WESTSIDE CREEKS ECOSYSTEM RESTORATION

Appendix F: Geotechnical Assessment

GEOTECHNICAL ASSESSMENT

GENERAL

The Westside Creeks (WSC) study focuses on Alazán, Apache, Martinez and San Pedro Creeks totaling approximately 14 miles of creek channel. WSC is part of the San Antonio Channel Improvement Project (SACIP) originally designed and constructed in the 1950's and 1960's.

- Alazán Creek from Woodlawn Lake to its confluence with Apache and San Pedro Creek. Significant area would be the Martinez Creek confluence.
- Apache Creek from Lake Elmendorf Lake to its confluence with San Pedro Creek. Significant areas include a sharp bend just upstream of S Zarzamora Street, and another significant bend and old channel remnant around S Brazos Street.
- Martinez Creek from W Hildebrand Avenue to its confluence with Alazán Creek. Significant areas would include the reaches along Interstate 10, series of bends between Fredericksburg Road and N. Sabinas Street, and close proximity to I-10 around Culebra Road.
- San Pedro Creek from the outlet of the San Pedro Tunnel to its confluence with the San Antonio River. Significant areas include U-lined channel through part of the downtown, underpasses and close alignment to I-35, and underpass to I-10.

GENERAL GEOLOGY AND PHYSIOGRAPHY

PHYSIOGRAPHY

Bexar County is located within the Interior Coastal Plain, Edwards Plateau and Black Prairie. The topography of the county is nearly level or undulating in the southern two-thirds of the county, where the area rises from 500-ft elevation NGVD to 1000-ft elevation from the southeast to the northwest. This region of the county is underlain by beds of old alluvium, chalk and marl dipping to the southeast at a greater rate than in the Edwards Plateau. In the northern third of the county covering the Edwards Plateau, the topography is strongly sloping to steep, rising from 1000-ft to 1900-ft in elevation and is underlain by limestone beds which dip very slightly toward the southeast.

The Balcones fault zone is a dominant geologic feature of Bexar County. It is characterized by numerous parallel and en echelon faults, usually downthrown to the southeast. To some extent, faulting has controlled soil formation and stream courses. The Balcones Escarpment forms a sharp boundary between the Interior Coastal Plains and Black Prairie. The project area lies approximately 5 to 10 miles south of the Edwards Aquifer recharge zone in south-central Texas, and completely within the Edwards Aquifer artesian zone. The San Pedro Springs are less than a mile from Martinez Creek, along the fault that transverses the confluence of Alazán and Martinez Creek. The springs may act as a direct link to the Edwards Aquifer.

SITE CONDITIONS

Overburden materials within the Westside Creeks project area contain moderately deep to deep clayey and calcareous soils over chalk and marl and in old alluvium. The soils within the study area range from well drained to practically impervious. Depth to seasonal high water table varies across the site from very deep to shallow and would need to be investigated prior to construction considerations.

Northeast-trending faults of the Balcones fault zone cross the project area. These faults are en echelon to the Balcones fault zone, high angle, normal, and downthrown to the southeast. Geomorphic expression of this fault may consist of expressions of clay-shale beds between hard, erosion- resistant limestone. This fault zone is highly complicated and contains numerous small and irregularly shaped fault blocks. Construction considerations in this area should take into account the potential limitations to structures and excavation due to faulting.

PRIMARY FORMATIONS

Geologic primary formations underlying the Westside Creeks study area consist of faulted stratigraphic units downthrown to the south and east. Geologic formations outcropping in the project study area are Cretaceous and Paleocene in age. In order of deposition (oldest to youngest), the Cretaceous age formations include the Austin Chalk (KA), Anacacho Limestone (KAN), Taylor Marl (KTA), and Navarro Group (KN). The Wills Point (TWP) formation of the Midway Group is Paleocene in age and outcrops at the southernmost extent of the project area.

The northern reaches of Martinez and Alazán Creek overlie the Taylor Marl, characterized by gray to brown marl and calcareous clay. This unit has a maximum thickness of 535 ft, and has very low porosity and permeability. This unit is not known to be water-bearing, but likely does transmit water through fractures especially in the Edwards Aquifer recharge zones. This unit does not tend to develop cave formations. The Taylor Marl forms a sharp contact with the Anacacho Limestone at a northeast to southwest trending fault plane.

The remaining extents of Martinez and Alazán Creek before the confluence overlie the Anacacho Limestone formation, which is characterized by brittle light yellow, yellow and light gray marly chalk. This unit thickens downdip and to the east to a maximum thickness of 355 ft and is not water-bearing, but may transmit water through fractures. The Anacacho Limestone may contain weathered bentonite beds and is fossiliferous. Within the project area, this unit forms a sharp contact with the Austin Chalk formation at a northeast to southwest trending fault plane. To the south, the Anacacho Limestone forms a sharp contact with a second outcropping fault block of the Taylor Marl formation at an east-northeast to west-southwest trending fault plane.

The Austin Chalk formation does not directly underlie any of the creeks within the scope of the project. The Austin Chalk is characterized by grayish white to white limestone and argillaceous chalky limestone, and contains local bentonite seams. This unit is nearly uniformly thick down dip with a 210-ft maximum thickness. The Austin chalk is fossiliferous and weathers to yellow. This unit is generally confining but is known to transmit water through fractures, and yields small to large supplies of water of good to poor quality. This unit has a low potential to develop cave formations. Like the Anacacho Limestone, the Austin Chalk within the project area forms a sharp contact with an outcropping fault block of the Taylor Marl at an east-northeast to west-southwest trending fault plane.

San Pedro Creek to the confluence with the San Antonio River overlies the Navarro Group, characterized by gray to brown clay and marl. This unit thickens downdip and toward the west to a maximum thickness of 535 ft. This unit may contain near-surface layers of well-indurated limestone. This unit is not known to be water-bearing, but water may transmit through fractures in the formation. The Navarro Group forms a sharp contact with the Wills Point formation at a northeast to southwest trending fault plane.

The Wills Point formation of the Midway Group outcrops to the south of the confluence of San Pedro Creek and the San Antonio River. This unit is characterized by greenish-gray to yellow-brown arenaceous clay containing numerous arenaceous and calcareous concretions. The Wills Point formation is moderately water-bearing and has a maximum thickness of 490-ft.

OVERBURDEN MATERIALS

Within the Westside Creeks project area, overburden materials are comprised of the Austin-Tarrant association, Lewisville-Houston Black terrace association and Venus-Frio-Trinity association. These overburden units can be divided by location, from the northern extent of the project area to the southern extent. Please refer to Figure 1: Overburden Soils for WSC Study Area for detailed soil locations.

Along Martinez Creek, overburden materials are anticipated to consist of Austin silty clay (AuC) (typically forming on 3 to 5 percent slopes) along the western embankment and Houston Black clay (HsB) along the eastern embankment.

Austin silty clay is a pale to dark, gray-brown silty clay with good to fair drainage. This soil forms from chalk, chalky marl and contains many small shale fragments. Austin silty clay is very hard when dry and crumbly when moist, has moderate runoff, high permeability and a moderate to severe hazard for water erosion. The pH of this soil typically ranges from 7.9 to 8.4 and the plasticity index ranges from 20 to 31 Construction considerations in this area should take into account the potentially severe impacts of the high shrink-swell potential, low soil strength when moist and potential corrosion to uncoated steel of these overburden soils.

The Houston Black clay is a deep, gray to black clay with poor to practically impervious drainage. This soil forms from old alluvium containing calcareous clay. The Houston Black clay is very firm when moist and cracks when desiccated, has slow runoff when dry to rapid runoff when saturated, very slow permeability and a moderate to severe hazard for water erosion, particularly on slopes without vegetation. In gravel lenses, the permeability is very high. The pH of this soil typically ranges from 7.5 to 8.4 and the plasticity index ranges from 56 to 77+. Construction considerations in this area should take into account the potentially severe impacts of the high shrink-swell potential, discontinuous gravel layers, potential corrosion to uncoated steel, and low shear strength when saturated.

Near the confluence with Alazán Creek, overburden materials along Martinez Creek are anticipated to consist of Houston Black clay along the western embankment and both Houston Black Clay and Lewisville silty clay along the eastern embankment.

Lewisville silty clay is a moderately deep, dark brown to grayish brown calcareous silty clay to clay with moderate to good drainage. This unit forms from old alluvium consisting of silty clay to gravelly loam with varying amounts of lime. Lewisville silty clay is very firm when dry and crumbly when moist, has slow to medium runoff, medium to high permeability and a moderate to severe hazard for water erosion, particularly on slopes without vegetation. The pH of this soil typically ranges from 7.9 to 8.4 and the plasticity index ranges from 20 to 44. Construction considerations in this area should take into account the potentially severe impacts of the high shrink-swell potential, discontinuous gravel layers, potential corrosion to uncoated steel, and low shear strength when saturated.

Along Alazán Creek upstream of the confluence with Martinez Creek, overburden materials are comprised of Houston Black clay along the eastern embankment and Houston Black gravelly clay along the western embankment.

Houston Black gravelly clay is deep, calcareous, black gravelly clay and has poor to impervious drainage. This soil forms from old alluvium containing calcareous clay. Generic properties and considerations are the same as for the Houston Black clay detailed above in the Martinez Creek discussion.

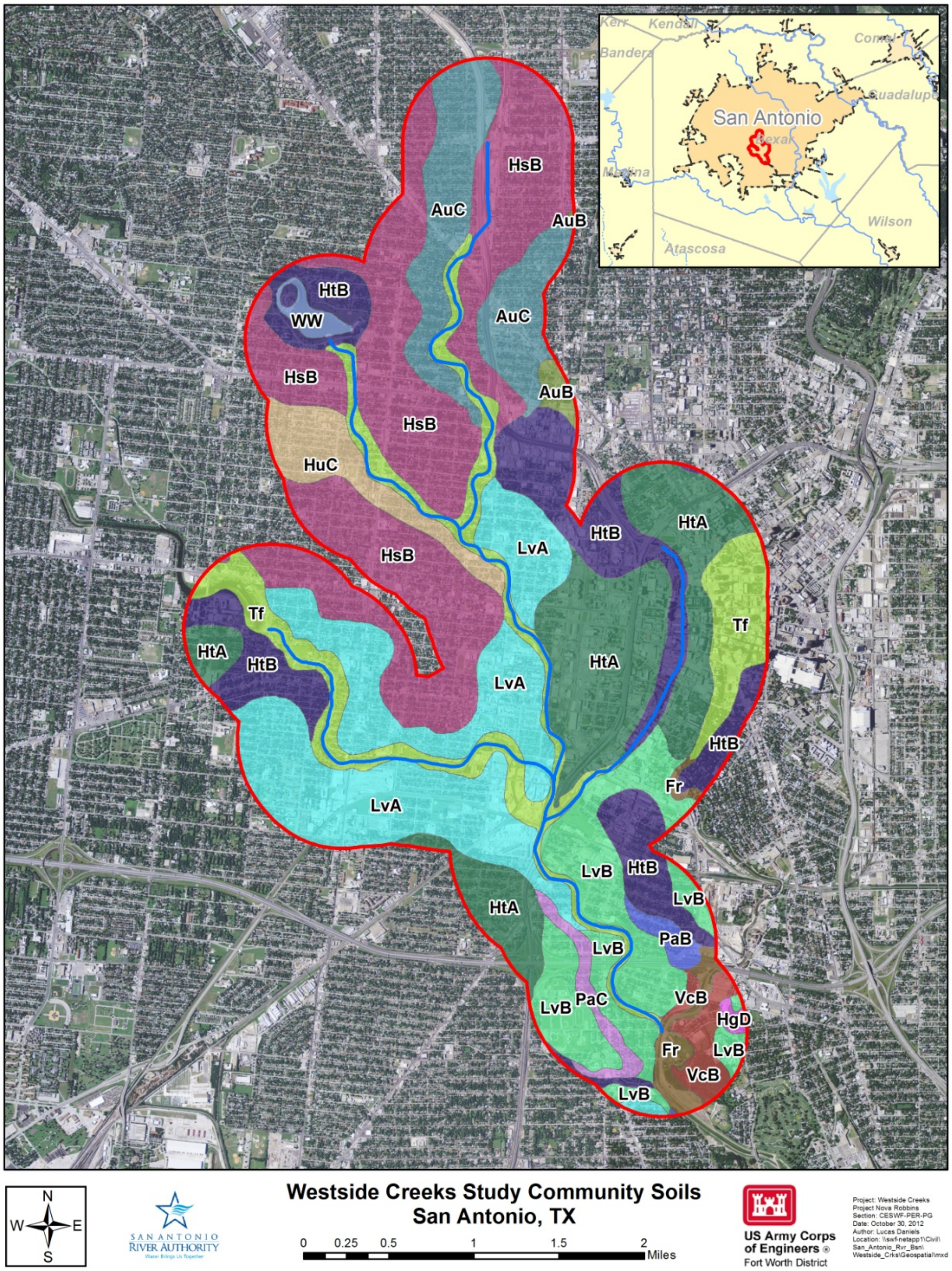


Figure 1: Overburden Soils for WSC Study Area

Along Alazán Creek downstream of the confluence with Martinez Creek, overburden materials are comprised of Lewisville silty clay and Houston Black clay on the eastern embankment and Lewisville silty clay on the western embankment. There are small sections of Houston Black clay and gravelly clay that extend into this extent from before the confluence.

Along the upstream third of Apache Creek, overburden materials consist of Houston Black clay along the both embankments. Along the remaining extent of Apache Creek, overburden materials are comprised of Lewisville silty clay.

Along San Pedro Creek before the confluence with Alazán Creek, overburden materials are mostly comprised of Houston Black clay. South of the confluence, overburden materials consist of Lewisville silty clay.

The stream channels and floodplains within the project area are generally composed of Trinity and Frio soils. This soil series is comprised of deep, brownish gray clay, silty clay and gravelly clay. This material forms from alluvium washed from clayey, upland soils and is subject to deposition and scouring. Channels that form in this material are generally poorly defined and of small capacity.

Available Geotechnical Data

For WSC Study, it was determined that a significant amount of available project and local geotechnical data was available.

Original SACIP Data

A potential source for existing geotechnical data is from the original SACIP plans and construction. Borings for the study area have been located by geo-referencing the available as-built information. The investigation, testing, and evaluations within the study area were performed prior to 1956. However, after review of the data within the study area, the average applicability of the data is fairly low due to predominantly shallow borings and the differences in state of the practice for investigation and design. The San Pedro and San Antonio tunnel projects are the exception. Significant drilling and testing was conducted during design and construction.

Mission Reach Restoration

The most recent and ample source for geotechnical information would be the Mission Reach project. The 8-miles of project along the San Antonio River had multiple rounds of geotechnical investigation, laboratory testing, back analyses of a large slope slide, and rigorous slope stability evaluations. In addition to technical data, there were some geotechnical lessons learned, as discussed below, that have been adapted into the WSC Study.

Slope Stability

Stability of the channel slopes became a major issue for MRR. Through feasibility into PED, the lack of stability issues on the project was used as justification that the existing slope configuration was stable; and was a major factor in the assumptions used to shape the project design. These assumptions were challenged late in the project design, and resulted in expensive remediation measures.

An initial assumption for WSC was that the overbank slopes of the channels are over-steepened. This in conjunction with restricted right of way meant that our channel modifications had to avoid impact to the channel over-bank slopes.

As the project was in an urban area, the width of right of way was often kept to a minimum, meaning that increased capacity most often came from increased channel depth. Consequently, as flows accumulate moving downstream, especially after confluences, the height of the channel banks generally tends to increase. This trend is apparent in the existing WSC study area, where the heights of the channel banks are consistently higher at the south end versus the north end of the study area. The channel banks of Martinez Creek are generally around 15 to 25 feet in height with the general trend of increasing height moving downstream. The channel banks of Alazán Creek are generally the same although increasing to heights of 30 to 35 feet at downstream of the Martinez confluence. The channel banks of Apache Creek have a little more variance as the channel width tends to vary more than the other creeks. The channel banks where the pilot channel alternative is being considered are generally 15 to 35 feet in height. The channel banks of San Pedro Creek are generally 20 to 35 feet in height, and have a very large cross section at the downstream edge of the study area.

A metric used to screen relative slope stability from the remediation design in MRR Phase 1 has been adapted for an initial screening of slope stability of existing and modified slopes for WSC Study. The crux of the metric is that rather than a static target slope, the stable configuration of a slope is based upon its height. Deepening and widening the pilot channel alters the overall channel slope configuration, and its impacts need to be evaluated. Utilizing this metric is applicable as the slope materials and underlying primary formations for the upper portion of MRR are the similar to those encountered in the WSC Study Area; especially in the southern portion of the study area.

FAULTING

Investigations were conducted to better locate a fault in MRR Phase 1. The impact to design was relatively minor, and the construction impact was to fill a few void spaces that were encountered. The WSC Study has many more faults crossing it than MRR. The WSC Study Area is within the Edward’s Aquifer Artesian zone, so while the study area generally does not have outcrops of the Edwards Aquifer unit at the ground surface, the aquifer unit underlies the surface formations. The primary formations of the study area are generally confining, but can transmit water through fractures. The San Pedro Spring system lies approximately 1 mile east of Martinez Creek, which may provide a link from the surface to the aquifer unit. Historically, there is no forthcoming documentation regarding faults impacting private construction or the original SACIP phases in the WSC study area. There were issues encountered in the tunneling operations for underground diversions of the San Antonio River and San Pedro Creek.

WESTSIDE CREEK DRAINAGE – DESKTOP STUDY

Following discussions on available data, SARA requested a geotechnical desktop study to an engineering firm they had under contract. On 23 February 2012, Raba Kistner Consultants, Inc. provided the *Westside Creek Drainage – Desktop Study* attached as Attachment 1 to this appendix. The report provided additional historic data that the consulting firm has available in areas pertinent to the study. Of particular notice were notes of bentonite seams at sites along Alazán and Apache creeks, with coinciding liquid limits up to 121 and 150. Although this would not impact the limited excavation for these reaches.

MILITARY BASE DATA

The study area is also located near multiple US Military bases. Data has not yet been accumulated and tabulated for use on this project, but additional laboratory data for the overburden and primary materials could be available based upon similar materials in the surrounding bases.

STABILITY SCREENING

The biggest challenge to this study from a geotechnical standpoint was assessing slope stability concerns and impacts from alternatives. The study area includes 28 miles of slopes, varying overburden materials, varying primary formations, hard armoring and slope reinforcement, and limited available geotechnical data. The solution implemented was to use the developed existing and proposed alternative hydraulic cross sections to come up with slope height and effective slope, and evaluate them against the metric used in MRR near the San Pedro confluence. The point data for 459 hydraulic cross-sections were sorted and run through a series of calculations that computed the critical average slope angle and height for both channel slopes for both existing and proposed alternatives. See Figure 2: Graphical output of slope screening for San Pedro Creek for a graphical output conveying the stability evaluations for San Pedro Creek.

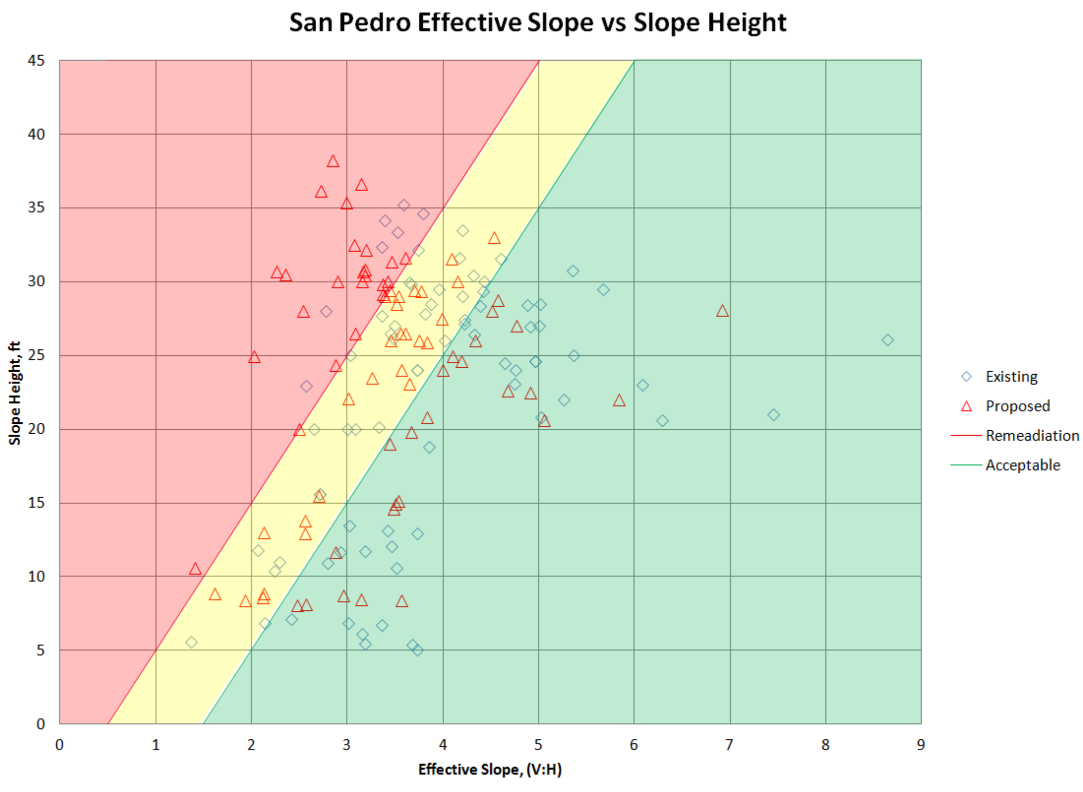


Figure 2: Graphical output of slope screening for San Pedro Creek

This output represents the qualitative chance of slope instability, and should err on the conservative side. There are also many locations with hard armoring or the cross sections were not tangential to the slope that needed the output to be altered or removed. Consequences also needed to be assessed for areas of concern so that the resulting information is risk-based per the pilot paradigm. Figures 2 to 5 depict the qualitative chance of slope instability.

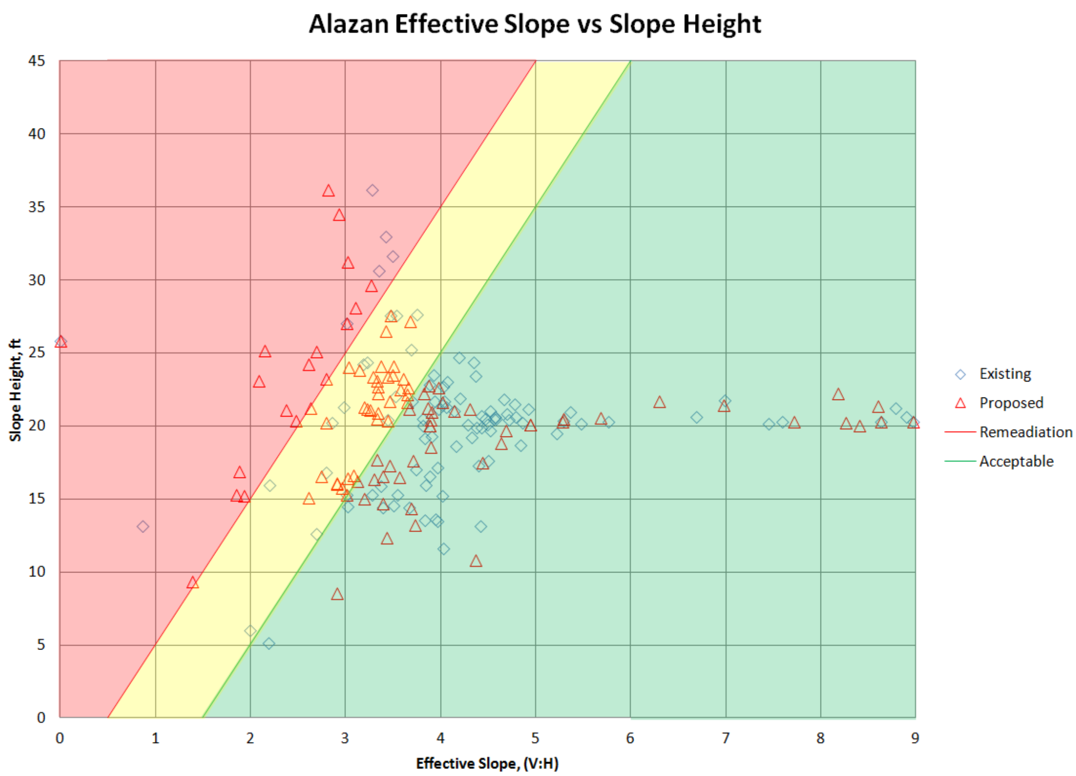


Figure 3: Graphical output of slope screening for Alazán Creek

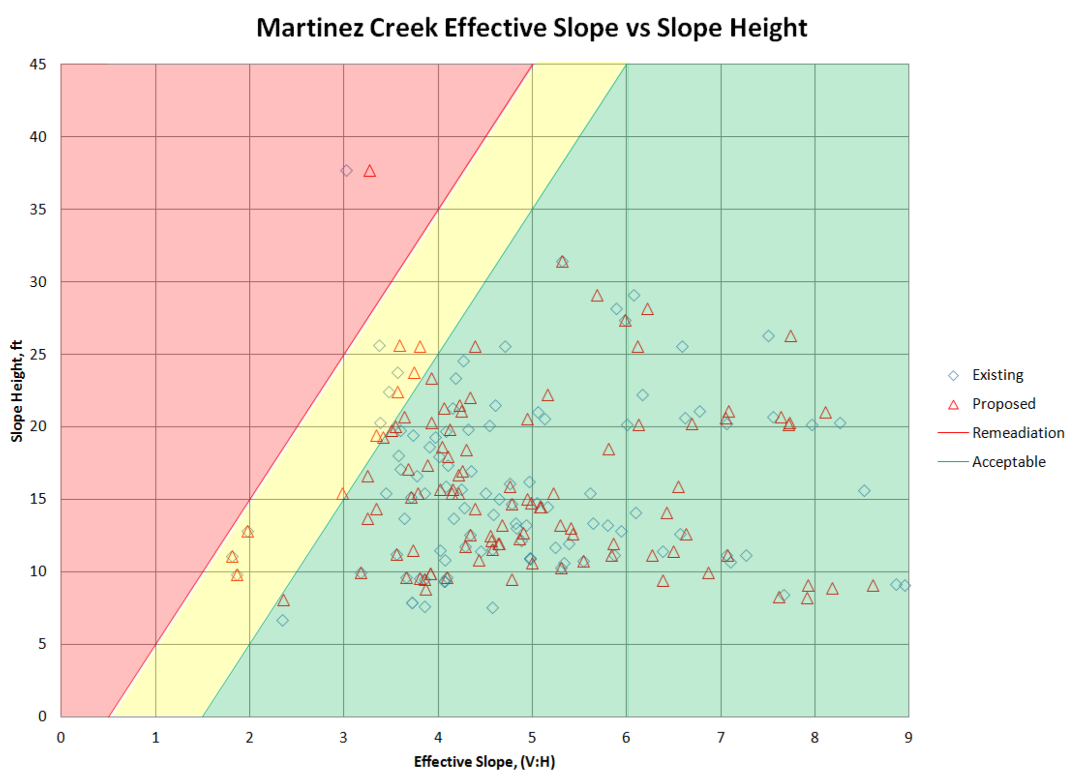


Figure 4: Graphical output of slope screening for Martinez Creek

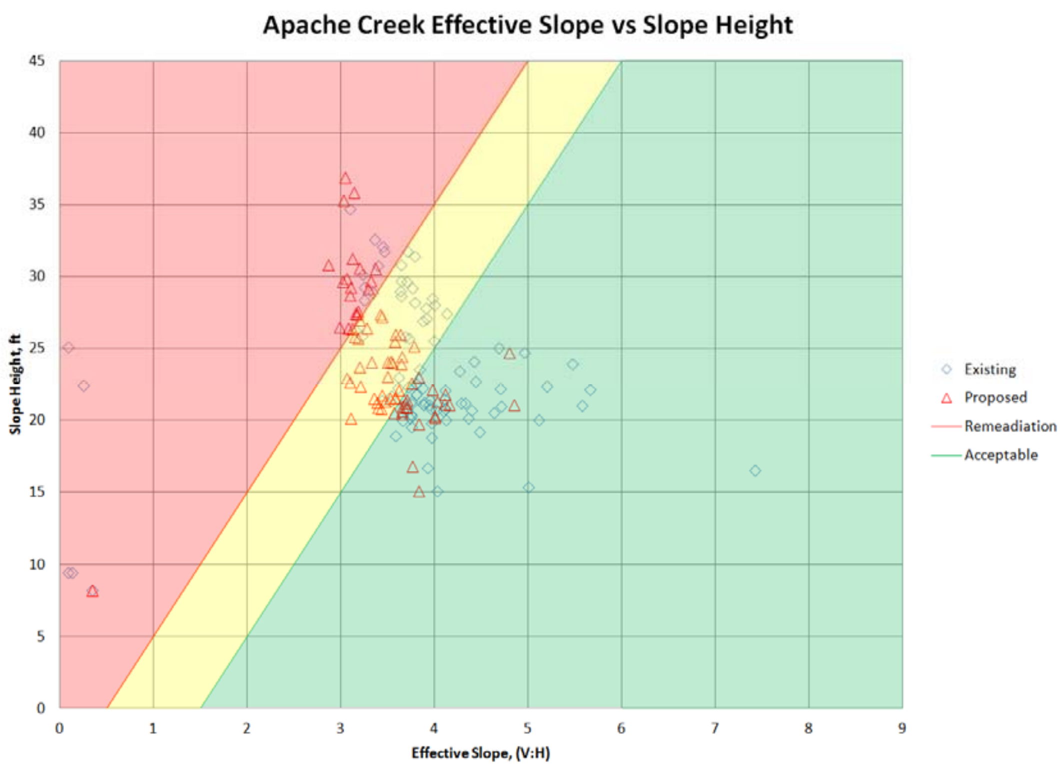


Figure 5: Graphical output of slope screening for Apache Creek

Discussion and Recommendations

Most of the key design considerations from a geotechnical standpoint for the existing and proposed project features were identified at the kickoff meeting, and have shaped the development of project alternatives. The major items have been tracked on the Geotechnical Risk Register, and minor items would have been covered in team discussion and correspondence.

Regional Faulting

At least 21 faults have been identified that cross the study area and existing creek channels. Fractured or brecciated zones at the faults could affect the overall stability of the channel slopes. The faults have apparently had little impact on the existing channel configuration based upon the good general performance of the channel slopes and lack of observed surficial features indicative of faulting. Although, a history of good performance does not mean that the faults could not be a problem. This was a primary consideration in an initial constraint that the feasibility study would not modify the overbank slopes to reduce the risk of triggering slope instability. One of these faults also crossed the northern section of the Mission Reach project.

Implementing the pilot paradigm for this project, the data acquisition costs for fault investigation would not be justified compared to the limited amount of risk reduction that could be obtained for the study at this time. The faults pre-date the original Westside Creek project and private construction activities in the region; with very minor impacts to construction at the surface level. Additional investigation of the faults would be pertinent and appropriate during the design phase where the faulting may coincide with critical structures, extensive excavation, or channel instability.

GLOBAL STABILITY

Concern and considerations for global stability were lessons learned on the Mission Reach project that definitely need to be applied to the WSC project. The desire to limit ROW acquisition and achieve flood damage reduction for the area coupled with the then state of the practice resulted in very steep slopes with respect to the current state of the geotechnical practice. This was also a primary consideration behind the initial constraint that the feasibility study would not modify the overbank slopes to reduce the risk of triggering slope instability.

The slope stability screening method discussed above was used to evaluate the existing and proposed alternatives with modification of the pilot channel. This preliminary screening was used to evaluate the potential design and construction costs where global instability may be a concern and which stations or reaches of the creeks may be at the highest risk. These results should be used to help shape the subsurface investigation and prioritize stability evaluation in design.

Some proposed and existing features could affect global stability. Permanent excavations or erosion within the creek channel could affect passive wedges for stability. The potential impact from the currently proposed alternatives would be very low, but should be evaluated when they coincide with areas identified as high risk for slope instability. Mass wasting is another potential concern in a natural channel system. However; the in stream structures are designed to balance sediment transport which should deter mass wasting of native soils. Some alternatives include the demolition of concrete structures which serve as scour protection. As discussed in the Civil Engineering Appendix, Turf Reinforcing Mats (TRM) will be used to account for shear stresses where concrete is removed. In general, this should be sufficient to prevent scour in areas that will not be inundated continuously, and suitability of TRMs should be evaluated in design. Existing concrete features that provide support to slopes or structures were not considered for demolition.

ATTACHMENT 1: WESTSIDE CREEKS DRAINAGE – DESKTOP STUDY BY RABA KISTNER

Raba Kistner
Consultants, Inc.
12821 W. Golden Lane
San Antonio, TX 78249

P.O. Box 690287
San Antonio, TX 78269-0287

www.rkci.com

P 210 :: 699 :: 9090
F 210 :: 699 :: 6426
TBPE Firm F-3257

Project No. ASA12-017-00
February 23, 2012

Russell A. Persyn, P.E., PhD, CFM
San Antonio River Authority
100 East Guenther
San Antonio, Texas 78204

RE: Westside Creek Drainage – Desktop Study
San Antonio River Authority
Bexar County, Texas

Dear Dr. Persyn:

Raba Kistner Consultants Inc. (RKCI) has completed the authorized desktop study for the Westside Creek Drainage area located in Bexar County, Texas. The purpose of this study was to provide subsurface information from geotechnical engineering reports previously prepared by **RKCI** at locations selected by the San Antonio River Authority (SARA).

Background

RKCI has performed over 10,000 geotechnical engineering studies in the Bexar County area and has developed a library of previous geotechnical engineering studies. The locations of a majority of these studies have been cross-referenced onto maps to show the original study location.

At the request of SARA, RKCI provided a map of the Westside Creek Drainage area indicating the location of previous geotechnical engineering studies. As a result of a review of these maps and our discussions, thirteen studies were selected. A map showing the approximate location of the previous projects is presented on Figure 1. Additionally, due to the variable geologic conditions across Bexar County, the project sites have been shown on a USGS map which reflects the surface geology across the area, which is presented on Figure 2. The boring location map, boring logs, and other collected data for the individual projects are separated by tabs labeled 1 through 13.

Surface Geology

As referenced above, as a result of our proximity to the Balcones fault and the alluvial nature of Bexar County, surface geologic formations vary highly across the region. Consequently, when comparing previous geotechnical engineering studies, it is important to cross reference surface geology to verify if the previous borings are drilled in the same geologic formation. In order to assist SARA in this regard, the surface geologic formations for each of the site is presented below.

Boring Location	Project Number	Surface Geology
1	ASA87-074-00	Fluviatile Terrace Deposits
2	ASA08-174-00	Fluviatile Terrace Deposits
3	ASA69-086-00	Fluviatile Terrace Deposits
4	ASA97-014-00	Fluviatile Terrace Deposits
5	ASA84-004-00	Fluviatile Terrace Deposits
6	ASA85-065-00	Fluviatile Terrace Deposits
7	ASA09-051-00	Fluviatile Terrace Deposits
8	ASA88-052-00	Fluviatile Terrace Deposits
9	ASA71-113-00	Navarro Group and Marlbrook Marls
10	ASA78-059-00	Navarro Group and Marlbrook Marls
11	ASA80-057-00	Navarro Group and Marlbrook Marls
12	ASA92-007-00	Navarro Group and Marlbrook Marls
13	ASA95-005-00	Pecan Gap Chalk

Geology

The geology listed above is the surface geology at the specific sites and does not indicate any depth at which this geology may transition to another geologic formation. Presented below are general descriptions of the surface geologic formations, as well as the Uvalde Gravel which may underlie the Fluviatile Terrace Deposits in some of the more southern and eastern projects. The boring logs should be consulted for more specific stratigraphic information.

All of the geologic formations were identified by reviewing the San Antonio Sheet in the Geologic Atlas of Texas.

Fluviatile Terrace Deposits Fluviatile terrace deposits are stream bed deposits typically consisting of clays, sands, silts, and gravels. Such deposits can contain point bars, cutbanks, oxbows, and abandoned channel segments associated with variations in stream bed activity. As a result, soil profiles in terrace deposit areas may vary greatly over relatively short distances. Key geotechnical engineering concerns for development supported on this formation are the expansive nature of the clays, the consistency or relative density of the deposits, and the absence/presence as well as thickness of potentially water-bearing gravels. Due to the alluvial nature of these deposits, significant variations can occur over short distances.

Navarro Group and Marlbrook Marls Navarro Group and Marlbrook Marls typically consist of clays and marly clays and can contain hard layers of marl, sandstone, and siltstone. The clays of this formation are typically highly expansive, montmorillonitic clays. These clays typically grade to harder, intermediate materials such as marl or chalk at depths typically ranging from 15 to 50 ft below existing grades. Key geotechnical engineering considerations for development supported on this formation is the expansive nature of the clays, and the depth to the harder, more competent material. Although near surface permanent ground water is not typically encountered in this formation, transient groundwater is commonly encountered at the clay/marl or clay/chalk interface, particularly following periods of heavy precipitation.

Pecan Gap Chalk The Pecan Gap Chalk weathers to form moderately deep soil and typically consists of clays, marly clays, and marl grading to chalk at depth. Thin seams of bentonite and/or bentonitic clays are also often encountered in this formation. Because such seams are typically thin and random, they are often difficult to locate and identify with standard geotechnical sampling methods and sampling intervals. Similar to the Navarro Group, key geotechnical engineering considerations for development supported on this formation is the expansive nature of the clays, and the depth to the harder, more competent material. Although near surface permanent ground water is not typically encountered in this formation, transient groundwater is commonly encountered at the clay/chalk interface, particularly following periods of heavy precipitation.

Uvalde Gravel Uvalde Gravel can consist of clays, silts, and gravels including cobbles, chert, boulders, and caliche-cemented gravel. The Uvalde Gravels can be highly variable and can therefore result in highly variable conditions over relatively short distances. Key geotechnical engineering concerns for development supported on the Uvalde Gravels are the expansive nature of the clays, the consistency and/or relative density of the deposits, the absence/presence as well as thickness of potentially water-bearing gravels, and the absence/presence of cobbles, boulders and/or cemented materials.

Limitations

The subsurface information presented in this report is specific to the site identified. Horizontal translations of subsurface profiles may not reflect actual subsurface conditions beneath adjacent sites, particularly for those sites located along creeks and streams. This information should be utilized for preliminary planning purposes only, and should not be utilized for final design.

We appreciate the opportunity to be of continued service to you on this project. If you have any questions or need additional assistance, please call.

Very truly yours,
RABA KISTNER CONSULTANTS, INC.

Matthew J. Robbins, E.I.T.
Graduate Engineer

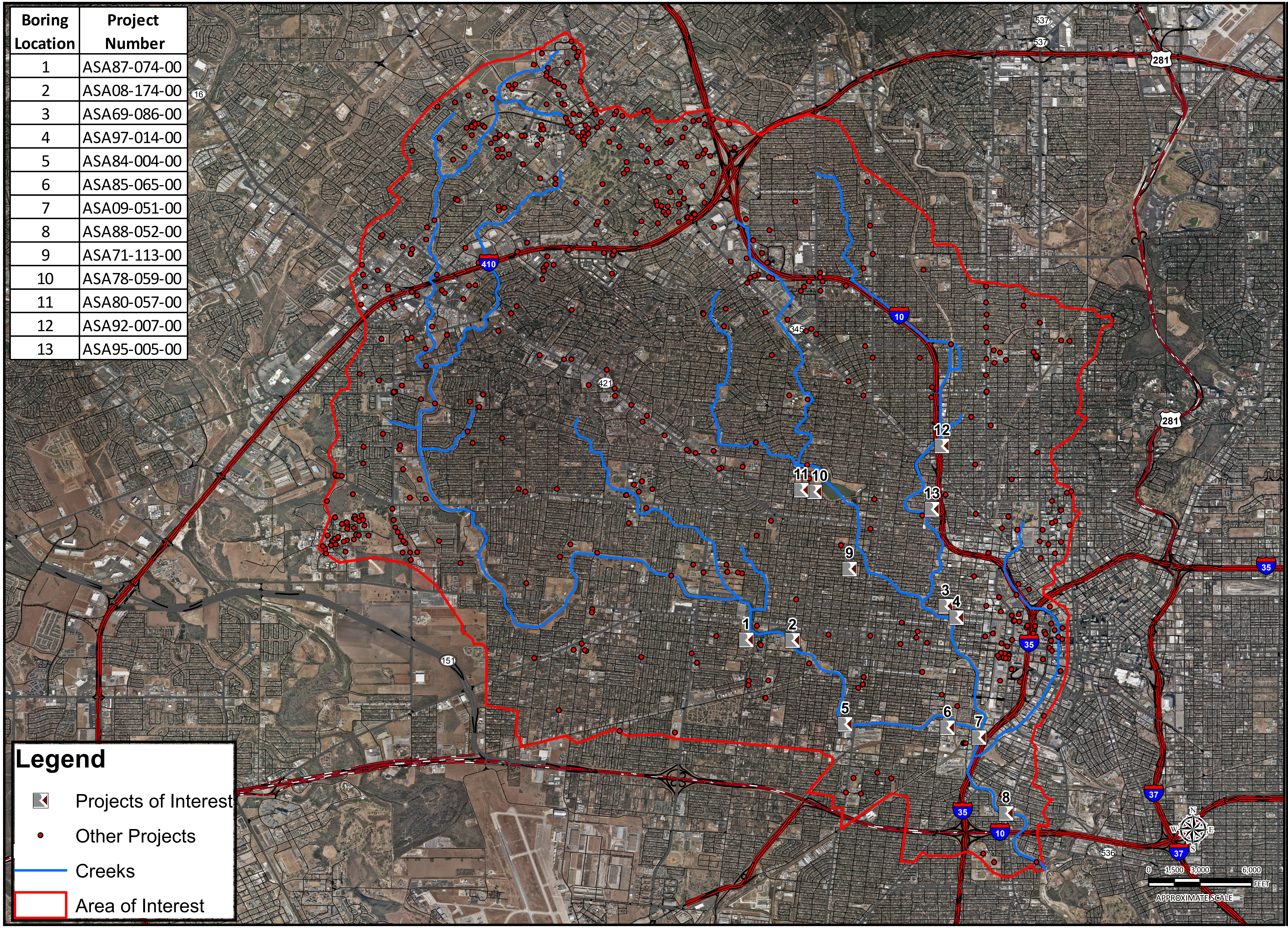
Chris L. Schultz, P.E., PMP
Senior Vice President

MJR/CLS/mem

Attachments

Copies Submitted: Above (3)

Boring Location	Project Number
1	ASA87-074-00
2	ASA08-174-00
3	ASA69-086-00
4	ASA97-014-00
5	ASA84-004-00
6	ASA85-065-00
7	ASA09-051-00
8	ASA88-052-00
9	ASA71-113-00
10	ASA78-059-00
11	ASA80-057-00
12	ASA92-007-00
13	ASA95-005-00



Legend

- Projects of Interest
- Other Projects
- Creeks
- Area of Interest

RABA KISTNER CONSULTANTS

Raba Kistner Consultants, Inc.

12821 West Golden Lane
San Antonio, Texas 78249
P 210 :: 699 :: 9090
F 210 :: 699 :: 6426
www.rkci.com
TBPE Firm Number 3257

Westside Creek Drainage - Desktop Study
San Antonio River Authority
San Antonio, Texas

SOURCE:

REVISIONS:

No.	DATE	DESCRIPTION

PROJECT No.: ASA12-017-00

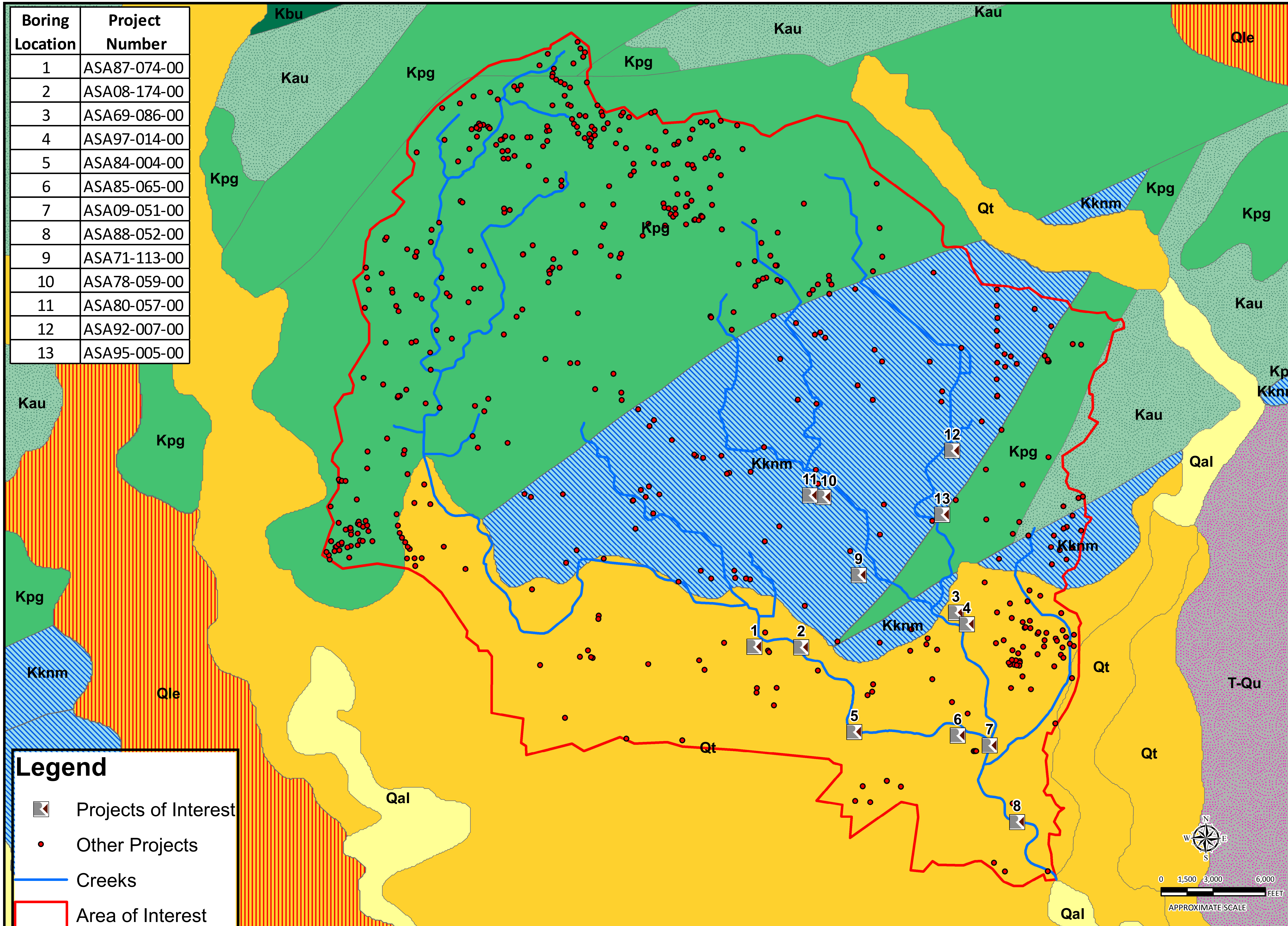
ISSUE DATE:	2/21/2012
DRAWN BY:	MJR
CHECKED BY:	MJR
REVIEWED BY:	CLS

FIGURE

1

NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes

Boring Location	Project Number
1	ASA87-074-00
2	ASA08-174-00
3	ASA69-086-00
4	ASA97-014-00
5	ASA84-004-00
6	ASA85-065-00
7	ASA09-051-00
8	ASA88-052-00
9	ASA71-113-00
10	ASA78-059-00
11	ASA80-057-00
12	ASA92-007-00
13	ASA95-005-00



NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes

RABA KISTNER CONSULTANTS

Raba Kistner Consultants, Inc.
12821 West Golden Lane
San Antonio, Texas 78249
P 210 :: 699 :: 9090
F 210 :: 699 :: 6426
www.rkci.com
TBPE Firm Number 3257

Westside Creek Drainage - Desktop Study
San Antonio River Authority
San Antonio, Texas

SOURCE:

REVISIONS:

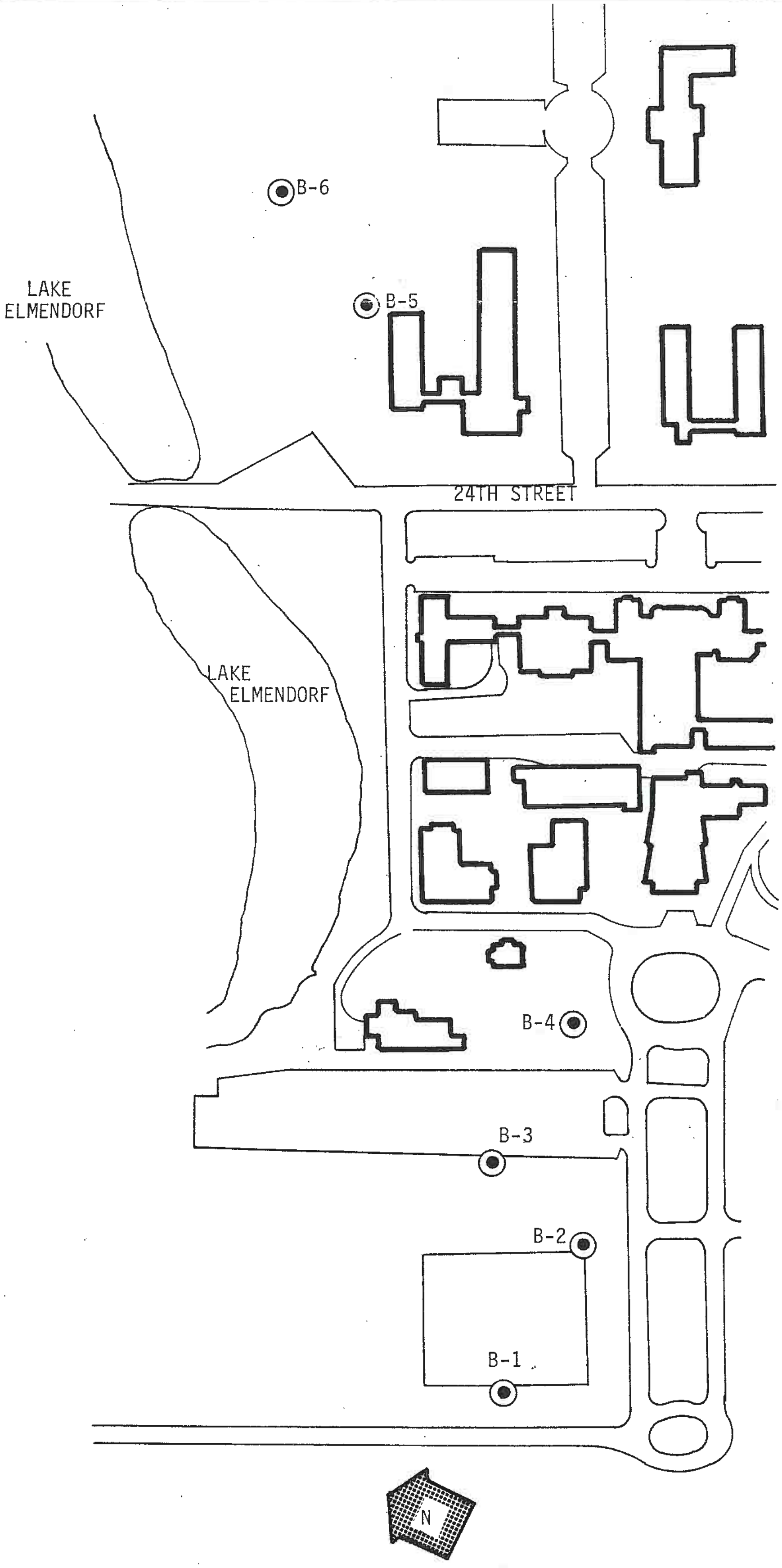
No.	DATE	DESCRIPTION

PROJECT No.: ASA12-017-00

ISSUE DATE:	2/21/2012
DRAWN BY:	MJR
CHECKED BY:	MJR
REVIEWED BY:	CLS

FIGURE 2

REPORT 1



PLAN OF BORINGS
SCALE: 1" = 250'

Raba-Kistner Consultants, Inc

PROJ. NO. SA0287-0074

PLATE 1

LOG OF BORING NO. B-1

UNIVERSITY ACTIVITIES AND WELLNESS CENTER
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon / 3" Shelby Tube

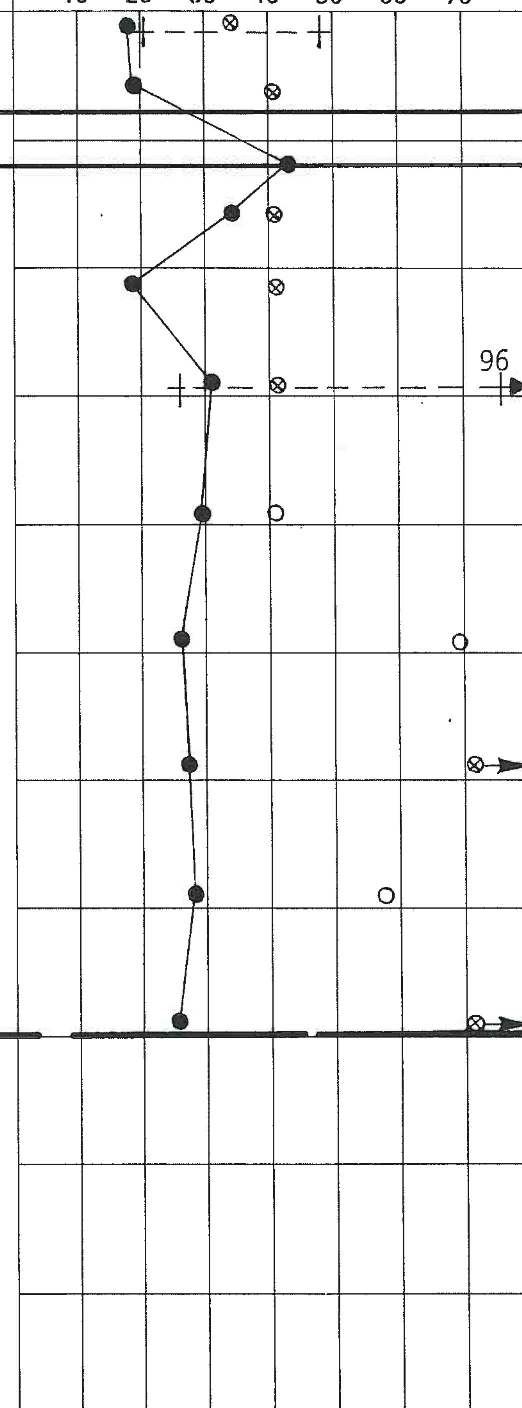
LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–4	CLAY, Stiff, Dark Brown with a trace of gravel		
4–5.5	CLAY, Gravelly, Medium Dense, Tan	17	
5.5–40	CLAY, Very Stiff, Tan and Gray with ferrous and organic stains		
	- mottled from 19.0' to 40.0'		93
			101
	- seam of gypsum at 39.0'		95

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

ELEVATION, FT.



COMPLETION DEPTH: 40.0'
DATE: 7-8-87

DEPTH TO WATER IN BORING: 4.9'

DATE: 7-10-87

PROJ. NO. SA0287-0074
PLATE 2

NOTE: These logs should not be usec paratately from the project report.

LOG OF BORING NO. B-2

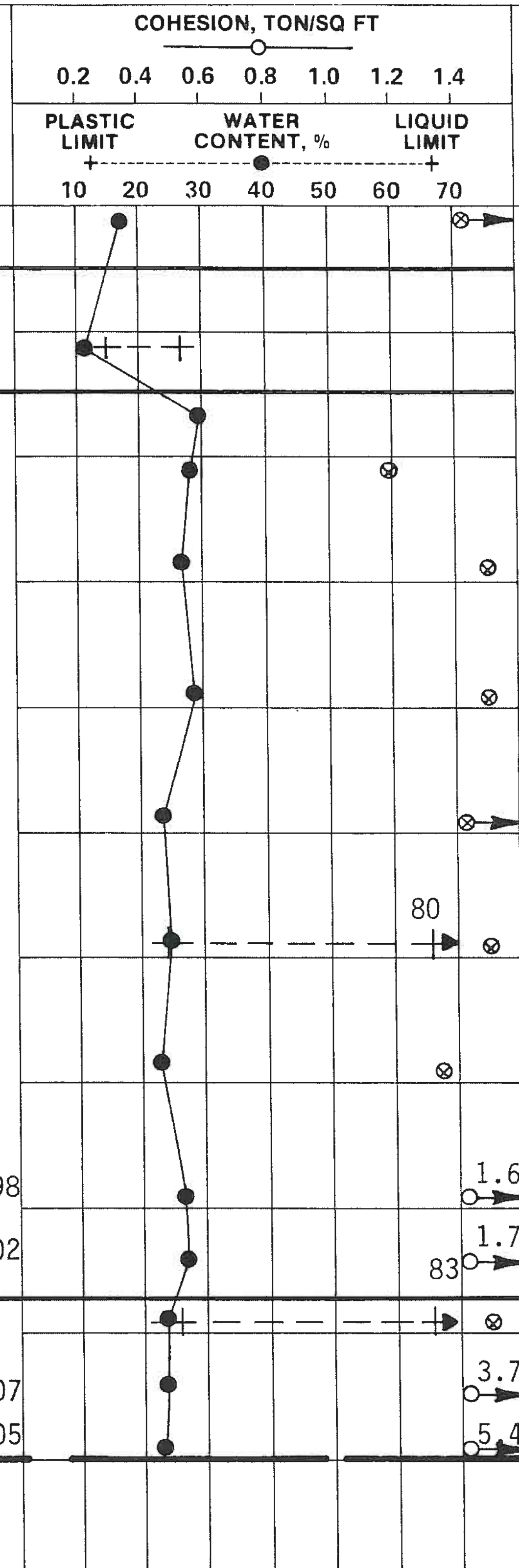
UNIVERSITY ACTIVITIES AND WELLNESS CENTER
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–3	CLAY, Very Stiff, Dark Brown with a trace of gravel	50	
3–7	CLAY, Gravelly, Dense to Very Dense, Tan (wet)	50/6"	
7–48	CLAY, Very Stiff to Hard, Tan and Gray with ferrous and organic stains	38	98, 102
	- mottled from 29.0' to 49.5'		
48–60	SHALE, Clay, Hard, Gray with a trace of shell		107, 105



ELEVATION, FT.

NOTE CHANGE IN INTERVAL

NOTE: These logs should not be used separately from the project report.

COMPLETION DEPTH: 60.0'
DATE: 7-8-87

DEPTH TO WATER IN BORING: 4.4'
DATE: 7-10-87

PROJ. NO. SA0287-0074
PLATE 3

LOG OF BORING NO. B-3

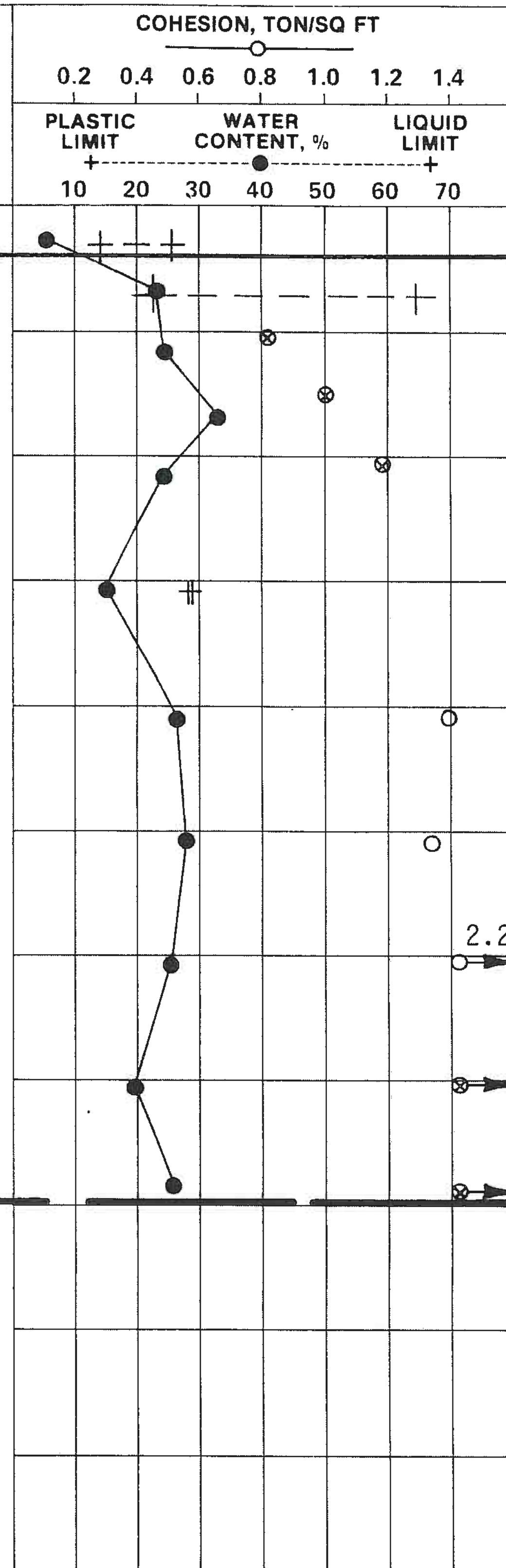
UNIVERSITY ACTIVITIES AND WELLNESS CENTER
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL.:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–2	PAVEMENT: ASPHALT - 1-1/2" BASE 22-1/2" (Tan Gravelly Clay)		
2–40	CLAY, Stiff to Hard, Tan and Gray with ferrous stains and a trace of caliche to 7.0'		
	- seam of Reddish-Brown Silt Stone from 15.0' to 16.5'		
19			98
24			99
	- mottled from 25.0' to 32.0'		
29			101
	- seams of Ferrous Oxide from 35.0' to 40.0'		



ELEVATION, FT.

COMPLETION DEPTH: 40.0'
DATE: 7-8-87

DEPTH TO WATER IN BORING: 7.0'
DATE: 7-10-87

PROJ. NO. SA0287-0074
PLATE 4

NOTE: These logs should not be used separately from the project report.

LOG OF BORING NO. B-4

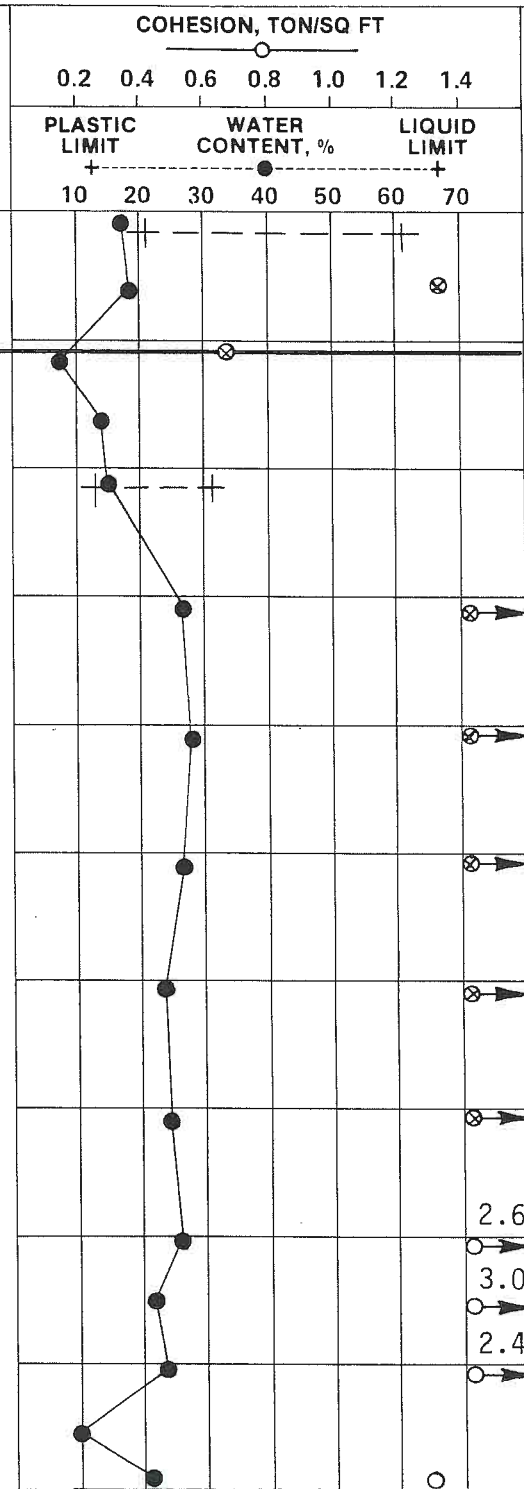
UNIVERSITY ACTIVITIES AND WELLNESS CENTER
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–5	CLAY, Stiff to Very Stiff, Dark Brown with a trace of gravel	13	
5–60	CLAY, Very Stiff to Hard, Tan and Gray with ferrous and organic stains	28	
	- silty clay from 10.0' to 12.0'	38	
	- mottled from 25.0' to 35.0'		
	- seams of gypsum at 35.0'		
40			101
			105
50			103
		50	
60			106



ELEVATION, FT.

NOTE CHANGE IN INTERVAL

NOTE: These logs should not be used separately from the project report.

COMPLETION DEPTH: 60.0'
DATE: 7-8-87

DEPTH TO WATER IN BORING: 7.0'
DATE: 7-10-87

PROJ. NO. SA0287-0074
PLATE 5

LOG OF BORING NO. B-5

UNIVERSITY ACTIVITIES AND WELLNESS CENTER
SAN ANTONIO, TEXAS

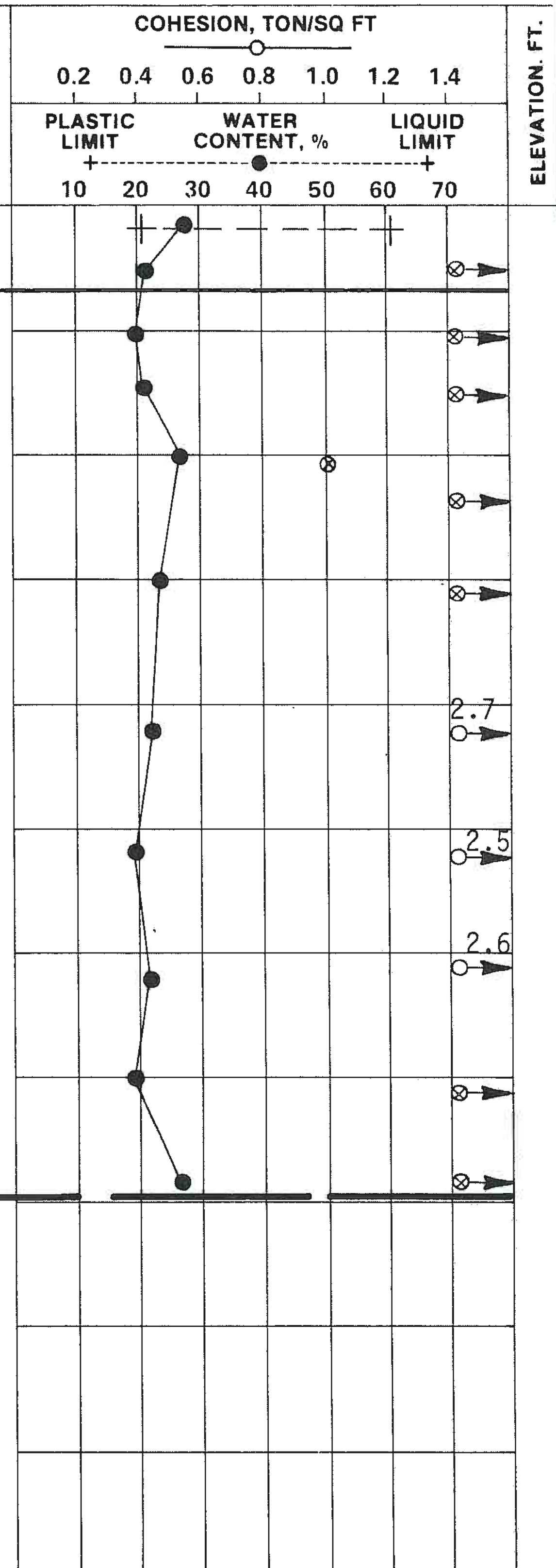
Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–3			CLAY, Stiff to Very Stiff, Dark Brown	12	
3–40			CLAY, Very Stiff to Hard, Tan and Gray with some ferrous stains		
20					107
25			- mottled from 26.0' to 40.0'		110
30					106

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50



COMPLETION DEPTH: 40.0'
DATE: 7-6-87

DEPTH TO WATER IN BORING: 9.0'

DATE: 7-7-87

PROJ. NO. SA0287-0074
PLATE 6

NOTE: These logs should not be used separately from the project report.

LOG OF BORING NO. B-6

UNIVERSITY ACTIVITIES AND WELLNESS CENTER
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

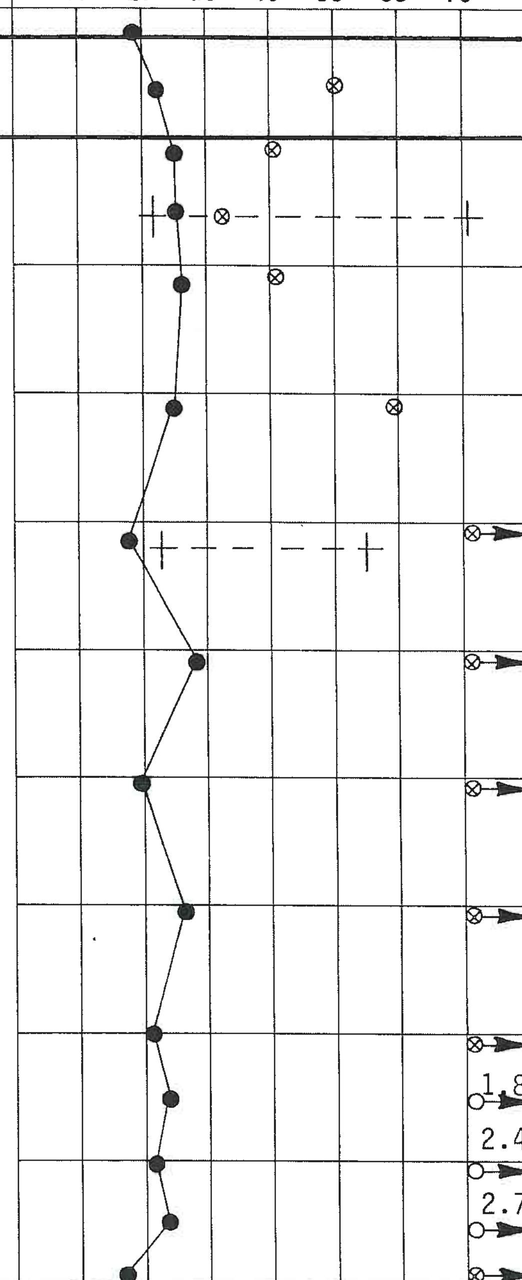
LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0			FILL: CLAYS, Dark Brown and Tan with gravel	10	
			CLAY, Stiff to Very Stiff, Dark Brown		
5			CLAY, Stiff to Hard, Tan and Gray with ferrous and organic stains		
10					
15					
20			- mottled from 21.0' to 56.0'		
25					
30					
35					
40					
					103
50			- seams of Gray Clay Shale and seams of gypsum from 50.0' to 60.0'		105
					105
60					

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

ELEVATION, FT.



NOTE CHANGE IN INTERVAL

NOTE: These logs should not be used separately from the project report.

COMPLETION DEPTH: 60.0'
DATE: 7-7-87

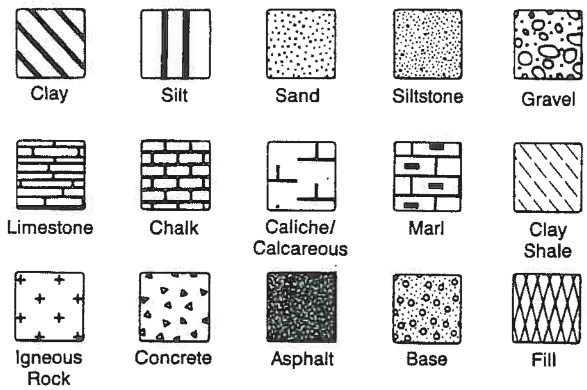
DEPTH TO WATER IN BORING: 8.0'
DATE: 7-10-87

PROJ. NO. SA0287-0074
PLATE 7

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL OR ROCK TYPES

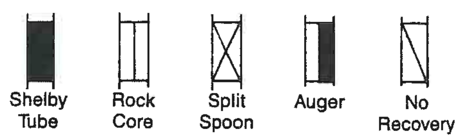
(shown in symbols column)



(Predominate Soil Types Shown Heavy)

SAMPLER TYPES

(shown in sample column)



STRENGTH TEST RESULTS

⊕ - Estimated Strength
◇ - Torvane
○ - Unconfined Compression

TRIAXIAL COMPRESSION

△ - Unconsolidated-undrained
□ - Consolidated-undrained

C - Cohesion (Total)
Φ - Angle of Internal Friction (Total)

C' - Cohesion (Effective)
Φ' - Angle of Internal Friction (Effective)

NOTE:

Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or condition are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc. 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated	- composed of thin layers of varying color and texture.
Interbedded	- composed of alternate layers of different soil types.
Calcareous	- containing appreciable quantities of calcium carbonate.
Well graded	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded	- predominantly of one grain size, or having a range of sizes with some intermediate size missing.

TERMS DESCRIBING CONSISTENCY OR CONDITION

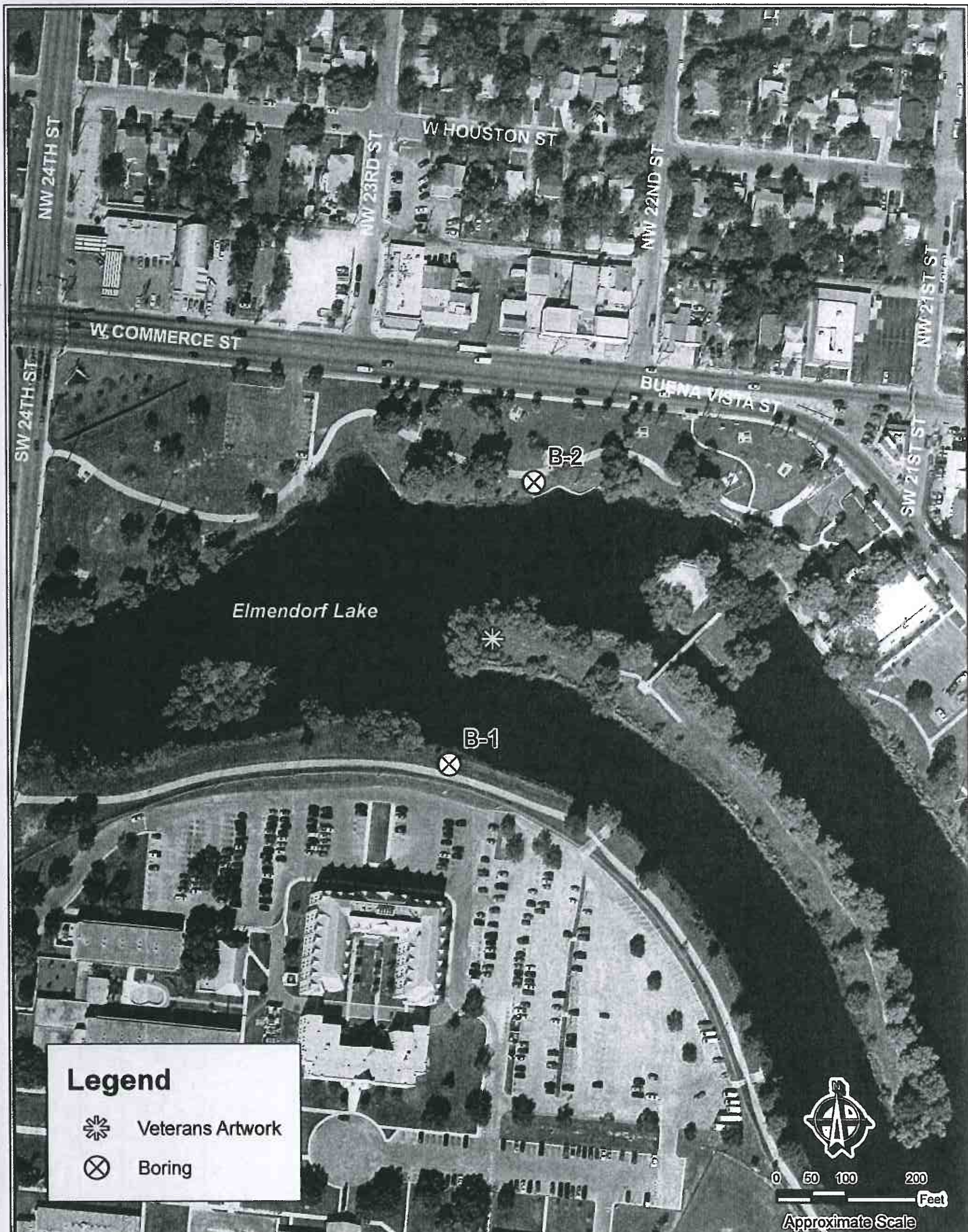
RELATIVE DENSITY		COHESIVE STRENGTH			PLASTICITY	
Penetration Resistance, blows per foot	Relative Density	Penetration Resistance, blows per foot	Consistency	Cohesion, TSF	Plasticity Index	Degree of Plasticity
0-4	Very Loose	0-2	Very Soft	0-0.125	0-5	None
4-10	Loose	2-4	Soft	0.125-0.25	5-10	Low
10-30	Medium Dense	4-8	Firm	0.25-0.5	10-20	Moderate
30-50	Dense	8-15	Stiff	0.5-1.0	20-40	Plastic
> 50	Very Dense	15-30	Very Stiff	1.0-2.0	> 40	Highly Plastic
		> 30	Hard	> 2.0		

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

Raba-Kistner Consultants, Inc.

PROJ. NO. SA0287-0074

REPORT 2



Raba Kistner Engineering • Testing • Environmental Facilities • Infrastructure	**BORING LOCATION MAP** ELMENDORF LAKE PARK VETERANS ARTWORK SAN ANTONIO, TEXAS	Project No. ASA08-174-00 **FIGURE 1**

SOURCE: 2007 Aerial Photograph Provided by The City of San Antonio (COSA)
NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes

LOG OF BORING NO. B-1

Elmendorf Lake Park Veteran's Artwork
San Antonio, Texas

Raba Kistner

DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

SHEAR STRENGTH, TONS/FT²: 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70 80

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
0 – 4.5	Clay	X	CLAY, Very Stiff, Dark Brown	15			
		X		24		42	
4.5 – 13.5	Clay	X	CLAY, Very Stiff, Dark Gray	22			
		X		19			
		X		28		46	
13.5 – 38.5	Clay	X	CLAY, Very Stiff to Hard, Tan, with gray mottling	28			
		X		44			
		X		50/6"		26	
		X	-DRILLER'S NOTE: WATER encountered at 28-1/2 ft	50/10"			
				ref/2"			
38.5 – 44.6	Clayshale	X	CLAYSHALE, Hard, Gray	50/6"			
		X		50/8"			

NOTE: THESE LOGS SHOULD NOT BE U SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	44.6 ft	**DEPTH TO WATER:**	28.5 ft	**PROJ. No.:**	ASA08-174-00
DATE DRILLED:	1/15/2009	**DATE MEASURED:**	1/15/2009	**FIGURE:**	2

LOG OF BORING NO. B-2

Elmendorf Lake Park Veteran's Artwork
San Antonio, Texas

Raba Kistner

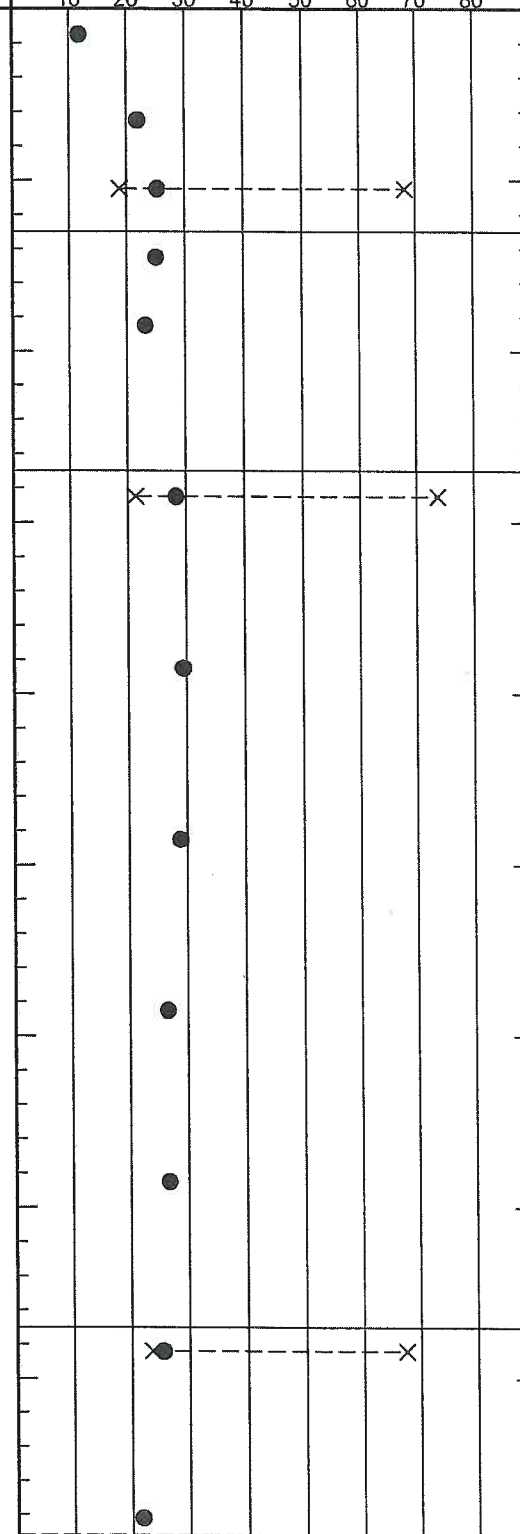
DRILLING METHOD: Straight Flight Auger

LOCATION: See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WIEGHT, pcf	PLASTICITY INDEX	% -200
			CLAY, Very Stiff to Hard, Dark Brown	46			
				50			
5				17		49	
			CLAY, Very Stiff, Dark Gray	22			
10				19			
15			CLAY, Very Stiff to Hard, Tan, with gray mottling	26		53	
20				41			
25				37			
30				42			
35				37			
40			CLAYSHALE, Hard, Gray	50/11"		44	
				50/8"			

SHEAR STRENGTH, TONS/FT^2: 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70 80



DEPTH DRILLED: 44.7 ft
DATE DRILLED: 1/15/2009

DEPTH TO WATER: Dry
DATE MEASURED: 1/15/2009

PROJ. No.: ASA08-174-00
FIGURE: 3

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

KEY TO TERMS AND SYMBOLS

MATERIAL TYPES

SOIL TERMS

- CALCAREOUS
- CALICHE
- CLAY
- CLAYEY
- GRAVEL
- GRAVELLY
- PEAT
- SAND
- SANDY
- SILT
- SILTY
- FILL

ROCK TERMS

- CHALK
- CLAYSTONE
- CLAY-SHALE
- CONGLOMERATE
- DOLOMITE
- IGNEOUS
- LIMESTONE
- MARL
- METAMORPHIC
- SANDSTONE
- SHALE
- SILTSTONE

OTHER

- ASPHALT
- BASE
- CONCRETE/CEMENT
- BRICKS / PAVERS
- WASTE
- NO INFORMATION

WELL CONSTRUCTION AND PLUGGING MATERIALS

- BLANK PIPE
- SCREEN
- BENTONITE
- CEMENT GROUT
- BENTONITE & CUTTINGS
- CONCRETE/CEMENT
- CUTTINGS
- GRAVEL
- SAND
- VOLCLAY

SAMPLE TYPES

- AIR ROTARY
- GRAB SAMPLE
- CORE
- GEOPROBE SAMPLER
- MUD ROTARY
- NO RECOVERY
- NX CORE
- TEXAS CONE PENETROMETER
- SHELBY TUBE
- SPLIT BARREL
- SPLIT SPOON

STRENGTH TEST TYPES

- POCKET PENETROMETER
- TORVANE
- UNCONFINED COMPRESSION
- TRIAXIAL COMPRESSION UNCONSOLIDATED-UNDRAINED
- TRIAXIAL COMPRESSION CONSOLIDATED-UNDRAINED

NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

PROJECT NO. ASA08-174-00

Raba-Kistner

REVISED 02/2005

FIGURE 4a

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-06 and D2488-00, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2005.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Depth measurements may be presented in a manner that implies greater precision in depth measurement, i.e 6.71 meters. The reader should understand and interpret this information only within the stated half-foot tolerance on depth measurements.

RELATIVE DENSITY

Penetration Resistance Blows per ft	Relative Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
> 50	Very Dense

COHESIVE STRENGTH

Resistance Blows per ft	Consistency	Cohesion TSF
0 - 2	Very Soft	0 - 0.125
2 - 4	Soft	0.125 - 0.25
4 - 8	Firm	0.25 - 0.5
8 - 15	Stiff	0.5 - 1.0
15 - 30	Very Stiff	1.0 - 2.0
> 30	Hard	> 2.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0 - 5	None
5 - 10	Low
10 - 20	Moderate
20 - 40	Plastic
> 40	Highly Plastic

ABBREVIATIONS

B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
BTEX = Total BTEX
TPH = Total Petroleum Hydrocarbons
ND = Not Detected
NA = Not Analyzed
NR = Not Recorded/No Recovery
OVA = Organic Vapor Analyzer
ppm = Parts Per Million

Qam, Qas, Qal = Quaternary Alluvium
Qat = Low Terrace Deposits
Qbc = Beaumont Formation
Qt = Fluviatile Terrace Deposits
Qao = Seymour Formation
Qle = Leona Formation
Q-Tu = Uvalde Gravel
Ewi = Wilcox Formation
Emi = Midway Group
Mc = Catahoula Formation
El = Laredo Formation
Kknm = Navarro Group and Marlbrook Marl
Kpg = Pecan Gap Chalk
Kau = Austin Chalk

Kef = Eagle Ford Shale
Kbu = Buda Limestone
Kdr = Del Rio Clay
Kft = Fort Terrett Member
Kgt = Georgetown Formation
Kep = Person Formation
Kek = Kainer Formation
Kes = Escondido Formation
Kew = Walnut Formation
Kgr = Glen Rose Formation
Kgru = Upper Glen Rose Formation
Kgrl = Lower Glen Rose Formation
Kh = Hensell Sand

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

SAMPLING METHODS

RELATIVELY UNDISTURBED SAMPLING

Cohesive soil samples are to be collected using three-inch thin-walled tubes in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587) and granular soil samples are to be collected using two-inch split-barrel samplers in general accordance with the Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586). Cohesive soil samples may be extruded on-site when appropriate handling and storage techniques maintain sample integrity and moisture content.

STANDARD PENETRATION TEST (SPT)

A 2-in.-OD, 1-3/8-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

SPLIT-BARRELL SAMPLER DRIVING RECORD

Blows Per Foot	Description
25	25 blows drove sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows drove sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows drove sampler 3 inches during initial 6-inch seating interval.

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Elmendorf Lake Park Veteran's Artwork
San Antonio, Texas

FILE NAME: ASA08-174-00.GPJ 3/4/2009

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-1	0.0 to 1.5	15	18								
	2.5 to 4.0	24	13	59	17	42					
	4.5 to 6.0	22	16								
	6.5 to 8.0	19	27								
	8.5 to 10.0	28	22	63	17	46					
	13.5 to 15.0	28	25								
	18.5 to 20.0	44	25								
	23.5 to 24.5	50/6"	17	44	18	26					
	28.5 to 29.8	50/10"	25								
	33.5 to 33.6	ref/2"	21								
	38.5 to 39.5	50/6"	24								
	43.5 to 44.6	50/8"	23								
B-2	0.0 to 1.5	46	12								
	2.5 to 4.0	50	22								
	4.5 to 6.0	17	25	68	19	49					
	6.5 to 8.0	22	25								
	8.5 to 10.0	19	23								
	13.5 to 15.0	26	28	74	21	53					
	18.5 to 20.0	41	29								
	23.5 to 25.0	37	29								
	28.5 to 30.0	42	26								
	33.5 to 35.0	37	27								
	38.5 to 39.9	50/11"	25	67	23	44					
	43.5 to 44.7	50/8"	22								

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

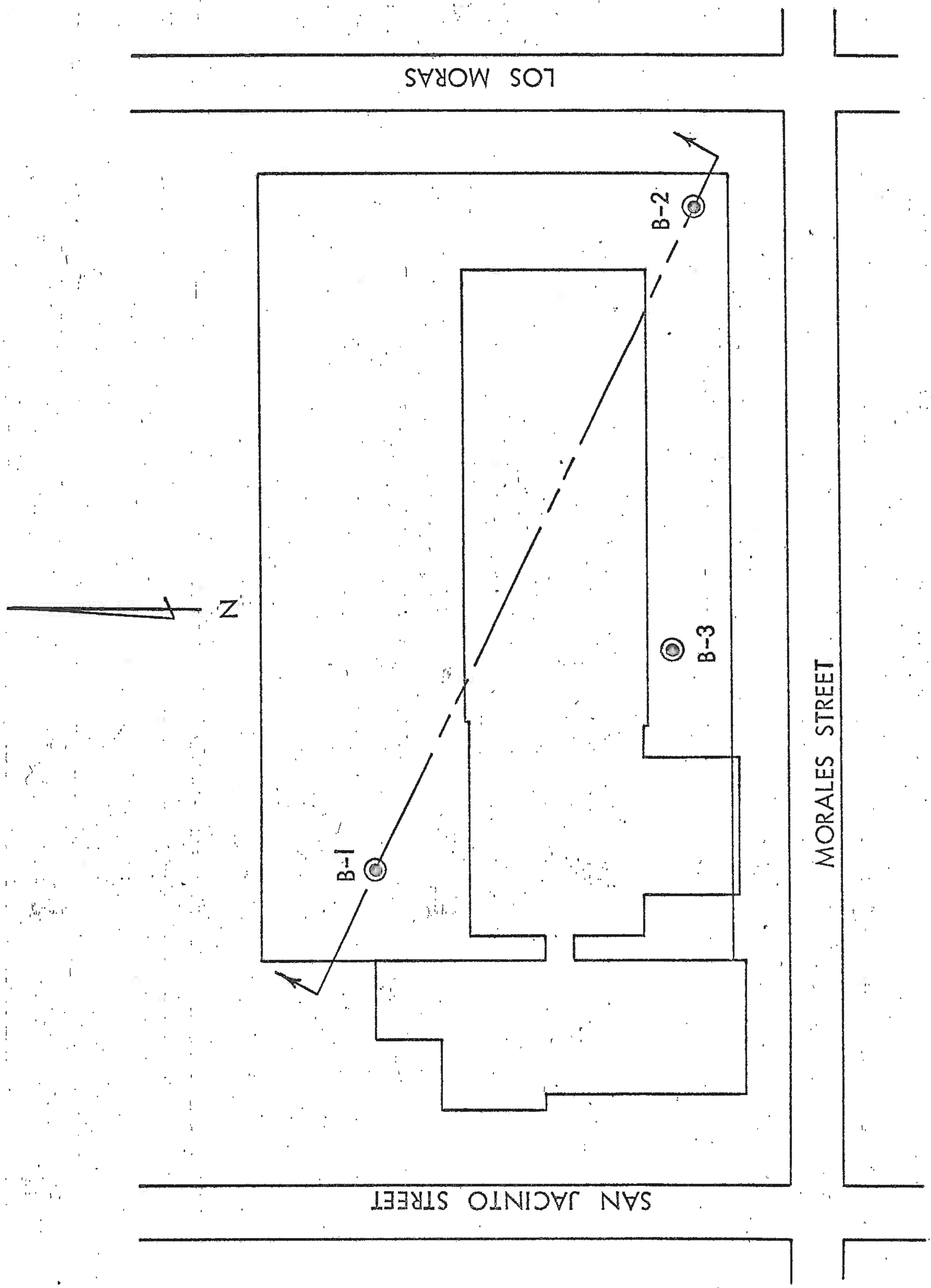
CU = Consolidated Undrained Triaxial

PROJECT NO. ASA08-174-00

Raba-Kistner

FIGURE 5

REPORT 3



LAYOUT OF BORINGS
Scale: 1" = 50'

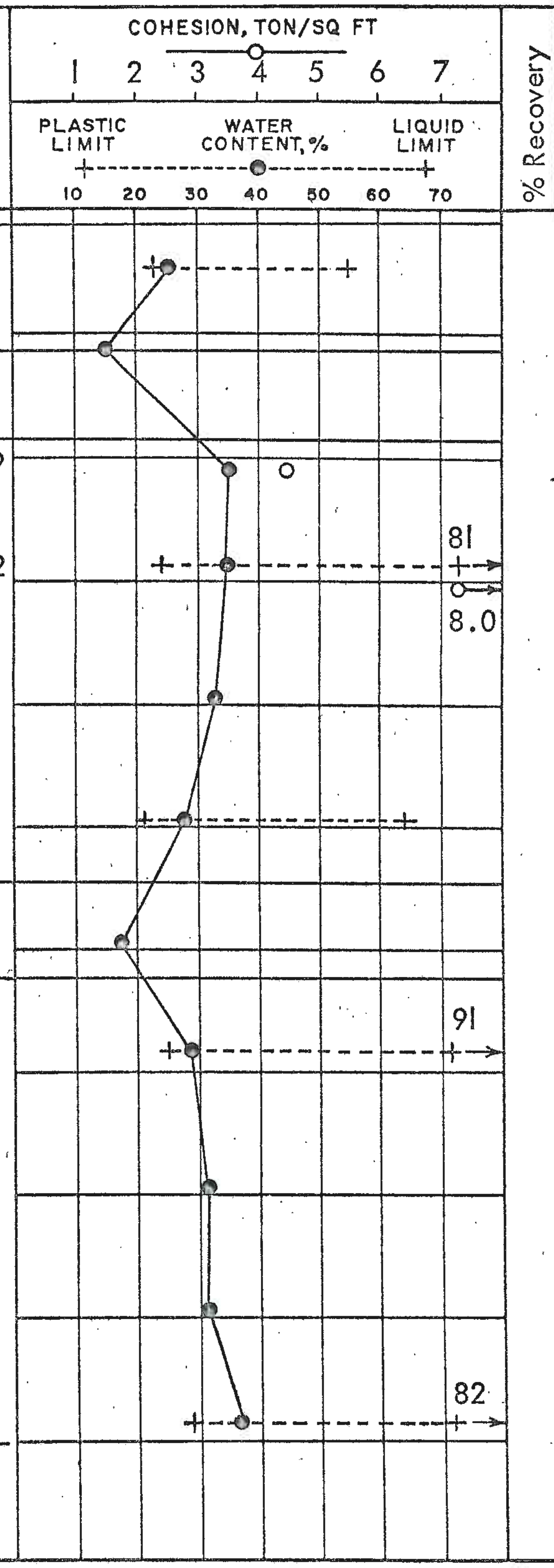
RABA AND TOLSON CONSULTING ENGINEERS, INC.

LOG OF BORING NO. 1

ANTHONY MARGILL ELEMENTARY SCHOOL
SAN ANTONIO, TEXAS

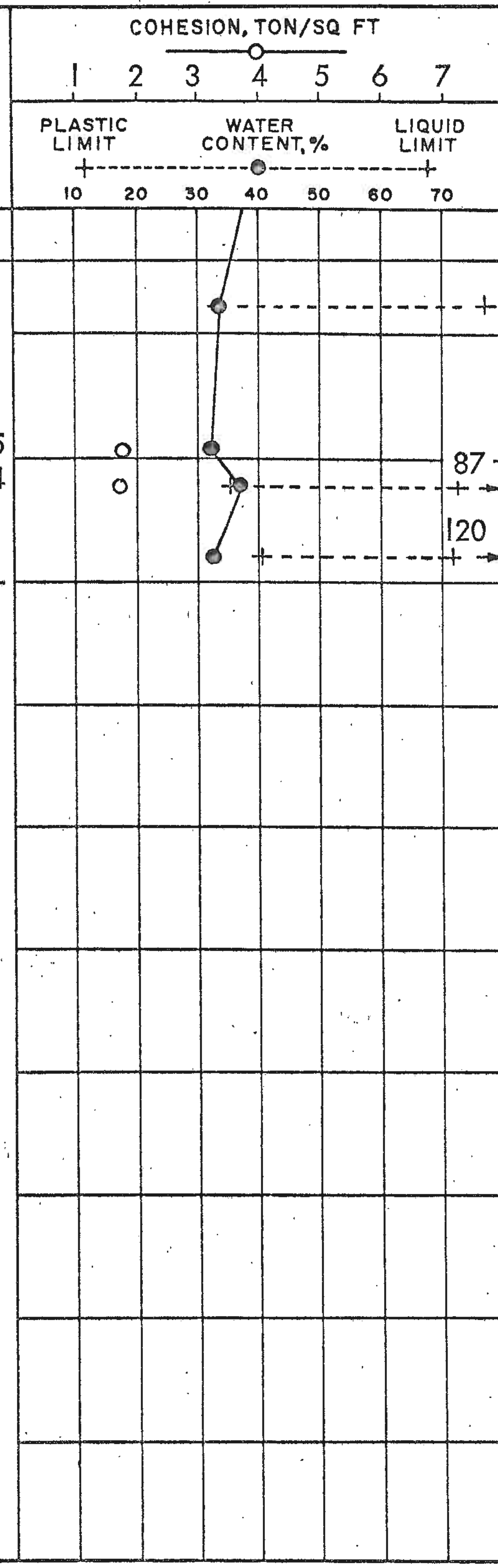
TYPE: 3" Shelby tube & NX Core Barrel LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL	UNIT DRY WT LB/CU FT
	Asphalt and Gravel Base	
	Very Stiff Dark Gray Clay	
5		
	Gravel (Dry)	
10	Very Stiff Tan and Gray Clay with calcareous pockets	89
		92
15		
20		
	- ferrous seam at 24'	
25		
	Very Stiff Gray Sandy Clay - slickensided at 60° at 30'	
30		
	Very Stiff to Hard Tan Clay - very jointed and slickensided with gypsum seams to 48'	
35		
	- slickensided at 60° at 40'	
40		
	- slickensided at 30° at 45'	
45		
	- very plastic layers with ferrous pockets below 48'	
50		
	CONTINUED	



LOG OF BORING NO. 1 (continued)

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIT DRY WT LB/CU FT	% Recovery
55 – 65			Gray Shaley Clay with bentonitic clay seams - limestone pockets at 58.5' - slickensided at 45° at 59' and 62'	85 84	92



Depth scale: 55, 60, 65, 70, 75, 80, 85, 90, 95, 100

COMPLETION DEPTH: 65'
DATE: August 29, 1969

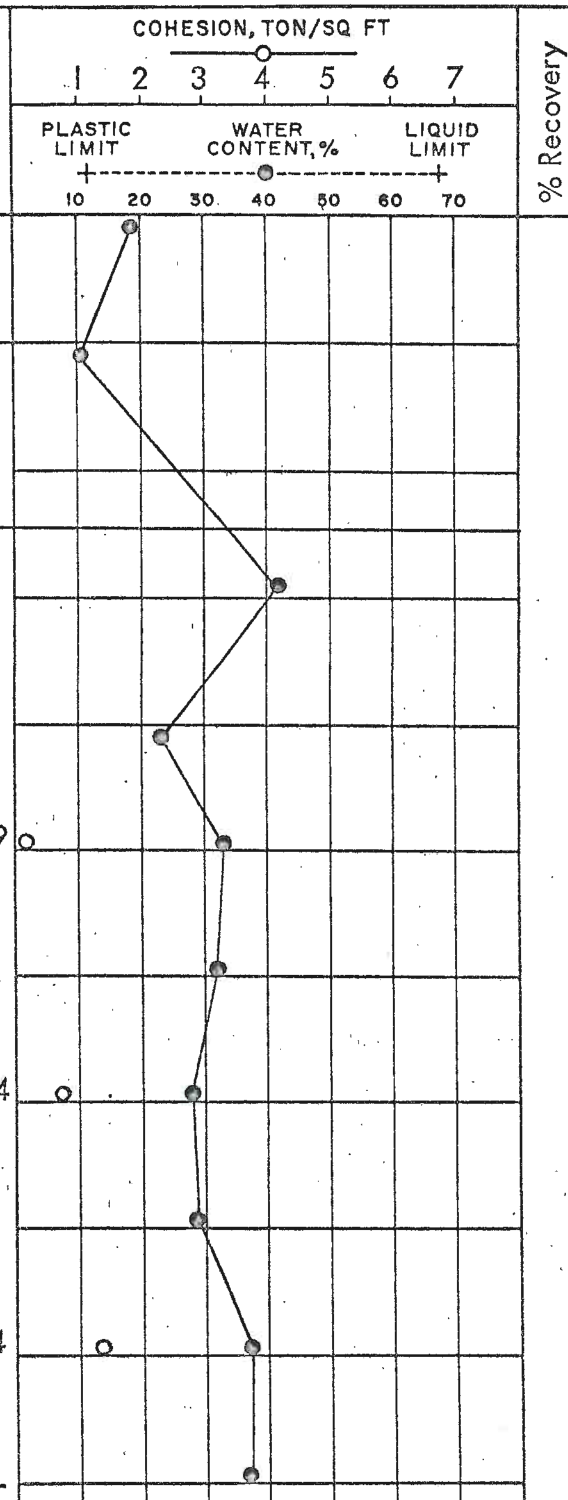
LOG OF BORING NO. 2

ANTHONY MARGILL ELEMENTARY SCHOOL
SAN ANTONIO, TEXAS

TYPE: 3" Shelby tube, 2" Split-spoon & NX Core Barrel

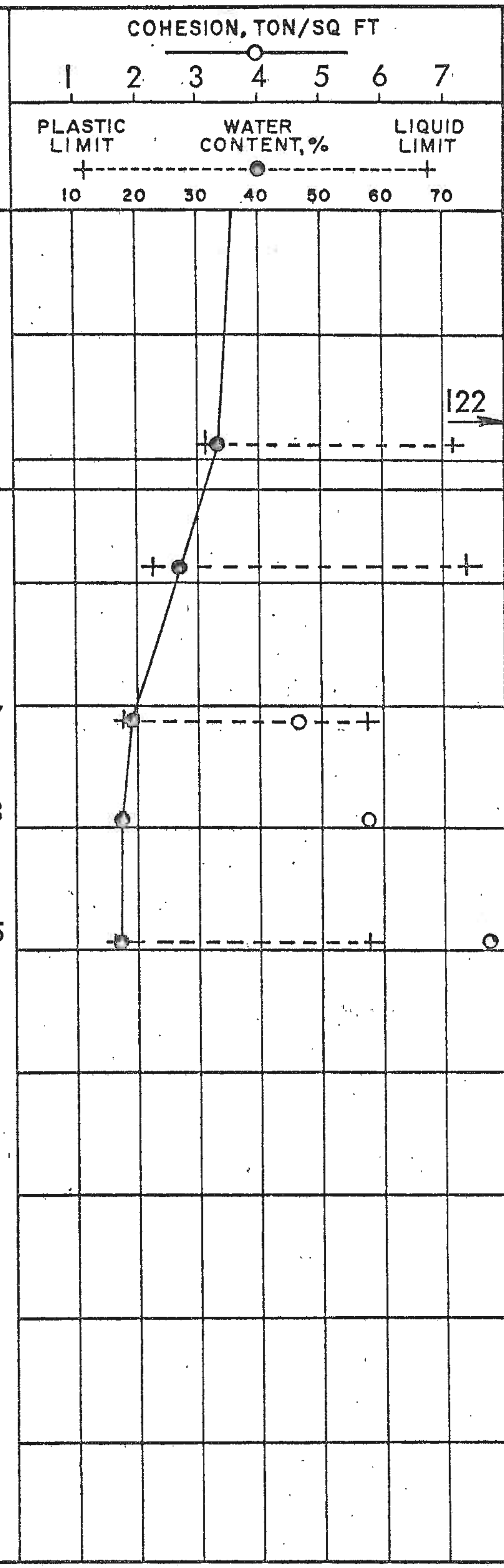
LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–4	Very Stiff Dark Gray Clay with gravel		
4–12	Clayey Gravel (Dry)	38	
12–50	Very Stiff Tan and Gray Clay, very jointed and slickensided		
24			89
34	- gypsum filled seams and pockets below 35'		94
	- slickensided at 45º at 35'		
44			84
48	- very plastic below 48'		
50	CONTINUED		



LOG OF BORING NO. 2 (continued)

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	% Recovery
55–60	- light tan bentonite below 56.5'			
60–80	Gray Shaley Clay			
70			107	
75			108	100
80			115	



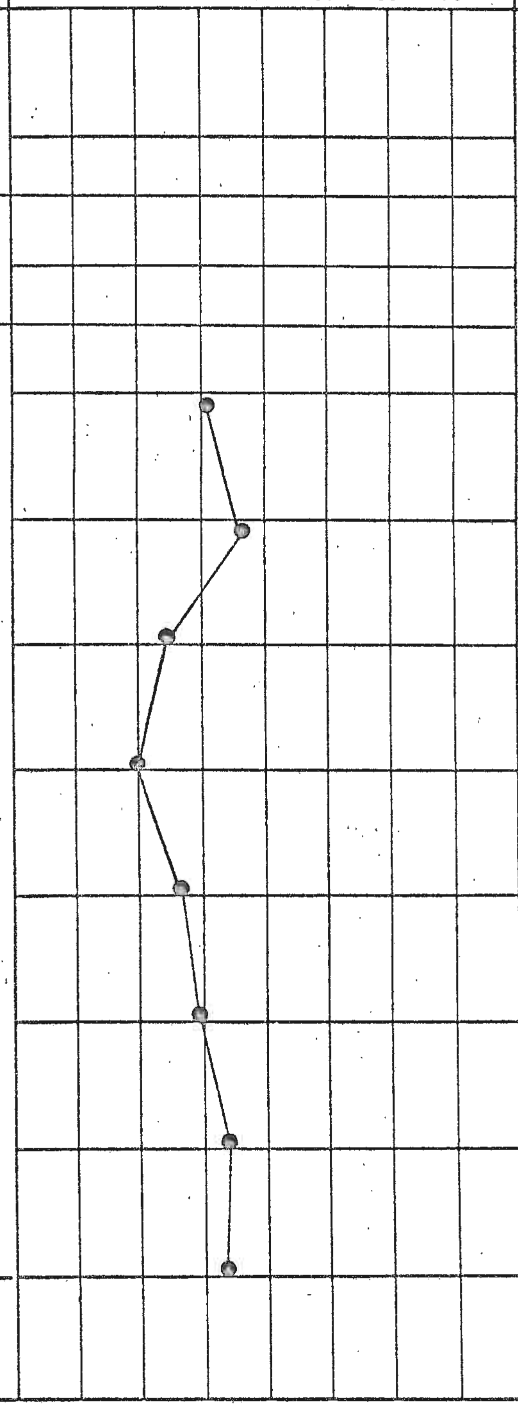
COMPLETION DEPTH: 80'
DATE: September 3, 1969

LOG OF BORING NO. 3

ANTHONY MARGILL ELEMENTARY SCHOOL
SAN ANTONIO, TEXAS

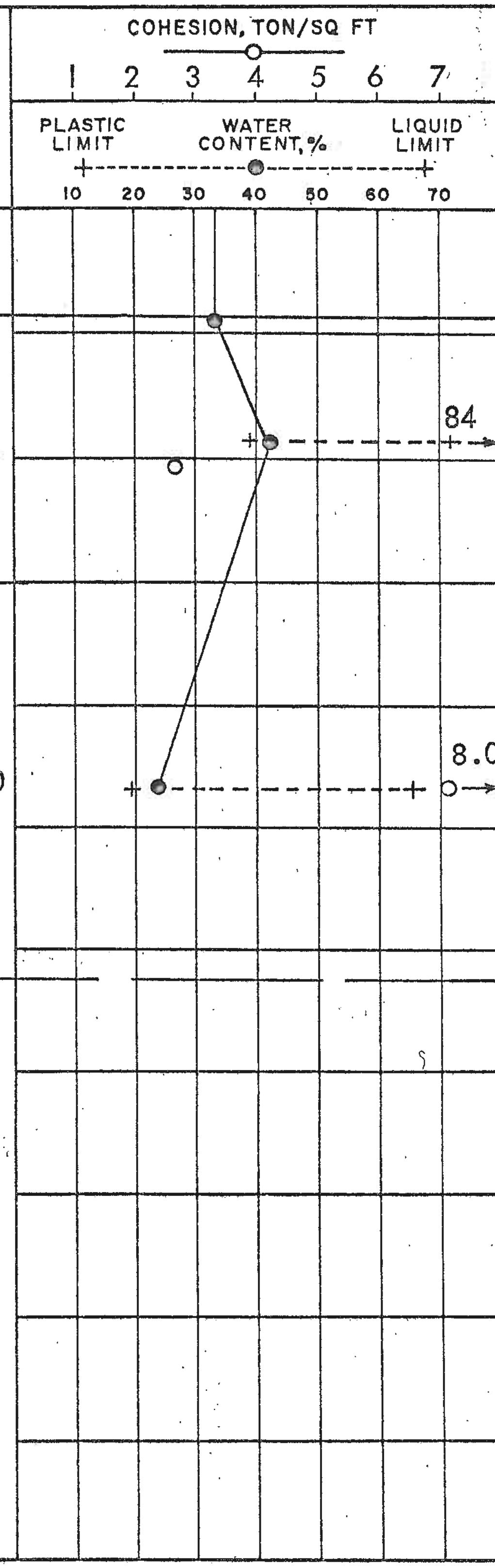
TYPE: 3" Shelby tube & NX Core Barrel   LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (1 2 3 4 5 6 7); PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	% Recovery
0–7			Very Stiff Dark Gray Clay			
7–12			Clayey Gravel (Dry)			
12–50			Very Stiff Tan and Gray Clay, very jointed and slickensided with gypsum filled seams - very highly jointed and shattered structure at 39'			
			CONTINUED			



LOG OF BORING NO. 3 (continued)

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIT DRY WT LB/CU FT	% Recovery
55–65			Gray Shaley Clay with bentonite clay seams - very strong gaseous odor at 59'	77	50
65–81			Gray Clay Shale	100	100
85–100			**Note:** Piezometer set in borehole upon completion of drilling.		



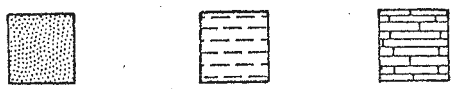
COMPLETION DEPTH: 81'
DATE: September 12, 1969

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL OR ROCK TYPES

(shown in symbols column)

Clay   Silt   Sand   Gravel

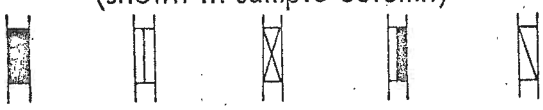


Sandstone   Shale   Limestone

Predominate Soil Types Shown Heavy

SAMPLER TYPES

(shown in sample column)



Shelby Tube   Rock Core   Split Spoon   Auger   No Recovery

STRENGTH TEST RESULTS

⊗ - Estimated Strength
○ - Unconfined Compression

TRIAXIAL COMPRESSION
(Single-Stage Tests)

△ - Unconsolidated-undrained
□ - Consolidated-undrained

(Multiple-Stage Tests)

c - Apparent Cohesion
ϕ - Apparent Angle of Internal Friction

NOTE:
Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

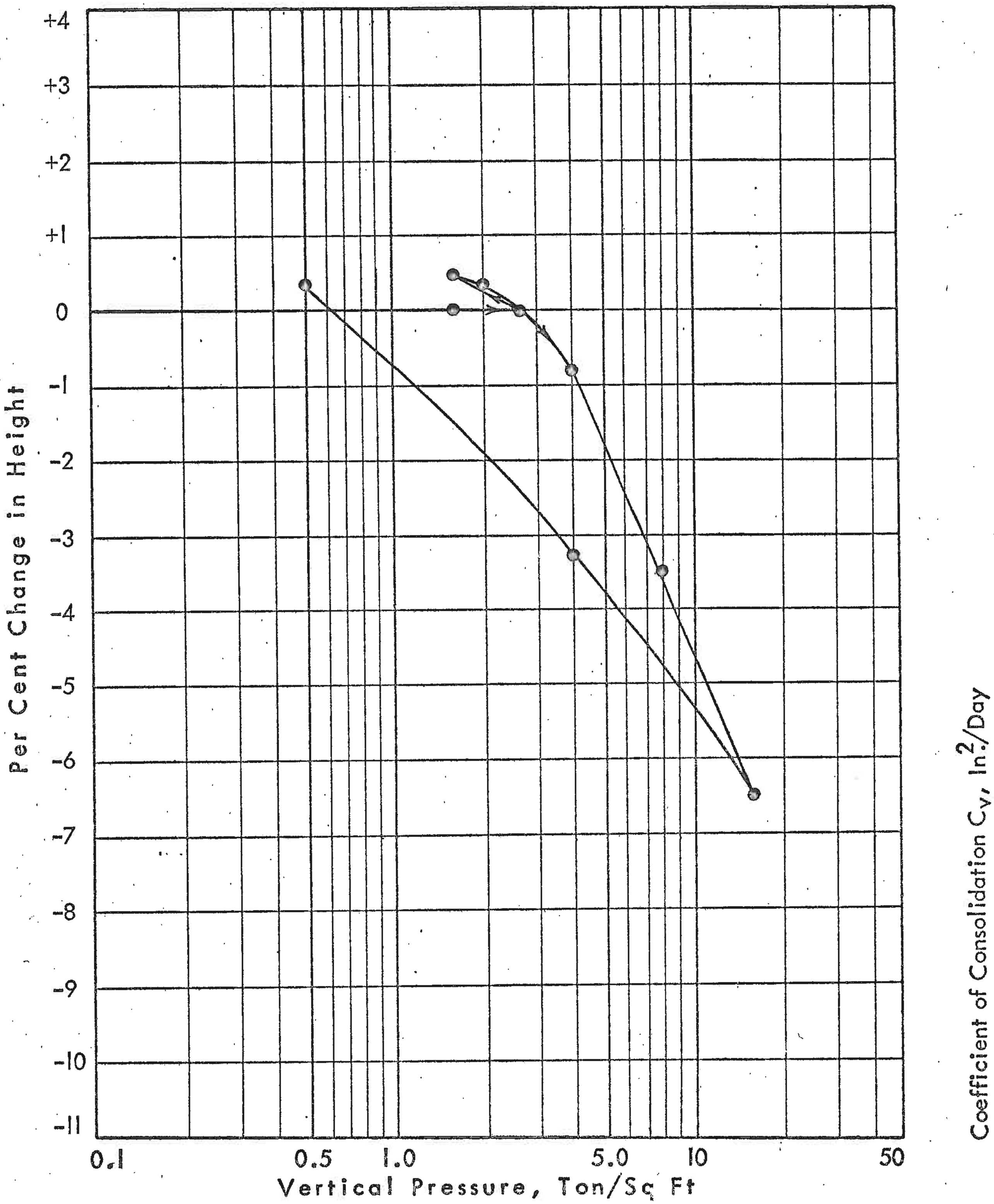
Terms used in this report to describe soils with regard to their consistency or condition are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., August, 1960, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided -	having inclined planes of weakness that are slick and glossy in appearance.
Fissured -	containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated -	composed of thin layers of varying color and texture.
Interbedded -	composed of alternate layers of different soil types.
Calcareous -	containing appreciable quantities of calcium carbonate.
Well graded -	having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded -	predominantly of one grain size, or having a range of sizes with some intermediate size missing.

Boring: B-1 Depth: 24.5'
Material: Very Stiff Tan and Gray Clay

Unit Dry Weight: 89 lb/cu ft
Water Content: 30 %
Liquid Limit: 65
Plastic Limit: 21

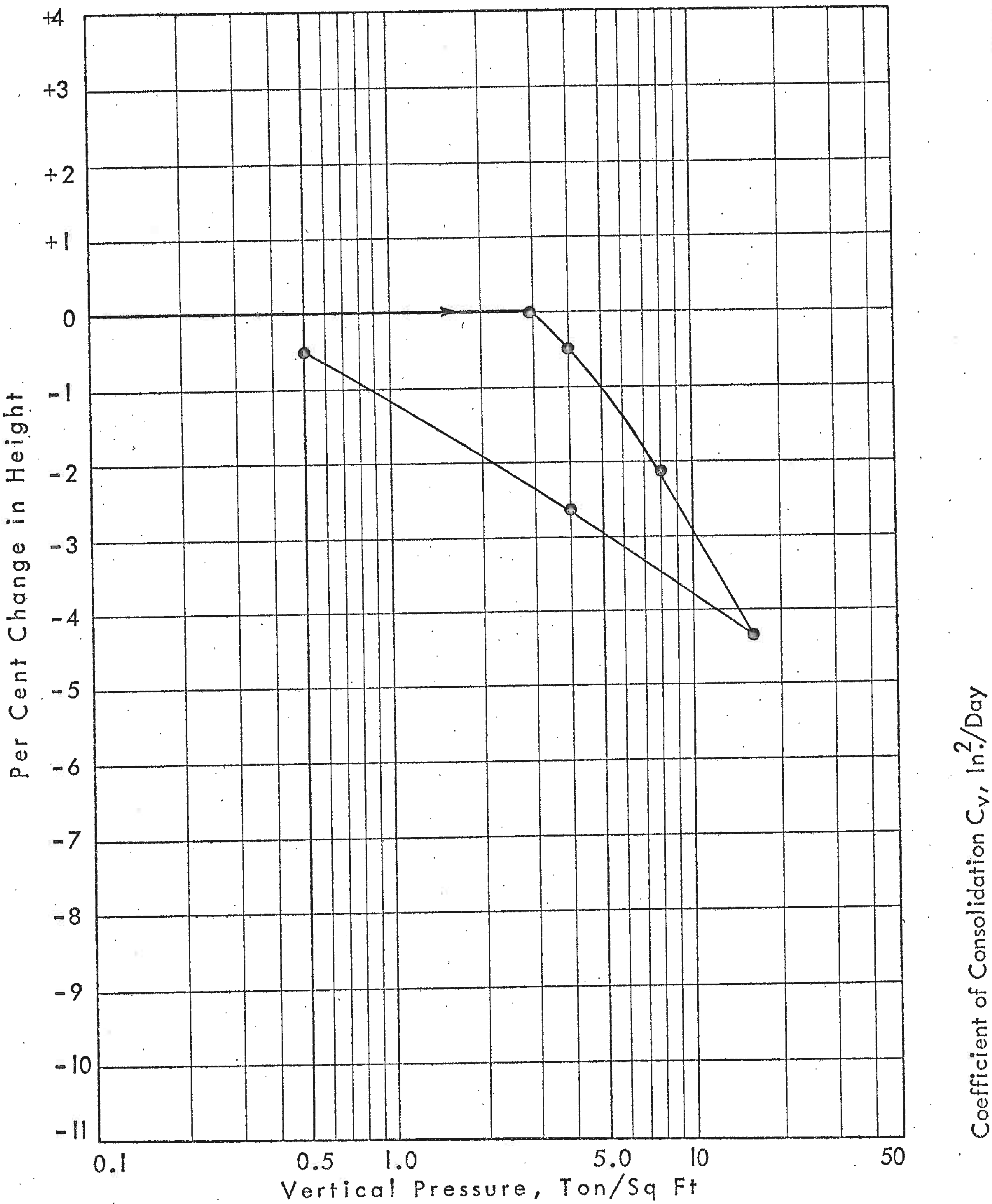


SWELL AND
CONSOLIDATION TEST RESULTS

RABA AND TOLSON CONSULTING ENGINEERS, INC.

Boring: B-1 Depth: 50'
Material: Very Stiff Tan Clay

Unit Dry Weight: 86 lb/cu ft
Water Content: 36 %
Liquid Limit: 82
Plastic Limit: 29

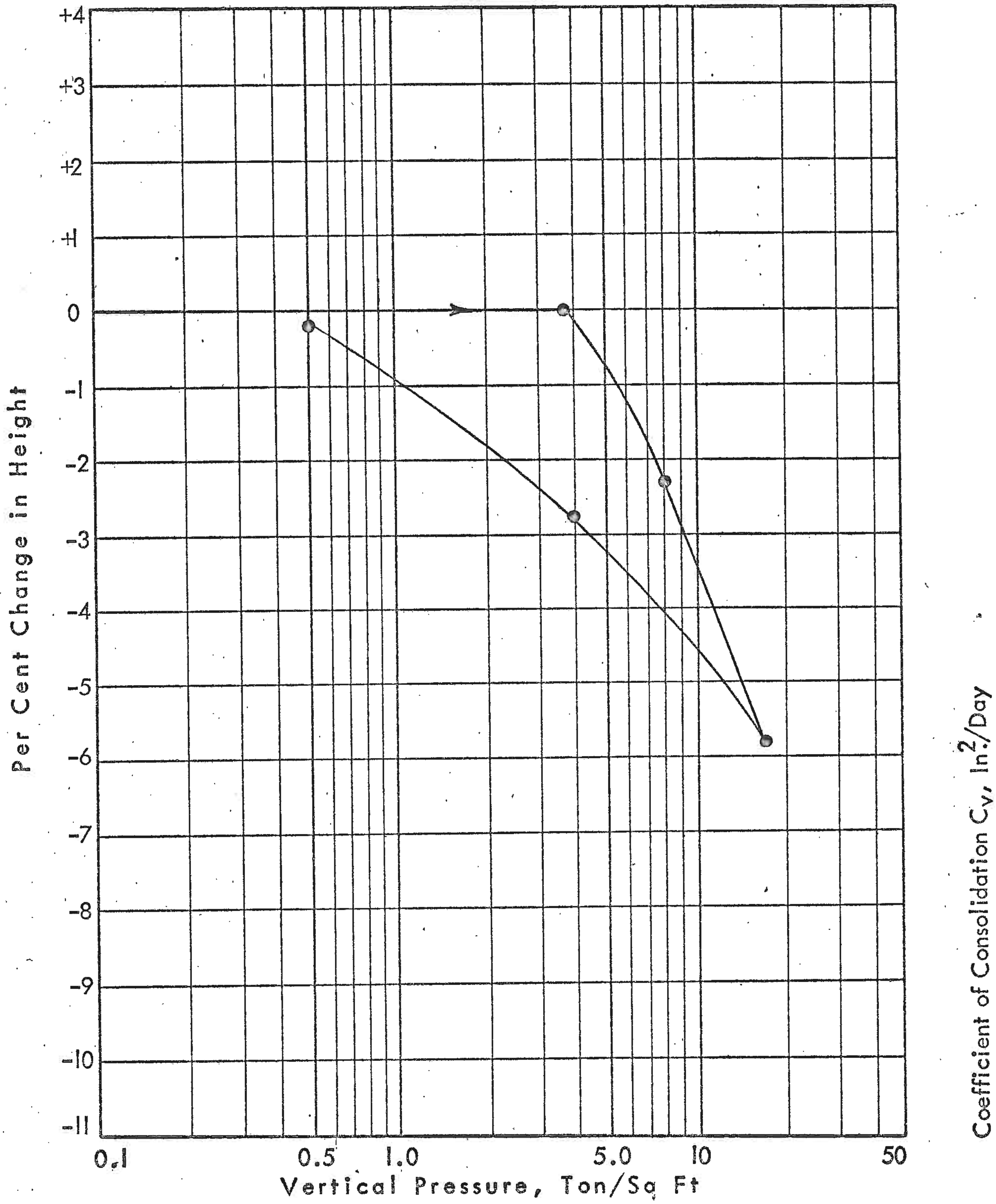


SWELL AND
CONSOLIDATION TEST RESULTS

RABA AND TOLSON CONSULTING ENGINEERS, INC.

Boring: B-2 Depth: 59'
Material: Very Stiff Light Tan Bentonitic Clay

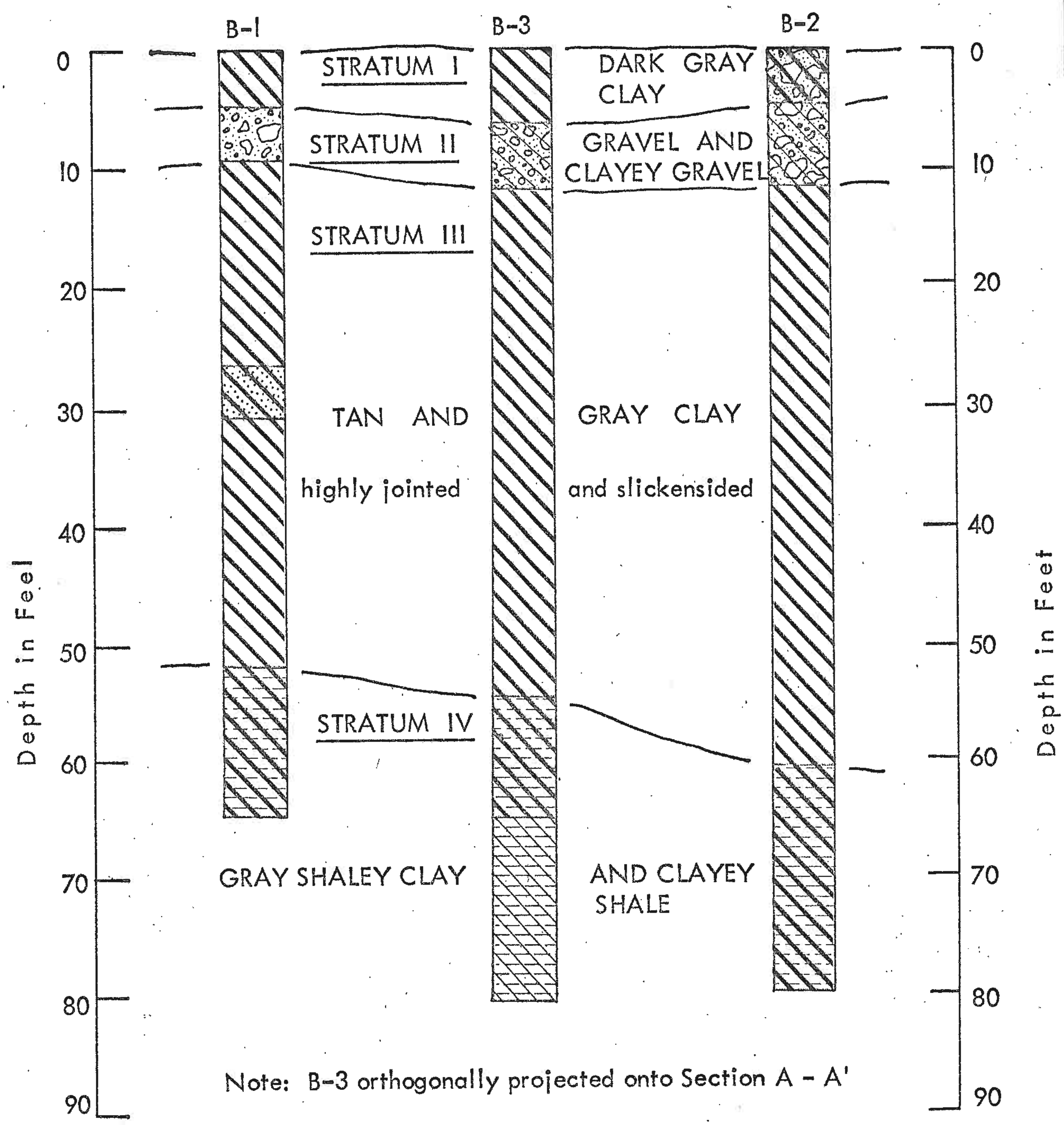
Unit Dry Weight: 73 lb/cu ft
Water Content: 47 %
Liquid Limit: 122
Plastic Limit: 31



SWELL AND
CONSOLIDATION TEST RESULTS

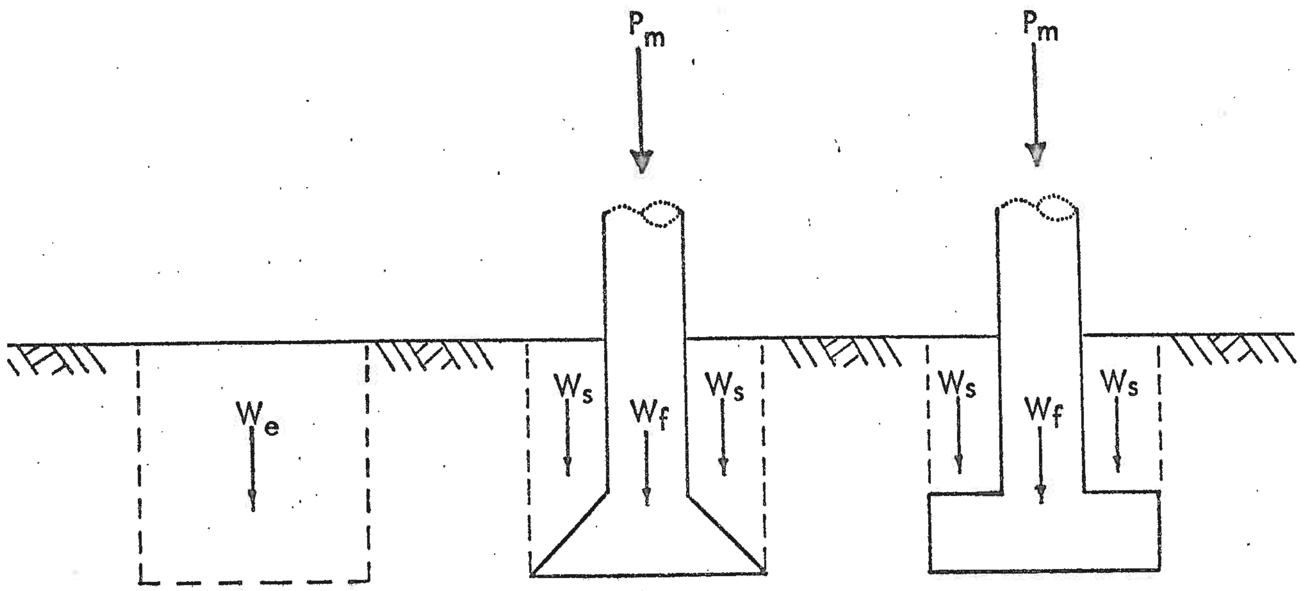
RABA AND TOLSON CONSULTING ENGINEERS, INC.

SECTION A - A'



GENERALIZED SOIL PROFILE

COMPUTATION OF BEARING PRESSURES



Gross Bearing Pressure, p, for any column load is the total effective pressure acting on the base of the foundation.

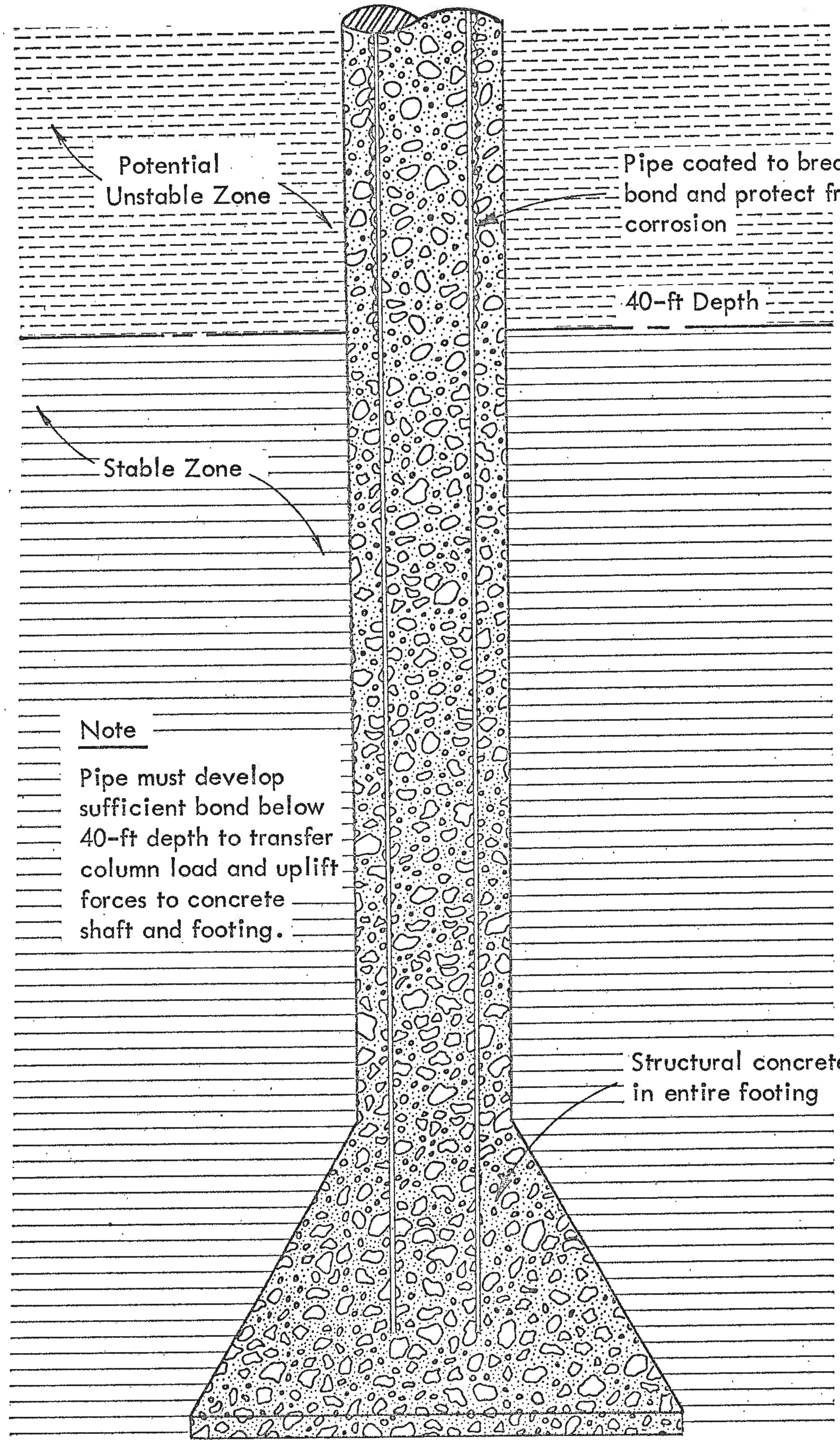
$$p = \frac{1}{A}(P_m + W_s + W_f)$$

Net Bearing Pressure, p', for any column load is the difference between the gross bearing pressure acting on the base of the foundation and the soil pressure existing at that elevation prior to excavation.

$$p' = \frac{1}{A}(P_m + W_s + W_f - W_e)$$

Where:
- A = Area of base of foundation
- P_m = Maximum design column load
- W_s = Weight of soil located above the foundation *
- W_f = Weight of foundation
- W_e = Weight of soil located above base of foundation prior to excavation *

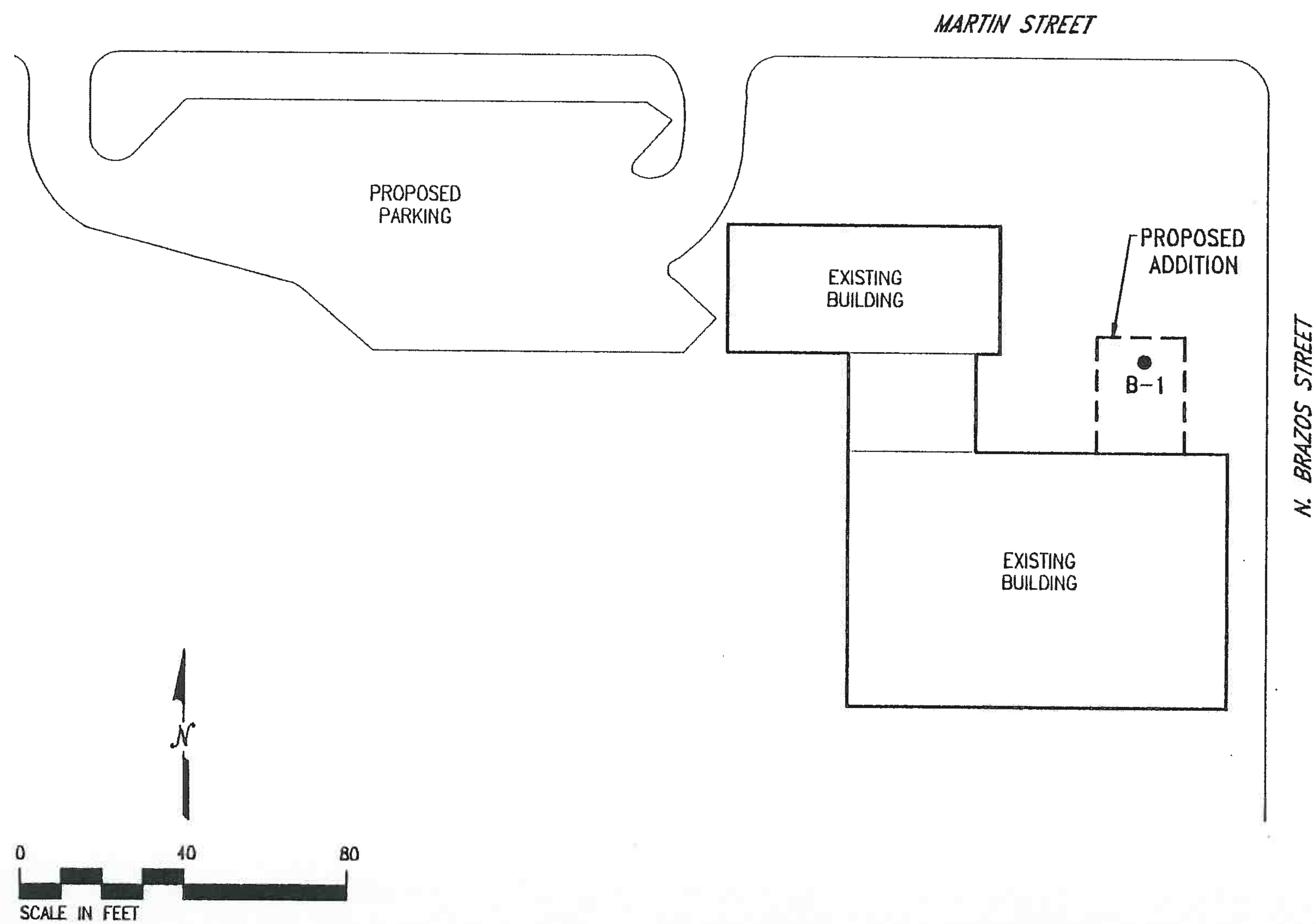
* Position of water table must be considered in determining unit weights. Effective, or buoyant unit weights should be used below the highest expected water table.



PIER DESIGN CRITERIA

RABA AND TOLSON CONSULTING ENGINEERS, INC.

REPORT 4



BORING LOCATION MAP
TOBIN RECREATION CENTER
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

PROJECT No. ASA97-014-00

LOG OF BORING NO. B-1

Tobin Community Center
San Antonio, Texas

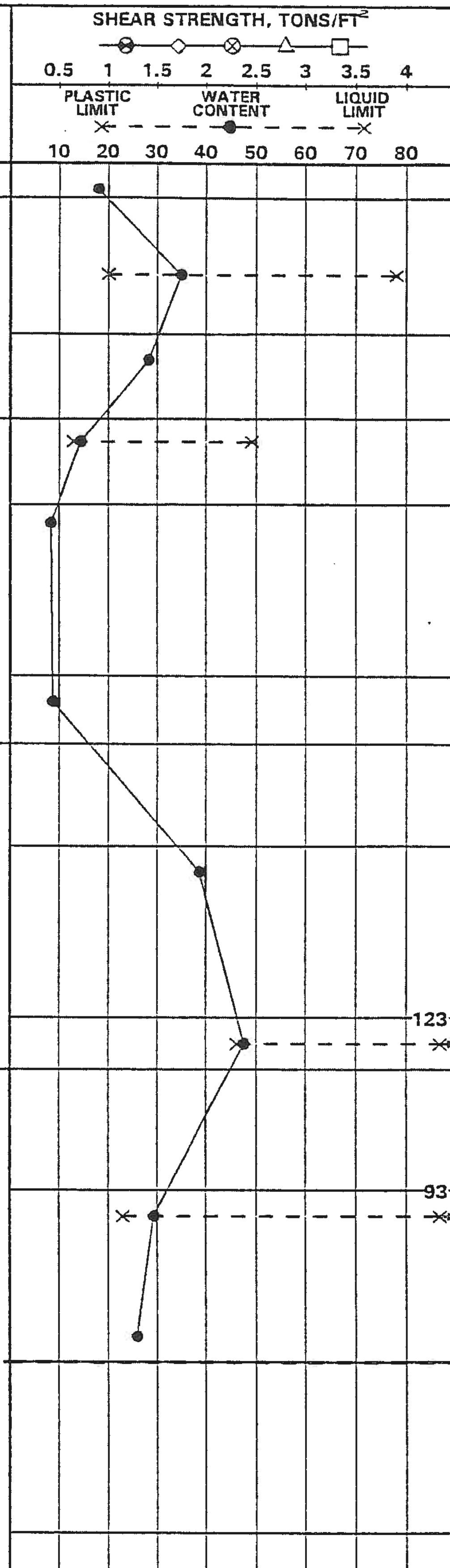
Raba-Kistner

DRILLING METHOD: Straight Flight Auger

LOCATION: See Plate 1

SURFACE ELEVATION:

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	%-200
0	FILL: CLAY, Dark Brown and Tannish-Gray, with gravel	9		
	CLAY, Stiff, Dark Brown, with a trace of very small gravel	8		
5		11		
	GRAVEL, Very Dense, Brown, Chert - clayey, with caliche pockets to 8.5 ft	50/10		
10		50/7"		15
15		50/12		
	CLAY, Bentonitic, Hard, Light Yellowish-Tan, with ferric stains, blocky, soapy			
20		32		
25	- pure bentonite at 25 ft	33		
	CLAY, Hard to Very Stiff, Tan and Gray, with occasional gypsum veins			
30		35		
35		29		
40				



DEPTH DRILLED: 35'	DEPTH TO WATER: Dry	PROJ. NO. ASA97-014-00
DATE DRILLED: 02/20/97	DATE MEASURED: 02/20/97	PLATE 2

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

KEY TO TERMS AND SYMBOLS

MATERIAL TYPES

SOIL TERMS

CALCAREOUS
PEAT
CALICHE
SAND
CLAY
SANDY
CLAYEY
SILT
GRAVEL
SILTY
GRAVELLY

ROCK TERMS

CHALK
LIMESTONE
CLAYSTONE
MARL
CLAY-SHALE
METAMORPHIC
CONGLOMERATE
SANDSTONE
DOLOMITE
SHALE
IGNEOUS
SILTSTONE

OTHER

ASPHALT
BASE
CONCRETE / CEMENT
FILL
WASTE
NO INFORMATION

WELL CONSTRUCTION AND PLUGGING MATERIALS

BLANK PIPE
BENTONITE
BENTONITE & CUTTINGS
CUTTINGS
SAND
SCREEN
CEMENT GROUT
CEMENT
GRAVEL
VOLCLAY

SAMPLE TYPES

AIR ROTARY
MUD ROTARY
SHELBY TUBE
AUGER
NO RECOVERY
3" SPLIT BARREL
3" CORE
NX CORE
2" SPLIT SPOON
KANSAS SAMPLER

STRENGTH TEST RESULTS

POCKET PENETROMETER
TORVANE
UNCONFINED COMPRESSION
TRIAXIAL COMPRESSION UNCONSOLIDATED-UNDRAINED
TRIAXIAL COMPRESSION CONSOLIDATED-UNDRAINED

NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

KEY TO TERMS & SYMBOLS (CONT'D)

TERMINOLOGY

Terms used in this report to describe soil with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D487-85 and D2488-84, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 1990.

RELATIVE DENSITY		COHESIVE STRENGTH			PLASTICITY	
Penetration Resistance Blows per ft	Relative Density	Resistance Blows per ft	Consistency	Cohesion TSF	Plasticity Index	Degree of Plasticity
0-4	Very Loose	0-2	Very Soft	0-0.125	0-5	None
4-10	Loose	2-4	Soft	0.125-0.25	5-10	Low
10-30	Medium Dense	4-8	Firm	0.25-0.5	10-20	Moderate
30-50	Dense	8-15	Stiff	0.5-1.0	20-40	Plastic
>50	Very Dense	15-30	Very Stiff	1.0-2.0	>40	Highly Plastic
		>30	Hard	>2.0		

ABBREVIATIONS

B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
BTEX = Total BTEX
TPH = Total Petroleum Hydrocarbons
ND = Not Detected
NA = Not Analyzed
OVA = Organic Vapor Analyzer
ppm = Parts Per Million

Qam, Qas, Qal = Quaternary Alluvium
Qat = Low Terrace Deposits
Qbc = Beaumont Formation
Qt = Fluviatile Terrace
Qao = Seymour Formation
Qle = Leona Formation
Q-Tu = Uvalde Gravel
Ewi = Wilcox Formation
Emi = Midway Group
Kknm = Navarro Group and Marlbrook Marl
Kpg = Pecan Gap Chalk
Kau = Austin Chalk

Kef = Eagle Ford Shale
Kbu = Buda Limestone
Kdr = Del Rio Clay
Kft = Fort Terrett Member
Kgt = Georgetown Formation
Kep = Person Formation
Kek = Kainer Formation
Kes = Escondido Formation
Kw = Walnut Formation
Kgr = Glen Rose Formation
Kgru = Upper Glen Rose Formation
Kgrl = Lower Glen Rose Formation
Kh = Hensell Sand

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Tobin Community Center
San Antonio, Texas

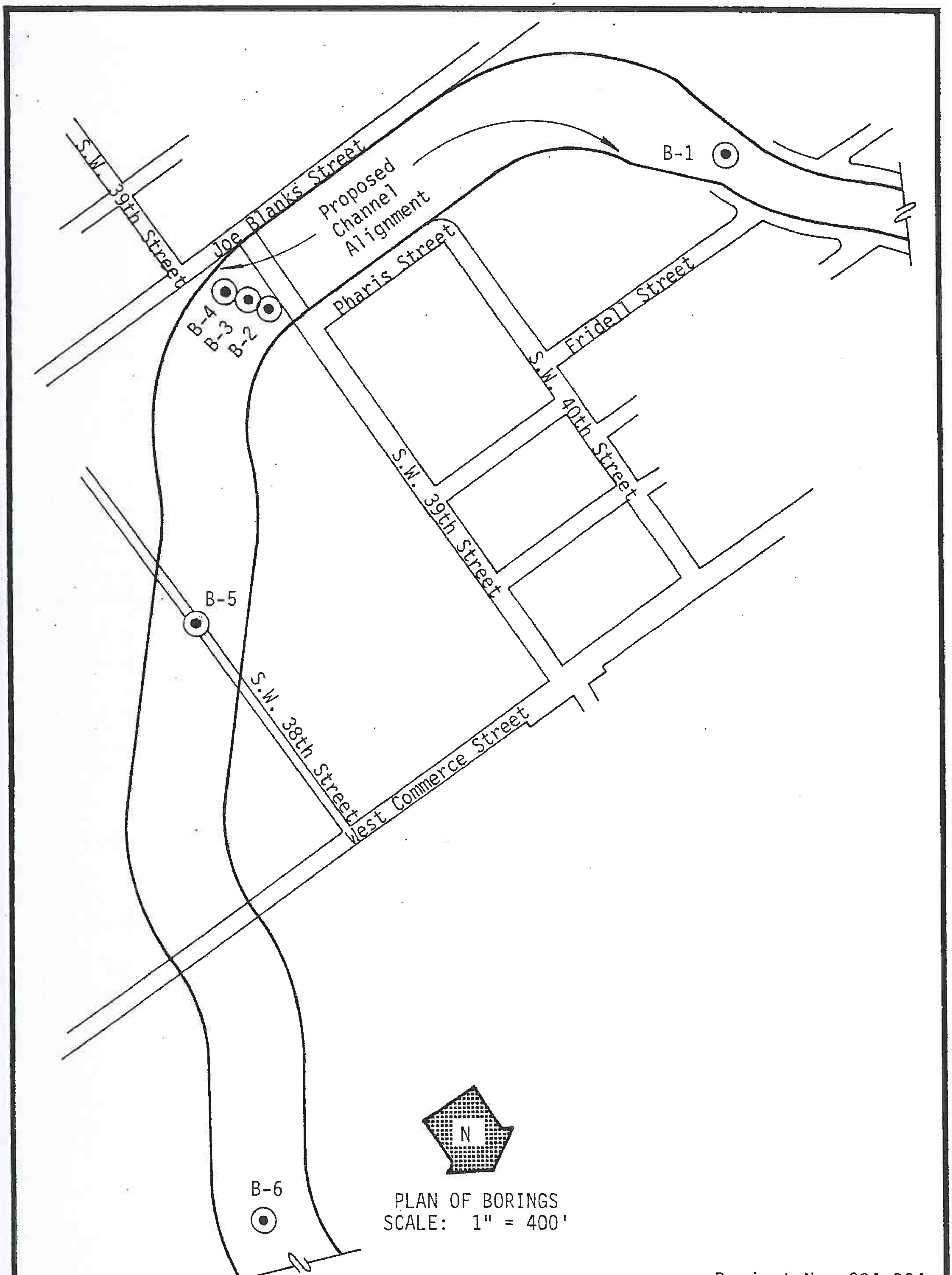
FILE NAME: 9701400

3/14/1997

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	%-200 Sieve	Shear Strength (tsf)	Strength Test
B-1										
	0.00 to 1.50	9	17.9							
	2.50 to 4.00	8	34.8	78	20	58	CH			
	5.00 to 6.50	11	28.3							
	7.50 to 8.83	50/10	14.4	49	13	36	GC			
	10.00 to 11.08	50/7"	8.3					15		
	15.00 to 16.50	50/12	8.7							
	20.00 to 21.50	32	38.6							
	25.00 to 26.50	33	47.4	123	46	77	CH			
	30.00 to 31.50	35	29.3	93	23	70	CH			
	33.50 to 35.00	29	25.9							

PP=Pocket Penetrometer UC=Unconfined Compression

REPORT 5



PLAN OF BORINGS
SCALE: 1" = 400'

Project No. 284-004

Raba-Kistner Consultants, Inc.

LOG OF BORING NO. B-1

CHANNEL AND BRIDGE IMPROVEMENTS, PROJECT 58E
SAN ANTONIO, TEXAS

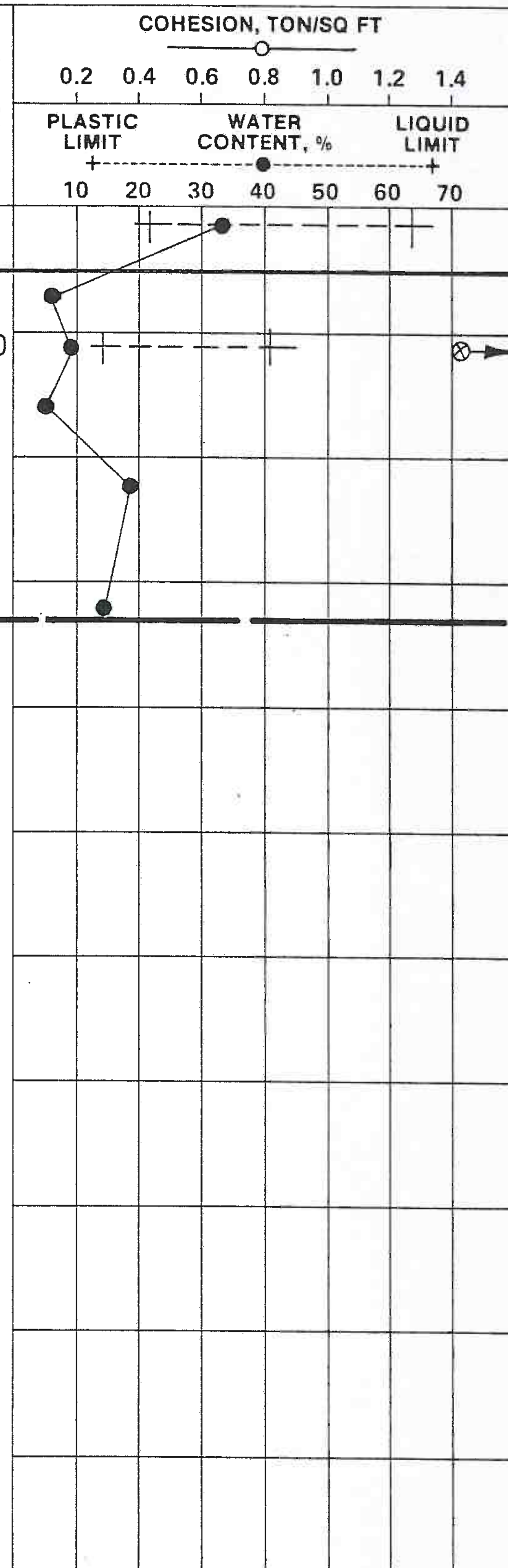
Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

SURF. EL:

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–2.5	Firm Brown Clay with roots and calcareous nodules	8	
2.5–16.5	Very Stiff to Hard Tan Clay with caliche, gravel and some ferrous stains	31	
			120
		50/4"	
	- encountered water at 10'	30	
		33	



ELEVATION, FT.

NOTE: These logs should not be used separately from the project report.

COMPLETION DEPTH: 16.5'
DATE: 1-20-84
DEPTH TO WATER IN BORING: 10'
DATE: 1-20-84
PROJ. NO. 284-004
PLATE 2

LOG OF BORING NO. B-2

CHANNEL AND BRIDGE IMPROVEMENTS, PROJECT 58E
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube
Core Barrel

LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–3	Stiff Dark Brown Clay with roots	13		
3–5	Very Stiff Light Brown Clay with calcareous nodules and gravel	43		
5–12	Stiff Tan Silty Clay - some caliche and organic stains at 7' - ferrous stains at 10'	13		
12–15	Gravel with Tan Silty Clay - encountered water at 15'			
15–50	Very Stiff to Hard Tan and Gray Clay - ferrous stains and gypsum seams from 15' to 20'	28		

DEPTH, FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
25	106	2.1
30	105	3.0
35	104	2.1
40	112	
45	109	2.2
50	115	7.6

(Continued)

NOTE: These logs should not be used separately from the project report.

PROJ. NO. 284-004
PLATE 3

LOG OF BORING NO. B-2 (Continued)

Raba-Kistner Consultants, Inc.

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4) / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10–70)	% Recovery
50–60			Hard Blue Clay Shale				
55			- lost circulation at 56'		115	8.9	100
60					118	2.9	

COMPLETION DEPTH: 60'
DATE: 1-19-84

DEPTH TO WATER IN BORING: 8.2'
DATE: 1-19-84

PROJ. NO. 284-004
PLATE 4

NOTE: These logs should not be used separately from the project report.

LOG OF BORING NO. B-3

CHANNEL AND BRIDGE IMPROVEMENTS, PROJECT 58E
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

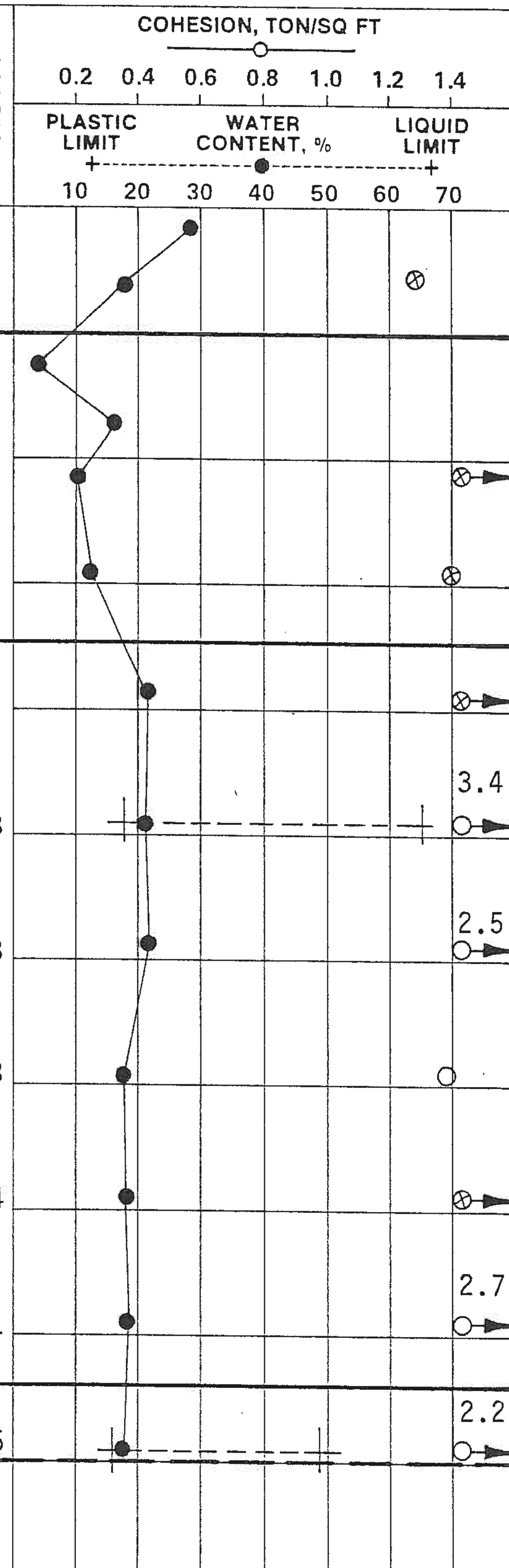
TYPE: Core Barrel
3" Shelby Tube
2" Split Spoon

LOCATION: See Plate 1

SURF. EL.:

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT.	UNIT DRY WT LB/CU FT
0–5	Firm to Very Stiff Dark Brown Clay with roots - calcareous nodules and gravel at 2.5'	6	
5–17	Very Stiff to Hard Tan Silty Clay with calcareous nodules, ferrous stains and organic stains - gravel from 5' to 10' - silty sand at 15'	50/6" 37	
17–46	Very Stiff to Hard Tan and Gray Clay with ferrous stains		108 103 113 104 111
46–50	Very Stiff to Hard Gray Clay - some tan clay and gypsum at 49'		106

(Continued)



ELEVATION, FT.

NOTE: These logs should not be used separately from the project report.

PROJ. NO. 284-004
PLATE 5

LOG OF BORING NO. B-3 (Continued)

Raba-Kistner Consultants, Inc.

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT.	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10 20 30 40 50 60 70)	% Recovery
55			Very Stiff to Hard Gray Clay with some tan clay (continued)				
60			Hard Blue Clay Shale	112		5.6	
65				116		9.2	100
70				111		7.0	
75							
80							
85							
90							
95							
100							

NOTE: These logs should not be used separately from the project report.

COMPLETION DEPTH: 70'
DATE: 1-20-84

DEPTH TO WATER IN BORING: 15'
DATE: 1-20-84

PROJ. NO. 284-004
PLATE 6

LOG OF BORING NO. B-4

CHANNEL AND BRIDGE IMPROVEMENTS, PROJECT 58E
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

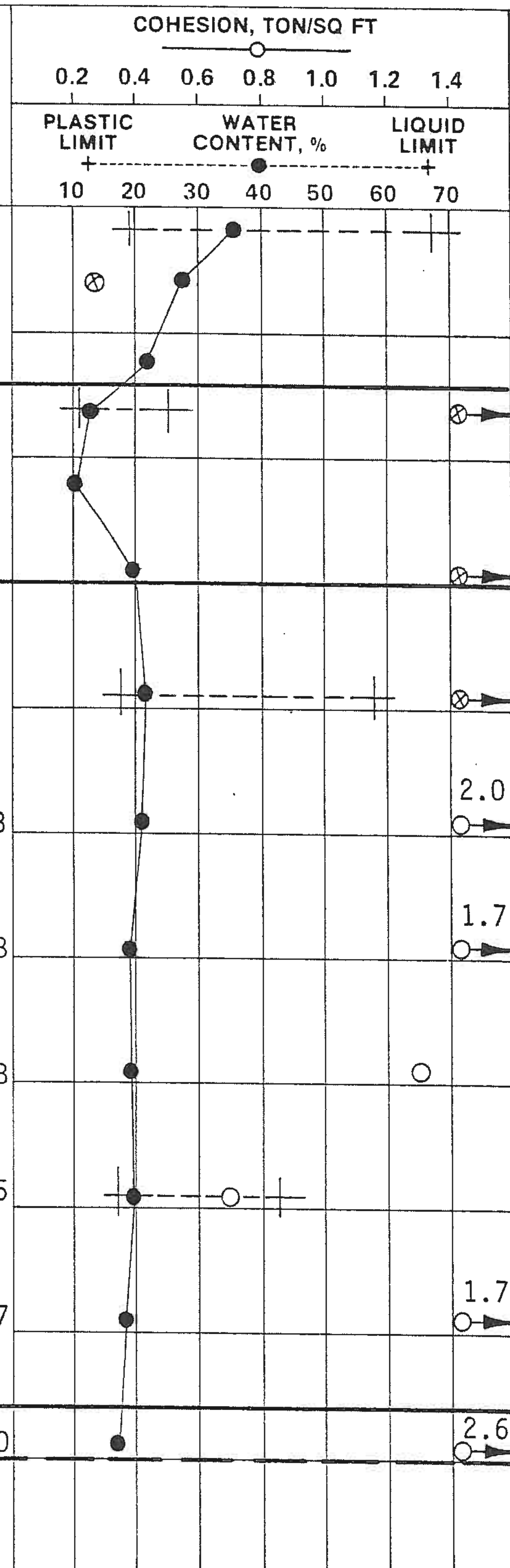
TYPE: Core Barrel; 2" Split Spoon; 3" Shelby Tube

LOCATION: See Plate 1

SURF. EL.:

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT.	UNIT DRY WT LB/CU FT
0–7	Firm to Very Stiff Dark Brown Clay with calcareous nodules	5; 22	
7–15	Very Stiff to Hard Tan Silty Clay with ferrous stains and organic deposits - gravel from 9' to 12.5'	50/6"	
15–48	Very Stiff to Hard Tan and Gray Clay with ferrous stains and organic stains		103; 108; 108; 105; 107
48–50	Hard Blue Clay Shale		110

(Continued)



NOTE: These logs should not be used separately from the project report.

PROJ. NO. 284-004
PLATE 7

LOG OF BORING NO. B-4 (Continued)

Raba-Kistner Consultants, Inc.

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 – 1.4) / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10 – 70)	% Recovery
			Hard Blue Clay Shale (continued)				
55					118	9.3	100
60					114	10.4	
65							
70							
75							
80							
85							
90							
95							
100							

COMPLETION DEPTH: 60'
DATE: 1-20-84

DEPTH TO WATER IN BORING: 15'
DATE: 1-20-84

PROJ. NO. 284-004
PLATE 8

NOTE: These logs should not be used separately from the project report.

LOG OF BORING NO. B-5

CHANNEL AND BRIDGE IMPROVEMENTS, PROJECT 58E
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

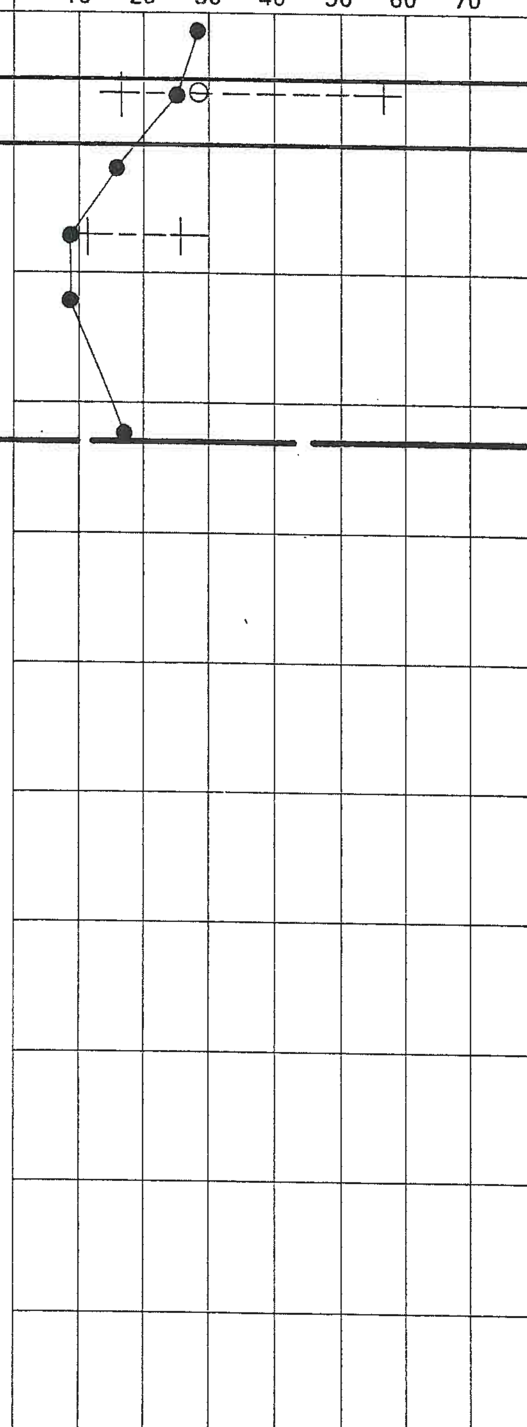
SURF. EL:

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT.	UNIT DRY WT LB/CU FT
0 – 2.5	Fill: Brown and Tan Clays with roots, organic deposits and trace caliche	3	
2.5 – 5	Stiff Dark Brown Clay - calcareous nodules and gravel at 3.5'		97
5 – 16.5	Hard Tan Silty Clay with gravel, ferrous stains and some caliche - encountered water at 10'	36, 40, 50, 40	

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + ---- WATER CONTENT, % ● ---- LIQUID LIMIT +: 10 20 30 40 50 60 70

ELEVATION, FT.



COMPLETION DEPTH: 16.5'
DATE: 1-20-84

DEPTH TO WATER IN BORING: None Observed
DATE: 1-20-84

PROJ. NO. 284-004
PLATE 9

NOTE: These logs should not be used separately from the project report.

LOG OF BORING NO. B-6

CHANNEL AND BRIDGE IMPROVEMENTS, PROJECT 58E
SAN ANTONIO, TEXAS

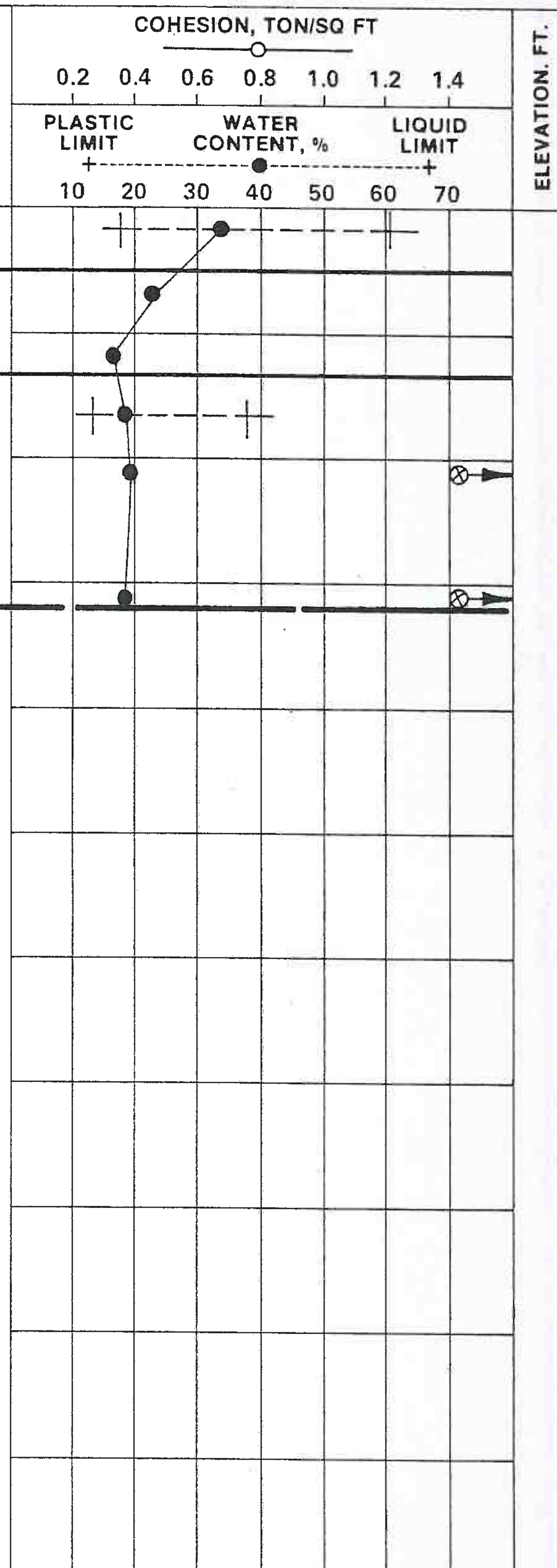
Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon / 3" Shelby Tube

LOCATION: See Plate 1

SURF. EL:

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT.	UNIT DRY WT LB/CU FT
0–2.5	Soft Dark Brown Clay with calcareous nodules and organic deposits	4	
2.5–6	Very Stiff Tan Silty Clay with calcareous nodules and gravel - encountered water at 2.5'	19	
		14	
6–10		18	
10–16	Very Stiff Tan and Gray Clay with ferrous stains and trace caliche		



COMPLETION DEPTH: 16'
DATE: 1-20-84

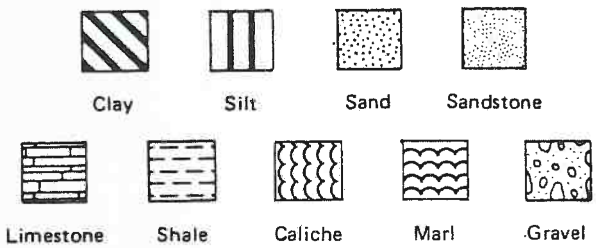
DEPTH TO WATER IN BORING: None Observed
DATE: 1-20-84

PROJ. NO. 284-004
PLATE 10

NOTE: These logs should not be used separately from the project report.

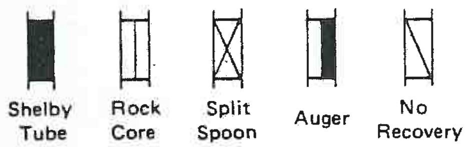
SYMBOLS AND TERMS USED ON BORING LOGS

SOIL OR ROCK TYPES
(shown in symbols column)



(Predominate Soil Types Shown Heavy)

SAMPLER TYPES
(shown in sample column)



STRENGTH TEST RESULTS

⊛ - Estimated Strength
◇ - Torvane
○ - Unconfined Compression

TRIAXIAL COMPRESSION

△ - Unconsolidated-undrained
□ - Consolidated-undrained

C - Cohesion (Total)
Φ - Angle of Internal Friction (Total)

C′ - Cohesion (Effective)
Φ′ - Angle of Internal Friction (Effective)

NOTE:

Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or condition are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc. 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

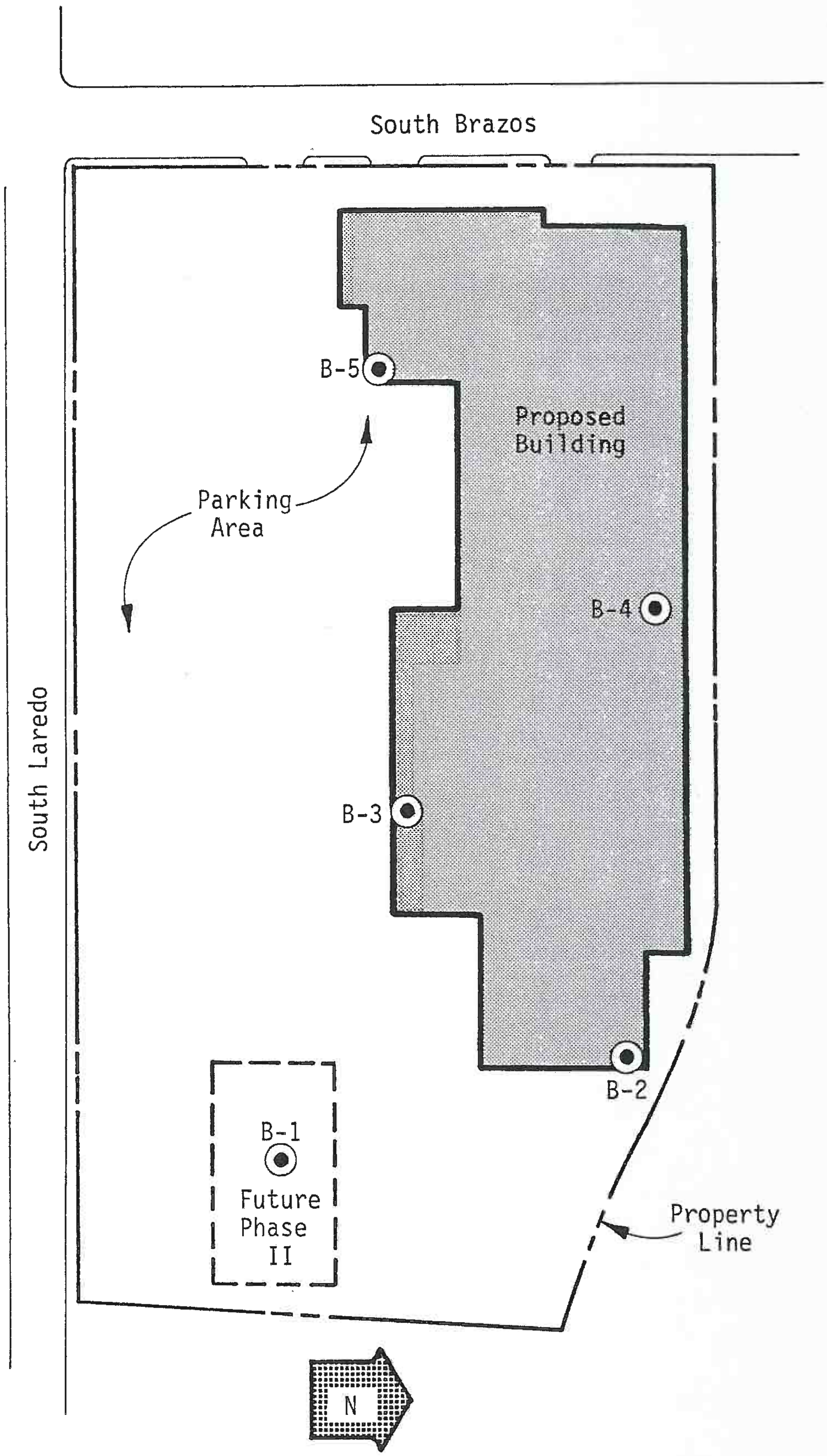
Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated	- composed of thin layers of varying color and texture.
Interbedded	- composed of alternate layers of different soil types.
Calcareous	- containing appreciable quantities of calcium carbonate.
Well graded	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded	- predominantly of one grain size, or having a range of sizes with some intermediate size missing.

TERMS DESCRIBING CONSISTENCY OR CONDITION

RELATIVE DENSITY		COHESIVE STRENGTH			PLASTICITY	
Penetration Resistance, blows per foot	Relative Density	Penetration Resistance, blows per foot	Consistency	Cohesion, TSF	Plasticity Index	Degree of Plasticity
0-4	Very Loose	0-2	Very Soft	0-0.125	0-5	None
4-10	Loose	2-4	Soft	0.125-0.25	5-10	Low
10-30	Medium Dense	4-8	Firm	0.25-0.5	10-20	Moderate
30-50	Dense	8-15	Stiff	0.5-1.0	20-40	Plastic
> 50	Very Dense	15-30	Very Stiff	1.0-2.0	> 40	Highly Plastic
		> 30	Hard	> 2.0		

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

REPORT 6



PLAN OF BORINGS
SCALE: 1" = 115'

Raba-Kistner Consultants, Inc

Project No. 285-065

PLATE 1

LOG OF BORING NO. B-1

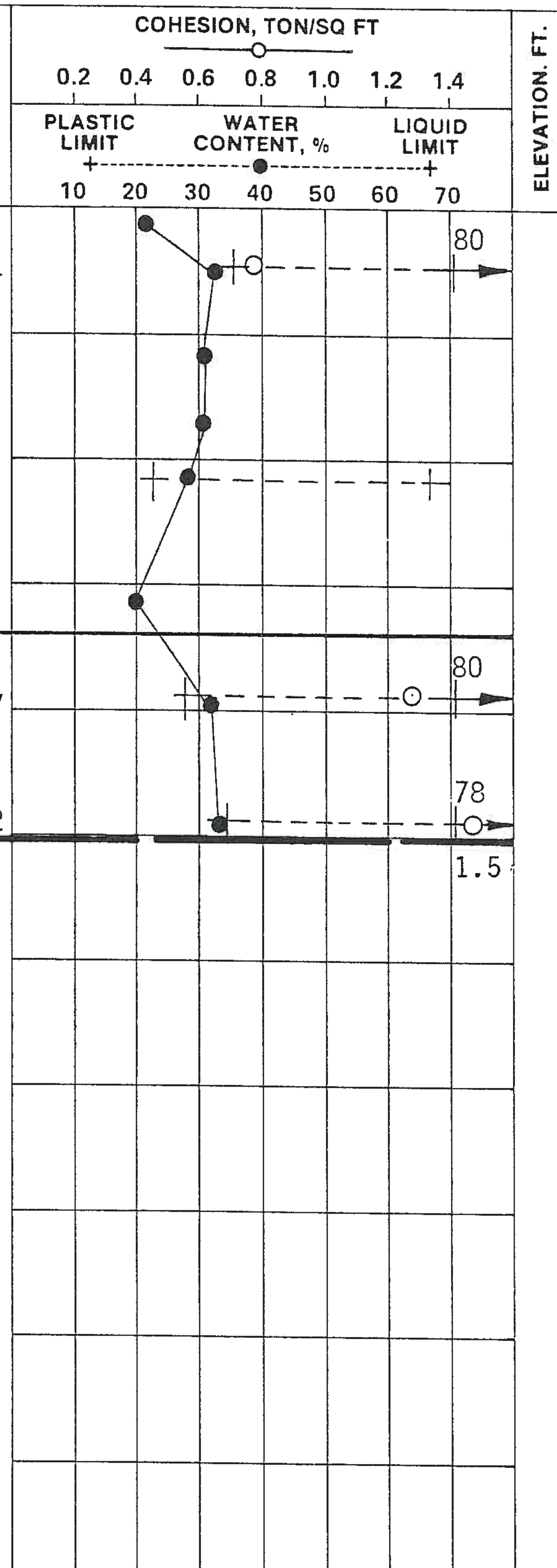
CONSOLIDATED PRODUCE WAREHOUSE
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–17			FILL: Brown Clay, Tan and Gray Clay and Gravel with fetid odor	12	
					84
				40	
				12	
			- groundwater seepage at 11'	29	
			- wire at 11.5'		
				12	
17–25			CLAY, Very Stiff, Tan and Gray with bentonitic clay seams and layers		87
					82



COMPLETION DEPTH: 25'
DATE: 3-22-85

DEPTH TO WATER IN BORING: 11.5'
DATE: 3-22-85

PROJ. NO. 285-065
PLATE 2

NOTE: These logs should not be used separately from the project report.

LOG OF BORING NO. B-2

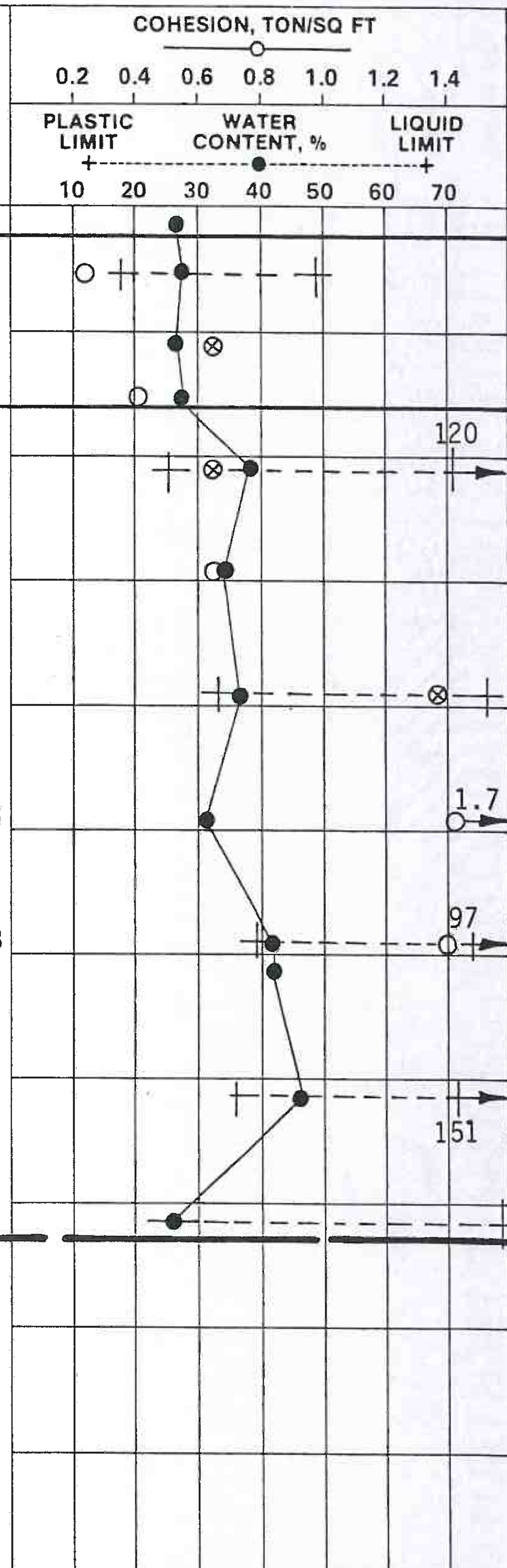
CONSOLIDATED PRODUCE WAREHOUSE
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL.:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0 – 1			FILL: Tan Clay, Gravel and Dark Gray Clay	7	
1 – 6.5			CLAY, Soft to Firm, Dark Gray		89, 95
6.5 – 41.5			CLAY, Stiff to Very Stiff, Tan and Gray with bentonitic clay seams and layers	30, 20, 35	82, 83, 73



COMPLETION DEPTH: 41.5'
DATE: 3-22-85

DEPTH TO WATER IN BORING: None Observed DATE: 3-22-85

PROJ. NO. 285-065
PLATE 3

NOTE: These logs should not be used separately from the project report.

LOG OF BORING NO. B-3

CONSOLIDATED PRODUCE WAREHOUSE
SAN ANTONIO, TEXAS

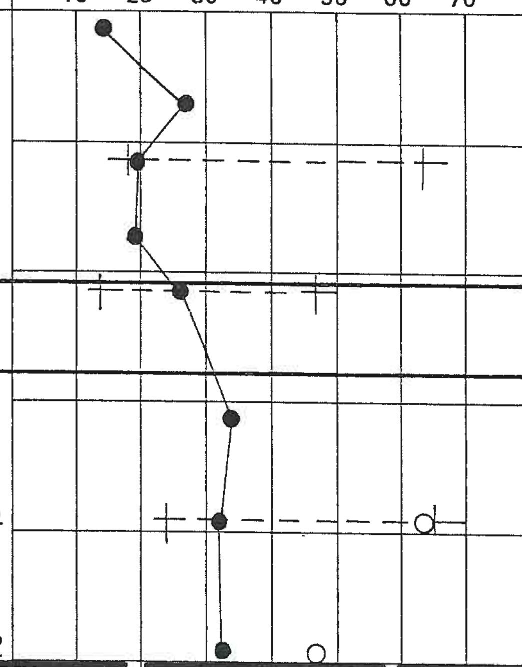
Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL.:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–11	CLAY, Stiff, Dark Gray	13	
		8	
	- gravel at 6.5'	9	
	- groundwater seepage at 10'	12	
11–14	GRAVEL, Medium Dense with chert	40	
14–25	CLAY, Stiff to Very Stiff, Tan and Gray with bentonitic clay seams and layers	24	
			84
			82

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4
PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70



ELEVATION, FT.

COMPLETION DEPTH: 25'
DATE: 3-22-85

DEPTH TO WATER IN BORING: 10'
DATE: 3-22-85

PROJ. NO. 285-065
PLATE 4

NOTE: These logs should not be used separately from the project report.

LOG OF BORING NO. B-4

CONSOLIDATED PRODUCE WAREHOUSE
SAN ANTONIO, TEXAS

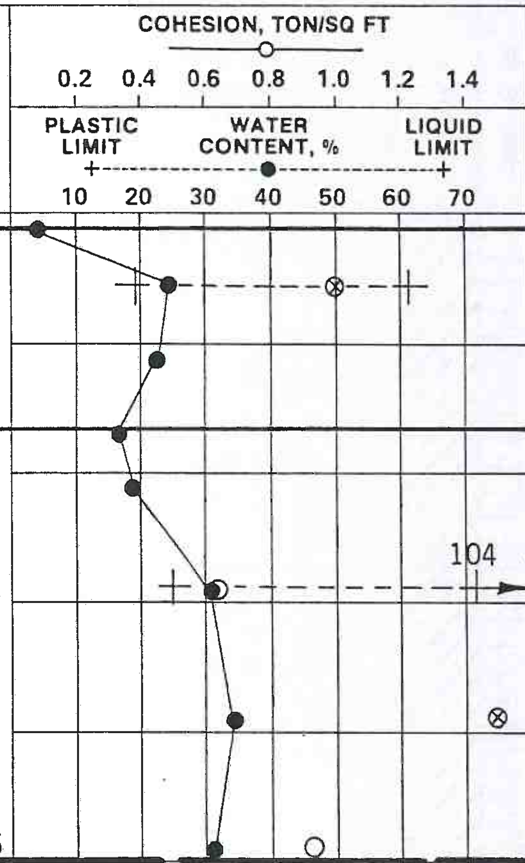
Raba-Kistner Consultants, Inc.

TYPE: Auger; 2" Split Spoon; 3" Shelby Tube

LOCATION: See Plate 1

SURF. EL:

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–2	FILL: Dark Gray Clay, Tan Clay and Gravel	28	
2–8	CLAY, Stiff to Very Stiff, Dark Gray with gravel	14	
8–25	CLAY, Firm to Stiff, Tan and Gray with bentonitic clay seams and layers	8 6	81 85



ELEVATION, FT.

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

COMPLETION DEPTH: 25'
DATE: 3-21-85

DEPTH TO WATER IN BORING: None Observed
DATE: 3-21-85

PROJ. NO. 285-065
PLATE 5

NOTE: These logs should not be used separately from the project report.

LOG OF BORING NO. B-5

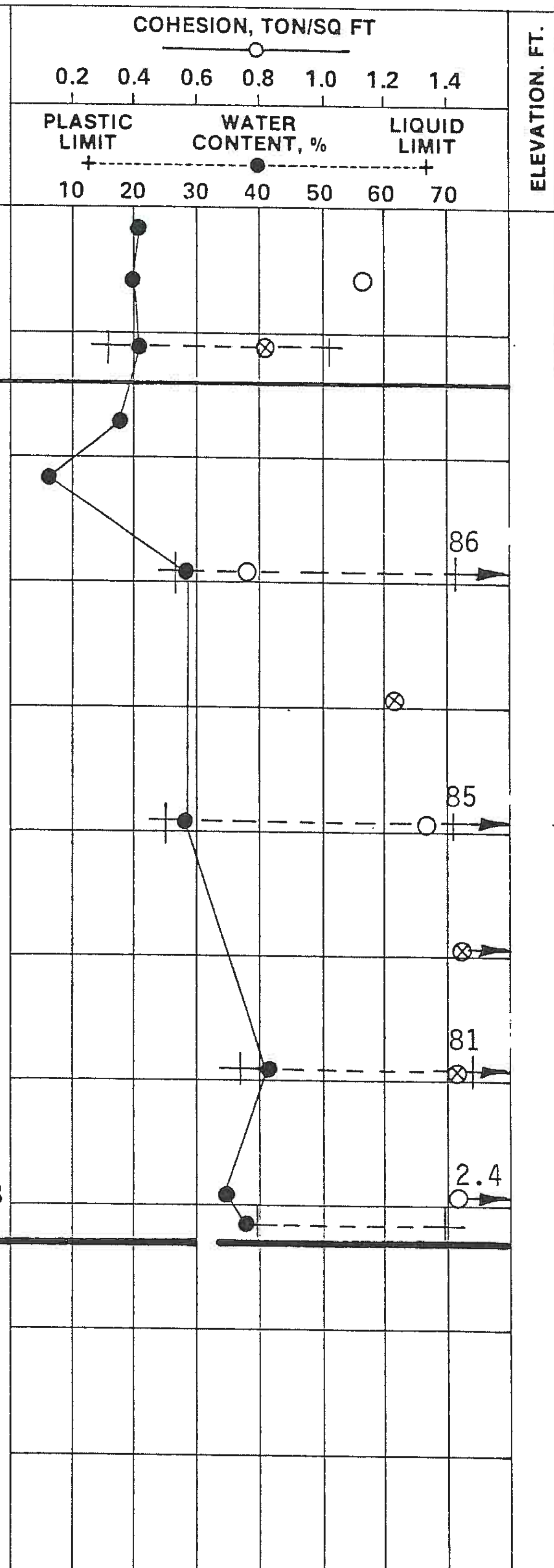
CONSOLIDATED PRODUCE WAREHOUSE
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–7			CLAY, Stiff to Very Stiff, Dark Gray		105
7–41.5			CLAY, Stiff to Very Stiff, Tan and Gray with bentonitic clay seams and layers - gravel from 7' to 7.5' - groundwater seepage at 7.5' - gravel and chert from 9.5' to 13.5'	11 48	90 90 78
				37	



COMPLETION DEPTH: 41.5'
DATE: 3-21-85

DEPTH TO WATER IN BORING: 7.5'

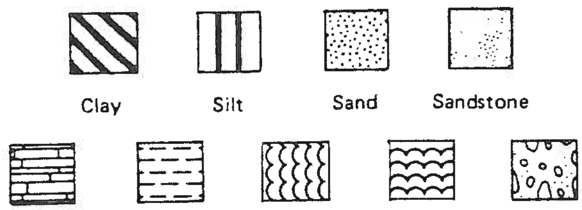
DATE: 3-21-85

PROJ. NO. 285-065
PLATE 6

NOTE: These logs should not be used separately from the project report.

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL OR ROCK TYPES
(shown in symbols column)



Clay, Silt, Sand, Sandstone

Limestone, Shale, Caliche, Marl, Gravel

(Predominate Soil Types Shown Heavy)

SAMPLER TYPES
(shown in sample column)

Shelby Tube, Rock Core, Split Spoon, Auger, No Recovery

STRENGTH TEST RESULTS

⊛ - Estimated Strength
◇ - Torvane
○ - Unconfined Compression

TRIAXIAL COMPRESSION

△ - Unconsolidated-undrained
□ - Consolidated-undrained

c - Cohesion (Total)
ϕ - Angle of Internal Friction (Total)

c' - Cohesion (Effective)
ϕ' - Angle of Internal Friction (Effective)

NOTE:

Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or condition are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc. 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

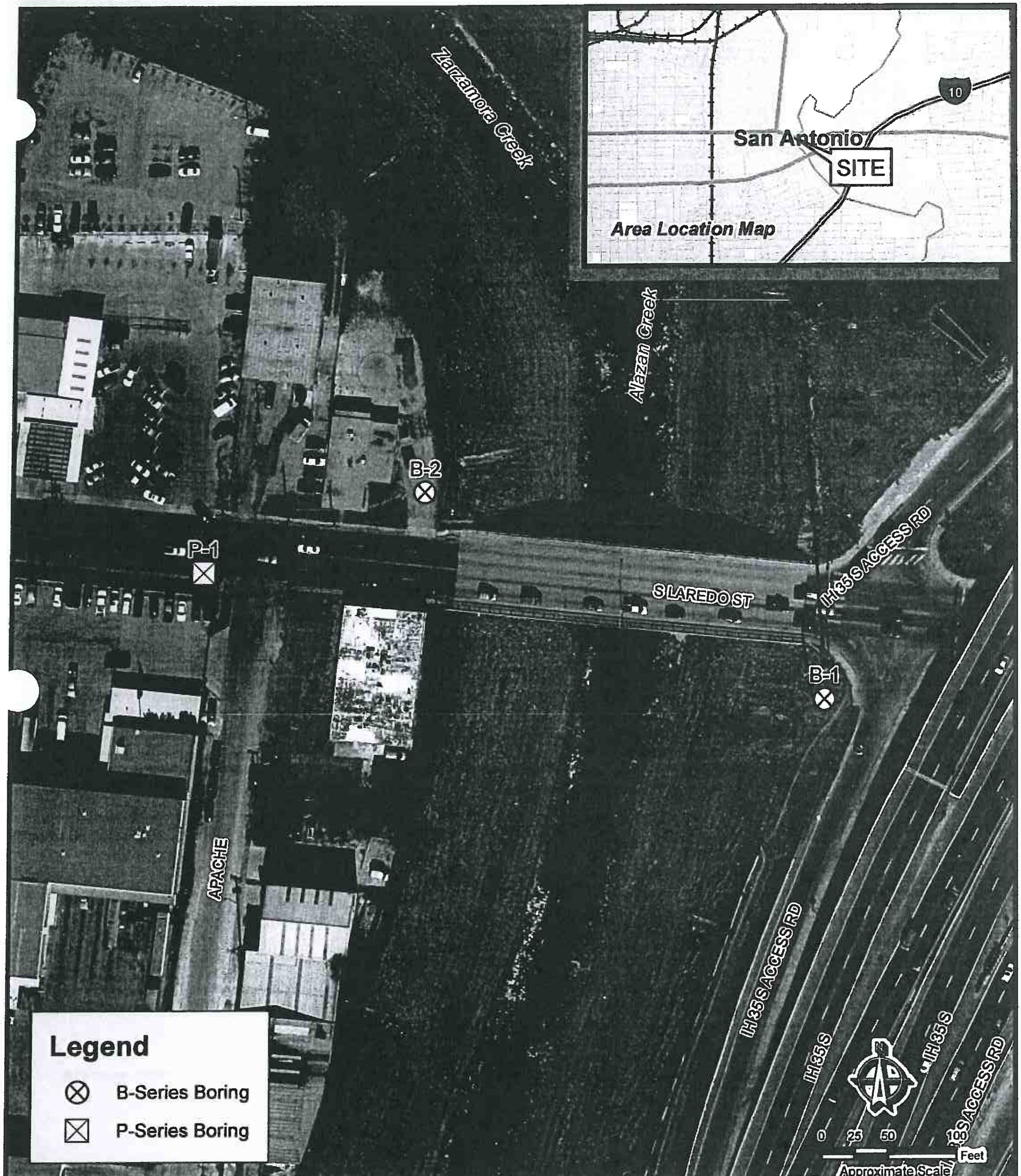
Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated	- composed of thin layers of varying color and texture.
Interbedded	- composed of alternate layers of different soil types.
Calcareous	- containing appreciable quantities of calcium carbonate.
Well graded	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded	- predominantly of one grain size, or having a range of sizes with some intermediate size missing.

TERMS DESCRIBING CONSISTENCY OR CONDITION

RELATIVE DENSITY		COHESIVE STRENGTH			PLASTICITY	
Penetration Resistance, blows per foot	Relative Density	Penetration Resistance, blows per foot	Consistency	Cohesion, TSF	Plasticity Index	Degree of Plasticity
0-4	Very Loose	0-2	Very Soft	0-0.125	0-5	None
4-10	Loose	2-4	Soft	0.125-0.25	5-10	Low
10-30	Medium Dense	4-8	Firm	0.25-0.5	10-20	Moderate
30-50	Dense	8-15	Stiff	0.5-1.0	20-40	Plastic
> 50	Very Dense	15-30	Very Stiff	1.0-2.0	> 40	Highly Plastic
		> 30	Hard	> 2.0		

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

REPORT 7



Raba Kistner ...neering • Testing • Environmental Facilities • Infrastructure 12821 West Golden Lane San Antonio, Texas 78249 (210)699-9090 TEL (210)699-6426 FAX www.rkci.com	SOURCE: 2008 Aerial Photograph Provided by The City of San Antonio (COSA) **BORING LOCATION MAP** ALAZAN CREEK BRIDGE (CIMS) SAN ANTONIO, TEXAS	REVISIONS: No. DATE DESCRIPTION	PROJECT No.: ASA09-051-00 ISSUE DATE: 8/5/09 DRAWN BY: CCL CHECKED BY: TIP REVIEWED BY: BMK **FIGURE 1**

NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes

DRILLING LOG

WinCore
Version 3.0

County	Bexar	Hole	B-1	District	San Antonio
Highway	South Laredo Street	Structure	Alazan Creek Bridge	Date	08/4/09
CSJ		Station	15+12.92	Grnd. Elev.	627.58 ft
		Offset	76.95	GW Elev.	N/A

Elev. (ft)	Texas Cone Penetrometer	Strata Description	Triaxial Test: Lateral Press. (psi)	Triaxial Test: Deviator Stress (psi)	Properties: MC	Properties: LL	Properties: PI	Properties: Wet Den. (pcf)	Additional Remarks
0		FILL MATERIAL, Stiff to Hard, Dark Brown with gravel			7				
5	50 (4.5) 50 (1)								-sandy below 6 ft
					12	34	17		-lime detected
10	9 (6) 14 (6)								
					28				
613.6 / 15	10 (6) 15 (6)	CLAY, Blocky, Stiff to Hard, Tan and Gray, with small gravel traces (CH)							
					30	79	57		
20	16 (6) 18 (6)								
					24				
25	23 (6) 25 (6)								
					24				
30	35 (6) 36 (6)								-with gypsum crystal deposits from 32 to 37 ft
					24				
35	39 (6) 42 (6)								
					23	52	36		
589.6		CLAYSHALE, Very Hard, Dark Gray							
40	50 (1.5) 50 (1)								
					19				
45	50 (1) 50 (1)								-with tan mottling above 45 ft
					21				
50	50 (1) 50 (0.5)								

Remarks:

The ground water elevation was not determined during the course of this boring.

Driller: Eagle Drilling **Logger:** Fred Mynar

Organization: Raba-Kistner Consultants, Inc.

FIGURE: 2a

DRILLING LOG

WinCore
Version 3.0

County	Bexar	Hole	B-1	District	San Antonio
Highway	South Laredo Street	Structure	Alazan Creek Bridge	Date	08/4/09
CSJ		Station	15+12.92	Grnd. Elev.	627.58 ft
		Offset	76.95	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test: Lateral Press. (psi)	Triaxial Test: Deviator Stress (psi)	Properties: MC	Properties: LL	Properties: PI	Properties: Wet Den. (pcf)	Additional Remarks
			CLAYSHALE, Very Hard, Dark Gray							
						21				
55		50 (0.5) 50 (0)								
						17				
60		50 (1) 50 (0.5)								WATER at 62 ft
						23				
65		50 (1) 50 (0.5)								
						19				
70		50 (0.5) 50 (0.5)								
						18				
75		50 (1) 50 (0.5)								
						16				
547.6 80		50 (1.5) 50 (0.5)								
85										
90										
95										
100										

Remarks:

The ground water elevation was not determined during the course of this boring.

Driller: Eagle Drilling **Logger:** Fred Mynar

Organization: Raba-Kistner Consultants, Inc.

FIGURE: 2b

DRILLING LOG

WinCore
Version 3.0

County	Bexar	Hole	B-2	District	San Antonio
Highway	South Laredo Street	Structure	Alazan Creek Bridge	Date	07/1/09
CSJ		Station	11+95.52	Grnd. Elev.	630.17 ft
		Offset	-55.43	GW Elev.	N/A

Elev. (ft)	Depth	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	Additional Remarks
			CLAY, Soft to Stiff, Tan to Light Tan (possible fill material) (CH)			11	42	29		ASPHALT (2 in.) BASE MATERIAL (6 in.)
	5	13 (6) 21 (6)				11				
	10	21 (6) 18 (6)				38	85	57		-with traces of gravel above 14 ft and calcareous deposits below 14 ft
	15	8 (6) 8 (6)				41				
611.2	20	11 (6) 11 (6)	CLAY, Blocky, Stiff to Hard, Tan and Gray, with ferrous staining (CH)			33				
	25	15 (6) 18 (6)				29				
	30	21 (6) 32 (6)				27				
	35	28 (6) 30 (6)				27				
	40	50 (6) 50 (6)				26				
585.2	45	50 (0.5) 50 (0.5)	CLAYSHALE, Very Hard, Dark Gray			30				
	50	50 (1) 50 (2.5)								

Remarks:

The ground water elevation was not determined during the course of this boring.

Driller: Alpha & Omega Drilling Logger: Steve Morris

Organization: Raba-Kistner Consultants, Inc.

FIGURE: 3a

DRILLING LOG

WinCore
Version 3.0

County	Bexar	Hole	B-2	District	San Antonio
Highway	South Laredo Street	Structure	Alazan Creek Bridge	Date	07/1/09
CSJ		Station	11+95.52	Grnd. Elev.	630.17 ft
		Offset	-55.43	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	Additional Remarks
			CLAYSHALE, Very Hard, Dark Gray							
						27				
55		50 (0.7) 50 (0.2)								
						27				
60		50 (1.2) 50 (1)								
						30				
65		50 (0.5) 50 (0)								
						15				
70		50 (0.5) 50 (0.5)								
						24				
75		50 (0.7) 50 (0.5)								
						17				
550.2 80		50 (0.2) 50 (0.5)								
85										
90										
95										
100										

Remarks:

.he ground water elevation was not determined during the course of this boring.

Driller: Alpha & Omega Drilling   Logger: Steve Morris

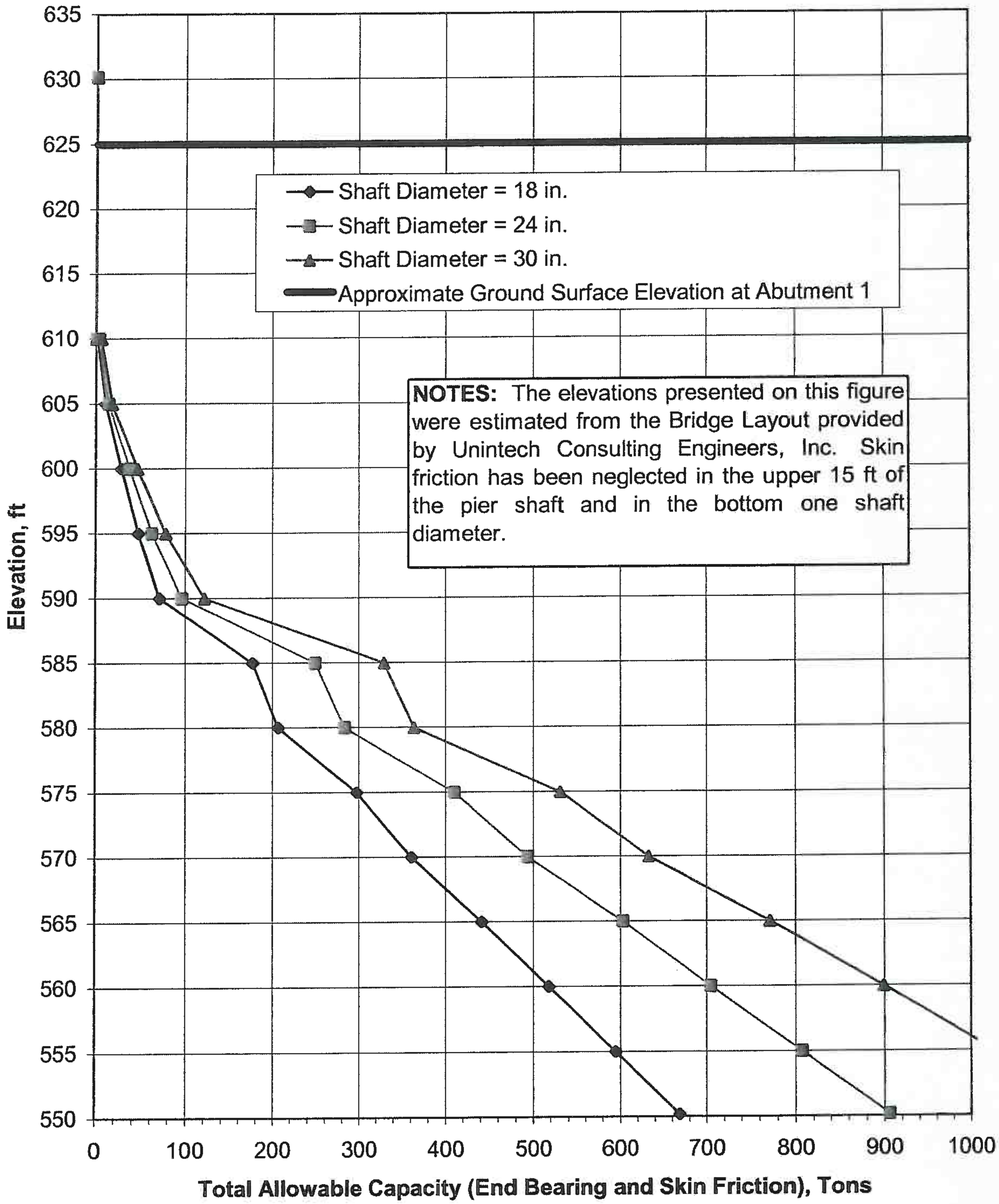
Organization: Raba-Kistner Consultants, Inc.

FIGURE: 3b

DRILLED PIER AXIAL CAPACITY CURVE

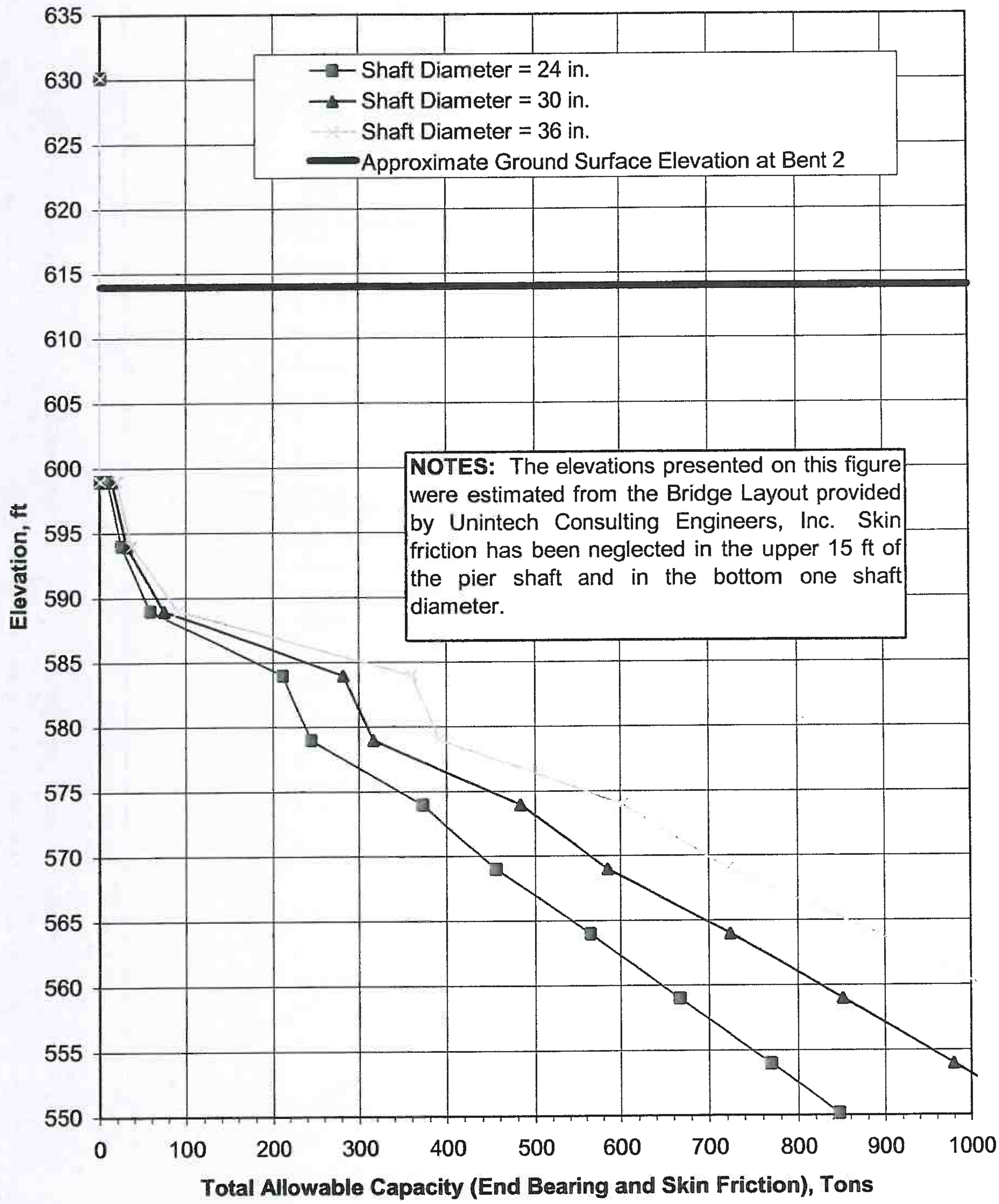
Straight Shaft Piers

Alazan Creek Bridge (CIMS)
San Antonio, Texas
(Boring B-2, Abutment 1)



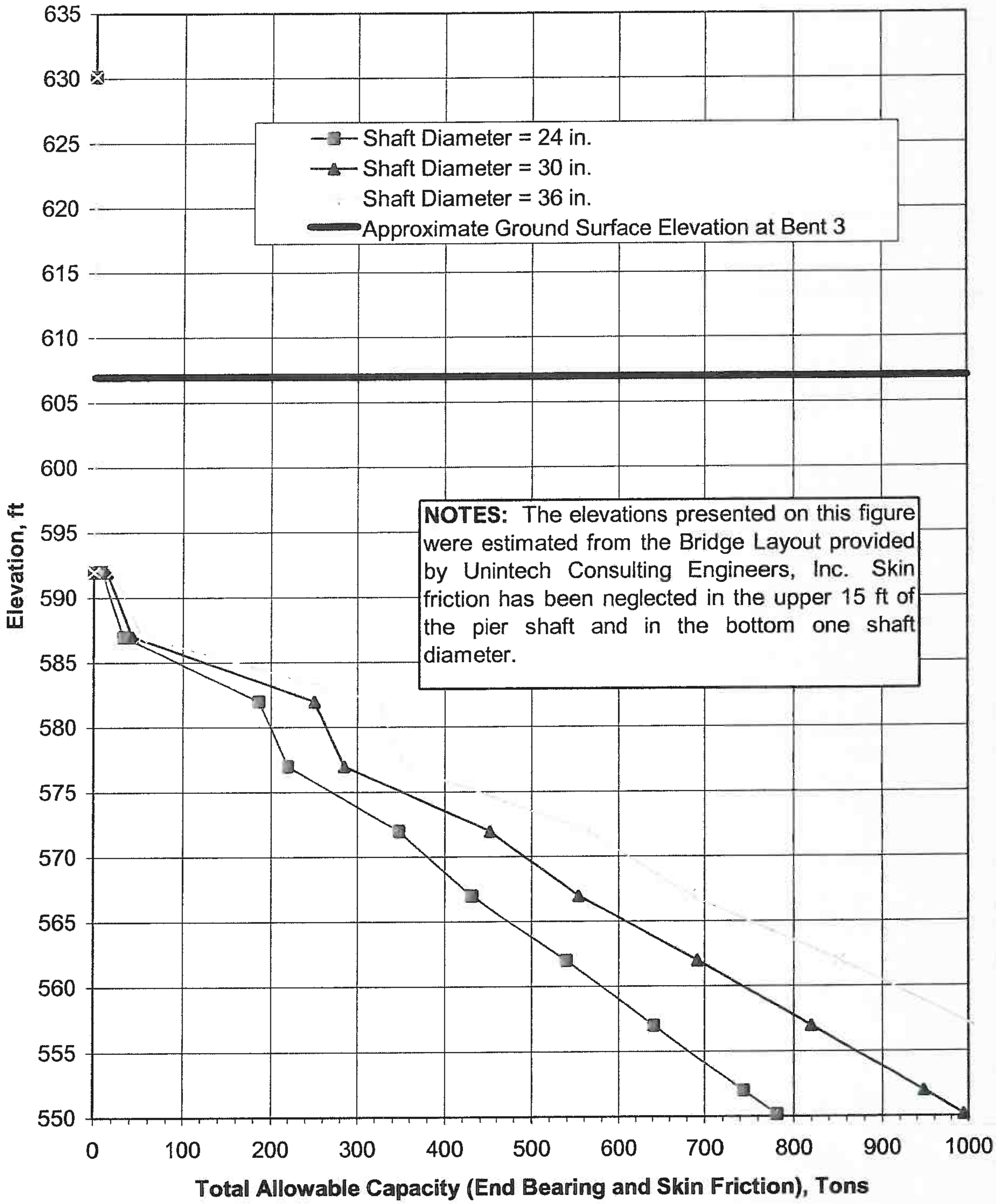
DRILLED PIER AXIAL CAPACITY CURVE
Straight Shaft Piers

Alazan Creek Bridge (CIMS)
San Antonio, Texas
(Boring B-2, Bent 2)



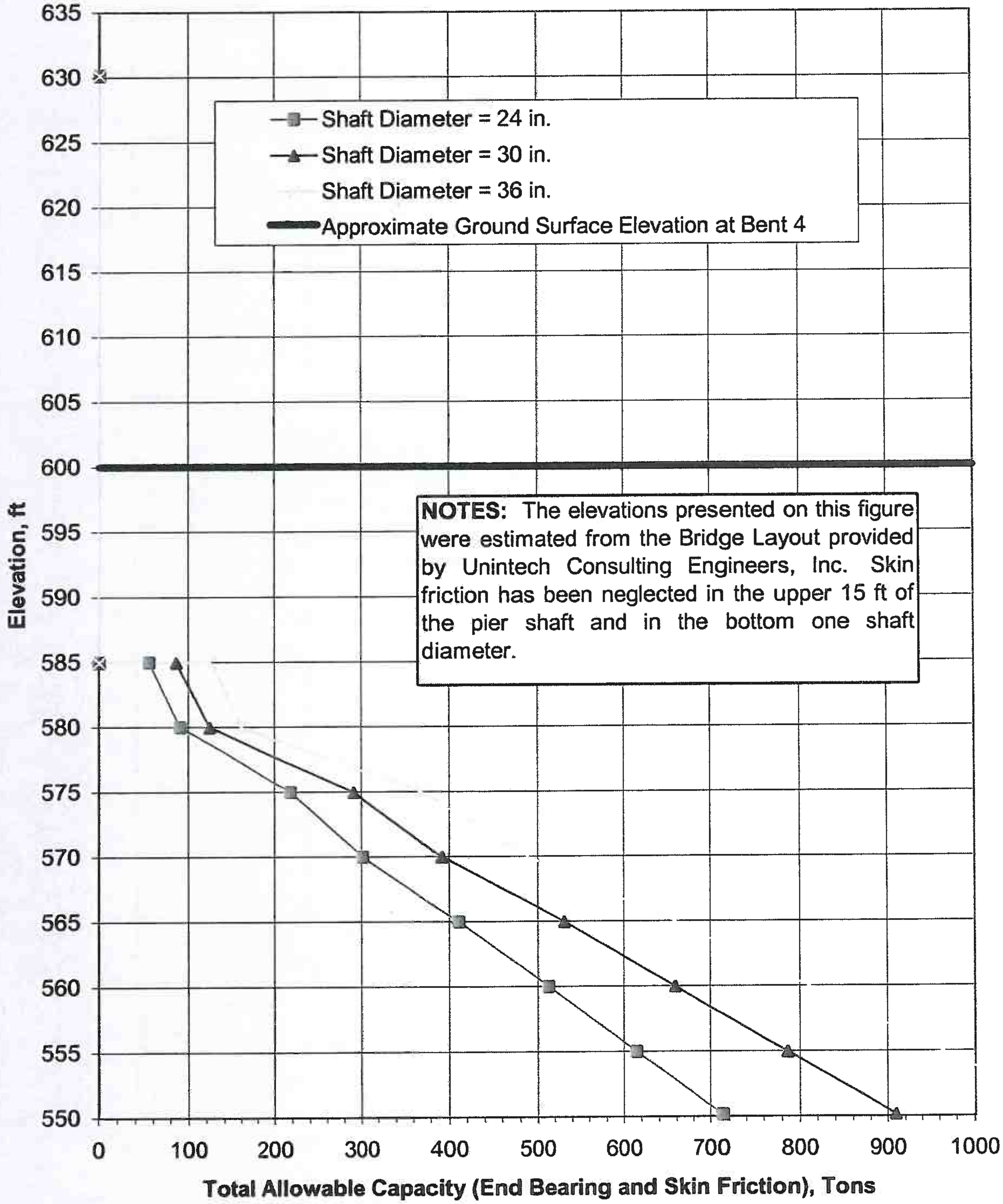
DRILLED PIER AXIAL CAPACITY CURVE
Straight Shaft Piers

Alazan Creek Bridge (CIMS)
San Antonio, Texas
(Boring B-2, Bent 3)



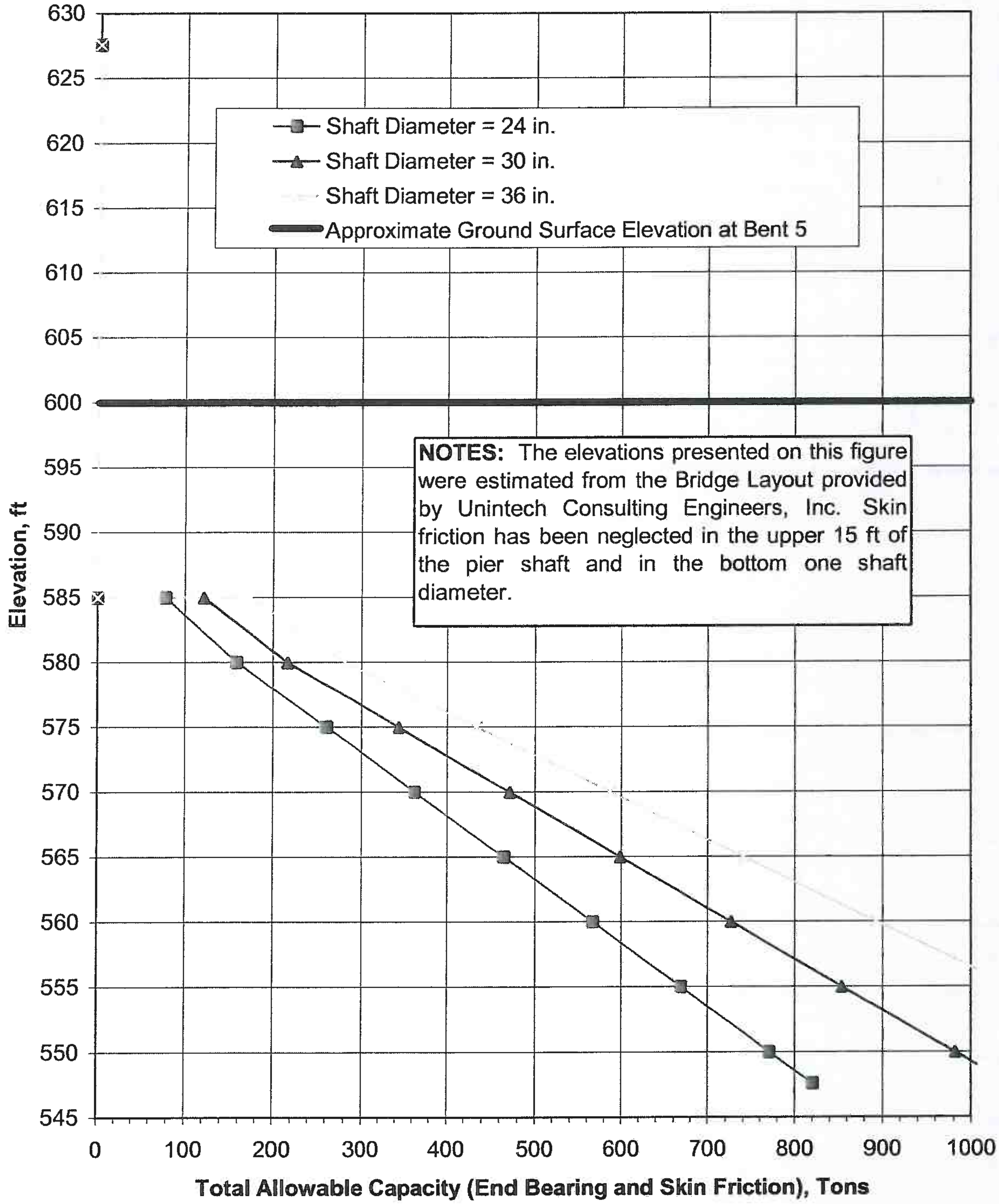
DRILLED PIER AXIAL CAPACITY CURVE
Straight Shaft Piers

Alazan Creek Bridge (CIMS)
San Antonio, Texas
(Boring B-2, Bent 4)



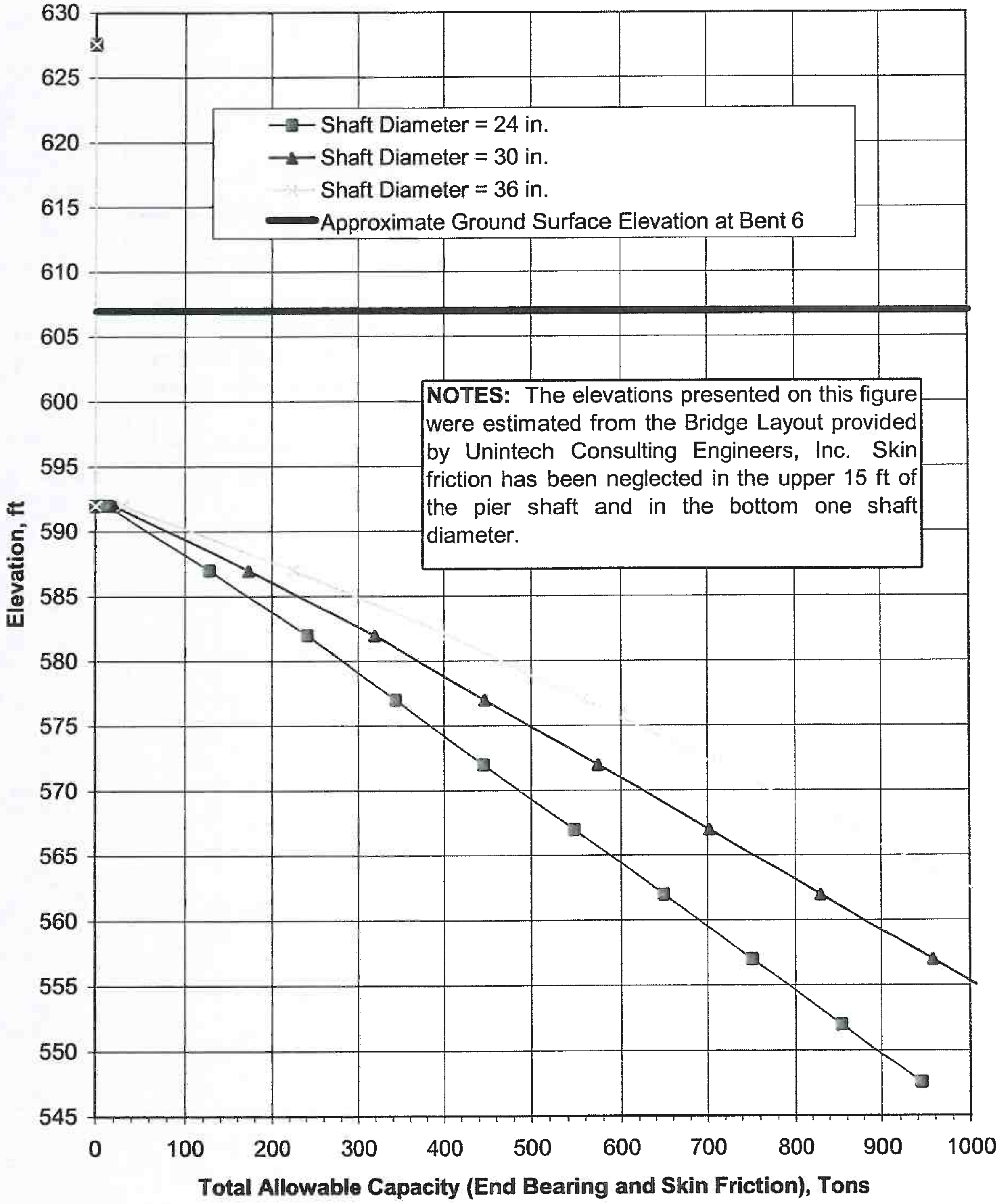
DRILLED PIER AXIAL CAPACITY CURVE
Straight Shaft Piers

Alazan Creek Bridge (CIMS)
San Antonio, Texas
(Boring B-1, Bent 5)



DRILLED PIER AXIAL CAPACITY CURVE
Straight Shaft Piers

Alazan Creek Bridge (CIMS)
San Antonio, Texas
(Boring B-1, Bent 6)



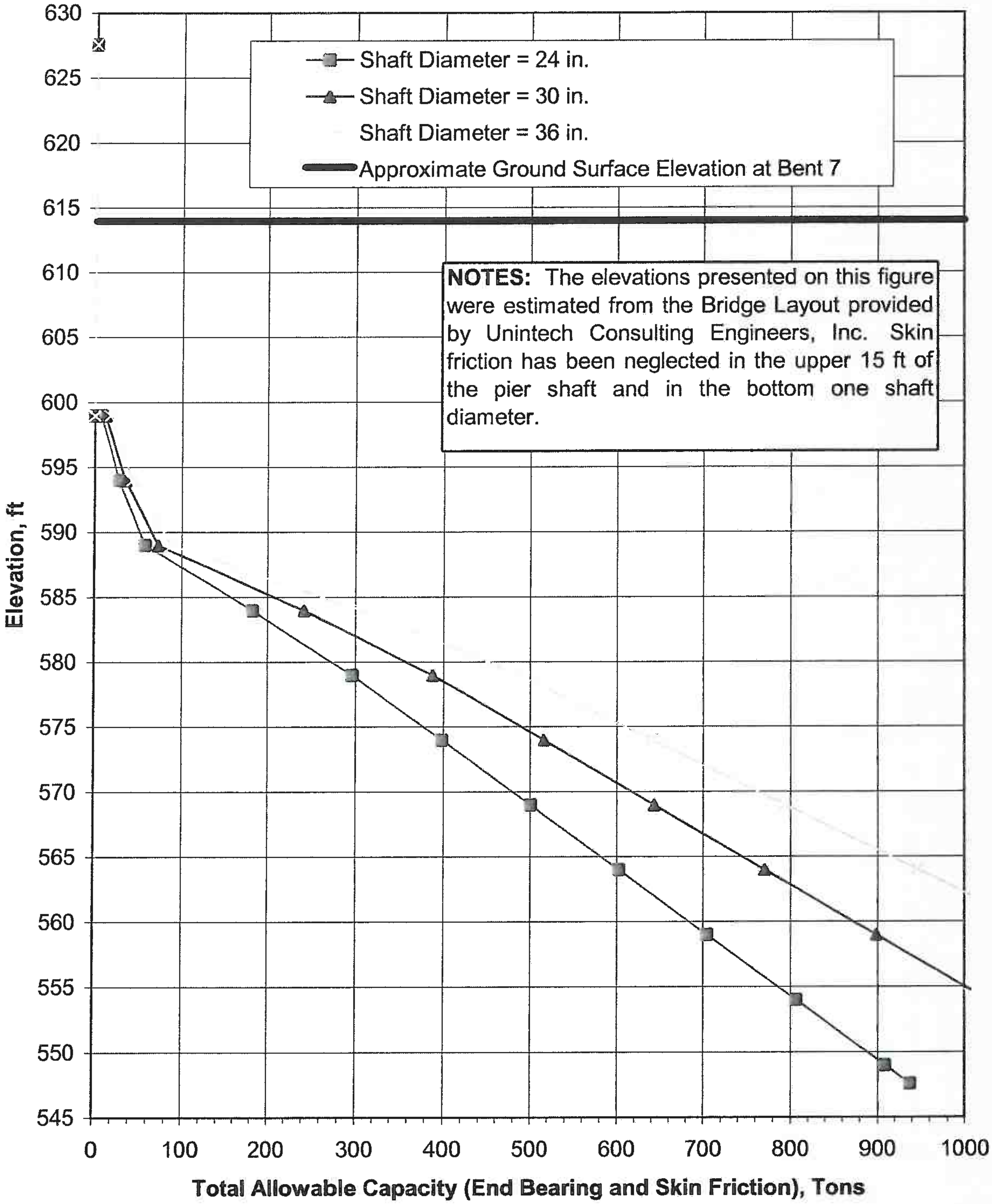
DRILLED PIER AXIAL CAPACITY CURVE

Straight Shaft Piers

Alazan Creek Bridge (CIMS)

San Antonio, Texas

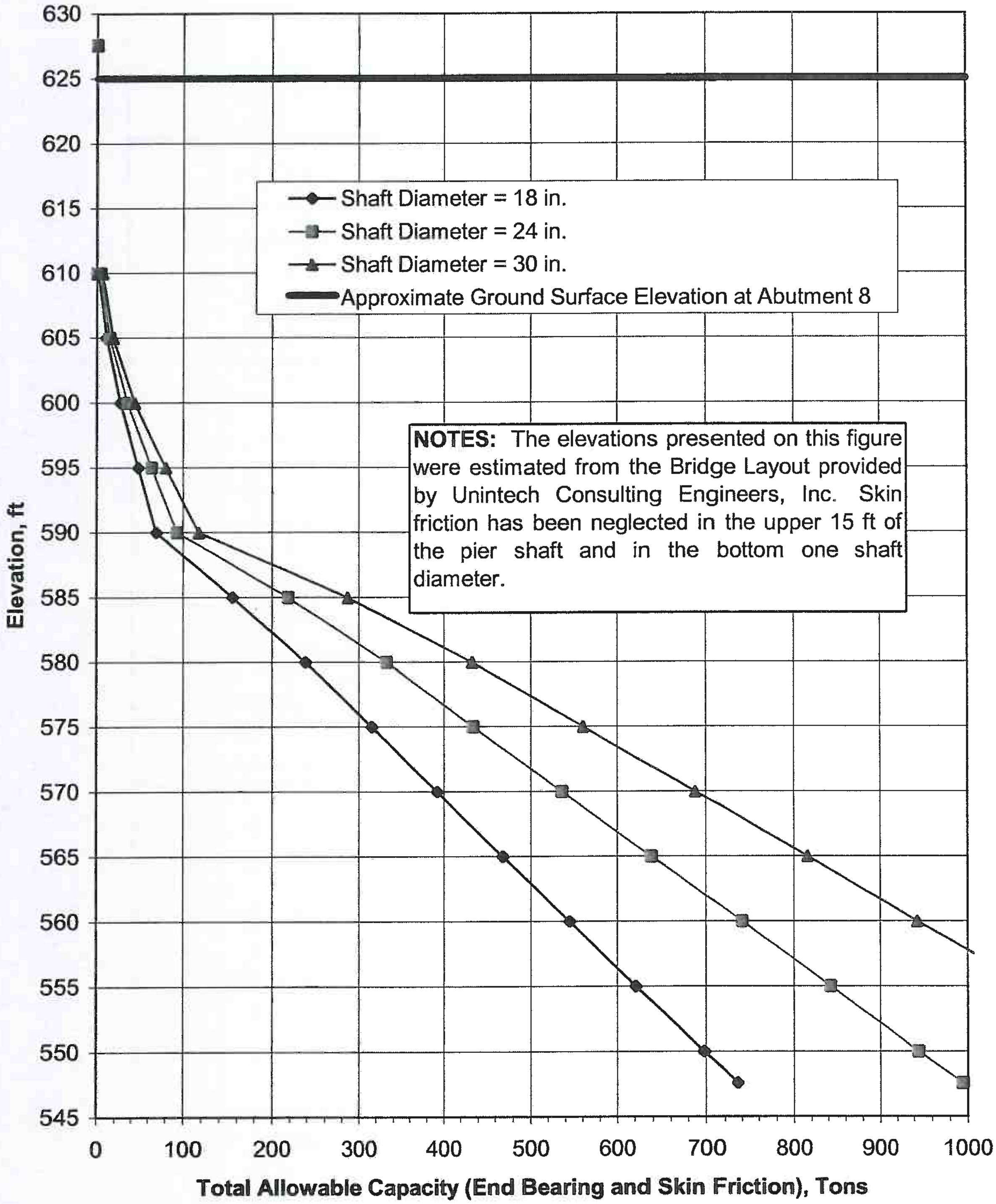
(Boring B-1, Bent 7)



DRILLED PIER AXIAL CAPACITY CURVE

Straight Shaft Piers

Alazan Creek Bridge (CIMS)
San Antonio, Texas
(Boring B-1, Abutment 8)



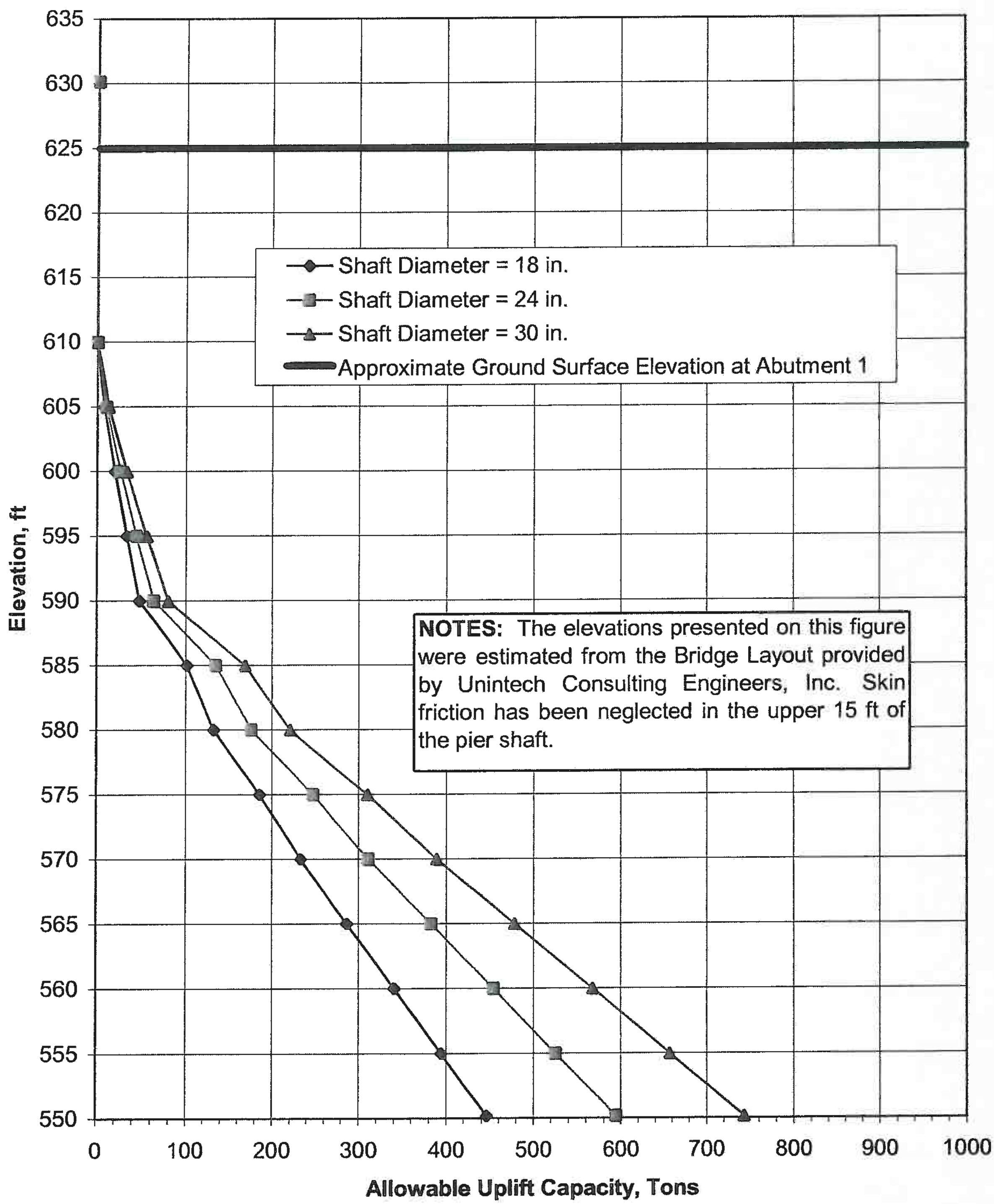
DRILLED PIER UPLIFT CAPACITY CURVE

Straight Shaft Piers

Alazan Creek Bridge (CIMS)

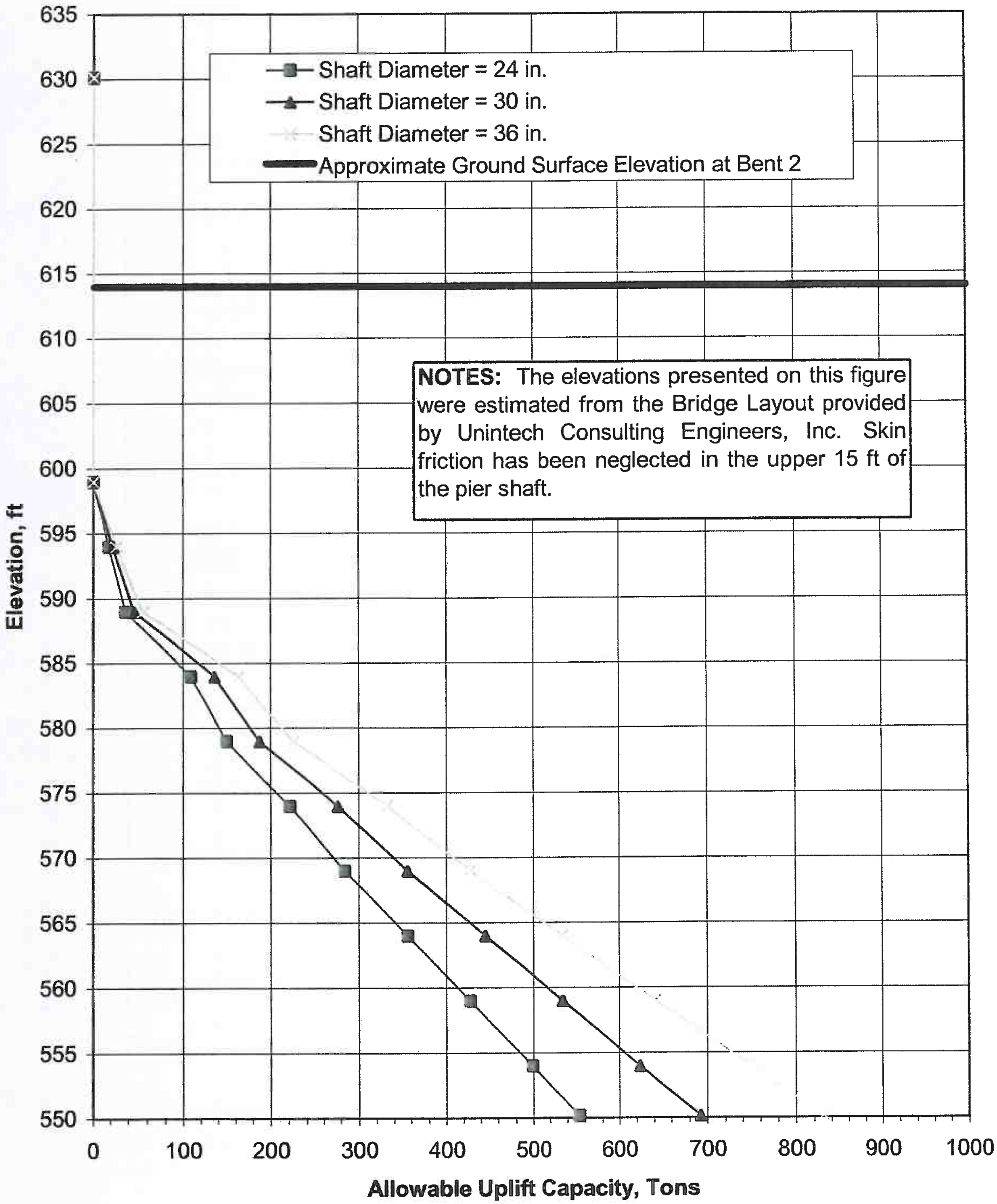
San Antonio, Texas

(Boring B-2, Abutment 1)



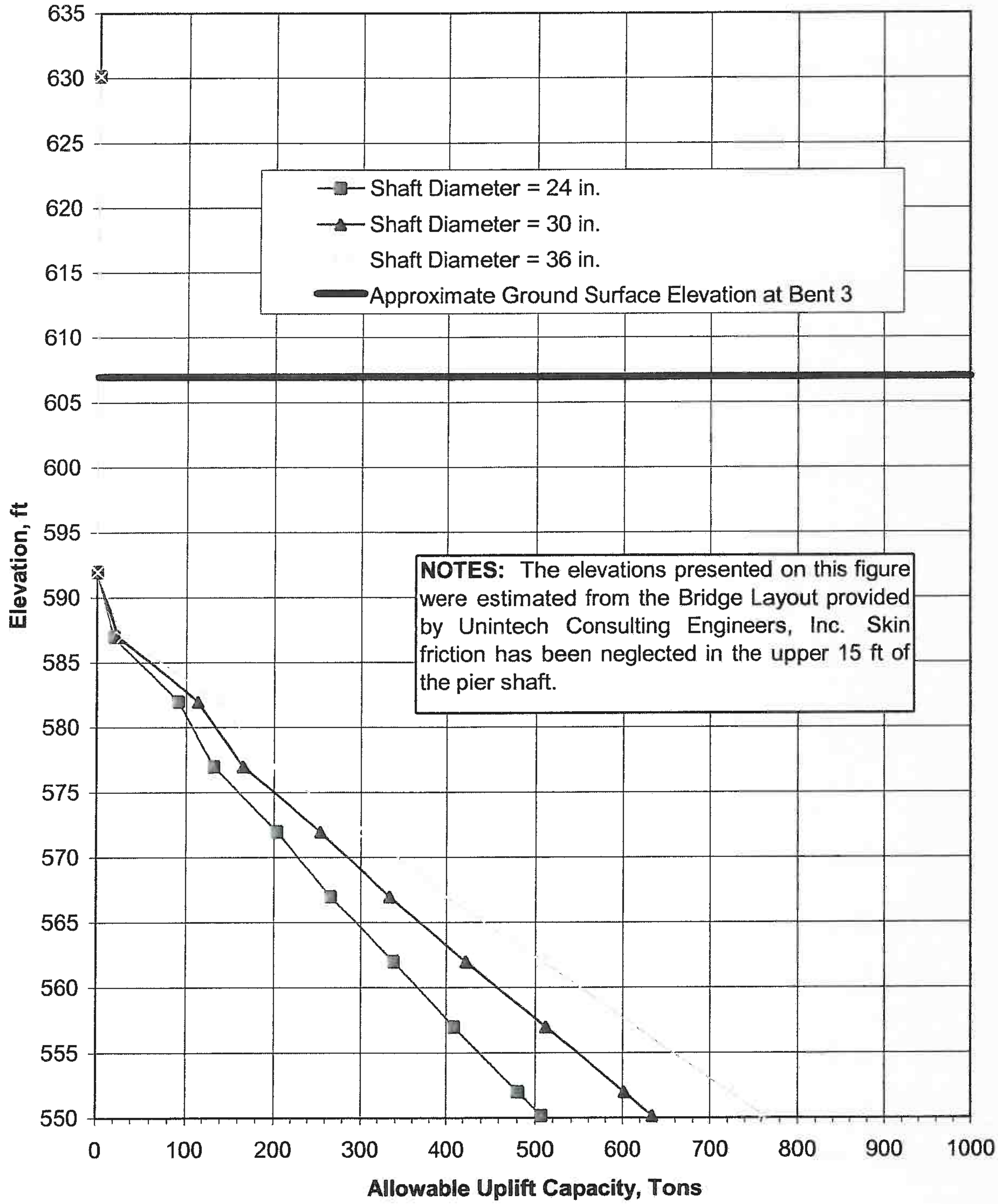
DRILLED PIER UPLIFT CAPACITY CURVE
Straight Shaft Piers

Alazan Creek Bridge (CIMS)
San Antonio, Texas
(Boring B-2, Bent 2)



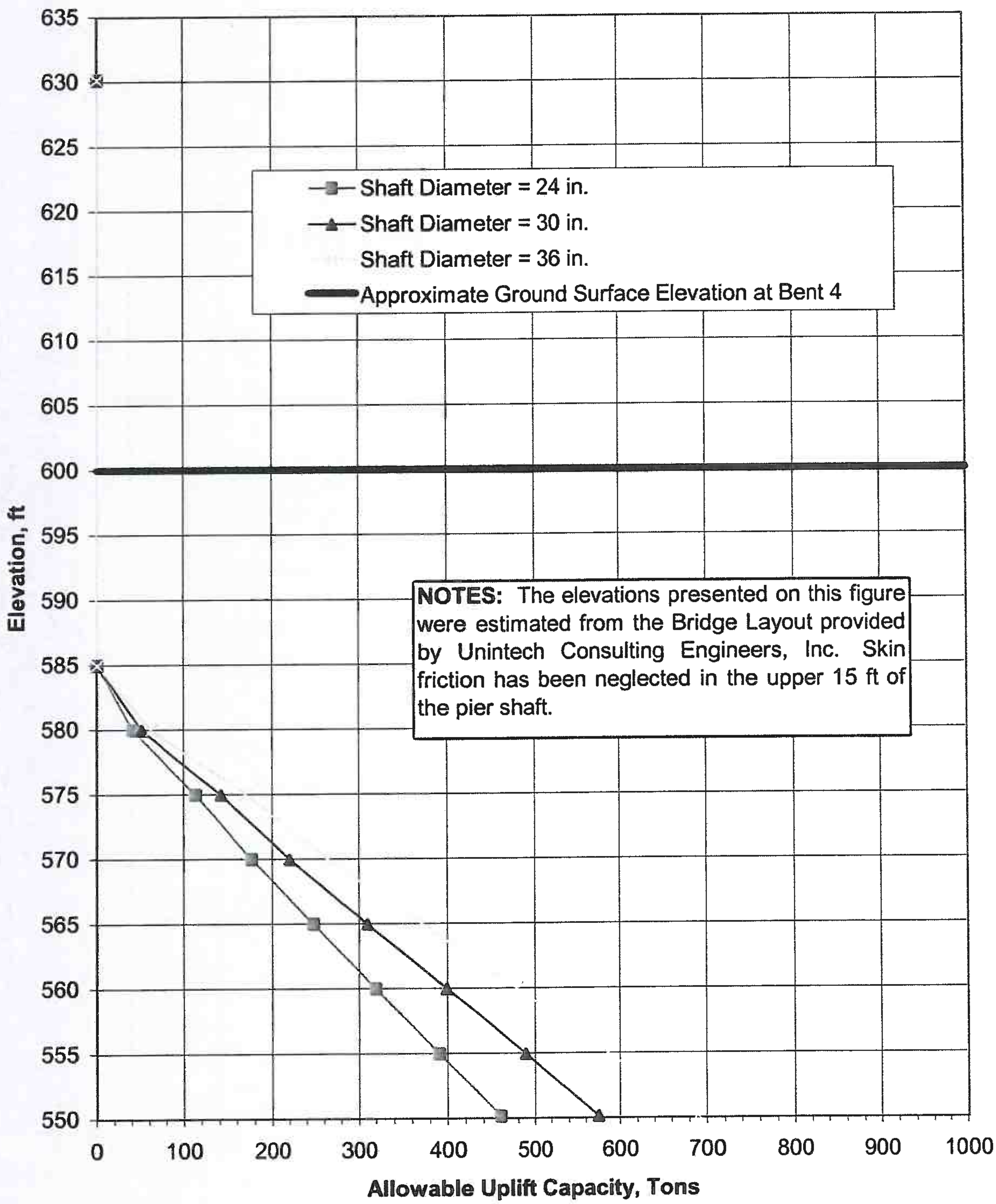
DRILLED PIER UPLIFT CAPACITY CURVE
Straight Shaft Piers

Alazan Creek Bridge (CIMS)
San Antonio, Texas
(Boring B-2, Bent 3)



DRILLED PIER UPLIFT CAPACITY CURVE
Straight Shaft Piers

Alazan Creek Bridge (CIMS)
San Antonio, Texas
(Boring B-2, Bent 4)



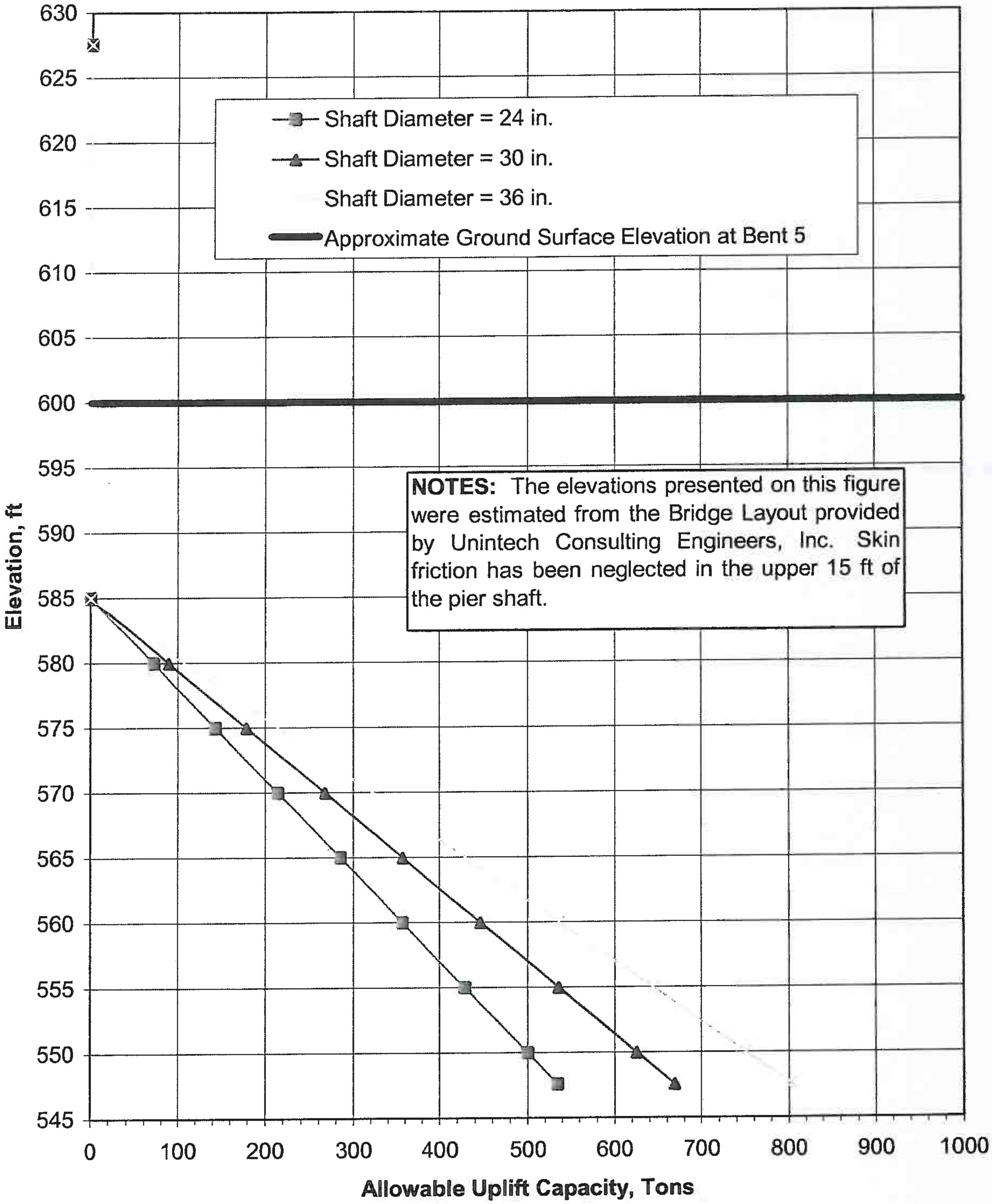
DRILLED PIER UPLIFT CAPACITY CURVE

Straight Shaft Piers

Alazan Creek Bridge (CIMS)

San Antonio, Texas

(Boring B-1, Bent 5)



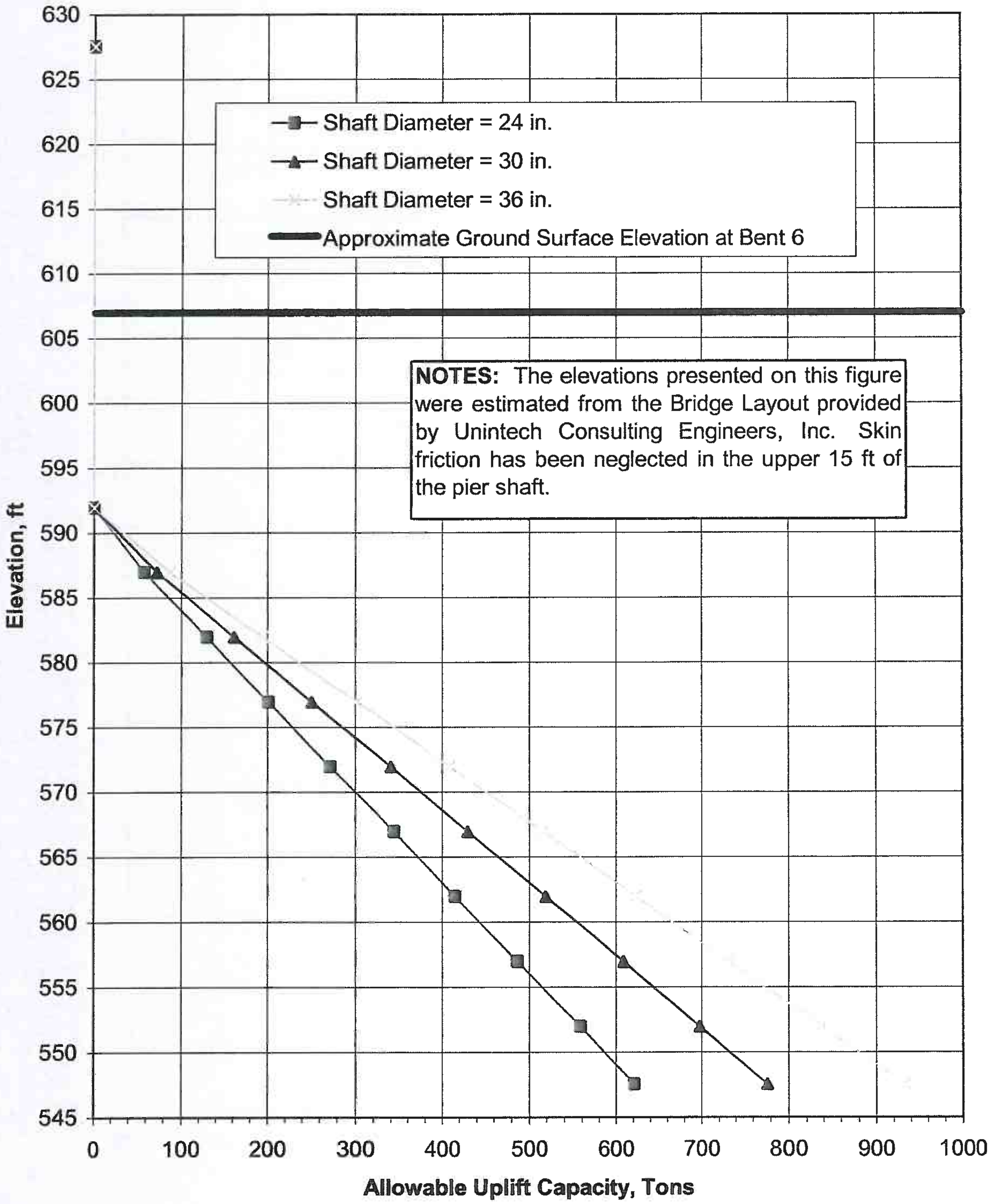
DRILLED PIER UPLIFT CAPACITY CURVE

Straight Shaft Piers

Alazan Creek Bridge (CIMS)

San Antonio, Texas

(Boring B-1, Bent 6)



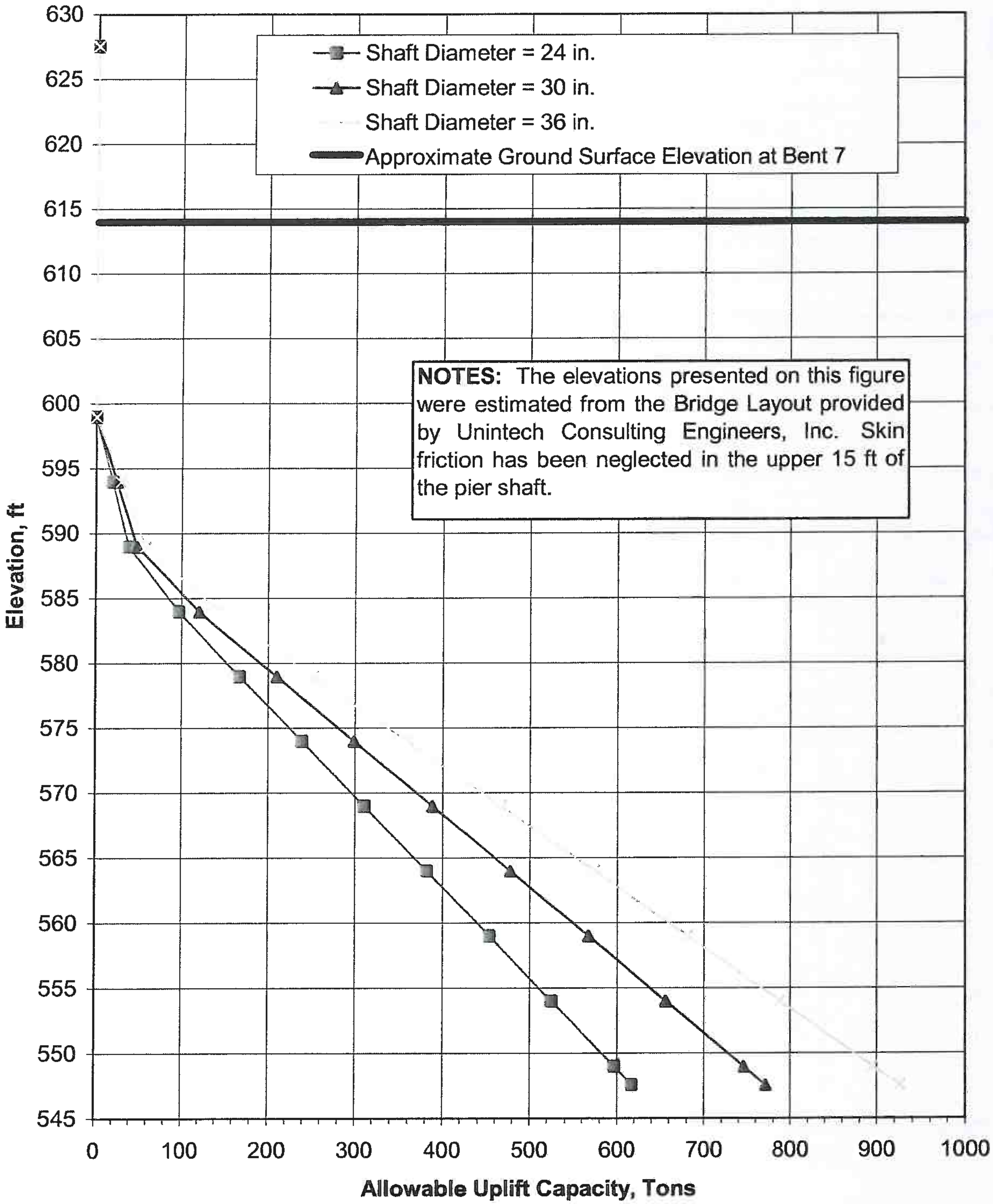
DRILLED PIER UPLIFT CAPACITY CURVE

Straight Shaft Piers

Alazan Creek Bridge (CIMS)

San Antonio, Texas

(Boring B-1, Bent 7)



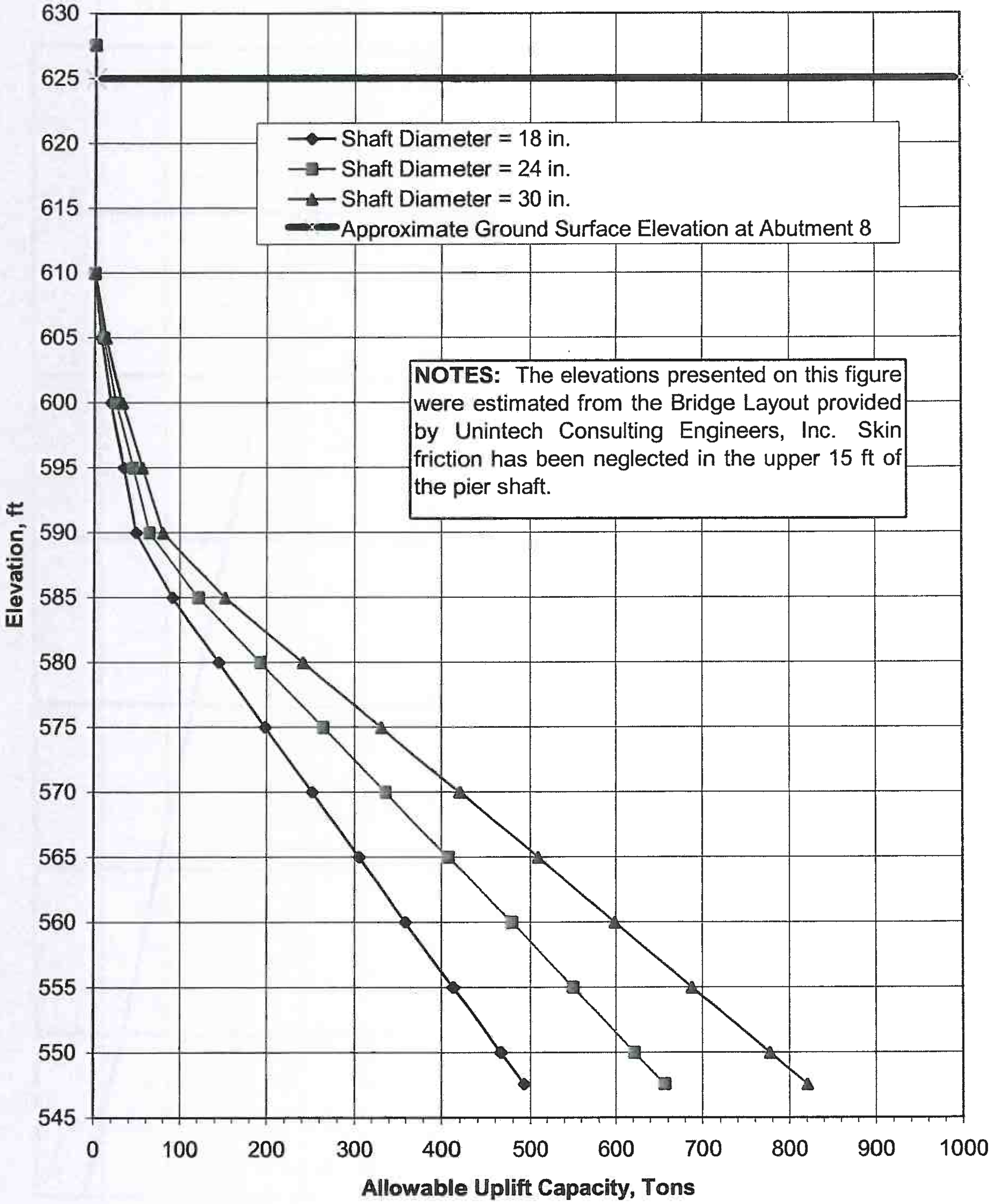
DRILLED PIER UPLIFT CAPACITY CURVE

Straight Shaft Piers

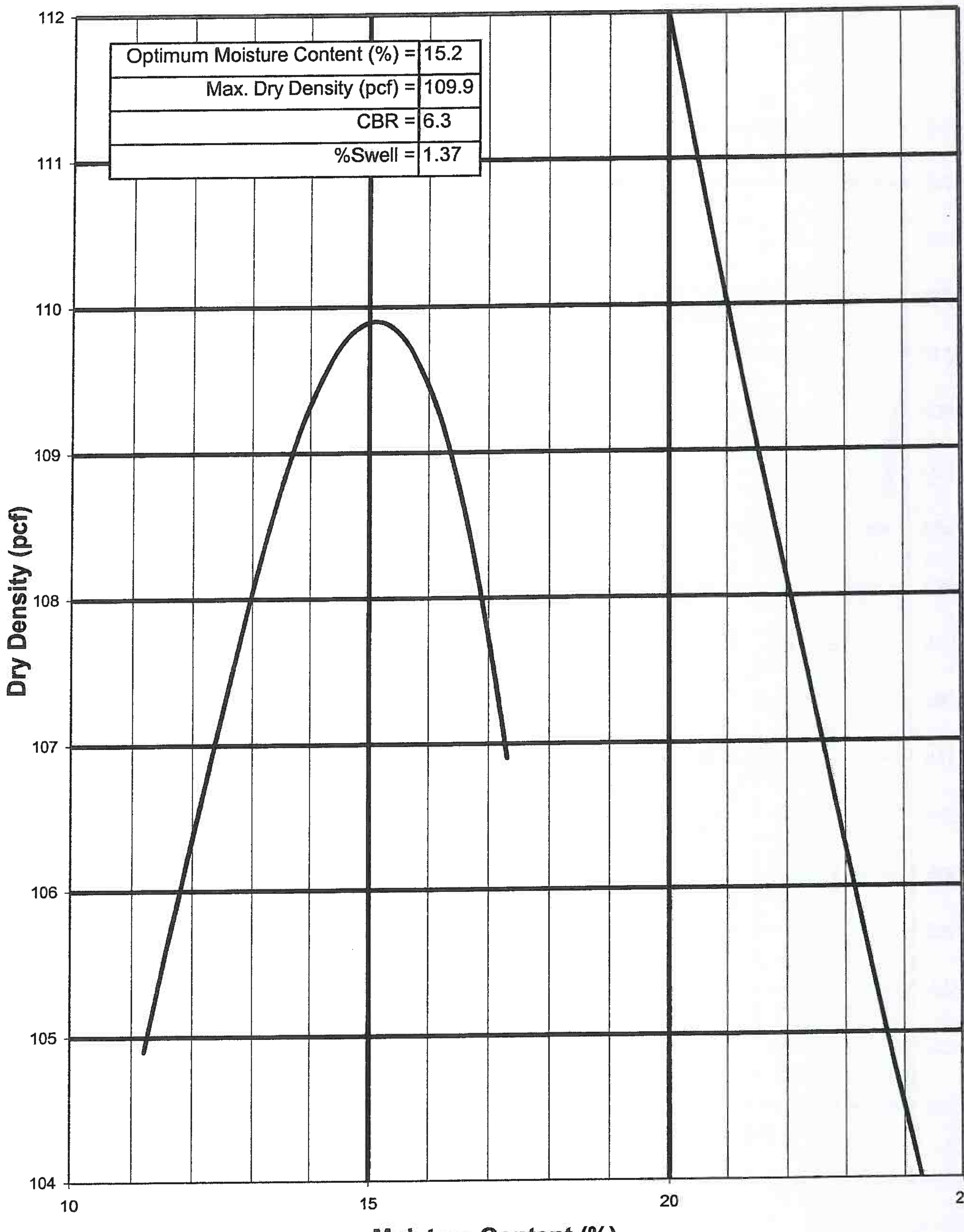
Alazan Creek Bridge (CIMS)

San Antonio, Texas

(Boring B-1, Abutment 8)



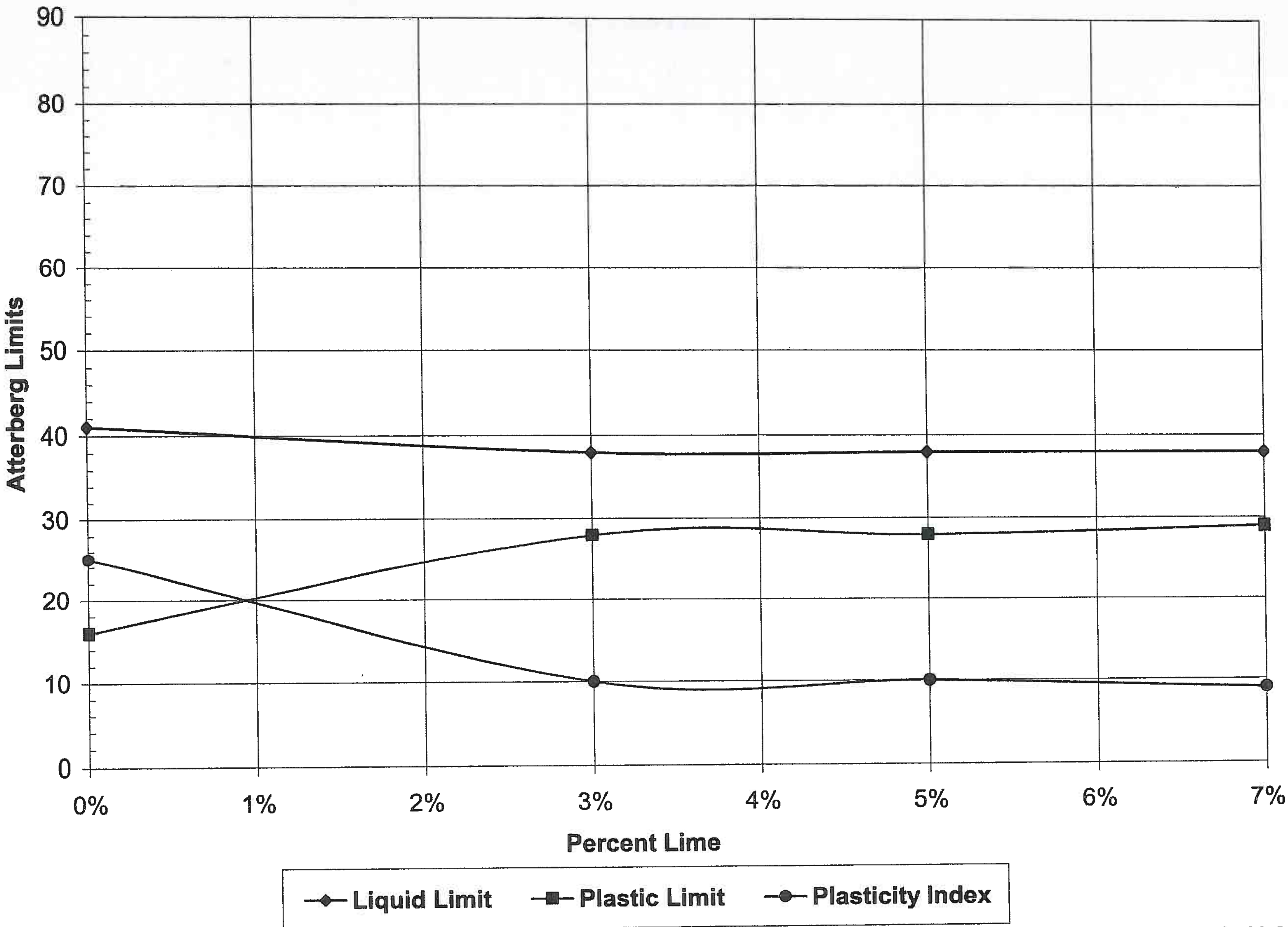
MOISTURE DENSITY RELATIONSHIP
Alzan Creek Bridge (CIMS)



ASA09-051-00
Figure 9

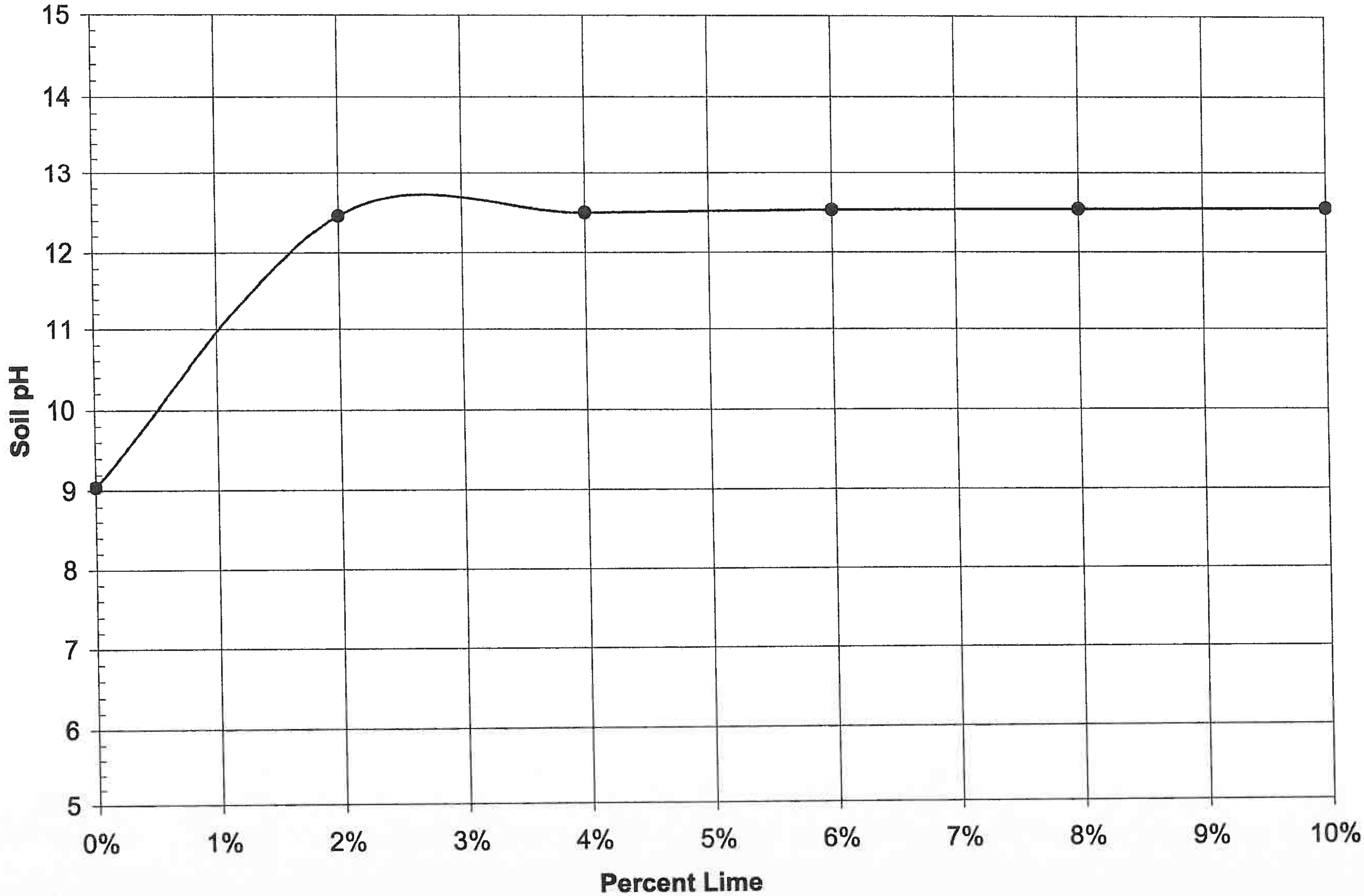
LIME SERIES CURVE

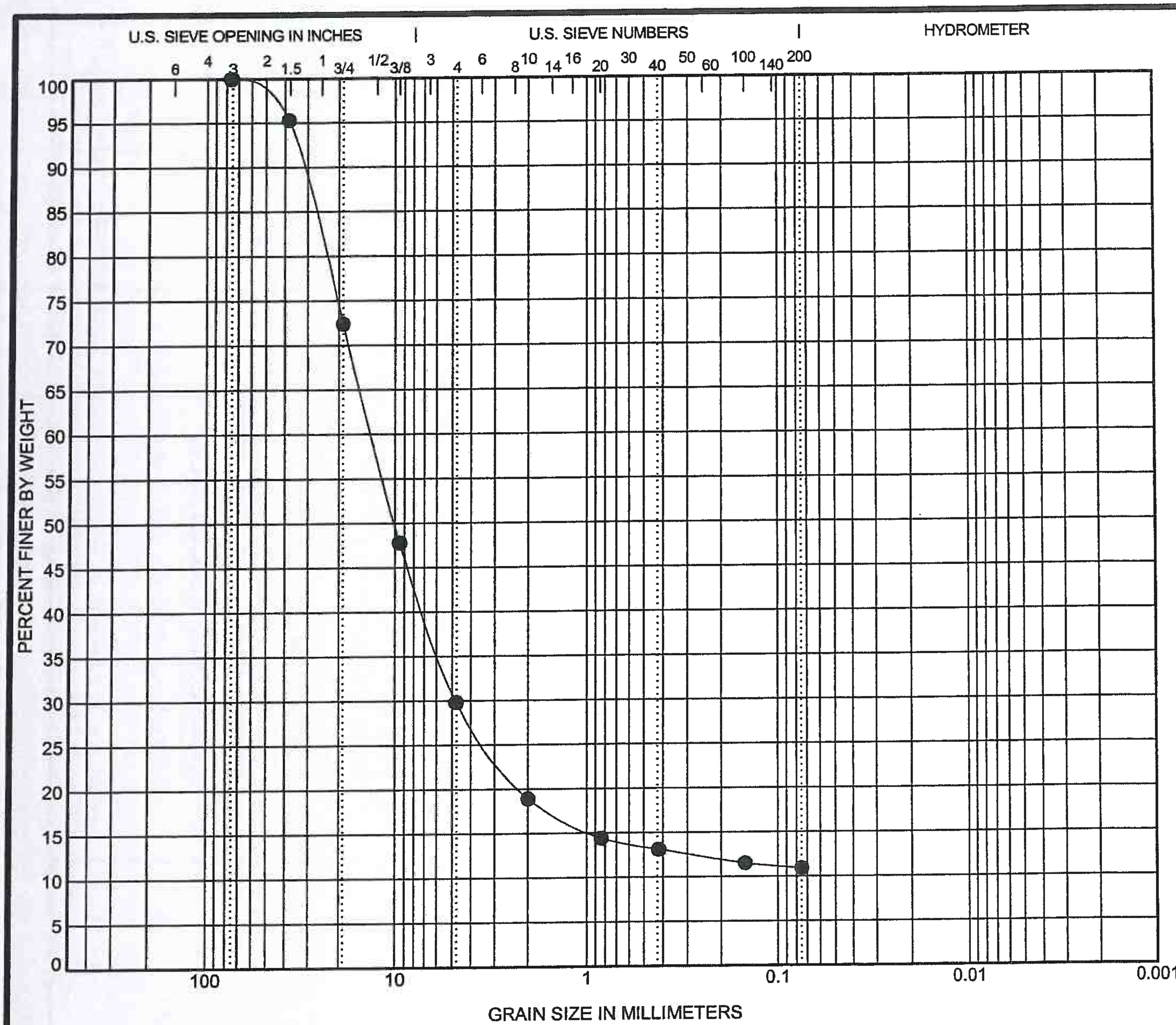
Alzan Creek Bridge (CIMS)



pH SERIES CURVE

Alzan Creek Bridge (CIMS)





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**Bulk**	**0.0**					**64.09**	**500.46**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**Bulk**	**0.0**	**76.2**	**13.404**	**4.797**		**70.1**	**18.9**	**10.9**	

Raba Kistner

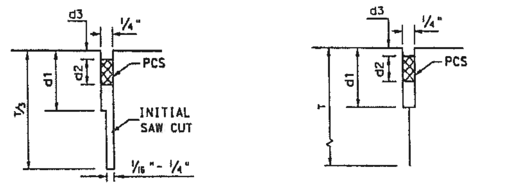
12821 W. Golden Lane
San Antonio, Texas 78249
(210) 699-9090
(210) 699-6426 fax
www.rkci.com

GRAIN SIZE DISTRIBUTION

Alazan Creek Bridge (CIMS)
San Antonio, Texas

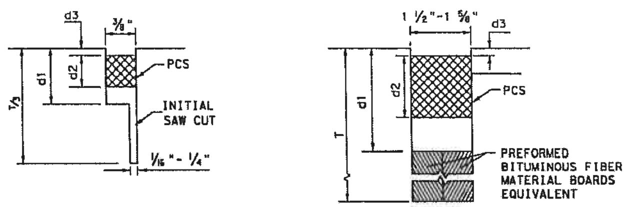
FIGURE 12

RK GRAIN SIZE ASA09-051-00.GPJ RKCI.GDT 8/20/09



SAWED LONGITUDINAL JOINT — LONGITUDINAL CONSTRUCTION JOINT

LONGITUDINAL JOINT SEALS



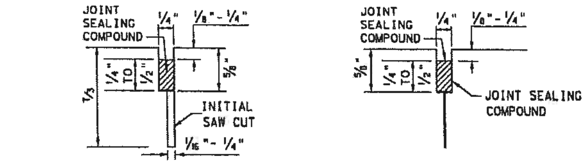
SAWED CONTRACTION JOINT — FORMED FORMED EXPANSION JOINT

TRANSVERSE JOINT SEALS

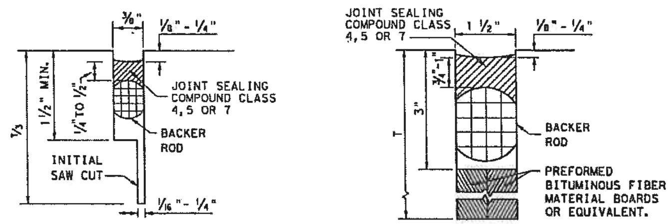
METHOD A: PREFORMED COMPRESSION SEALS (PCS)
(CLASS 6 PREFORMED JOINT SEALANT)

GENERAL NOTES FOR METHOD "A"

1. UNLESS OTHERWISE SHOWN IN THE PLANS, EITHER METHOD "A" OR METHOD "B" MAY BE USED.
2. THE LOCATION OF JOINTS SHALL BE AS SHOWN ELSEWHERE IN THE PLANS.
3. DIMENSIONS d1, d2, AND d3 SHALL BE IN ACCORDANCE WITH THE PREFORMED COMPRESSION SEAL MANUFACTURES RECOMMENDATION.
4. THE JOINT RESERVOIR FOR SEALANT SHALL BE SAWED UNLESS OTHERWISE SHOWN ON THE PLANS FOR THE LONGITUDINAL AND TRANSVERSE CONSTRUCTION AND THE TWO SAWED JOINTS.
5. THE JOINTS SHALL BE CLEANED IN ACCORDANCE WITH THE ITEM 438 AND PRIOR TO BEGINNING OPERATIONS, THE CONTRACTOR SHALL SUBMIT A STATEMENT FROM THE SEALANT MANUFACTURER SHOWING THE RECOMMENDED EQUIPMENT AND INSTALLATION PROCEDURES TO BE USED.
6. THE SAW CUT FOR THE LONGITUDINAL JOINT SHALL BE ONE FOURTH THE SLAB THICKNESS WHEN CRUSHED LIMESTONE IS USED AS THE COARSE AGGREGATE.



SAWED LONGITUDINAL JOINT — LONGITUDINAL OR TRANSVERSE CONSTRUCTION JOINT



TRANSVERSE SAWED CONTRACTION JOINT — TRANSVERSE FORMED EXPANSION JOINT

METHOD B: JOINT SEALING COMPOUND

GENERAL NOTES FOR METHOD "B"

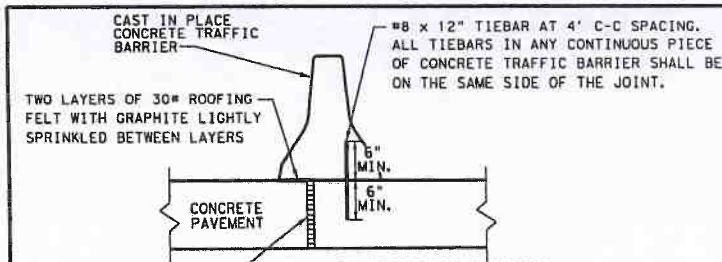
1. UNLESS OTHERWISE SHOWN IN THE PLANS, EITHER METHOD "A" OR METHOD "B" MAY BE USED.
2. THE LOCATION OF JOINTS SHALL BE AS SHOWN ELSEWHERE IN THE PLANS.
3. THE ENGINEER SHALL SELECT A TARGET PLACEMENT THICKNESS FOR THE SEALANT DETAILS WHICH SHOW RANGES IN THICKNESS. THE TARGET THICKNESS WILL NORMALLY BE THE MIDPOINT OF THE RANGE.
4. THE JOINT RESERVOIR FOR SEALANT SHALL BE SAWED UNLESS OTHERWISE SHOWN ON THE PLANS FOR THE LONGITUDINAL AND TRANSVERSE CONSTRUCTION AND THE TWO SAWED JOINTS.
5. THE JOINTS SHALL BE CLEANED IN ACCORDANCE WITH THE ITEM 438 AND PRIOR TO BEGINNING OPERATIONS, THE CONTRACTOR SHALL SUBMIT A STATEMENT FROM THE SEALANT MANUFACTURER SHOWING THE RECOMMENDED EQUIPMENT AND INSTALLATION PROCEDURES TO BE USED.
6. THE SAW CUT FOR THE LONGITUDINAL JOINT SHALL BE ONE FOURTH THE SLAB THICKNESS WHEN CRUSHED LIMESTONE IS USED AS THE COARSE AGGREGATE.

PROJECT No. ASA09-051-00
Figure 13A

Texas Department of Transportation
Construction Division (Pavement)

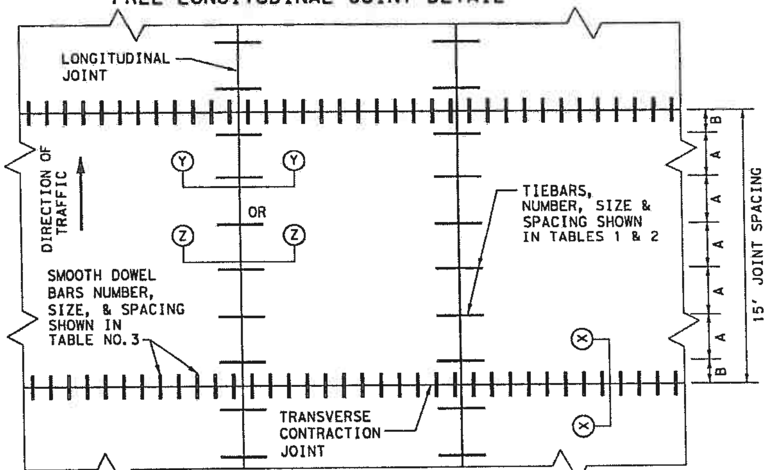
CONCRETE PAVING DETAILS JOINT SEALS

JS-94



FREE LONGITUDINAL JOINT WITH NO TIEBARS. LOCATION OF THE JOINT WILL BE AS DIRECTED BY THE ENGINEER FORMED WITH PREFORMED FIBER BOARD OR ASPHALT BOARD IN ACCORDANCE WITH ITEM "JOINT SEALANT AND FILLERS".

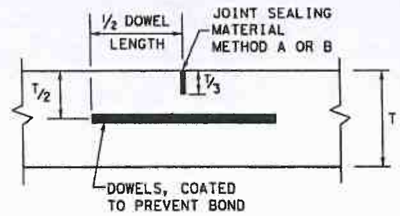
FREE LONGITUDINAL JOINT DETAIL



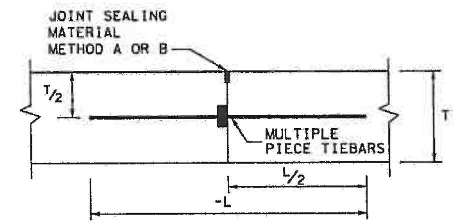
PAVEMENT DETAIL LAYOUT

TABLE NO. 1 TIEBARS REQUIRED FOR LONGITUDINAL JOINT JOINTS FOR EACH 15' SLAB						
ASTM A-616 OR A-615 (GRADE 60) STRAIGHT OR MULIPLE PIECE REINFORCING TIEBARS		CONCRETE SLAB THICKNESS	DISTANCE FROM THE LONGITUDINAL JOINT TO THE NEAREST LONGITUDINAL FREE EDGE			
			< OR =16'	< OR =24'	< OR =34'	< OR =50'
BAR LENGTH, "L" INCHES	BAR SIZE	"T" INCHES	REQUIRED NO. OF BARS	REQUIRED NO. OF BARS	REQUIRED NO. OF BARS	REQUIRED NO. OF BARS
42	#5 (5/8")	8	5	5	6	9
		9	5	5	7	10
		10	5	5	7	11
		11	5	6	8	12
		12	5	6	9	13
		13	5	7	9	13
		14	6	7	10	NA
		15	6	8	11	NA
50	#6 (3/4")	8	5	5	5	6
		9	5	5	5	7
		10	5	5	5	8
		11	5	5	6	8
		12	5	5	6	9
		13	5	5	7	10
		14	5	5	7	10
		15	5	6	8	11

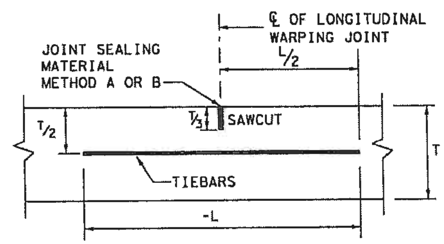
THE DISTANCE TO THE FREE EDGE WILL BE DETERMINED BY THE ENGINEER AND THE DISTANCE WILL BE BASED ON THE NOMINAL WIDTHS OF THE LANES AND SHOULDERS PLUS ANY TIED RAMPS OR CONNECTING ROADWAYS.



TRANSVERSE CONTRACTION JOINT
SECTION X-X



LONGITUDINAL CONSTRUCTION JOINT
SECTION Y-Y



LONGITUDINAL WARPING JOINT
SECTION Z-Z

TABLE NO. 2 TIEBAR SPACINGS		
SPACING REQUIREMENT FOR 15' SLAB FOR REQUIRED NUMBER OF BARS		
REQUIRED NO. OF BARS	REGUALR SPACING "A" INCHES	FIRST AT JOINT "B" INCHES
5	36	18
6	30	15
7	25	15
8	21	16.5
9	18	18
10	16	18
11	15	15
12	13	18.5
13	12	18

TABLE NO. 3 DOWELS REQUIEMENTS		
T, IN.	DOWELS (SMOOTH BARS)	
	SIZE AND LENGTH	AVERAGE SPACING (INCHES)
8	1" X 18"	12
9	1 1/8" X 18"	12
10	1 1/4" X 18"	12
11	1 3/8" X 18"	12
12	1 1/2" X 18"	12
13	1 5/8" X 18"	12
14	1 3/4" X 18"	12
15	1 7/8" X 18"	12

GENERAL NOTES

1. CONCRETE SLABS WIDER THAN 100' WITHOUT A FREE JOINT, ARE NOT COVERED BY THIS STANDARD.
2. FOR FURTHER INFORMATION REGARDING THE PLACEMENT OF CONCRETE AND LOAD TRANSFER DEVICES REFER TO THE GOVERNING SPECIFICATIONS FOR "CONCRETE PAVEMENT" AND "REINFORCING STEEL."
3. DETAILS FOR PAVEMENT WIDTH, PAVEMENT THICKNESS, AND CROWN CROSS SLOPE SHALL BE AS SHOWN ELSEWHERE IN THE PLANS.
4. THE DETAIL FOR THE JOINT SEALANT AND RESERVOIR WILL BE SHOWN IN CONCRETE PAVEMENT DETAIL, JOINT SEALANT STANDARD (JS-94).
5. PAVEMENT WIDTHS IN EXCESS OF 16' SHALL BE PROVIDED WITH A LONGITUDINAL JOINT (SECTION Z-Z OR Y-Y). THESE JOINTS SHALL BE LOCATED WITHIN 6" OF THE LANE LINES UNLESS SHOWN ELSEWHERE ON THE PLANS.
6. THE JOINT BETWEEN OUTSIDE LANE AND SHOULDER SHALL BE A LONGITUDINAL WARPING JOINT (SECTION Z-Z) UNLESS OTHERWISE SHOWN IN THE PLANS.
7. THE SPACING BETWEEN TRANSVERSE JOINTS SHALL BE 15 FEET UNLESS OTHERWISE SHOWN IN THE PLANS.
8. WHERE A MONOLITHIC CURB IS SPECIFIED, THE JOINT IN THE CURB SHALL COINCIDE WITH PAVEMENT JOINTS AND MAY BE FORMED BY ANY MEANS APPROVED BY THE ENGINEER.
9. TRANSVERSE CONSTRUCTION JOINTS MAY BE FORMED BY USE OF METAL OR WOOD FORMS EQUAL IN DEPTH TO THE NOMINAL DEPTH OF THE PAVEMENT, OR BY METHODS APPROVED BY THE ENGINEER.
10. THE ENGINEER WILL ADJUST THE REQUIRED NUMBER OF TIEBARS FOR SLABS SHORTER OR LONGER THAN 15'. SPACING "B" WILL BE ADJUSTED TO MAINTAIN A MINIMUM CLEARANCE OF 2" BETWEEN THE TIEBAR AND THE DOWEL BARS AT THE TRANSVERSE JOINT AND THE "A" SPACING WILL REMAIN AS REQUIRED FOR THE PAVEMENT SLAB WIDTH.
11. MULTIPLE PIECE TIEBARS SHALL BE USED AT LONGITUDINAL CONSTRUCTION JOINTS UNLESS OTHERWISE SPECIFIED IN THE PLANS.
12. THE SAW CUT FOR LONGITUDINAL WARPING AND THE TRANSVERSE CONSTRUCTION JOINTS MAY BE ONE FOURTH THE SLAB THICKNESS WHEN CRUSHED LIMESTONE IS USED AS THE COARSE AGGREGATE.

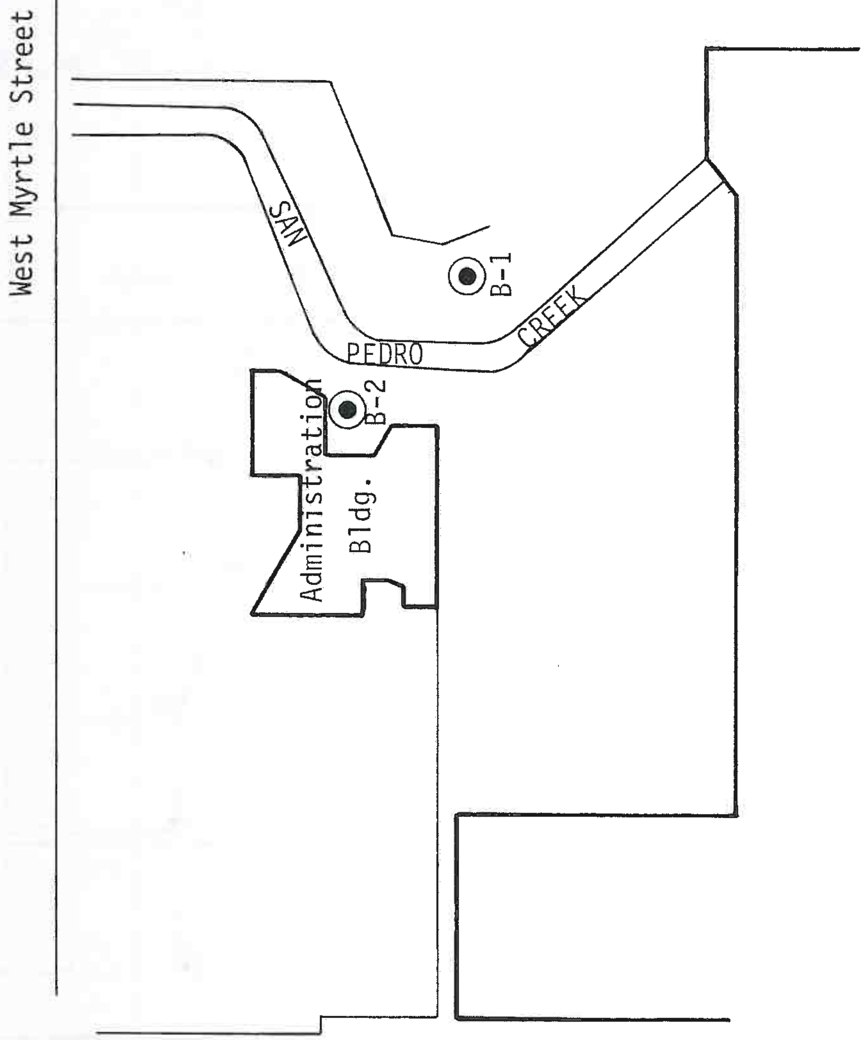
PROJECT No. ASA09-051-00
Figure 13B

Texas Department of Transportation
Construction Division (Pavements)

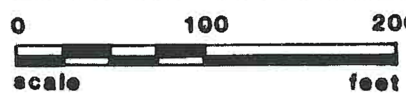
CONCRETE PAVEMENT DETAILS
CONTRACTION DESIGN
T-8 THROUGH 15 INCHES
CPCD-94

LEVELS DISPLAYED

REPORT 8



PLAN OF BORINGS



PROJ. NO. SA0288-0052

PLATE 1

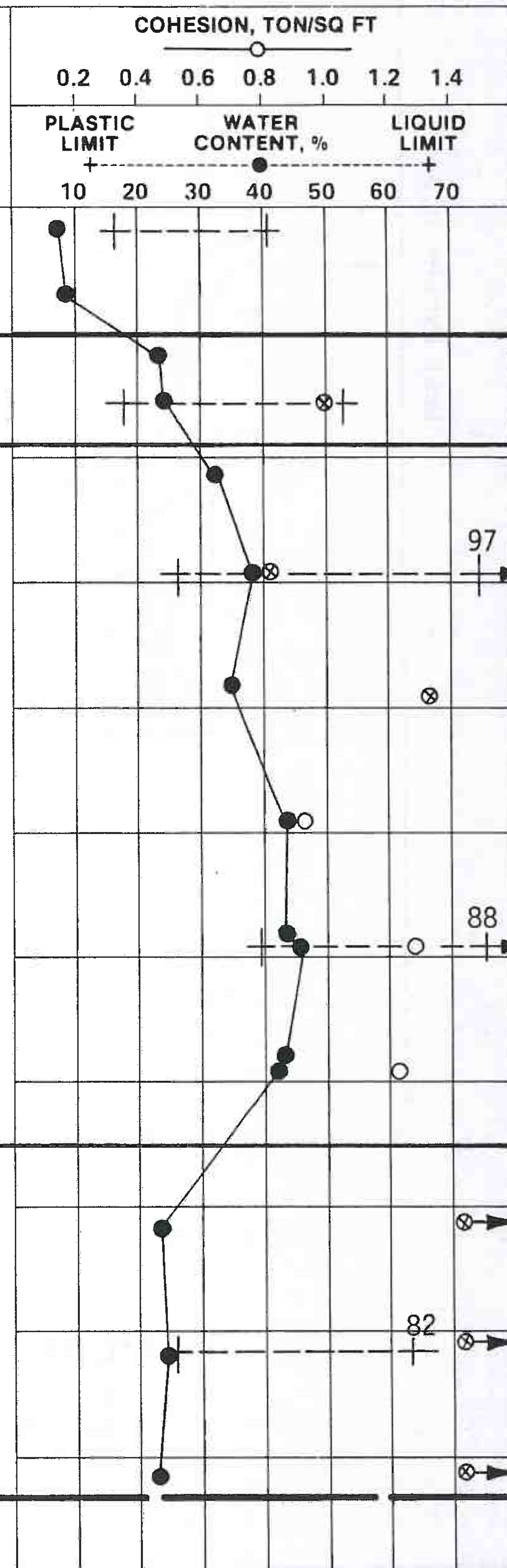
LOG OF BORING NO. B-1

VIA PEDESTRIAN BRIDGE
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

TYPE: Hollow Stem Auger **LOCATION:** See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0	FILL: CLAY, Silty, Hard, Dark Grayish-Brown with calcareous nodules, some coarse gravels, asphalt pieces, metal fragments - reddish-brown loam and light yellowish-tan calcareous silty clays at 3.0'	32	
		31	
5		16	
	CLAY, Stiff to Very Stiff, Dark Gray with some fine gravels - gravelly from 8.0' to 9.5' - trace of ground water seepage at 9.5'		
10		13	
	CLAY, Stiff, Mottled Tan and Gray, Ferrous Stained with a trace of calcareous nodules and fine gravels - bentonitic, jointed, brown and gray below 14.0' - very stiff with marly seam at 20.0' - very stiff, slightly silty, brownish-gray below 28.0' - light bluish-gray with clay-shale seams below 34.0'		
25			75
30			73
35			76
40	CLAY-SHALE, Hard, Bluish-Gray with a trace of shells	50/11"	
45		50	
50		48	



NOTE: These logs should not be used separately from the project report.

COMPLETION DEPTH: 51.5' DEPTH TO WATER IN BORING: None Observed (4-19-88) 38.6' (4-21-88)(Bottom @ 46.0") PROJ. NO. SA0288-0052

DATE: 4-19-88 PLATE 2

RABA & ASSOCIATES CONSULTING ENGINEERS INC.

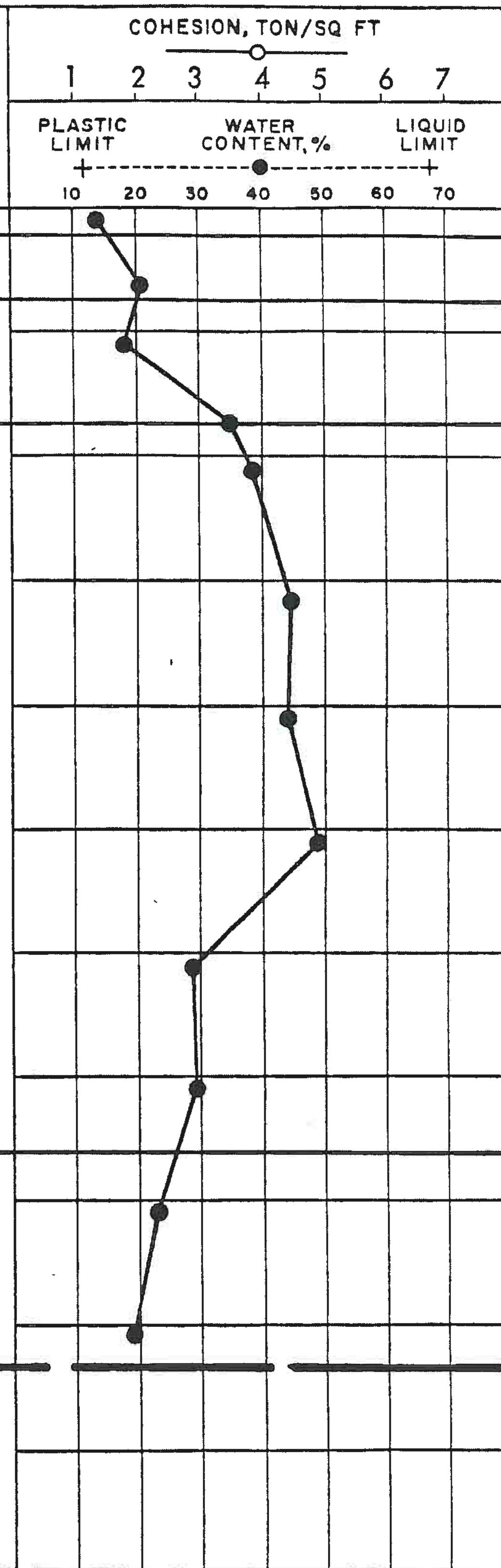
LOG OF BORING NO. 2

OFFICE FACILITY
SAN ANTONIO TRANSIT AUTHORITY

TYPE: 3" Shelby tube   LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL:)
0–1	Brown Silty Clay with very fine gravel
1–3	Dark Gray Silty Clay
3–8	Very Stiff Gray Clay with caliche and occasional tan clay seams - fine gravel and clay layer at 6' to 7.5'
8–37	Stiff Tan and Gray Clay with occasional caliche and organic deposits - clays darker in color with a jointed structure below 15' - bentonitic seams from 15' to 24.5' - bentonitic layer at 24.5' to 27' - gypsum seams below 29' - occasional blue clay-shale seams below 34.5'
37–46.5	Very Stiff Blue Clay-Shale - occasional tan clay seams at 38' to 41' - occasional pyrite nodules at 45' to 46'

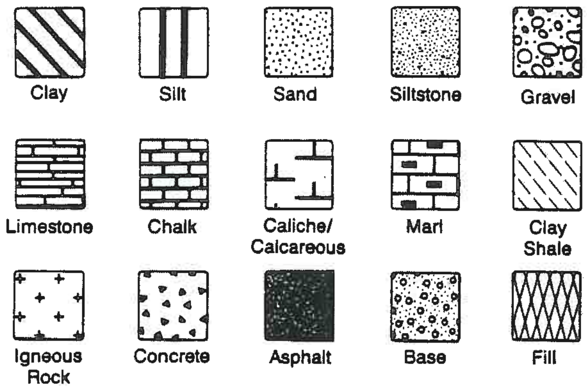
Column headings: DEPTH, FT; SYMBOL; SAMPLES; DESCRIPTION OF MATERIAL; BLOWS PER FT; UNIT DRY WT LB/CU FT; COHESION, TON/SQ FT; ELEVATION, FT



COMPLETION DEPTH: 46.5'
DATE: 3/15/72
DEPTH TO WATER IN BORING: 6.3'
DATE: 3/22/72
PLATE 3

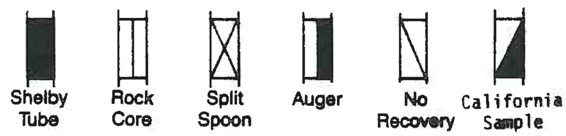
SYMBOLS AND TERMS USED ON BORING LOGS

SOIL OR ROCK TYPES
(shown in symbols column)



(Predominate Soil Types Shown Heavy)

SAMPLER TYPES
(shown in sample column)



STRENGTH TEST RESULTS

- ◉ - Estimated Strength
- ◇ - Torvane
- ○ - Unconfined Compression

TRIAXIAL COMPRESSION

- △ - Unconsolidated-undrained
- □ - Consolidated-undrained

- C - Cohesion (Total)
- Φ - Angle of Internal Friction (Total)

- C' - Cohesion (Effective)
- Φ' - Angle of Internal Friction (Effective)

NOTE:

Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or condition are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc. 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

- Slickensided - having inclined planes of weakness that are slick and glossy in appearance.
- Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
- Laminated - composed of thin layers of varying color and texture.
- Interbedded - composed of alternate layers of different soil types.
- Calcareous - containing appreciable quantities of calcium carbonate.
- Well graded - having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
- Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

TERMS DESCRIBING CONSISTENCY OR CONDITION

RELATIVE DENSITY

Penetration Resistance, blows per foot	Relative Density
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
> 50	Very Dense

COHESIVE STRENGTH

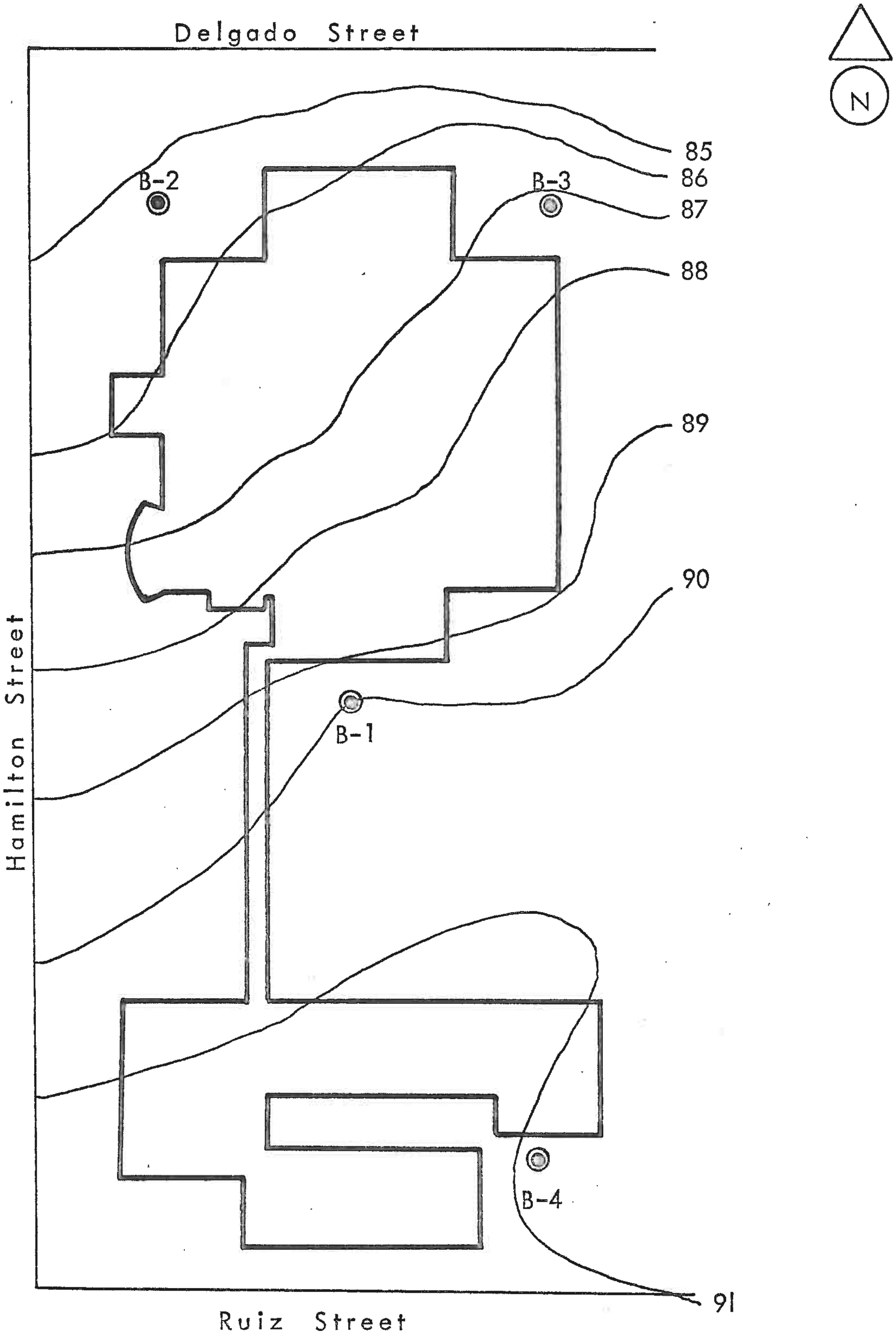
Penetration Resistance, blows per foot	Consistency	Cohesion, TSF
0-2	Very Soft	0-0.125
2-4	Soft	0.125-0.25
4-8	Firm	0.25-0.5
8-15	Stiff	0.5-1.0
15-30	Very Stiff	1.0-2.0
> 30	Hard	> 2.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0-5	None
5-10	Low
10-20	Moderate
20-40	Plastic
> 40	Highly Plastic

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

REPORT 9



PLAN OF BORINGS
Scale: 1" = 100'

LOG OF BORING NO. 1

IRVING JUNIOR HIGH SCHOOL
SAN ANTONIO, TEXAS

RABA & ASSOCIATES CONSULTING ENGINEERS INC.

TYPE: 3" Shelby tube, 2" Split-spoon & NX Core Barrel

LOCATION: See Plate 1

SURF. EL: 690.0 ± 0.5

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–7	Stiff Dark Gray Clay with some gravel		107	3.5
7–11	Very Stiff Tan and Gray Clay		118	2.1
11–40	Very Stiff Tan and Gray Marly Clay - 2" clay seam at 16' - 4" clay seam at 24' - clay seams from 28.5 to 32' - clay seams at 34 to 36'	50/6"	101	1.6
40–50	Hard Blue Gray Limy Shale - limestone seams 42 to 46'		148 147 139	26.5 22.5 27.1

Chart axes:

- Cohesion, ton/sq ft: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
- Plastic limit, water content (%) and liquid limit: 10, 20, 30, 40, 50, 60, 70
- Elevation, ft

COMPLETION DEPTH	DATE	DEPTH TO WATER IN BORING	DATE	PLATE
50'	7/1/71	16.3'	7/2/71	2

LOG OF BORING NO. 2
IRVING JUNIOR HIGH SCHOOL
SAN ANTONIO, TEXAS

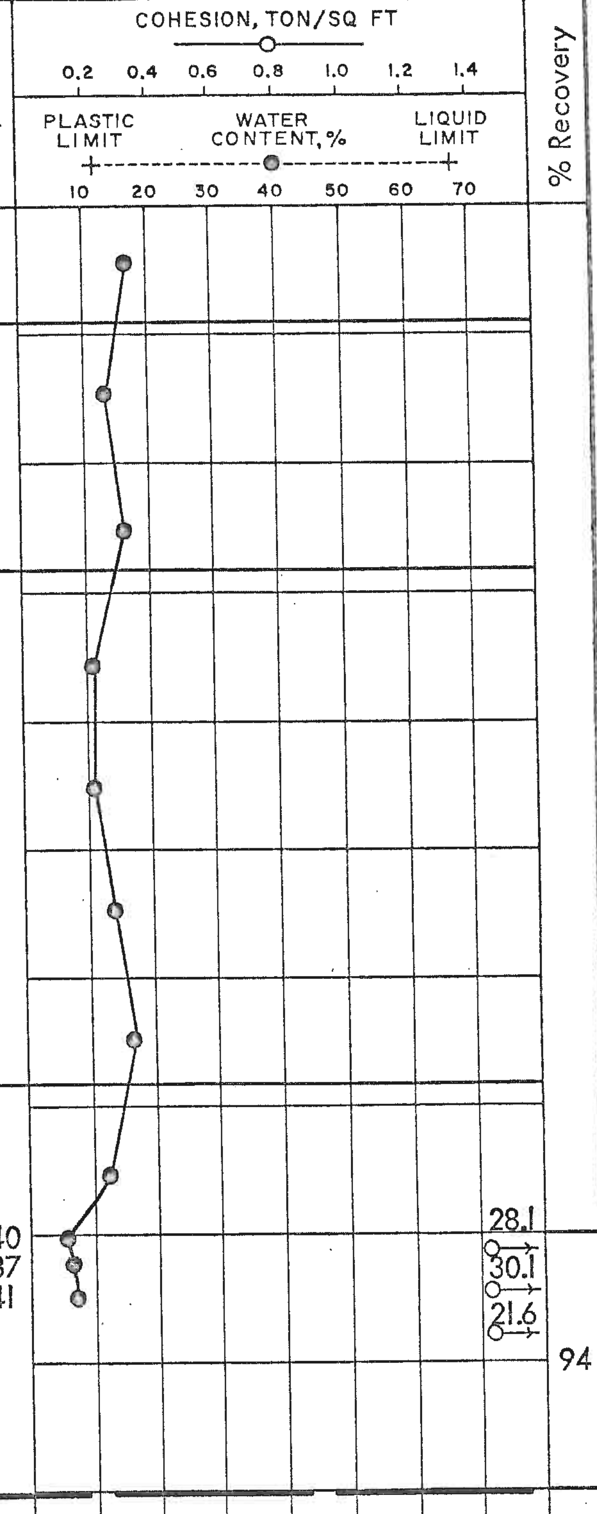
RABA & ASSOCIATES CONSULTING ENGINEERS INC.

TYPE: NX Core Barrel

LOCATION: See Plate I

SURF. EL: 685.3 ± 0.5

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	% Recovery
0 – 4.5	Dark Gray Clay with some gravel			
4.5 – 14	Tan Clay - damp streak 11' to 12'			
14 – 34	Tan and Light Gray Marly Clay - damp streaks 24' to 28' - damp streak 29' to 30.5'			
34 – 50	Hard Blue Gray Limy Shale - tan clay streaks at 34.5' to 35' and 38.5' to 39'		140 137 141	94



COMPLETION DEPTH: 50'
DATE: 6/30/71

DEPTH TO WATER IN BORING: 17.7'
DATE: 6/31/71

PLATE 3

LOG OF BORING NO. 3
IRVING JUNIOR HIGH SCHOOL
SAN ANTONIO, TEXAS

RABA & ASSOCIATES CONSULTING ENGINEERS INC.

TYPE: NX Core Barrel

LOCATION: See Plate I

SURF. EL: 687.2 ± 0.5

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	% Recovery
0–4	Dark Gray Clay with calcareous nodules				
4–13	Tan Clay with occasional calcareous pockets				
13–39	Tan and Light Gray Marly Clay – damp streak at 22.5 to 23' – damp streak at 29 to 31' – damp streak at 34.5 to 35'				
39–48.5	Hard Glue Gray Limy Shale – tan clay seams at 40'. 43' and 44'		134 129 140	33.5 16.9 30.1	100

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 48.5'

DATE: 6/30/71

DEPTH TO WATER IN BORING: 9.7'

DATE: 7/1/71

PLATE 4

LOG OF BORING NO. 4
IRVING JUNIOR HIGH SCHOOL
SAN ANTONIO, TEXAS

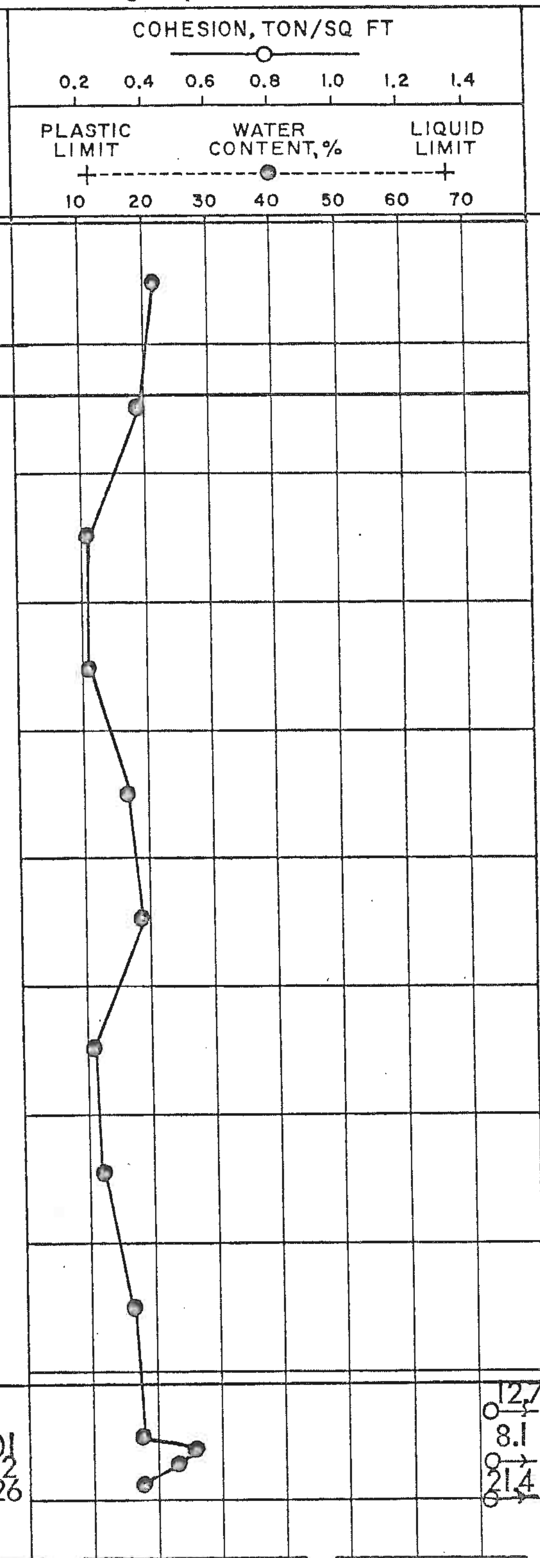
RABA & ASSOCIATES CONSULTING ENGINEERS INC.

TYPE: NX Core Barrel

LOCATION: See Plate I

SURF. EL: 690.9 ± 0.5

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	% Recovery
0	Caliche Gravel Base				
	Dark Gray Clay				
5	Tan and Gray Clay				
10	Tan and Light Gray Marly Clay				
	- damp streaks 18 to 20'				
	- damp streaks 24 to 26'				
	- damp streak 31 to 32'				
	- damp streak 51 to 52'				
	- damp below 57'				
60	Hard Blue Gray Limy Shale		101	12.7	
			112	8.1	
			126	21.4	100

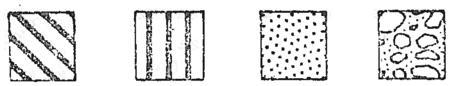


SCALE CHANGE

COMPLETION DEPTH: 75'
DATE: 7/1/71
DEPTH TO WATER IN BORING: 11.9'
DATE: 7/1/71
PLATE 5

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL OR ROCK TYPES
(shown in symbols column)

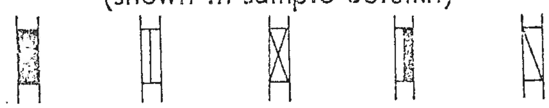


Clay   Silt   Sand   Gravel

Sandstone   Shale   Limestone

Predominate Soil Types Shown Heavy

SAMPLER TYPES
(shown in sample column)



Shelby Tube   Rock Core   Split Spoon   Auger   No Recovery

STRENGTH TEST RESULTS

⊗ - Estimated Strength
○ - Unconfined Compression

TRIAXIAL COMPRESSION
(Single-Stage Tests)

△ - Unconsolidated-undrained
□ - Consolidated-undrained

(Multiple-Stage Tests)

c - Apparent Cohesion
ϕ - Apparent Angle of Internal Friction

NOTE:
Values symbolized on boring logs represent shear strengths unless otherwise noted.

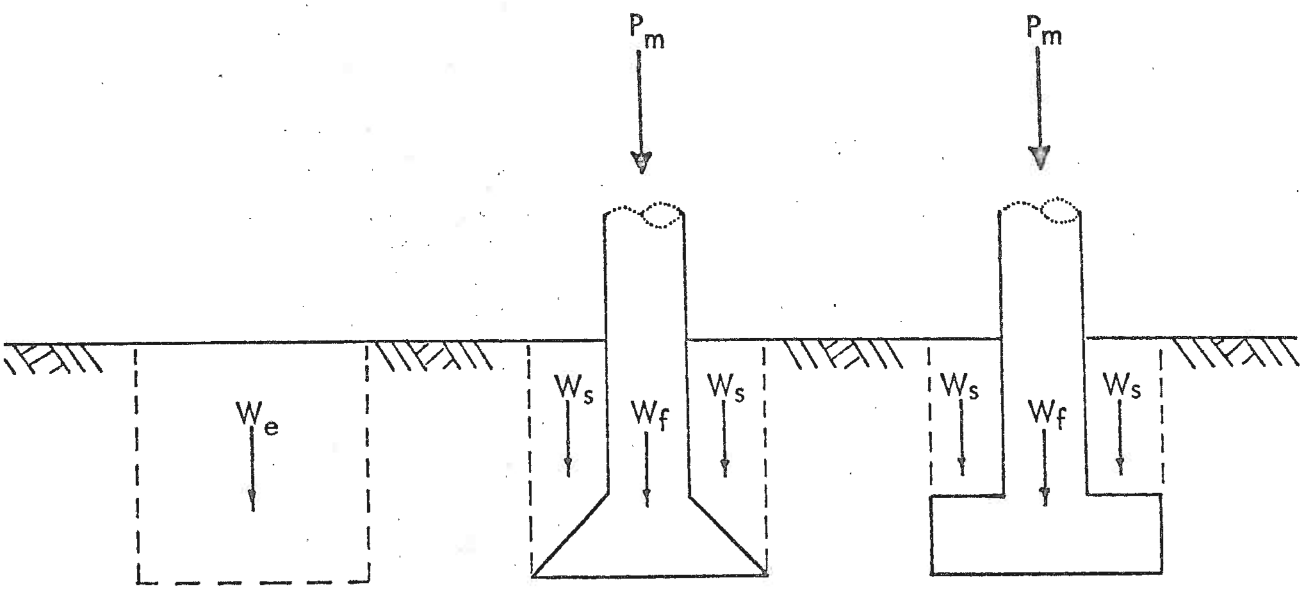
TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or condition are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., August, 1960, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

- Slickensided - having inclined planes of weakness that are slick and glossy in appearance.
- Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
- Laminated - composed of thin layers of varying color and texture.
- Interbedded - composed of alternate layers of different soil types.
- Calcareous - containing appreciable quantities of calcium carbonate.
- Well graded - having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
- Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

COMPUTATION OF BEARING PRESSURES



Gross Bearing Pressure, p, for any column load is the total effective pressure acting on the base of the foundation.

$$p = \frac{1}{A}(P_m + W_s + W_f)$$

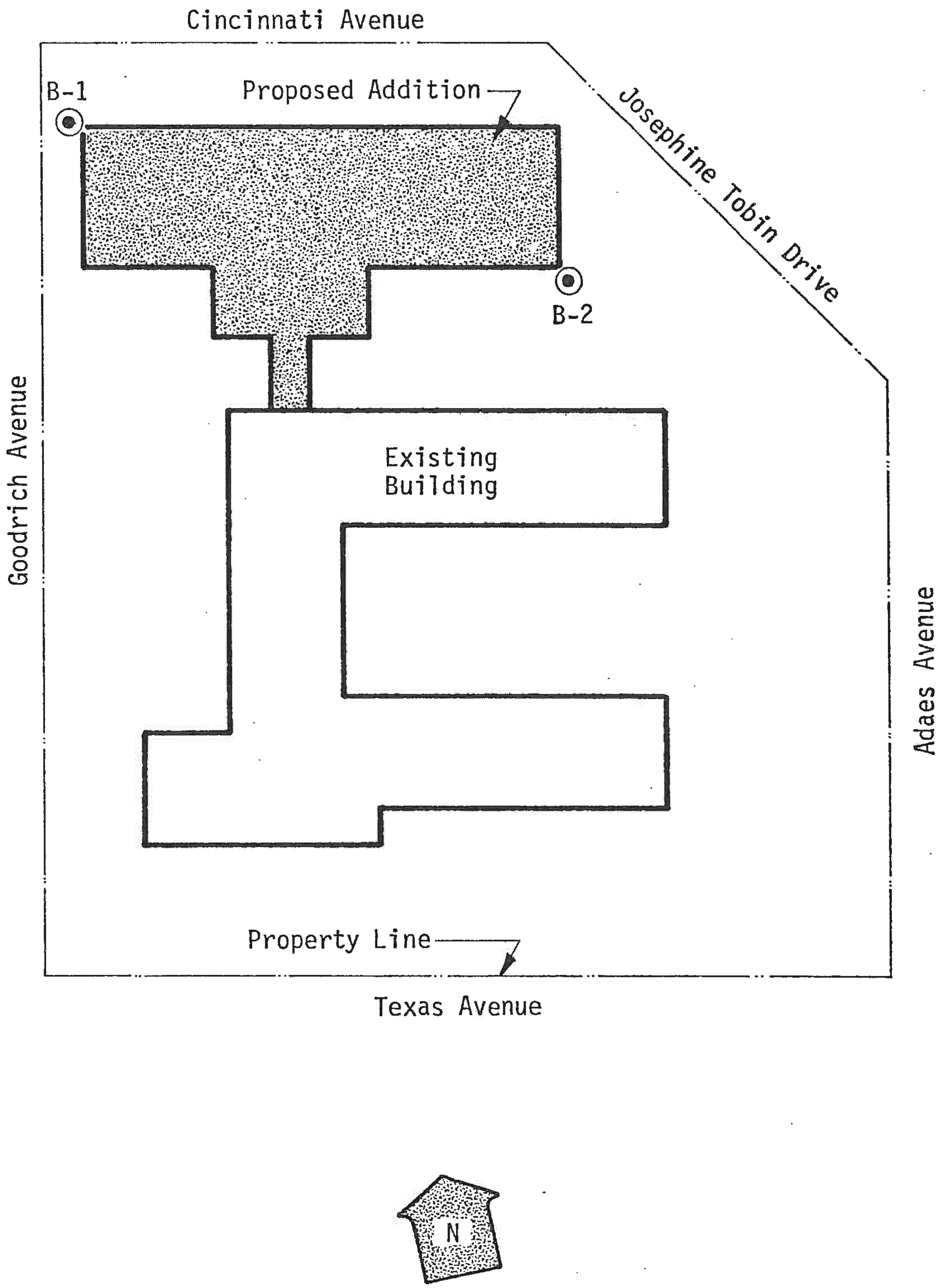
Net Bearing Pressure, p', for any column load is the difference between the gross bearing pressure acting on the base of the foundation and the soil pressure existing at that elevation prior to excavation.

$$p' = \frac{1}{A}(P_m + W_s + W_f - W_e)$$

Where:
- A = Area of base of foundation
- P_m = Maximum design column load
- W_s = Weight of soil located above the foundation *
- W_f = Weight of foundation
- W_e = Weight of soil located above base of foundation prior to excavation *

* Position of water table must be considered in determining unit weights. Effective, or buoyant unit weights should be used below the highest expected water table.

REPORT 10



PLAN OF BORINGS

Scale: 1" = 30'

LOG OF BORING NO. B-1

SARAH ROBERTS FRENCH NURSING HOME
SAN ANTONIO, TEXAS

RABA & ASSOCIATES CONSULTING ENGINEERS INC.

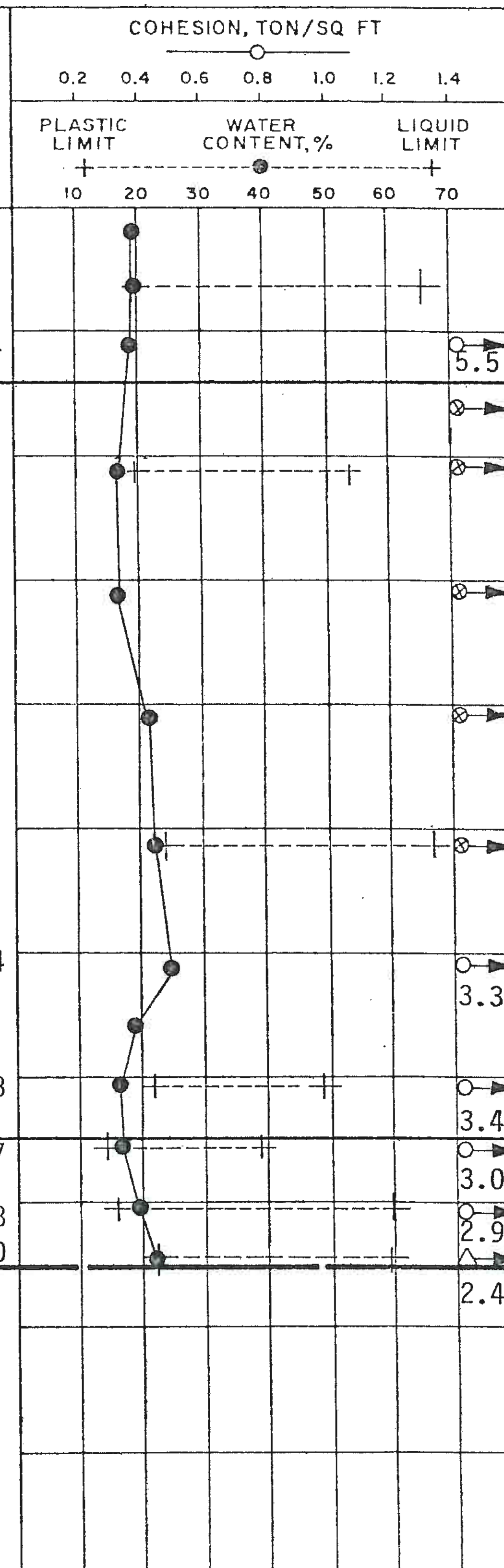
TYPE: NX Core Barrel, 2" Split Spoon & 3" Shelby Tube LOCATION: See Plate 1

SURF. EL:

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	% Recovery
0–7	Stiff to Very Stiff Dark Gray Clay - with gravel, calcareous nodules and organic material	17 14	104	
7–43	Very Stiff Tan and Gray Clay - silt at 15' - gypsum below 30'		104 113	
43–55	Very Stiff Blue Clay Shale - with tan and gray clay, gypsum and ferrous stains - water seepage at 45'		107 118 110	80

Depth scale: 5, 10, 15, 20, 25, 30, 40, 50, 60, 70

*Note Change In Scale



COMPLETION DEPTH: 55' DATE: 3/15/78 DEPTH TO WATER IN BORING: 45' DATE: 3/15/78 PLATE 2

LOG OF BORING NO. B-2

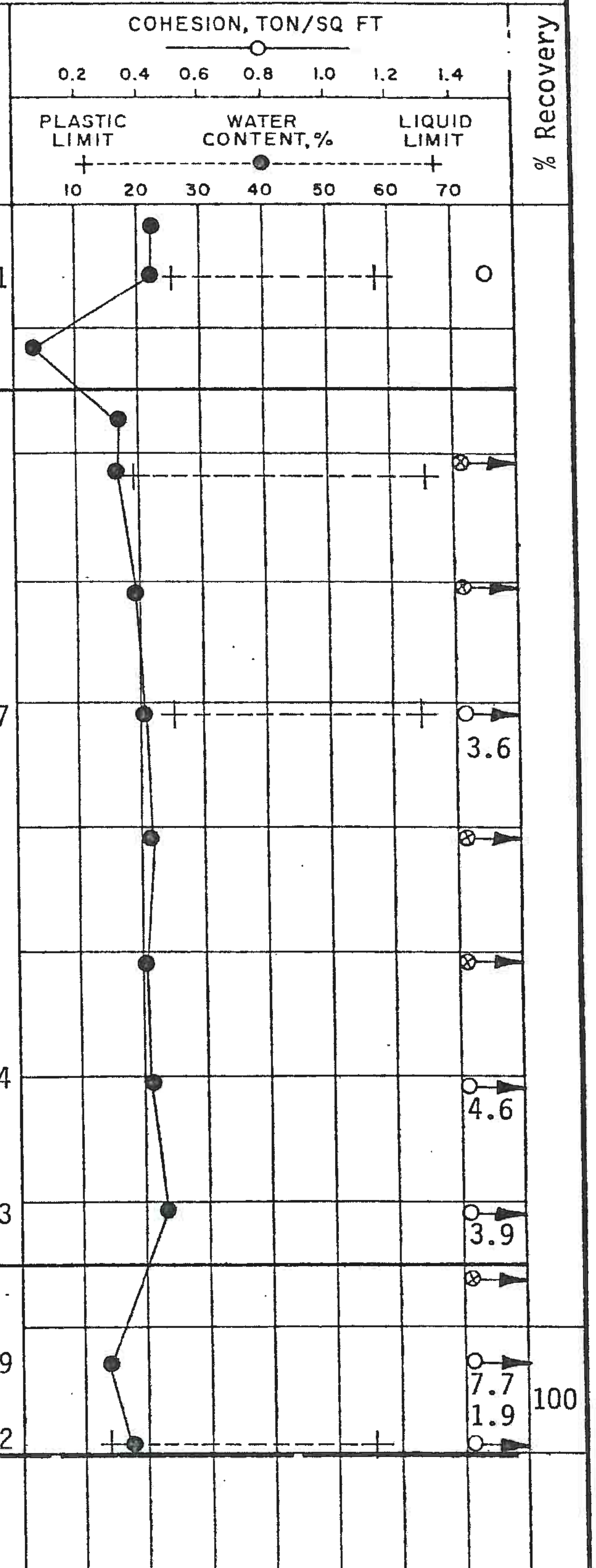
SARAH ROBERTS FRENCH NURSING HOME
SAN ANTONIO, TEXAS

RABA & ASSOCIATES CONSULTING ENGINEERS INC.

TYPE: NX Core Barrel, 2" Split Spoon & 3" Shelby Tube LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–7.5	Stiff to Very Stiff Dark Gray Clay - with calcareous nodules, ferrous stains and organic material - gravel from 5 to 7.5'	9	101
		50	
7.5–45	Very Stiff Tan and Gray Clay	15	
			107
	- gypsum at 35'		104
	- blue shale seam at 41'		103
45–60	Very Stiff Blue Clay Shale - with tan and gray clay		119
			112

*Note Change In Scale



COMPLETION DEPTH: 60'
DATE: 3/16/78

DEPTH TO WATER IN BORING: None Observed DATE: 3/16/78

PLATE 3

SYMBOLS AND TERMS USED ON BORING LOGS

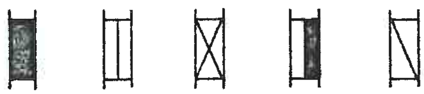
SOIL OR ROCK TYPES
(shown in symbols column)

Clay Silt Sand Gravel

Sandstone Shale Limestone

(Predominate Soil Types Shown Heavy)

SAMPLER TYPES
(shown in sample column)



Shelby Tube Rock Core Split Spoon Auger No Recovery

STRENGTH TEST RESULTS

⊗ - Estimated Strength
◇ - Torvane
○ - Unconfined Compression

TRIAXIAL COMPRESSION

△ - Unconsolidated-undrained
□ - Consolidated-undrained

c - Cohesion (Total)
ϕ - Angle of Internal Friction (Total)

c' - Cohesion (Effective)
ϕ' - Angle of Internal Friction (Effective)

NOTE:

Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or condition are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc. 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

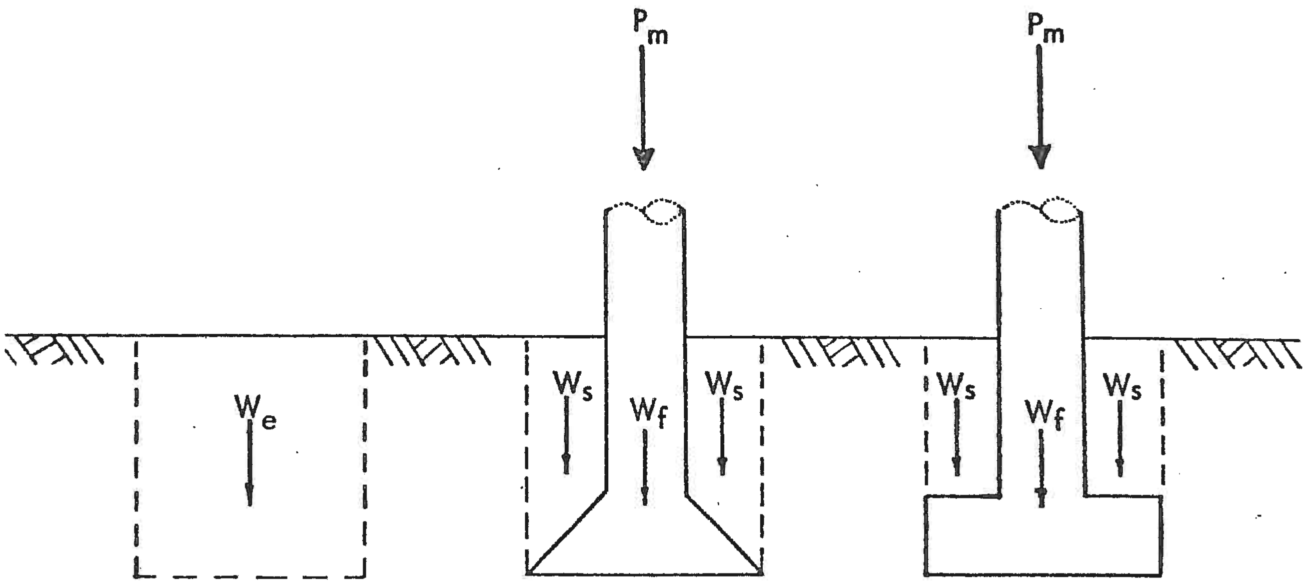
Slickensided - having inclined planes of weakness that are slick and glossy in appearance.
Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated - composed of thin layers of varying color and texture.
Interbedded - composed of alternate layers of different soil types.
Calcareous - containing appreciable quantities of calcium carbonate.
Well graded - having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

TERMS DESCRIBING CONSISTENCY OR CONDITION

RELATIVE DENSITY		COHESIVE STRENGTH			PLASTICITY	
Penetration Resistance, blows per foot	Relative Density	Penetration Resistance, blows per foot	Consistency	Cohesion, TSF	Plasticity Index	Degree of Plasticity
0-4	Very Loose	0-2	Very Soft	0-0.125	0-5	None
4-10	Loose	2-4	Soft	0.125-0.25	5-10	Low
10-30	Medium Dense	4-8	Firm	0.25-0.5	10-20	Moderate
30-50	Dense	8-15	Stiff	0.5-1.0	20-40	Plastic
> 50	Very Dense	15-30	Very Stiff	1.0-2.0	> 40	Highly Plastic
		> 30	Hard	> 2.0		

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

COMPUTATION OF BEARING PRESSURES



Gross Bearing Pressure, p, for any column load is the total effective pressure acting on the base of the foundation.

$$p = \frac{1}{A} (P_m + W_s + W_f)$$

Net Bearing Pressure, p', for any column load is the difference between the gross bearing pressure acting on the base of the foundation and the soil pressure existing at that elevation prior to excavation.

$$p' = \frac{1}{A} (P_m + W_s + W_f - W_e)$$

Where:

A	=	Area of base of foundation
P_m	=	Maximum design column load
W_s	=	Weight of soil located above the foundation *
W_f	=	Weight of foundation
W_e	=	Weight of soil located above base of foundation prior to excavation *

* Position of water table must be considered in determining unit weights. Effective, or buoyant unit weights should be used below the highest expected water table.

LIME SLURRY PRESSURE INJECTION SPECIFICATIONS

FOR THE

INFLATABLE PACKER SYSTEM

SCOPE: The work consists of application of lime slurry into the ground at specified intervals within specified areas of the project.

EQUIPMENT: Equipment shall be suitable for the work, as approved by the Geotechnical Engineers. Equipment shall be constructed to provide a positive seal for preventing the slurry from flowing out onto the ground and shall have controls and gages for setting of pressure and determination of pressure.

a. Packers of an acceptable type and length with a minimum diameter of 4 inches shall be utilized by the contractor to prevent slurry from flowing out onto the ground surface.

b. Mixer tanks shall be approved by the Geotechnical Engineers and shall be continuously agitated to insure uniformity of mixture.

LIME SLURRY:

a. The lime slurry shall be a pumpable suspension of hydrated lime in water. The water or liquid portion of the slurry shall not contain dissolved material in sufficient quantity and/or nature injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of "solids content", shall consist principally of hydrated lime of a quality and fineness sufficient to meet THD Item 264, Type A as to chemical composition and residue.

b. Proportion lime slurry within the range of two and one-half (2 ½) to three (3) pounds of hydrated lime per gallon water. Check specific gravity of slurry with Ertco Hydrometer No. 2545 or equivalent. Specific gravity readings shall range from 1.14 to 1.16.

c. A surfactant (wetting agent) approved by the Geotechnical Engineer shall be used in the lime slurry, according to manufacturer's recommendations, but in no case shall proportions be less than one (1) part per fifteen hundred (1500) gallons of water.

PROCEDURE:

a. The subgrade should be shaped to rough designed grades and scarified or plowed so that excess slurry will be trapped within the building area.

b. Pre-drill holes to accommodate the contractor's inflatable packers to * feet. The spacing for injections shall not exceed five (5) feet on center in each direction, and extending a minimum of five (5) feet beyond the limits of the building.

c. Set and inflate packer to seal hole.

d. Inject each hole through a packer at a minimum pressure of fifty (50) psi and a maximum of two hundred (200) psi pump pressure, adjusted to disperse the maximum possible volume of slurry, and continue to inject slurry to refusal, as defined by the Geotechnical Engineer.

e. The lime slurry shall be continuously agitated to insure uniformity of mixture. Specific gravity checks should be made at both mixer tanks and at injectors no less than one (1) test per four (4) hours of agitation.

f. The contractor will insure that lime slurry is applied evenly across the scarified or plowed subgrade during the stabilization process. The excess slurry ponded on the ground surface shall be scarified into the soil and the soil-lime mixture recompacted to subgrade specifications prior to placement of fill, if required.

INSPECTION AND CONTROL:

a. The work will be under the direct inspection of a representative of the Geotechnical Engineer who will measure the specific gravity of the mixture, determine suitable operation of the equipment used, and determine the point of injection refusal.

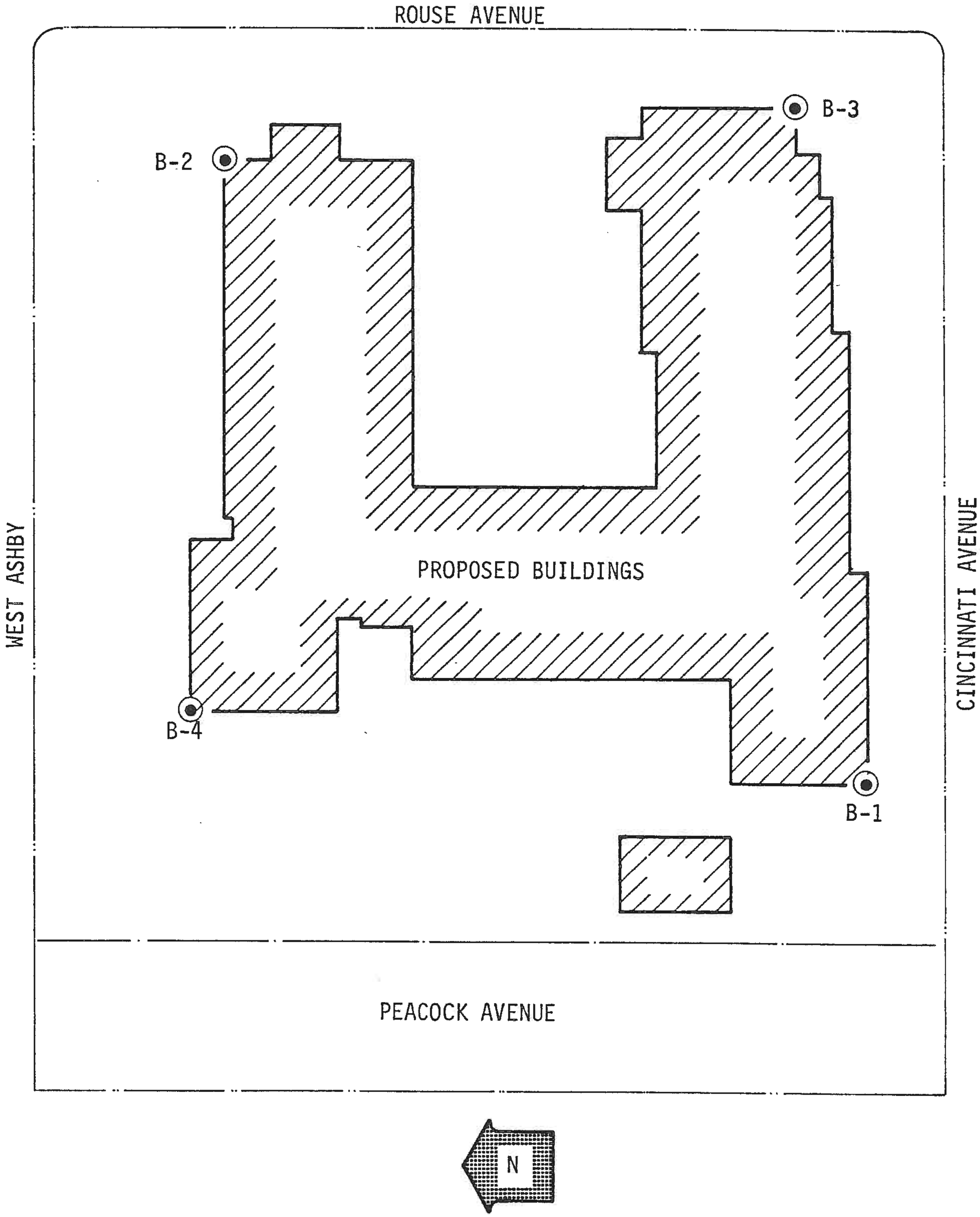
b. Acceptance of the soil stabilization shall be on the basis of continuous on site inspection by a representative of the Geotechnical Engineer. The contractor may be required to inject portions of the site with lime slurry more than once to meet the approval of the Geotechnical Engineer.

c. The Geotechnical Engineer will be provided weight certificates of all lime devlivered to the site for use in stabilization. No lime or lime slurry will be removed from the site for use on other projects.

* Note See depth recommended in this report.

Revised March 7, 1978

REPORT 11



PLAN OF BORINGS
SCALE: 1" = 50'

RABA - KISTNER CONSULTANTS, INC.

Raba Kistner Consultants, Inc.

LOG OF BORING NO. B-1

WILLIAM BOOTH APARTMENTS
SAN ANTONIO, TEXAS

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT.
0–4.5			Firm to Very Stiff Dark Gray Clay	6	110	3.6	
4.5–25			Very Stiff Tan and Gray Clay - with ferrous stains - gravel from 4.5' to 6'	24	114 113	2.8 3.4	

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

COMPLETION DEPTH: 25'
DATE: 2/18/80

DEPTH TO WATER IN BORING: None Observed
DATE: 2/19/80

PLATE 2

Raba Kistner Consultants, Inc.

LOG OF BORING NO. B-2

WILLIAM BOOTH APARTMENTS
SAN ANTONIO, TEXAS

TYPE: 2" Split Spoon; 3" Shelby Tube

LOCATION: See Plate 1

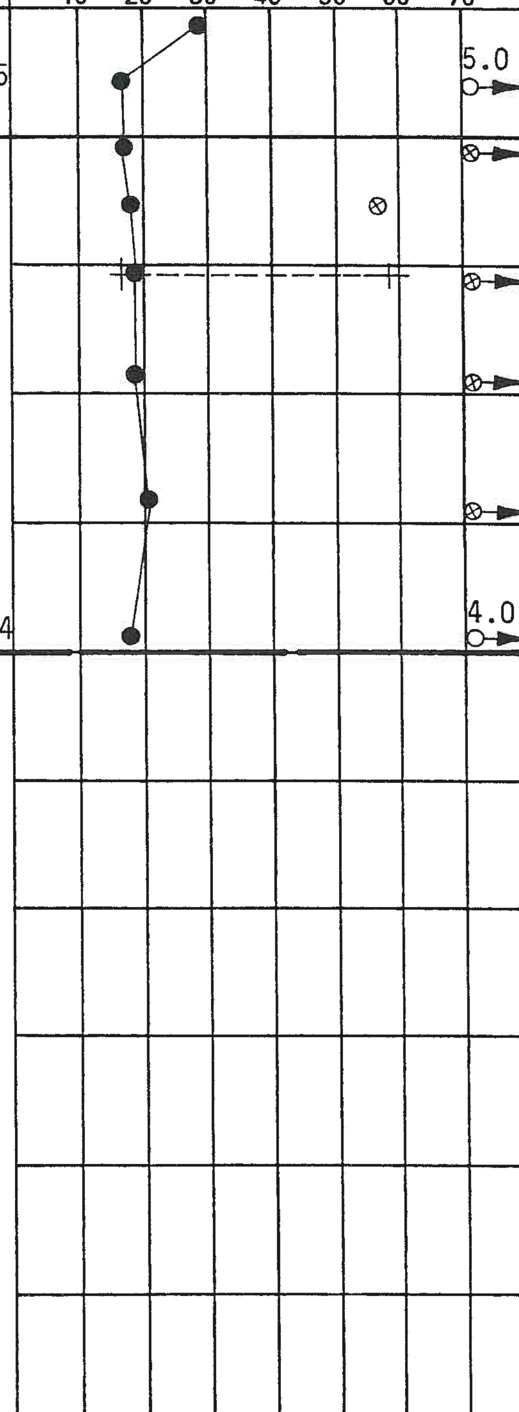
SURF. EL.:

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–5	Very Stiff Dark Gray Clay - gravel seams at 2'		105
5–25	Very Stiff Tan and Gray Clay - gravel at 5' - gypsum seams from 7.5' to 10'		
	- gypsum seams at 25'		114

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

ELEVATION, FT.



COMPLETION DEPTH: 25'
DATE: 2/18/80
DEPTH TO WATER IN BORING: 21.7'
DATE: 2/19/80
PLATE 3

LOG OF BORING NO. B-3

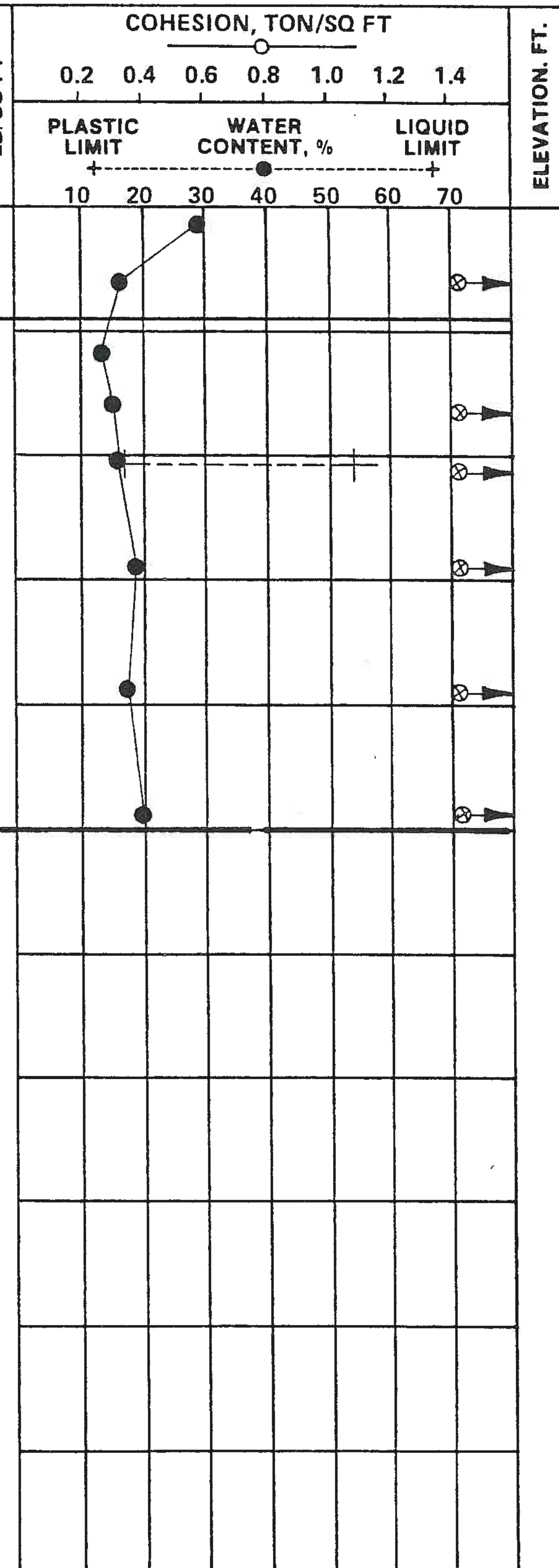
WILLIAM BOOTH APARTMENTS
SAN ANTONIO, TEXAS

Raba Kistner Consultants, Inc.

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–3.5			Firm to Very Stiff Dark Gray Clay	9	
3.5–25			Very Stiff Tan and Gray Clay - gravel from 4.5' to 6.5' - gravel at 7.5'	26	



Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

COMPLETION DEPTH: 25'
DATE: 2/18/80

DEPTH TO WATER IN BORING: 23.1'
DATE: 2/19/80

PLATE 4

Raba Kistner Consultants, Inc.

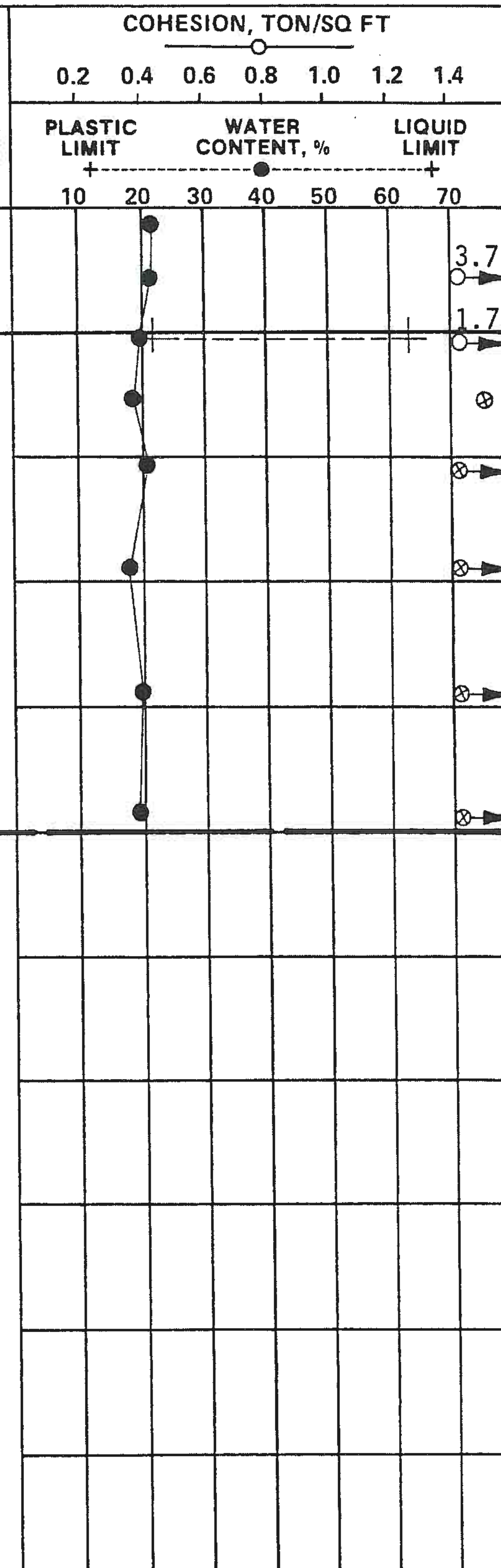
LOG OF BORING NO. B-4

WILLIAM BOOTH APARTMENTS
SAN ANTONIO, TEXAS

TYPE: 2" Split Spoon
3" Shelby Tube

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT	ELEVATION, FT.
0–5			Stiff to Very Stiff Dark Brown Clay	16	99	3.7	
5–25			Very Stiff Tan and Gray Clay		107	1.7	



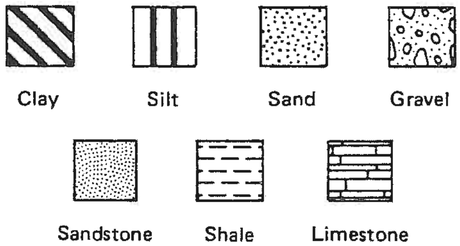
COMPLETION DEPTH: 25'
DATE: 2/18/80

DEPTH TO WATER IN BORING: 22.3'
DATE: 2/19/80

PLATE 5

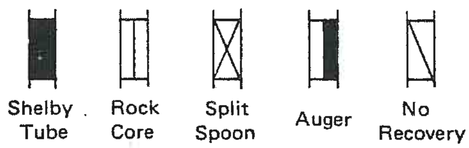
SYMBOLS AND TERMS USED ON BORING LOGS

SOIL OR ROCK TYPES
(shown in symbols column)



(Predominate Soil Types Shown Heavy)

SAMPLER TYPES
(shown in sample column)



STRENGTH TEST RESULTS

⊗ - Estimated Strength
◇ - Torvane
○ - Unconfined Compression

TRIAXIAL COMPRESSION

△ - Unconsolidated-undrained
□ - Consolidated-undrained

C - Cohesion (Total)
Φ - Angle of Internal Friction (Total)

C′ - Cohesion (Effective)
Φ′ - Angle of Internal Friction (Effective)

NOTE:

Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or condition are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc. 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided - having inclined planes of weakness that are slick and glossy in appearance.
Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated - composed of thin layers of varying color and texture.
Interbedded - composed of alternate layers of different soil types.
Calcareous - containing appreciable quantities of calcium carbonate.
Well graded - having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

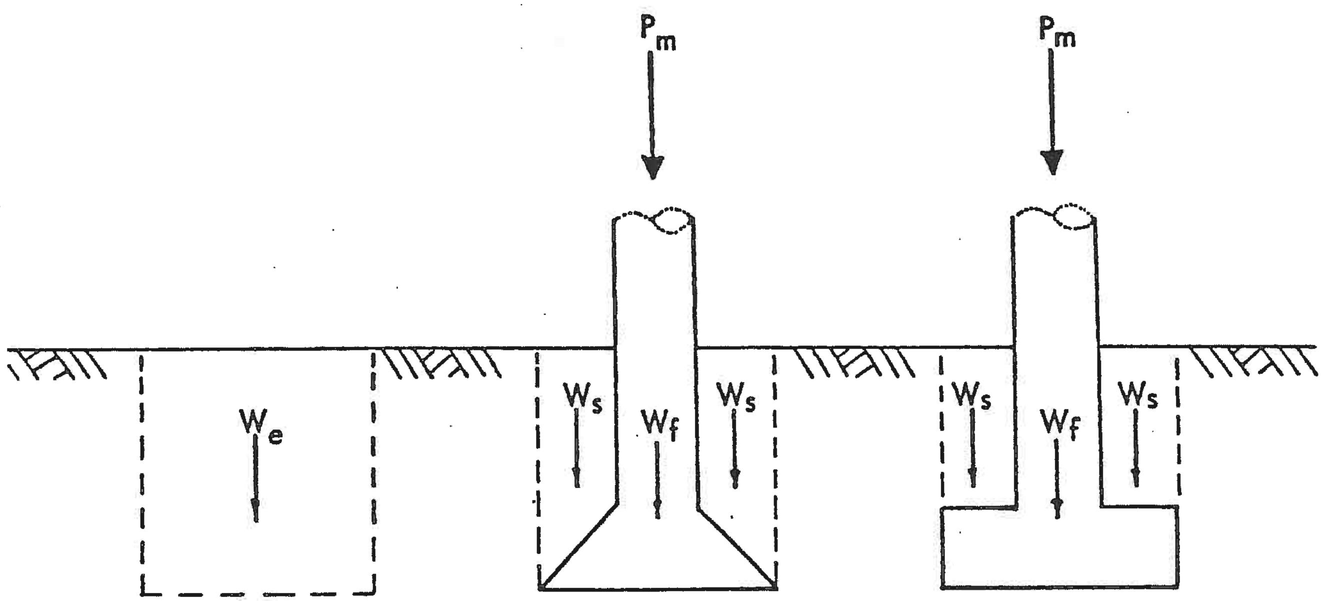
TERMS DESCRIBING CONSISTENCY OR CONDITION

RELATIVE DENSITY		COHESIVE STRENGTH			PLASTICITY	
Penetration Resistance, blows per foot	Relative Density	Penetration Resistance, blows per foot	Consistency	Cohesion, TSF	Plasticity Index	Degree of Plasticity
0-4	Very Loose	0-2	Very Soft	0-0.125	0-5	None
4-10	Loose	2-4	Soft	0.125-0.25	5-10	Low
10-30	Medium Dense	4-8	Firm	0.25-0.5	10-20	Moderate
30-50	Dense	8-15	Stiff	0.5-1.0	20-40	Plastic
> 50	Very Dense	15-30	Very Stiff	1.0-2.0	> 40	Highly Plastic
		> 30	Hard	> 2.0		

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

RABA - KISTNER CONSULTANTS, INC.

COMPUTATION OF BEARING PRESSURES



Gross Bearing Pressure, p, for any column load is the total effective pressure acting on the base of the foundation.

$$p = \frac{1}{A}(P_m + W_s + W_f)$$

Net Bearing Pressure, p', for any column load is the difference between the gross bearing pressure acting on the base of the foundation and the soil pressure existing at that elevation prior to excavation.

$$p' = \frac{1}{A}(P_m + W_s + W_f - W_e)$$

Where: A = Area of base of foundation

P_m = Maximum design column load

W_s = Weight of soil located above the foundation *

W_f = Weight of foundation

W_e = Weight of soil located above base of foundation prior to excavation *

* Position of water table must be considered in determining unit weights. Effective, or buoyant unit weights should be used below the highest expected water table.

LIME SLURRY PRESSURE INJECTION SPECIFICATIONS

FOR THE

STRAIGHT PIPE INJECTION SYSTEM

SCOPE: The work consists of application of lime slurry into the ground at specified intervals within specified areas of the project.

EQUIPMENT: Equipment shall be suitable for the work, as approved by the Geotechnical Engineers prior to the commencement of work. Equipment shall be constructed to provide straight pipe injection to the depth specified and shall inject through a positive seal for preventing the slurry from flowing out onto the ground and shall have controls and gauges near the point of injection for setting of pressure and determination of pressure.

a. Injection pipes shall be spaced five (5) feet on centers.

b. Nozzles on injection pipes shall be designed with a hole pattern that will uniformly disperse the lime slurry radially.

c. Injection pressure shall be adjusted to disperse as large a volume of lime slurry as possible within a pressure range of fifty (50) to two hundred (200) pounds per square inch at the injector.

d. Mixer tanks shall be approved by the Geotechnical Engineers and shall be continuously agitated to insure uniformity of mixture.

e. Plugs of a suitable type shall be utilized by the Contractor in the injector holes to prevent the slurry from flowing out of the subgrade onto the ground surface.

LIME SLURRY:

a. The lime slurry shall be a pumpable suspension of hydrated lime in water. The water or liquid portion of the slurry shall not contain dissolved material in sufficient quantity and/or nature injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of "solids content", shall consist principally of hydrated lime of a quality and fineness sufficient to meet THD Item 264, Type A as to chemical composition and residue.

b. Proportion lime slurry within the range of two and one-half (2½) to three (3) pounds of hydrated lime per gallon water. Check specific gravity of slurry with Ertco Hydrometer No. 2545 or equivalent. Specific gravity readings shall range from 1.14 to 1.16.

c. A surfactant (wetting agent) approved by the Geotechnical Engineer shall be used in the lime slurry, according to manufacturer's recommendations, but in no case shall proportions be less than one (1) part per fifteen hundred (1500) gallons of water.

PROCEDURE:

a. General: Injection pipes, spaced as specified, shall be forced downward, injecting the lime slurry at approximately twelve (12) inch intervals to refusal or ten (10) gallons, whichever is greater, for a total depth of * feet.

b. Injection Spacing shall not exceed five (5) feet on centers both ways within an area defined by lines five (5) feet outside of all building lines.

c. The lime slurry shall be continuously agitated to insure uniformity of mixture. Specific gravity checks should be made at both mixer tanks and at injectors no less than one (1) test per four (4) hours of agitation.

d. The excess slurry ponded on the ground surface shall be scarified into the soil and the soil-lime mixture recompacted to subgrade specifications prior to placement of fill, if required.

INSPECTION AND CONTROL:

a. The work will be under the direct inspection of the Geotechnical Engineer, who will measure the specific gravity of the mixture, determine suitable operation of the equipment used, and determine the point of injection refusal.

b. Acceptance of the soil stabilization shall be on the basis of continuous on site inspection by a representative of the Geotechnical Engineer. The contractor may be required to inject the site or portions of the site with lime slurry more than once to meet the approval of the Geotechnical Engineer.

c. The Geotechnical Engineer will be provided weight certificates of all lime delivered to the site for use in stabilization. No lime or lime slurry will be removed from the site for use on other projects.

<u>* Note</u> See depth recommended in this report.

Revised March 7, 1978

LIME SLURRY PRESSURE INJECTION SPECIFICATIONS

FOR THE

INFLATABLE PACKER SYSTEM

SCOPE: The work consists of application of lime slurry into the ground at specified intervals within specified areas of the project.

EQUIPMENT: Equipment shall be suitable for the work, as approved by the Geotechnical Engineers. Equipment shall be constructed to provide a positive seal for preventing the slurry from flowing out onto the ground and shall have controls and gauges for setting of pressure and determination of pressure.

a. Packers of an acceptable type and length with a minimum diameter of 4 inches shall be utilized by the contractor to prevent slurry from flowing out onto the ground surface.

b. Mixer tanks shall be approved by the Geotechnical Engineers and shall be continuously agitated to insure uniformity of mixture.

LIME SLURRY:

a. The lime slurry shall be a pumpable suspension of hydrated lime in water. The water or liquid portion of the slurry shall not contain dissolved material in sufficient quantity and/or nature injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of "solids content", shall consist principally of hydrated lime of a quality and fineness sufficient to meet THD Item 264, Type A as to chemical composition and residue.

b. Proportion lime slurry within the range of two and one-half (2½) to three (3) pounds of hydrated lime per gallon water. Check specific gravity of slurry with Ertco Hydrometer No. 2545 or equivalent. Specific gravity readings shall range from 1.14 to 1.16.

c. A surfactant (wetting agent) approved by the Geotechnical Engineer shall be used in the lime slurry, according to manufacturer's recommendations, but in no case shall proportions be less than one (1) part per fifteen hundred (1500) gallons of water.

PROCEDURE:

a. The subgrade should be shaped to rough designed grades and scarified or plowed so that excess slurry will be trapped within the building area.

b. Pre-drilled holes to accommodate the contractor's inflatable packers to * feet. The spacing for injections shall not exceed five (5) feet on center in each direction, and extending a minimum of five (5) feet beyond the limits of the building.

c. Set and inflate packer to seal hole.

d. Inject each hole through a packer at a minimum pressure of fifty (50) psi and a maximum of two hundred (200) psi pump pressure, adjusted to disperse the maximum possible volume of slurry, and continue to inject slurry to refusal, as defined by the Geotechnical Engineer.

e. The lime slurry shall be continuously agitated to insure uniformity of mixture. Specific gravity checks should be made at both mixer tanks and at injectors no less than one (1) test per four (4) hours of agitation.

f. The contractor will insure that lime slurry is applied evenly across the scarified or plowed subgrade during the stabilization process. The excess ponded on the ground surface shall be scarified into the soil and the soil-lime mixture recompacted to subgrade specifications prior to placement of fill, if required.

INSPECTION AND CONTROL:

a. The work will be under the direct inspection of a representative of the Geotechnical Engineer who will measure the specific gravity of the mixture, determine suitable operation of the equipment used, and determine the point of injection refusal.

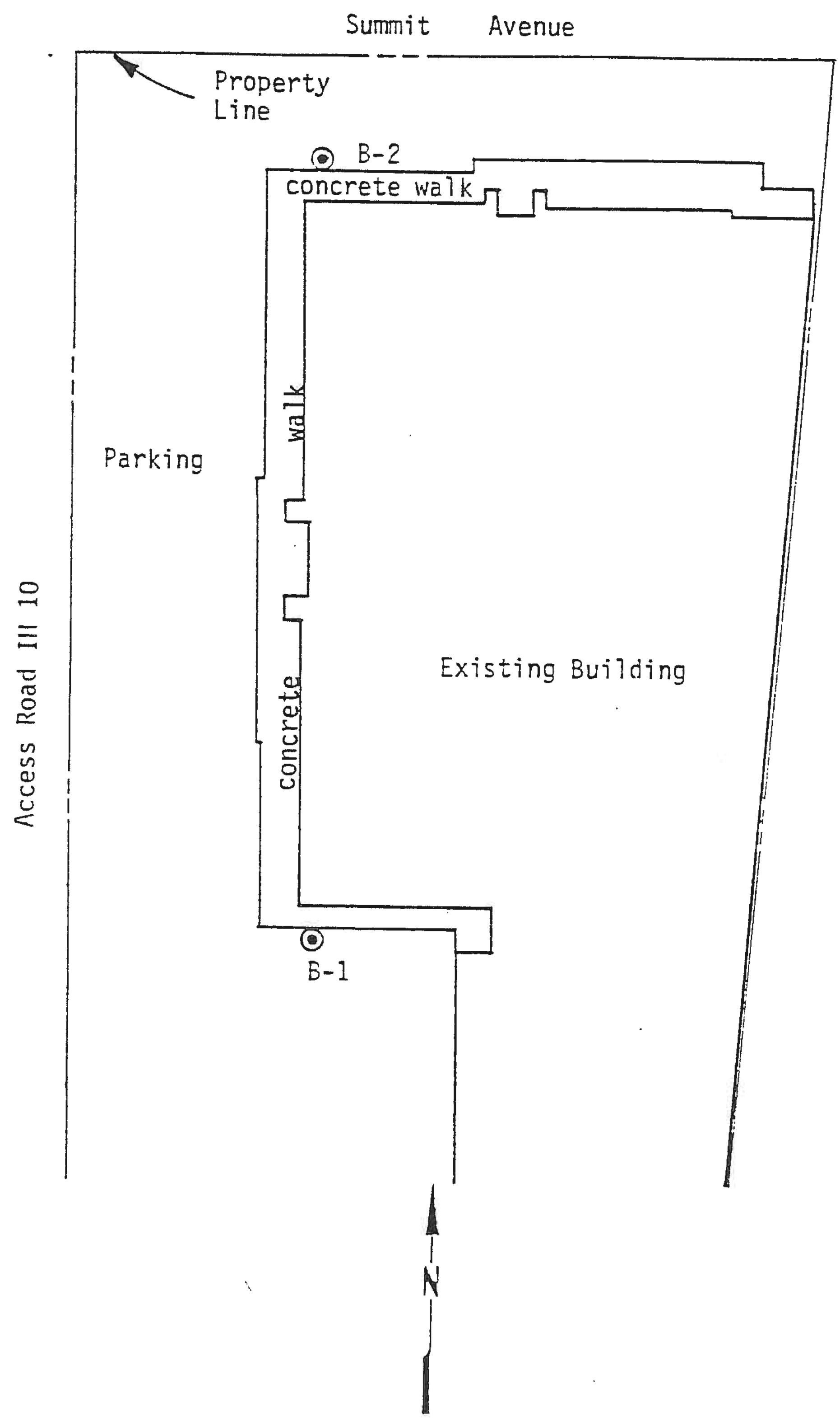
b. Acceptance of the soil stabilization shall be on the basis of continuous on site inspection by a representative of the Geotechnical Engineer. The contractor may be required to inject portions of the site with lime slurry more than once to meet the approval of the Geotechnical Engineer.

c. The Geotechnical Engineer will be provided weight certificates of all lime delivered to the site for use in stabilization. No lime or lime slurry will be removed from the site for use on other projects.

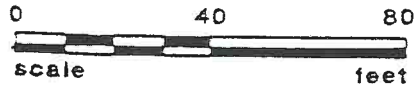
* Note — See depth recommended in this report.

Revised March 7, 1978

REPORT 12



PLAN OF BORINGS



Raba-Kistner Consultants, Inc

Proj. No. ASA92-007-00

PLATE 1

LOG OF BORING NO. B-1
CENTER FOR HEALTH CARE S[illegible]VICES
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	COHESION, TON/SQ FT (0.3, 0.6, 0.9, 1.2, 1.5, 1.8, 2.1) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70)	%-200
			SURFACE ELEVATION:				
			CONCRETE (5")				
			BASE, Sand, Tan (2")	16			
			CLAY, Very Stiff, Dark Gray with traces of small gravel				
5			- with abundant gravel below 4.5'				
			- with very dense gravel seam at 5'	50			
			CLAY, Hard, Tan and Gray with some ferrous staining and traces of calcareous nodules	38			
10			- with abundant calcareous material from 6.5' to 10'		108		
15				46			
20				50			
25				49			
30			- slightly sandy at 30'	50			
			- with gypsum below 33.5'	50			
35							
40							
45							
50							

DEPTH DRILLED: 35.0'	DEPTH TO WATER: Dry	PROJ. No. ASA92-007-00	
DATE DRILLED: 1/28/92	DATE MEASURED: 1/28/92	PLATE 2	

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-2
CENTER FOR HEALTH CARE S VICES
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

LOCATION: See Plate 1

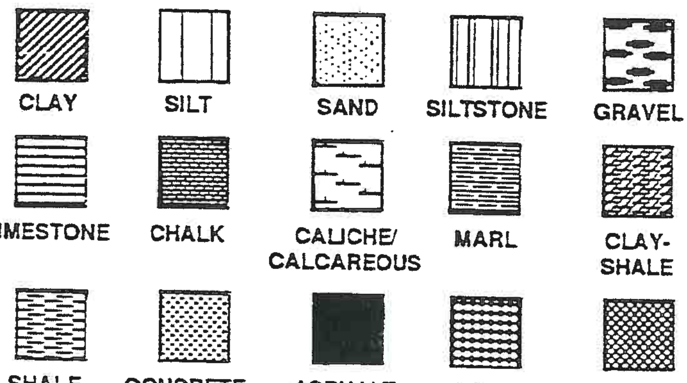
DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION:	BLOWS PER FT	UNIT DRY WEIGHT, pcf	⊗ COHESION, TON/SQ FT ⊗ 0.3 0.6 0.9 1.2 1.5 1.8 2.1 PLASTIC LIMIT + — WATER CONTENT ● — LIQUID LIMIT + 10 20 30 40 50 60 70	%-200
			CONCRETE (5")				
			BASE - Sand, Tan with small gravel (3")	19			
5			CLAY, Very Stiff, Dark Gray with traces of small gravel - with abundant gravel from 4' to 6.8'	23			
10			CLAY, Stiff to Hard, Tan and Gray, with some ferrous staining and traces of calcareous nodules - with abundant calcareous material from 6.8' to 11.5'	30			
15				34			
20				38			
25				38			
30					98		
35							
40							
45							
50							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

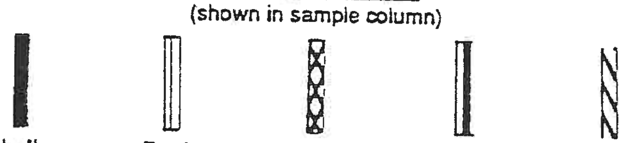
DEPTH DRILLED:	30.0'	DEPTH TO WATER:	Dry	PROJ. No.	ASA92-007-00
DATE DRILLED:	1/28/92	DATE MEASURED:	1/28/92	PLATE	3

TERMS AND SYMBOLS USED ON BORING LOGS

SOIL OR ROCK TYPES
(shown in symbols column)



SAMPLER TYPES
(shown in sample column)



STRENGTH TEST RESULTS

- ⊖ Pocket Penetrometer
- ◇ Torvane
- ⊗ Unconfined Compression

TRIAXIAL COMPRESSION

- △ Unconsolidated-undrained
- □ Consolidated-undrained

- C Cohesion (Total)
- Φ Angle of Internal Friction (Total)

- C' Cohesion (Effective)
- Φ' Angle of Internal Friction (Effective)

NOTE: Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE. Terzaghi and Peck, John Wiley & Sons, Inc. 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	having inclined planes of weakness that are slick and glossy in appearance
Fissured	containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical
Laminated	composed of thin layers of varying colors and texture
Interbedded	composed of alternate layers of different soil types
Calcareous	containing appreciable quantities of calcium carbonate
Well graded	having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Poorly graded	predominantly of one grain size, or having a range of sizes with some intermediate size missing

TERMS DESCRIBING CONSISTENCY OR CONDITION

RELATIVE DENSITY

Penetration Resistance blows per ft.	Relative Density
0-4	Very loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
>50	Very Dense

COHESIVE STRENGTH

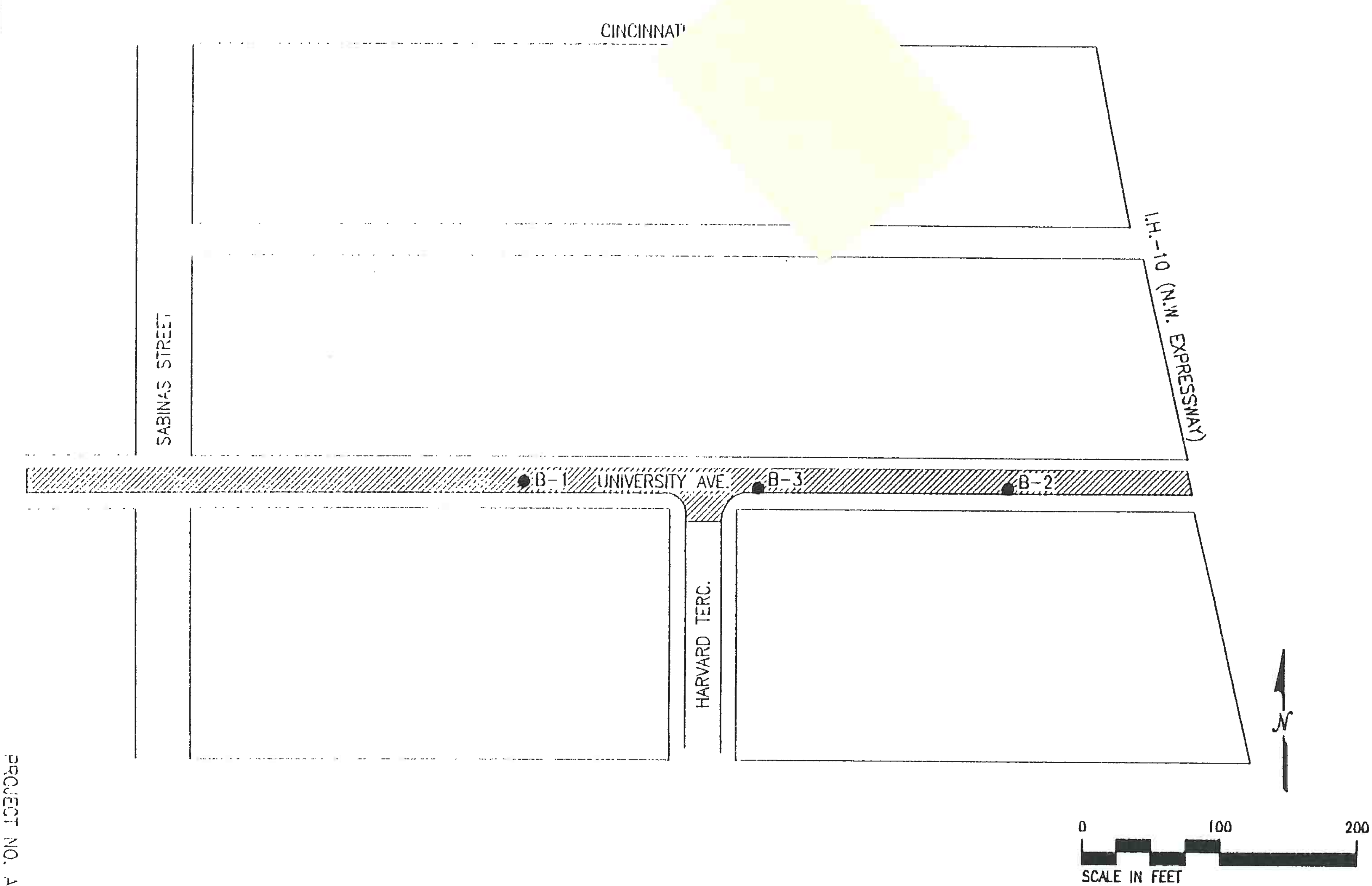
Penetration Resistance, blows per ft.	Consistency	Cohesion TSF
0-2	Very Soft	0-0.125
2-4	Soft	0.125-0.25
4-8	Firm	0.25-0.5
8-15	Stiff	0.5-1.0
15-30	Very Stiff	1.0-2.0
>30	Hard	>2.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0-5	Non-Plastic
5-10	Low
10-20	Moderate
20-40	Plastic
>40	Highly Plastic

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

REPORT 13



BORING LOCATION MAP
UNIVERSITY AVE. STREET IMPROVEMENT – SABINAS ST TO IH-10
SAN ANTONIO, TEXAS

Raba-Kis[illegible]er Consultants, Inc.

PROJECT NO. ASA95-005-00

Acad: 00BLM01

LOG OF BORING NO. B-1

UNIVERSITY AVE STREET IMPROVEMENT - SABINAS ST TO IH-10
SAN ANTONIO, TEXAS

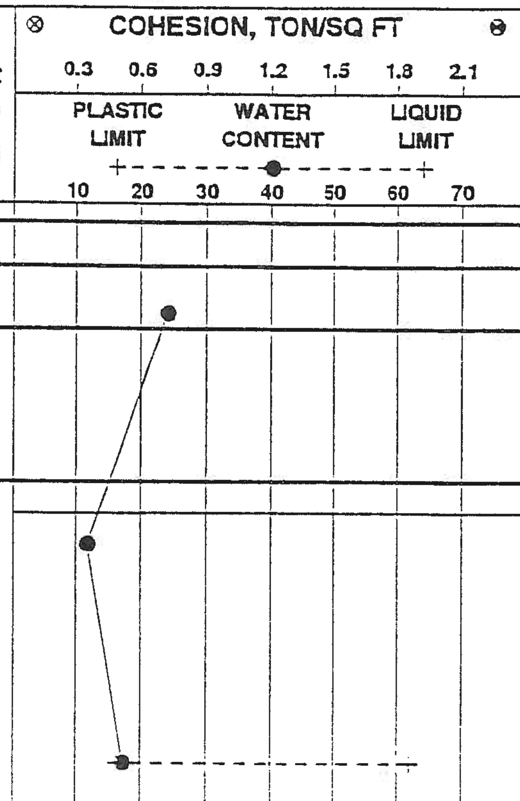
Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

LOCATION: See Plate 1

SURFACE ELEVATION:

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	% 200
	ASPHALTIC CONCRETE (4")			
	BASE MATERIAL (8")			
	CLAY, Hard, Dark Gray with a trace of fine gravel	37		
	GRAVEL, Clayey, Very Dense, Tan with abundant chert fragments	50/5"		
5	CLAY, Very Stiff, Tan and Gray - with small chert fragments and calcareous pockets from 4.5' to 6.5'	22		
		26		
		28		
10				
15				
20				



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 10.0'	DEPTH TO WATER: Dry	PROJ. No. ASA95-005-00
DATE DRILLED: 1/31/95	DATE MEASURED: 1/31/95	PLATE 2

LOG OF BORING NO. B-2
UNIVERSITY AVE STREET IMPROVEMENT - SABINAS ST TO IH-10
SAN ANTONIO, TEXAS

Raba-Kistner
Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION:	BLOWS PER FT	UNIT DRY WEIGHT, pcf	COHESION, TON/SQ FT (0.3, 0.6, 0.9, 1.2, 1.5, 1.8, 2.1) PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70)	% 200
			ASPHALTIC CONCRETE (4")				
			BASE MATERIAL (8")				
			CLAY, Stiff to Very Stiff, Dark Gray with a trace of fine gravel	10			
				21			
5			CLAY, Very Stiff, Light Gray and Tan with calcareous pockets and ferric staining	20			
10							
15							
20							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 8.0'
DATE DRILLED: 1/31/95
DEPTH TO WATER: Dry
DATE MEASURED: 1/31/95
PROJ. No. ASA95-005-00
PLATE 3

LOG OF BORING NO. B-3

UNIVERSITY AVE STREET IMPROVEMENT - SABINAS ST TO IH-10

SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	COHESION, TON/SQ FT (0.3, 0.6, 0.9, 1.2, 1.5, 1.8, 2.1) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70)	% 200
			SURFACE ELEVATION:				
			ASPHALTIC CONCRETE (4")				
			BASE MATERIAL (8")				
			CLAY, Stiff, Dark Gray with a trace of fine gravel	9			
				13			
5							
			GRAVEL, Clayey, Very Dense, Tan with abundant chert fragments	50/11"			
				50			
10				50			
			CLAY, Hard, Tan to Tan and Gray				
				31			
15							
20							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 15.0'	DEPTH TO WATER: Dry	PROJ. No. ASA95-005-00	
DATE DRILLED: 1/31/95	DATE MEASURED: 1/31/95	PLATE 4	

KEY TO TERMS AND SYMBOLS

MATERIAL TYPES

SOIL TERMS

- CALCAREOUS
- CALICHE
- CLAY
- CLAYEY
- GRAVEL
- GRAVELLY
- PEAT
- SAND
- SANDY
- SILT
- SILTY

ROCK TERMS

- CHALK
- CLAYSTONE
- CLAY-SHALE
- CONGLOMERATE
- DOLOMITE
- IGNEOUS
- LIMESTONE
- MARL
- METAMORPHIC
- SANDSTONE
- SHALE
- SILTSTONE

OTHER

- ASPHALT
- BASE
- CONCRETE / CEMENT
- FILL
- WASTE
- NO INFORMATION

WELL CONSTRUCTION AND PLUGGING MATERIALS

- BLANK PIPE
- SCREEN
- BENTONITE
- BENTONITE-CEMENT GROUT
- BENTONITE & CUTTINGS
- CEMENT
- CUTTINGS
- GRAVEL
- SAND
- VOLCLAY

SAMPLE TYPES

- AIR ROTARY
- AUGER
- 3" CORE
- KANSAS SAMPLER
- MUD ROTARY
- NO RECOVERY
- NX CORE
- SHELBY TUBE
- 3" SPLIT BARREL
- 2" SPLIT SPOON

STRENGTH TEST RESULTS

- POCKET PENETROMETER
- TORVANE
- UNCONFINED COMPRESSION
- TRIAXIAL COMPRESSION UNCONSOLIDATED-UNDRAINED
- TRIAXIAL COMPRESSION CONSOLIDATED-UNDRAINED

NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

KEY TO TERMS & SYMBOLS (CONT'D)

TERMINOLOGY

Terms used in this report to describe soil with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D487-85 and D2488-84, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 1990.

RELATIVE DENSITY

Penetration Resistance Blows per ft	Relative Density
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
>50	Very Dense

COHESIVE STRENGTH

Resistance Blows per ft	Consistency	Cohesion TSF
0-2	Very Soft	0-0.125
2-4	Soft	0.125-0.25
4-8	Firm	0.25-0.5
8-15	Stiff	0.5-1.0
15-30	Very Stiff	1.0-2.0
>30	Hard	>2.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0-5	None
5-10	Low
10-20	Moderate
20-40	Plastic
>40	Highly Plastic

ABBREVIATIONS

B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
BTEX = Total BTEX
TPH = Total Petroleum Hydrocarbons
ND = Not Detected
NA = Not Analyzed
OVA = Organic Vapor Analyzer
ppm = Parts Per Million

Cam, Cas, Cal = Quaternary Alluvium
Qat = Low Terrace Deposits
Qbc = Beaumont Formation
Qt = Fluviatile Terrace
Qao = Seymour Formation
Qle = Leona Formation
Q-Tu = Uvalde Gravel
Ewi = Wilcox Formation
Emi = Midway Group
Kknm = Navarro Group and Marlbrook Marl
Kpg = Pecan Gap Chalk
Kau = Austin Chalk

Kef = Eagle Ford Shale
Kbu = Buda Limestone
Kdr = Del Rio Clay
Kgt = Georgetown Formation
Kep = Person Formation
Kek = Kainer Formation
Kes = Escondido Formation
Kw = Walnut Formation
Kgr = Glen Rose Formation
Kgrl = Lower Glen Rose Formation
Kgru = Upper Glen Rose Formation
Kh = Hensell Sand
Psa = San Angelo Formation

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: UNIVERSITY AVE STREET IMPROVEMENT - SABINAS ST TO IH-10

PROJECT LOCATION: SAN ANTONIO, TEXAS

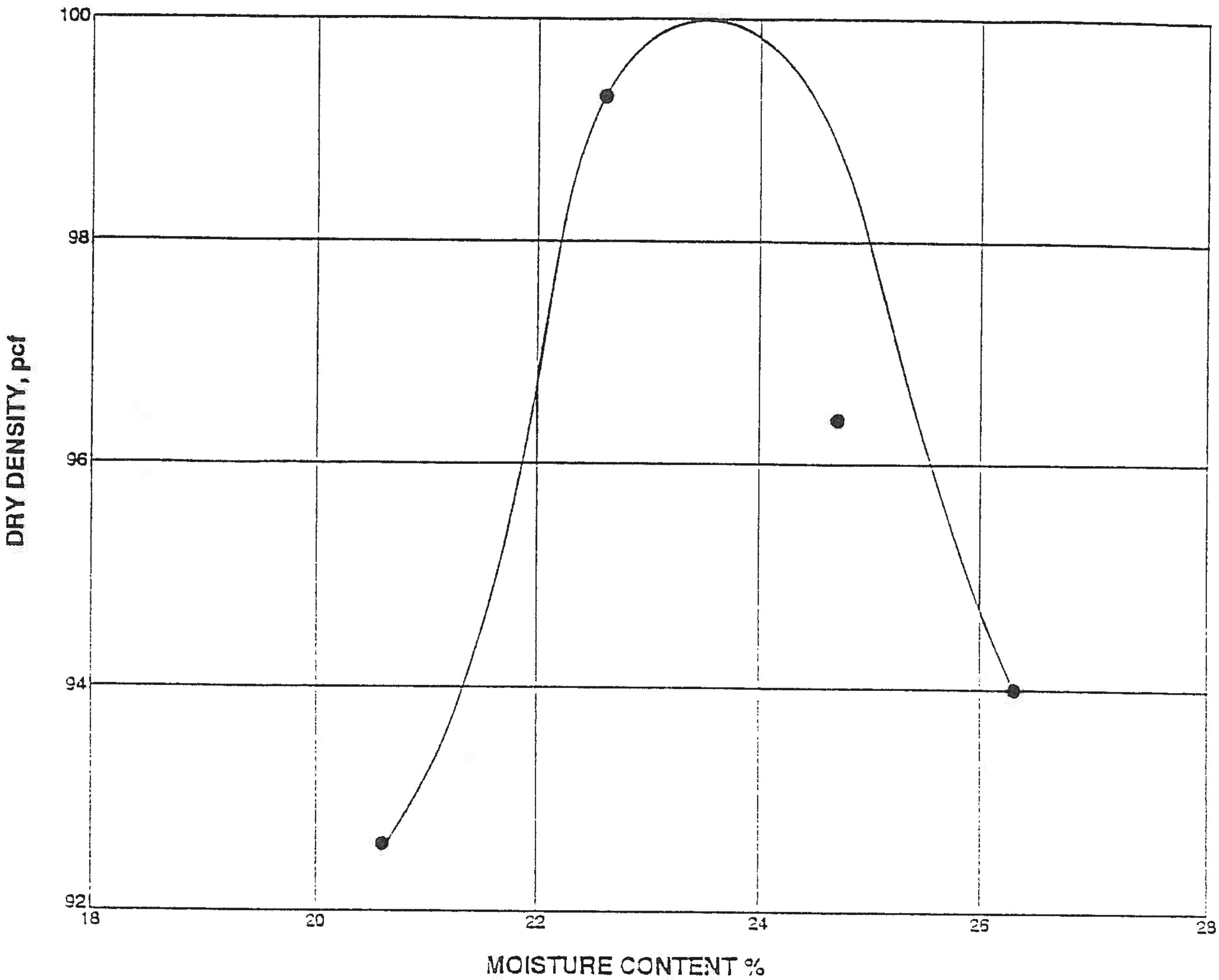
FILE NAME: UNIVAVE.WQ1

02/03/95

BORING NUMBER	SAMPLE DEPTH (FT)	BLOWS PER FT	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS
B-1	0.00 to 1.00						
	1.00 to 2.50	37	24.1				
	2.50 to 3.90	50/5"					
	5.00 to 6.50	22	11.7				
	7.50 to 8.50	26					
	8.50 to 10.00	28	17.1	62	16	46	CH
B-2	0.00 to 1.00						
	1.00 to 2.50	10					
	2.50 to 4.00	21	24.2				
	5.00 to 6.50	20		64	16	48	CH
	6.50 to 8.00		17.2				
B-3	0.00 to 1.00						
	1.00 to 2.50	9		74	21	53	CH
	2.50 to 4.00	13	29.7				
	5.00 to 6.40	50/11"					
	7.50 to 9.00	50	7.9				
	10.00 to 11.50	50					
	13.50 to 15.00	31	18.4				

MOISTURE-DENSITY RELATIONSHIP

UNIVERSITY AVE STREET IMPROVEMENT - SABINAS ST TO IH-10
SAN ANTONIO, TEXAS



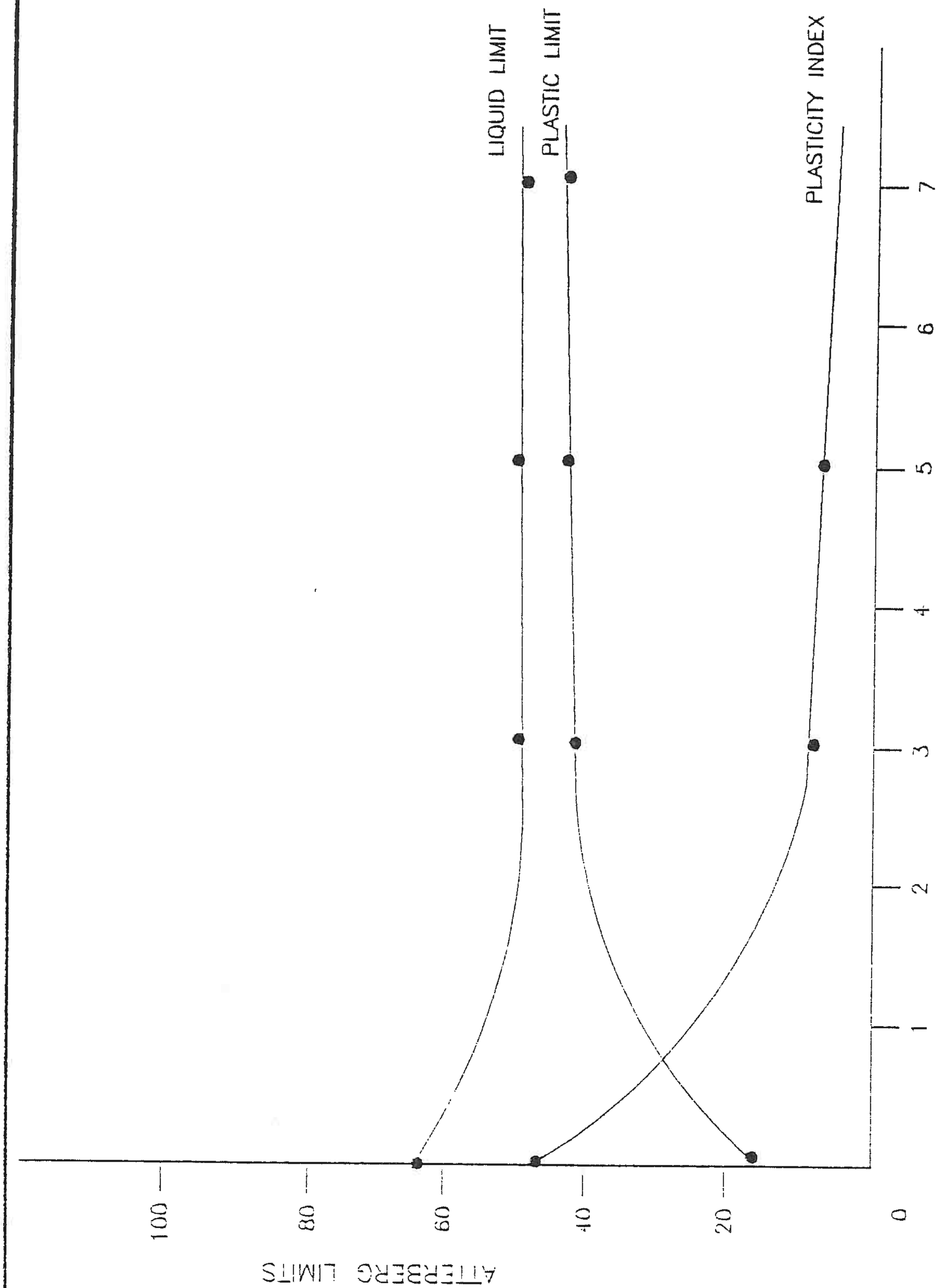
Material Description:	CLAY, Dark Gray with a trace of fine gravel
Maximum Dry Density:	100.0 pcf
Optimum Moisture:	23.7%
Compaction Series:	THD 6.63 ft-lbs/cu in.
Liquid Limit:	64
Plasticity Index:	47
Sample Date:	1/31/95
Sampled by:	Drill Crew
CBR:	2.0%, 3.8%, 3.6% (Remolded to 79.2%, 90.3%, 99.0% of Max. Dry Density at 24.8%, 24.0%, 24.2% Moisture Content and Soaked for 96 Hours)
Moisture Content:	35.5%, 32.0%, 31.6% Respectively (Top 1") 34.9%, 27.6%, 24.8% Respectively (Middle)
Percent Swell:	2.7, 0.3, 3.1 Respectively

Laboratory No. 4-119157

02/20/95

Raba-Kistner Consultants, Inc.

PROJECT No. ASA95-005-00



LIME SERIES CURVE
UNIVERSITY AVE STREET IMPROVEMENT – SABINAS ST TO IH-10
SAN ANTONIO, TEXAS

Raba-Kistner Consultants, Inc.

PROJECT No. ASA95-005-00