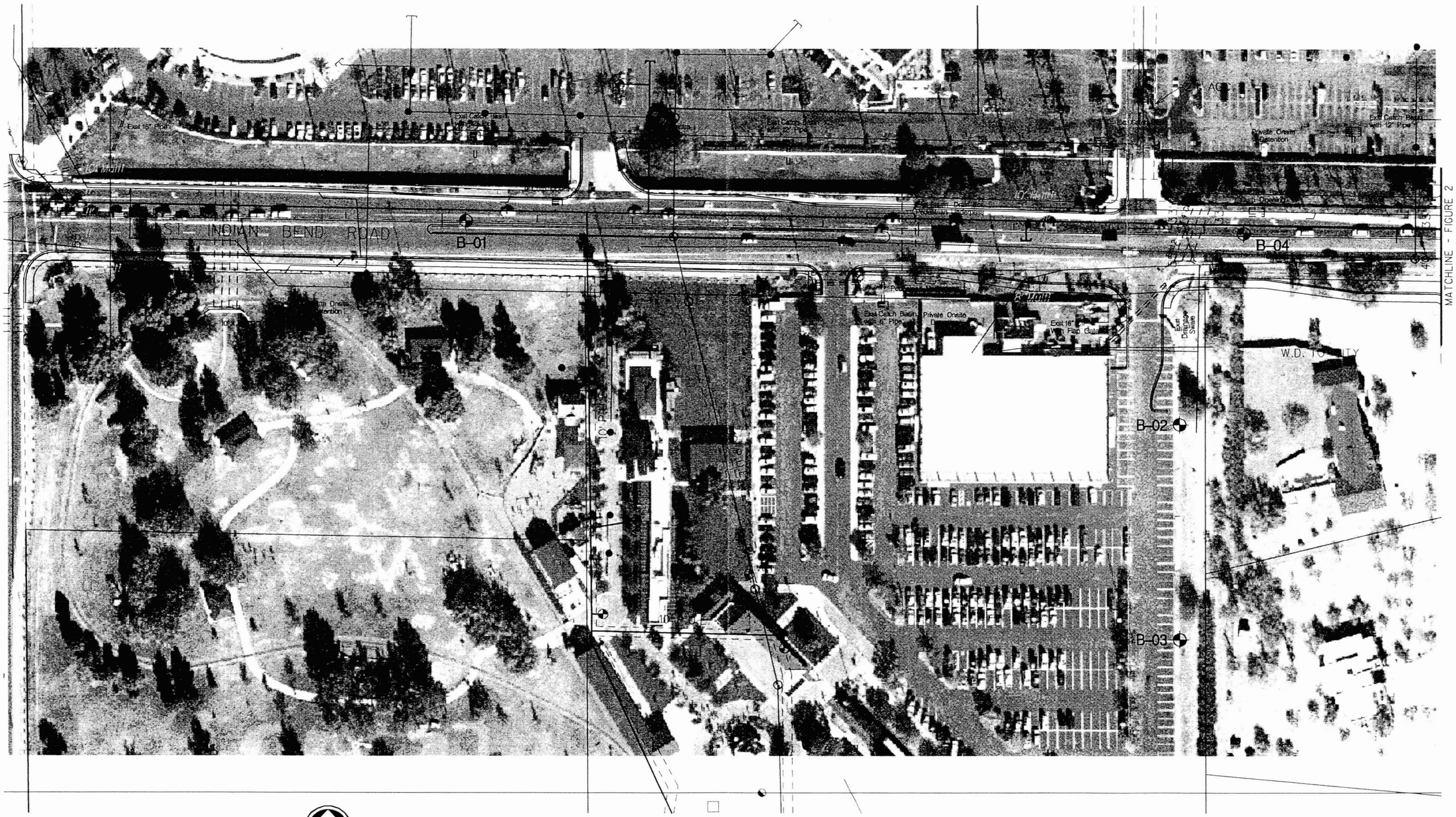
Kulhawy, F.H. and Mayne, P.W., 1990, Manual on Estimating Soil Properties for Foundation Design, Electric Power Research Institute, Palo Alto California, prepared by Geotechnical Engineering Group, Cornell University, Ithaca, New York, Final Report, Report No. EL-6800, August.

Maricopa Association of Governments (MAG), 2004, Uniform Specifications for Public Works Construction.

Purdue University, 1999, Users Manual for PCSTABL6, West Lafayette, Indiana.

APPENDIX A

FIELD INVESTIGATION



NORTH

KEY

B-01 BORING LOCATIONS

JOB NO.	5-117-001077
DESIGN:	EHS
DRAWN:	GWH
DATE:	2/2006
SCALE:	1" = 100'

SITE PLAN
SHOWING BORING LOCATIONS

INDIAN BEND WASH IMPROVEMENTS

FIGURE 1

amec

KEY

B-05 ⊕ BORING LOCATIONS

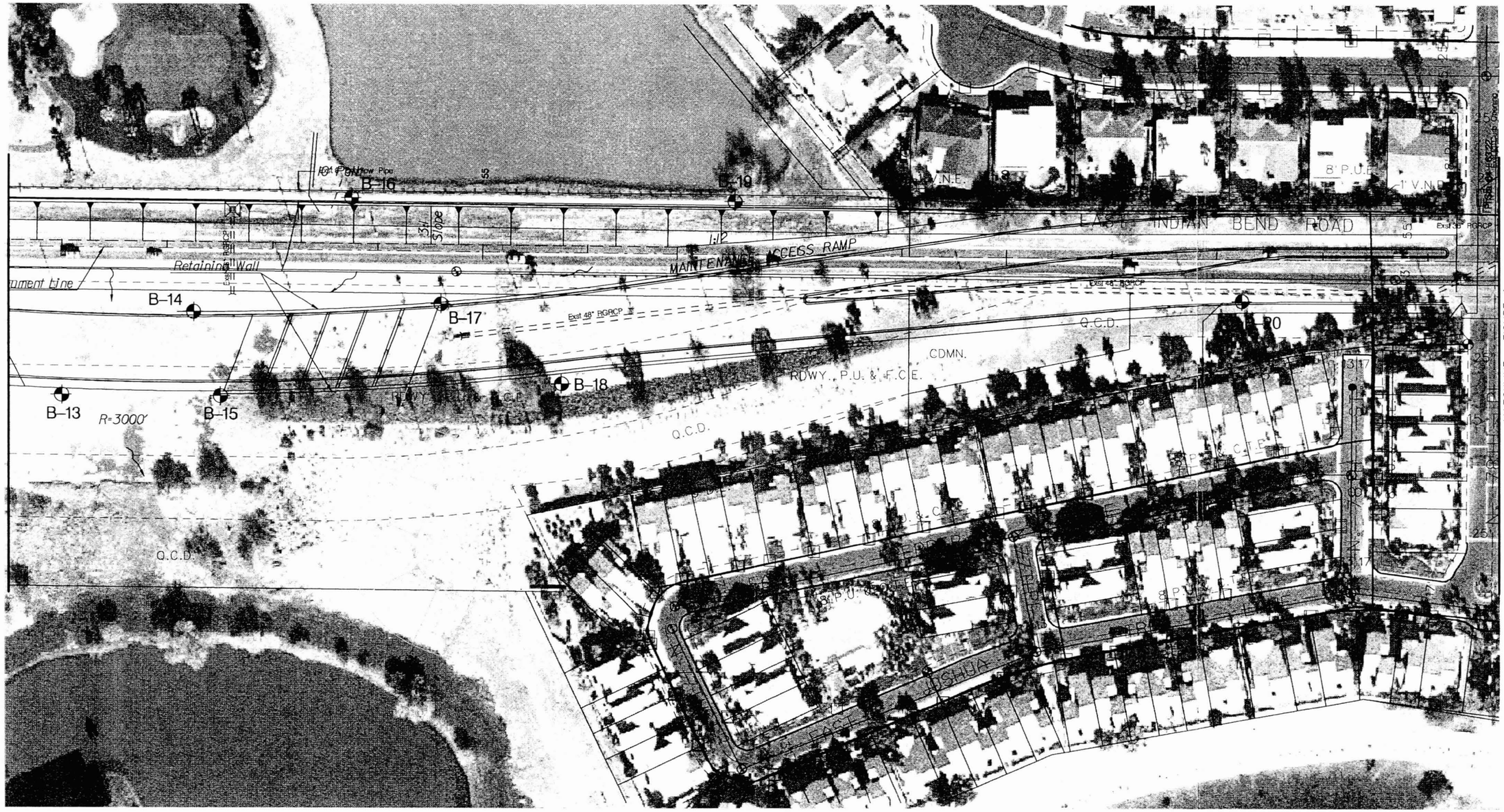
JOB NO.	5-117-001077
DESIGN:	EHS
DRAWN:	GWH
DATE:	2/2006
SCALE:	1" = 100'

SITE PLAN
SHOWING BORING LOCATIONS

INDIAN BEND WASH IMPROVEMENTS

FIGURE 2

amec



NORTH

KEY

B-13 ⊕ BORING LOCATIONS

JOB NO.	5-117-001077
DESIGN:	EHS
DRAWN:	GWH
DATE:	2/2006
SCALE:	1" = 100'

SITE PLAN
SHOWING BORING LOCATIONS

INDIAN BEND WASH IMPROVEMENTS

FIGURE 3

amec

NORTH

KEY

B-21 ⊕ BORING LOCATIONS

JOB NO.	5-117-001077	SITE PLAN SHOWING BORING LOCATIONS	
DESIGN:	EHS		
DRAWN:	GWH	INDIAN BEND WASH IMPROVEMENTS	FIGURE 4
DATE:	2/2006		
SCALE:	1" = 100'		

amec

TEST DRILLING EQUIPMENT AND PROCEDURES

Description of Subsurface Exploration Methods

Auger Boring Drilling through overburden soils is performed with 6 5/8-inch O.D., 3 1/4-inch I.D. hollow stem auger or 4 1/2-inch solid stem continuous flight auger. Carbide insert teeth are normally used on bits so they can penetrate soft rock or very strongly cemented soils. A CME-75 truck-mounted drill rig is used to advance the auger. The drill rigs are powered with six-cylinder Cummins diesel engines capable of delivering about 11.4 kN-m torque to the drill spindle. The spindle is advanced with twin hydraulic rams capable of exerting 90 kN (20,000 pounds) downward force.

Generally, refusal to penetration of the auger is adopted as top of the SGC or "river-run" material or harder bedrock, which require other techniques for penetration. Grab samples or auger cuttings may be taken as necessary. Standard penetration tests or 2.42-inch diameter ring samples are taken in conjunction with the auger borings as needed, with the sampling interval and type being indicated on the boring logs.

Hammer Drill Drilling with the Hammer drill is accomplished with a Drill Systems AP-1000 drill rig advancing a double-walled drive casing with a link-belt 180 diesel pile driving hammer, having a rated energy of 8,100 foot-pounds per blow. Where noted on the boring log, the hammer is equipped with a supercharger which can boost the energy to approximately 12,000 foot-pounds per blow. The supercharger is used only in portions of the boring where blow counts are relatively high. Cuttings are removed with compressed air by a reverse circulation process, and are collected in a cyclone from which grab samples are obtained. The drive casing is either 9-inch O.D. by 6-inch I.D. or 6 5/8-inch O.D. by 4-inch I.D. and employs an expendable bit of slightly larger diameter than the O.D. of the casing. Hammer blows required to advance the drive casing are recorded in 1-foot increments, as noted on the boring logs. Standard penetration tests or 2.42-inch diameter ring samples taken are noted on the boring logs.

Core Boring Rock core samples are retrieved using a CME-75 drill rig, SAITECH GH 3 rig or Burley 2500, 4500 or 4000. The GH 3 is a portable hydraulic core drill. The GH 3 is powered by a Kohler two-cylinder 25-horsepower engine. The hydraulics motor which feeds a two-speed transmission and powers the BW spindle. This unit has a 3-foot stroke and is hand-fed with a 2,000 pound push-pull capability. The GH 3 has the capability of drilling with either B- or N-size core steel using standard or wireline systems. N-size core is the preferred size and it has a nominal O.D. of about 2 inches. The Burley 2500 and 4500 series are portable hydraulic core drills. The 4500 series is capable of a track-mounted or skid-type chassis. The Burley 2500 and 4500 series are powered by 44 and 75 HP power units, respectively, provide up to 2,000 foot-pounds (ft.-lbs.) of torque and in excess of 1,000 revolutions per minute (RPM) of spindle speed. Both rigs are capable of retrieving either N- or H-sized core using wireline systems. The N-size core has a nominal O.D. of about 2 inches and the H-size of about 2.4 inches. The Burley 4000 is a track-mounted core drill.

The CME-75 utilizes a wireline core drilling system that takes N-size cores. Using the NQ wireline system, core is recovered quickly by retrieving the core-laden inner tube through the drill string.

TEST DRILLING EQUIPMENT AND PROCEDURES (Cont.)

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 test procedure. In many cases, 2-inch O.D., 1 3/8-inch I.D. samples are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3-inch O.D. samples lined with 2.42-inch I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140-pound, 30-inch free fall drop hammer required to advance the samples in 6-inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2- or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per 6 inches on the boring logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587), pitcher samplers, Denison samplers or continuous CME samplers. Where samples of rock are required, they are obtained by NQ diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings. Also, representative samples are obtained from the cuttings from the hammer and Schramm drill rig.

Boring Records Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares the boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487), with appropriate group symbols being shown on the boring logs.

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. **Relative Density.** Terms for description of relative density of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0-4	Very loose
5-10	Loose
11-30	Medium dense
31-50	Dense
50+	Very dense

2. **Relative Consistency.** Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16-30	Very stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

3. **Relative Firmness.** Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-50	Very firm
50+	Hard

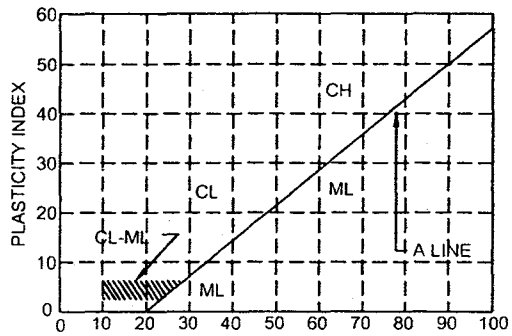
UNIFIED CLASSIFICATION SYSTEM FOR SOILS

Soils are visually classified by the United Soil Classification System on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see " The Unified Soil Classification System " ASTM Designation: D2487

MAJOR DIVISION				GRAPH SYMBOL	GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sized mixtures or sand-gravel-cobble mixture.
					GP	Poorly graded gravels, gravel-sized mixtures or sand-gravel-cobble mixture.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixture.
			Limits plot below "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixture.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot below "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS LIMITS PLOT BELOW "A" LINE & HATCH ZONE ON PLASTICITY CHART	SILTS OF LOW PLASTICITY (Liquid limit less than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid limit more than 50)			MH	Inorganic silts of high plasticity, silty soils, elastic silts.
	CLAYS LIMITS PLOT BELOW "A" LINE & HATCH ZONE ON PLASTICITY CHART	CLAYS OF LOW PLASTICITY (Liquid limit less than 50)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid limit more than 50)			CH	Inorganic clays of high plasticity, fat clays, silty and sandy clays of high plasticity.

NOTE: Coarse-grained soils with between 5 % to 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart to have dual symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Boulders	Above 300mm (12in.)
Cobbles	300mm to 75mm (12in. to 3in.)
Gravel	75mm (3in.) to No. 4 sieve
Coarse gravel	75mm to 19mm (3in to 3/4in.)
Fine gravel	19mm (3/4in.) to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/6/06

LOCATION Sta. 25+25, Centerline

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										6" Asphaltic Concrete
				S	10-7-			SC		**CLAYEY SAND WITH GRAVEL,** trace to some of coarse grained, subangular to subrounded gravel, well graded, subangular, medium to high plasticity, brown to gray
				A	7				slightly moist to moist	
				U	18	99	13		moderately firm to firm	
								SC-CL		**CLAYEY SAND TO SANDY CLAY ,** trace of coarse grained, subangular to subrounded gravel, predominantly fine grained, subangular to subrounded, medium plasticity, light brown
5				S	5-6-11				moist	
									firm	
										note: locally grading to clayey sand below about 9'
								SC		**CLAYEY SAND,** trace of silt, predominantly fine to medium grained, subangular to subrounded, medium plasticity, light brown
10				S	9-5-4		15		moist	
									moderately firm to hard	
15				S	9-9-10					
										Stopped Auger at 14'6" Stopped Sampler at 16'
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-01

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/6/06

LOCATION Sta. 32+75, 200' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										6" Asphaltic Concrete
				S	3-5-7			CL-ML		**SANDY SILTY CLAY,** predominantly fine grained, subangular to subrounded sand, low plasticity, brown
				A					slightly moist	
				U	20	104	7		moderately firm	
										note: light brown below about 4'
				S	3-4-3					
5										note: weakly lime cemented below about 5'
				U	36		4			
10										
										note: trace of coarse grained subangular to subrounded gravel below about 14'
				S	16-14-23					
15										
										Stopped Auger at 14'6" Stopped Sampler at 16'
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-02

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/5/06

LOCATION Sta. 32+75, 425' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										6" Asphaltic Concrete
				S A	1-7-6			SC	slightly moist	**CLAYEY SAND,** predominantly fine to medium grained, subangular to subrounded sand, low to medium plasticity, brown
				S	5-7-8				moderately firm	note: weakly cemented below about 4'
5				U	13	88	7	CL	slightly moist moderately firm	**SANDY CLAY,** trace of silt, fine to medium grained, subangular to subrounded, low plasticity, brown to light brown
								SC-CL	slightly moist hard	**CLAYEY SAND TO SANDY CLAY,** predominantly fine grained, subangular to subrounded, weakly cemented, medium plasticity, light brown
10				S	7-19-35					
15				S	12-23-38					
										Stopped Auger at 14'6" Stopped Sampler at 16'
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-03

amec

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/6/06

LOCATION Sta. 33+40, Centerline

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										6" Asphaltic Concrete
				S A	9-9- 11			SC-CL	slightly moist	**Man-made FILL** **CLAYEY SAND TO SANDY CLAY,** predominantly fine grained, subangular to subrounded, low to medium plasticity, brown
				S	16-9- 6		2		moderately firm to firm	note: considerable gravel between 2' & 3'6", well graded, subangular to subrounded
								CL	slightly moist	**Native** **SANDY CLAY,** fine grained, subangular to subrounded, medium plasticity, brown
5				S	3-3-2				soft	
								ML		**SANDY SILT,** trace of clay, trace of fine grained, subangular gravel, well graded, nonplastic to low plasticity, brown to light brown
10				U	23	113	5		soft moist moderately firm to firm	
15				S	3-3-6					
										Stopped Auger at 14'6' Stopped Sampler at 16'
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-04

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/6/06

LOCATION Sta. 37+40, Centerline

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										4" Asphaltic Concrete over 8" Aggregate Base Course
				A				SC	slightly moist very firm	**CLAYEY SAND,** trace to some coarse grained, subangular to subrounded gravel, predominantly fine to medium grained, subangular to subrounded, low plasticity, brown
				S	9-5-30					
								SC	slightly moist to moist moderately firm	**CLAYEY SAND,** trace silt, predominantly fine to medium grained, subangular to subrounded, weakly cemented, low plasticity, brown
5				S	11-6-3		5			
10				S	3-3-4					note: soft at 10', slight increase in moisture content
15				U	9					
										Stopped Auger at 14'6" Stopped Sampler at 15'6"
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-05

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/14/06

LOCATION Sta. 40+25, Centerline

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										4" Asphaltic Concrete over 6" Aggregate Base Course
				A				CL	slightly moist to moist firm	**Man-made Fill** **SANDY CLAY WITH GRAVEL,** trace to some coarse grained, subangular to subrounded gravel, predominantly fine grained, subangular to subrounded, low to medium plasticity, brown note: large asphalt fragments encountered at about 4'
				S	9-8-16					
								SC-CL		
5				U	52	114	11		slightly moist to moist hard	**Native** **CLAYEY SAND TO SANDY CLAY,** trace of fine grained, subangular gravel, predominantly fine to medium grained, subangular to subrounded, low to medium plasticity, brown
								SC-CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY WITH GRAVEL,** some coarse grained, subangular to subrounded gravel, predominantly fine to medium grained, subangular to subrounded, low plasticity, brown
10				S	3-4-5		6			
15				S	3-4-5		6			
										Stopped Auger at 14'6" Stopped Sampler at 16'
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▼			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-07

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/7/06

LOCATION Sta. 45+75, 100' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										Grouted Rip-Rap, 18"
				A				CL		**SANDY CLAY,** predominantly fine grained, subangular to subrounded, weakly cemented, medium plasticity, brown
				S	2-3-4				slightly moist to moist soft	
								SC-CL		**CLAYEY SAND TO SANDY CLAY,** trace of coarse grained, subangular to subrounded gravel, predominantly fine grained, subangular to subrounded, low plasticity, brown
5				S	3-3-3				moist soft to firm	
10				U	16		16			
								CL		**SANDY CLAY,** predominantly fine grained, subangular to subrounded, medium plasticity, light brown to brown
15				S	25-50/5"				slightly moist hard	
								SC-SM		**CLAYEY SAND TO SILTY SAND,** predominantly fine to medium grained, subangular to subrounded, weakly cemented, nonplastic to low plasicity, light brown to tan
20				U	100/6"	98	7		slightly moist hard	
										Stopped Auger at 24'6" Sampler refused at 25'
25				S	100/6"					

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-08

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/5/06

LOCATION Sta. 47+50, 50' L

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0				S A	2-3- 10			SC	slightly moist to moist soft	**CLAYEY SAND,** predominantly fine to medium grained, subangular to subrounded, low to medium plasticity, brown
				S	2-2-3					
								SC-CL	moist moderately firm	**CLAYEY SAND TO SANDY CLAY,** trace of coarse grained, subangular to subrounded gravel, predominantly fine grained, subangular to subrounded, low plasticity, brown to dark brown
5				U	11	98	23			
								CL	moist soft	**SANDY CLAY,** predominantly fine to medium grained, subangular to subrounded, medium plasticity, brown
10				S	1-3-5					
								SC-CL	slightly moist to moist	**CLAYEY SAND TO SANDY CLAY,** predominantly fine grained, subangular to subrounded, medium plasticity, brown
15				U	60	110	18			
								SC	slightly moist to moist hard	**CLAYEY SAND,** well graded, subangular to subrounded, weakly cemented, low plasticity, brown to gray
20				S	12-26- 26					
								CL		**SANDY CLAY**
25				U	100/10"	115	15			

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-09

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/5/06

LOCATION Sta. 47+50, 50' L

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
25								CL	slightly moist to moist hard	**SANDY CLAY,** predominantly fine grained, subangular to subrounded, low to medium plasticity, brown
30				S	28-38-50/3"					
										Stopped Auger at 29'6" Sampler refused at 30'9"
35										
40										
45										
50										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-09

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/7/06

LOCATION Sta. 47+45, 215' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										Grouted Rip-Rap, 19"
				A				CL	slightly moist to moist	**SANDY CLAY,** predominantly fine to medium grained, subangular to subrounded, weakly cemented, brown
				U	26	100	18		moderately firm to firm	
5				S	4-9-5					
								SC	slightly moist	**CLAYEY SAND,** trace of silt, well graded, subangular to subrounded, low plasticity, brown
10				S	5-7-12				firm	
								CL	slightly moist	**SANDY CLAY,** predominantly fine grained, subangular to subrounded, medium plasticity, light brown
15				U	100/4"	98	15		hard	
				S	50/3"			SC	slightly moist	**CLAYEY SAND,** trace of silt, well graded, subangular to subrounded, low plasticity, light brown
20									hard	
										Stopped Auger at 19'6" Sampler refused at 19'8"
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-10a

amec

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/7/06

LOCATION Sta. 48+50, 120' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										Grouted Rip-Rap, 19"
				A				CL		**SANDY CLAY,** trace of silt, predominantly fine grained, subangular to subrounded sand, low to medium plasticity, brown
				U	24	121	7		slightly moist to moist	
									moderately firm to firm	
5				S	3-4-7					
10				S	4-8-16					
15				U	58	103	19			note: occasional medium to coarse grained, subangular to subrounded sand below about 14'
								CL		**SANDY CLAY,** trace of medium to coarse grained, subangular to subrounded sand, predominantly fine grained, uncemented, medium to high plasticity, brown
20				S	50/6"				slightly moist hard	
										Stopped Auger at 19'6" Sampler refused at 20'
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-11

amec

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/7/06

LOCATION Sta. 49+80, 50' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										Grouted Rip-Rap, 19"
				A				CL		**SANDY CLAY,** predominantly fine grained, subangular to subrounded, low to medium plasticity, brown
				S	3-4-3				moist	
									soft to firm	note: trace of coarse grained, subangular to subrounded sand & fine grained, subangular to subrouned gravel below about 4'
5				U	26	110	17			
								CL	slightly moist to moist	**SANDY CLAY,** occasional subangular to subrounded gravel, predominantly fine to medium grained, subangular to subrounded, medium plasticity, light brown to brown
10				S	6-12-40				hard	
15				S	17-29-32		23			
								SC-CL	slightly moist	**CLAYEY SAND TO SANDY CLAY,** predominantly fine to medium grained, subangular to subrounded, medium plasticity, brown
20				S	8-8-25				very firm	
										Stopped Auger at 19'6" Stopped Sampler at 21'
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-12

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/6/06

LOCATION Sta. 51+00, 140' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										Grouted Rip-Rap, 19"
				A				CL		**SANDY CLAY,** trace of coarse grained, subangular gravel, predominantly fine grained, subangular to subrounded, medium plasticity, light brown to brown
				S	5-11-16		17		moist firm	
5				S	5-15-19					
								SC-CL	moist hard	**CLAYEY SAND TO SANDY CLAY,** predominantly fine to medium grained, subangular to subrounded, low to medium plasticity, light brown to brown
10				U	100/11"		14			
15				S	9-23-40					note: predominantly fine grained, subangular to subrounded sand below about 14'
								SC	slightly moist to moist hard	**CLAYEY SAND,** well graded, subangular to subrounded, nonplastic, brown to gray
20				U	100/7"	114	10			
										Stopped Auger at 19'6" Sampler refused at 20'7"
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-13

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/6/06

LOCATION Sta. 52+25, 60' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										Grouted Rip-Rap, 24"
				A				CL-ML	slightly moist to moist hard	**SANDY CLAY TO SANDY SILT,** predominantly fine grained, subangular to subrounded, low to medium plasticity, brown
5				U	72	115	15			
								SC	slightly moist to moist hard	**CLAYEY SAND,** predominantly fine to medium grained, subangular to subrounded, low plasticity, brown
10				S	16-23-34					
								SM	moist hard	**SILTY SAND,** trace of clay, trace of fine grained, subangular gravel, predominantly fine to medium grained, subangular to subrounded, low to medium plasticity, brown
15				U	100/11"	95	23			
										note: predominantly fine grained, subangular to subrounded sand below about 18'
20				S	17-50/5"					
										note: increase in medium grained sand, light brown below about 24'
25				S	25-50/6"					

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-14

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/6/06

LOCATION Sta. 52+25, 60' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
25			X					SM		**SILTY SAND WITH CLAY,** continued
										Stopped Auger at 24'6"
										Sampler refused at 25'6"
30										
35										
40										
45										
50										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-14

amec

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/5/06

LOCATION Sta. 52+50, 140' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										Grouted Rip-Rap, 19"
				A				SC		**CLAYEY SAND,** fine grained, occasional subangular gravel, well graded, subangular to subrounded, medium plasticity, brown to gray
				S	5-19-23		15		moist to slightly moist	
									very firm	
5				U	77	108	17			
										note: increase in fine to medium grained sand below about 7'
10				S	14-27-32					
								SC-CL		**CLAYEY SAND TO SANDY CLAY,** predominantly fine grained, subangular to subrounded, medium plasticity, light brown to brown
15				S	27-25-50/5 1/2"		16		moist hard	
20				S	12-17-26					
25				S	37-50/5"					

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-15

amec

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/5/06

LOCATION Sta. 52+50, 140' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
25										
										Stopped Auger at 24'6" Sampler refused at 25'9"
30										
35										
40										
45										
50										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-15

amec

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/5/06

LOCATION Sta. 53+75, 50' L

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0				U	34	109	6	SC-CL	slightly moist to moist	**CLAYEY SAND TO SANDY CLAY** well graded, subangular to subrounded, medium plasticity, light brown
				A						
				S	9-14-17				moderately firm to firm	
				S	3-5-5					note: light brown to brown color below about 4'
5										
								CL		**SANDY CLAY,** predominantly fine grained, subangular, medium plasticity, light brown to brown
				U	33	105	18			
10									moist	
									firm	
				S	9-10-12					
15										
								SM		**SILTY SAND,** predominantly fine to medium grained, subangular to subrounded, nonplastic, brown
				U	31	111	11		slightly moist	
20									moderately firm to firm	
					10-12-15					note: weakly cemented below about 24'
25				S						

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-16

amec

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/5/06

LOCATION Sta. 53+75, 50' L

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
25								SC		**CLAYEY SAND,** trace of silt, predominantly fine to medium grained, subangular to subrounded, low plasticity, brown
										note: predominantly fine grained sand below about 29'
				U	65	112	14			
30										
										Stopped Auger at 29'6" Sampler refused at 31'
35										
40										
45										
50										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-16

amec

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/5/06

LOCATION Sta. 54+60, 50' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										Grouted Rip-Rap, 19"
				A				SC-SM		**CLAYEY SAND TO SILTY SAND,** predominantly fine to medium grained, subangular to subrounded, low to medium plasticity, brown
				S	9-17-19		15		slightly moist to moist firm to very firm	
5				S	7-8-13					
								CL		**SANDY CLAY,** predominantly fine grained, subangular to subrounded sand, low to medium plasticity, light brown
10				U	100/10"				moist hard	
										note: increase in medium grained, subangular to subrounded sand, uncemented below about 14'
15				S	21-30-36					
20				S	42-50/3"					
										Stopped Auger at 19'6" Sampler refused at 20'3"
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▼			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-17

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/4/06

LOCATION Sta. 55+75, 125' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0				S A	6-15-28			SC	slightly moist very firm	**CLAYEY SAND,** trace of silt, predominantly fine grained, subangular to subrounded, medium plasticity, brown
				U	88	111	6	CL	slightly moist firm to hard	**SANDY CLAY,** predominantly fine grained, subangular to subrounded, low to medium plasticity, brown
5				S	5-9-6					
				S	10-20-20		7	SC	slightly moist very firm to hard	**CLAYEY SAND,** predominantly fine grained, subangular to subrounded, medium plasticity, brown
10										
15				S	15-16-34					
20										Stopped Auger at 14'6" Sampler refused at 16'
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▼			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-18

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/4/06

LOCATION Sta. 57+40, 50' L

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0				S A	3-12- 12			SC	slightly moist to moist firm	**CLAYEY SAND,** trace of silt, predominantly fine grained, subangular to subrounded, medium plasticity, brown
								SC-CL		
				U	9	109	12		slightly moist to moist moderately firm	**CLAYEY SAND TO SANDY CLAY,** predominantly fine grained, subangular to subrounded, low plasticity, light brown
5				S	3-5-6					
								SC	slightly moist to moist moderately firm	**CLAYEY SAND,** fine to medium grained, subangular to subrounded, weakly cemented, low to medium plasticity, brown
10				S	10-5- 6					
15				U	22	108	5			
								CL	slightly moist to moist hard	**SANDY CLAY,** predominantly fine grained sand, subangular to subrounded, low to medium plasticity, light brown to brown
20				S	17-35- 50/5"					
								SC		**CLAYEY SAND**
25				S	21-29- 23					

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-19

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/4/06

LOCATION Sta. 57+40, 50' L

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
25			X					SC	slightly moist to moist hard	**CLAYEY SAND,** predominantly fine to medium grained, subangular to subrounded sand, medium plasticity, brown
								CL	slightly moist to moist very firm	**SANDY CLAY,** predominantly fine grained, subangular to subrounded sand, medium plasticity, brown
30			X	S	9-14-17					
										Stopped Auger at 29'6" Sampler refused at 31'
35										
40										
45										
50										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-19

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PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/6/06

LOCATION Sta. 62+25, 40' R

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0				A				CL	slightly moist	**SANDY CLAY,** predominantly fine grained, subangular to subrounded, low to medium plasticity, brown
5										Stopped Auger at 5'
10										
15										
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-20

PROJECT Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Scottsdale, Arizona

JOB NO. 5-117-001077 **DATE** 4/6/06

LOCATION Sta. 67+00, Centerline

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM URS Basemap

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count (S) Per 6-inches (U) Per 12-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0										6" Asphaltic Concrete
				A				SC-CL	slightly moist	**CLAYEY SAND TO SANDY CLAY,** trace of fine grained, subangular to subrounded gravel, predominantly fine to medium grained, subangular to subrounded, low plasticity, brown
5										Stopped Auger at 5'
10										
15										
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 3" O.D. CME tube sample
NR - No Recovery

LOG OF TEST BORING NO. B-21

APPENDIX B

LABORATORY TEST RESULTS

LABORATORY TESTING PROCEDURES

Consolidation Tests Soiltest or Clockhouse apparatus of the "floating-ring" type are employed for the one-dimensional consolidation tests. They are designed to receive 1-inch high 2.5-inch O.D. brass liner rings with soil specimens as secured in the field. Procedures for the tests generally are those outlined in ASTM D2435. Loads are applied in several increments to the upper surface of the test specimen and the resulting deformations are recorded at selected time intervals for each increment. For soils which are essentially saturated, each increment of load is maintained until the deformation versus log of time curve indicates completion of primary consolidation. For partially saturated soils, each increment of load is maintained until the rate of deformation is equal or less than 1/10,000 inch per hour. Applied loads are such that each new increment is equal to the total previously applied loading. Porous stones are placed in contact with the top and bottom of the specimens to permit free addition or expulsion of water. For partially saturated soils, the tests are normally performed at in situ moisture conditions until consolidation is complete under stresses approximately equal to those which will be imposed by the combined overburden and foundation loads. The samples are then submerged to show the effect of moisture increase and the tests continued under higher loadings. Generally, the tests are continued to about twice the anticipated curve due to overburden and structural loads with a rebound curve then being established by releasing loads.

Expansion Tests The same type of consolidometer apparatus described above is used in expansion testing. Undisturbed samples contained in brass liner rings are placed in the consolidometers, subjected to appropriate surcharge loads and submerged. The loads are maintained until the expansion versus log of time curve indicates the completion of "primary swell".

Direct Shear Tests Direct shear tests are run using a Clockhouse or Soiltest apparatus of the strain-control of approximately 0.05 inch per minute. The machine is designed to receive one of the 1-inch high 2.42-inch diameter specimens obtained by tube sampling. Generally, each sample is sheared under a normal load equivalent to the effective overburden pressure at the point of sampling. In some instances, samples are sheared at several normal loads to obtain the cohesion and angle of internal friction. When necessary, samples are saturated and/or consolidated before shearing in order to approximate the anticipated controlling field loading conditions.

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PROJECT:	Indian Bend Wash	JOB NO:	5-117-001077
LOCATION:	Scottsdale, Arizona	WORK ORDER NO:	1
SAMPLE SOURCE:	SEE BELOW	DATE ASSIGNED:	4/7/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	Lab #

PERCENT PASSING BY WEIGHT

B-18 @ 2.0-3.0'	CL	32	12	67	78	83	85	86	89	92	93	96	97	99	100	100	100	100	100	100	100	100	44
B-19 @ 2.0-3.0'	CL	30	12	58	70	76	78	79	84	89	90	97	99	100	100	100	100	100	100	100	100	100	50
B-19 @ 14.5-15.5'	SC	37	20	20	23	27	33	40	55	69	73	91	95	99	100	100	100	100	100	100	100	100	53

AASHTO R18

REVIEWED BY Cy

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PROJECT:	Indian Bend Wash	JOB NO:	5-117-001077
LOCATION:	Scottsdale, Arizona	WORK ORDER NO:	1
SAMPLE SOURCE:	SEE BELOW	DATE ASSIGNED:	4/7/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	Lab #
PERCENT PASSING BY WEIGHT																							
B-02 @ 2.0-3.0'	CL-ML	25	7	67	86	93	94	95	97	98	99	100	100	100	100	100	100	100	100	100	100	100	2
B-03 @ 4.5-5.5'	CL	27	8	58	69	75	77	79	84	88	90	97	99	99	100	100	100	100	100	100	100	100	8
B-09 @ 4.5-5.5'	CL	37	18	89	93	95	96	97	98	99	99	99	100	100	100	100	100	100	100	100	100	100	14
B-09 @ 14.5-15.5	CL	48	27	71	83	93	95	96	98	99	99	100	100	100	100	100	100	100	100	100	100	100	16
B-09 @ 24.5-25.3'	CL	36	17	56	78	88	91	93	95	97	97	99	99	100	100	100	100	100	100	100	100	100	18
B-15 @ 4.5-5.5'	SC	49	22	44	59	68	72	75	80	83	84	89	90	91	92	96	100	100	100	100	100	100	22
B-16 @ 0.0-1.0'	SC	36	19	50	59	65	68	71	77	81	83	87	89	92	94	96	100	100	100	100	100	100	28
B-16 @ 9.5-10.5'	CL	47	28	69	81	87	90	92	96	98	99	100	100	100	100	100	100	100	100	100	100	100	31
B-16 @ 19.5-20.5'	SM	NV	NP	13	21	38	49	57	73	82	85	93	96	98	100	100	100	100	100	100	100	100	33
B-16 @ 29.5-30.5'	SC	32	11	46	62	73	79	83	89	92	93	97	98	99	100	100	100	100	100	100	100	100	35

AASHTO R18

REVIEWED BY

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PROJECT:	Indian Bend Wash	JOB NO:	5-117-001077
LOCATION:	Scottsdale, Arizona	WORK ORDER NO:	2
SAMPLE SOURCE:	SEE BELOW	DATE ASSIGNED:	4/7/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	Lab #

PERCENT PASSING BY WEIGHT

B-01 @ 2.0-3.0	SC	56	28	41	51	58	61	64	70	74	76	82	85	88	90	90	100	100	100	100	100	100	59
B-04 @ 9.5-10.5'	ML	21	1	53	72	78	80	82	86	89	90	93	94	95	96	96	100	100	100	100	100	100	67
B-05 @ 0.0-5.0'	SC	28	9	29	36	43	47	51	60	67	70	83	88	95	98	99	100	100	100	100	100	100	69
B-13 @ 9.5-10.4'	CL	37	18	56	67	73	75	78	84	89	90	96	97	99	100	100	100	100	100	100	100	100	77
B-14 @ 4.5-5.5'				50	61	68	70	72	76	79	80	82	83	84	85	87	87	87	100	100	100	100	81
B-14 @ 14.5-15.5'	SM	51	22	45	55	63	67	71	79	85	87	94	97	99	100	100	100	100	100	100	100	100	83

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PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	3
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	4/7/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	Lab #

PERCENT PASSING BY WEIGHT

B-11 @ 4.5-6.0'	CL	38	15	75	84	88	89	91	95	97	97	99	99	100	100	100	100	100	100	100	100	100	100
B-12 @ 4.5-5.5'	CL	27	11	74	86	91	92	93	95	96	96	98	99	100	100	100	100	100	100	100	100	100	106
B-20 @ 0.0-5.0'	CL	32	15	60	69	74	76	78	82	87	88	92	94	96	97	99	99	100	100	100	100	100	110

AASHTO R18

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PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	4
SAMPLE SOURCE:	SEE BELOW	**DATE SAMPLED:**	4/20/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	Lab #

PERCENT PASSING BY WEIGHT

B-7 @ 4.5-5.5'	SC	34	14	43	51	57	60	62	69	73	75	83	86	90	93	97	100	100	100	100	100	100	114

AASHTO R18

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PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	1
MATERIAL:	Soil	**LAB NO:**	SEE BELOW
SAMPLE SOURCE:	SEE BORING	**DATE ASSIGNED:**	4/7/06

DENSITY OF SOIL IN PLACE BY THE DRIVE-CYLINDER METHOD(ASTM D2937)

LAB #	BORING	MOISTURE WET WT. (g)	MOISTURE DRY WT. (g)	MOISTURE CONTENT	NUMBER OF RINGS	WET WEIGHT & RINGS (g)	WEIGHT OF RINGS (g)	DRY DENSITY (pcf)
2	B-02 @ 2.0-3.0'	427.9	400.2	6.9%	5.0	893.7	224.3	103.7
8	B-03 @ 4.5-5.5'	356.1	334.2	6.5%	3.0	473.7	134.2	88.0
14	B-09 @ 4.5-5.5'	491.2	399.6	22.9%	6.0	1,140.4	266.0	98.2
16	B-09 @ 14.5-15.5	463.0	391.9	18.1%	5.0	1,016.5	228.9	110.4
18	B-09 @ 24.5-25.3'	519.3	451.6	15.0%	5.0	1,021.8	224.8	114.8
22	B-15 @ 4.5-5.5'	473.4	405.9	16.6%	5.0	984.5	225.1	107.8
28	B-16 @ 0.0-1.0'	387.5	364.4	6.3%	4.0	760.2	199.8	109.1
31	B-16 @ 9.5-10.5'	409.0	346.5	18.0%	5.0	975.5	226.9	105.0
33	B-16 @ 19.5-20.5'	474.7	426.9	11.2%	6.0	1,160.5	268.0	110.8
35	B-16 @ 29.5-30.5'	493.7	432.1	14.3%	6.0	1,191.2	264.1	112.0
44	B-18 @ 2.0-3.0'	465.5	439.0	6.0%	6.0	1,126.3	270.5	111.4
50	B-19 @ 2.0-3.0'	397.4	356.5	11.5%	3.0	575.4	135.8	108.9
53	B-19 @ 14.5-15.5'	405.4	384.6	5.4%	5.0	914.9	227.7	108.0

REVIEWED BY

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PROJECT:	Indian Bend Wash	JOB NO:	5-117-001077
LOCATION:	Scottsdale, Arizona	WORK ORDER NO:	2
MATERIAL:	Soil	LAB NO:	SEE BELOW
SAMPLE SOURCE:	SEE BORING	DATE ASSIGNED:	4/7/06

DENSITY OF SOIL IN PLACE BY THE DRIVE-CYLINDER METHOD(ASTM D2937)

LAB #	BORING	MOISTURE WET WT. (g)	MOISTURE DRY WT. (g)	MOISTURE MOISTURE CONTENT	NUMBER OF RINGS	WET WEIGHT & RINGS (g)	WEIGHT OF RINGS (g)	DRY DENSITY (pcf)
59	B-01 @ 2.0-3.0'	412.1	365.7	12.7%	3.0	540.7	136.3	99.0
67	B-04 @ 9.5-10.5'	426.4	407.8	4.6%	5.0	931.5	221.4	112.5
79	B-13 @ 19.5-20.5'	756.2	689.4	9.7%	5.0	974.5	217.7	114.3
81	B-14 @ 4.5-5.5'	480.4	418.2	14.9%	6.0	1,224.4	268.3	114.9
83	B-14 @ 14.5-15.5'	369.4	301.1	22.7%	5.0	926.5	221.5	95.2

REVIEWED BY

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PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	3
MATERIAL:	Soil	**LAB NO:**	SEE BELOW
SAMPLE SOURCE:	SEE BORING	**DATE ASSIGNED:**	4/7/06

DENSITY OF SOIL IN PLACE BY THE DRIVE-CYLINDER METHOD(ASTM D2937)

LAB #	BORING	MOISTURE WET WT. (g)	MOISTURE DRY WT. (g)	MOISTURE MOISTURE CONTENT	NUMBER OF RINGS	WET WEIGHT & RINGS (g)	WEIGHT OF RINGS (g)	DRY DENSITY (pcf)
90	B-08 @ 19.5-20.0'	639.3	595.4	7.4%	5.0	855.0	214.9	98.7
93	B-10a @ 2.0-3.0'	810.2	689.7	17.5%	6.0	1,122.0	269.8	100.1
96	B-10a @ 14.5-15.5'	835.2	707.5	18.0%	6.0	1,102.7	266.6	97.8
99	B-11 @ 2.0-3.0'	936.6	875.3	7.0%	6.0	1,210.8	268.7	121.5
102	B-11 @ 14.5-15.0'	884.8	746.8	18.5%	6.0	1,176.5	289.0	103.4
106	B-12 @ 4.5-5.5'	458.6	391.0	17.3%	6.0	1,201.4	270.9	109.5

REVIEWED BY

amec

PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	4
MATERIAL:	Soil	**LAB NO:**	SEE BELOW
SAMPLE SOURCE:	SEE BORING	**DATE SAMPLED:**	4/20/06

DENSITY OF SOIL IN PLACE BY THE DRIVE-CYLINDER METHOD(ASTM D2937)

		MOISTURE						
LAB #	BORING	WET WT. (g)	DRY WT. (g)	MOISTURE CONTENT	NUMBER OF RINGS	WET WEIGHT & RINGS (g)	WEIGHT OF RINGS (g)	DRY DENSITY (pcf)
114	B-7 @ 4.5-5.5'	462.8	415.9	11.3%	5.0	999.8	228.3	114.8

REVIEWED BY CJ

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PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	1
MATERIAL:	See Below	**LAB NO:**	See Below
SAMPLE SOURCE:	See Below	**DATE ASSIGNED:**	4/7/06

MOISTURE CONTENT OF SOIL (ASTM D2216)

LAB #	BORING & DEPTH	WET WT. (gram)	DRY WT. (gram)	MOISTURE CONTENT
4	B-02 @ 9.5-10.5'	786.0	753.0	4.4%
21	B-15 @ 2.0-3.5'	790.3	688.2	14.8%
24	B-15 @ 14.5-16.0'	1074.5	929.2	15.6%
37	B-17 @ 2.0-3.5'	1031.0	896.1	15.1%
39	B-17 @ 9.5-10.5'	689.2	596.9	15.5%
45	B-18 @ 4.5-6.0'	673.0	633.0	6.3%
46	B-18 @ 9.5-11.0'	344.3	322.6	6.7%

AASHTO R18

REVIEWED BY

amec

PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	2
MATERIAL:	See Below	**LAB NO:**	See Below
SAMPLE SOURCE:	See Below	**DATE ASSIGNED:**	4/7/06

MOISTURE CONTENT OF SOIL (ASTM D2216)

LAB #	BORING & DEPTH	WET WT. (gram)	DRY WT. (gram)	MOISTURE CONTENT
61	B-01 @ 9.5-11.0'	244.1	211.8	15.3%
65	B-04 @ 2.0-3.5'	466.6	455.6	2.4%
71	B-05 @ 4.5-6.0'	846.1	803.2	5.3%
75	B-13 @ 2.0-3.5'	1080.8	920.7	17.4%
77	B-13 @ 9.5-10.4'	228.9	200.9	13.9%

AAR® AASHTO R18

REVIEWED BY CG

amec

PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	3
MATERIAL:	See Below	**LAB NO:**	See Below
SAMPLE SOURCE:	See Below	**DATE ASSIGNED:**	4/7/06

MOISTURE CONTENT OF SOIL (ASTM D2216)

LAB #	BORING & DEPTH	WET WT. (gram)	DRY WT. (gram)	MOISTURE CONTENT
88	B-08 @ 9.5-10.5'	737.1	633.1	16.4%
108	B-12 @ 14.5-16.0'	775.5	629.1	23.3%

AASHTO R18

REVIEWED BY

amec

PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	4
MATERIAL:	Soil	**LAB NO:**	See Below
SAMPLE SOURCE:	See Below	**DATE ASSIGNED:**	4/20/06

MOISTURE CONTENT OF SOIL (ASTM D2216)

LAB #	BORING & DEPTH	WET WT. (gram)	DRY WT. (gram)	MOISTURE CONTENT
115	B-7 @ 9.5-11.0'	433.0	408.7	6.0%
116	B-7 @ 14.5-16.0'	261.7	246.6	6.1%

AASHTO R18

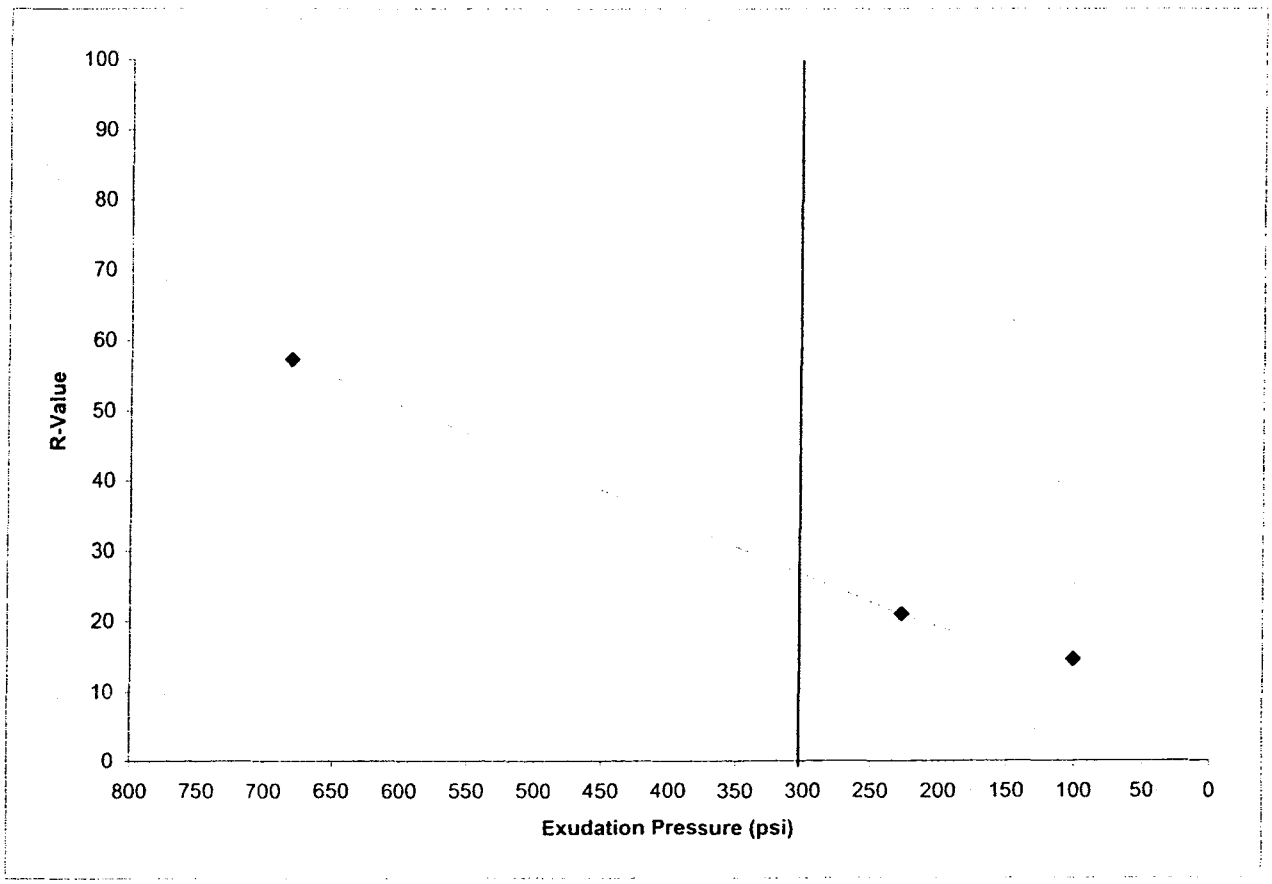
REVIEWED BY

amec

PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	2
MATERIAL:	Sandy Silt	**LAB NO:**	69
SAMPLE SOURCE:	B-05 @ 0.0-5.0	**DATE SAMPLED:**	04/07/06

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	A	B	C
Moisture Content	11.3%	10.4%	9.5%
Compaction Pressure (psi)	175	225	350
Specimen Height (inches)	2.45	2.50	2.42
Dry Density (pcf)	123.8	125.9	129.4
Horiz. Pres. @ 1000lbs (psi)	53.0	46.0	25.0
Horiz. Pres. @ 2000lbs (psi)	125.0	117.0	55.0
Displacement	4.08	3.45	3.29
Expansion Pressure (psi)	0.5	0.9	2.0
Exudation Pressure (psi)	101	228	681
R Value	15	21	57



R Value at 300 PSI = 28

AASHTO R18

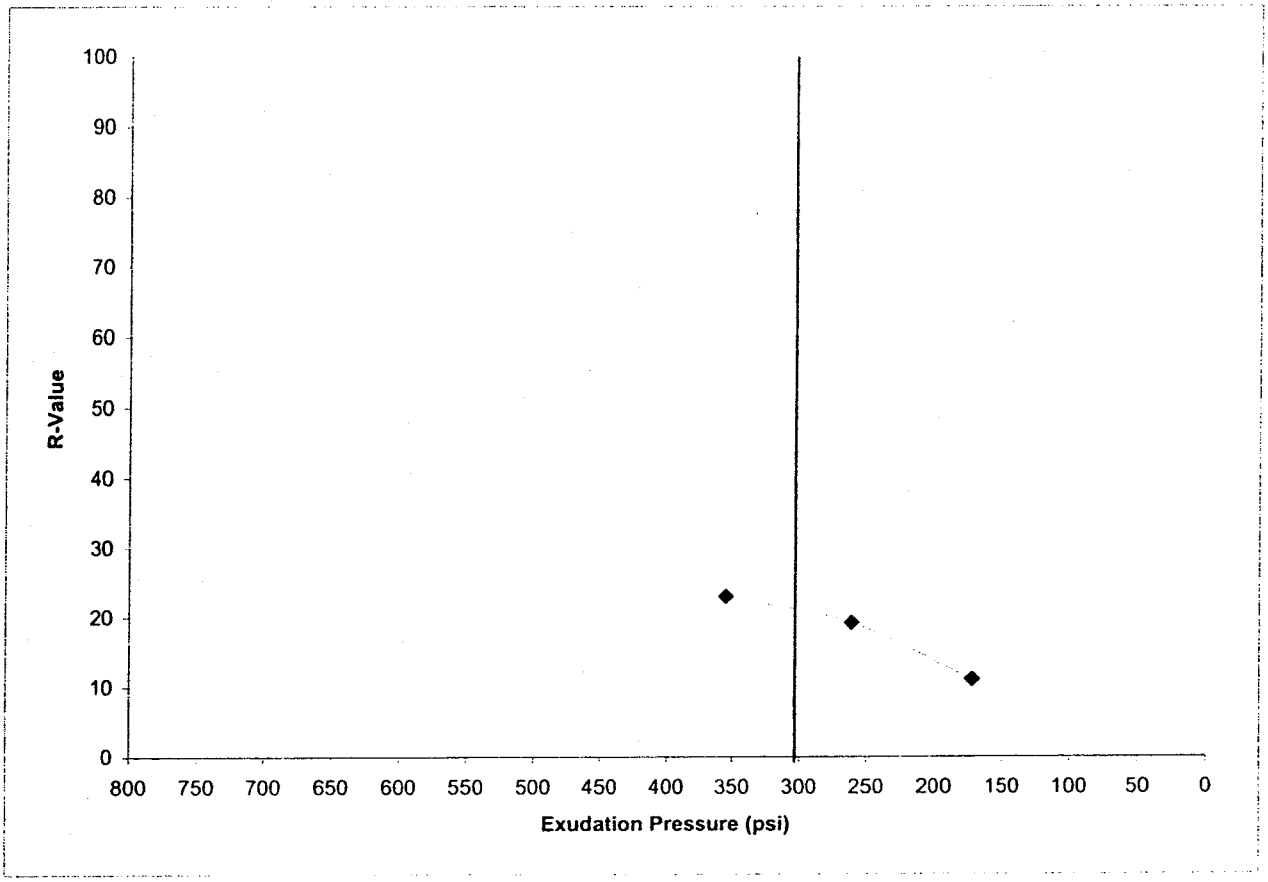
REVIEWED BY

amec

PROJECT:	Indian Bend Wash	**JOB NO:**	5-117-001077
LOCATION:	Scottsdale, Arizona	**WORK ORDER NO:**	3
MATERIAL:	Sandy Clay	**LAB NO:**	110
SAMPLE SOURCE:	B-20 @ 0.0-5.0'	**DATE SAMPLED:**	04/07/06

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	16.3%	15.4%	14.5%
Compaction Pressure (psi)	75	125	175
Specimen Height (inches)	2.55	2.50	2.50
Dry Density (pcf)	113.8	115.4	115.9
Horiz. Pres. @ 1000lbs (psi)	57.0	50.0	45.0
Horiz. Pres. @ 2000lbs (psi)	134.0	120.0	115.0
Displacement	3.90	3.50	3.27
Expansion Pressure (psi)	0.3	0.9	1.3
Exudation Pressure (psi)	172	261	355
R Value	11	19	23



R Value at 300 PSI = 21

AASHTO R18

REVIEWED BY

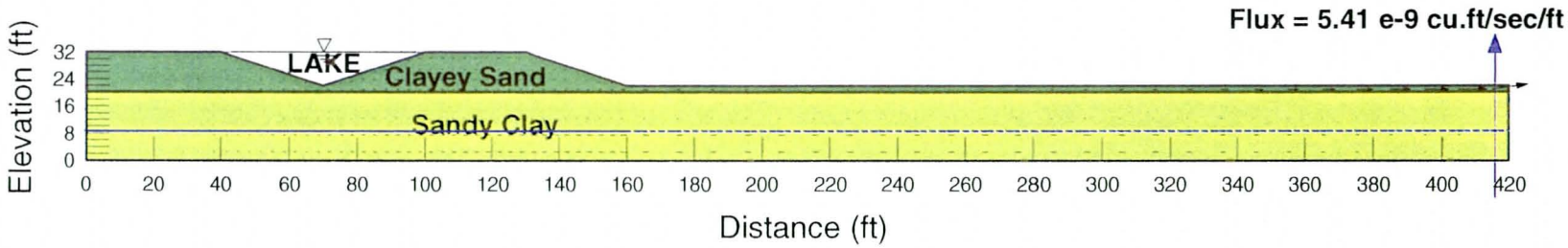
APPENDIX C

SEEPAGE ANALYSIS

Simulation -1

Indian Bend Wash
Drop Structure

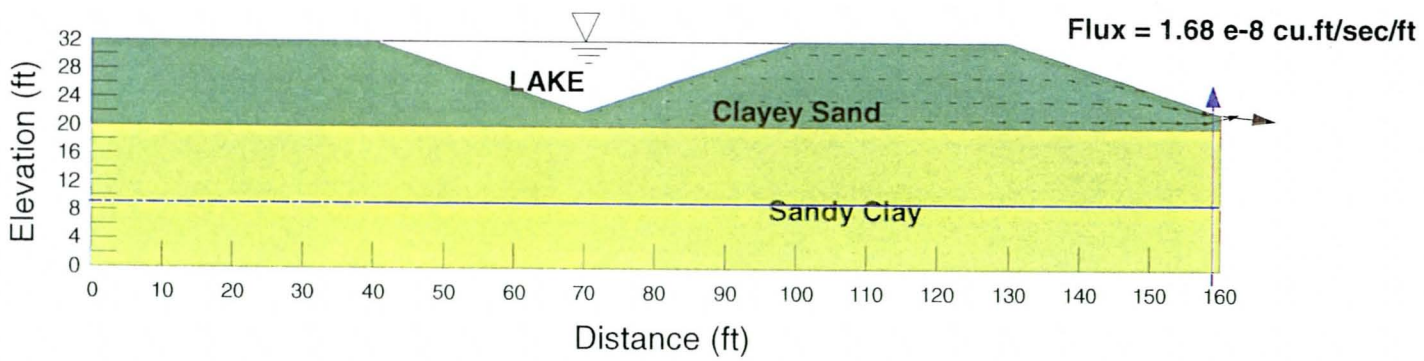
Steady State Analsis



Simulation -2

Indian Bend Wash
Drop Structure

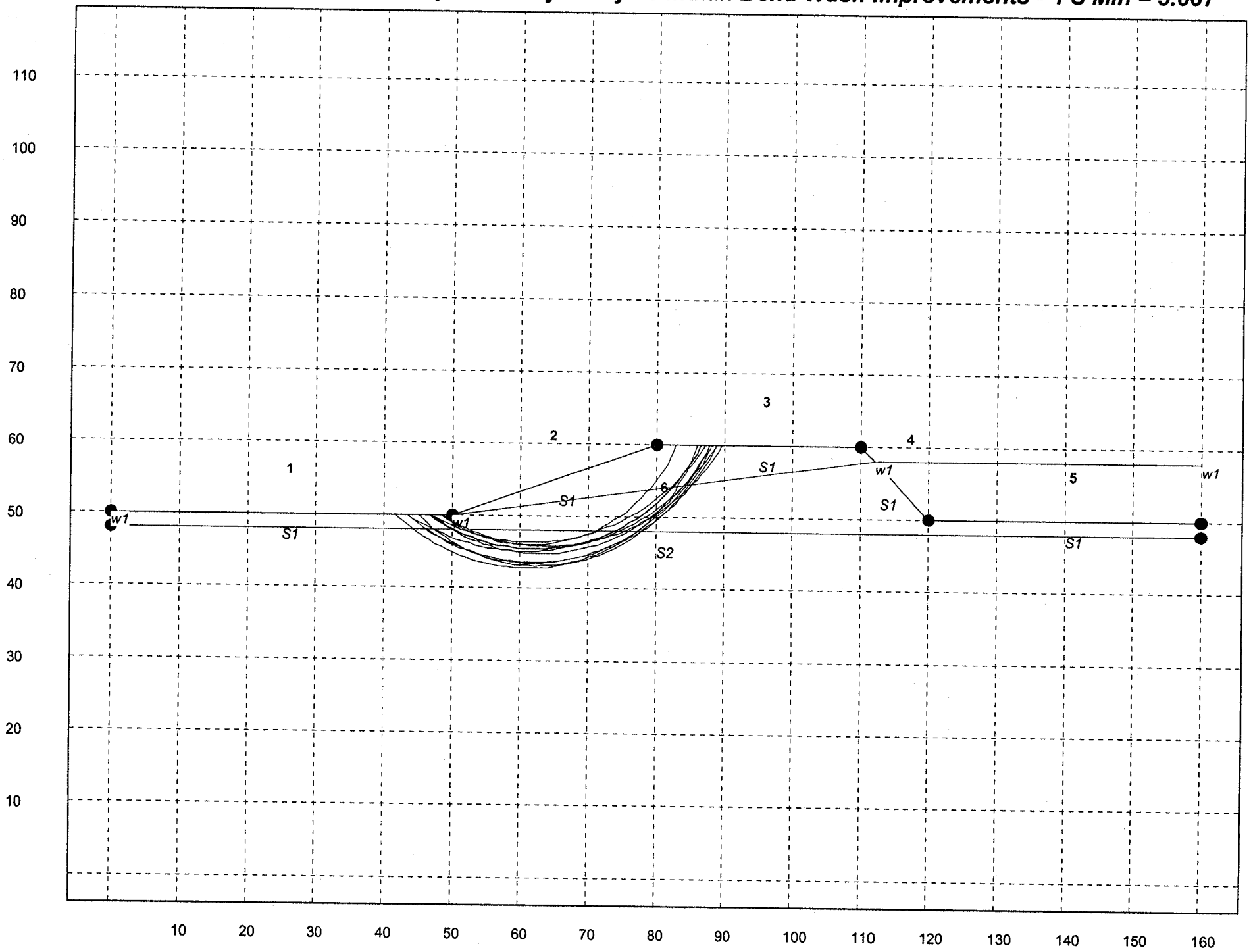
Steady State Analsis



APPENDIX D

SLOPE STABILITY ANALYSIS

Scenerio 1A: Downstream Slope Stability Analysis Indian Bend Wash Improvements - FS Min = 5.667



** PCSTABL6 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: ENGLISH
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Scenerio 1A: Downstream Slope Stability Analysis Indian Bend Wash Improvements

BOUNDARY COORDINATES

5 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	50.00	50.00	1
2	50.00	50.00	80.00	60.00	1
3	80.00	60.00	110.00	60.00	1
4	110.00	60.00	120.00	50.00	1
5	120.00	50.00	160.00	50.00	1
6	0.00	48.00	160.00	48.00	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	116.0	128.0	500.0	31.0	0.00	0.0	0
2	116.0	128.0	500.0	28.0	0.00	0.0	0

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	50.00
2	50.00	50.00
3	112.00	58.00
4	160.00	58.00

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 35.00 ft.
and X = 50.00 ft.

Each Surface Terminates Between X = 80.00 ft.
and X = 95.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.

1.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -45.0
And 5.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	50.00
2	47.51	49.47
3	48.38	48.96
4	49.26	48.49
5	50.15	48.05
6	51.07	47.64
7	51.99	47.26
8	52.93	46.92
9	53.88	46.61
10	54.85	46.34
11	55.82	46.10
12	56.79	45.89
13	57.78	45.72
14	58.77	45.59
15	59.77	45.49
16	60.76	45.42
17	61.76	45.39
18	62.76	45.40
19	63.76	45.45
20	64.76	45.52
21	65.75	45.64
22	66.74	45.79
23	67.72	45.97
24	68.70	46.20
25	69.67	46.45
26	70.62	46.74
27	71.57	47.06
28	72.50	47.42
29	73.42	47.81
30	74.33	48.23
31	75.22	48.69
32	76.09	49.18

33	76.95	49.69
34	77.79	50.24
35	78.60	50.82
36	79.40	51.42
37	80.17	52.06
38	80.92	52.72
39	81.65	53.41
40	82.35	54.12
41	83.02	54.86
42	83.67	55.62
43	84.29	56.41
44	84.88	57.21
45	85.45	58.04
46	85.98	58.88
47	86.48	59.75
48	86.62	60.00

Circle Center At X = 62.0 ; Y = 73.4 and Radius, 28.0

*** 5.667 ***

Individual data on the 52 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.8	26.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.9	78.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.9	130.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.7	146.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.2	34.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.1	24.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.8	225.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.9	328.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.9	406.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1.0	482.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1.0	555.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1.0	626.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	1.0	693.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1.0	757.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	1.0	816.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	1.0	871.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1.0	922.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1.0	967.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	1.0	1008.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1.0	1042.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1.0	1071.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1.0	1095.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1.0	1112.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1.0	1124.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1.0	1129.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1.0	1129.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1.0	1123.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.9	1111.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.9	1094.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.9	1072.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.4	468.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.5	576.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.9	1012.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.9	974.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.9	933.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.8	888.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.8	840.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.8	788.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.6	573.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.2	160.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.7	662.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.7	584.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.7	506.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.1	37.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.6	394.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.6	357.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.6	286.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

48	0.6	219.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.6	155.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.5	95.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.5	39.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.1	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	50.00
2	47.49	49.43
3	48.33	48.89
4	49.20	48.39
5	50.07	47.91
6	50.97	47.47
7	51.88	47.05
8	52.81	46.68
9	53.75	46.33
10	54.70	46.02
11	55.66	45.74
12	56.63	45.50
13	57.60	45.29
14	58.59	45.11
15	59.58	44.98
16	60.57	44.87
17	61.57	44.81
18	62.57	44.78
19	63.57	44.78
20	64.57	44.82
21	65.57	44.90
22	66.56	45.01
23	67.55	45.15
24	68.53	45.34
25	69.51	45.55
26	70.48	45.81
27	71.44	46.09
28	72.38	46.41
29	73.32	46.77
30	74.24	47.15
31	75.15	47.57
32	76.04	48.03
33	76.91	48.51
34	77.77	49.03
35	78.61	49.57
36	79.43	50.15
37	80.23	50.75
38	81.00	51.38
39	81.75	52.04
40	82.48	52.73
41	83.18	53.44
42	83.86	54.17
43	84.51	54.93
44	85.13	55.72
45	85.73	56.52
46	86.29	57.34
47	86.83	58.19
48	87.33	59.05
49	87.81	59.93
50	87.84	60.00

Circle Center At X = 62.9 ; Y = 72.7 and Radius, 28.0

*** 5.672 ***

1

Failure Surface Specified By 55 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.33	50.00

2	44.13	49.40
3	44.95	48.82
4	45.78	48.27
5	46.64	47.75
6	47.51	47.25
7	48.39	46.79
8	49.29	46.36
9	50.21	45.95
10	51.13	45.58
11	52.07	45.23
12	53.02	44.92
13	53.98	44.64
14	54.95	44.39
15	55.93	44.18
16	56.91	43.99
17	57.90	43.84
18	58.89	43.72
19	59.89	43.64
20	60.89	43.58
21	61.89	43.56
22	62.89	43.58
23	63.89	43.62
24	64.88	43.70
25	65.88	43.81
26	66.87	43.96
27	67.85	44.14
28	68.83	44.35
29	69.80	44.59
30	70.76	44.86
31	71.71	45.17
32	72.65	45.51
33	73.58	45.87
34	74.50	46.27
35	75.40	46.70
36	76.29	47.16
37	77.16	47.65
38	78.02	48.16
39	78.86	48.71
40	79.68	49.28
41	80.48	49.88
42	81.26	50.50
43	82.02	51.15
44	82.76	51.83
45	83.48	52.53
46	84.17	53.25
47	84.83	54.00
48	85.48	54.76
49	86.09	55.55
50	86.68	56.36
51	87.25	57.18
52	87.78	58.03
53	88.29	58.89
54	88.77	59.77
55	88.89	60.00

Circle Center At X = 62.0 ; Y = 73.8 and Radius, 30.2

*** 5.704 ***

Failure Surface Specified By 54 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.33	50.00
2	44.12	49.38
3	44.93	48.79
4	45.75	48.23
5	46.60	47.69
6	47.46	47.19
7	48.34	46.71
8	49.24	46.27
9	50.15	45.86
10	51.07	45.48

11	52.01	45.13
12	52.96	44.81
13	53.92	44.53
14	54.89	44.28
15	55.86	44.06
16	56.85	43.88
17	57.83	43.73
18	58.83	43.61
19	59.82	43.53
20	60.82	43.49
21	61.82	43.48
22	62.82	43.50
23	63.82	43.56
24	64.82	43.65
25	65.81	43.77
26	66.80	43.93
27	67.78	44.13
28	68.75	44.36
29	69.72	44.62
30	70.67	44.91
31	71.62	45.24
32	72.55	45.60
33	73.47	45.99
34	74.38	46.41
35	75.27	46.87
36	76.14	47.35
37	77.00	47.86
38	77.84	48.41
39	78.66	48.98
40	79.46	49.58
41	80.24	50.21
42	81.00	50.86
43	81.73	51.54
44	82.44	52.25
45	83.12	52.97
46	83.78	53.73
47	84.42	54.50
48	85.02	55.29
49	85.60	56.11
50	86.15	56.95
51	86.67	57.80
52	87.16	58.67
53	87.63	59.56
54	87.84	60.00

Circle Center At X = 61.7 ; Y = 72.5 and Radius, 29.0

*** 5.706 ***

1

Failure Surface Specified By 53 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.33	50.00
2	44.19	49.49
3	45.07	49.01
4	45.96	48.55
5	46.86	48.12
6	47.78	47.72
7	48.70	47.34
8	49.64	46.99
9	50.59	46.67
10	51.54	46.38
11	52.51	46.12
12	53.48	45.88
13	54.46	45.68
14	55.44	45.50
15	56.43	45.35
16	57.43	45.24
17	58.42	45.15
18	59.42	45.09
19	60.42	45.06

20	61.42	45.07
21	62.42	45.10
22	63.42	45.16
23	64.41	45.25
24	65.41	45.37
25	66.40	45.52
26	67.38	45.70
27	68.36	45.91
28	69.33	46.15
29	70.29	46.42
30	71.25	46.71
31	72.19	47.04
32	73.13	47.39
33	74.05	47.77
34	74.97	48.18
35	75.87	48.61
36	76.76	49.07
37	77.63	49.56
38	78.49	50.07
39	79.33	50.61
40	80.16	51.17
41	80.96	51.76
42	81.76	52.37
43	82.53	53.01
44	83.28	53.67
45	84.02	54.34
46	84.73	55.05
47	85.42	55.77
48	86.09	56.51
49	86.74	57.27
50	87.36	58.05
51	87.96	58.85
52	88.54	59.67
53	88.76	60.00

Circle Center At X = 60.9 ; Y = 78.6 and Radius, 33.5

*** 5.734 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	50.00
2	47.56	49.55
3	48.46	49.12
4	49.38	48.72
5	50.31	48.36
6	51.25	48.02
7	52.20	47.71
8	53.17	47.44
9	54.13	47.19
10	55.11	46.97
11	56.09	46.79
12	57.08	46.64
13	58.08	46.52
14	59.07	46.43
15	60.07	46.37
16	61.07	46.35
17	62.07	46.35
18	63.07	46.39
19	64.07	46.46
20	65.06	46.57
21	66.05	46.70
22	67.04	46.86
23	68.02	47.06
24	68.99	47.29
25	69.96	47.55
26	70.92	47.84
27	71.86	48.16
28	72.80	48.51
29	73.72	48.89
30	74.64	49.30

31	75.54	49.73
32	76.42	50.20
33	77.29	50.69
34	78.14	51.22
35	78.98	51.76
36	79.80	52.34
37	80.60	52.94
38	81.38	53.57
39	82.14	54.22
40	82.88	54.89
41	83.59	55.59
42	84.29	56.31
43	84.96	57.05
44	85.60	57.81
45	86.22	58.60
46	86.82	59.40
47	87.24	60.00

Circle Center At X = 61.4 ; Y = 77.7 and Radius, 31.4

*** 5.744 ***

1

Failure Surface Specified By 49 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	48.33	50.00
2	49.21	49.51
3	50.09	49.05
4	51.00	48.62
5	51.91	48.22
6	52.84	47.84
7	53.78	47.50
8	54.73	47.19
9	55.69	46.91
10	56.66	46.66
11	57.63	46.44
12	58.62	46.26
13	59.60	46.11
14	60.60	45.99
15	61.59	45.90
16	62.59	45.84
17	63.59	45.82
18	64.59	45.83
19	65.59	45.87
20	66.59	45.94
21	67.58	46.05
22	68.57	46.19
23	69.56	46.36
24	70.54	46.56
25	71.51	46.80
26	72.47	47.06
27	73.43	47.36
28	74.37	47.69
29	75.31	48.05
30	76.23	48.44
31	77.13	48.86
32	78.03	49.31
33	78.91	49.78
34	79.77	50.29
35	80.62	50.82
36	81.44	51.38
37	82.25	51.97
38	83.04	52.58
39	83.81	53.22
40	84.56	53.88
41	85.29	54.57
42	85.99	55.28
43	86.67	56.02
44	87.33	56.77
45	87.96	57.55
46	88.56	58.34

47	89.14	59.16
48	89.70	59.99
49	89.70	60.00

Circle Center At X = 63.8 ; Y = 76.5 and Radius, 30.7

*** 5.753 ***

Failure Surface Specified By 57 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	41.67	50.00
2	42.43	49.36
3	43.22	48.74
4	44.03	48.16
5	44.86	47.59
6	45.71	47.06
7	46.57	46.56
8	47.45	46.08
9	48.35	45.64
10	49.26	45.22
11	50.18	44.84
12	51.11	44.49
13	52.06	44.17
14	53.02	43.88
15	53.99	43.62
16	54.96	43.40
17	55.94	43.21
18	56.93	43.05
19	57.92	42.92
20	58.92	42.83
21	59.92	42.78
22	60.92	42.75
23	61.92	42.76
24	62.91	42.80
25	63.91	42.88
26	64.91	42.99
27	65.90	43.13
28	66.88	43.31
29	67.86	43.52
30	68.83	43.76
31	69.79	44.04
32	70.74	44.34
33	71.68	44.68
34	72.61	45.05
35	73.53	45.45
36	74.43	45.88
37	75.32	46.34
38	76.19	46.84
39	77.04	47.36
40	77.88	47.90
41	78.70	48.48
42	79.49	49.08
43	80.27	49.71
44	81.02	50.37
45	81.76	51.05
46	82.47	51.75
47	83.15	52.48
48	83.81	53.23
49	84.45	54.01
50	85.06	54.80
51	85.64	55.61
52	86.19	56.44
53	86.72	57.30
54	87.22	58.16
55	87.68	59.05
56	88.12	59.95
57	88.14	60.00

Circle Center At X = 61.1 ; Y = 72.5 and Radius, 29.8

*** 5.759 ***

1

Failure Surface Specified By 52 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.00	50.00
2	45.74	49.32
3	46.50	48.68
4	47.29	48.07
5	48.11	47.48
6	48.94	46.93
7	49.80	46.42
8	50.67	45.94
9	51.57	45.49
10	52.48	45.08
11	53.41	44.71
12	54.35	44.38
13	55.31	44.08
14	56.27	43.82
15	57.25	43.60
16	58.23	43.42
17	59.22	43.28
18	60.22	43.18
19	61.22	43.12
20	62.22	43.09
21	63.22	43.11
22	64.21	43.17
23	65.21	43.27
24	66.20	43.40
25	67.18	43.58
26	68.16	43.80
27	69.13	44.05
28	70.08	44.34
29	71.03	44.68
30	71.96	45.04
31	72.87	45.45
32	73.77	45.89
33	74.65	46.37
34	75.51	46.88
35	76.34	47.42
36	77.16	48.00
37	77.95	48.61
38	78.72	49.26
39	79.46	49.93
40	80.17	50.63
41	80.86	51.36
42	81.51	52.11
43	82.14	52.89
44	82.73	53.70
45	83.29	54.53
46	83.82	55.38
47	84.31	56.25
48	84.77	57.14
49	85.19	58.04
50	85.57	58.97
51	85.92	59.91
52	85.95	60.00

Circle Center At X = 62.3 ; Y = 68.1 and Radius, 25.0

*** 5.777 ***

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	48.33	50.00
2	49.17	49.46
3	50.04	48.95
4	50.92	48.48
5	51.82	48.05
6	52.74	47.66
7	53.68	47.30
8	54.63	46.99
9	55.59	46.72
10	56.56	46.49
11	57.54	46.30
12	58.53	46.15
13	59.53	46.05
14	60.52	45.99
15	61.52	45.97
16	62.52	45.99
17	63.52	46.06
18	64.52	46.16
19	65.50	46.32
20	66.49	46.51
21	67.46	46.74
22	68.42	47.02
23	69.37	47.34
24	70.30	47.69
25	71.22	48.09
26	72.12	48.53
27	73.00	49.00
28	73.86	49.51
29	74.70	50.06
30	75.51	50.64
31	76.30	51.26
32	77.06	51.91
33	77.79	52.59
34	78.49	53.30
35	79.16	54.04
36	79.80	54.81
37	80.41	55.61
38	80.98	56.43
39	81.51	57.27
40	82.01	58.14
41	82.47	59.03
42	82.90	59.93
43	82.92	60.00

Circle Center At X = 61.5 ; Y = 69.4 and Radius, 23.4

*** 5.792 ***

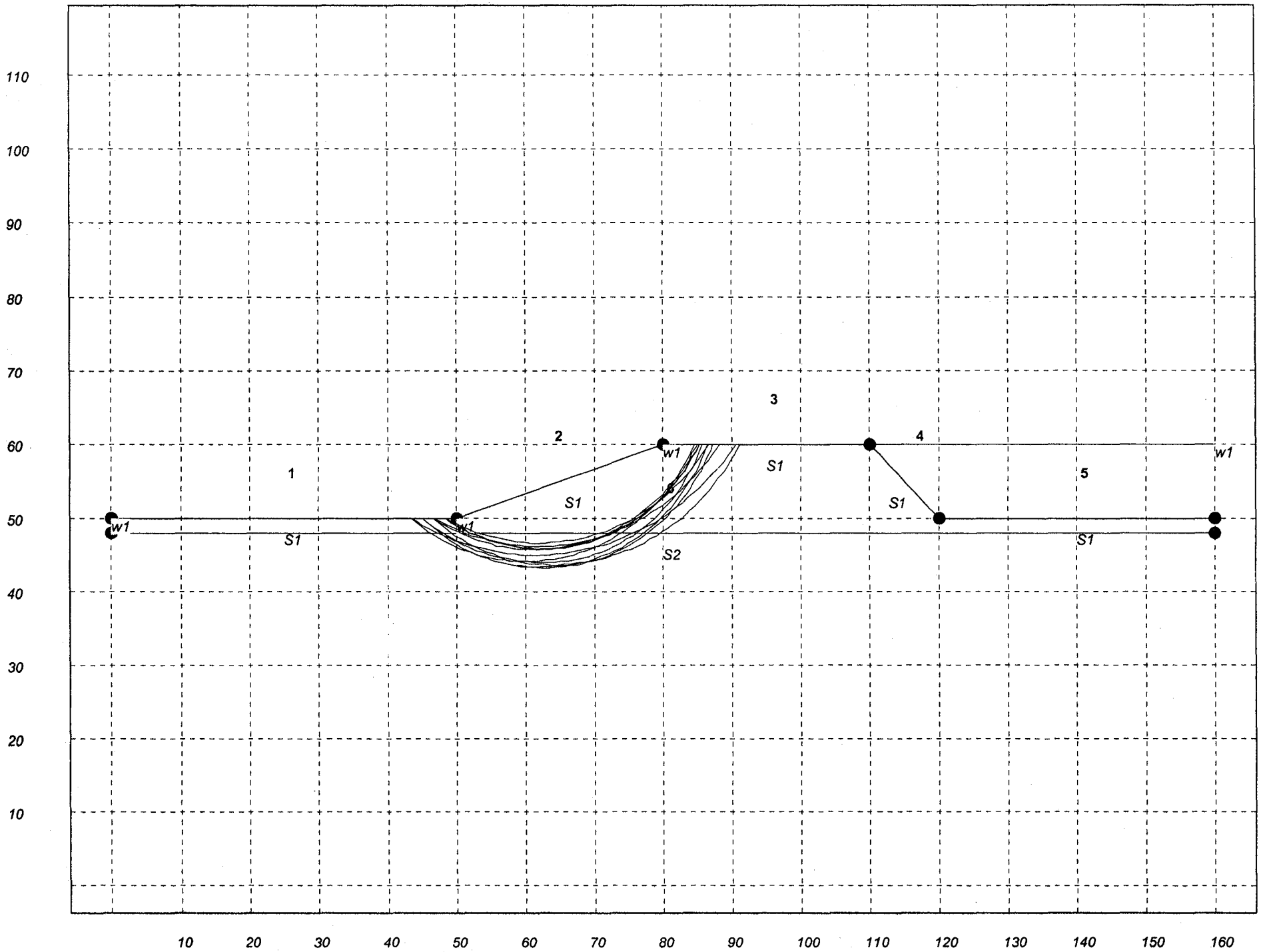
1

```
            Y            A     X     I     S            F     T

            0.00      20.00     40.00     60.00     80.00    100.00
X       0.00 +---------+---------+---**----+---------+---------+
             -
             -
             -
             -
             -
       20.00 +
             -
             -
             -
             -
             -                          ..
A      40.00 +                        ....
             -                       ...33
             -                       ..831
             -                      ..831*
             -                      ..311.
             -                      .831..
X      60.00 +                      .821...
             -                      .821...
             -                      ..216...
```

```
                -                    ..311...
                -                    ..8216...
                -                     ..3116...
I      80.00 +                         ..311100*
                -                       ...21110
                -                        ...3211
                -                         ....73
                -                           ....
                -
S     100.00 +
                -
                -
                -                                *
                -                               W
                -
      120.00 +                            *
                -
                -
                -
                -
                -
F     140.00 +
                -
                -
                -
                -
                -
T     160.00 +                           **   W
```

Scenerio 1B: Downstream Slope Stability Analysis Indian Bend Wash Improvements - FS Min = 5.699



** PCSTABL6 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: ENGLISH
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Scenerio 1B: Downstream Slope Stability Analysis Indian Bend Wash Improvements

BOUNDARY COORDINATES

5 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	50.00	50.00	1
2	50.00	50.00	80.00	60.00	1
3	80.00	60.00	110.00	60.00	1
4	110.00	60.00	120.00	50.00	1
5	120.00	50.00	160.00	50.00	1
6	0.00	48.00	160.00	48.00	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	116.0	128.0	500.0	31.0	0.00	0.0	0
2	116.0	128.0	500.0	28.0	0.00	0.0	0

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	50.00
2	50.00	50.00
3	80.00	60.00
4	160.00	60.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 35.00 ft.
and X = 50.00 ft.

Each Surface Terminates Between X = 80.00 ft.
and X = 95.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

1.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -45.0 And 5.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	48.33	50.00
2	49.18	49.47
3	50.05	48.98
4	50.94	48.52
5	51.85	48.09
6	52.77	47.70
7	53.70	47.35
8	54.65	47.03
9	55.61	46.75
10	56.58	46.51
11	57.56	46.31
12	58.55	46.14
13	59.54	46.02
14	60.53	45.93
15	61.53	45.88
16	62.53	45.87
17	63.53	45.90
18	64.53	45.96
19	65.53	46.07
20	66.51	46.21
21	67.50	46.40
22	68.47	46.62
23	69.44	46.88
24	70.39	47.17
25	71.34	47.51
26	72.27	47.88
27	73.18	48.28
28	74.08	48.72
29	74.96	49.20
30	75.82	49.71
31	76.66	50.25
32	77.48	50.82

33	78.27	51.43
34	79.04	52.07
35	79.79	52.73
36	80.51	53.43
37	81.20	54.15
38	81.86	54.90
39	82.50	55.67
40	83.10	56.47
41	83.67	57.29
42	84.21	58.13
43	84.72	58.99
44	85.19	59.88
45	85.25	60.00

Circle Center At X = 62.3 ; Y = 71.6 and Radius, 25.7

*** 5.699 ***

Individual data on the 48 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.8	26.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.8	72.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.1	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.9	146.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.9	226.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.2	66.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.7	239.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.9	385.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.9	462.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1.0	536.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1.0	607.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1.0	675.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	1.0	738.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1.0	797.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	1.0	852.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	1.0	900.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1.0	944.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1.0	981.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	1.0	1012.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1.0	1037.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1.0	1055.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1.0	1067.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1.0	1073.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1.0	1072.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1.0	1065.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.9	1051.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.9	1032.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.3	310.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.6	696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.9	976.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.9	940.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.9	899.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.8	854.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.8	805.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.8	753.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.8	698.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.7	640.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.2	174.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.5	402.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.7	498.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.7	421.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.6	346.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.6	274.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.6	206.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.5	143.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.5	84.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.5	30.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	50.00
2	47.52	49.48
3	48.39	48.99
4	49.28	48.53
5	50.19	48.11
6	51.11	47.72
7	52.04	47.36
8	52.99	47.04
9	53.95	46.75
10	54.92	46.50
11	55.89	46.29
12	56.88	46.11
13	57.87	45.97
14	58.86	45.87
15	59.86	45.80
16	60.86	45.77
17	61.86	45.77
18	62.86	45.82
19	63.85	45.90
20	64.85	46.01
21	65.84	46.17
22	66.82	46.36
23	67.79	46.59
24	68.76	46.85
25	69.71	47.15
26	70.65	47.48
27	71.58	47.85
28	72.50	48.25
29	73.40	48.68
30	74.28	49.15
31	75.15	49.65
32	75.99	50.19
33	76.82	50.75
34	77.63	51.34
35	78.41	51.97
36	79.17	52.62
37	79.90	53.30
38	80.61	54.00
39	81.29	54.73
40	81.94	55.49
41	82.57	56.27
42	83.17	57.07
43	83.73	57.90
44	84.27	58.74
45	84.77	59.61
46	84.98	60.00

Circle Center At X = 61.2 ; Y = 72.8 and Radius, 27.0

*** 5.701 ***

1

Failure Surface Specified By 52 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.00	50.00
2	45.76	49.35
3	46.54	48.73
4	47.35	48.13
5	48.17	47.57
6	49.02	47.04
7	49.89	46.54
8	50.77	46.08
9	51.68	45.65
10	52.59	45.25
11	53.53	44.89
12	54.47	44.56

13	55.43	44.27
14	56.40	44.02
15	57.37	43.80
16	58.36	43.62
17	59.35	43.48
18	60.34	43.37
19	61.34	43.30
20	62.34	43.27
21	63.34	43.28
22	64.34	43.32
23	65.33	43.41
24	66.32	43.53
25	67.31	43.68
26	68.29	43.88
27	69.27	44.11
28	70.23	44.38
29	71.18	44.68
30	72.12	45.02
31	73.05	45.40
32	73.96	45.81
33	74.86	46.26
34	75.74	46.73
35	76.59	47.24
36	77.43	47.79
37	78.25	48.36
38	79.05	48.97
39	79.82	49.60
40	80.57	50.26
41	81.29	50.95
42	81.99	51.67
43	82.66	52.41
44	83.30	53.18
45	83.91	53.97
46	84.49	54.79
47	85.04	55.62
48	85.56	56.48
49	86.04	57.35
50	86.49	58.25
51	86.91	59.16
52	87.26	60.00

Circle Center At X = 62.6 ; Y = 69.8 and Radius, 26.5

*** 5.733 ***

Failure Surface Specified By 52 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.00	50.00
2	45.76	49.35
3	46.54	48.72
4	47.34	48.13
5	48.17	47.56
6	49.02	47.03
7	49.88	46.53
8	50.77	46.07
9	51.67	45.64
10	52.59	45.25
11	53.53	44.89
12	54.47	44.57
13	55.43	44.28
14	56.40	44.04
15	57.38	43.83
16	58.36	43.65
17	59.35	43.52
18	60.35	43.42
19	61.35	43.37
20	62.35	43.35
21	63.35	43.37
22	64.34	43.43
23	65.34	43.52
24	66.33	43.66

25	67.32	43.83
26	68.29	44.04
27	69.26	44.29
28	70.22	44.58
29	71.17	44.90
30	72.10	45.26
31	73.02	45.66
32	73.92	46.09
33	74.81	46.55
34	75.67	47.05
35	76.52	47.58
36	77.35	48.15
37	78.15	48.74
38	78.93	49.37
39	79.68	50.03
40	80.41	50.71
41	81.11	51.42
42	81.79	52.16
43	82.43	52.92
44	83.05	53.71
45	83.63	54.52
46	84.18	55.36
47	84.70	56.21
48	85.19	57.09
49	85.64	57.98
50	86.06	58.89
51	86.44	59.81
52	86.51	60.00

Circle Center At X = 62.3 ; Y = 69.2 and Radius, 25.9

*** 5.737 ***

1

Failure Surface Specified By 49 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	50.00
2	47.43	49.36
3	48.23	48.75
4	49.04	48.17
5	49.88	47.63
6	50.74	47.12
7	51.63	46.65
8	52.52	46.21
9	53.44	45.81
10	54.37	45.45
11	55.32	45.13
12	56.28	44.84
13	57.25	44.60
14	58.23	44.40
15	59.22	44.23
16	60.21	44.11
17	61.20	44.03
18	62.20	43.99
19	63.20	43.99
20	64.20	44.03
21	65.20	44.11
22	66.19	44.23
23	67.18	44.39
24	68.16	44.60
25	69.13	44.84
26	70.09	45.12
27	71.03	45.44
28	71.97	45.80
29	72.88	46.20
30	73.78	46.64
31	74.67	47.11
32	75.53	47.61
33	76.37	48.16
34	77.19	48.73
35	77.98	49.34

36	78.75	49.98
37	79.49	50.66
38	80.20	51.36
39	80.88	52.09
40	81.53	52.85
41	82.16	53.63
42	82.74	54.44
43	83.30	55.27
44	83.82	56.12
45	84.30	57.00
46	84.75	57.89
47	85.16	58.80
48	85.54	59.73
49	85.63	60.00

Circle Center At X = 62.7 ; Y = 68.4 and Radius, 24.4

*** 5.738 ***

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	50.00
2	47.56	49.54
3	48.46	49.11
4	49.37	48.71
5	50.30	48.34
6	51.24	47.99
7	52.19	47.68
8	53.15	47.39
9	54.12	47.14
10	55.09	46.92
11	56.07	46.72
12	57.06	46.56
13	58.05	46.43
14	59.04	46.32
15	60.04	46.25
16	61.04	46.22
17	62.04	46.21
18	63.04	46.23
19	64.04	46.28
20	65.04	46.37
21	66.03	46.49
22	67.02	46.63
23	68.00	46.81
24	68.98	47.02
25	69.95	47.26
26	70.91	47.53
27	71.87	47.83
28	72.81	48.15
29	73.75	48.51
30	74.67	48.90
31	75.58	49.31
32	76.48	49.76
33	77.36	50.23
34	78.22	50.73
35	79.08	51.25
36	79.91	51.80
37	80.73	52.38
38	81.52	52.98
39	82.30	53.61
40	83.06	54.26
41	83.80	54.94
42	84.52	55.63
43	85.21	56.35
44	85.89	57.09
45	86.53	57.85
46	87.16	58.63
47	87.76	59.43
48	88.16	60.00

Circle Center At X = 61.8 ; Y = 78.3 and Radius, 32.1

*** 5.741 ***

1

Failure Surface Specified By 55 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.00	50.00
2	45.81	49.41
3	46.63	48.84
4	47.48	48.31
5	48.34	47.80
6	49.21	47.31
7	50.10	46.86
8	51.01	46.43
9	51.93	46.04
10	52.86	45.67
11	53.80	45.34
12	54.75	45.03
13	55.71	44.75
14	56.68	44.51
15	57.66	44.30
16	58.64	44.12
17	59.63	43.97
18	60.62	43.85
19	61.62	43.76
20	62.62	43.71
21	63.62	43.69
22	64.62	43.70
23	65.62	43.74
24	66.61	43.81
25	67.61	43.92
26	68.60	44.06
27	69.58	44.23
28	70.56	44.43
29	71.54	44.66
30	72.50	44.92
31	73.46	45.22
32	74.40	45.54
33	75.34	45.90
34	76.26	46.28
35	77.17	46.70
36	78.07	47.14
37	78.95	47.61
38	79.81	48.11
39	80.66	48.64
40	81.50	49.20
41	82.31	49.78
42	83.10	50.38
43	83.88	51.02
44	84.63	51.67
45	85.37	52.35
46	86.08	53.06
47	86.76	53.78
48	87.43	54.53
49	88.07	55.30
50	88.68	56.09
51	89.27	56.90
52	89.83	57.72
53	90.37	58.57
54	90.88	59.43
55	91.19	60.00

Circle Center At X = 63.8 ; Y = 74.8 and Radius, 31.2

*** 5.747 ***

Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	48.33	50.00
2	49.23	49.55
3	50.14	49.14
4	51.06	48.76
5	52.00	48.40
6	52.95	48.08
7	53.90	47.79
8	54.87	47.54
9	55.84	47.31
10	56.83	47.12
11	57.81	46.97
12	58.81	46.84
13	59.80	46.75
14	60.80	46.70
15	61.80	46.67
16	62.80	46.69
17	63.80	46.73
18	64.80	46.81
19	65.79	46.92
20	66.78	47.07
21	67.76	47.25
22	68.74	47.46
23	69.71	47.70
24	70.67	47.98
25	71.62	48.29
26	72.56	48.63
27	73.49	49.01
28	74.40	49.41
29	75.30	49.85
30	76.19	50.31
31	77.06	50.81
32	77.91	51.33
33	78.74	51.88
34	79.56	52.46
35	80.35	53.07
36	81.13	53.70
37	81.88	54.36
38	82.61	55.05
39	83.31	55.76
40	83.99	56.49
41	84.65	57.24
42	85.28	58.02
43	85.88	58.82
44	86.46	59.63
45	86.70	60.00

Circle Center At X = 62.0 ; Y = 76.3 and Radius, 29.6

*** 5.750 ***

1

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.33	50.00
2	44.13	49.39
3	44.94	48.81
4	45.78	48.27
5	46.64	47.75
6	47.51	47.27
7	48.41	46.82
8	49.32	46.40
9	50.24	46.02
10	51.18	45.67
11	52.13	45.36
12	53.09	45.08
13	54.06	44.84

14	55.04	44.64
15	56.02	44.47
16	57.01	44.34
17	58.01	44.24
18	59.01	44.19
19	60.01	44.17
20	61.01	44.18
21	62.01	44.24
22	63.00	44.33
23	63.99	44.46
24	64.98	44.62
25	65.96	44.83
26	66.93	45.06
27	67.89	45.34
28	68.84	45.65
29	69.78	46.00
30	70.71	46.38
31	71.62	46.79
32	72.51	47.24
33	73.39	47.72
34	74.24	48.23
35	75.08	48.78
36	75.90	49.35
37	76.70	49.96
38	77.47	50.59
39	78.22	51.26
40	78.94	51.95
41	79.64	52.67
42	80.31	53.41
43	80.95	54.18
44	81.56	54.97
45	82.14	55.78
46	82.69	56.61
47	83.21	57.47
48	83.70	58.34
49	84.16	59.23
50	84.51	60.00

Circle Center At X = 60.0 ; Y = 71.0 and Radius, 26.8

*** 5.764 ***

Failure Surface Specified By 55 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.33	50.00
2	44.20	49.50
3	45.08	49.03
4	45.98	48.58
5	46.88	48.16
6	47.80	47.77
7	48.73	47.40
8	49.67	47.05
9	50.62	46.73
10	51.58	46.44
11	52.54	46.18
12	53.51	45.94
13	54.49	45.73
14	55.47	45.55
15	56.46	45.39
16	57.45	45.26
17	58.45	45.17
18	59.44	45.09
19	60.44	45.05
20	61.44	45.03
21	62.44	45.05
22	63.44	45.09
23	64.44	45.15
24	65.44	45.25
25	66.43	45.37
26	67.42	45.52
27	68.40	45.70

28	69.38	45.91
29	70.35	46.14
30	71.32	46.40
31	72.27	46.69
32	73.22	47.01
33	74.16	47.35
34	75.09	47.71
35	76.01	48.11
36	76.92	48.52
37	77.82	48.97
38	78.70	49.44
39	79.57	49.93
40	80.43	50.45
41	81.27	50.99
42	82.09	51.55
43	82.90	52.14
44	83.70	52.75
45	84.47	53.38
46	85.23	54.03
47	85.97	54.71
48	86.69	55.40
49	87.39	56.12
50	88.07	56.85
51	88.73	57.60
52	89.36	58.37
53	89.98	59.16
54	90.57	59.96
55	90.60	60.00

Circle Center At X = 61.5 ; Y = 80.8 and Radius, 35.7

*** 5.772 ***

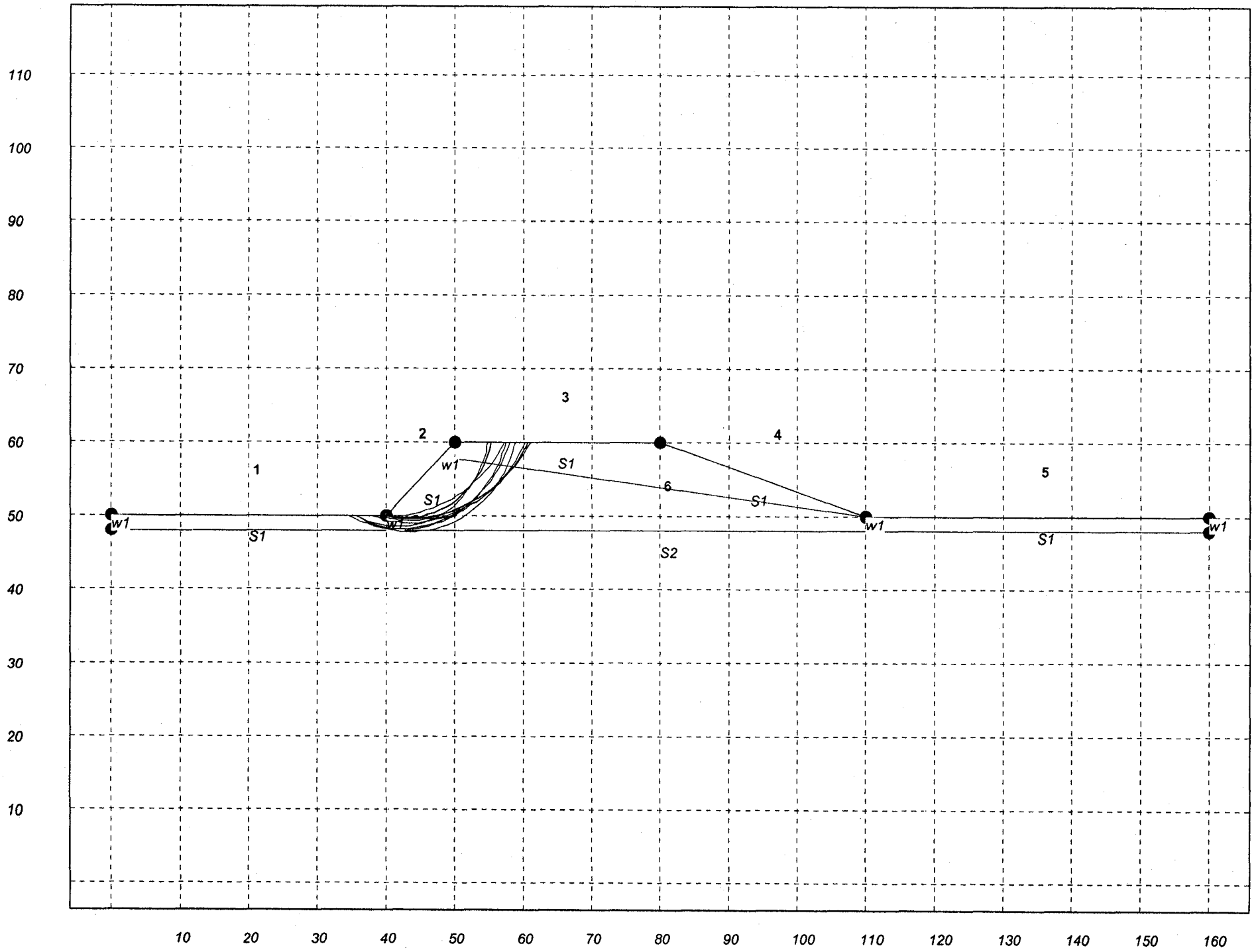
1

```
              Y            A     X     I     S            F     T

              0.00      20.00     40.00     60.00     80.00    100.00
X       0.00 +---------+---------+---**----+---------+---------+
             -
             -
             -
             -
             -
       20.00 +
             -
             -
             -
             -
             -
A      40.00 +                       ..
             -                      ....
             -                     ...99
             -                     ...32
             -                    ...31*
             -                    ..321.
             -                    ..318.
X      60.00 +                    ..31...
             -                    ..31...
             -                    ..318..
             -                    ..311...
             -                    ..7311..
             -                     ..3311...
I      80.00 +                      ..3311..*
             -                      ..731112
             -                       ..77331
             -                        ...777
             -                          ....
             -
S     100.00 +
             -
             -
             -                            *
             -
             -
```

```
        120.00 +                    *
               -
               -
               -
               -
               -
F       140.00 +
               -
               -
               -
               -
               -
T       160.00 +                    **    W
```

Scenerio 2: Upstream Slope Stability Analysis Indian Bend Wash Improvements - FS Min = 3.818



** PCSTABL6 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: ENGLISH
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Scenerio 2: Upstream Slope Stability Ana
lysis Indian Bend Wash Improvements

BOUNDARY COORDINATES

5 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.00	40.00	50.00	1
2	40.00	50.00	50.00	60.00	1
3	50.00	60.00	80.00	60.00	1
4	80.00	60.00	110.00	50.00	1
5	110.00	50.00	160.00	50.00	1
6	0.00	48.00	160.00	48.00	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	116.0	128.0	500.0	31.0	0.00	0.0	0
2	116.0	128.0	500.0	28.0	0.00	0.0	0

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	50.00
2	40.00	50.00
3	48.00	58.00
4	110.00	50.00
5	160.00	50.00

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 30.00 ft.
and X = 40.00 ft.

Each Surface Terminates Between X = 50.00 ft.
and X = 65.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.

1.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -45.0
And 5.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.00	50.00
2	40.98	49.82
3	41.98	49.72
4	42.98	49.70
5	43.98	49.75
6	44.97	49.89
7	45.95	50.10
8	46.90	50.39
9	47.83	50.76
10	48.73	51.19
11	49.60	51.70
12	50.42	52.27
13	51.19	52.90
14	51.91	53.60
15	52.57	54.35
16	53.17	55.15
17	53.71	55.99
18	54.18	56.87
19	54.58	57.79
20	54.90	58.74
21	55.15	59.70
22	55.20	60.00

Circle Center At X = 42.8 ; Y = 62.4 and Radius, 12.7

*** 3.818 ***

Individual data on the 24 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.0	66.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.0	197.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1.0	321.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.0	434.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.0	534.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.0	618.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1.0	685.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.9	734.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.2	137.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.7	626.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.9	772.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.4	372.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.4	380.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.8	664.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.7	563.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.7	463.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.6	366.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.5	276.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.5	194.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.1	46.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.3	76.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.3	65.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.2	22.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	38.89	50.00
2	39.89	49.94
3	40.89	49.94
4	41.89	49.99
5	42.88	50.09
6	43.87	50.24
7	44.85	50.45
8	45.81	50.71
9	46.77	51.01
10	47.70	51.37
11	48.61	51.78
12	49.50	52.23
13	50.37	52.73
14	51.21	53.28
15	52.02	53.87
16	52.79	54.50
17	53.53	55.17
18	54.24	55.88
19	54.90	56.63
20	55.53	57.41
21	56.11	58.22
22	56.65	59.06
23	57.15	59.93
24	57.18	60.00

Circle Center At X = 40.5 ; Y = 68.8 and Radius, 18.9

*** 3.996 ***

1

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	35.56	50.00

2	36.45	49.56
3	37.38	49.17
4	38.32	48.85
5	39.29	48.59
6	40.27	48.40
7	41.26	48.27
8	42.26	48.21
9	43.26	48.22
10	44.26	48.29
11	45.25	48.43
12	46.23	48.63
13	47.19	48.90
14	48.13	49.23
15	49.05	49.63
16	49.94	50.08
17	50.80	50.59
18	51.62	51.16
19	52.41	51.78
20	53.15	52.46
21	53.84	53.18
22	54.49	53.94
23	55.08	54.75
24	55.61	55.59
25	56.09	56.47
26	56.52	57.38
27	56.87	58.31
28	57.17	59.26
29	57.35	60.00

Circle Center At X = 42.7 ; Y = 63.2 and Radius, 15.0

*** 4.125 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	35.56	50.00
2	36.46	49.57
3	37.39	49.21
4	38.35	48.92
5	39.33	48.71
6	40.32	48.57
7	41.31	48.50
8	42.31	48.52
9	43.31	48.60
10	44.30	48.77
11	45.27	49.00
12	46.22	49.31
13	47.14	49.69
14	48.04	50.14
15	48.89	50.66
16	49.71	51.24
17	50.48	51.88
18	51.20	52.57
19	51.86	53.32
20	52.46	54.12
21	53.01	54.96
22	53.48	55.84
23	53.89	56.75
24	54.23	57.69
25	54.50	58.65
26	54.69	59.63
27	54.74	60.00

Circle Center At X = 41.7 ; Y = 61.7 and Radius, 13.2

*** 4.129 ***

1

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.00	50.00
2	40.99	49.86
3	41.99	49.76
4	42.98	49.72
5	43.98	49.72
6	44.98	49.77
7	45.98	49.87
8	46.97	50.03
9	47.95	50.23
10	48.91	50.47
11	49.87	50.77
12	50.81	51.11
13	51.73	51.50
14	52.63	51.94
15	53.51	52.41
16	54.36	52.94
17	55.19	53.50
18	55.99	54.10
19	56.76	54.74
20	57.49	55.42
21	58.19	56.13
22	58.85	56.88
23	59.48	57.66
24	60.07	58.47
25	60.61	59.31
26	61.02	60.00

Circle Center At X = 43.4 ; Y = 69.9 and Radius, 20.2

*** 4.163 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	35.56	50.00
2	36.43	49.52
3	37.34	49.10
4	38.27	48.73
5	39.22	48.43
6	40.19	48.19
7	41.18	48.01
8	42.17	47.89
9	43.17	47.84
10	44.17	47.85
11	45.17	47.92
12	46.16	48.06
13	47.14	48.26
14	48.10	48.52
15	49.05	48.85
16	49.97	49.23
17	50.87	49.67
18	51.74	50.17
19	52.57	50.72
20	53.37	51.32
21	54.12	51.98
22	54.84	52.68
23	55.50	53.42
24	56.12	54.21
25	56.69	55.03
26	57.20	55.89
27	57.66	56.78
28	58.06	57.70
29	58.40	58.64
30	58.68	59.60
31	58.77	60.00

Circle Center At X = 43.5 ; Y = 63.5 and Radius, 15.7

*** 4.165 ***

1

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	37.78	50.00
2	38.73	49.71
3	39.71	49.47
4	40.69	49.29
5	41.68	49.16
6	42.68	49.08
7	43.68	49.06
8	44.68	49.10
9	45.67	49.19
10	46.66	49.33
11	47.64	49.54
12	48.61	49.79
13	49.56	50.10
14	50.49	50.46
15	51.40	50.87
16	52.29	51.33
17	53.15	51.84
18	53.98	52.40
19	54.78	53.00
20	55.55	53.64
21	56.27	54.33
22	56.96	55.05
23	57.61	55.82
24	58.21	56.61
25	58.77	57.44
26	59.29	58.30
27	59.75	59.19
28	60.12	60.00

Circle Center At X = 43.5 ; Y = 67.1 and Radius, 18.1

*** 4.173 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	38.89	50.00
2	39.87	49.81
3	40.86	49.66
4	41.86	49.57
5	42.86	49.53
6	43.86	49.54
7	44.85	49.60
8	45.85	49.71
9	46.83	49.86
10	47.81	50.07
11	48.78	50.33
12	49.73	50.64
13	50.67	50.99
14	51.58	51.39
15	52.48	51.84
16	53.35	52.33
17	54.20	52.86
18	55.01	53.43
19	55.80	54.05
20	56.56	54.71

21	57.28	55.40
22	57.96	56.13
23	58.61	56.89
24	59.22	57.68
25	59.79	58.50
26	60.31	59.35
27	60.67	60.00

Circle Center At X = 43.2 ; Y = 69.4 and Radius, 19.8

*** 4.176 ***

1

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	38.89	50.00
2	39.86	49.77
3	40.85	49.60
4	41.84	49.47
5	42.84	49.40
6	43.84	49.39
7	44.84	49.42
8	45.83	49.51
9	46.82	49.65
10	47.80	49.85
11	48.77	50.09
12	49.73	50.39
13	50.67	50.73
14	51.58	51.13
15	52.48	51.57
16	53.35	52.06
17	54.20	52.60
18	55.01	53.18
19	55.79	53.80
20	56.54	54.47
21	57.25	55.17
22	57.93	55.91
23	58.56	56.68
24	59.16	57.49
25	59.70	58.32
26	60.21	59.19
27	60.63	60.00

Circle Center At X = 43.7 ; Y = 68.3 and Radius, 18.9

*** 4.181 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	34.44	50.00
2	35.35	49.58
3	36.29	49.22
4	37.24	48.91
5	38.21	48.66
6	39.19	48.47
7	40.18	48.34
8	41.18	48.27
9	42.18	48.25
10	43.17	48.30
11	44.17	48.40
12	45.16	48.56
13	46.13	48.78
14	47.09	49.06

15	48.03	49.40
16	48.95	49.79
17	49.85	50.23
18	50.72	50.73
19	51.56	51.28
20	52.36	51.87
21	53.13	52.51
22	53.85	53.20
23	54.54	53.93
24	55.18	54.70
25	55.77	55.50
26	56.32	56.34
27	56.81	57.21
28	57.25	58.11
29	57.64	59.03
30	57.97	59.97
31	57.98	60.00

Circle Center At X = 41.9 ; Y = 65.1 and Radius, 16.9

*** 4.186 ***

1

```
            Y           A     X     I     S           F     T

            0.00     20.00     40.00     60.00     80.00    100.00
X      0.00 +---------+---------+---**----+---------+---------+
            -
            -
            -
            -
            -
      20.00 +
            -
            -
            -                        ..
            -                       ..0
            -                       .33
A     40.00 +                      ..3*
            -                      ..31.
            -                      ..312. W
            -                      ..6312..*
            -                      ...631114
            -                       ....3321
X     60.00 +                        ....555
            -                          .....
            -
            -
            -
            -
I     80.00 +                             *
            -
            -
            -
            -
            -
S    100.00 +
            -
            -
            -                        *
            -
            -
     120.00 +
            -
            -
            -
            -
            -
F    140.00 +
            -
            -
            -
            -
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T     160.00 +                    **
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