NOVEMBER 1999

FEATURE DESIGN MEMORANDUM 2

RIO PUERTO NUEVO
PUERTO RICO

ADVANCE COPY
SUBJECT TO REVISION

US Army Corps
of Engineers
Jacksonville District

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

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RIO PUERTO NUEVO PROJECT
PERTINENT DATA

Puerto Nuevo Channel:

Total Channel Length (miles).....	6.46
Bulkheaded Trapezoidal Channel (miles).....	1.66
Concrete Rectangular Channel (miles).....	4.80

Puerto Nuevo Channel - New Bridges:

1. Pedestrian Bridge at Station 195+00
2. P.R. 1

Puerto Nuevo Channel - Bridge Modifications:

1. Kennedy Avenue (Puente Constitucion)
2. De Diego Expressway
3. Las Americas Expressway
4. N.E. Access Ramp
5. Pinero Avenue
6. S.E. Access Ramp
7. P.R. 177

Puerto Nuevo Channel - Bridge Replacements

1. Roosevelt Avenue
2. Notre Dame Street
3. P.R. 176
4. Pedestrian Bridge at Station 301+25

Margarita Channel:

Total Channel Length (miles).....	1.70
Trapezoidal Channel (miles).....	1.03
Concrete Rectangular Channel (miles).....	0.67

Margarita Channel - Bridge Modifications

1. De Diego Expressway

Josefina Channel:

Concrete Rectangular Channel (miles).....	1.46

Josefina Channel - Bridge Replacements

1. Pinero Avenue
2. Andalucia Avenue
3. Pedestrian Bridge at Station 40+35
4. Americo Miranda Avenue
5. 31st Street S.E.
6. 21st Street S.E.
7. 9th Street S.E.
8. 54th Street S.E.

RIO PUERTO NUEVO
PERTINENT DATA (CONT.)

Dona Ana Channel:
Concrete Rectangular Channel (miles)..... 0.62

Dona Ana Channel - Bridge Replacements
1. Americo Miranda Avenue
2. 29th Street S.E.
3. 21st Street S.E.

Buena Vista Diversion Channel:
Concrete Rectangular Channel (miles)..... 0.80

Buena Vista Diversion Channel - New Bridges
1. Service Road
2. 17th Street

Buena Vista Diversion Channel - Replacement Bridges
1. 4th Street
2. P.R. 21

Guaracanal Channel:
Concrete Rectangular Channel (miles)..... 0.16

Puerto Nuevo Stilling Area:
Location (Station in feet)..... 149+80
Channel Bottom Elevation..... Varies
Baffle blocks:
Two Rows (Height in feet)..... 8.00
Six Rows (Height in feet)..... 4.00

Margarita Stilling Basin:
Location (Station in feet)..... 54+10
Design Discharge (c.f.s.)..... 8012
Apron Elevation (feet)..... -17.87
Apron Length (feet)..... 65.00
Endsill Height (feet)..... 1.83
Baffle Block Height (feet)..... 3.67
Number of Rows of Baffle Blocks..... 2

Puerto Nuevo Debris Basin:
Area (acres)..... 9.5
Outlet Structure Type....."L" shaped side discharge
Design Headwater Elevation (feet)..... 96.00

RIO PUERTO NUEVO
PERTINENT DATA (CONT.)

Puerto Nuevo Debris Basin (cont.):	
Design Tailwater Elevation (feet)	86.70
Design Discharge (c.f.s.)	26,123
Crest Length - Length x Width (feet)	300 x 75
Crest Elevation	87.40
Guaracanal Debris basin:	
Area (acres)	6.50
Outlet Structure Type	"L" shaped side discharge
Design Headwater Elevation (feet)	74.20
Design Tailwater Elevation (feet)	72.90
Design Discharge (c.f.s.)	11,075
Crest Length - Length x Width (feet)	150 x 50
Crest Elevation (feet)	57.60

Note: All elevations refer to National Geodetic Vertical Datum (mean sea level of 1929)

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

1. INTRODUCTION

1.1 Authorization. The Rio Puerto Nuevo Survey Investigation was initiated in 1978 at the request of the Commonwealth of Puerto Rico. Flood control studies were conducted under the authority of Section 204 of the Flood Control Act of 1970, Public Law 19-611. The Rio Puerto Nuevo, Puerto Rico, project was authorized for construction as a part of the Water Resources Development Act of 1986, Public Law 99-662, November 17, 1986.

1.2 Purpose and Scope. This report presents the designs for the second study phase of the Rio Puerto Nuevo flood control project which includes the main channel from about Station 64+00 to Station 147+40 and the Margarita Channel from Station M0+00 to Station M89+60.

1.3 Project Location. The Rio Puerto Nuevo flood control project drains a 25-square mile basin located within a highly developed area of the city of San Juan on the northern coast of Puerto Rico. Plate L-1A shows the location and vicinity of the project.

1.4 Prior Studies and Reports.

a. *Rio Puerto Nuevo Erosion Prevention Study,* INCA Engineers, Inc., December 1998.

b. *Alternative Design Study, Roosevelt Avenue Bridge Replacement, Rio Puerto Nuevo Project,* Post, Buckley, Schuh, & Jernigan, Inc., August 1996.

c. *Rio Puerto Nuevo, Puerto Rico, Engineering Division Quality Control Plan, Feature Design Memorandum 2,* Jacksonville District, February 1996.

d. *Value Engineering Study, Miramar Trunk Sewer Siphon Relocation, Puerto Nuevo Project, San Juan, Puerto Rico,* Black & Veatch, November 1994.

e. *Value Engineering Study, Rio Puerto Nuevo Flood Control Project, De Diego Expressway to Station 147+40 (Reach 2) and the Josefina/Dona Ana Tributaries,* OVEST, June 1994.

f. *Rio Puerto Nuevo, Puerto Rico, Feature Design Memorandum 1,* Jacksonville District, November 1992.

g. *Ground-Water Hydrology and the Effects of Channel Modifications of the Rio Puerto Nuevo on Ground-water Levels in the San Juan Metropolitan Area, Puerto Rico* (Draft), U.S. Geological Survey, Caribbean District, San Juan, Puerto Rico, July 1992.

h. *Rio Puerto Nuevo, Puerto Rico, General Design Memorandum,* Jacksonville District, December 1991.

i. *Concrete Materials Design Memorandum, Rio Puerto Nuevo, Puerto Rico,* Jacksonville District, July 1992.

j. *Corrosion Mitigation Study, Rio Puerto Nuevo, San Juan, Puerto Rico,* Michael J. Baker, Jr., Inc., August 1990.

k. *Engineering Report, Kennedy Avenue Bridge, Rio Puerto Nuevo Project, San Juan, Puerto Rico,* The Johnson McAdams Firm, P.A. October 1990.

l. *Rio Puerto Nuevo, Puerto Rico, Survey Report,* Jacksonville District, October 1984.

m. *Phase 1 General Design Memorandum, San Juan Harbor,* Jacksonville District, March 1982.

n. *Agua-Guagua Project Final Letter Report: Dredging Martin Peña Navigation Channel,* Jacksonville District, August 1983.

2. Description of Proposed Improvements

2.1 General. The Rio Puerto Nuevo flood control project consists of 11.2 miles of channel improvements to the existing Rio Puerto Nuevo/Rio Piedras and to five tributaries: Margarita, Josefina, Dona Ana, Buena Vista, and Guaracanal. The project improvements include the construction of eight different channel sections, the replacement of seventeen bridges (15 highway and 2 pedestrian), the modification of eight bridges, and the construction of four new bridges (3 highway and 1 pedestrian). The project plan also includes two debris basins with side overflow spillways, two stilling basins, sidewalks and bike paths for recreation, and the relocation of a segment of De Diego Expressway. After construction of all phases, the project will provide conveyance for the 100-year flood event with a design life of 50 years. Refer to the General Design Memorandum and the plans and specifications for Rio Puerto Nuevo, Puerto Rico, Contract 1 and Contract 2A for information on improvements for the entire project.

2.2 Contract 1. Contract 1 was awarded during the last quarter of fiscal year 95, and construction began during the first quarter of fiscal year 96. The scope of Contract 1 is the lower Puerto Nuevo channel, from the harbor at Station 0+90 upstream to Station 64+00, and includes the following features:

(a) King Pile Wall System - Northeast Wall from Station 9+00 to Station 57+73 and Southwest Wall from about Station 23+35 to Station 64+00

(b) Steel Sheet Pile Wall System - East Wall from Station 57+73 to Station 64+00

(c) Dredging - Removal of Approximately 2,000,000 Cubic Yards of Material to Form a 400-Foot-Wide by 25-Foot-Deep Trapezoidal Channel with Disposal of the Dredged Material in an Ocean Disposal Area

(d) Kennedy Avenue Bridge Modification

(e) De Diego Expressway Relocation - Approximately 2,000 Linear Feet Relocated to the East to Allow Widening of the Channel to 400 Feet Between the Expressway and the Landfill

(f) Removal of Part of the Existing Martin Peña King Pile Wall - Approximately 323 Bents to Allow Widening of the Existing Channel to the Northeast

(g) Removal of an Abandoned Bridge at About Station 44+40, and

(h) Relocation of the Miramar Trunk Sewer Siphon Crossing - Existing Crossing at Approximately Station 18+85.

2.3 Phase 2. The scope of the second phase of the Rio Puerto Nuevo flood control project is the main channel from Station 64+00 to Station 147+40 and the Margarita Tributary from Station

M0+00 to Station M89+60. The following features are included in the second phase of the project:

(a) Composite Steel Pipe Pile/Steel Sheet Pile Wall System - West Wall from Station 64+00 to Station 74+32.5 and East Wall from Station 64+00 to Station 70+00

(b) Cantilever Steel Sheet Pile Wall - East Wall from Station 70+00 to Station 72+00

(c) Relocation of the San Jose Sewer Siphon Crossing - Existing Crossing at Approximately Station 18+85

(d) Trapezoidal Earth Channel - Main Channel from Station 72+00 on the Eastside and Station 74+32.5 on the Westside to Station 88+33 and the Margarita Channel from Station M0+00 to Station M54+10. Material from Margarita Station M22+00 to M37+00 to be Disposed of in Upland Disposal Area. Remainder of Material to be Disposed of in Ocean Disposal Area.

(e) Mangrove Planting Areas For Mitigation

(f) Divider Wall at the Margarita Channel/Main Channel Confluence from Margarita Station M0+00 to Station M4+00

(g) Excavation with Upland Disposal of Excavated Material - Main Channel from Station 88+33 to Station 147+40 and Margarita Channel from Station M54+10 to Station M89+60

(h) Margarita Stilling Basin from Station M54+10 to Station M54+75

(i) Margarita Concrete U-Frame Channel from Station M54+75 to Station M89+60

(j) Composite Steel Pipe Pile/Steel Sheet Pile Retaining Wall at Margarita along the De Diego Expressway from Station M49+00 to Station M53+00

(k) Main Channel Composite Steel Pipe Pile/Steel Sheet Pile Walls from Station 88+33 to Station 147+40

(l) Tie-In Channel at the Josefina Confluence

(m) De Diego Expressway (over Margarita Channel) Bridge Modification

(n) De Diego Expressway (over the Main Channel) Bridge Modification

(o) Roosevelt Avenue Bridge Detour and Replacement

(p) Earth Work Transition to the Existing River at Station 147+40

(q) Grouted Concrete Panel System Installed on the Bottom of the Main Channel from Station 88+33 to Station 147+40 for Erosion Control and Hydraulic Smoothness, and

(r) Utility Relocations that include power, telephone, and cable television line crossings; park lighting fixtures; residential power, water, and sewer service; a 30-inch and 36-inch sewer line crossing; and a 48-inch water line crossing.

2.3.1 Contract 2A. Features (a) through (f) above are not included in this report; instead these features were broken out as Contract 2A, and plans and specifications were developed concurrently with this report. This prevented a lapse in

construction between the completion of Contract 1 and the start of Phase 2. Contract 2A was awarded to Cashman Equipment Corporation on September 1998, and construction is on-going at this time. Structural features for Contract 2A were limited to the composite steel pipe pile/steel sheet pile wall (item a), the cantilever steel sheet pile wall (item b), the San Jose Sewer Siphon Relocation (item c), and the steel sheet pile divider wall at the Margarita Channel/main channel confluence (item f). The San Jose Sewer Siphon relocation (item c) is almost identical to the Miramar Sewer Siphon relocation in Contract 1, and the steel sheet pile walls (items b and f) are economical structures used on many previous projects. Thus, alternative studies and further detailed design for these features and the earthen channel and mangrove mitigation areas (items d and e) were not necessary prior to preparation of plans and specifications for Contract 2A. The composite steel pipe pile/steel sheet pile wall (item a) is similar to items j and k above. Alternative studies, design assumptions and loading conditions presented in Chapter 7, *Structural Design,* of this report for items j and k would also pertain to item a. Contract 2AA.

The scope of this report includes all remaining features (items g through r); however, actual construction will be done in four contracts - Contract 2B, 2C, 2D, and 2E. The limits of these contracts are shown on Plate L-1B.

2.3.2 Contract 2B. The scope of Contract 2B will be the Roosevelt Avenue Bridge Replacement. Refer to Volume 3 of this report for detailed design information on this project feature.

2.3.3 Contract 2C. The scope of Contract 2C will be the Margarita Channel from about Station M54+10 to Station M89+60. There will be some overlap downstream of Station M54+10 to tie-in to the end of Contract 2A. Structural features will include the Margarita stilling basin (Station M54+10 to M54+75), the Margarita concrete U-Frame channel (Station M54+75 to Station M89+60), modification of the De Diego Expressway (over the Margarita Channel) Bridge, and the composite steel pipe pile/steel sheet pile retaining wall along the De Diego Expressway from Margarita Station M49+00 to Station M53+00.

2.3.4 Contract 2D. The scope of Contract 2D will consist of construction of the main channel composite steel pipe pile/steel sheet pile walls from Station 88+33 to Station 147+40 and excavation of the channel in this reach. Other features would include the tie-in channel at the Josefina Confluence, modification of the De Diego Expressway (over the Main Channel) Bridge, and an earthwork transition to the existing river at Station 147+40. This contract will be further divided into two phases for construction. Phase 1 will be the modification of the De Diego (over the Main Channel) Bridge. INCA Engineers, Inc.

should begin final design and preparation of the plans and specifications for this bridge modification in July 1999. The remaining features would be constructed as Phase 2.

2.3.5 Contract 2E. The scope of Contract 2E will consist of installation of the grouted concrete panel system on the bottom of the main channel from Station 88+33 to Station 147+40. Refer to the study by INCA Engineers, Inc. (see Paragraph 1.4.a) for information on alternatives investigated and design and cost data for the selected alternative.

2.4 Channel Improvements.

2.4.1 Retaining Wall at Margarita along the De Diego Expressway. This wall is located on the south side of the channel from Margarita Station M49+00 to Station M53+00 and is required due to the proximity of the De Diego Expressway. This wall also serves as part of the wing wall to transition from the 30-foot wide concrete U-frame channel to the trapezoidal earth channel. A composite pipe pile/steel sheet pile wall is proposed. Refer to Plates S-1 and S-2.

2.4.2 Margarita Stilling Basin. A 30-foot wide stilling basin is proposed from Margarita Station M54+10 to Station M54+75. The stilling basin would be constructed as a concrete U-frame with two rows of baffle blocks. See Plates S-4 and S-5. The purpose of the stilling basin is to fix the location of the hydraulic jump during major flood events as flow transitions from supercritical in the upstream concrete rectangular channel to subcritical in the downstream trapezoidal earth channel.

2.4.3 Margarita Concrete U-Frame Channel. From Station M54+75 to Station M89+60, the channel would be a thirty-foot wide rectangular concrete U-frame structure. Refer to Plate S-7. Because this reach of the channel is highly developed with commercial properties, the design channel would closely follow the existing Margarita alignment with a change in bed slope to induce supercritical flow. Design velocities in this reach would range from 18 to 38 feet per second.

2.4.4 Main Channel - Station 88+33 to Station 147+40. The existing earth channel would be widened and deepened in this reach to provide a rectangular channel with widths ranging from 180 feet to 150 feet, and invert elevations ranging from Elevation -16 feet to -12.7 feet, NGVD. The design flow velocities would range from 19 to 15 feet per second. While this reach is within the subcritical flow regime, a concrete channel would be necessary to protect against erosion and provide the smooth hydraulic surface required to prevent overtopping of four cloverleaf bridges upstream. A composite steel pipe pile/sheet pile wall is proposed with a concrete facing from the top of the

wall down to the channel invert. See Plate S-11. A grouted panel system would be used to provide a smooth bottom surface that could be constructed without dewatering in this tidal reach. Refer to the study by INCA Engineers, Inc. (see Paragraph 1.4.a) for detailed information on the proposed grouted panel bottom system.

2.4.5 Tie-In Channel at the Josefina Confluence. This concrete transition will allow tie-in of the Josefina Channel, which will be built as part of Phase 3 of the Puerto Nuevo Project, with the main channel to be built as part of Phase 2. The tie-in would consist of constructing the first 300 feet of the Josefina Channel, and then an earthwork transition to the existing tributary. The concrete tie-in would be constructed as a concrete U-frame structure with the north wall acting as a divider wall between the Josefina Channel and the main channel from about Josefina Station J0+00 to J1+50. Refer to Plate S-13.

2.5 Bridges.

2.5.1 De Diego Expressway (over Margarita Channel) Bridge Modification. The proposed channel cross section under this bridge would be a reinforced concrete U-frame channel. The invert would be approximately three feet lower than the existing channel, and there should be no impact to the bridge substructure. Refer to Plate S-21.

2.5.2 De Diego Expressway (over the Main Channel) Bridge Modification. Construction of the proposed bridge section beneath this bridge would involve deepening the existing invert approximately twelve feet. The proposed channel width is 180 feet (increased from 120 feet) which fits within the existing bridge abutments. The proposed channel section under the bridge would be soil nailed walls with grouted panels on the bottom. Soil nails for the walls would be spaced for installation between the piles at each abutment. Seven additional piles would be added at each interior bent between existing piles to bring the bridge substructure up to current standards using AASHTO 1996 specifications (with 1997 and 1998 interim revisions) for HS30-44 loading. Bolting and shear blocks would also be used at the interior bents and abutments to provide seismic stability. Refer to Plates S-25 through S-28.

2.5.3 Roosevelt Avenue Bridge Detour and Replacement. The widening and deepening of the main channel for the Rio Puerto Nuevo flood control project would require that the Roosevelt Avenue Bridge be replaced. The new bridge would be 191.25 feet long (from centerline bearing to centerline bearing) with two equal spans. This span arrangement is dictated by the required hydraulic opening and the proposed channel configuration given in the General Design Memorandum. The new bridge would accommodate

three lanes of traffic in each direction (33.00 feet from curb to curb) with sidewalks on each side (8.0 feet wide) and a raised, closed median (19.67 feet wide). Roadway barriers would be provided on each side of the bridge. The superstructure would consist of an 8-inch thick concrete deck slab supported on prestressed concrete Type IV AASHTO beams. The substructure would consist of a pile bent supported on steel H-piles. During construction, a temporary bridge would be provided on the south (upstream) side of the existing eastbound lanes for detour and maintenance of traffic. Refer to Volume 3 of this report for complete design information on the Roosevelt Avenue Bridge Replacement.

2.6 Changes Since the General Design Memorandum (GDM). After detailed analysis and design refinement at the FDM level, the following changes to the project design have occurred for Phase 2 since the GDM was approved in 1991:

a. Wall and Slab Thickness of the Margarita Stilling Basin

b. Type of Retaining Wall along De Diego Expressway at Margarita Station M49+00 to Station M53+00. The GDM proposed an inverted concrete tee wall. The selected alternative is now a composite pipe pile/steel sheet pile wall system.

c. Dimensions of the Margarita U-Frame Channel

d. Type of Retaining Wall Along the Main Channel From Station 88+33 to Station 147+40. The GDM proposed a relieving platform wall system. The selected alternative is now a composite pipe pile/steel sheet pile wall system.

e. Channel Bottom Paving System for the Main Channel From Station 88+33 to Station 147+40. The GDM proposed a three-foot thick tremie concrete slab anchored with helical soil anchors. The selected alternative is now a system of precast panels placed in the wet and grouted underneath.

f. De Diego Expressway (Over the Main Channel) Bridge Modification. The GDM plan included concrete inverted tee channel walls with an 18-inch concrete bottom slab. The selected plan is now soil-nailed channel walls with precast concrete panels grouted in place on the channel bottom. Additional piles are now proposed to be added at the interior bents to up-grade the bridge substructure to current standards. In addition, bolting and shear blocks would be used to upgrade superstructure to substructure connectivities to resist seismic forces.

Refer to Chapter 7, *Structural Design*, of this report for a discussion of alternatives investigated and the reasoning for the selected alternative for each feature of Phase 2.

3. HYDRAULIC DESIGN

3.1 General. The hydraulic design for the Rio Puerto Nuevo Project was presented in the Rio Puerto Nuevo General Design Memorandum dated December 1991. The General Design Memorandum presents detailed hydraulic design data tables for the entire project. There have been no changes to the hydraulic design resulting from work done for this Feature Design Memorandum. This section presents a general overview of the design and a discussion of diversion requirements during construction.

3.2 Construction of Project Features. The upstream end of Contract No. 1 was located at approximately Station 64+00 on the Main Channel to avoid interference with the San Jose trunk sewer. Contract 2A consisted of the remainder of the earthen channel along the main channel (Station 64+00 to 88+33) and the earthen portion of the Margarita Channel (Margarita Station M0+00 to approximately Station M51+00). This was done to limit the number of structural features in Contract 2A such as the stilling basin in the Margarita Channel. The only structural features included in Contract 2A were the San Jose Sewer Siphon Relocation and the wall at the confluence of the Margarita and Puerto Nuevo Channels. Contract 2B will be the Roosevelt Avenue Bridge Replacement. Contract 2C will include the remaining portion of the Margarita Channel (Station M53+00 to M89+60). The walls for the main channel from Station 88+33 to 147+40 will be constructed as Contract 2D, and the channel bottom along this same reach will be constructed as Contract 2E. ~~will be removed once~~ The structure ~~will~~ the remainder of the Margarita Channel is constructe as Contra 2C

3.3 Margarita Channel. A grade control structure ~~will be required~~ constructed at the end of Contract 2A (approximate Margarita Station M51+00) in order to prevent head-cutting upstream during high flow periods. Project features to be constructed during Contract 2C include the stilling basin (Margarita Stations M54+10 to M54+75) and the concrete rectangular channel (Margarita Stations M54+75 to M89+60). The stilling basin is located just downstream from the De Diego Expressway bridge where the bed slope changes from steep to mild. The channel cross-section configuration and lining material also change at this location from ~~concrete rectangular channel to~~ riprap trapezoidal channel. ~~to CC rect channel~~ SIC

3.3.1 Diversion During Construction. Due to the limited right-of-way and construction easements along the upper portions of the Margarita Channel, it is not possible to divert water around the construction area for the entire length. For the construction of the stilling basin and a short portion of the rectangular section downstream of the De Diego Bridge over the Margarita Channel, it is possible to divert flow around the construction site. However, the remaining portion of the channel will require a series of cofferdams to block portions of the channel. The Contractor will be required to pre-excavate the

channel cross-section template to provide additional channel area prior to blocking any portion of channel with cofferdams. In order to pass the daily flow in the channel, a 36-inch diameter pipe will be placed through the cofferdam at the outer edge of the newly excavated channel template. HEC-2 models were constructed to determine 2-Year and 5-Year water surface elevations for the proposed sequence of construction. Cofferdams were assumed to be 250 feet in length. The cofferdam height was selected to overtop at between the 2-year and 5-year events. It should be noted that under large storm events (100-Year and Standard Project Flood (SPF)), conditions upstream of the cofferdam are slightly worsened due to the constrictions in the channel. Under these extreme flood conditions it will be necessary for the contractor to remove the cofferdam until the event is over.

3.4 Main Channel. Construction of the Main Channel from Stations 88+33 to 147+00 will be done in two construction contracts (Contracts 2D and 2E). This section of the Main Channel consists of composite pipe pile/steel sheet pile walls with grouted concrete panels for bottom protection. Right-of-way and construction easements are available for much of the channel works in this reach. The majority of construction for both composite walls is outside the current Rio Piedras alignment, therefore no diversion is required. Channel walls will be constructed first, followed by excavation of the channel template between them, followed by the placement of the bottom panels. From approximately Station 135+00 to 147+00, the existing Rio Piedras crosses the Main Channel alignment in several places. The contractor will be required to do some excavation to "straighten" the existing river into the proper alignment and divert flow into the new channel alignment prior to constructing the channel walls. Dewatering will be required for construction of the new bridge piers for the Roosevelt Avenue Bridge replacement and construction under the existing De Diego Bridge over Rio Piedras. HEC-2 models were constructed to determine 2-Year and 5-Year water surface elevations for the proposed sequence of construction.

3.5 Interior Drainage. There have been no changes to the interior drainage designs resulting from the work done for this feature design memorandum.

3.5.1 Margarita Channel. The Margarita Channel runs through a highly populated area. Dense development along the existing Margarita Tributary contributes runoff through culverts and storm sewers. Twelve side inlets to the Margarita Channel were identified in the General Design Memorandum. Of the twelve identified, two will be replaced, one modified, and the remainder will be undisturbed. Table 1 contains a description of the side inlets and required action for the Margarita Channel.

3.5.2 Main Channel. The main channel runs through a highly populated area. Dense development along much of the existing Rio Piedras contributes runoff through culverts and storm sewers. From Station 88+33 to Station 147+00, twenty-seven side inlets were identified in the General Design Memorandum. Due to the change of the channel alignment and channel improvements (widening and deepening), many of the inlets will require replacement or modification. Table 2 contains a description of the side inlets and required action for the Puerto Nuevo Main Channel.

3.6 Sediment Transport During Construction. During construction, the sediment transport of sands and gravels are expected to increase due to construction activities. Standard control measures would be taken to minimize erosion during construction, but there would be some increase in the amount of silts and clays introduced into the harbor as a result of the project. This is because channelization will confine flood waters which would, under existing conditions, deposit such materials in overbank areas during flood events as flood waters recede. The rate of transport of these fine materials is expected to decline in the future with the continued development in the basin. Upon project completion debris basins will minimize transport of larger grain sizes to the harbor, such as sand and gravels.

4. GEOLOGY AND SOILS

4.1 Field Investigations. The geotechnical field investigations were accomplished by A/E drilling contractors under the direction of the Jacksonville District. The investigations included core borings, undisturbed sampling, and laboratory testing of selected samples from the borings. Copies of the complete boring logs and laboratory test data are included in Appendix B-1.

The field investigations also included Dilatometer testing made Jan-Feb 1996 at four locations throughout the limits of FDM 2. The results of the testing (designated as DMT-1 through DMT-6) are included in a report entitled "*Puerto Nuevo Channel - Dilatometer Testing*" dated February 8, 1996 by Law Engineering. A copy of the Dilatometer readings is included in Appendix B-1.

After the preliminary design for various channel walls was completed, the district design team concluded that more precise soil responses to lateral loadings should be measured for the extent of the design depths. Consequently, the district retained the University of Florida to conduct Pressuremeter and Dilatometer testing at three sites in March 1998. Site 1 was located next to CB-PNL-59 within the Contract 2A limits. Site 2 was located next to CB-MC-30 which is close to the retaining wall downstream of the Margarita Stilling Basin. Site 3 was located next to CB-PNB-4 on the southwest corner of the De Diego Bridge abutment. Load versus deflection (P-Y) curves were developed for the Pressuremeter (PMT), Dilatometer (DMT), and combined PMT/DMT. The PMT P-Y curves were recommended for the lateral load analysis because they represented the softest curves from the three methods. The results of all the P-Y curves are included in a report entitled "*Pressuremeter and Dilatometer Testing at Puerto Nuevo Flood Control Project*" dated March 1998. Copy of the PMT P-Y curves is included in Appendix B-1.

4.2 Subsurface Conditions.

4.2.1 General. Locations of the borings are shown on Plates L-1 through L-14. Geologic profiles showing the subsurface stratigraphy based on the consistency of the materials and soil classifications were developed from the boring information and are shown on Plates G-1 through G-3. As can be seen from the profiles, the subsurface is comprised primary of clays and silts. The soil consistency varies from very soft (mucky) to very hard (splitspoon refusal). The soil generally becomes harder at greater depth except for a surface stratum of soft to medium soils which overlie very soft to soft soils in some areas.

Initial refusal (defined as the first 100+ blow/foot occurrence of boring) of the standard splitspoon occurred at elevations ranging

from Elevation -38 feet (NGVD) to Elevation -80 feet (NGVD). Weathered rock fragments were occasionally found in the soil samples between these elevations. The groundwater level in the borings varied from approximately Elevation +10 feet (NGVD) to Elevation -4 feet (NGVD).

4.2.2 Margarita Channel Station M49+00 to M54+10. Subsoil in this reach consists primarily of inorganic plastic clays (CH & CL). Silt and sandy-gravely soils (GC, SC, SM) are present to a lesser extent. In this area, a surface strata of medium soils generally overlie very soft to soft soils. The soils are very soft to soft between Elevation +5 feet (NGVD) to -22(+/-) feet (NGVD), transitioning to stiff and hard below.

4.2.3 Margarita Channel Station M54+10 to M54+75. The soils are characterized by core boring CB-MC-52. Soils are primarily CL, very soft to stiff in consistency with thin lenses or pockets of MH, SM, and CH.

4.2.4 Margarita Channel Station M54+75 to M89+60. Subsoil immediately beneath the foundation grade consists primarily of inorganic plastic clays (CH & CL) that are soft to medium in consistency. Underlying this soft to medium clay layer, the clays become stiff to hard. Silt and sandy-gravely soils (GC, GM, SC, and SM) are also present within this layer.

4.2.5 Puerto Nuevo Main Channel, Station 88+33.2 to 147+40. The subsoils along the north alignment of the wall are primarily clays (CH & CL), soft to very stiff in consistency with lenses or pockets of OH, GC, SC, SM, SP, and ML. Initial refusal (defined as the first 100+ blows/foot) of the standard splitspoon occurred at elevations ranging from Elevation -24 feet (NGVD) to Elevation -55 feet (NGVD). Top of the saprolitic limestone was encountered at elevations ranging from Elevation -37 feet (NGVD) to Elevation -55 feet (NGVD). Groundwater level in the borings varied from Elevation +1.5 feet (NGVD) to Elevation -4.3 feet (NGVD). The subsoils along the south alignment of the wall are very similar to the subsoils of the north alignment except the initial refusal materials were encountered at the deeper depths than that of the north alignment. Groundwater level in the borings varied from Elevation +2.47 feet (NGVD) to Elevation -7.7 feet (NGVD). The U.S.G.S. Groundwater Study Report (1992) indicated the groundwater levels in this reach are between Elevation +2 feet (NGVD) and Elevation +10 feet (NGVD). Their observation well located in the vicinity of Roosevelt Avenue Bridge had an average groundwater reading of Elevation +7.7 from 1985 to 1990.

4.3 Analyses.

4.3.1 General. Soil shear strength parameters used in the report were derived from blow counts of the Standard Penetration Tests (SPT) and Triaxial Tests.

4.3.1.1 Unconsolidated Undrained Shear Strength. Unconsolidated undrained triaxial tests (Q tests) were performed on twelve samples. Values from triaxial tests are listed in Table G-1.

Table G-1 - Q Strength (ϕ=0)

Boring	Elev. ft	N, bpf	Soil Type	c, psf
CB-MC-32U	-5.9	2	CH	320
CB-MC-32U	-14.9	2	CH	700
CB-MC-32U	-36.9	13	SC-H	1040
CB-MC-52U	-29.0	48	CH	1300
CB-MC-44U	-4.0	2	CH	760
CB-PNB-7U	-6.9	1	CH	720
CB-PNB-7U	-24.9	15	CL	1060
CB-PNB-4U	-35.3	30	CH	1100
CB-PNB-11U	-7.6	3	CH	1040
CB-PNB-13U	-1.8	4	CH	1220
CB-PNB-13U	-1.8	4	CH	1220
CB-PNM-56	+2.0	4	CH	580

4.3.1.2 Drained Shear Strength. Ten undisturbed samples were tested using either consolidated undrained triaxial tests with pore pressure measurements (R-bar) or direct shear tests. Values from these drained shear tests are listed in Table G-2.

Table G-2 - S Strength (C=0)

Boring	Elev. ft	Test	N, bpf	Class	ϕ, deg
CB-MC-32U	-5.9	R-bar	2	CH	26.5
CB-MC-32U	-14.9	D/S	2	CH	19.5
CB-MC-32U	-36.9	D/S	13	SC-H	27.5
CB-MC-52	-29.0	D/S	48	CH	30.5
CB-PNB-7U	-6.9	R-bar	1	CH	26.7
CB-PNB-7U	-24.9	R-bar	15	CL	26.7
CB-PNB-11U	-7.6	R-bar	3	CH	27.0
CB-PNB-13U	+3.7	R-bar	4	CH	27.0
CB-PNB-13U	-1.8	D/S	4	CH	28.0
CB-PNM-56	+2	R-bar	4	CH	33.3

Note: Direct Shear Test is abbreviated as D/S.

4.3.1.3 Consolidated Undrained Shear Strength. Consolidated undrained triaxial shear tests (R tests) were performed on seven samples. Values from these tests are listed in Table G-3.

Table G-3 - R Strength

Boring	Elev. ft	N, bpf	Soil Type	ϕ, deg	c, psf
CB-MC-32U	-5.9	2	CH	12.7	260
CB-PNB-4U	-34.9	30	CH	8.3	1180
CB-PNB-7U	-24.9	15	CH	14.9	440
CB-PNB-11U	-7.6	1	CH	9.5	600
CB-PNB-13U	+3.7	4	CH	15.3	440
CB-PNB-13U	-1.8	4	CH	14.0	480
CB-PNM-56	+2.0	4	CH	14.5	400

4.3.1.4 Reduction in Shear Strength of Cohesive Soils Due to Seismic Loading. Some clays have been observed to liquefy in the field such as in China (Wang, 1979). These clay materials had the following characteristics:

Percent finer than 0.005 mm < 15%
Liquid Limit < 35
Water Content > 0.9 x Liquid Limit

These clay materials are substantially different from those found at the Rio Puerto Nuevo area. The cohesive materials at Puerto Nuevo have much higher plasticity than that found in the Chinese case. The higher the plasticity, the less susceptible clays are to liquefaction. Per Makdisi and Seed, 1977, in order for significant strains to develop in a cohesive material, the cyclic stress level has to surpass the cyclic yield strength. For practical purposes, the cyclic yield strength is typically in the range of 80% to 95% of the clays static undrained strength. Geotechnical Branch recommends that an 80% of R strength be used for all the seismic loading design.

4.3.2 Margarita Channel.

4.3.2.1 Retaining Wall Along De Diego Expressway at Margarita - Station M49+00 to M54+10.

4.3.2.1.1 General. This retaining wall is located downstream of the Margarita Channel Stilling Basin. The wall provides flood control protection and serves as a wing wall for the flow exiting the stilling basin. Three retaining wall alternatives were considered. They were (1) cantilevered sheet pile wall, (2) anchored sheet pile wall, and (3) composite pipe pile/sheet pile wall. The composite pipe pile/sheet pile wall

was the selected alternative. See Section 6.4 for a detailed discussion of the alternatives investigated.

The anchored sheet pile wall with either dead man or soil anchors was considered unacceptable due to the following reasons: (1) it was in close proximity to De Diego Expressway and (2) the strength of the weaker soils and high Atterberg Liquid Limit (LL) of the stiffer soils in which anchors would be constructed. Due to the thick strata of weaker soils overlying the stiffer soils, the anchor length required to penetrate the soil layer that could support the anchor load would be excessive. In addition, as previously discussed in Paragraph 4.2, the primary soils in this reach are CH, MH and CL. Both CH and MH materials have Liquid Limits between 70 and 100. The Federal Highway Administration (FHWA) does not recommend installation of anchors in organic soils or cohesive soils with a Liquid Limit greater than 50 because of long-term soil-anchor creep (*Permanent Ground Anchors*, Technical Report FHWA-DP-68-1R). In Rio Puerto Nuevo Contract 1, six test anchors are scheduled to be tested. After the test results of these test anchors are available, the option of using an anchor sheet pile wall will be reevaluated.

The recommended pipe pile/sheet pile system consists of Arbed AZ18 sheet piles and 36- and 48-inch diameter pipe piles. The wall thicknesses of the 36- and 48-inch pipe piles are 0.5 and 0.75 inch, respectively. The 36-inch diameter piles are located between Sta. 49+50 and 53+00. The 48-inch diameter piles are located between Sta. 53+00 and 54+10.

4.3.2.1.2 Minimum Pile Tip Elevations. The depth of penetration of the piling governs rotational stability of a cantilever wall. The adequacy of the pipe pile/sheet pile wall against rotational failure was checked using the slope stability computer program UTEXAS3. Minimum pile tip elevations for the pipe piles were determined from UTEXAS3 runs. The sheet piling tips were set (1) below the dredge line and (2) beyond the bottom of the soft clay layer. Core borings CB-MC-30, CB-MC-32, CB-MC-33, CB-MC-34 and CB-MC-52 were all considered to develop the soil properties used in the UTEXAS3 analyses. These soil properties are listed in Tables G-4, G-5 and G-6.

Table G-4 - Q Strength for short-term loading condition

Elev. Ft	Soil Type	N, Bpf	γ_{sat} pcf	γ_m pcf	C Psf	ϕ deg
Top to 8	SC-H	8	115	110	600	0
8 to 5	CL	2.5	100	95	550	0
5 to -15	CH	1	95	92	320	0
-15 to -28	CH	13	115	-	1200	0
-28 to -46	CH	13	115	-	850	0
below -46	LS	> 50	135	-	4000	0

Table G-5 - S Strength for long-term loading condition

Elev. Ft	Soil Type	N, Bpf	γ_{sat} pcf	γ_m pcf	C Psf	ϕ deg
Top to 8	SC-H	8	115	110	0	26
8 to 5	CL	2.5	100	95	0	24
5 to -15	CH	1	95	92	0	20
-15 to -28	CH	13	115	-	0	27
-28 to -46	CH	13	115	-	0	24
below -46	LS	> 50	135	-	0	38

Table G-6 - R Strength

Elev. Ft	Soil Type	N, Bpf	γ_{sat} pcf	γ_m pcf	C Psf	ϕ deg
Top to 8	SC-H	8	115	110	300	11
8 to 5	CL	2.5	100	95	240	10
5 to -15	CH	1	95	92	200	9
-15 to -28	CH	13	115	-	800	10
-28 to -46	CH	13	115	-	500	9
below -46	LS	> 50	135	-	2000	17

Minimum tip elevations for the pipe piles and safety factors for the UTEXAS3 runs are shown in Table G-7. UTEXAS3 results are shown in Appendix B-2.

Table G-7 - Results of Rotational Stability Analyses

Stations	Loading Condition	Minimum Pipe Pile Tip Elev., ft	Safety Factor
M50+00	Short Term	@ -25	1.865
	Long Term		2.128
	Seismic		**1.069**
M51+00	Short Term	@ -28	1.454
	Long Term		2.245
	Seismic		**1.005**
M52+00	Short Term	@ -37	3.214
	Long Term		3.280
	Seismic		**1.048**
M53+00	Short Term	@ -43	2.457
	Long Term		3.494
	Seismic		**1.037**

4.3.2.1.3 Lateral Load Analysis. The computer program LPILE was used for the lateral load analysis on the pipe piles. The soil properties listed in Table G-8 were provided to EN-DS for LPILE analysis.

Table G-8 - LPILE Soil Input

Elevation	Q Case	S Case	80% R Case
Top to 8′	py 3	py 4	py 7
	c=4.2psi	c=0.0psi	c=1.7psi
	ϕ=0.0	$\phi=26^0$	$\phi=11^0$
	k=75pci	k=60pci	k=36pci
	ε_{50}=0.0125	ε_{50}=0.0	ε_{50}=0.0125
	γ=0.064pci		
8′ to 5′	py 2	py 4	py 7
	c=4.0psi	c=0.0psi	c=1.7psi
	ϕ=0.0	$\phi=24^0$	$\phi=9^0$
	k=67pci	k=50pci	k=33pci
	ε_{50}=0.015	ε_{50}=0.0	ε_{50}=0.015
	γ=0.055pci		
5′ to -15′	py 1	py 4	py 7
	c=2.2psi	c=0.0psi	c=1.11psi
	ϕ=0.0	$\phi=20^0$	$\phi=7^0$
	k=35pci	k=40pci	k=29pci
	ε_{50}=0.02	ε_{50}=0.0	ε_{50}=0.02
	γ'=0.019pci		
-15′to -28′	py 2	py 4	py 7
	c=8.3psi	c=0.0psi	c=4.44psi
	ϕ=0.0	$\phi=27^0$	$\phi=8^0$
	k=400pci	k=60pci	k=43pci
	ε_{50}=0.007	ε_{50}=0.0	ε_{50}=0.007
	γ'=0.03pci		
-28′ to -46′	py 2	py 4	py 7
	c=5.9psi	c=0.0psi	c=3.5psi
	ϕ=0.0	$\phi=24^0$	$\phi=9^0$
	k=100pci	k=50pci	k=41pci
	ε_{50}=0.01	ε_{50}=0.0	ε_{50}=0.01
	γ'=0.03pci		
below -46′	py 2	py 4	py 7
	c=27.8psi	c=0.0psi	c=11.11psi
	ϕ=0.0	$\phi=38^0$	$\phi=17^0$
	k=2000pci	k=100pci	k=93.5pci
	ε_{50}=0.004	ε_{50}=0.0	ε_{50}=0.004
	γ'=0.042pci		

Notes:

1. The above py curves were selected using the list of soil types from the LPILE User's Manual.
2. k = Soil Modulus. Values selected were interpreted from Tables 3.2 and 3.3 of the LPILE User's Manual.
3. ε_{50} = Strain at 50% of the maximum stress. Values shown in the above table were interpreted from Tables 3.4 and 3.5 of the LPILE User's manual.

The PMT P-Y curves shown in Appendix B-1 were collected after the completion of the pipe pile/sheet pile wall design. It was decided by the district design team that reanalysis using the insitu P-Y curves is not necessary at this time because static/statnamic lateral load testing is scheduled to be done during construction of Contract 2A. It was the team's consensus to wait on the test results before performing any reanalysis. If the test results indicate problems related to the proposed design, there will still be time for the design to be modified prior to the preparations of the plans and specifications (P&S). The PMT curves are the softest curves; therefore, the proposed design should be on the conservative side. See Section 6.4 for details of the LPILE analysis.

4.3.2.1.4 Pile Drivability. Using CB-MC-52, SPT97 analyses were performed to provide side friction and end bearing for Wave Equation Analysis. Two GRLWEAP97 analyses were performed to evaluate drivability of both the 36-inch and 48-inch pipe piles. Results of GRLWP97 analyses indicated that there is no problem driving the 36-inch piles to Elevation -55 feet (NGVD). However, it is not the case for the driving of 48-inch piles to their design elevation of -69 feet (NGVD). For the 48-inch piles, GRLWEAP97 estimated blow counts of greater than 244 blows/ft from Elevation -51 feet (NGVD) down. Three IHC hydraulic hammers were used in the WEAP analyses. It was concluded that predrilling would be necessary before driving the 48-inch piles. See Appendix B-3 for details of the SPT97 analyses and GRLWP97 analyses.

4.3.2.2 Margarita Channel Stilling Basin - Station M54+10 to M54+75.

4.3.2.2.1 General. The Margarita Channel reinforced concrete stilling basin from Station M54+10 to M54+75 would provide the structural and hydraulic transition from upstream concrete U-frame channel to downstream trapezoidal earthen channel. A soil-founded, conventionally reinforced concrete monolith was the only alternative investigated. Steel sheet pile wing walls would be used to transition to the earthen channel. The soil properties used in the design of this stilling basin are based on soil boring CB-MC-52.

4.3.2.2.2 Bearing Capacity. Bearing capacity analyses were performed for the proposed stilling basin. Because the foundation would be clay (CH), the ultimate bearing capacity would vary with cohesion and be independent of base width and soil weight. A Q-test performed on the CH material from CB-MC-52 indicated a cohesive strength (C) of 1,300 psf. Therefore, the ultimate bearing capacity was estimated as 7,410 psf (P_{ult}=5.7C). A factor of safety (FS) of 3 was chosen to be consistent with recommendations in EM 1110-1-1905 (FS should not be less than 3

in consideration of the seismic zone). The allowable bearing capacity (P_{all}) therefore was estimated as 2470psf. This bearing capacity was provided to EN-DS for the structure dimension sizing.

4.3.2.2.3 Settlement. Settlement analysis was performed in accordance with EM 1110-1-1904. One consolidation test was performed on the CH material from CB-MC-52. The compression index (C_c) required for the settlement analysis was determined from the laboratory consolidation curves. C_c was estimated as approximately 0.064. Foundation pressure given by EN-DS was approximately 2,000 psf. Total settlement calculated was small (less than 3-inch) for a normally consolidated clay. However, the consolidation test indicated this clay was preconsolidated. If preconsolidation was factored into the analysis then the amount of settlement would be even less. Therefore, settlement would not be a problem for the stilling basin. See Appendix B-4 for details of the bearing capacity and settlement analyses.

4.3.2.2.4 Stone Protection. Stone protection would be required to line the earthen channel downstream of the stilling basin between Stations M51+00 and M54+10. The SPF average channel velocity in this area would be between 7.4 and 11 feet per second. Tables G-9 and G-10 show the recommended stone protection for this area.

Table G-9 - Stone Protection for Sta. 53+70 to 54+10

Protected Area	Thickness
Channel Bottom	Riprap = 60″ Bedding = 18″
Channel slopes	Riprap = 18″ Bedding = 12″

Riprap and bedding stone gradation requirements for the reach from Station M53+70 to M54+10 would be as follows:

Riprap Stone Weight in pounds 60″ Blanket	% by Weight Consisting of Lighter Stone
1,200	100
750	70-90
400	40-60
170	20-40
20	0-20

18″ Bedding Layer Bedding in U.S. Standard Sieve Opening in inches or Sieve Designation	Percent finer by Weight
6″	100
4″	75-90
2″	40-70
¾″	10-40
No.4	0-5

Riprap Stone Weight in pounds 18″ Blanket	% by Weight Consisting of Lighter Stone
20	100
11	70-90
8	50-70
3.5	15-40
1	0-15

12″ Bedding Layer Bedding in U.S. Standard Sieve Opening in inches or Sieve Designation	Percent finer by Weight
1″	100
¾″	55-85
3/8″	15-55
No.10	0-15

Table G-10 - Stone Protection for Sta. 51+50 to 53+70

Protected Area	Thickness
Channel Bottom	Riprap = 30″ Bedding = 12″
Channel slopes	Riprap = 18″ Bedding = 12″

Riprap and bedding stone gradation requirements for the reach from Station M51+50 to M53+70 would be as follows:

Riprap Stone Weight in pounds 30″ Blanket	% by Weight Consisting of Lighter Stone
70	100
50	70-90
30	45-65
13	20-40
6	0-20

12" Bedding Layer Bedding in U.S. Standard Sieve Opening in inches or Sieve Designation	Percent finer by Weight
2"	100
1 1/4"	60-85
3/8"	15-50
No.10	0-10

Stone protection for the sideslopes would have the same gradations as specified for Station M53+70 to M54+10. See Appendix B-5 for details of the stone protection design.

4.3.2.3 Margarita Concrete U-Frame Channel - Station M54+75 to M89+60.

4.3.2.3.1 General. The soil properties used in the design of this concrete U-frame channel were based on soil borings CB-MC-34, CB-MC-43, CB-MC-44, CB-MC-45, CB-MC-46 and CB-MC-47. See Appendix B-6 for details of these soil properties.

4.3.2.3.2 Slope Stability. The temporary excavation slope was analyzed using the computer program UTEXAS3. The soil strata used in the analysis were based primarily on boring CB-MC-43. Both short-term case (Q strength) and dewatering/sudden drawdown condition (minimum of the combined R and S envelopes) were analyzed. Table G-11 summarizes the results of the stability analysis for the temporary excavation slope in this reach.

Table G-11 - Results of slope stability analysis at Sta. 67+00

Load Condition	Factor of Safety
Short Term	1.520
Dewatering/Sudden Drawdown	1.146

For the short-term condition, a factor of safety of 1.520 was obtained, which is more than the 1.3 required for this condition. For the dewatering/sudden drawdown case, a minimum factor of safety of 1.0 is required, and 1.146 was obtained which is adequate.

4.3.2.3.3 Bearing Capacity. Bearing capacity analyses were performed for the proposed concrete U-frame channel extending from Station M54+75 to Station M89+60. Because the foundation would be clay (CH), the ultimate bearing capacity would vary with cohesion and be independent of base width and soil weight. The computer program CBEAR, *Bearing Capacity Analysis of Shallow Foundations*, was used to calculate bearing capacity. A two-layer soil system, softer clay overlying stiffer

clay, was modeled in each of the CBEAR analyses. Results of the CBEAR analyses are listed in Table G-12. A factor of safety of 3 was chosen consistent with recommendations in EM 1110-1-1905. The FS should not be less than 3 in consideration of the seismic zone. The calculated allowable bearing capacity (P_{all}), therefore is P_{ult} /3. The input and output of each CBEAR run is shown in Appendix B-7.

Table G-12 - CBEAR Bearing Capacity Analysis Results

STATION	CORE BORING	q_u (ksf)	q_a (ksf)	EXCAVATION BOTTOM
M55+00	CB-MC-34	7.71	2.57	EL. -20.43′
M67+00	CB-MC-43	3.02	1.01	EL. - 4.63′
M71+00	CB-MC-44	3.49	1.16	EL. - 2.75′
M77+00	CB-MC-45	2.95	0.98	EL. - 0.17′
M81+00	CB-MC-46	2.83	0.94	EL. + 1.19′
M89+00	CB-MC-47	6.48	2.16	EL. + 9.03′

Table G-12 was provided to EN-DS for sizing of the structural members.

4.3.2.3.4 Settlement. Settlement analysis was performed in accordance with EM 1110-1-1904. Two consolidation tests were performed on the undisturbed samples of soft CH materials from CB-MC-32 and CB-MC-44. Compression indices (C_c) required for the settlement analysis were determined from the laboratory consolidation curves. In addition, compression indices were developed using the empirical correlations of C_c with natural water contents and liquid limits. Table G-13 shows the values of C_c determined from both the empirical correlations and consolidation tests.

Table G-13 - C_c values

Boring	Elev. ft	N, bpf	Soil Type	W_n (%)	LL (%)	C_c=.012W_n	C_c=.01(LL-13)	C_c Lab
CB-MC-32	-5.9	2	OH	93	104	1.12	0.91	1.25
CB-MC-43	-1.4	1	CH	76	92	0.91	0.79	
	-10.4	7	CH	35	69	0.42	0.56	
CB-PNB-40	-11.1	3	CH	55	68	0.66	0.55	
CB-MC-44	-4.0	1	CH	37	99	0.44	0.86	0.18

C_c of 1.25 and C_c of 0.56 were selected as the typical compression indices for soft clays and medium clays, respectively. Due to the large dispersiveness of the C_c values from CB-MC-44, this set of data was discarded.

Settlement analyses were performed for the reach of concrete U-frame channel. The results of the analyses indicate that foundation displacement of approximately 19 inches would occur within the project life. See Appendix B-8 for details of the analyses. Overexcavating the soft soil at the subgrade level and

backfilling with gravel is recommended. The channel stations and their overexcavation limits are showed in Table G-14.

Table G-14 - Overexcavation limits

Channel Stationing	Excavation Invert (ft)	Overexcavation Elevation, ft
M56+50 to M59+00	-9.5	-11.0
M60+40 to M61+00	-7.7	-11.0
M61+00 to M62+00	-7.5	-10.0
M62+00 to M63+00	-6.9	-9.0
M63+00 to M64+00	-6.4	-8.0
M64+00 to M71+00	-4.4	-7.0
M71+00 to M72+00	-2.5	-6.0
M72+00 to M73+00	-2.1	-5.0
M73+00 to M74+00	-2.0	-4.0
M74+00 to M75+00	-1.7	-3.0

4.3.3 Puerto Nuevo Main Channel.

4.3.3.1 Retaining Wall - Station 88+33.2 to 147+40

4.3.3.1.1 General. The GDM report recommended a relieving platform wall as the most feasible wall design for this reach. The subsequent OVEST value engineering (VE) study recommended that a cantilevered and anchored sheet pile retaining wall be used, or that modifications to the relieving platform design be made to reduce construction and maintenance costs.

Several wall types were considered. See Section 6.7 for details of the alternatives investigated. The preferred wall alternative is a composite pipe pile/sheet pile wall. The recommended system consists of Arbed AZ18 (or equal) sheet piles and 42-inch diameter pipe piles. The wall thickness of the pipe piles would be 1.0 inch. The wall would also include a cast-in-place six-inch minimum concrete facing for corrosion protection.

Four stations were selected to represent the entire retaining wall reach based on boring locations and soil properties for these borings. These stations include 92+00, 98+00, 114+00, and 140+00. See Plates L-1 through L-14 and Plates G-1 through G-3 for boring locations and geologic profiles, respectively.

4.3.3.1.2 Lateral Load Analysis. Soil properties listed in Tables G-15, G-15.1, G-15.2, G-15.3, and G-15.4 were provided to EN-DS for lateral load analysis.

Table G-15 - Soil Shear Strength Parameters

Station	Core Boring	Pile Tip El, ft	Soil Layers El, ft	Q, c(psf) ϕ=0	S, ϕ(deg) c=0	80%R c(psf)	80%Rϕ (deg)
92+00	CB-PNB-7	-71	above -1,GC	1000	28	320	14
	Ground @ El.10		-1 to -8,OH	500	18	200	6
			-8 to -37,CH	1060	22	480	8
			-37 to -8,SP	0	33	0	27
			-58 to -76,CL	1630	28	800	10
98+00	CB-PNB-4	-70	above 6,GC	1260	30	300	14
	Ground @ El.24		6 to 0,CH	700	22	320	8
			0 to -12,CH	1060	22	500	7
			-12 to -23,CL	1500	28	350	12
			-23 to -36,CH	1260	26	800	11
			-36 to -47,CH	2000	26	1000	9
			-47 to -76, LS	3000	36	1000	15
114+00	CB-PNM-45	-59	above -6,CH	1000	27	320	13
	Ground @ El.10		-6 to -19,CL	550	26	200	15
			-19 to -33,CL	1600	28	350	12
			-33 to -40,SC	2000	32	500	19
			-40 to -53,LS	3500	38	800	23
			below -53,LS	4000	38	1000	23
140+50	CB-PNM-48	-59	above 4.5,CL	1600	28	350	12
	Ground @ El.9		4.5 to -4,CH	500	20	250	8
			-4 to -23,CL	1600	28	350	12
			-23 to -33,SC	1600	31	700	13
			-33 to -55,ML	1600	30	750	12
			below -55,LS	4000	38	1000	23

Table G-15.1 - LPILE Input for Station 92+00, Dredge Line @ El. -15.5′

Soil Layers El, ft	Q Case ϕ=0	S Case c=0	80%R Case
-15.5 to -37,CH	py 2	py 4	py 7
γ'=0.032pci	k=100pci	k=50pci	k=40pci
	ε_{50}=0.01	-	ε_{50}=0.01
-37 to -58,SP	py 4	py 4	py 7
γ'=0.036pci	k=50pci	k=50pci	k=40pci
	-	-	-
-58 to -76,CL	py 2	py 4	py 7
γ'=0.033pci	k=500pci	k=100pci	k=80pci
	ε_{50}=0.005	-	ε_{50}=0.005

Table G-15.2 - LPILE Input for Station 98+00, Dredge Line @ El. -15.0′

Soil Layers El, ft	Q Case ϕ=0	S Case c=0	80%R Case
-15 to -23,CL	py 2	py 4	py 7
γ'=0.030pci	k=100pci	k=50pci	k=40pci
	ε_{50}=0.01	-	ε_{50}=0.01
-23 to -36,CH	py 2	py 4	py 7
γ'=0.030pci	k=100pci	k=50pci	k=40pci
	ε_{50}=0.01	-	ε_{50}=0.01
-36 to -47,CH	py 2	py 4	py 7
γ'=0.033pci	k=400pci	k=60pci	k=48pci
	ε_{50}=0.005	-	ε_{50}=0.005
-47 to -76, LS	py 2	py 4	py 7
γ'=0.042pci	k=1000pci	k=100pci	k=80pci
	ε_{50}=0.005	-	ε_{50}=0.005

Table G-15.3 - LPILE Input for Station 114+00, Dredge Line @ El. -14.50'

Soil Layers El, ft	Q Case ϕ=0	S Case c=0	80%R Case
-14.5 to -33,CL	py 2	py 4	py 7
γ'=0.033pci	k=100pci	k=50pci	k=40pci
	ε_{50}=0.01	-	ε_{50}=0.01
-33 to -40,SC	py 2	py 4	py 7
γ'=0.039pci	k=400pci	k=50pci	k=40pci
	ε_{50}=0.01	-	ε_{50}=0.01
-40 to -57,LS	py 2	py 4	py 7
γ'=0.042pci	k=500pci	k=100pci	k=80pci
	ε_{50}=0.005	-	ε_{50}=0.005
Below -57, LS	py 2	py 4	py 7
γ'=0.042pci	k=1000pci	k=125pci	k=100pci
	ε_{50}=0.005	-	ε_{50}=0.005

Table G-15.4 - LPILE Input for Station 140+50, Dredge Line @ El. -13.0'

Soil Layers El, ft	Q Case ϕ=0	S Case c=0	80%R Case
-13 to -23,CL	py 2	py 4	py 7
γ'=0.032pci	k=100pci	k=50pci	k=40pci
	ε_{50}=0.01	-	ε_{50}=0.01
-23 to -33,SC	py 2	py 4	py 7
γ'=0.033pci	k=100pci	k=50pci	k=40pci
	ε_{50}=0.01	-	ε_{50}=0.01
-33 to -55,ML	py 2	py 4	py 7
γ'=0.042pci	k=400pci	k=100pci	k=80pci
	ε_{50}=0.005	-	ε_{50}=0.005
Below -55, LS	py 2	py 4	py 7
γ'=0.042pci	k=1000pci	k=125pci	k=100pci
	ε_{50}=0.005	-	ε_{50}=0.005

Note: The above soil parameters were selected using the suggested values from the LPILE User's Manual.

As previously discussed in Paragraph 4.3.2.1.3, reanalysis using PMT P-Y curves was not performed. After the completion of the lateral load testing, final P-Y curves will be selected, and the design presented in this report will be readjusted if necessary.

4.3.3.1.3 Pile Drivability. Using CB-PNB-62, SPT94 analyses were performed to provide side friction and end bearing for Wave Equation Analysis. GRLWEAP97 analyses were performed to evaluate drivability of the 42-inch pipe piles. Results of the GRLWP97 analyses indicated that an IHC 150 hydraulic hammer could successfully drive the 42-inch piles to their design tip elevations. See Appendix B-9 for details of the SPT94 analyses and GRLWP97 analyses.

4.3.3.1.4 Channel Bottom Protection. In 1998, INCA Engineering, Inc. (INCA) was retained by the Jacksonville District to complete a study of a channel bottom erosion prevention system for this project reach. INCA submitted the complete study report to the district in December 1998. One of the governing criteria for the channel bottom protection is that the smoothness of the channel must provide a Manning's coefficient equal to or less than 0.020. In addition, the system must be constructible under 15-20 feet of water. Initially, nine alternatives were generated. A precast (and prestressed) panel system was selected as the preferred alternative. Each panel would have a dimension of 10'x 30'x 8". Sixteen inches of tremie concrete would be placed under the panels to provide a firm bearing surface. Each panel would have two, 6-inch diameter drain holes to relieve uplift pressures. To meet the Manning's coefficient criterion, guide beams would be used to lower the panels to their designated locations. The top of the panel elevation would be adjusted by rotating the panel pipe posts. See the INCA report for a more detailed discussion.

4.3.3.1.5 Additional Investigations. An A/E will be retained by the Government to perform an alternative study. A DDR and plans and specifications will be prepared by the A/E.

4.3.3.2 De Diego Expressway Over the Main Channel Bridge Modification.

4.3.3.2.1 Pile Axial Capacity Analysis. Deepening of the channel would remove approximately 12.6 feet (Elevation -3 feet (NGVD) to Elevation -15.6 feet (NGVD)) of supporting soil surrounding the existing bridge piles. SPT94 was used to verify the post-excavation capacity of these piles. The piles are 36-inch OD and 26-inch ID concrete pipe piles. The exact pile lengths of these piles are unknown. Based on the old construction drawing, the east bent and west bent piles are approximately 68 feet and 76 feet long, respectively.

Considering the bridge deck is at Elevation +18.4 feet (NGVD) and the current ground surface is at Elevation -3.0 feet (NGVD), the embedment lengths are 46.6 and 54.6 feet, respectively. Two sets of SPT94 analyses were performed using two borings (CB-PNB-5&5D and CB-PNB-7&7D) with ground elevation at -3 feet (NGVD)(before-excavation) and then at -15.6 feet (NGVD)(post-excavation). The results of these analyses are summarized in Tables G-15 and G-16.

TABLE G-16 - SUMMARY OF CAPACITIES - BORING CB-PNB-5&5D

Tip El. (ft)	Friction (tons)	Bearing (tons)	Davisson (tons)	Allowable (tons)	FS^1 Max	FS^2 Ave
Prior to Excavation Ground @ -3.0′						
-46.0	272.7	99.6	360.6	180.3	1.80	2.64
-54.0	338.6	218.3	543.2	271.6	2.80	3.98
Post-Excavation Ground @ -15.6′						
-46.0	200.9	99.6	288.7	144.4	1.50	2.11
-54.0	266.8	218.2	445.7	271.6	2.30	3.27

TABLE G-17 - SUMMARY OF CAPACITIES - BORING CB-PNB-7&7D

Tip El. (ft)	Friction (tons)	Bearing (tons)	Davisson (tons)	Allowable (tons)	FS^1 Max	FS^2 Ave
Prior to Excavation Ground @ -3.0′						
-46.0	213.8	102.7	304.8	152.4	1.56	2.23
-54.0	256.1	104.8	347.2	173.6	1.78	2.54
Post-Excavation Ground @ -15.6′						
-46.0	156.5	99.0	243.8	121.9	1.25	1.79
-54.0	197.4	102.0	285.8	142.9	1.46	2.09

Notes: 1) FS^1 = Davisson x 2 /390kips, where 390 kips is the maximum design pile load for HS20 loading.
2) FS^2 = Davisson x 2 /272.9kips, where 272.9 kips is the average design pile load for HS20 loading.

The old construction drawings show that the allowable (design) pile load is 160 tons, which agrees well with the above pre-excavation allowable capacities (180.3 and 152.4 tons). The excavation of the channel would not cause axial failure of the pile foundation. Nevertheless, the FS is reduced to values below 2.0, which warrants additional retrofitting designs. In addition, during design PRHTA requested the bridge be upgraded to handle HS30 and seismic loading. This would require substructure retrofitting anyway.

4.3.3.2.2 Pile Lateral Capacity Analysis.

a. Initially, FDOT program FLPIER was used in the pile lateral load analysis for the HS20 loading. Core borings

CB-PNB-5 and CB-PNB-5D were used for the analyses. Soil parameters used for O'Neill's p-y curves are shown in Appendix B-10. P-y multipliers were equal to 1.0 (no multipliers) and the prestressed concrete was considered to be linear (no cracking). These parameters are based on (1) the piles acting as a single row, hence no multipliers, and (2) keeping the deformation below 1-inch, hence no cracking. Four sets of post-excavation conditions were analyzed: (1) as-built conditions for the eight piles, (2) two additional "outrigger" piles for a total of ten piles, (3) ten piles plus a spread footing at post-excavation grade tying together all ten piles for increased rigidity, and (4) eight piles plus a spread footing at post-excavation grade. The results of the FLPIER analyses are shown in Table G-18.

TABLE G-18 - SUMMARY OF FLPIER ANALYSIS RESULTS

Condition	Deformation X Direction	Deformation Y Direction	Deformation Z Direction	Pile Max. Moment, ft-k
as built	3.90"	0.64"	0.08"	349.2
10 piles	2.10"	0.32"	0.08"	276.7
10 piles&ftn	0.34"	0.39"	0.07"	125.0
8 piles&ftn	0.41"	0.41"	0.08"	125.0

Note: Maximum moment is at various depths within the pile.
$M_{cracking}$ = 175 ft-kips

FLPIER analyses suggest that lateral loading of the post-excavation pile group would cause serious deformations (3.9 inches) and excessive bending moments (349.2 ft-kips). Accordingly, a stiffening shallow spread footing connecting the piles at the post-excavation elevation was recommended. The geotechnical recommendation was to avoid using "outrigger" piles, and rely on placing a stiffening shallow footing to provide the lost skin friction as well as the lateral load resistance. CBEAR analyses were performed to size a spread footing to compensate for the skin friction loss. The results of the CBEAR analyses suggest that a 69-foot by 6-foot footing would be more than adequate. The FLPIER and CBEAR results are shown in Appendix B-11.

b. Later in the design phase, PRHTA requested that the bridge be upgraded to handle both HS30 and seismic loads. The recommended fix of using a shallow spread footing connecting the existing piles would not work for this retrofit. Additional piles were determined to be necessary. The type of piling to be used is governed by (1) limited headroom under the bridge and (2) limited vibration impact on the existing bridge. A drilled shaft alternative was considered more favorable for working in such

conditions rather than the displacement pile method. The following information was provided to EN-DS for structural analyses.

Top of Rock Elevations:

CB-PNB-5	-68.2′
CB-PNB-6	-78.7′
CB-PNB-7	-81.8′
Channel	-65′

Lateral Group Effects: As a rule of thumb, if piles are spaced within three times the equivalent pile diameter, their stress fields would interact causing increases in pile deflection, moments, and settlement. For group effect analysis, the following procedures were used.

1. $Y_g = C_y * Y_s$ where Y_g is the group pile displacement, C_y is the displacement amplification factor and Y_s is the single pile displacement (from COM624).

2. $M_g = C_m * M_s$ where M_g is the group moment, C_m is the moment amplification factor, and M_s is the single pile moment (from COM624).

C_y of 3.28 to 3.57 and C_m of 1.38 to 1.39 were provided to EN-DS for all four boring locations. In addition, other soil properties were provided to EN-DS for a lateral load soil-structure interaction analysis (COM624). They are shown in Appendix B-6.

4.3.3.2.3 Recommended Retrofit. The new piles (seven per bent) would be added at the midpoint between all existing pilings (Reference Plate S-53). The new 30-inch drilled shafts would be placed on top of the rock at approximately Elevation -65 feet (NGVD).

4.3.3.2.4. Soil Nailed Wall. Due to the limited headroom beneath the existing bridge, a soil nailing system was selected to retain excavation slopes to facilitate the channel wall construction. The system would consist of a reinforced shotcrete facing constructed incrementally from the top down and an array of reinforcing members (soil nails) grouted into the soil mass. A cast-in-place concrete facing would be subsequently constructed in front of the shotcrete facing. Soil properties from boring CB-PNB-7 were input into the SNAIL computer program (Version 2.11 from California Department of Transportation) for the soil nailing wall design. Several SNAIL analyses were performed. An earthquake acceleration coefficient of 0.15 was considered in the analyses. See Appendix B-12 for details of the

SNAIL analyses. Plate S-26 shows the final design wall section and details.

4.3.3.2.5 Additional Investigations. INCA will be retained by the Government to evaluate the proposed design. In addition, INCA will investigate other retrofit alternatives. A DDR and plans and specifications will be prepared by INCA for the De Diego Expressway Bridge Modification.

4.3.4 Margarita and Puerto Nuevo Siphons. New siphons are to be constructed at Station M66+29 of Margarita Channel and at Station 99+04 of the Puerto Nuevo main channel. The structures are 14'x21' and 16'x21', respectively. The design boundary conditions of these two structures are summarized in Table G-19. Both shallow and deep foundation alternatives were considered. See Appendix B-13 for details of the foundation analysis.

Table G-19 - Design Boundary Conditions

Site	Size, ft	Unfactored Design Load, Tons	Applied Stress, TSF	Invert El.[a] Ft
Margarita	14x21	300	1.02	-5.3
Puerto Nuevo	16x21	336	1.00	-6.4

Note: Invert El.[a] includes foundation slab (2.5 feet thick)

4.3.4.1 Margarita Siphon. Soil borings CB-MC-43 and CB-MC-44 were used for the Margarita siphon design. Soil properties for the settlement analysis are listed in Table G-20.

Table G-20 - Settlement Parameters (Margarita Siphon)

Elevation, Ft	Soil Type	N_{avg}, blow/ft	Cohesion C,TSF	Modulus E_s, Ksf
+10 to -1.4	Fill	5		
-1.4 to -17.9	Soft CH	8.8	C_c=0.183 C_r=0.057 P_c=1 tsf e_0=1.076	
-17.9 to -22.4	SC	11.5		E_s(kPa)=250(N+15)= 132.5
-22.4 to -32.9	CH	16.8	0.06N=1.008	E_s=300C=600
-32.9 to -37.4	Stiff CH	50.0	0.06N=3	E_s=400C=2400

Settlement analysis indicated approximately three inches of settlement at this site. A scenario of overexcavating five feet of the soft soil and backfilling with gravel was evaluated. Using this scenario, the calculated settlement was reduced to 1.5 inches.

The computer program SPT94 was used for the deep foundation analysis. The design considered a six-pile layout; hence, each pile would have a design load of approximately 50 tons. Results of the SPT94 analyses are summarized in Table G-21.

Table G-21 - Pile Analyses - Margarita Siphon

Pile Type[1]	Pile Tip, ft	Pile Length ft	Cost
14"x14" Prestressed Concrete	-19.4	14.1	-
14x73 H pile[2]	-29.4	24.1	$3,694+ installation
12x53 H pile[2]	-33.4	28.1	$3,127+ installation
10" round Concrete[3]	-33.4	28.1	$2,866
12" round Concrete[4]	-25.4	20.1	$2,291

Notes:
1. Mr. Eduardo Bonar of Fuentes Pile, San Juan (787)785-9065, suggested the above pile sizes and prices.
2. HP 14x73 and HP 12x53 are approximately $0.35/lb (HP 14x73 = 73lb/ft x 24.1ft x 6 piles x $0.35/lb = $3,694 + installation)
3. 10" round concrete pile = $17/ft installed.
4. 12" round concrete pile = $19/ft installed.

From this cost estimate, the 12-inch round concrete piles are the most economical. The 12-inch round concrete piles are manufactured in lengths of 10, 15, 20, and 25 feet.

4.3.4.2 Puerto Nuevo Siphon. The unfactored design load of the Puerto Nuevo siphon structure was approximately 336 tons. Two pile groups were considered - six piles and eight piles. The design loads per pile for the six- and eight-pile groups are 56 tons and 42 tons, respectively. Since the 10-inch and 12-inch round concrete piles were the more economical pile types based on the results shown in Table G-21, SPT94 analyses were performed considering both pile sizes. Soil borings CB-PNM-44 and CB-PNM-44D were used in the analyses. The SPT94 results are listed in Table G-22.

Table G-22 - Pile Analyses - Puerto Nuevo Siphon

Pile Type	Pile Group	Pile Length	Cost
10" round	6 piles	50'	$ 5,100
12" round	6 piles	45'	$ 5,130
10" round	8 piles	45'	$ 6,120
12" round	8 piles	45'	$ 6,840

From these analyses, a six-pile group of 12-inch round concrete piles is recommended. Drivability analyses (GRLWP97) were performed for the 12-inch round concrete pile using a KOBE 25 hammer. The analyses showed that an ultimate capacity of approximately 300 kips could be achieved successfully without problems. A driving length of 65 feet was assumed based upon a construction scenario of first driving the pile, then excavating to the invert and subsequently cutting off the piles.

5. UTILITIES

5.1 Electrical.

5.1.1 Introduction. The proposed channelization would impact many electrical transmission and distribution lines including telephone and cable television lines. Electrical utility crossings over the channels and utility spans parallel to the channel would require relocation. These crossings are graphically depicted on Plates E-1 through E-5. Utilities supported on Roosevelt Bridge would be replaced. Refer to Volume 3 of this report for detail design information on the Roosevelt Avenue Bridge replacement.

This design memorandum addresses electrical, telephone, and cable TV utilities in conflict with the proposed channel. Power outages would require scheduling through the Contracting Officer approved by the Puerto Rico Electric Power Authority (PREPA). Electrical system materials indicated to be removed would require disposal by the contractor unless otherwise indicated. Contractor to perform electrical work would require PREPA approval. Final construction plans would require approval by PREPA in accordance with PREPA standards and regulations.

Utility POCs:

Puerto Rico Electric Power Authority (PREPA)
Tomas E. Veles (787) 289-3060
Puerto Rico Telephone Company (PRTC)
Luis M. Hernandez (787) 749-3116
Pedro M. Santiago (787) 749-2219
Cable TV of Greater San Juan (CATV)
Jorge Ilarraza (787) 766-0909
Agustin Garcia (787) 766-0909
Fideicomso de Parques Nacionales de Puerto Rico
Lillian Rivera (787) 763-0568

5.1.2 Crossings at Margarita Channel Station M75+00. Power poles in this area are a combination of wooden poles and concrete. All new construction in this area would be based on the use of concrete poles.

5.1.2.1. Relocation of the 38 kV transmission line paralleling the Margarita channel around tower no. 115; traversing poles numbers PP-56(conc), PP-118(conc), PP-116(wood), and PP-113(wood); would require relocation. The proposed relocation is to the north side of the channel as depicted in Plate E-2. The crossing from pole PP-56 to pole PP-118 would be maintained to provide power to a service drop located on pole PP-118 at Station M76+00.

5.1.2.2. Relocation of the 13.2 kV distribution line paralleling the Margarita channel around electrical tower no. 115, via pole no PP-116, would require relocation to the north side of the channel as depicted in Plate E-2.

5.1.3 Municipal Area Lighting, Margarita Station M65+00. Relocation of two lighting fixtures as shown on Plate E-3, LP-79 and LP-80, and associated circuits and conduits would be required. The lighting fixtures are cobra head type lighting fixtures mounted on twenty-five foot wooden poles. The lighting fixtures, located at Station M65+00, are maintained by Fideicomso de Parques Nacionales de Puerto Rico.

5.1.4 Abandoned Lighting Fixtures, Margarita Station M55+00. Lighting fixtures mounted on wood poles north of the De Diego Expressway as shown on Plate E-3 would require removal and disposal. The four abandoned poles of concern are poles: PP-182, PP-183, PP-186, and PP-187.

5.1.5 Residential Services, Calle 25 NE. Power and telephone lines serving residential buildings along Calle 25 NE from Calle 10 NE north to Calle 18 NE as shown on Plates E-4 and E-5 would require demolition. Approximately 24 buildings along this section of the Puerto Nuevo Channel from Station 100+00 to Station 110+00 have been identified for demolition. Removal would require the demolition of feeders, services, meters, transformers, poles, conduits, etc. as necessary. Utility equipment and hardware disposal would require clearance through respective utility company before disposal. This demolition would involve partial removal of street lighting circuits and concrete lighting poles.

5.1.6 38 kV Transmission Line, Calle 25 NE. Wooden poles (45 foot) that previously supported a 38 kV transmission along the Puerto Nuevo Channel from Station 100+00 to Station 110+00 would require removal. Material and equipment disposal would require clearance through PREPA. The line is currently out of service and will be relocated to the west of the proposed channel alignment as shown on Plates E-4 and E-5.

5.1.7 Crossing at Rio Puerto Nuevo Station 102+00. The 4 kV distribution line crossing the channel at Station 102+00 would require removal. The 4 kV line feeds residential services which would be demolished as outlined in paragraph 5.1.5. The crossing includes a wooden pole supporting a single transformer.

5.1.8 Crossing at Rio Puerto Nuevo Station 110+00. A 4 kV distribution line crossing the channel at Station 110+00 would require relocation. The 4 kV distribution line runs along the west side of the channel supported on wooden (45 foot) poles from Station 115+00 to Station 110+00 which would require relocation

farther to the west. After making the crossing, the line runs along the east of the channel from the crossing at Station 110+00 north to Station 100+00 which would require relocation farther to the east. The two sections of the line running parallel to the channel share wooden poles supporting 38 kV transmission lines. The 38 kV line to the west is described in paragraph 5.1.6. The lines are shown on Plates E-4 and E-5.

5.1.9 Crossing at Rio Puerto Nuevo Station 114+00. A 38 kV transmission line crossing the channel at Station 114+00 would require relocation. The 38 kV line runs from the crossing north along the east side of the channel up to Station 110+00 at which point a 4 kV distribution line begins sharing the supporting poles as described in paragraph 5.1.8. This 38 kV line would require relocation farther east of the channel. The crossing is from a concrete pole on the west side to a wooden pole to the east side. A second 38 kV transmission line begins at this crossing running along the west side of the channel. This second 38 kV line, as described in paragraph 5.1.6, shares wooden poles with a 4 kV distribution line, as described in paragraph 5.1.8. This second line would require relocation farther to the west. These lines are shown on Plates E-4 and E-5.

5.1.10 Crossings at Roosevelt Avenue Bridge, Station 120+00. Refer to Volume 3 of this report for detailed design information on utility crossings and required relocations at the Roosevelt Avenue Bridge.

5.1.11 Crossing at Rio Puerto Nuevo Station 131+00. A 13.2 kV distribution line crossing the channel at Station 131+00 would require relocation. The relocation would involve the relocation of three wooden (45 foot) poles to the south of the channel as the line runs parallel to the channel before making the crossing to the north. The three poles would require relocation farther to the south as depicted in Plate E-6.

5.1.12 Area Lighting Fixtures, Parque Luis Muñoz Marin. Approximately thirty-eight lighting fixtures shown on Plates E-6 and E-7 along the park path north of the Puerto Nuevo Channel from Station 133+00 south to Station 150+00 would require relocation. The fixtures are of the global or spherical type mounted on steel (10 foot) poles. The fixtures are fed underground from a single pole-mounted transformer at Station 145+00 as described in paragraph 5.1.13.

5.1.13 Municipal Crossing at Rio Puerto Nuevo Station 145+00. An underground 13.2 kV circuit makes transition to an aerial line to cross the channel. The crossing would require relocation of the riser on the north side of the channel and elevating the pole on the south side of the channel. The riser on the north side serves an underground circuit providing power

to area lighting fixtures. Both poles are wooden (40 foot) poles. The line is maintained by Fideicomso de Parques Nacionales de Puerto Rico.

5.2 Water and Sewer.

5.2.1 Introduction. The Rio Puerto Nuevo project channelizes waterways in a highly urbanized area in the Commonwealth. Many utilities would be affected. Major water and sewer crossings impacted by the Channelization are presented in Table ME-1. These crossings are graphically depicted upon Plates ME-1 through ME-10. These crossings are discussed in sections 5.2.2 through 5.2.7. Conflicts are discussed in order of .appearance as one travels up the Puerto Nuevo Channel.

In order to provide optimal utility relocation in a complex urban environment such as San Juan, coordination with the local water and sewer companies is demanded. This provides for relocation that is done in a manner that is acceptable for the local sponsor. The local sponsor can plan their improvements coherently with the project. This has been on-going for the Puerto Nuevo project. To this end, a meeting was held between the Puerto Rican Aqueduct and Sewer Authority (PRASA) and Corps of Engineers personnel on February 27, 1996. The purpose of the meeting was two fold:

1) to respond to AAA's comments and discuss design features from previous coordination and

2) to obtain a consensus from PRASA and DNR personnel on both the desired and economical methods for relocation.

The consensus of this meeting is reflected in the discussions of the various solutions to relocation for the crossings.

Table ME-1 Major Utility Crossings Impacted by Contract 2

a. 36-inch Puerto Nuevo Trunk Sewer crossing under Puerto Nuevo channel. (Plates ME-2, ME-3, & ME-4)

b. Street water and sewer lines of 10 houses in vicinity of Calle 10 NE (south), Calle 25 NE (east boundary), and Calle 14 on the North. (Plates ME-5 & ME-6)

c. 48-inch Water Line in the vicinity of Calle 10 & Calle 25 NE. (Plate ME-7)

d. 10-inch & 30-inch water lines crossing south of Roosevelt Bridge. (Refer to Volume 3 of this report.)

e. 36-inch Sewer crossing under Margarita Channel. (Plate ME-8 & ME-9)

5.2.2 First Conflict: Relocation of 30" Puerto Nuevo Sewer line by Nemesio Canales and Storm water Pump station

a. Description of the problem see plate ME-2, This conflict comprises a 30 " reinforced concrete sewer that collects sewage from the Puerto Nuevo Norte Community and crosses the Puerto Nuevo Channel at approximate station 100+ 50. It continues as a 36 " Puerto Nuevo Interceptor Sewer and discharges into the 90" San Jose Trunk Sewer. The sewer was constructed in 1958 as siphon crossing of the Puerto Nuevo Channel . It comprises two barrels of reinforced concrete pipe. It has a rated capacity of 9.54 MGD. Based upon both barrels flowing full. The upstream sewer to the siphon is a 30 inch sewer laid at a slope of .0016. I t has design capacity of 10.7 MGD.

Significant construction has occurred since the sewer was installed. A storm water pump station and outlet structure was built which has changed the topography of the area substantially. The inlet and outlet structure for the siphon are buried in the process. A field survey was taken in February to locate structures and correlate survey data with as-built data. The existing siphon structures were not located however the upstream and down stream manhole structures were located . The siphon route and elevations were plotted on the design drawings based upon the 1958 Construction Drawings.
During the site visit, the 30 inch sewer's flow depth was measured during peak morning flows. Based upon an operating depth of 25 " and slope flow was calculated as 10.6 MGD. Note: the capacity of a gravity sewer flowing at 83-94 % depth exceeds the capacity of the same sewer flowing full.

b. Evaluation of Alternatives and Proposed Relocation table ME-1 Base upon cost and PRASA operations requirements, replacement of the existing siphon with a siphon of similar capacity is the proposed relocation plan. This plan was corroborated with PRASA personnel on February 27 1996 and is the recommended plan. Siphons can be constructed of several materials. Historically, they have be constructed of reinforced concrete or ductile iron pipe encased in concrete. The reinforced concrete encasement is required to prevent joint leakage of sewage contamination of the water. This increases the weight of the crossing and requires support piles. This construction is expensive requiring driven pile foundation and cofferdam

construction. Within the last 10 years, this type of construction has be replaced with high density polyethylene plastic pipe. The joints are thermoplastically welded and provide protection against leakage. They are flexible and can be stretched within joint failure. Therefore concrete encasement is not required . The weight is substantially reduced and pile and coffer dam construction is not required. Therefore, this is the chosen construction for siphons. The presence of so many structures and underground utilities in a constrained site demand the use of a very flexible pipe to be used for the relocation. The siphon would be relocated as shown in Plate ME-3 . It would comprise two barrels diameters of 24 OD and 18 OD ".and 400 feet long. The crossing would entail an inlet and outlet structures and diversion manholes. The siphon barrels would be laid 6 feet below the channel. Diversion structures/manholes would be constructed upstream of the existing siphon and sewage diverted north to the new siphon.
Besides the siphon construction, there is a small pump station that collects flow from the Nemesio Canales Urbanization, the 8 inch forcemain discharges to the Puerto Nuevo Trunk sewer. This line would require relocation and rerouting to the Puerto Nuevo Trunk sewer. A 12 inch sewer in the vicinity would be impacted by the relocation would require relocation and rerouting into the Puerto Nuevo Trunk sewer.

c. Design and Evaluation for Relocation see Plate ME-4:

The relocation was analyzed hydraulically (using the Hazen-Williams) equation to calculate headloss requirements for full pipe flow. The pipe friction losses and existing structure invert elevations were used to set final siphon elevations. The analysis used a very conservative friction coefficient of 140 for the HDPE pipe barrels. The barrels were sized for 24 inch SDR 26 (22.154 " ID) and a 18 inch SDR 26 (16.616 " ID). This provides a capacity of 14.47 MGD with flushing velocities above 3 feet per second. The results are tabulated in table ME-2

d. Construction Sequence

1.) Excavate the channel to within limits of existing crossing. excavate the pipe trench as needed.

2.) Set up staging area for pipe connections and assembly

3) Relocate 8 " forcemain and tap to existing Puerto Nuevo sewer as indicated (Plate ME-3).

4.) Drive piles new structures and diversion structures. Drive piles to bottom elevation of 21.29 for siphon barrels to set on this.

5.) Construct Influent and Effluent Siphon Structures

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6.) Heat fuse lengths of piping and pressure test .

7) Construct by-pass manhole over Puerto Nuevo Trunk sewer and install plugs in manhole for final connection. Perform incidental demolition.

8.) Assemble HDPE pipe for launch and attach concrete sleepers Provide protective wraps around the pipe. Jet pipe under existing manhole "A"

9.) Cold bend pipe to required radii for installation.

10.) Perform sub-aqueous inspection. Sled channel bottom as required to main 6 foot depth below proposed invert.

11.) Launch 40 foot segments of pipe sink into place and perform bottom inspection.

12.) Connect piping to influent and effluent structures and plug.

13.) Perform hydrostatic test.

14.) Construct diversion manhole ahead of existing siphon on top of 30 " RCP influent line.

15.) Construct diversion manhole and construct sewer from existing effluent siphon to new siphon.

16.) Perform sewage bypass to new siphon. Plug diversion manholes so sewage will not flow to existing structures.

17.) Demolish existing siphon and barrels .

18.) Demolish and remove manhole "A" from the channel. Plug all connections to the existing Puerto Nuevo Sewer.

5.2.3 Second Conflict: Street Sewer and Water Lines in vicinity of Calle 10 and 25 NE

a. Description of the problem see plate ME-5 & ME-6 . The hydraulic path of the Puerto Nuevo channel at Station 102+ 00 would require the demolition of approximately 16 houses on the East side of Calle 25 NE. The installation of the sheet pile wall and driving of the soil anchors would disrupt the water and sewer utilities to the untouched houses on the west side of Calle 25 NE in the Puerto Nuevo Norte neighborhood.. This would disrupt approximately 650 feet of street sewer and water line. The water line can be easily relocated however the 12 inch

street sewer is reinforced concrete and would require replumbing to collect sewage from the impacted houses and convey it to the sewage system.

b. Proposed Relocation (see plate ME-6 & ME-7) This relocation is straightforward. The existing ground elevation is 10.00 (+/-) and the invert of the nearest sewer (manhole SMH-227) is 6.025 The design would use 12 inch PVC sewer sloped from this grade to the manhole. This would require a tapping existing manhole 228 at elevation 6.41 and diverting the sewer to Manhole SMH-228A then re-laying the sewer above the soil anchors. To new manhole SMH 227A. New manhole SMH 227A would be juxtaposed against existing manhole SMH 227 . The sewer would terminate at elevation 6.025 at manhole 227. Flow can then be diverted to SMH 227 by removal of the adjoining wall installation of a tap . Existing manholes 227 and 228 would require that the tops be raised to elevation 10.00 by installing riser rings to prevent storm inflow into these manholes. Residences 270, 272,274,276,278, and 300 would be reconnected to this new sewer. The sewer installation would require coordination with the house demolition of structure s in the way and channel wall construction. Some sewage by-pass pumping from manhole SMH- 228 to SMH 227 would be required until final connections are made. The connections to the demolished houses would require demolition, rerouting and /or plugging.
The water relocation would be conducted similarly. The design would use 2 inch PVC schedule 40 water pipe. It would be mounted on the channel wall above sewer pipe to prevent any chance (whatsoever) of cross connection. Some temporary connections to maintain water service would be required during house demolition. This work would require careful coordination with channel excavation and sheet pile wall construction.

c. Construction Sequence

(1.) Condemnation of houses 267-315. termination of water and sewer connections from these houses to the street. Blanking off of lines at the channel excavation limits.
(2.) By pass of street water line around channel limits.
(3.) Installation of a small solids pump in manhole SMH-228 for sewage by-pass to SMH-227.
(4.) Installation of a temporary sewer from houses 1001 to 300 (7 houses) to provide service while sheet pile wall is being driven.
(5.) Installation of sheet pile wall and soil anchors
(6.) Construction of new SMH 227A and SMH-228A, laying of new sewer and connection to SMH-227.
(7.) Final Connection of houses 1001-300 to the new sewer.
(8.) Installation of new water line above new sewer.
(9.) Connection of houses to the new water line.

(10.) Excavation of channel and channel construction on the east side of the driven sheet pile wall.
(11.) Raising of manhole tops of 227 and 228.

5.2.4 Third Conflict 48 " Water line North of Roosevelt Ave Bridge.

a. Description of the problem see plate ME-7. This conflict occurs at station 109+50 The third conflict is a 48 inch ductile iron water line that crosses the channel. The driving of the pipe pile wall would destroy the line. This would require installation 6 feet below the channel bottom to meet DNR and Corps engineering regulations. Top of pipe would be situated at elevation - 21.75.

b. Evaluation of Alternatives and Proposed Relocation (see table ME-3)

The line can be replaced with a variety of pipes. This includes ductile iron, concrete, or a variety of plastic. The depth of installation (-21.75) would require an excavation of 35 feet and extensive dewatering to ensure proper jointing of the ductile iron or concrete pipe.
A cost effective alternative to this would be the installation of thermofused High Density Polyethylene Pipe. The pipe is flexible and sufficiently light that it could be floated in place and placed in a wet environment by divers. In San Juan the water system is operated at lower pressures as there are no hills. Operating pressure is below 100 psi.

c. Design and Evaluation for Relocation Plate ME-8.
A Design pressure of 128 psi was used for the relocation to provide some safety factor for surges. A higher design pressure also has the advantage of increasing the service life proportionately. The use of surge arrestors would be evaluated at the design , plans and specifications stage. The plastic pipe is much more resilient than rigid ductile iron pipe therefore sudden valve closures do not create a 100 + psi pressure increase that would typically rupture these pipe materials. Moreover, the pipes are designed with a safety factor of 2.5 over rated SDR pressure to accommodate transient pressure surges.
48 inch high density polyethylene pipe is not available for higher pressures such as 128 psi. The largest pipe which can meet 128 psi requirements is 36 inch SDR 13.5 pipe (30.666 " I.D.) . It would require 3 pipes of this diameter to match the hydraulic capability of a single 48 inch ductile iron pipe. The multiple barrels provide redundancy in that a single barrel can be out of service yet 66 % capacity would be maintained.
There is an institutional reluctance of AAA to accept plastic pipe that merits discussion. This is due to some catastrophic problems that occurred with another plastic pipe material :

polybutylene. These problems occurred not only in Puerto Rico but all over the U.S. High Density Polyethylene is very different from polybutylene and sustains the same track record as polyvinyl chloride (PVC). It has been used in high pressure applications and underground for more than 3 decades in petroleum and other industrial applications.

d. Construction Sequence

1.) Excavate the channel to within limits of existing crossing. excavate the pipe trench as needed.

2.) Set up staging area for pipe connections and assembly

3.) Drive piles for new structures. Drive piles to bottom elevation of 21.29 5.) Construct Valve box Structures.

4.) Heat fuse lengths of piping and pressure test .

5.) Construct by-pass tap and gate valve for final connection. Perform incidental demolition.

6.) Assemble HDPE pipe for launch and attach concrete sleepers Provide protective wraps around the pipe.

7.) Cold bend pipe to required radii for installation.

8.) Perform sub-aqueous inspection. Sled channel bottom as required to main 6 foot depth below proposed invert.

9.) Launch 40 foot segments of pipe sink into place and perform bottom inspection.

10.) Connect piping to new structures..

11.) Perform hydrostatic test.

12.) Perform bypass to new HDPE pipes.

5.2.5 Fourth Conflict : 10 and 30 " Water line South of Roosevelt bridge: This occurs at river channel station 119+00. This relocation is addressed in Volume 3 of this report, *Roosevelt Avenue Bridge Replacement*.

5.2.6: Fifth Conflict 36 " Crossing under Margaret Channel

a. Description of the problem see plate ME-8. This occurs at Margaret river channel station M76+00. The fifth conflict entails a 36 " crossing at Margarita Creek. It is located at station M64+80. The existing sewer is encased in

concrete and laid across the creek approximately 6" under the water level. The pipe is laid under the De Diego Expressway. It discharges to a manhole in front of a car dealership approximately. 900 feet away (Kennedy Ave.) From the hydraulic analysis, the 36 " pipe has a capacity of 23 MGD. The crossing is in a very constricted area . It is located in a parking lot behind Unesoc Corporation, a concrete storm drainage channel, Margaret Canal, and De Diego Expressway.

Requests have been made to PRASA Operations department for flow monitoring information but without any success. For this reason, we have used field observations on February 29 to estimate current capacity. These field observations indicated a 2 foot depth in the manhole. Based upon the length of the pipe, conservative judgments on friction losses, average daily flow was estimated to be 15.1 MGD. Low flows are estimated to be approximately 6 MGD.

b. Evaluation of Alternatives and Proposed Relocation : The very constricted work place demands the use of very flexible pipe. The low head loss requirements demand a very hydraulically efficient pipe. This requires use of HDPE pipe.

c. Design and Evaluation for Relocation , table ME-4, Plate ME-8, Plate ME-9. The siphon would be relocated as shown in Plate ME-3 . It would comprise two barrels diameters of 26 inch OD (SDR 19) 125 feet long. The crossing would entail an inlet and outlet structures and diversion manholes. The siphon barrels would be laid 6 feet below the channel. Diversion structures/manholes would be constructed upstream of the existing siphon and sewage diverted north to the new siphon

d. Construction Sequence :

1.) Excavate the channel to within limits of existing crossing. excavate the pipe trench as needed. Drive piles for wall in siphon barrels path and terminate at elevation (6 feet below channel invert)

2.) Set up staging area for pipe connections and assembly.

3.) Construct Diversion Manholes . Construct by-pass manhole over sewer and install plugs in manhole for final connection. Perform incidental demolition.

4.) Construct Influent and Effluent Siphon Structures.
5.) Heat fuse lengths of piping and pressure test .
6.) Assemble HDPE pipe for launch and attach concrete sleepers Provide protective wraps around the pipe.
7.) **Cold bend pipe to required radii for installation.**

8.) Perform sub-aqueous inspection. Sled channel bottom as required to main 6 foot depth below proposed invert.
9.) Launch 40 foot segments of pipe sink into place and perform bottom inspection.
10.) Connect piping to influent and effluent structures and plug.
11.) Perform hydrostatic test.
12.) Construct sewer from new effluent siphon to diversion manhole
13.) Construct sewer from new influent siphon to diversion manhole.
15.) Perform sewage bypass to new siphon. Plug diversion manholes so sewage will not flow to existing structures.
16.) Demolish existing sewer crossing. .

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Outstanding Items to check for field survey.

1. Check diameter of influent pipe in manhole ahead of PN siphon.

2.. Size of water line for Calle 25 NE and
3. depth of flow in the 12 " sewer for Calle 25

4. Elevation of concrete encasement for Margarita siphon.

5. Pressure rating of 48 " water line ask Eng. Collazo
6. Relook at utilities under Roosevelt bridge
7. Invert elevation of manhole at car dealership on the other side of the margaret siphon.

6. STRUCTURAL DESIGN

6.1 General. The recommended plan of improvement includes hydraulic structures along with both bridge and utility modifications. The structural design of these features is based on the current guidance set forth by the civil works engineering and design publications of the U.S. Army Corps of Engineers, subject to modifications indicated by engineering judgment and experience.

6.2 Design Criteria.

6.2.1 Conventional Reinforced Concrete. Design is based on the requirements of EM 1110-2-2104, *Strength Design For Reinforced-Concrete Hydraulic Structures;* ACI 318-89/318R-89, *Building Code Requirements for Reinforced Concrete and Commentary;* and/or AASHTO, *Standard Specifications for Highway Bridges* as appropriate for each structural feature of the project. The compressive strength used in design of the concrete channel structural features was 3000 psi in accordance with the recommendation in paragraph 2-3a(1) of EC 1110-2-270, *Structural Design of Concrete-Lined Flood Control Channels.* However, several concrete features of the project were designed using higher strength concrete to gain cost savings or improve durability. For construction, concrete material requirements would be in accordance with EM 1110-2-2000 and the Concrete Materials Design Memorandum (See Paragraph 1.5.i). Steel reinforcement would be ASTM A615 Grade 60.

6.2.2 Structural Steel. Design is based on EM 1110-2-2101, *Working Stresses for Structural Design.* All structural steel would conform to the requirements of ASTM A36 or A572 for embedded items and miscellaneous steel components.

6.2.3 Steel Piles. For steel sheet piles, design is based on EM 1110-2-2504, *Design of Sheet Pile Walls.* Steel sheet piling would conform to the requirements of ASTM A328, A572 (Grade 50), or A690 (marine grade). Steel HP-type piles would conform to ASTM A572 (Grade 50).

6.2.4 U-Frame Concrete Structures. Design is based on EM 1110-2-2007, *Design of U-Frame Hydraulic Concrete Structures.* See Paragraph 6.2.1 for additional criteria.

6.2.5 Retaining Walls. Designs for temporary and permanent retaining walls are based on:

a. EM 1110-2-2502, *Retaining and Floodwall Design*

b. EM 1110-2-2504, *Design of Sheet Pile Walls*

c. EM-1110-2-2906, *Design of Pile Foundations*

d. FHWA-RD-89-193, *Soil Nailing for Stabilization of Highway Slopes and Excavations*

6.2.6 Seismic Design. Design was based on ER 1110-2-1806, *Earthquake Design and Evaluation for Civil Works Projects.*

6.3 Design Loading Conditions.

6.3.1 Hydraulic Structures. The load conditions used for the design of the hydraulic structures are described below. These load combinations were obtained from EC 1110-2-270, *Structural Design of Concrete-Lined Flood Control Channels* (pages A-19 to A-28), and EM 1110-2-2502, *Retaining and FloodWalls* (Tables 4-1 and 4-2).

1. Construction Conditions:

CASE 1A: UNUSUAL
Structure complete with backfill in place, at-rest earth pressures, channel empty, compaction effects (See NOTE 1), construction surcharge (See NOTE 2), no groundwater pressures.

CASE 1B: UNUSUAL
Structure complete with backfill not in place, wind forces (See NOTE 3).

2. Design Flood Loading Conditions:

CASE 2A: USUAL
Water in channel at maximum design water level, at-rest earth pressure, backfill saturated to normal ground water level, drainage assumed to lower normal groundwater to level of water in channel if lower than groundwater. If water level in channel is higher than normal groundwater, then drainage check valves assumed closed.

CASE 2B: UNUSUAL
Water in channel to top of wall, at-rest earth pressure (passive for inverted T-type wall), backfill saturated to top of wall, drainage check valves assumed closed preventing flow into backfill.

3. Drawdown Loading Conditions:

CASE3A: USUAL
Channel empty, at-rest earth pressure, backfill saturated to normal ground water level, drainage assumed to be 50% effective thereby lowering ground water level to 50% of height above drain outlet.

CASE3B: UNUSUAL
Channel empty, at-rest earth pressure, groundwater elevation at maximum, drainage assumed to be 50% effective thereby lowering ground water level to 50% of height above drain outlet.

CASE 3C: EXTREME
Channel empty, at-rest earth pressure, groundwater elevation at maximum, drainage assumed to be ineffective (See NOTE 4).

4. Earthquake Loading Condition:

CASE4A: UNUSUAL
Construction complete, water in channel to normal level, earth pressures determined per EM 1110-2-2502, backfill saturated to normal ground water level, drainage assumed to be 50% effective thereby lowering ground water level to 50% of height above drain outlet, seismic effects.

NOTE 1: A 2-TON (4000 LB) self-propelled drum roller was assumed for compactor-induced soil pressures adjacent to walls.

NOTE 2: A uniform surcharge of 200 PSF was for equipment/construction surcharge-induced soil pressures adjacent to walls. Surcharge effects were checked independently of compaction effects.

NOTE 3: Wind loads were applied during construction prior to backfill placement, in accordance with Paragraph 3-25 of EM 1110-2-2502, for locations subjected to hurricanes (50 PSF) for walls 20 FT or less in height above the adjacent terrain. For walls higher than 20 feet above the adjacent terrain, the provisions of ASCE 7-88 for a basic wind velocity of 110 MPH and an Exposure C were used in determining wall pressures.

NOTE 4: The maximum elevation of the groundwater assumed during drawdown loadings varied based on the surface drainage system and backfill material present at each specific feature.

6.3.2 Bridge Structures. Load conditions used for the design of bridge structures were as prescribed in Table 3.22.1A of the 1992 *AASHTO Standard Specifications for Highway Bridges.* Bridge abutments that would be part of the channel wall were also designed to meet the load requirements described herein for hydraulic structures.

6.4 Retaining Wall Along De Diego Expressway at Margarita Station M49+50 to M54+10.

6.4.1 General. This retaining wall is located downstream of the Margarita Channel Stilling Basin. The distance from the wall to the edge of the De Diego Expressway varies from 13 feet at Station M49+50 to 130 feet at Station M54+10. Between Station M53+00 and Station M54+10 the wall is aligned at an angle of 30^0 to the centerline of the channel. Downstream of Station M53+00 the alignment is defined by a line that passes through a point thirteen feet from the edge of De Diego Expressway at Station M50+00. Plates L-1 and L-2 show the alignment of the wall. The wall provides flood control protection and serves as a wing wall for the flow exiting the stilling basin. This reach is within the zone of tidal influence.

The geometric constraints on the wall include the following:

a. The wing walls must be symmetric from Stations M53+00 to M54+10.

b. The wing walls must be aligned at an angle between 30^0 and 45^0 from the channel's alignment.

c. The top of the wall elevation is 10.5 feet, which is the existing ground surface at Station M49+50, and remains constant to Station M53+00. The elevation then varies gradually down to Elevation 9.4 feet (NGVD) at Station M54+10.

The containment of flow on the left side of the channel downstream from Station M53+00 would be accomplished by a levee constructed as part of Rio Puerto Nuevo Contract 2AA - Bechara Industrial Area. During preparation of plans and specifications, the layout of the wing wall on the left side of the channel will be finalized to tie-in to the final alignment of the levee. To provide an estimate in this report for the left wing wall, quantities for the right wall between Station M53+00 and M54+10 were doubled.

The Puerto Rico Highway and Transportation Authority is considering adding an exit to De Diego Expressway in the vicinity of this wall. It is, therefore, possible that the wall may have to be realigned during preparation of the plans and specifications.

6.4.2 Alternatives Investigated. The high water table, tidal influence, proximity to De Diego Expressway, and low bearing capacity of the soil in this area limited the design alternatives to pile type walls, including: (1) cantilevered sheet pile wall, (2) anchored sheet pile wall, and (3) a composite pipe/sheet pile wall.

A cantilevered sheet pile wall was not selected because the required section modulus dictated the use of an all box pile wall. Large deflections at the top of the wall, in close proximity to De Diego Expressway, were also considered unacceptable. The anchored sheet pile wall was eliminated for several reasons relating to the quality of the soils in the area. The most significant issue was the evaluation made by EN-GS that anchorage would be difficult to obtain in the soils in this area. A dead man or anchor wall was considered unacceptable due to the proximity of De Diego Expressway and due to the weak soils in which it would have to be constructed. Soil anchors were not considered because of the length required to penetrate into a soil layer that could support the anchor load. In addition to anchorage limitations, the depth of penetration of the sheet pile required to obtain an approximately fixed condition was deemed excessive.

6.4.3 Preferred Alternative. A composite pipe/sheet pile wall system is the preferred alternative. The recommended system would consist of Arbed AZ18 sheet piles (ASTM A572, Grade 50) and 36- and 48-inch diameter pipe piles (ASTM A252, Grade 3). The wall thicknesses of the 36- and 48-inch pipe piles would be 0.5 and 0.75 inch, respectively. The 36-inch diameter piles would be located between Stations M49+50 and M53+00. The 48-inch diameter piles would be located between Stations M53+00 and M54+10.

The pipe piles would be filled with soil to about six inches from the top, and a six-inch concrete cap would be placed. An MC18X42.7 structural channel would serve as a pile cap for the sheet piles. The top of the wall at Station M49+50 would be at the same elevation as the ground contours; therefore, for safety, a chain link fence would be placed along the length of the wall and would be supported by the pile caps.

6.4.4 Design Loading Conditions. The loading combinations were based on guidance in EM 1110-2-2504, *Design of Sheet Pile Walls*, and in EM 1110-2-2502, *Retaining and Floodwalls*. The water surface elevations in the channel were obtained from Table 12, *Hydraulic Design Data for Channels*, and Plate H-5, *Hydraulic Design Profiles*, in the General Design Memorandum. The surcharge representing De Diego Expressway was based on *Standard Specifications for Highway Bridges by the American Association of*

State Highway Officials, 1992. The water table elevation was provided by EN-GS based on the available boring logs.

The wall was analyzed at sections located at Stations M50+00, M51+00, M52+00, M53+00 and M54+10. These sections were selected based on the varying wall heights (27.3 ft at Station M54+10 to 2.95 ft at Station M50+00) and the varying soil properties along the length of the wall. These sections are shown on Plate S-1.

The loading combinations as shown on Plate S-1 are:

a. Load Case 1: Usual load case with the normal saturation level, normal low tide in the channel, and the De Diego Expressway surcharge. This is a long term loading condition and the soil's S-strengths were used.

b. Load Case 2: Unusual load case representing the post construction condition. The water table and channel water surfaces are at normal levels. Surcharges are used to represent both a construction load and the De Diego Expressway. This load case occurs just after the channel is excavated; therefore, the soil's Q-strengths were appropriate.

c. Load Case 3: Extreme load case representing the post flood conditions. The retained soil has been saturated by the floodwaters that have subsided in the channel. The surcharge representing De Diego Expressway is included. This load case was analyzed using both S and Q soil strengths.

d. Load Case 4: Extreme load case representing the flood condition. The water in the channel is to the top of the wall. This is a short-term loading; therefore, the Q-soil properties were used. A separation crack is assumed to form next to the wall. This crack is assumed to be filled with water so the water surface on the retained soil side would be at the elevation of the ground at the wall. This load case assumes that the ground water table has not increased and is at the normal level.

e. Load Case 5: Extreme load case representing the earthquake loading. This load case consists of the usual loadings in Load Case 1 with the addition of the .15g horizontal accelerations to represent the earthquake load. The soil strengths were assumed to be 80% of the soils R-strengths. This assumption was suggested by EN-GS. The soil pressures representing the earthquake load were based on the forces obtained by the wedge method. A wedge was considered on both sides of the wall - one representing the driving force and the other representing a resisting force. The pressure distribution was calculated based on these forces and was assumed linear with a maximum pressure at the retained soil surface and zero pressure at the tip of the sheet pile.

6.4.5 Design Procedure and Criteria. It was assumed for the analysis of this wall system that the sheet piles would be driven to a depth that prevents a soil failure underneath the sheet pile tip. These depths were provided by EN-GS and are Elevation -15 feet (NGVD) between Station M49+50 and Station M53+00 and Elevation -21 feet (NGVD) between Station M53+00 and Station M54+10. The pipe piles would be driven to a depth equal to the deeper of (1) the depth required to provide system stability or (2) the depth required by EN-GS to provide protection against a deep-seated rotational failure of the entire soil mass. These depths along with a profile of the wall are shown on Plate S-2.

The loads on the pipe piles were assumed to be the total loads based on the spacing of the pipe piles (i.e., the sheet piles transfer load to the pipe piles and provide no resisting force for stability calculations). The net soil pressures were obtained by assuming that a driving wedge exists from the bottom of the sheet pile to the retained soil surface and a resisting wedge exists from the sheet pile tip to the dredge line. The pressures were calculated based on Coulomb's coefficients. The driving loads were assumed to be active pressures. The resisting loads were assumed to be at-rest pressures. The actual resisting pressures would be between at-rest and full passive pressure. Since the deflections below the dredge line would be small, the pressures would be closer to at-rest than full passive. Assuming the resisting loads were at-rest resulted in a conservative net pressure distribution.

The pipe piles were analyzed using a single pile analysis. The program LPILE was used for the analysis. This program is a Windows-based program that models the pile as a flexible beam. The resistance to load is dependent on the pile movement and is modeled by soil-resistance (p-y) curves. LPILE contains a number of p-y curves for various soil types. These curves were adjusted based on the soil properties of the site. The p-y curves were "softened" 10% if the spacing of the piles was less than 2.5 times the pile diameter based on EM 1110-2-2906, *Design of Pile Foundations*. Since these curves are based on experimental data for various soil types at various locations, it is recommended to perform a lateral load test at the site to verify the design. To allow time for the design to be adjusted based on the findings of this test, the test was included in the plans and specifications for construction of Contract 2A. This contract was awarded to Cashman Equipment Corporation on 29 October 1999.

The criteria used to determine the required penetration depth is that two points of zero deflection exist near the tip of the pile. The two points of zero deflection simulate a "fixed" condition. The required pile section was based on the maximum

moments and allowable steel strengths. The yield strength of ASTM 252 Grade 3 steel is 45 ksi. The allowable strengths were 50, 66.5 and 87.5 percent of the yield strength for the usual, unusual and extreme load cases, respectively.

A further criterion was to limit deflections of the wall to acceptable levels. The application of this criterion was somewhat subjective; however, the goal was to limit deflection of the top of the wall to less than 3% of the wall height (distance from top of wall to the dredge line). This criterion was used as a guideline. The percentage calculated for Station M50+00 exceeded 3%. At this station, the wall would be 2.95 feet high. As a result, small deflections would result in large percentages. Since the maximum deflection was calculated to be 3.3 inches during an extreme load case and 1.9 inches during the usual load case, the deflections were considered acceptable.

6.5 Margarita Channel Stilling Basin - Station M54+10 to M54+75

6.5.1 General. The Margarita Channel reinforced-concrete stilling basin from Station M54+10 to M54+75 would provide the structural and hydraulic transition from upstream concrete U-frame channel to downstream trapezoidal earthen channel. Wall heights of the 30-foot wide basin would range from 26.97 feet at Station M54+75 to 27.27 feet at Station M54+10. Refer to Plates S-3 through S-6. This reach is within the zone of tidal influence, and a drainage system would be required to relieve uplift pressures. Final drainage system design will be determined during preparation of plans and specifications.

6.5.2 Alternatives Investigated. Only one alternative, a single, soil-founded, conventionally reinforced concrete monolith with two rows of baffle blocks and steel sheet pile wing walls, was investigated. This design disagrees with the structural configuration proposed in the General Design Memorandum only in the wall and slab thickness.

6.5.3 Preferred Structural Alternative. A single, soil-founded, conventionally reinforced concrete monolith with steel sheet pile wing walls is the preferred structural alternative. See Plate S-3. The sheet pile wing walls would be ASTM A690 steel coated with USACE Paint System No. 6-A-Z.

6.5.4 Design Assumptions and Loading Conditions. Design assumptions and loading conditions included the following:

a. A rough trapezoidal channel template would be excavated first. A separate flow bypass channel would be excavated adjacent to this template. Construction of the basin and slab drainage system would be completed prior to placing backfill.

b. Concrete U-frame design and analyses, using the ultimate strength method, were performed with CASE program CUFRBC.

c. Flexible sheet pile analyses, using classical earth pressure equilibrium design methods, were performed with CASE program CWALSHT. Free earth tip conditions were used for bending moment, shear, and required tip penetration.

d. Loading conditions for construction, Standard Design Flood, quick drawdown, and seismic cases were used to size wall and slab thicknesses. Usual and unusual loading conditions, with and without surcharge and seismic effects, were developed for both Q and S case soil conditions. Safety factors used for soils, sheet piles, anchors, and concrete slab were in accordance with the appropriate USACE Engineering Manual or standard practice.

6.6 Margarita Concrete U-Frame Channel - Station M54+75 to M89+60.

6.6.1 Proposed Channel Improvements. The Margarita Channel would be improved to a rectangular concrete channel from Station M54+75 to Station M89+60. The channel invert elevation would vary from Elevation -17.87 feet (NGVD) to Elevation +12.60 feet (NGVD). Its width would be 30 feet.

6.6.2 Alternatives Considered.

6.6.2.1 Cast-in-Place U-Frame. The General Design Memorandum conceptually shows a cast-in-place U-frame for the entire run of rectangular channel. Since the proposed bridge modification for the De Diego Expressway over the Margarita Channel would also use this type of construction, it would be advantageous to continue it throughout the remainder of the improvements. However, protective sheet piling would be necessary for construction of the cast-in-place U-frame due to right-of-way restrictions and dewatering requirements along the new channel alignment.

6.6.2.2 Tieback Steel Sheet Piling. This type of system uses multiple levels of grouted anchors to tieback a driven sheet pile wall. Using this method, the depth of penetration for the sheet pile can be shortened to just below the channel bottom elevation. Since sheet piling would be necessary for cast-in-place construction, it would be economical to incorporate it into a permanent wall. However, the cohesive soils at the site would necessitate the use of long anchors that extend beyond the channel right-of-way. This would require costly underground easements to be obtained.

6.6.2.3 Soil Nailing. Soil nailing consists of making four to five-foot vertical cuts of soil, spraying three to four inches of shotcrete on the exposed soil face, and then installing

steel rods (nails) to create a reinforced soil mass. This is repeated until the required depth of excavation is reached. The major advantage of this method is the ease of construction with restricted headroom conditions. The distinct disadvantage is that longer, more closely spaced nails are required when being used to retain the type of cohesive soils located at this site. This reduces the economy of the system. Additionally, the performance of this type of permanent wall in areas subjected to seismic loadings is not fully known. Since headroom restrictions are not an issue with the channel construction except at the bridge locations, other more common techniques would be more economical.

6.6.3 Preferred Structural Alternative. Based on the previous discussions, the preferred structural alternative is a cast-in-place concrete U-frame channel.

6.6.4 Dewatering and Bypass. In order to provide an adequate working environment and still be able to pass normal daily flows and minor flood flows (up to a five-year event), a staged construction operation featuring a dewatering and bypass system would be employed. Refer to Plates S-22 through S-24. Since construction would progress from downstream to upstream, all channel improvements from the De Diego Expressway bridge down would be completed (from approximately Station M62+00 down to the stilling basin).

The U-channel would be constructed in 300-foot phases. Temporary sheet piling would be installed so the existing channel could be excavated to a bottom width of approximately 50 feet without affecting existing structures. At the upstream end of the current phase, the excavation would be transitioned so that a four-foot high dewatering fence could be constructed. The fence would consist of soldier piles and timber lagging in the bed of the channel and sheet piling to enclose the cofferdam. A small frame would be substituted for the timber lagging between two of the soldier piles along one side of the channel. This would be used to attach a flexible pipe to pass the normal daily flows. At the downstream end, a small frame would be used that could be attached to the completed monolith from the previous phase. It would serve as the discharge point for the flexible pipe. This system would enable half of the new channel to be built in the dry. Once completed, the upstream frame and attached flexible pipe from the dewatering fence would be moved to the other side to allow the remaining portion of the channel to be built.

In the case of oncoming flood events that would overtop the dewatering fence, the contractor would be required to vacate the construction site and remove the timber lagging and small frame from the upstream dewatering fence. The downstream frame would also be removed. This would allow relatively unobstructed flow through the area to prevent any upstream flooding as a result of the construction activities.

6.6.5 Design Assumptions and Loading Conditions. All components of the channel were designed to satisfy the load cases specified in Paragraph 6.3.1. Safety factors used are in accordance with the applicable USACE Engineering Manual or standard practice. Since the channel is influenced by tidal effects, a minimum channel water elevation of 1.0 foot (NGVD) was assumed for Cases 3 and 4. The normal groundwater elevation was taken at 6.0 feet (NGVD), and lateral earth pressures on the channel walls were determined using the properties of select backfill. The existing foundation conditions alter from a very stiff to a very soft saturated clay.

6.6.6 Results. To optimize the design of the channel cross-section along the entire alignment, the Waterways Experiment Station (WES) computer program CUFRBC was used. From observation of the required channel invert elevations, top of wall elevations, and existing topography, the two worst case sections were analyzed (Station M54+75 and Station M55+90.56). Using the program's design mode, each load case was run to determine the minimum concrete dimensions and reinforcement required to satisfy structural capacity, flotation stability, and overturning stability. Once determined, the program's analysis mode was then used to re-run all the load cases using the final design dimensions and parameters selected.

From Station M54+75 to Station M55+90.56, the channel design dimensions would be a four-foot thick bottom slab with four-foot thick walls at the invert. From Station M55+90.56 to Station M89+60, the dimensions would be a two-foot, six-inch bottom slab with two-foot, six-inch thick walls at the invert. At each section the walls would slope one on six to a thickness of sixteen inches and then remain constant to the top of wall. There would be one-foot heels that extend beyond each channel wall, as well as drain holes at two feet above the channel invert. Refer to Plate S-7.

Plate S-8 shows the flotation stability free-body diagram along with a table of results. Case 3A, which is a "usual" drawdown loading condition with the channel empty, backfill saturated to the normal groundwater level, and drains assumed 50% effective, governed at both sections. The factor of safety for both was computed as 1.48, which is just at the allowable value of 1.5.

Plate S-9 shows the bearing capacity free-body diagram along with a table of results. At Station M54+75, the foundation material is a stiff clay with an ultimate bearing capacity of 7100 psf. Case 1A governed, which is an "unusual" construction condition with the channel empty, backfill in place, construction surcharge, and no groundwater. The factor of safety was computed as 4.55, which is well above the allowable value of 2.0. At Station M55+90.56, the foundation material is a soft clay with an ultimate bearing capacity of 3100 psf. Case 1B governed, which is an "unusual" construction condition with the structure

complete, backfill not in place, and wind forces acting. The factor of safety was computed as 3.73, which is well above the allowable value of 2.0.

Plate S-10 displays the location and value of maximum moments, shears and required areas of reinforcing steel for different key areas of the U-frame. Case 1AB governed the design of the wall for both sections as well as the base slab at Station M55+90.56. It is an "unusual" construction condition with the channel empty, backfill in place, compaction effects and no groundwater. Case 4A governed the design of the base slab at Station M54+75. It is an "unusual/extreme" earthquake loading condition with the channel water at normal level, backfill saturated to the normal groundwater level, drains assumed 50% effective and seismic effects taken into account.

6.7 Puerto Nuevo Main Channel Retaining Wall - Station 88+33.2 to 147+40.

6.7.1 General. This reach is within the zone of tidal influence and would require walls with 24- to 27-foot heights. The design presented in the General Design Memorandum (see Paragraph 1.5.h) indicated that a relieving platform wall may be the most feasible wall type to construct. A subsequent value engineering study (see Paragraph 1.5.e) recommended that a cantilevered and anchored sheet pile retaining wall be used, or that modifications to the relieving platform design be made to reduce construction and maintenance costs.

Several construction restrictions influenced the choice of wall system for this reach. The existing channel is within the proposed channel alignment. Construction easements would be limited to approximately 30 feet in many areas due to residential and commercial development along the channel banks. Therefore, dry construction, using hydraulic flow by-pass and tidal containment, would be impractical due to construction complications and costs.

Other significant construction factors and considerations included the following:

a. Wall Heights Along the Channel: The wall heights along the channel would vary gradually from 24.0 feet at Station 88+33 to 27.1 feet at Station 147+40. This range of wall heights does not warrant the use of multiple wall types; for example, no significant benefit exists in using an anchored sheet pile wall for a portion of the channel and a relieving platform wall for the remainder.

b. Wall Types Being Used at Tributary Confluences and Bridges: The main channel intersections with the Margarita and Josefina tributaries and the De Diego Expressway and Roosevelt

Avenue bridges were coordinated to allow for compatible wall movements and adequate clearance for soil anchors or anchor piles.

c. Hydraulic Considerations: The wall surface must be relatively smooth for proper hydraulic performance of the channel during major storm events. For this reason, steel wall components above the channel invert would require a concrete facing. This facing would also provide protection against corrosion, especially in critical areas such as the splash zone and at the mud line. A previous corrosion mitigation study (see Paragraph 1.5.j) recommended a minimum six-inch concrete facing. This concrete facing would be cast in place and secured to the steel wall by welded studs. The facing system would be adjusted as required for face flush intersections with other wall types referenced above.

6.7.2 Alternatives Investigated. Several wall types were considered for use in this reach including:

a. Cantilevered Steel or Concrete Sheet Pile Wall: A cantilevered sheet pile wall was not feasible due to high bending moments and lateral wall deflections.

b. Anchored Steel or Concrete Sheet Pile Wall: An anchored sheet pile with one row of soil anchors was not feasible due to inadequate soil capacity for grouted or helical soil anchors. Use of two rows of anchors is problematic in areas where the existing grade is low with respect to the top of wall, requiring extensive fill or installation of the lower row underwater. Therefore, this option was not investigated. Insufficient right-of-way exists for a sheet pile anchor wall.

c. Relieving Platform Wall: A relieving platform wall is defined here as a steel sheet pile wall anchored by tie-rods, embedded in a concrete slab, which connect to steel HP-type anchor piles approximately 20 feet from the wall face. A relieving platform wall could be adequate but was not completely designed due to unresolved lateral and axial pile capacities within the active wedge acting on the sheet pile.

d. Concrete Inverted-T Wall: A concrete inverted-T wall was not feasible due to required dry construction requirements.

e. Slurry Wall: A slurry wall was not feasible due to anticipated high bearing pressures, sliding and overturning stability problems, and concerns about the availability of excavation equipment for a thick wall.

f. King Pile Wall: A king pile wall, defined here as the combination of plumb and anchor steel HP-type piles with intermittent steel sheet piles, would be adequate except for local overstressing of the plumb pile under seismic loading.

g. Master Pile Wall: A master pile wall, defined here as pipe piles with intermittent steel sheet piles, would be adequate.

6.7.3 Preferred Structural Alternative. A master pile wall is the preferred structural alternative. This wall system would consist of 42-inch diameter steel pipe piles (ASTM A252, Grade 3) with a one-inch wall thickness and AZ-18 (ASTM A572, Grade 50) steel sheet piles, or equal. The wall would also include a cast-in-place concrete cap and a concrete facing with a minimum thickness of six inches. Refer to Plate S-11. Unfaced portions of the sheet piles would be coated with USACE Paint System No. 6-A-Z.

6.7.4 Design Assumptions and Loading Conditions. Design loading conditions for the master pile wall system are listed below. Note that no channel flow (daily, no-rain) conditions, where channel water level is influenced by tidal effects only, produced the highest differential water levels on the retaining wall due to the high ground water table. Safety factors used are in accordance with the applicable USACE Engineering Manual or standard practice.

a. Post-Construction Condition: unusual, channel water at Elevation 0.0 feet (NGVD), ground water table at Elevation 7.7 feet (NGVD), wall drains 50% effective, surcharge = 200 psf, Q-state soils.

b. Daily (No-Rain) Condition: usual, channel water at Elevation 0.0 feet (NGVD), ground water table at Elevation 7.7 feet (NGVD), wall drains 50% effective, S-state soils.

c. Seismic Condition: unusual, channel water at Elevation 0.0 feet (NGVD), ground water table at Elevation 7.7 feet (NGVD), wall drains 50% effective, R-state soils, wall system subject to inertial forces.

6.7.5 Design Procedure and Criteria. The design procedure and criteria for the master pile wall system included the following:

a. Design Procedure: The master piles were analyzed as single piles subject to combined axial and lateral loadings. A non-linear lateral analysis program, CASE program COM624G, was used, and p-y curves that correspond to the soil states in each load case were selected.

1. It was assumed that a pair of pipe piles would be driven first, followed by the pair of sheet piles between the pipe piles. The intermittent sheet piles would be driven to a depth three feet below the channel invert. It was assumed that this depth would be adequate for channel bottom liner excavation and long term slope stability.

2. Due to program loading limitations, the pile was modeled as unsupported above the channel invert. For each load case, an applied distributed load was used on the unsupported pile length to represent the net soil/water lateral pressure for the soil above the channel invert, and loads were applied to the pile head to represent the concrete cap and facing. Classical earth pressure equilibrium methods were used with CASE program CWALSHT to find the net pressure diagrams.

3. The required pipe pile lengths were estimated and various pipe diameters were analyzed to determine the minimum required system.

b. Design Criteria: The following design criteria were used to supplement the criteria in the engineering manuals:

1. Four stations were selected to represent the entire retaining wall reach based on boring locations and the soil properties for these particular borings. These stations included 92+00, 98+00, 114+00, and 140+00. See Plate S-11.

2. A lateral deflection limit of two percent of the unsupported wall height was used for non-seismic loading conditions. For a 27-foot wall, this limit is 6.5 inches at the top of the wall. For the seismic load case, no specific limit was used. Instead, pile stresses were used to determine adequacy, as long as deflections were consistent with the assumptions of the analysis.

3. The general wedge method was used to determine equivalent static lateral wall loading due to inertial soil forces. Inertial forces were also determined for the wall self-weight and channel water. Inertial forces were then combined with daily (no-rain) static loads for total wall loads.

6.8 Puerto Nuevo Channel / Josefina Channel Confluence.

6.8.1 General Description. At the Josefina Channel confluence, the main Puerto Nuevo Channel is joined by the Josefina Tributary. The junction begins at Josefina Station J0+00 and ends at Station J3+00. A plan view and cross sections of the junction are shown on Plate S-13.

6.8.2 Preferred Alternative. A concrete monolithic U-frame design was selected for the Puerto Nuevo Channel / Josefina Channel confluence. Based on the soil conditions present, ease of construction, and economy, this is the preferred structural alternative.

6.8.3 Design Assumptions and Loading Conditions. The design and analysis of the concrete U-frame was performed using CASE program CUFRBC. All components were designed to satisfy the load cases specified in Paragraph 6.3.1. Safety factors used are in accordance with the applicable USACE Engineering Manual or standard practice.

6.8.4 Results. From the required geometry of the confluence, three sections were analyzed (Josefina Stations J0+00, J1+20, and J1+50). See Plate S-14. Using the design mode of CASE program CUFRBC, each load case was run to determine the minimum concrete dimensions and reinforcement required for stability and structural capacity. Once determined, the program's analysis mode was then used to re-run all the load cases using the final design dimensions and parameters selected.

6.8.4.1 Stability. Results of the analysis for flotation stability, sliding stability, and bearing capacity are tabulated on Plates S-15 through S-19. Allowable factors of safety were met for each station analyzed for all load cases.

6.8.4.2 Stress Analysis. Channel geometry and reinforcing were determined from the results generated by CUFRBC. The location and maximum values of shear forces, bending moments, and required areas of reinforcing steel are summarized on Plate S-20.

6.9 De Diego Expressway Over Margarita Bridge Modification.

6.9.1 Existing Conditions. The expressway crossings (eastbound and westbound) at the Margarita Tributary are typical slab and girder type bridges. They were built around 1972 and consist of post-tensioned concrete girders with a cast-in-place deck slab and barrier rails. The superstructure is supported by pile-founded, closed-type abutments on each end. The expressway is an eight-lane divided highway with paved shoulders, and its alignment is skewed to the channel alignment by approximately 32°.

Normal flow of water is within the rectangular channel created by the bridge abutments, wingwalls, and natural channel bed (See Plate S-21). Vegetation in and around the channel bed is dense, but practically non-existent underneath each structure.

6.9.2 Proposed Channel Improvements. The new channel cross-section at the expressway crossings would be rectangular in shape and concrete lined. The invert elevation would be deepened

approximately three feet lower than existing to Elevation -4.54 feet (NGVD), and the channel width would be 30 feet. These changes would provide for conveyance of the 1 in 100 year storm event.

6.9.3 Alternatives Considered.

6.9.3.1 Cast-in-Place U-Frame. The General Design Memorandum conceptually shows a cast-in-place U-frame channel for this bridge modification, as well as for a majority of the Margarita Tributary improvements. A conventionally built, reinforced-concrete U-frame channel is a logical choice for this situation since the channel width is small enough to take advantage of the structural continuity provided by the rigid frame. Its construction would require excavation near the bridge abutments; however, this will not be a problem since the existing bridge abutments are closed, and the new channel invert is only about three feet lower than existing. Thus, a temporary sloped excavation may be used for construction without exposing the piling or pile caps of the bridge abutments.

6.9.3.2 Tieback Steel Sheet Piling. This type of system uses multiple levels of grouted anchors to tieback a driven sheet pile wall. This method is not feasible given the existing topography and the close proximity of the existing bridge structure. The area between the channel walls and the bridge abutment walls would have to be filled, and there is not enough distance between the walls to install the required length of anchor.

6.9.3.3 Soil Nailing. Soil nailing consists of making four to five-foot vertical cuts of soil, spraying three to four inches of shotcrete on the exposed soil face, and then installing steel rods (nails) to create a reinforced soil mass. This is repeated until the required depth of excavation is reached. For reasons similar to those stated in Paragraph 6.9.3.2 for the tieback steel sheet piling, this method is also not feasible. It is arguable whether there is adequate distance between the existing bridge structure and the proposed channel wall to install the nails, and the area between the channel walls and the bridge abutment walls would have to be filled. This equates more to a reinforced-earth system than a soil nailed system (i.e., filling instead of excavating).

6.9.4 Preferred Structural Alternative. Based on the discussions above, the preferred structural alternative is a cast-in-place concrete U-frame channel. The restrictive area requirements and unique topography lend themselves to this type of construction.

6.9.5 Dewatering and Bypass. In order to provide an adequate working environment and still be able to pass normal daily flows and minor flood flows (up to a five-year event), a staged construction operation featuring a dewatering and bypass

system would be employed. Since construction would progress from downstream to upstream, all channel improvements downstream of the bridge would already be completed (from approximately Station M58+00 to the stilling basin) prior to construction of the channel under the bridge.

The existing channel between the wingwalls and underneath the bridge would be excavated to a bottom width of approximately 50 feet. At the upstream end, steel sheet piling would be used to tie into the wingwalls and transition the excavation so that a four-foot high dewatering fence could be constructed at the upstream side of the bridge (at approximately Station M62+00). The fence would consist of soldier piles and timber lagging in the bed of the channel, and sheet piling to enclose the cofferdam. A small frame would be substituted for the timber lagging between two of the soldier piles along one side of the channel. This would allow attachment of a flexible pipe to pass the normal base flows. At the downstream end, a timber frame would be used which can be attached to a completed monolith. It would serve as the discharge point for the flexible pipe. This system enables half of the new channel to be built in the dry. Once completed, the upstream frame and attached flexible pipe from the dewatering fence would be moved to the other side to allow the remaining portion of the channel to be built (Reference Plates S-22 through S-24).

In the case of oncoming flood events that would overtop the dewatering fence, the contractor would be notified to vacate the construction site and remove the timber lagging and small frame from the upstream dewatering fence. The downstream frame would also be removed. This would allow relatively unobstructed flow through the area to prevent any upstream flooding that could result from the construction activities.

6.9.6 Design Assumptions and Loading Conditions. All components of the channel were designed to satisfy the load cases specified in Paragraph 6.3.1. Safety factors used were in accordance with the applicable USACE Engineering Manual or standard practice. Since the channel is influenced by tidal effects, a minimum channel water elevation of 1.0 foot (NGVD) was assumed for Cases 3 and 4. The normal groundwater elevation was taken at 6.0 feet (NGVD), and lateral earth pressures on the channel walls were determined using the properties of select backfill. The foundation conditions vary from a very stiff to a very soft saturated clay.

6.9.7 Results.

6.9.7.1 U-Frame Channel. To optimize the design of the channel cross-section, the Waterways Experiment Station (WES) computer program CUFRBC was used. From observation of the required channel invert elevations, top of wall elevations, and existing topography near the bridge, the section at Margarita

Station M55+90.56 was analyzed as a typical section under the bridge. Using the program's design mode, each load case was run to determine the minimum concrete dimensions and reinforcement required to satisfy structural capacity, flotation stability, and overturning stability. Once determined, the program's analysis mode was then used to re-run all the load cases using the final design dimensions and parameters selected.

The channel design dimensions under the bridge would be a two-foot, six-inch bottom slab with two-foot, six-inch thick walls at the invert. The walls would slope one on six to a thickness of sixteen inches, and then remain constant to the top of wall. There would be one-foot heels that extend beyond each channel wall, as well as drain holes at two feet above the channel invert (See Plate S-7).

Plate S-8 shows the flotation stability free-body diagram along with a table of results. Case 3A governs which is a "usual" drawdown loading condition with the channel empty, backfill saturated to the normal groundwater level, and drains assumed 50% effective. The factor of safety was computed as 1.48 which is just at the allowable value of 1.5.

Plate S-9 shows the bearing capacity free-body diagram along with a table of results. The foundation material is a soft clay with an ultimate bearing capacity of 3100 psf. Case 1B governs which is an "unusual" construction condition with the structure complete, backfill not in place, and wind forces acting. The factor of safety was computed as 3.73 which is well above the allowable value of 2.0.

Plate S-10 displays the location and value of maximum moments, shears, and required areas of reinforcing steel for different key areas of the U-frame. Case 1AB governs the design of the wall and base slab at Station M55+90.56. It is an "unusual" construction condition with the channel empty, backfill in place, compaction effects, and no groundwater.

6.9.7.2 Upstream Dewatering Fence and Frame. The upstream dewatering fence and frame were designed to stand a hydrostatic water pressure head of four feet. The smallest steel H-pile section available (HP8x36) was chosen for the soldier piles, and the 6x6 timber lagging was designed assuming southern yellow pine, #2 grade. The moveable frame would use ASTM A36 steel members to easily fit in the slot created by adjacent H-piles. It was sized to be as lightweight as possible, and still accept the flexible pipe to be used for flow bypass (See Plate S-23).

6.9.7.3 Downstream Dewatering Frame. The downstream dewatering frame was designed to stand a hydrostatic water pressure head of eight feet. It would be constructed of 6x6 timbers arranged to form several triangular frames. The frames would be spaced six feet apart and connected together with double

6x6 walers at the top and bottom. The walers would be faced with 6x6 needle beams skinned with plywood. All timber was designed assuming southern yellow pine, #2 grade. The frames would be attached to the concrete channel monoliths with clip angles and bolts with expansion anchors (See Plate S-24).

6.9.8 Stability of Existing Bridge. Temporary excavation during construction of the new channel would be approximately two feet below the bottom of the bridge abutment pile cap. However, the excavation would be sloped and would not expose the pile cap or pilings. Consequently, the stability of the existing bridge would not be affected.

6.10 De Diego Expressway Over the Main Channel Bridge Modification.

6.10.1 Existing Conditions. The De Diego Expressway crossings (eastbound and westbound) at Rio Puerto Nuevo are typical slab and girder type bridges. They were built around 1972 and consist of post-tensioned concrete girders with a cast-in-place deck slab and barrier rails. The superstructure is supported by pile founded spill-through type abutments on each end and multi-column pile bents within the channel. The expressway is an eight-lane divided highway with paved shoulders, and its alignment is skewed to the channel alignment by approximately 44°.

Normal flow of water is within the existing channel between the bridge abutment and adjoining pier bent to the southwest for both the eastbound and westbound structures. The land to the northeast remains dry during normal daily flows. Vegetation in and around the channel bed is light and practically non-existent underneath each structure.

6.10.2 Proposed Channel Improvements. The proposed channel cross-section at the expressway crossings would be rectangular in shape and concrete lined. Its invert elevation would be deepened approximately twelve feet lower than existing, to elevation -15.64 feet (NGVD). Its width would increase from about 120 feet to 180 feet. These changes would provide for conveyance of the 1 in 100 year storm event.

6.10.3 Alternatives Considered.

6.10.3.1 Cast-in-Place Walls. The General Design Memorandum conceptually shows cast-in-place inverted T-walls being used for this bridge modification. The large channel width makes using U-frame construction at this section less economical. Conventionally built reinforced concrete walls of any type (L-shaped, inverted T, etc.) are a logical choice for this situation, but would require excavation near the bridge abutments. Since there is insufficient room for a sloped excavation, a vertical cut would have to be made. The proximity of the bridge abutment pilings coupled with the limited clearance

between existing ground and the superstructure would make driving any sort of piling for excavation precarious and inefficient.

Other methods of stabilizing slopes at steeper grades exist such as soil nailing. When this type of a system is used, however, the need for another independent structural system is optional. The soil nailed slope can be concrete faced to form a vertical wall and can be designed to carry the same loads as a conventional retaining wall.

6.10.3.2 Tieback Steel Sheet Piling. This type of system uses multiple levels of grouted anchors to tieback a driven sheet pile wall. Using this method, the depth of penetration for the sheet pile can be shortened to just below the channel bottom elevation. This would eliminate interference with the existing bridge pilings, but the problem of limited headroom for driving procedures would still exist.

6.10.3.3 Soil Nailing. Soil nailing consists of making four to five-foot vertical cuts of soil, spraying three to four inches of shotcrete on the exposed soil face, and then installing steel rods (nails) to create a reinforced soil mass. This is repeated until the required depth of excavation is reached. The major advantages of this method are the incorporation of a temporary excavation system into a permanent functioning structure and ease of construction with restricted headroom conditions. The distinct disadvantage is that longer, more closely spaced nails are required when being used to retain the type of cohesive soils located at this site. This reduces the economy of the system. Additionally, the performance of this type of permanent wall in areas subjected to seismic loadings is not fully known.

6.10.4 Preferred Structural Alternative. Based on the discussions above, a permanent soil-nailed excavation is the most advantageous system to use. This would allow the excavation required near the bridge abutments to be carried out easily and economically, as well as provide for a permanent structure.

6.10.5 Channel Bottom. Excavation of the new channel would decrease the amount of embedment of the pilings in the multi-column bridge pile bents. This would make the foundation susceptible to scour from the fast moving floodwaters. In order to protect the foundation and to provide a smooth surface for proper hydraulic performance, an erosion control paving system is proposed. Refer to the *Rio Puerto Nuevo Erosion Prevention Study* by INCA Engineers, Inc., dated December 1998.

6.10.6 Dewatering and Bypass. In order to provide an adequate working environment and still be able to pass normal daily flows and minor flood flow (up to a five-year event), a staged construction operation featuring a dewatering and bypass system would be employed. Many different methods for stabilizing excavations exist such as soldier piles with lagging or steel

sheet piling. However, as discussed earlier, there are vertical clearance problems to driving temporary piling underneath the bridge structures. A sloped earthen embankment can be constructed from channel dredge material to provide a dewatered area and to bypass flood flows (See Plate S-28).

First, the west side of the channel would be excavated down to Elevation -17.14 feet (NGVD) and sloped up at the west interior pile bents to existing ground. A dewatering dike would be constructed at the centerline of the bridge and tied into the east bank at the upstream and downstream ends of the bridge. This would contain any rising water from the natural channel and enable the eastern channel wall to be built. The second phase would involve reconfiguring the dewatering dike to tie into the western bank at the upstream and downstream ends of the bridge. This would divert flow to the eastern half of the channel and enable the western channel wall to be built. Finally, the dewatering dike would be removed, and the channel bottom paving system would be placed.

6.10.7 Design Assumptions and Loading Conditions. All components of the channel were designed to satisfy the load cases and minimum safety factors specified in Paragraph 6.3.1. Since the channel is influenced by tidal effects, a minimum channel water elevation of 1.0 foot (NGVD) was assumed for Cases 3 and 4. The normal groundwater elevation was taken at 6.0 feet (NGVD), and properties of the in-situ soil varied from a very soft (at the top) to a very stiff saturated clay (Reference Chapter 5, *Geology and Soils*).

6.10.8 Analysis and Results.

6.10.8.1 Soil-Nailed Wall. Load Cases 2A and 2B were not analyzed since they would not govern for this type of construction. Load Case 1B was not applicable, and only surcharge effects were considered for Case 1A since there would be no appreciable compaction. The California Department of Transportation (CALTRANS) computer program SNAIL was used to determine wall pressures, nail forces, and factors of safety.

Horizontal spacing of the nails was governed by the location of the 12-inch diameter cast-in-place piles on which the abutment structure is founded. These piles are spaced at approximately 5'-0", so the nails would have to be centered between the piles on the same spacing. Vertical spacings, nail size, nail length, and inclination can all be varied to meet strength and factor of safety (FS) requirements. For walls over 20 feet in height such as this, a nail size equivalent to a #8 bar is typically required.

Plate S-26 shows the final design wall section and details. A 15° inclination would be used with #8 rebar nails which are 70 feet long for the first two rows, and 50 feet long the rest of

the way down. Vertical spacing would be 3'-0". A 10-inch facing would be used comprised of three inches of initial shotcrete, with the remaining portion being formed to provide a smooth, regular surface. Vertical strip drains would be used along with drain holes at the bottom of the wall to reduce hydrostatic pressures.

Case 3A governed the design. This load case is a "usual" drawdown loading condition with the channel empty, existing ground saturated to the normal groundwater level, and drains assumed 50% effective. The factor of safety was computed as 1.49 which is just at the allowable value of 1.5. It should be noted that the design nail lengths and spacings were developed using typical pullout capacities for the materials classified during geotechnical investigation. Nail spacing and lengths may need to be modified to accommodate actual pullout capacities measured at the site.

6.10.9 Stability of Existing Bridge.

6.10.9.1 Design Criteria. The bridge was initially designed using the American Association of State Highway Officials (AASHO) 1969 specifications including the 1970 interim specifications. The following design criteria used for analysis of the bridge is adapted from as-built drawings provided by the Puerto Rico Highway and Transportation Authority (PRHTA):

Design Loading HS20-44
Cast-in-place Concrete
  Slab & Diaphragms ..... f_c' = 4000 psi
  Other ..... f_c' = 3000 psi
Prestressed Concrete
  AASHO Type IV Beams ..... f_c' = 5000 psi
  36" Cylinder Piles ..... f_c' = 7000 psi
Reinforcing Steel-Mild ..... F_y = 40000 psi
Reinforcing Steel-Prestressing Strand ..... F_s' = 140000 psi

6.10.9.2 Areas of Concern. The major item of concern with the bridge resulting from channel improvements is at the interior pile bents. Removing soil from around them to create the necessary channel dimensions presents several problems. First, the soil provides skin friction which, along with end bearing, is what enables the pilings to carry applied vertical loads. Any reduction in skin friction causes a reduction in load carrying capacity. Second, the soil provides lateral restraint. A reduction in lateral restraint increases structural instability, and causes larger bending moments to form in the pilings. Lastly, the soil protects the pilings from wind loads and flood flow pressures. Removing soil causes an increase in the exposed area of the piles, thereby generating higher forces from these two events.

6.10.9.3 Analysis and Results. A typical interior bent configuration was analyzed according to the American Association of State Highway and Transportation Officials (AASHTO) 1992 specifications and 1996 interim specifications. Sample calculations are provided in Appendix C. First, a pile fixity depth in the soil was determined based on pile material properties, section properties, and soil strength parameters. The computer structural analysis program STAAD-III was then used to determine moments, shears, and axial loads in the pier cap and pilings from Group I through Group VI AASHTO loadings. In addition, the piling moments were magnified to account for slenderness effects. Results of the analysis showed that the pilings have adequate structural capacity to carry the applied HS20 loads. The interaction diagram with the governing loads plotted for the 36-inch prestressed cylinder pile clearly demonstrated this. The bent cap concrete design performed by STAAD-III compared with the actual design indicates that the existing bent cap is also satisfactory (ρ_{min} is used).

Although the latest topographic surveys show the existing channel invert elevation at -3.3 feet (NGVD), the as-built bridge plans note a future invert elevation of -10.8 feet (NGVD). It is logical to assume then, that the pilings were originally designed neglecting any skin friction or lateral restraint above this elevation. The new channel invert would be at Elevation -15.64 feet (NGVD), which is an additional five feet lower. Investigation of existing pile capacities in this post-excavation condition showed a FS between 1.35 and 1.99, with an average of 1.51. In design, a FS is typically on the order of 2 to 3. Therefore, while the piles most likely would not fail as a result of the excavation, the FS is not at a comfortable level. In addition, the PRHTA has declared their intention to upgrade this bridge to handle HS30 loads. This would require substructure retrofitting anyway.

6.10.9.4 Seismic Performance. Load case Group VII in AASHTO requires the evaluation of seismic forces when they apply. The island of Puerto Rico is located in a 20% acceleration coefficient zone (based on AASHTO specifications). In order to accurately determine the response of the bridge under this loading, the computer program SEISAB was used. The entire bridge was modeled, including the effects of different superstructure-to-substructure connectivities.

The Federal Highway Administration (FHA) publishes a book entitled, *Seismic Retrofitting Manual for Highway Bridges* (1995). In it, they describe the "Capacity/Demand (C/D) Ratio Method" for evaluating bridge components that have the potential of being damaged during an earthquake. This method quantitatively evaluates each bridge component's ability to resist the design

earthquake motion. Seismic demands are determined from the SEISAB model and seismic capacities are calculated at nominal ultimate values without capacity reduction factors (ϕ). C/D ratios are meant to reflect only component failures, and must be assessed in terms of their effect on unacceptable overall performance of the bridge. They are used to evaluate the need for retrofitting.

Examining the bridge with channel improvements, the following ratios were calculated:

	C/D RATIO
EXPANSION JOINTS AND BEARINGS	
Support Length	1.25
Forces	0.15
REINFORCED CONCRETE COLUMNS	
Moment	0.69
Shear	4.59
Anchorage	0.86
ABUTMENTS	
Displacement	1.22

In calculating the C/D ratios, no column yielding (ductile behavior) was assumed. This is due to the hollow prestressed piles. The lack of confinement reinforcement on the inside face of the piles will cause a rapid loss of flexural capacity due to crushing of the concrete at the plastic hinge region below ground. Sample calculations are provided in Appendix C.

From these results, two items stand out. First, the bearing force capacity is almost non-existent as compared to the large seismic demand forces. The 1-1/4-inch bolts used to attach the Type IV girders to the pier caps do not have the required ten bolt diameter edge distance to take full credit for their strength. Second, the column moment capacity coupled with the reinforcement anchorage capacity is more than 40% below the demand.

The critical elements of the bridge for seismic performance are the intermediate pile bents. Failure of the piles, pier cap or the superstructure connections to the pile bents would result in collapse of the elevated spans. Since the spans are simply supported, they are not very efficient at transferring forces away from the weaker pile bents to the stronger abutments. Also, since the bearing bolts are inadequate, the potential exists for the superstructure to become unseated and collapse. The abutments, however, are more tolerant. Abutment failures almost never result in collapse of the structure, particularly for this type of construction.

6.10.9.5 Recommended Retrofit Measures. In order to handle the larger HS30 loads, increase the FS due to channel excavation, and provide additional lateral strength for seismic loads, additional pilings would be added. The existing 36-inch prestressed cylinder pilings are spaced at approximately 12'-7" on centers. As is the case for the channel construction, limited headroom would restrict the type of piling that could be used. Since the area would be dewatered, an augercast system could be used to construct the piles below ground, and the remainder could be formed up to the pier cap. The largest typical pile used for this method is 30 inches. The new piles (7 per bent) would be added at the midpoint between all the existing pilings (Refer to Plate S-27).

Additionally for seismic, the superstructure would be tied together at the intermediate bents longitudinally using 1-inch bolts through the center of each partial depth diaphragm. Shear blocks would also be added in both the transverse and longitudinal directions. At the abutments, longitudinal shear blocks would also be added to transmit forces to the abutments if the bearing bolts fail. No additional measures are recommended for the abutments (Reference Plate S-27).

6.11 Roosevelt Avenue Bridge Detour and Replacement. Refer to Volume 3 of this report for design documentation of the Roosevelt Avenue Bridge Replacement.

7. CONSTRUCTION

7.1 Construction Methods.

7.1.1 Excavation. Excavation for Phase 2 would be accomplished by dragline or backhoe for the Margarita Channel (Station M54+10 to M89+60) and by mechanical dredging for the Puerto Nuevo Main Channel (Station 88+33 to Station 147+40). Excavated material from the Margarita would be placed in the upland disposal area located northeast of the main channel from about Station 27+00 to Station 56+00. The upland disposal area is shown on Plate L-16. Dredged material from the main channel would be disposed of in an ocean disposal area located approximately six miles from San Juan Harbor. The location of the ocean disposal area is shown on Plate L-1A.

7.1.2 Real Estate Considerations. Due to the extensive commercial and residential development up to the banks of the existing river and the extreme cost of this real estate in Phase 2, construction methods that limit the required construction easement would be used. For construction of the Margarita concrete U-frame channel, steel sheet piling would be used in many areas to reduce the easement required for construction excavation slopes. For construction of the main channel pipe pile walls, excavation of the channel, driving of the pipe piles and sheet piles, backfilling within the pipe piles, and concrete placement for the cap and facing could be accomplished from barges within the channel. Using this type of wall also reduces the permanent right-of-way required compared to an anchored wall. Prior to preparation of plans and specifications, a value engineering study will be performed to optimize the cost of wall construction including real estate requirements. Refer to Plates L-17 through L-21 for right-of-way, easement, and control information.

7.1.3 Diversion Plans. Flow by-pass is planned during construction of the Margarita concrete U-frame channel, Margarita stilling basin, the Josefina Channel confluence, and modification of the De Diego Bridges. Various methods would be used for dewatering such as steel sheet piling, a dewatering fence and frame with flexible pipe, an earth embankment, and earth by-pass channel. This will allow construction of these structural features in the dry while still passing normal daily flows and minor flood flows (between a two to five-year event) around the construction area. Diversion of water would not be required for the main channel pipe pile wall as construction would be accomplished in the wet. Also, construction of the retaining wall along the De Diego Expressway at the Margarita Channel (pipe pile/steel sheet pile wall from Station M49+50 to M54+10) could

be accomplished in the dry prior to excavation of the channel in this reach.

7.1.4 Traffic Control During Construction. Close coordination with the local sponsor and the Puerto Rico Highway Authority would be maintained before and during all Phase 2 construction in order to minimize disruption of traffic. Construction of the main channel from Station 88+33 to 147+40 will have minor impact to traffic in the residential and commercial areas adjacent to the new channel. Construction of the Margarita stilling basin and channel from Station 54+10 to Station 89+60 should have minimal impact to traffic as the new alignment closely follows the existing alignment with no substantial increase in width. During replacement of the Roosevelt Avenue Bridge, a temporary bridge would be used to provide traffic detour lanes; however, adverse impact to traffic flow on this major highway can still be expected due to reduced speeds and less lanes (three lanes vs. four existing lanes) during construction.

Three options will be developed during preparation of plans and specifications for the De Diego Bridge modification: (1) all construction completed below the deck with no interruption to traffic, (2) limited construction activities taking place on the deck during evening and weekend hours using existing lanes for detours and maintenance of traffic, and (3) filling the open median of the bridge to provide additional traffic lanes for detours and maintenance of traffic. For option (3), the additional lanes would be designed as a permanent widening of the bridge. Based on bid proposals received, the Puerto Rico Highway Authority and the local sponsor would be able to choose the option that best met their needs and budget requirements.

7.1.5 Access. Numerous existing streets would provide construction access along the alignment of Phase 2. Most residential streets have load or weight limitations so some accesses would be restricted. Existing streets would also provide suitable access for future maintenance of the channel. Access roads are indicated on Plates L-22 and L-23.

7.1.6 Protection of Existing Structures During Construction Activities. Extensive development up to and within the limits of construction increase the risk of damage to residential and commercial buildings and appurtenant structures and utilities in the area. In order to preclude any damage to structures in close proximity to channel construction, the contractor would be responsible for determining and documenting the preconstruction condition of existing structures within the zone of influence, monitoring construction activities and taking appropriate measures to prevent damage during construction, and for

performing a post-construction verification inspection of those structures previously inspected.

The contractor and his vibration control specialist would be responsible for determining the distance from existing structures, based upon the type of soils in the area, contractor equipment, and the current condition of nearby structures and their foundations, at which vibration producing equipment may operate safely without causing damage to existing structures, either directly to the structure or indirectly through consolidation of the foundation material which would result in settlement or movement. This distance would be defined as the vibration impact distance.

Any existing structure at a distance equal to or less than the vibration impact distance from any point on the boundary of the project work area would be inspected prior to commencement of the work. After completion of the work, the contractor would conduct a post-construction structural inspection/evaluation. The contractor would be responsible for remedying any damage resulting from construction activities.

The contractor would be responsible for implementing a vibration monitoring plan. Vibration levels would be continuously monitored at structures within the vibratory impact distance. An allowable vibration level would be determined based upon the maximum level of vibration that a structure could experience without incurring any damage. The contractor must immediately halt operation of vibration producing equipment whenever a vibration monitoring station records a reading above the allowable level. The contractor would adjust his operation through the use of modified procedures or smaller equipment in order to continue work without producing vibrations above the allowable level.

7.1.7 Upland Disposal and Staging Area. An upland site is available as shown on Plate L-16 for staging and disposal of clearing debris and excavated material from the Margarita Channel. The area is located northeast of the main channel from about Station 27+00 to 56+00. The area is broken into three areas in order to avoid conflicts with existing overhead power lines. A minimum easement of 50 feet on each side of these power lines must be maintained during staging and disposal operations. This area is currently being used for disposal and staging for Contracts 1 and 2A that are now under construction. During preparation of plans and specifications for future contracts, the area would be surveyed so that regions suitable for staging and with remaining capacity for disposal could be identified. Disposal must not be allowed closer than 25 feet to the mangrove planting areas, channel walls, or De Diego roadway embankment.

7.2 Construction Materials.

7.2.1 Concrete. Approximately 56,000 cubic yards of precast concrete, 31,000 cubic yards of cast-in-place concrete, and 650 cubic yards of underwater concrete would be required for construction of Contracts 2C, 2D, and 2E. Information on concrete requirements can be found in the *Rio Puerto Nuevo, Puerto Rico, Concrete Materials Design Memorandum* (refer to Paragraph 1.4.i).

Based on test data presented in the corrosion mitigation study performed by Michael J. Baker, Jr., Inc. (refer to Paragraph 1.4.j), chlorides and sulfates are in sufficient concentrations to warrant concern over the deterioration of concrete in Phase 2. To mitigate corrosion activity, concrete for Phase 2 should be of superior quality. Based on testing done by the South Atlantic Division Laboratory using materials available in the San Juan area, the recommendations listed below for durability with respect to sulfate and chloride attack should be followed:

a. Use of potable quality mixing water. The use of sea water or river water would be prohibited.

b. Use of strong, durable aggregates that are free from chlorides, non-alkali reactive, and graded to obtain dense concrete. Of the two primary types of aggregates available in Puerto Rico, a crushed volcanic type rock (commonly called blue rock) is recommended rather than a limestone (white rock).

c. Use of a Type I cement with a C_3A content less than 10% for resistance to sulfate attack.

d. A maximum water-cement ratio of 0.45.

e. Use of a water-reducing admixture to improve workability while reducing the water demand at a constant cement content.

f. Use of a corrosion inhibiting admixture for resistance to chloride ion penetration, along with adequate cover, to provide maximum protection of the reinforcing steel against chloride attack.

7.2.2 Steel Sheet Piles and Pipe Piles. Steel sheet piles would be subjected to moderate corrosion attack in Phase 2. This attack would be more pronounced in the tidal zone and at the mud line due to oxygen differential concentrations. For steel sheet piling, ASTM A690 (marine grade) steel would be specified. Also, a factory-applied coating with field touch-up would be used for any steel piling not faced with concrete. The coating would be COE Paint System 6-A-Z. This paint system consists of white metal blasting and then painting with COE E-303 zinc-rich primer

and two coats of COE C-200a coal tar epoxy for a minimum 16-mil coating.

7.2.3 Fill and Backfill. Approximately 5,500 cubic yards of granular fill and backfill would be required. Suitable material would be obtained from an off-site source.

7.2.4 Stone Protection. Approximately 2,100 cubic yards of riprap would be required. It is recommended that riprap stones weigh at least 160 pcf. Refer to the *Rio Puerto Nuevo, Puerto Rico, Concrete Materials Design Memorandum* (Paragraph 1.4.i) for information on sources for stone protection.

7.3 Operation and Maintenance. Operation and maintenance of the flood control project would be the responsibility of the local sponsor after completion of construction.

7.3.1 Channel. Final clean-out of the newly constructed Phase 2 channels would be required prior to acceptance at the completion of each contract (2A, 2B, 2C, 2D, and 2E). In addition, maintenance of the lower reaches during construction in the upper reaches would be required. Based on the time to complete the total project and the amount of material to be excavated, periodic examination surveys should be made and maintenance dredging performed when conditions dictate. Based on experience with other projects, three maintenance dredging operations are estimated to be reasonable during construction of the upper reaches. After completion of the total project, all upper channels would be concrete-lined and two debris basins would be provided; thus, shoaling is expected to be minimal. Maintenance equipment and access would be the same required for construction.

7.3.2 Structures. Operation and maintenance of the structural features of Phase 2 would consist of periodic inspections to ensure the structural integrity of the De Diego Bridges, the Margarita concrete stilling basin and U-frame channel, and the steel pipe pile/sheet pile walls.

Inspections would be performed annually for the first five years after end of project construction (five inspections), every other year for the second six years (three inspections), and every five years for the next 39 years (eight inspections) for a total of sixteen inspections over the 50 year life of the project.

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

TABLES

Table 1
Margarita Channel Side Inlets

Actions
(1) Not to be Disturbed
(2) Modify exisiting culvert
(3) New culvert/side spillway
(4) Replace old culvert with new
(5) Discharge into existing channel/collector channel

	Side Inlet			Culvert			Side Spillway Inlet					
Station & Bank (Looking Downstream)	No.	Design Discharge (cfs)	Channel Water Surface Elevation (ft.,NGVD)	No. & Diameter (in.)	Invert Elev. (ft.,NGVD)	Flap Gates or Recessed Inlet	Crest Elev. (Upp/Low) (ft.,NGVD)	Length (ft.)	Side Chan. Inv. Elev. at Upper End (ft.,NGVD)	Supply Chan. Widths (Upp/Low) (ft.,NGVD)	Average Ground Elev. At Station (ft.,NGVD)	Action To Be Taken
16+15 R	1		5.68	1-42	-0.91						7.0	1,5
19+80 R	2		5.70	1-43x68	-0.63						7.0	1,5
20+30 L	3	428	5.70	4-72	-3.00	Flap Gate					5.0	3
26+40 R	4		5.80	1-36x72	1.99						7.0	1,5
35+90 R	5		5.90	2-48	0.58						6.0	1,5
37+10 R	6		6.00	1-46							6.0	1,5
42+10 R	7	334	6.10	1-58x91	-1.03						8.0	1,5
44+20 R	8		6.10	2-42	0.3/0.5						8.0	1,5
47+70 R	9		6.10	1-60	0.71						9.0	1,5
48+90 R	10		6.10	1-45	-1.75						8.0	1,5

Table 1
Margarita Channel Side Inlets

Actions
(1) Not to be Disturbed
(2) Modify exisiting culvert
(3) New culvert/side spillway
(4) Replace old culvert with new
(5) Discharge into existing channel/collector channel

	Side Inlet			Culvert			Side Spillway Inlet					
Station & Bank (Looking Downstream)	No.	Design Discharge (cfs)	Channel Water Surface Elevation (ft.,NGVD)	No. & Diameter (in.)	Invert Elev. (ft.,NGVD)	Flap Gates or Recessed Inlet	Crest Elev. (Upp/Low) (ft.,NGVD)	Length (ft.)	Side Chan. Inv. Elev. at Upper End (ft.,NGVD)	Supply Chan. Widths (Upp/Low) (ft.,NGVD)	Average Ground Elev. At Station (ft.,NGVD)	Action To Be Taken
64+75 L	11		11.80		4.50	Recessed					16.0	2
66+50 R	12	100	12.60		2.10	Flap Gate					10.0	3

Table 2
Puerto Nuevo Channel Side Inlets

Actions
(1) Not to be Disturbed
(2) Modify exisiting culvert
(3) New culvert/side spillway
(4) Replace old culvert with new

	Side Inlet			Culvert			Side Spillway Inlet					
Station & Bank (Looking Downstream)	No.	Design Discharge (cfs)	Channel Water Surface Elevation (ft.,NGVD)	No. & Diameter (in.)	Invert Elev. (ft.,NGVD)	Flap Gates or Recessed Inlet	Crest Elev. (Upp/Low) (ft.,NGVD)	Length (ft.)	Side Chan. Inv. Elev. at Upper End (ft.,NGVD)	Supply Chan. Widths (Upp/Low) (ft.,NGVD)	Average Ground Elev. At Station (ft.,NGVD)	Action To Be Taken
63+25 R	1		4.17	1-30	1.68	Flush					20.0	2
93+50 L	2		3.27	1-72	-3.73	Flush					7.5	3
Old Margarita Flushing Culvt	2a			2-48	-4.00	Flush						
96+37 R	3		5.64	2-	1.83	Flush					10.0	2
99+92.5 L	4		5.97	1-42		Flush					10.0	2
100+05 L	5		5.98	1-30		Flush					10.0	2
101+10 R	6		6.08	1-36	0.84	Flush					8.0	2
113+10 R	7		7.35	1-24	4.61						9.0	4
			7.35	2-72	0.35	Flush					9.0	
113+90 L	8		7.47	4-72	0.47	Flush					10.0	3

Table 2
Puerto Nuevo Channel Side Inlets

Actions
(1) Not to be Disturbed
(2) Modify exisiting culvert
(3) New culvert/side spillway
(4) Replace old culvert with new

	Side Inlet			Culvert			Side Spillway Inlet					
Station & Bank (Looking Downstream)	No.	Design Discharge (cfs)	Channel Water Surface Elevation (ft.,NGVD)	No. & Diameter (in.)	Invert Elev. (ft.,NGVD)	Flap Gates or Recessed Inlet	Crest Elev. (Upp/Low) (ft.,NGVD)	Length (ft.)	Side Chan. Inv. Elev. at Upper End (ft.,NGVD)	Supply Chan. Widths (Upp/Low) (ft.,NGVD)	Average Ground Elev. At Station (ft.,NGVD)	Action To Be Taken
114+90	9		7.62	1-24	4.83						12.4	4
			7.62	2-72	0.62	Flush					12.4	
116+20 R	10		7.81	1-18	6.00						15.6	4
			7.81	2-72	0.81	Flush					15.6	
117+00 L	11		7.93	2-72	0.93	Flush					10.0	4
118+80 R	12		8.20	1-48	2.49						15.0	4
			8.20	2-72	1.20	Flush					15.0	
119+02 L	13		8.23	1-24	2.02						14.4	4
			8.23	2-72	1.23	Flush					14.4	
122+22 L	14		8.57	1-36	0.71	Flush					14.0	2
122+45 L	15		8.60	1-36	1.30	Flush						
122+57 L	16		8.61	1-36	1.40	Flush					14.0	2

Table 2
Puerto Nuevo Channel Side Inlets

Actions
(1) Not to be Disturbed
(2) Modify exisiting culvert
(3) New culvert/side spillway
(4) Replace old culvert with new

	Side Inlet			Culvert			Side Spillway Inlet					
Station & Bank (Looking Downstream)	No.	Design Discharge (cfs)	Channel Water Surface Elevation (ft.,NGVD)	No. & Diameter (in.)	Invert Elev. (ft.,NGVD)	Flap Gates or Recessed Inlet	Crest Elev. (Upp/Low) (ft.,NGVD)	Length (ft.)	Side Chan. Inv. Elev. at Upper End (ft.,NGVD)	Supply Chan. Widths (Upp/Low) (ft.,NGVD)	Average Ground Elev. At Station (ft.,NGVD)	Action To Be Taken
123+52 L	17		8.71	1-36	1.16	Flush					14.0	2
124+58 L	18		8.82	1-36	1.30	Flush					14.0	2
126+12.5 R	19		8.99	1-24	6.46	Flush					12.9	2
131+17.5 R	20		9.53	1-12x26	0.35	Flush					15.3	2
132+50 L	21		9.67	1-36	1.83	Flush					14.2	2
133+30 L	22		9.99	1-48	4.23						15.0	4
			9.99	1-72	2.99	Flush					15.0	
136+65 R	23		10.31	1-12	3.11							4
			10.31	2-72	3.31							
138+12.5 L	24		10.41	1-36	4.59						12.0	4
			10.41	1-72	3.41	Flush					12.0	
142+00 R	25		10.67	2-72	3.67	Flush					15.0	3

Table 2
Puerto Nuevo Channel Side Inlets

Actions
(1) Not to be Disturbed
(2) Modify exisiting culvert
(3) New culvert/side spillway
(4) Replace old culvert with new

	Side Inlet			Culvert			Side Spillway Inlet					
Station & Bank (Looking Downstream)	No.	Design Discharge (cfs)	Channel Water Surface Elevation (ft.,NGVD)	No. & Diameter (in.)	Invert Elev. (ft.,NGVD)	Flap Gates or Recessed Inlet	Crest Elev. (Upp/Low) (ft.,NGVD)	Length (ft.)	Side Chan. Inv. Elev. at Upper End (ft.,NGVD)	Supply Chan. Widths (Upp/Low) (ft.,NGVD)	Average Ground Elev. At Station (ft.,NGVD)	Action To Be Taken
143+00 L	26		10.73	1-72	3.73	Flush					15.0	3
145+07.5 L	27		10.93	1-30	3.01	Flush					16.5	2

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

TABLE 3
COST SUMMARY

Puerto Nuevo River FDM-2

Contract 2C Margarita Channel
Contract 2D PN Main Ch. Walls
Contract 2E PN Main Ch. Bottom

Designed By: U.S.Army Corps of Engineers
Estimated By: G. Torres

Prepared By: G. Torres

Preparation Date: 04/08/99
Effective Date of Pricing: 04/12/99

Sales Tax: 0.00%

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The scope of the Puerto Nuevo River FDM includes the main channel from Sta 88+33 to Sta 147+40 and the Margarita Channel from Sta 54+10 to Sta 89+60. The project has been divided in three contracts. The following features are included on the FDM:

a. Excavation with upland disposal of excavated material for the main channel from Sta 88+33 to 147+40 and the Margarita Channel from Sta 54+10 to 89+60.

b. Margarita stilling Basin from Sta.54+10 to Sta 54+75.

c. Margarita Concrete U frame Channel from Sta 54+75 to 89+60.

d. Retaining wall at Margarita along the De Diego Expressway from Sta. 49+00 to Sta 53+00.

e. Main Channel steel sheet pipe pile walls from Sta 88+33 to Sta 147+40

f. Tie in channel at the Josefina Confluence.

g. De Diego Expressway (over the main channel) Bridge Modification.

h. De Diego Expressway (over Margarita Channel) Bridge Modification.

i. Earthwork transition to the existing river at Sta. 147+40.

j. Utility relocation that include power line crossings; park lighting fixtures; residential power. water. and sewer service; a 30 inch and 36 inch sewer line crossing; and a 48inch water line crossing.

A 15 percentage has been used for contingencies. A 9 and 10% has been used for E&D and S&A respectively. The Puerto Rico labor and equipment data bases were used in the cost development as well as the unit price book, quotes, historical data and other cost sources.

SUMMARY REPORTS SUMMARY PAGE

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No Backup Reports...

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** PROJECT OWNER SUMMARY - Feature (Rounded to 100's) **

	QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COST
2C. Margarita Channel			19,235,300	3,547,400	22,782,700	
2D. Main Channel Walls			97,576,400	18932100	116,508,500	
2E. Main Channel Bottom			35,255,700	5,288,400	40,544,100	
TOTAL Puerto Nuevo River FDM-2			152,067,400	27767800	179,835,300	

** PROJECT OWNER SUMMARY - Sub Feat (Rounded to 100's) **

	QUANTY UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COST
2C. Margarita Channel					
2C._ 01 Construction Costs		10,600,300	1,590,000	12,190,400	
2C._ 02 Non Construction Costs		8,635,000	1,957,400	10,592,400	
TOTAL Margarita Channel		19,235,300	3,547,400	22,782,700	
2D. Main Channel Walls					
2D._ 01 Construction Costs		45,900,400	6,885,100	52,785,500	
2D._ 02 Non Construction Costs		51,676,000	12047000	63,723,000	
TOTAL Main Channel Walls		97,576,400	18932100	116,508,500	
2E. Main Channel Bottom					
2E._ 01 Construction Costs		29,625,700	4,443,900	34,069,600	
2E._ 02 Non Construction Costs		5,630,000	844,500	6,474,500	
TOTAL Main Channel Bottom		35,255,700	5,288,400	40,544,100	
TOTAL Puerto Nuevo River FDM-2		152,067,400	27767800	179,835,300	

** PROJECT OWNER SUMMARY - Element (Rounded to 100's) **

	QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COST
2C. Margarita Channel						
2C._ 01 Construction Costs						
2C._ 01.02 Relocations			1,435,200	215,300	1,650,500	
2C._ 01.09 Channels and Canals			9,165,100	1,374,800	10,539,800	
TOTAL Construction Costs			10,600,300	1,590,000	12,190,400	
2C._ 02 Non Construction Costs						
2C._ 02.01 Land and Damages			6,621,000	1,655,300	8,276,300	
2C._ 02.30 Planning, Engineering and Design			954,000	143,100	1,097,100	
2C._ 02.31 Construction Management			1,060,000	159,000	1,219,000	
TOTAL Non Construction Costs			8,635,000	1,957,400	10,592,400	
TOTAL Margarita Channel			19,235,300	3,547,400	22,782,700	
2D. Main Channel Walls						
2D._ 01 Construction Costs						
2D._ 01.02 Relocations			2,806,100	420,900	3,227,000	
2D._ 01.08 Roads, Railroads, and Bridges			2,303,600	345,500	2,649,200	
2D._ 01.09 Channels and Canals			40,790,700	6,118,600	46,909,300	
TOTAL Construction Costs			45,900,400	6,885,100	52,785,500	
2D._ 02 Non Construction Costs						
2D._ 02.01 Land and Damages			42,956,000	10739000	53,695,000	
2D._ 02.30 Planning, Engineering and Design			4,130,000	619,500	4,749,500	
2D._ 02.31 Construction Management			4,590,000	688,500	5,278,500	
TOTAL Non Construction Costs			51,676,000	12047000	63,723,000	
TOTAL Main Channel Walls			97,576,400	18932100	116,508,500	
2E. Main Channel Bottom						
2E._ 01 Construction Costs						
2E._ 01.09 Channels and Canals			29,625,700	4,443,900	34,069,600	
TOTAL Construction Costs			29,625,700	4,443,900	34,069,600	

** PROJECT OWNER SUMMARY - Element (Rounded to 100's) **

	QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COST
2E._ 02 Non Construction Costs						
2E._ 02.30 Planning, Engineering and Design			2,670,000	400,500	3,070,500	
2E._ 02.31 Construction Management			2,960,000	444,000	3,404,000	
TOTAL Non Construction Costs			5,630,000	844,500	6,474,500	
TOTAL Main Channel Bottom			35,255,700	5,288,400	40,544,100	
TOTAL Puerto Nuevo River FDM-2			152,067,400	27767800	179,835,300	

** PROJECT OWNER SUMMARY - Sub Asmb (Rounded to 100's) **

			QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COST
2C.		Margarita Channel						
2C._	01	Construction Costs						
2C._	01.02	Relocations						
2C._	01.02.03	Utilities						
2C._	01.02.03_01	Mob, Demob & Preparatory Work						
2C._	01.02.03_01_ 01	Mob, Demob & Preparatory Work			81,200	12,200	93,400	
		TOTAL Mob, Demob & Preparatory Work			81,200	12,200	93,400	
2C._	01.02.03_02	Electrical						
2C._	01.02.03_02_ 1	Remove 13.2 KV Line	250.00	LF	2,000	300	2,300	9.02
2C._	01.02.03_02_ 2	Relocate 13.2 KV Line to N. Ch	410.00	LF	25,900	3,900	29,700	72.55
2C._	01.02.03_02_ 3	Remove 38 KV Line	400.00	LF	2,600	400	3,000	7.47
2C._	01.02.03_02_ 4	Relocate 38 KV Line	450.00	LF	35,200	5,300	40,500	89.9[illegible]
2C._	01.02.03_02_ 5	Remove/Disp Lines, Poles 182-187	250.00	LF	24,200	3,600	27,800	111.[illegible]
2C._	01.02.03_02_ 6	Rem/Disp/Reloc Lines Poles 79-80	250.00	LF	15,800	2,400	18,200	72.67
		TOTAL Electrical			105,600	15,800	121,400	
2C._	01.02.03_08	Mechanical						
2C._	01.02.03_08_ 01	Margarita Channel Siphon			1,248,400	187,300	1,435,700	
		TOTAL Mechanical			1,248,400	187,300	1,435,700	
		TOTAL Utilities			1,435,200	215,300	1,650,500	
		TOTAL Relocations			1,435,200	215,300	1,650,500	
2C._	01.09	Channels and Canals						
2C._	01.09.01	Channels						
2C._	01.09.01_01	Mob, Demob & Prep Work						
2C._	01.09.01_01_ 01	Mob, Demob & Preparatory Work	1.00	JOB	518,800	77,800	596,600	596593.99
		TOTAL Mob, Demob & Prep Work			518,800	77,800	596,600	
2C._	01.09.01_03	Sitework						

** PROJECT OWNER SUMMARY - Sub Asmb (Rounded to 100's) **

		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COST
2C._ 01.09.01_03_ 01	36" and 48" Pipe Pile Wall	1.00	JOB	1,842,900	276,400	2,119,400	2119355.43
2C._ 01.09.01_03_ 02	Chain Link Fence	510.00	LF	7,600	-1,100	8,800	17.23
2C._ 01.09.01_03_ 03	Clearing and Grubbing	6.00	ACR	11,200	1,700	12,900	2153.51
2C._ 01.09.01_03_ 04	Excavation Sta. 49+50-89+60	55804	CY	363,200	54,500	417,600	7.48
2C._ 01.09.01_03_ 05	Granular Backfill Stilling Basin	3000.00	CY	30,000	4,500	34,500	11.49
2C._ 01.09.01_03_ 06	Stone Revetment Stilling Basin	1.00	JOB	90,700	13,600	104,300	104308.01
2C._ 01.09.01_03_ 07	Test Pile	1.00	JOB	42,000	6,300	48,200	48245.91
2C._ 01.09.01_03_ 08	Static/Lateral Pile Load Test	1.00	EA	26,400	4,000	30,400	30351.93
2C._ 01.09.01_03_ 09	Upstream Dewatering Fence	1.00	JOB	256,900	38,500	295,400	295428.23
2C._ 01.09.01_03_ 10	Downstream Dewatering Frame	1.00	JOB	72,200	10,800	83,000	83021.33
2C._ 01.09.01_03_ 11	Steel Sheet Pile-Place & Remove	1.00	JOB	538,200	80,700	618,900	618891.95
	TOTAL Sitework			3,281,200	492,200	3,773,400	
2C._ 01.09.01_04	Concrete						
2C._ 01.09.01_04_ 01	Channel Concrete (3000 PSI)	20080	CY	5,201,000	780,100	5,981,100	297.87
2C._ 01.09.01_04_ 02	Stilling Basin Concrete	564.00	CY	164,100	24,600	188,700	334.58
	TOTAL Concrete			5,365,100	804,800	6,169,900	
	TOTAL Channels	1.00	JOB	9,165,100	1,374,800	10,539,800	10539835.15
	TOTAL Channels and Canals			9,165,100	1,374,800	10,539,800	
	TOTAL Construction Costs			10,600,300	1,590,000	12,190,400	
2C._ 02	Non Construction Costs						
2C._ 02.01	Land and Damages			6,621,000	1,655,300	8,276,300	
2C._ 02.30	Planning, Engineering and Design			954,000	143,100	1,097,100	
2C._ 02.31	Construction Management			1,060,000	159,000	1,219,000	
	TOTAL Non Construction Costs			8,635,000	1,957,400	10,592,400	
	TOTAL Margarita Channel			19,235,300	3,547,400	22,782,700	
2D.	Main Channel Walls						
2D._ 01	Construction Costs						
2D._ 01.02	Relocations						
2D._ 01.02.03	Cemetery, Utilities, & Structure						
2D._ 01.02.03_01	Mob, Demob & Preparatory Work						

** PROJECT OWNER SUMMARY - Sub Asmb (Rounded to 100's) **

		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COST
2D._ 01.02.03_01_ 01	Mob, Demob & Preparatory Work			158,800	23,800	182,700	
	TOTAL Mob, Demob & Preparatory Work			158,800	23,800	182,700	
2D._ 01.02.03_02	Electrical						
2D._ 01.02.03_02_ 3	Remove 38 KV Line	410.00	LF	19,700	3,000	22,700	55.26
2D._ 01.02.03_02_ 4	Relocate 38 KV Line	450.00	LF	215,000	32,300	247,300	549.51
2D._ 01.02.03_02_ 5	Remove 4 KV Line	410.00	LF	6,200	900	7,100	17.33
2D._ 01.02.03_02_ 7	Remove 13.2 KV Line	4320.00	LF	7,300	1,100	8,400	1.93
2D._ 01.02.03_02_ 8	Relocate 13.2 kV Line	450.00	LF	89,400	13,400	102,800	228.51
2D._ 01.02.03_02_ 01	Relocate 4 KV			57,300	8,600	65,900	
	TOTAL Electrical			394,900	59,200	454,100	
2D._ 01.02.03_03	Mechanical						
2D._ 01.02.03_03_ 01	Puerto Nuevo Siphon @ Sta 99+00			1,685,400	252,800	1,938,200	
2D._ 01.02.03_03_ 02	Cut Sewer/Waterline @ Sta 102+00			17,700	2,700	20,400	
2D._ 01.02.03_03_ 03	48" Waterline Reloc @ Sta 109+25			549,300	82,400	631,700	
	TOTAL Mechanical			2,252,400	337,900	2,590,200	
	TOTAL Cemetery, Utilities, & Structure			2,806,100	420,900	3,227,000	
	TOTAL Relocations			2,806,100	420,900	3,227,000	
2D._ 01.08	Roads, Railroads, and Bridges						
2D._ 01.08.01	Roads						
2D._ 01.08.01_01	Mob, Demob & Preparatory Work						
2D._ 01.08.01_01_ 1	Mob, Demob & Preparatory Work			130,400	19,600	150,000	
	TOTAL Mob, Demob & Preparatory Work			130,400	19,600	150,000	
2D._ 01.08.01_05	Bridges, Foundations @ Main Ch.						
2D._ 01.08.01_05_ 01	Soil Anchors 50 & 70 Feet Long			1,323,800	198,600	1,522,300	
2D._ 01.08.01_05_ 03	Shotcrete 4000 PSI 3" Thick	1438.00	SY	47,100	7,100	54,200	37.68
2D._ 01.08.01_05_ 04	Concrete Facing	12130	SF	52,800	7,900	60,700	5.01
2D._ 01.08.01_05_ 05	30" Dia Drilled Shafts	2100.00	LF	499,200	74,900	574,100	273.40
2D._ 01.08.01_05_ 06	Transv/Long Shear Block Concrete			35,000	5,200	40,200	
2D._ 01.08.01_05_ 08	1"x16" Long Continuity Bolts	36.00	EA	36,000	5,400	41,300	1148.9
2D._ 01.08.01_05_ 09	Dewatering Dikes	3810.00	CY	47,400	7,100	54,500	14.3

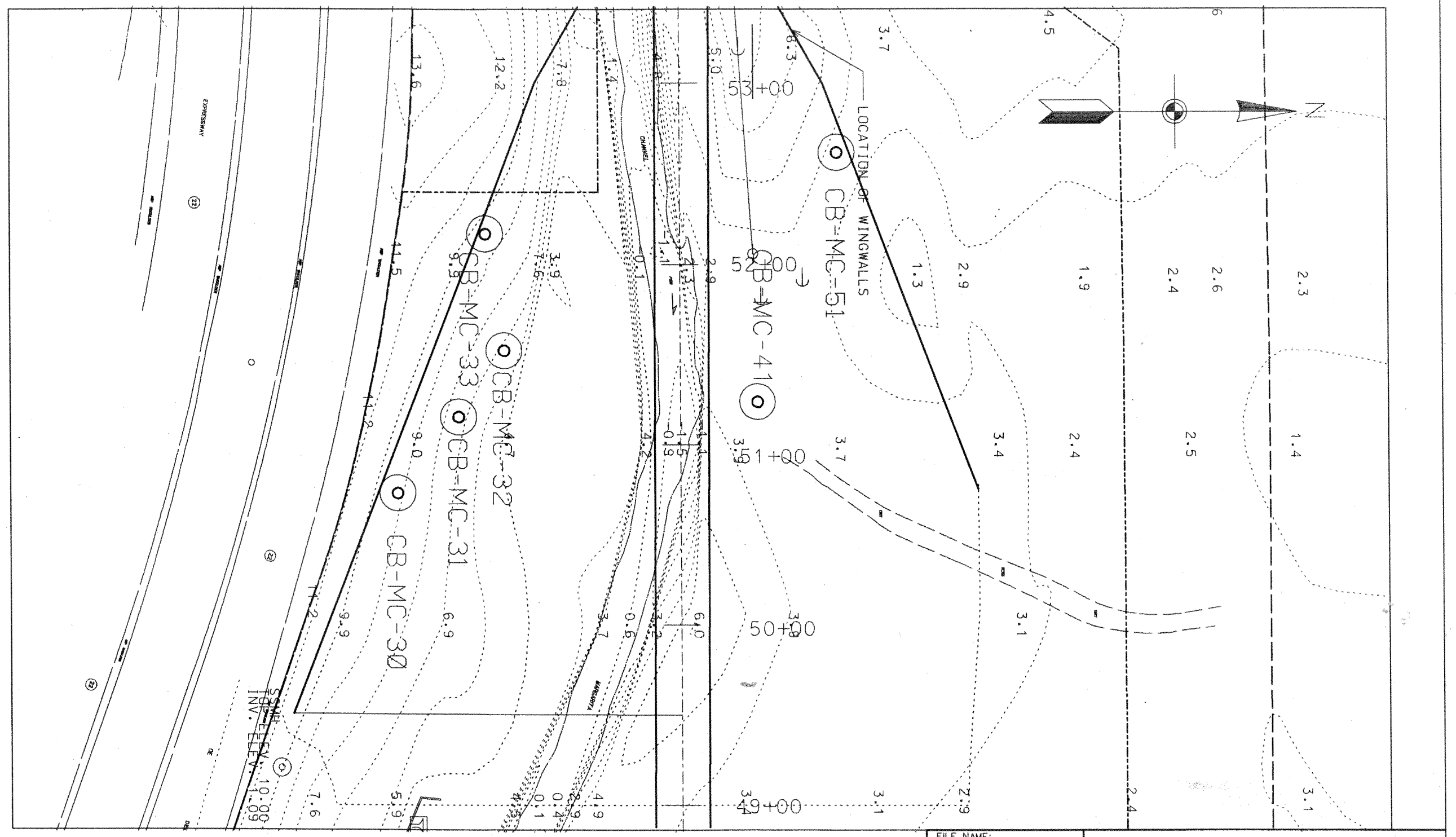
** PROJECT OWNER SUMMARY - Sub Asmb (Rounded to 100's) **

		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COST
2D._ 01.08.01_05_ 10	Channel Bottom Tremie Concrete	650.00	CY	132,000	19,800	151,800	233.54
	TOTAL Bridges, Foundations @ Main Ch.			2,173,300	326,000	2,499,200	
	TOTAL Roads			2,303,600	345,500	2,649,200	
	TOTAL Roads, Railroads, and Bridges			2,303,600	345,500	2,649,200	
2D._ 01.09	Channels and Canals						
2D._ 01.09.01	Channels						
2D._ 01.09.01_01	Mob, Demob & Prep Work						
2D._ 01.09.01_01_ 01	Mob, Demob & Preparatory Work			2,309,600	346,400	2,656,000	
	TOTAL Mob, Demob & Prep Work			2,309,600	346,400	2,656,000	
2D._ 01.09.01_03	Sitework						
2D._ 01.09.01_03_ 01	Clearing and Grubbing	35.30	ACR	65,500	9,800	75,400	2135.21
2D._ 01.09.01_03_ 02	Excavation	484430	CY	2,250,500	337,600	2,588,000	5.34
2D._ 01.09.01_03_ 03	BackFill	4840.00	CY	101,600	15,200	116,900	24.15
2D._ 01.09.01_03_ 04	Culverts/Flapgates			232,800	34,900	267,700	
2D._ 01.09.01_03_ 05	Drainage Material	2500.00	CY	25,000	3,700	28,700	11.49
2D._ 01.09.01_03_ 06	Test Piles			49,900	7,500	57,400	
2D._ 01.09.01_03_ 09	42" Dia Pipe Pile Wall			35,755,800	5,363,400	41,119,200	
	TOTAL Sitework			38,481,100	5,772,200	44,253,300	
	TOTAL Channels			40,790,700	6,118,600	46,909,300	
	TOTAL Channels and Canals			40,790,700	6,118,600	46,909,300	
	TOTAL Construction Costs			45,900,400	6,885,100	52,785,500	
2D._ 02	Non Construction Costs						
2D._ 02.01	Land and Damages			42,956,000	10739000	53,695,000	
2D._ 02.30	Planning, Engineering and Design			4,130,000	619,500	4,749,500	
2D._ 02.31	Construction Management			4,590,000	688,500	5,278,500	
	TOTAL Non Construction Costs			51,676,000	12047000	63,723,000	
	TOTAL Main Channel Walls			97,576,400	18932100	116,508,500	
2E.	Main Channel Bottom						

** PROJECT OWNER SUMMARY - Sub Asmb (Rounded to 100's) **

	QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT COS.
2E._ 01 Construction Costs						
2E._ 01.09 Channels and Canals						
2E._ 01.09.01 Channels						
2E._ 01.09.01_01 Mob, Demob & Prep Work						
2E._ 01.09.01_01_ 01 Mob, Demob & Preparatory Work			1,672,900	250,900	1,923,800	
TOTAL Mob, Demob & Prep Work			1,672,900	250,900	1,923,800	
2E._ 01.09.01_03 Sitework						
2E._ 01.09.01_03_ 01 Excavation	350640	CY	1,196,100	179,400	1,375,500	3.92
2E._ 01.09.01_03_ 02 Additional Excavation	56140	CY	185,000	27,800	212,800	3.79
TOTAL Sitework			1,381,200	207,200	1,588,300	
2E._ 01.09.01_04 Concrete						
2E._ 01.09.01_04_ 01 Precast Concrete Panel System	56170	CY	22,774,800	3,416,200	26,191,000	466.1[illegible]
2E._ 01.09.01_04_ 05 Concrete Facing	290550	SF	2,738,600	410,800	3,149,400	10.84
2E._ 01.09.01_04_ 06 Concrete Cap	1345.00	CY	1,058,200	158,700	1,217,000	904.82
TOTAL Concrete			26,571,700	3,985,800	30,557,400	
TOTAL Channels			29,625,700	4,443,900	34,069,600	
TOTAL Channels and Canals			29,625,700	4,443,900	34,069,600	
TOTAL Construction Costs			29,625,700	4,443,900	34,069,600	
2E._ 02 Non Construction Costs						
2E._ 02.30 Planning, Engineering and Design			2,670,000	400,500	3,070,500	
2E._ 02.31 Construction Management			2,960,000	444,000	3,404,000	
TOTAL Non Construction Costs			5,630,000	844,500	6,474,500	
TOTAL Main Channel Bottom			35,255,700	5,288,400	40,544,100	
TOTAL Puerto Nuevo River FDM-2			152,067,400	27767800	179,835,300	

MATCH TO SHEET 2 - STA. 53+40.82



LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

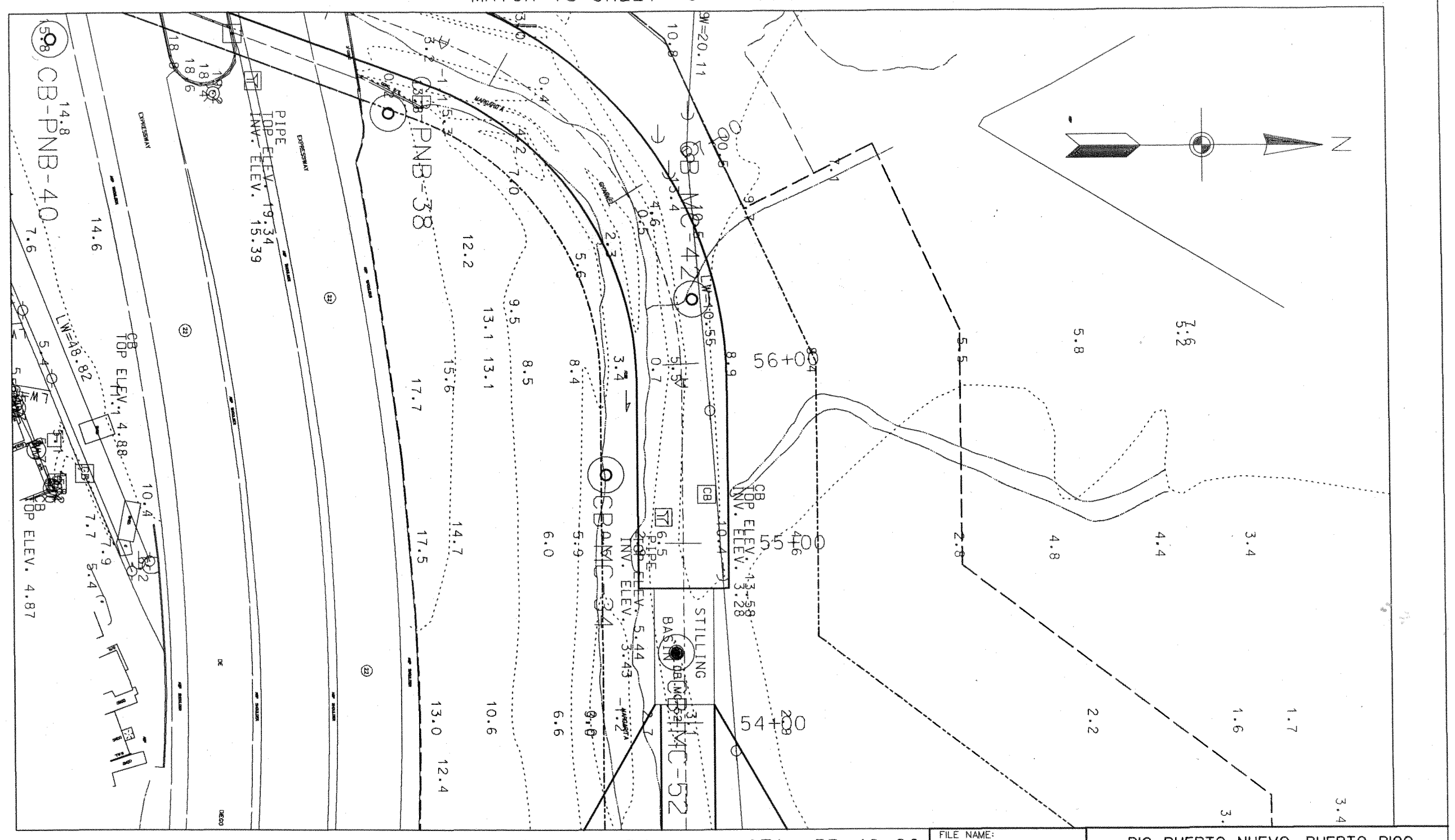
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DESIGN ENG.: D.A.S.	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: D.A.S./R.L.H. / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997

pnf2c01.dgn

PLATE L-1

MATCH TO SHEET 3. - STA. 58+83.8



MATCH TO SHEET 1. - STA. 53+40.82

LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

60' 0 60'

pnf2c02.dgn

FILE NAME: pnf2c02.dgn
REFERENCE FILE NAME: marg.dgn t330rold.dgn t330rt01.dgn t330ru01.dgn x085_row.dgn x085_ce.dgn fdm2align.dgn

DESIGN ENG.: D.A.S.

DWN. BY: D.A.S./R.L.H.

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

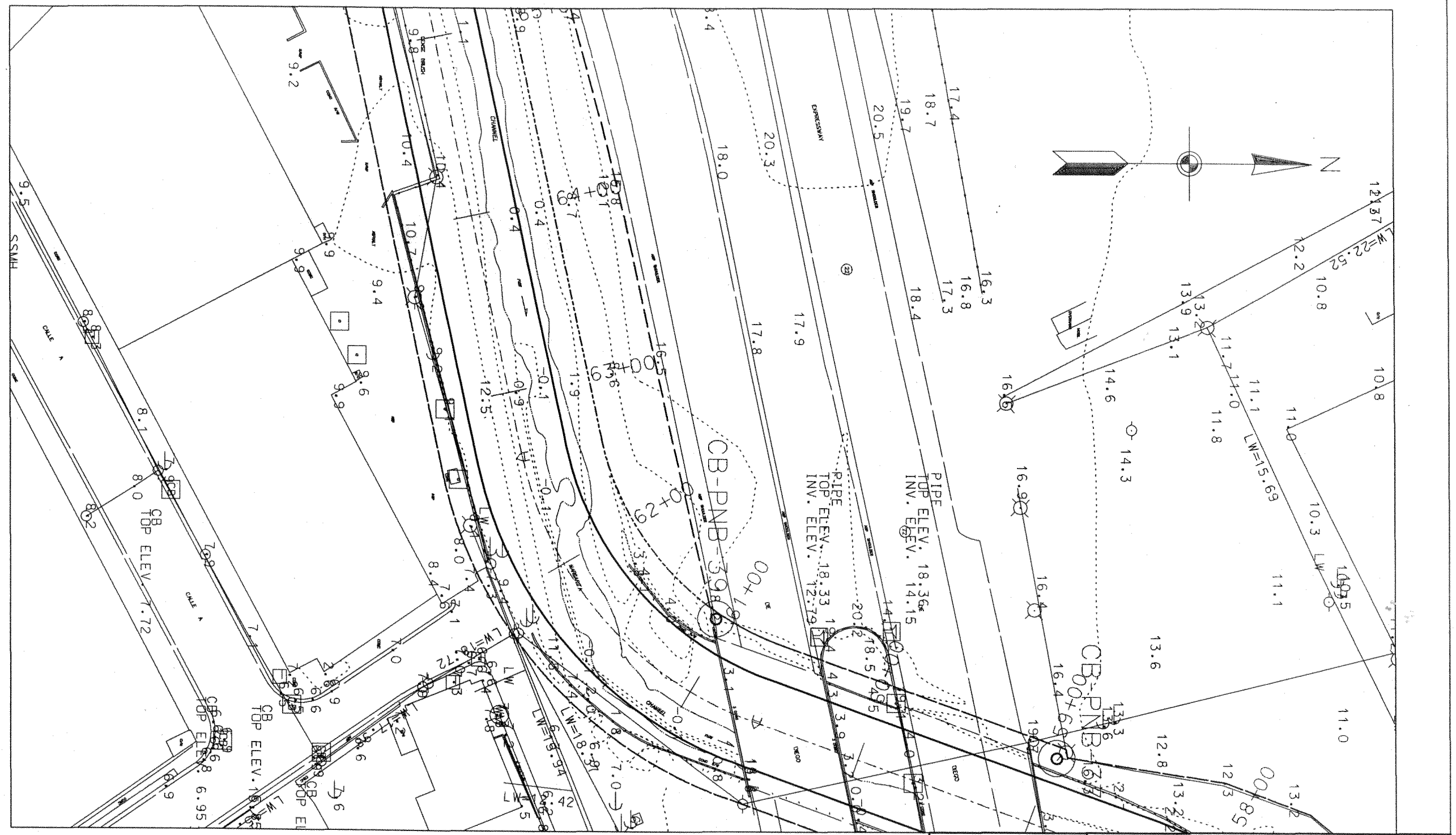
MARGARITA CHANNEL
PLAN SHEETS
STA. 53+40.82 TO 58+83.8
LEVEES AND WATERWAYS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997

PLATE L-2

MATCH TO SHEET 4. - STA.65+16.2



MATCH TO SHEET 2. - STA. 58+83.8

LEGEND:

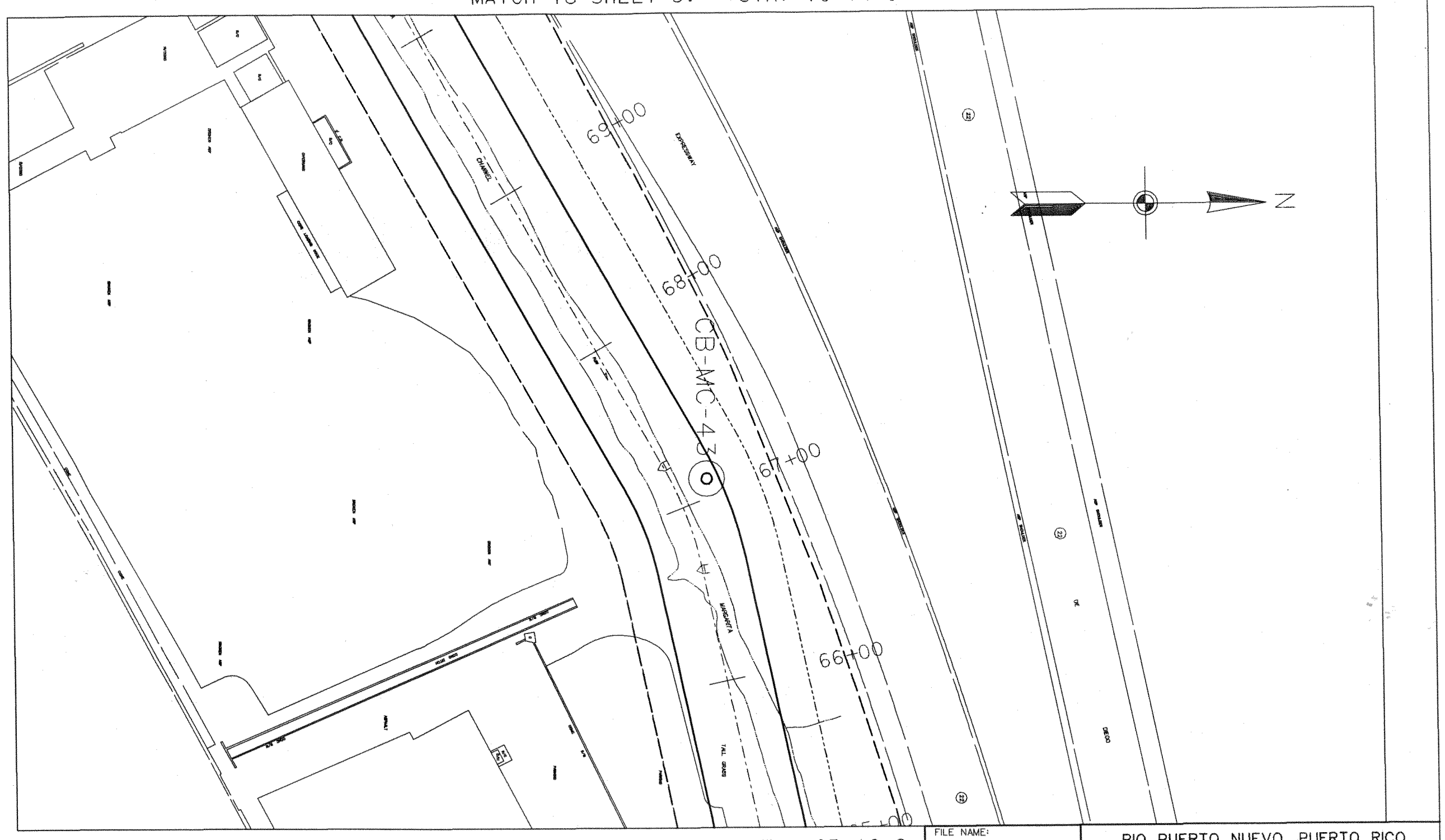
- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

60' 0 60'

FILE NAME: pnf2c03.dgn REFERENCE FILE NAME: marg.dgn t330rold.dgn t330rt01.dgn t330ru01.dgn x085_row.dgn x085_ce.dgn fdm2algn.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 MARGARITA CHANNEL PLAN SHEETS STA. 53+83.8 TO 65+16.2 LEVEES AND WATERWAYS DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DESIGN ENG.: D.A.S.	
DWN. BY: D.A.S./R.L.H. CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997

MATCH TO SHEET 5. - STA. 70+14.9



MATCH TO SHEET 3. - STA. 65+16.2

LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

60' 0 60'

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pnf2c04.dgn
REFERENCE FILE NAME:
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t330rt01.dgn
t330ru01.dgn
x085_row.dgn
x085_ce.dgn
fdm2algn.dgn

DESIGN ENG.: D.A.S.

DWN. BY: D.A.S./R.L.H.

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

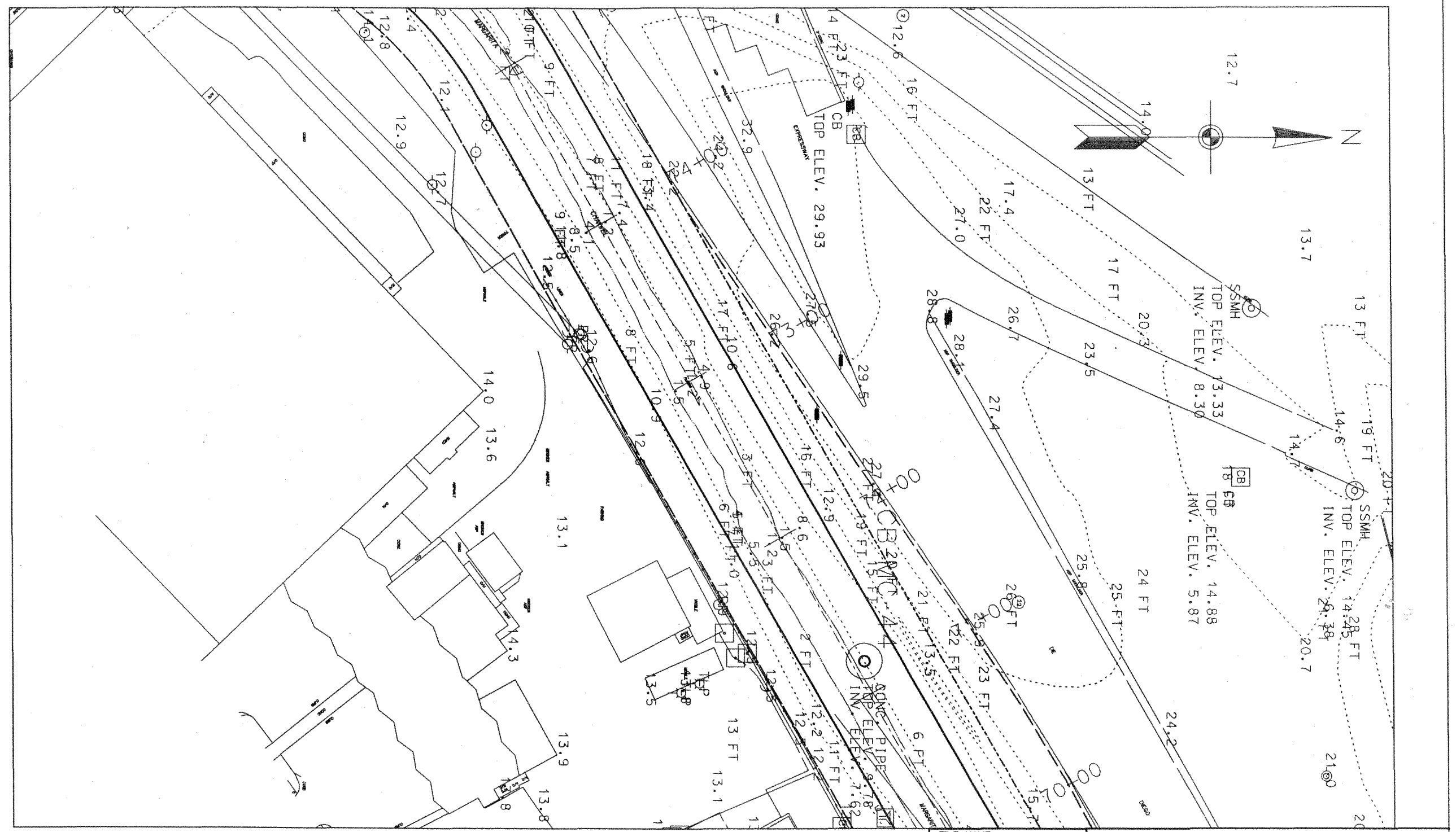
MARGARITA CHANNEL
PLAN SHEETS
STA. 65+16.2 TO 70+14.9
LEVEES AND WATERWAYS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997

PLATE L-4

MATCH TO SHEET 6. - STA. 74+38.7



MATCH TO SHEET 4. - STA. 70+14.9

LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

60' 0 60'

FILE NAME:
pnf2c05.dgn
REFERENCE FILE NAME:
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t330rold.dgn
t330rt01.dgn
t330ru01.dgn
x085_row.dgn
x085_ce.dgn
fdm2align.dgn

DESIGN ENG.:
D.A.S.

DWN. BY:
D.A.S./R.L.H.

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL
PLAN SHEETS
STA. 70+14.9 TO 74+38.7
LEVEES AND WATERWAYS

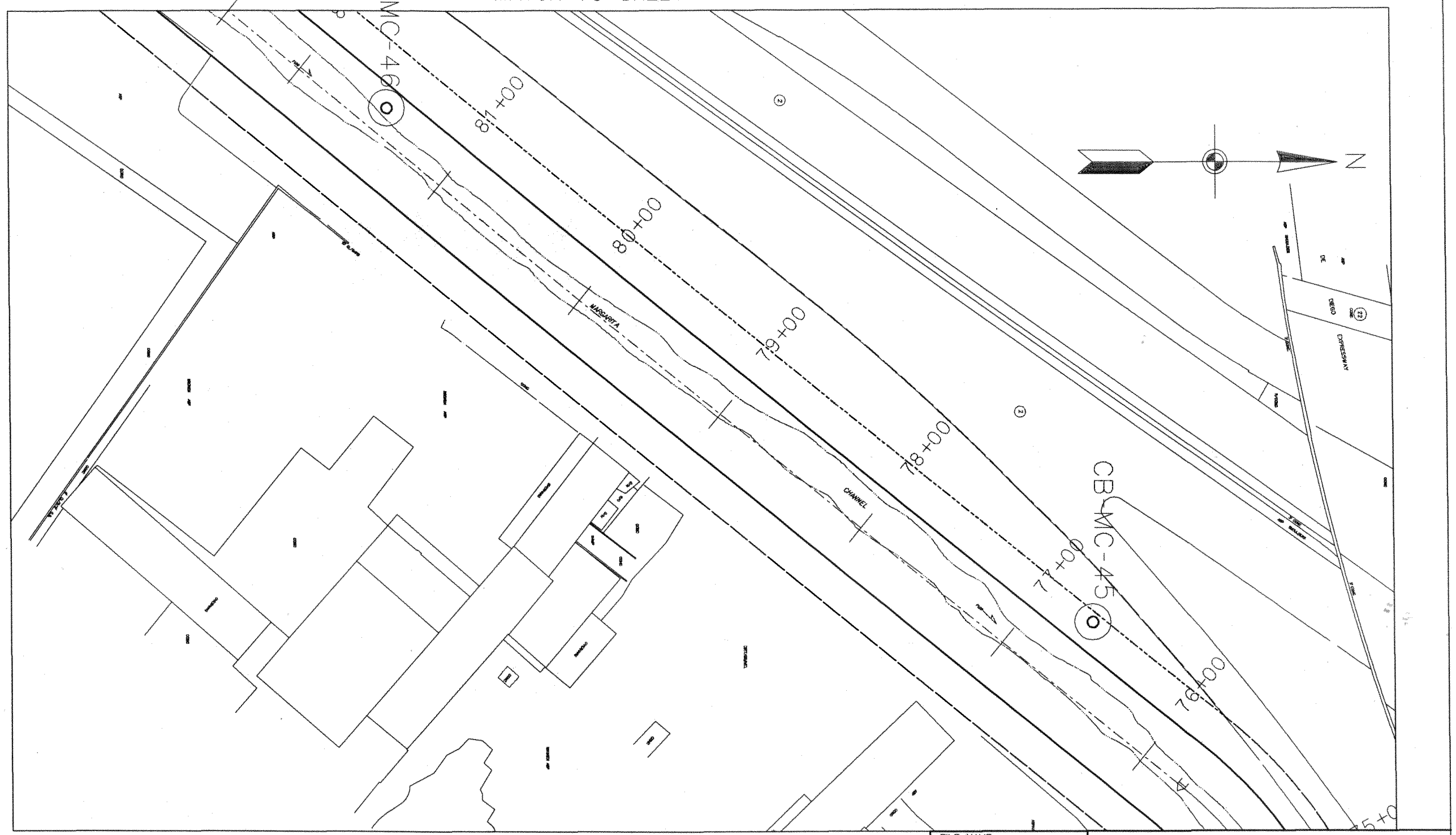
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997

pnf2c05.dgn

PLATE L-5

MATCH TO SHEET 7. - STA. 82+50.7



MATCH TO SHEET 5. - STA. 74+38.7

LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

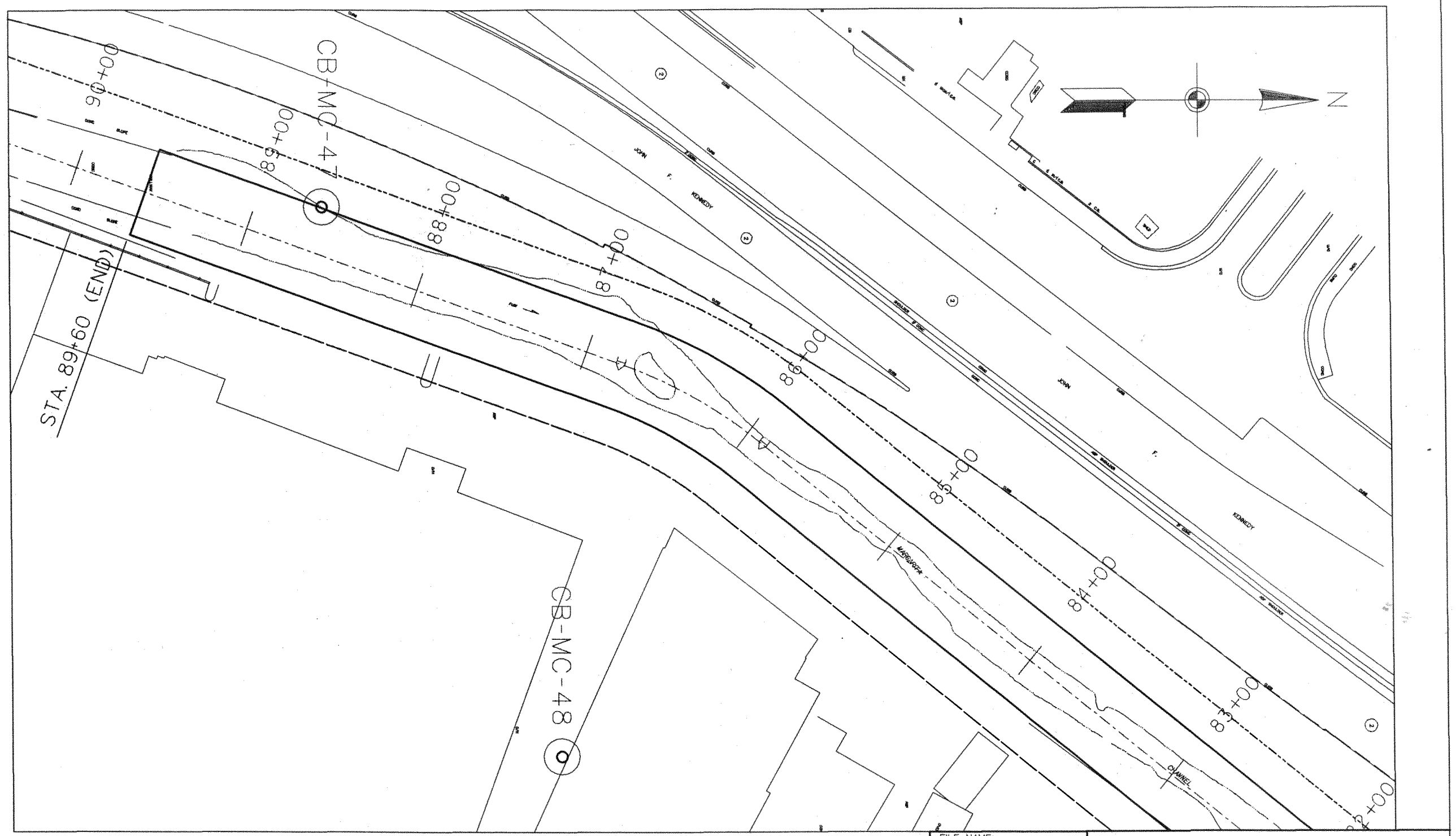
GRAPHIC SCALE

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DESIGN ENG.: D.A.S.	
DWN. BY: D.A.S./R.L.H. CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997

pnf2c06.dgn

PLATE L-6



MATCH TO SHEET 6. - STA. 82+50.7

LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

60' 0 60'

FILE NAME:
pnf2c07.dgn
REFERENCE FILE NAME:
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t330ru01.dgn
x085_row.dgn
x085_ce.dgn
fdm2algn.dgn

DESIGN ENG.: D.A.S.

DWN. BY: D.A.S./R.L.H.

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

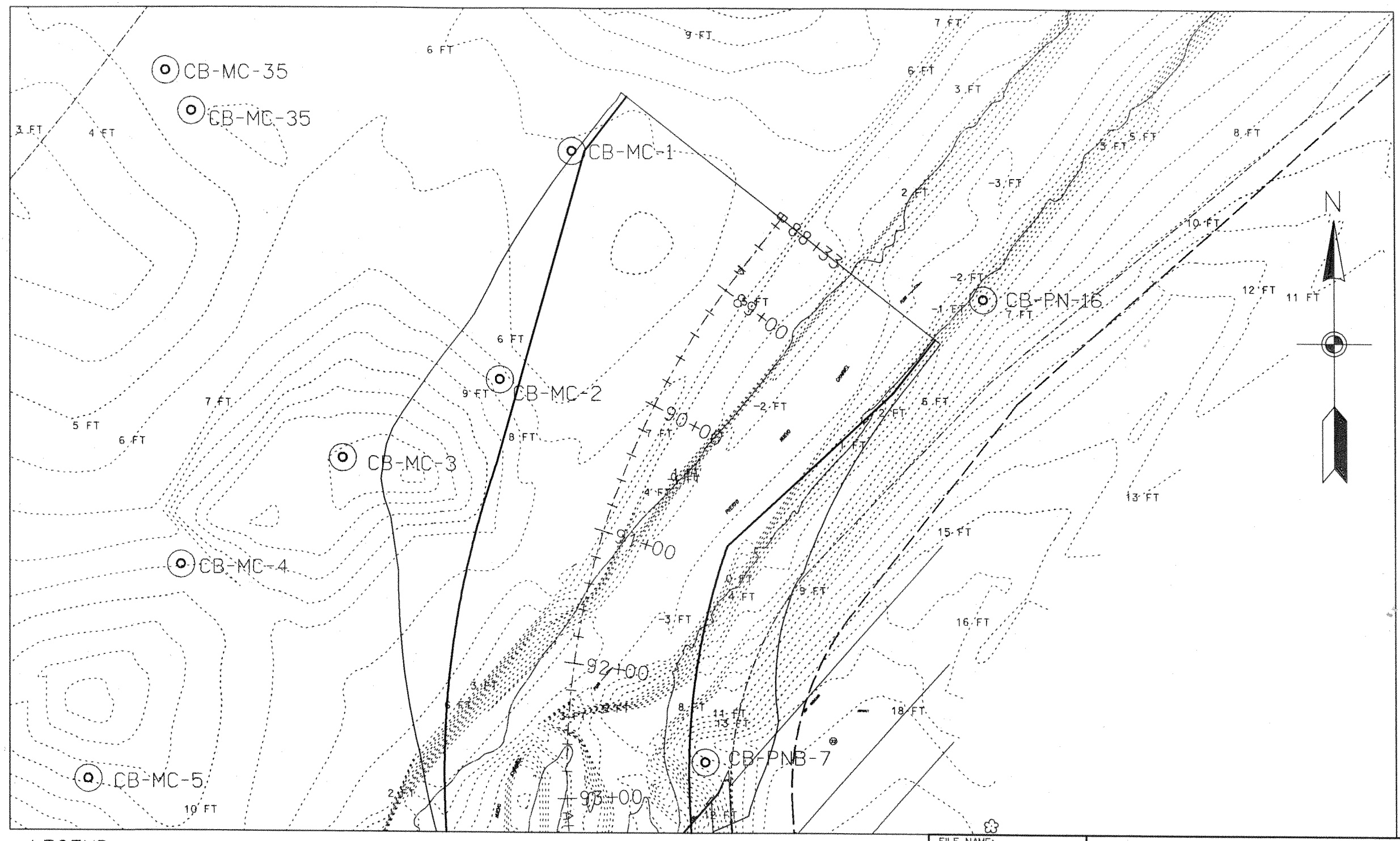
MARGARITA CHANNEL
PLAN SHEETS
STA. 82+50.7 TO 89+60
LEVEES AND WATERWAYS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997

pnf2c07.dgn

PLATE L-7



MATCH TO SHEET 9. - STA. 93+24.98

LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

80' 0 80'

pnf2c08.dgn

FILE NAME:
pnf2c08.dgn
REFERENCE FILE NAME:
pn.dgn
t330rold.dgn
t330rt01.dgn
t330ru01.dgn
x085_row.dgn
x085_ce.dgn
fdm2algn.dgn

DESIGN ENGR:
K.H.W.

DWN. BY:
K.H.W./R.L.H.

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL

PLAN SHEETS

STA. 88+33 TO 93+24.98

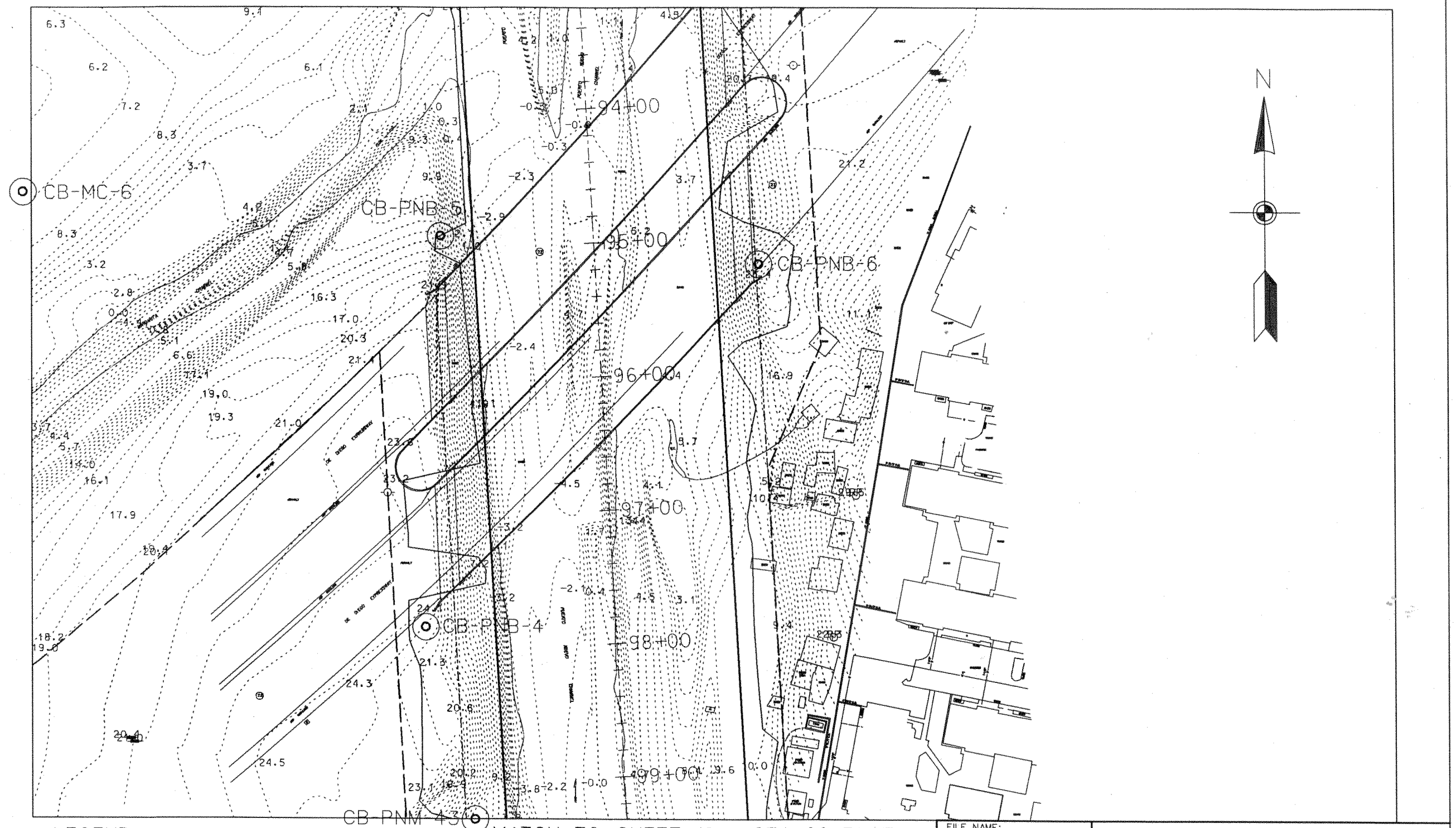
LEVEES AND WATERWAYS

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997

MATCH TO SHEET 8. - STA. 93+24.98



MATCH TO SHEET 10. - STA. 99+31.97

LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

80' 0 80'

FILE NAME:
pnf2c09.dgn
REFERENCE FILE NAME:
pn.dgn
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t330ru01.dgn
x085_row.dgn
x085_ce.dgn
fdm2algn.dgn

DESIGN ENG.:
K.H.W.

DWN. BY:
K.H.W./R.L.H.

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL
PLAN SHEETS
STA. 93+24.98 TO 99+73.28
LEVEES AND WATERWAYS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997

pnf2c09.dgn

MATCH TO SHEET 09. - STA. 99+31.97



MATCH TO SHEET 11. - STA. 105+85.66

LEGEND:

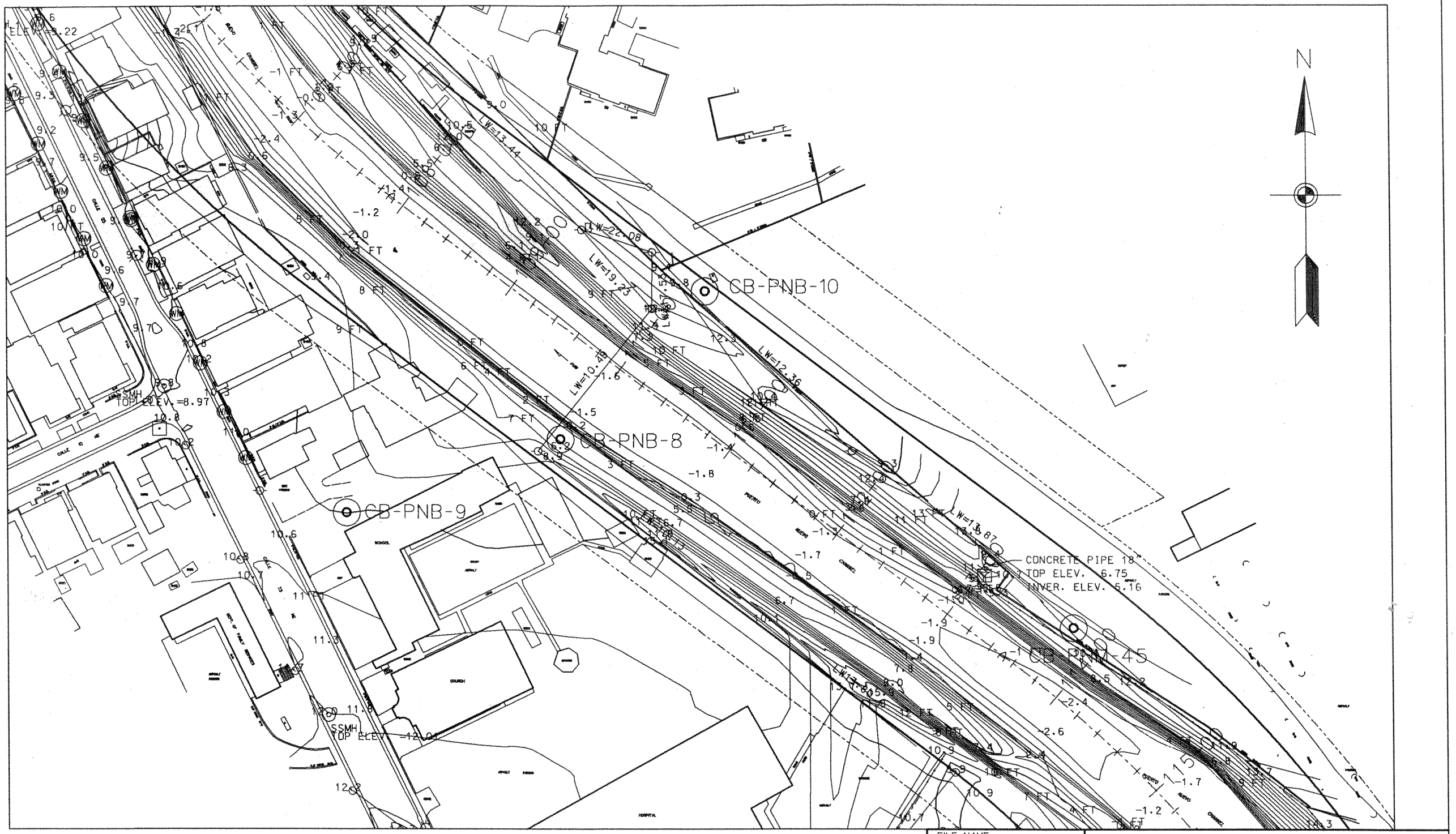
- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

80' 0 80'

FILE NAME: pnf2c10.dgn REFERENCE FILE NAME: pn.dgn t330rold.dgn t330rt01.dgn t330ru01.dgn x085_row.dgn x085_ce.dgn fdm2algn.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 PUERTO NUEVO CHANNEL PLAN SHEETS STA. 99+73.28 TO STA. 105+85.66 LEVEES AND WATERWAYS DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DESIGN ENG.: K.H.W.	
DWN. BY: K.H.W./R.L.H. / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997

MATCH TO SHEET 10. - STA. 105+85.66



LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

MATCH TO SHEET 12. - STA. 115+38.17

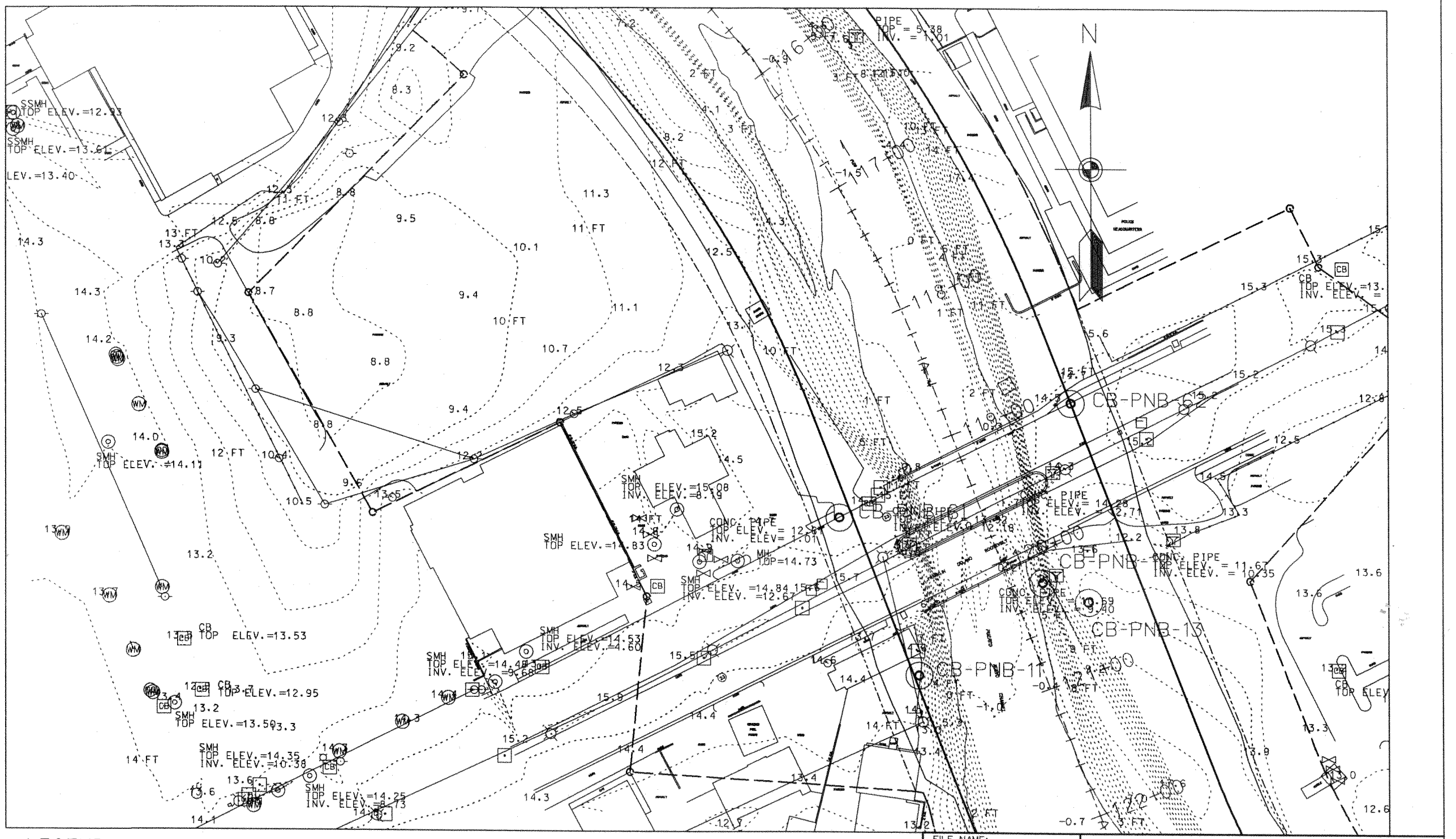
GRAPHIC SCALE

80' 0 80'

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DESIGN ENG.: K.H.W.	
DWN. BY: K.H.W./R.L.H. / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997

pnf2c11.dgn

MATCH TO SHEET 11. STA. 115+38.17



MATCH TO SHEET 13. - STA. 122+14.65

LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

80' 0 80'

FILE NAME:
pnf2c12.dgn

REFERENCE FILE NAME:
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t330rold.dgn
t330rt01.dgn
t330ru01.dgn
x085_row.dgn
x085_ce.dgn
fdm2algn.dgn

DESIGN ENG.:
K.H.W.

DWN. BY: K.H.W./R.L.H.

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

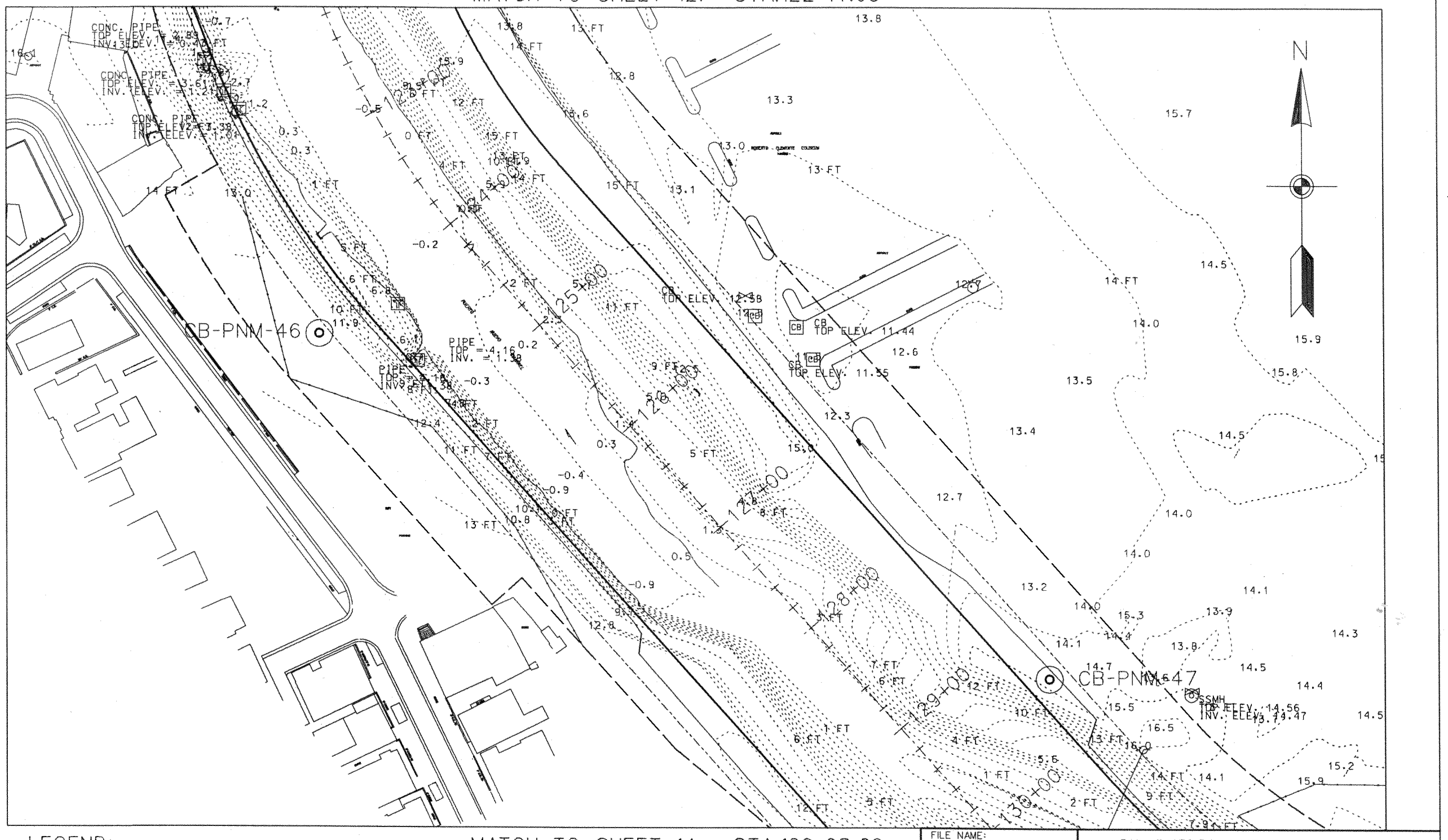
PUERTO NUEVO CHANNEL
PLAN SHEETS
STA. 115+38.17 TO 122+14.65
LEVEES AND WATERWAYS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997

PLATE L-12

MATCH TO SHEET 12. - STA.122+14.65



MATCH TO SHEET 14. - STA.129+98.69

LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

80' 0 80'

FILE NAME:
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REFERENCE FILE NAME:
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t330ru01.dgn
x085_row.dgn
x085_ce.dgn
fdm2algn.dgn

DESIGN ENG.: K.H.W.

DWN. BY: K.H.W./R.L.H.

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL

PLAN SHEETS

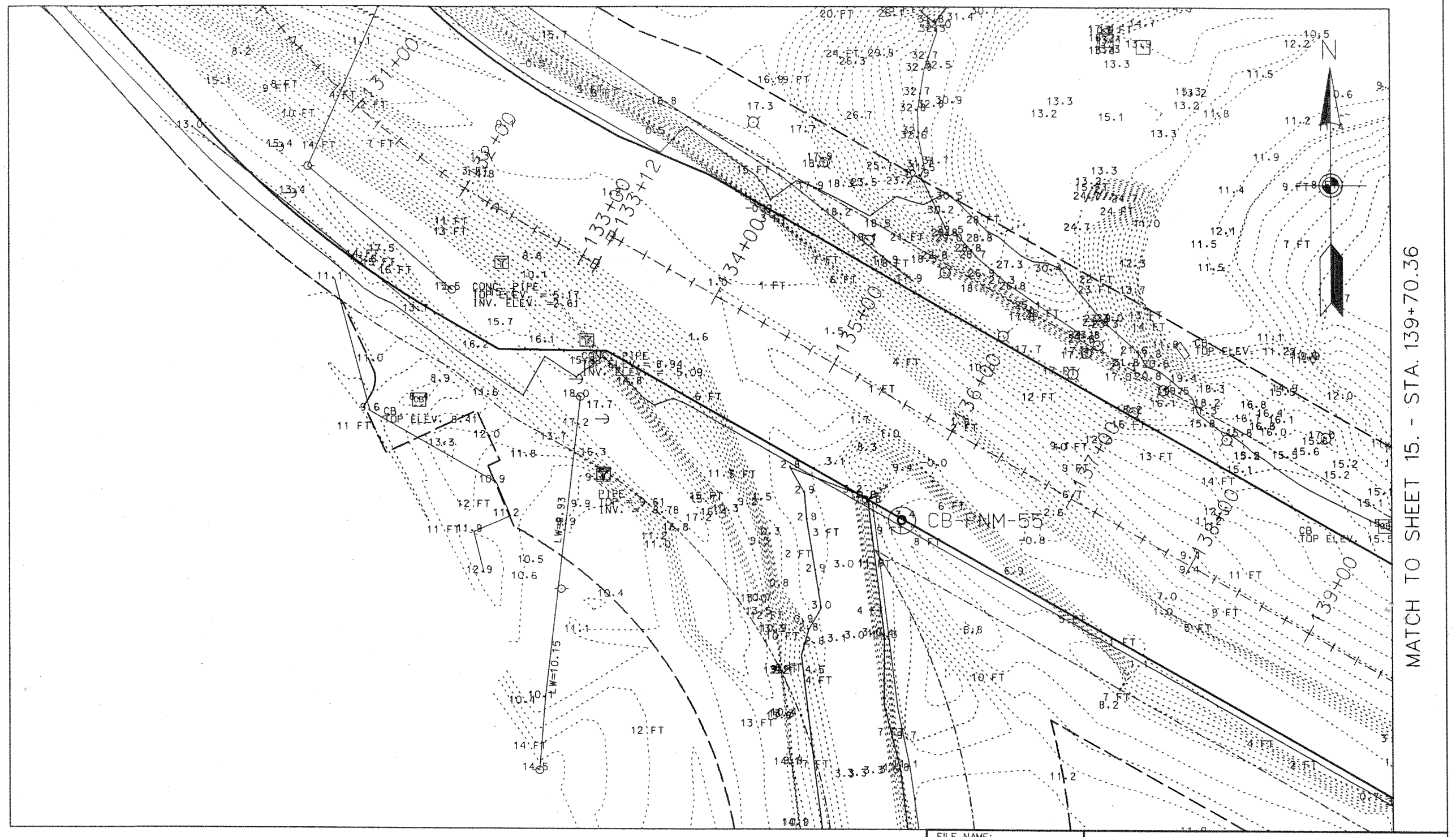
STA. 122+14.65 TO STA. 129+98.69

LEVEES AND WATERWAYS

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997



LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

80' 0 80'

FILE NAME:
pnf2c14.dgn
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t330ru01.dgn
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x085_ce.dgn
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DESIGN ENG.:
K.H.W.

DWN. BY:
K.H.W./R.L.H.

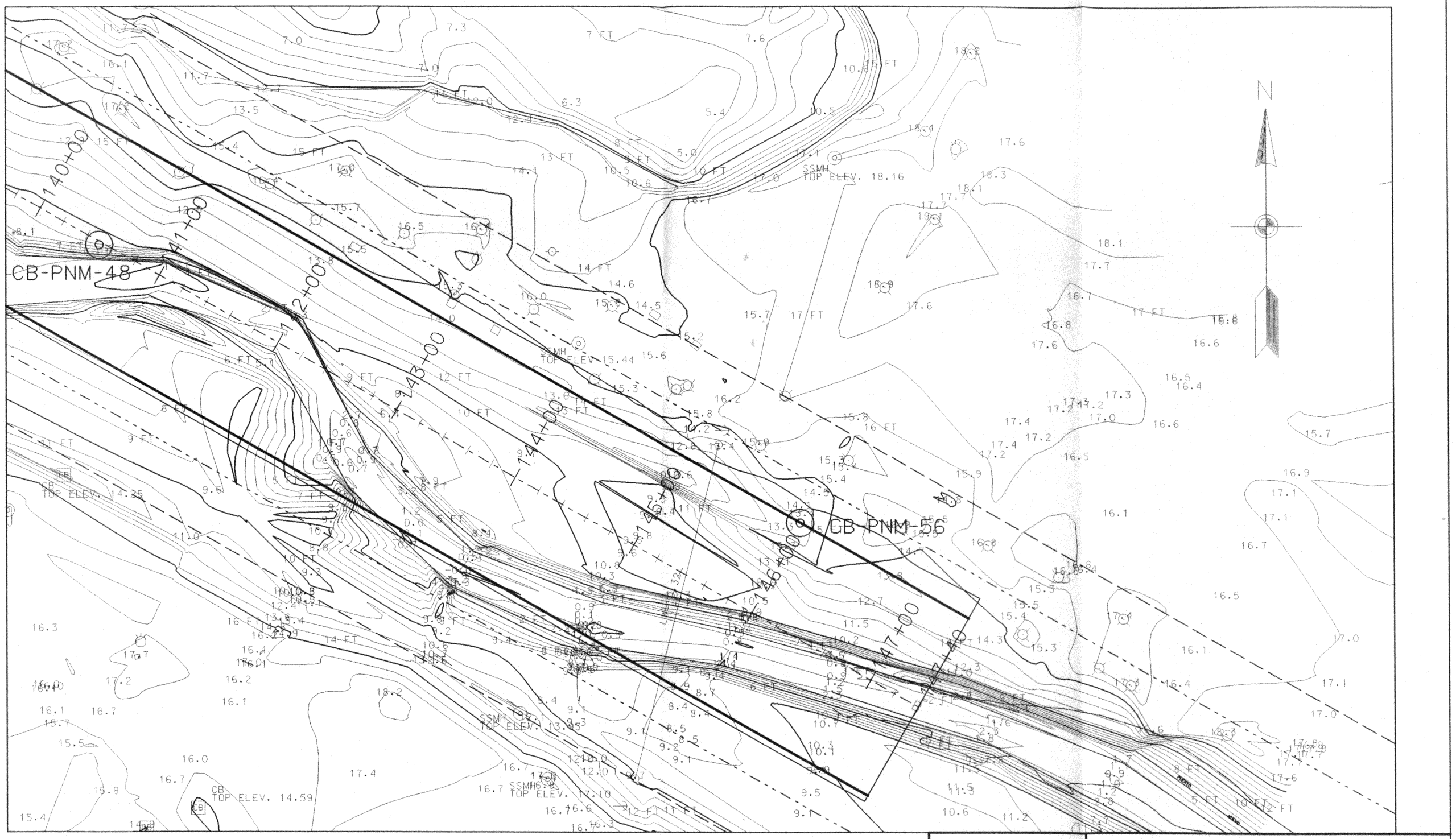
CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL
PLAN SHEETS
STA. 129+98.69 TO STA. 139+70.36
LEVEES AND WATERWAYS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997



LEGEND:

- RIGHT-OF-WAY
- CONSTRUCTION LIMITS
- CENTERLINE OF CHANNEL
- MAJOR CONTOUR
- MINOR CONTOUR

GRAPHIC SCALE

80' 0 80'

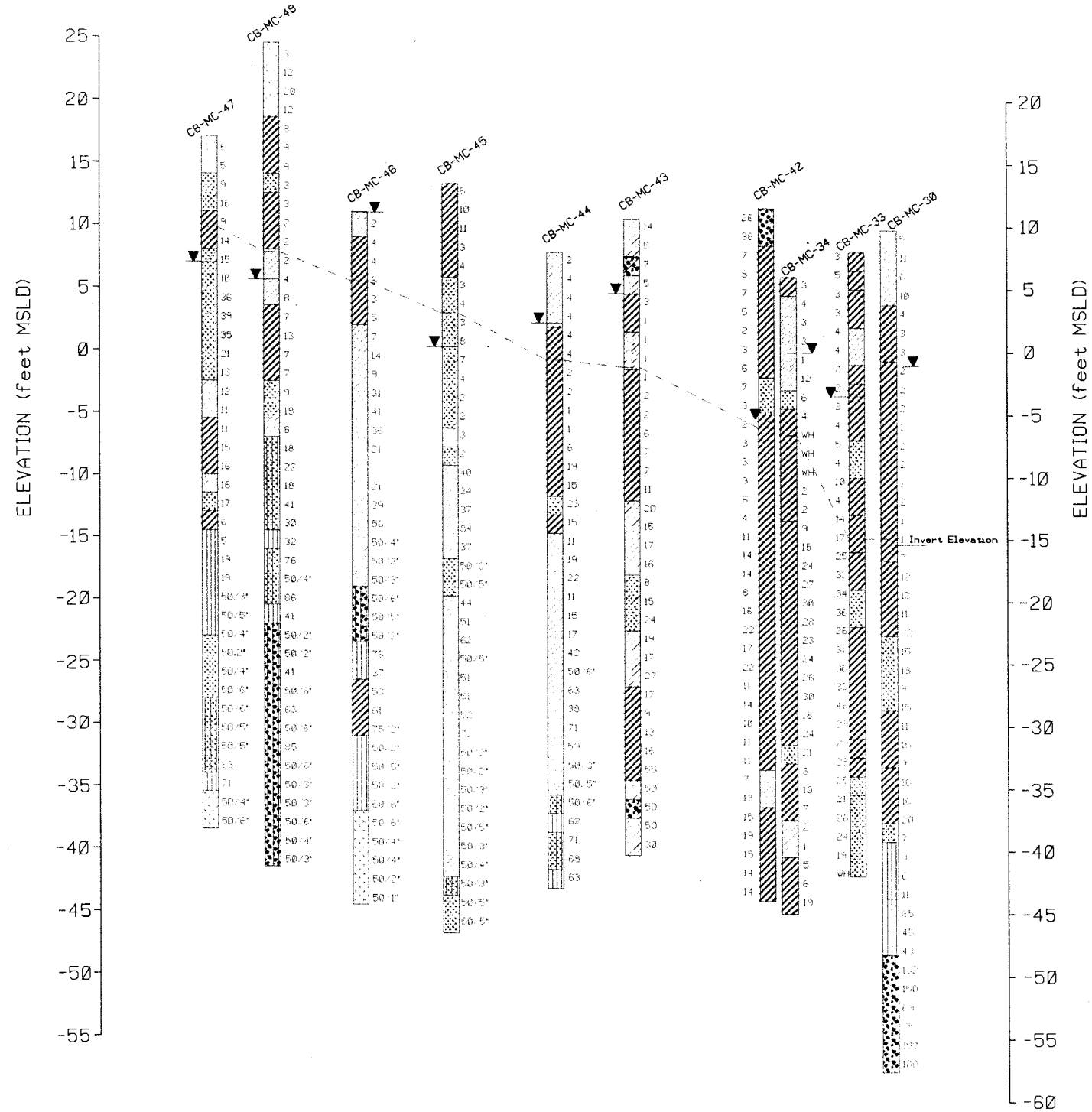
DESIGN ENG.: K.H.W.	
DWN. BY: K.H.W./R.L.H.	CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2
PUERTO NUEVO CHANNEL
MAIN CHANNEL
STA. 139+70.36 TO STA. 147+40
LEVEES AND WATERWAYS
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-37,451 NOVEMBER 1997

pnf2ch15.dgn

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

GEOTECHNICAL
PLATES



(CH) HIGH PLASTICITY CLAY

(CL) LOW PLASTICITY CLAY

(OH) ORGANIC CLAY

(ML) LOW PLASTICITY SILT

(SC) CLAYEY SAND

(SM) SILTY SAND

(SP) POORLY GRADED SAND

(GC) CLAYEY GRAVEL

(GM) SILTY GRAVEL

(SS) SILTSTONE

-- INVERT ELEVATION

▼_ OBSERVED GROUNDWATER ELEVATION DURING DRILLING

NOTES:

1. See plates L1 thru L7 for core boring locations.
2. Groundwater is subject to fluctuation.

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL
MARGARITA TRIBUTARY
GEOLOGIC SECTION

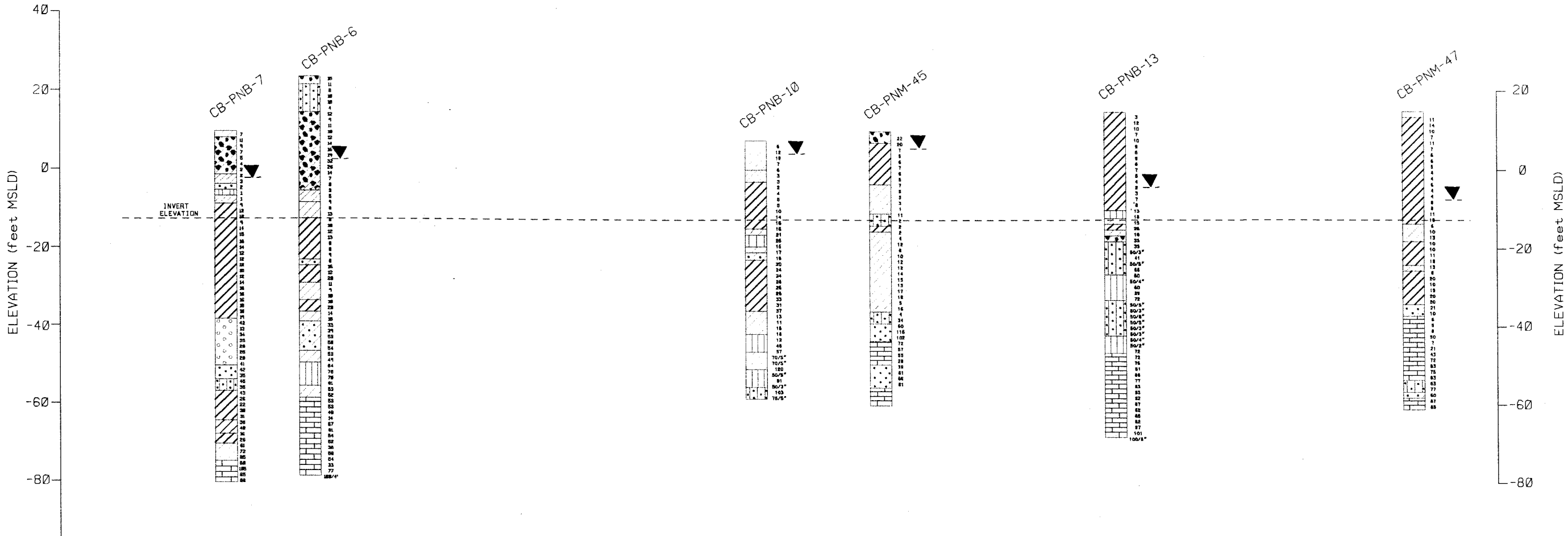
GEOTECHNICAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

DESIGN ENG.:	
	P.S.
DWN. BY:	CKD. BY:
D.H.	P.S.

D.O. FILE NO. 101-37.451 NOVEMBER 1997

PLATE G-1



LEGEND:

(CH) HIGH PLASTICITY CLAY

(SC) CLAYEY SAND

(GC) CLAYEY GRAVEL

(OH) ORGANIC CLAY

(SM) SILTY SAND

(LM) LIMESTONE

(CL) LOW PLASTICITY CLAY

(SP) PODRLY GRADED SAND

0 250

feet

HORIZONTAL SCALE

NOTE:

1. See plates L-8 thru L-13 for core boring locations.
2. Groundwater is subject to fluctuate.

▼ OBSERVED GROUNDWATER ELEVATION DURING DRILLING

- - - - PROPOSED CHANNEL INVERT

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2
PUERTO NUEVO CHANNEL
MAIN CHANNEL RETAINING WALL
NORTH BANK

GEOLOGIC SECTION

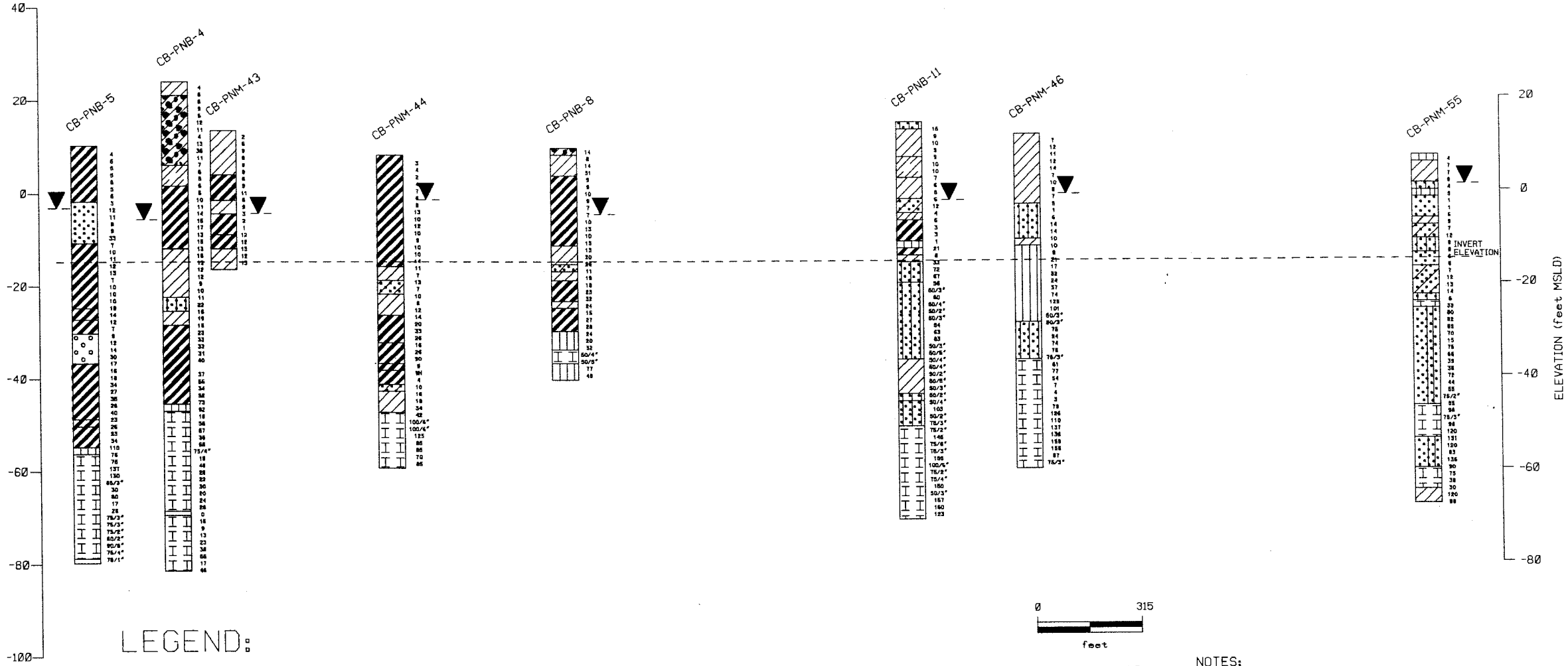
GEOTECHNICAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

DESIGN ENG.:	
P.S.	
DWN. BY:	CKD. BY:
D.H.	P.S.

D.O. FILE NO. 101-37.451 NOVEMBER 1997

PLATE G-2



LEGEND:

(CH) HIGH PLASTICITY CLAY

(CL) LOW PLASTICITY CLAY

(DH) ORGANIC CLAY

(ML) LOW PLASTICITY SILT

(SC) CLAYEY SAND

(SM) SILTY SAND

(SP) POORLY GRADED SAND

(SW) WELL GRADED SAND

(SP-SM) POORLY GRADED SILTY SAND

(GC) CLAYEY GRAVEL

(LM) LIMESTONE

0 315

feet

HORIZONTAL SCALE

NOTES:

1. See plates L-9 thru L-14 for core boring locations.
2. Groundwater is subject to fluctuate.

PROPOSED CHANNEL INVERT

OBSERVED GROUNDWATER ELEVATION DURING DRILLING

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL
MAIN CHANNEL RETAINING WALL
SOUTH BANK

GEOLOGIC SECTION

GEOTECHNICAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

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	P.S.
DWN. BY: D.H.	CKD. BY: P.S.

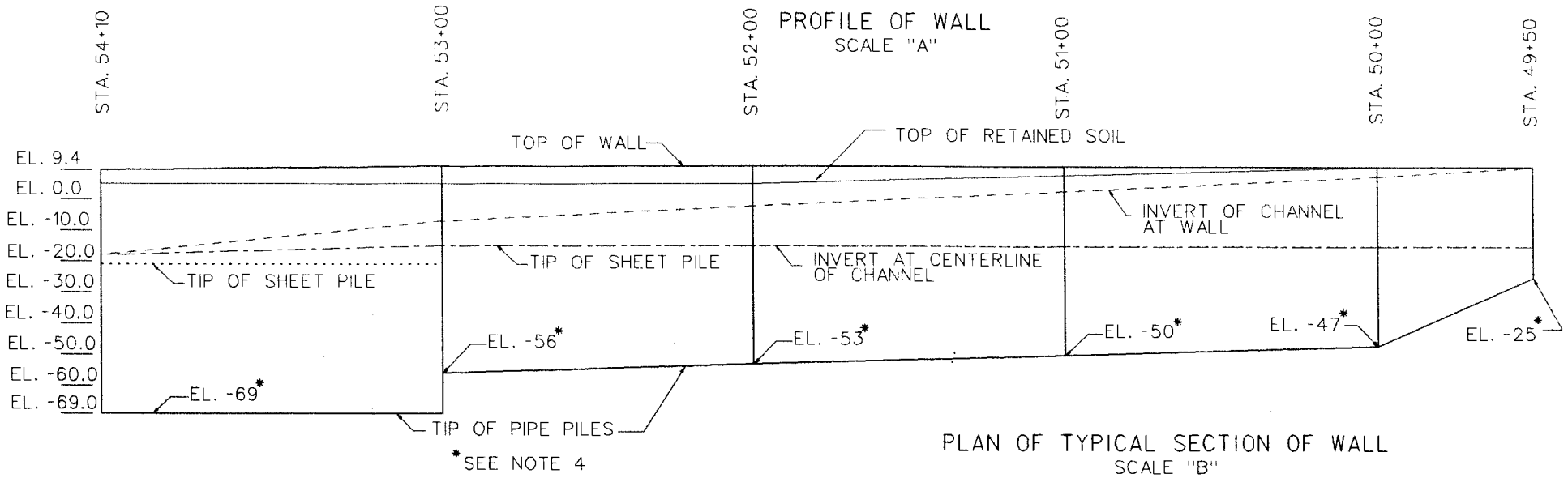
D.O. FILE NO. 101-37,451 NOVEMBER 1997

NOTES:
1. SEE PLATE L-1 AND L-2 FOR PLAN VIEW OF THE WALL.
2. ALL OF THE UNDRAINED (Q) LOAD CASES INCLUDED A WATER FILLED CRACK NEXT TO THE SHEET PILE FROM THE GROUND SURFACE TO A DEPTH EQUAL TO Dc=2(C)/GAMMA.
3. THIS STATION WAS NOT EVALUATED BECAUSE THE STABILITY REQUIRED PENETRATION INTO THE LIMESTONE LAYER. THEREFORE, THE DEEP SEATED STABILITY DID NOT CONTROL.
4. THE TIP ELEVATION OF THE PIPE PILES IS BASED ON THE DEEPER OF (1) THE DEPTH REQUIRED FOR SYSTEM STABILITY OR (2) THE DEPTH REQUIRED TO PREVENT DEEP-SEATED ROTATIONAL FAILURE OF THE ENTIRE SOIL MASS.

EN-GS REQUIRED PILE TIP ELEVATIONS		
STATION	PIPE PILES	SHEET PILES
54+10	SEE NOTE 3	-21
53+00	-43*	-15
52+00	-37*	-15
51+00	-28*	-15
50+00	-25*	-15

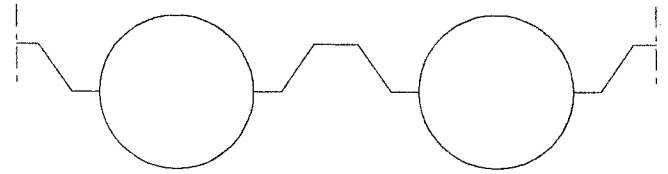
*SEE NOTE 4

PROFILE OF WALL
SCALE "A"



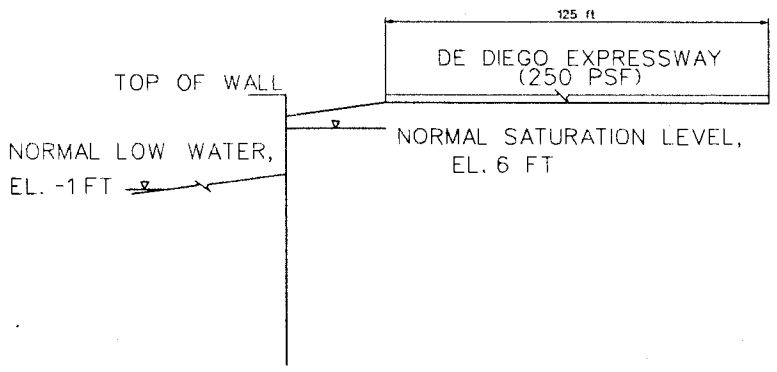
*SEE NOTE 4

PLAN OF TYPICAL SECTION OF WALL
SCALE "B"

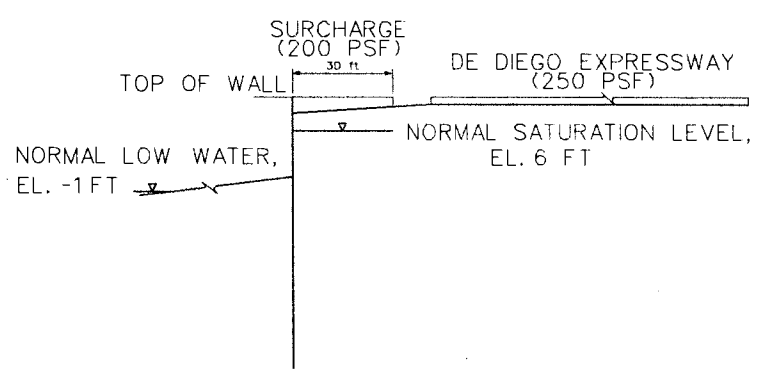


LOAD CASES:

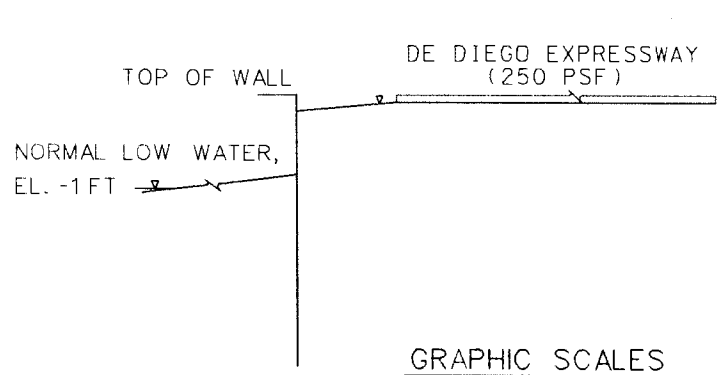
LOAD CASE 1:
USUAL LOAD CASE
NORMAL SATURATION LEVEL
NORMAL LOW WATER
DRAINED SOIL CONDITIONS (S)



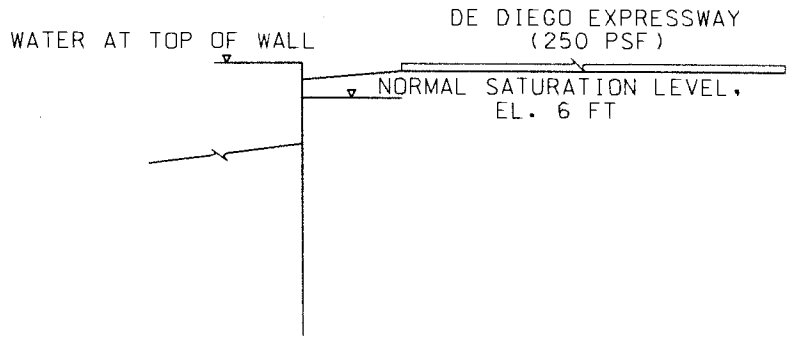
LOAD CASE 2:
UNUSUAL LOAD CASE
CONSTRUCTION LOAD
NORMAL SATURATION LEVEL
200 PSF SURCHARGE
UNDRAINED SOIL CONDITION (Q)



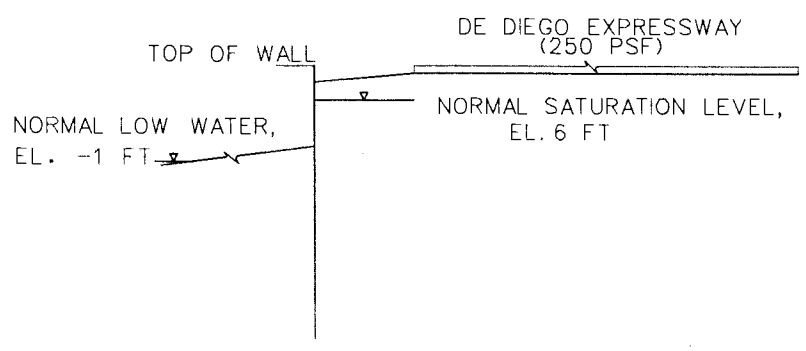
LOAD CASE 3:
EXTREME LOAD CASE
POST FLOOD CONDITIOIN
WATER HAS BEEN TO TOP OF WALL AND HAS SATURATED THE SOIL
FLOOD WATERS HAVE SUBSIDED IN CHANNEL
UNDRAINED SOIL CONDTIONS (Q) (3B: S)



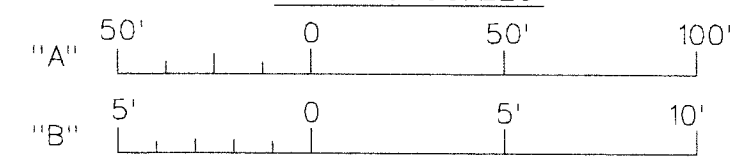
LOAD CASE 4:
EXTREME LOAD CASE
FLOOD CONDITION
WATER TO TOP OF WALL
NORMAL SATURATION
UNDRAINED CONDITION (Q)



LOAD CASE 5:
EXTREME LOAD CASE
EARTHQUAKE LOAD (a=.15g)
NORMAL WATER AND SATURATION LEVELS
CONSOLIDATED, UNDRAINED SOIL CONDITIONS (R)



GRAPHIC SCALES



FILE NAME: puerto2/fdm2/ds/pnf2s01.dgn

DESIGN ENG.: DAD
DWN. BY: | CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL

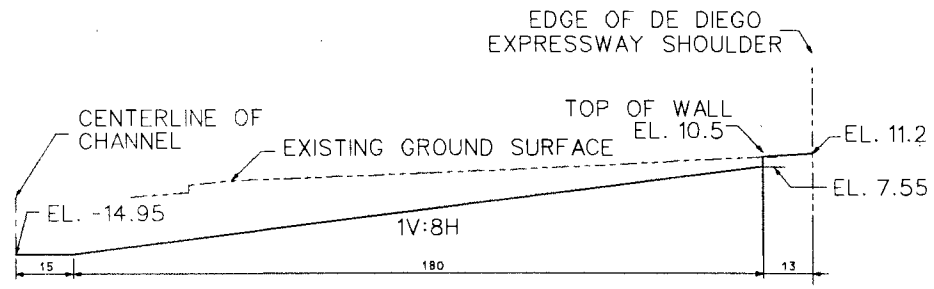
DE DIEGO EXPRESSWAY WALL
ELEVATION, SECTIONS, LOADING CONDITIONS
STRUCTURAL

DEPARTMENT OF THE ARMY

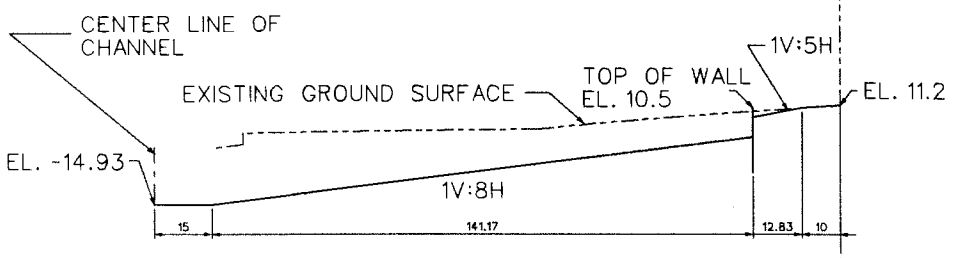
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-37,451 NOVEMBER 1997

PLATE L-3

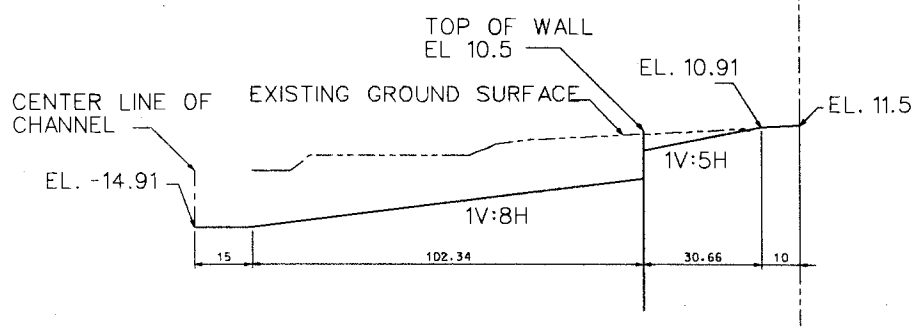
SECTION AT STA. 50+00



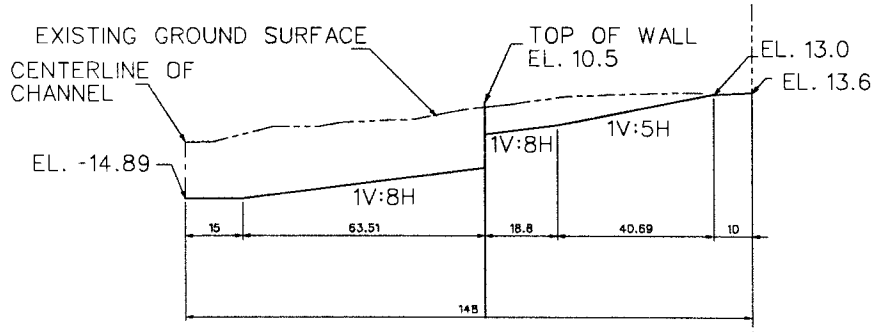
SECTION AT STA. 51+00



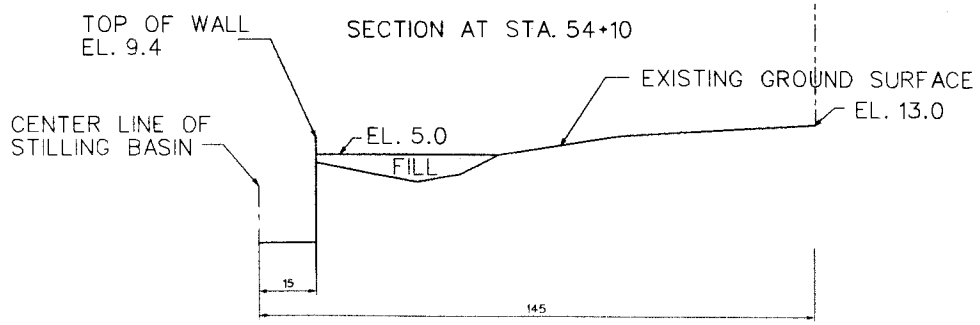
SECTION AT STA. 52+00



SECTION AT STA. 53+00



SECTION AT STA. 54+10



SUMMARY OF ANALYSIS RESULTS						
	LOAD CASE AND SOIL CONDITION					
STATION	1 S	2 Q	3 Q	3B S	4 Q	5 R
	PIPE PILE TIP ELEVATION (FT)					
50+00	-46.2	-16.2	-16.2	-46.2	-26.2	-37.4
51+00	-49.9	-26.2	-37.8	-49.9	-42.8	-41.6
52+00	-52.8	-34.5	-47.8	-52.8	-42.8	-42.8
53+00	-55.3	-47.8	-48.7	-55.3	-47.0	-47.8
54+10	-68.9	-59.8	-66.4	-68.1	-58.9	-63.1
	MAXIMUM BENDING MOMENT (IN LBS)					
50+00	5,607,000	.159,200	159,200	9,277,000	-808,700	2,118,000
51+00	7,567,000	576,300	3,603,000	7,828,000	-6,938,000	7,265,000
52+00	7,650,000	1,609,000	11,940,000	7,636,000	-5,457,000	5,272,000
53+00	10,340,000	8,922,000	11,560,000	12,510,000	7,344,000	12,450,000
54+10	25,810,000	15,900,000	29,940,000	26,520,000	-13,330,000	44,180,000
	MAXIMUM DEFLECTION (INCHES)					
50+00	1.9	0.1	.1	3.3	-1.5	0.5
51+00	3.2	0.1	1.0	3.3	-2.1	2.0
52+00	3.5	0.4	4.7	3.5	-1.7	1.5
53+00	5.3	3.5	4.9	6.6	-2.7	4.4
54+10	5.1	2.7	6.3	5.3	-2.2	6.8
	REQUIRED SECTION MODULUS (IN^3)					
50+00	249	5	4	236	21	54
51+00	336	19	92	199	176	185
52+00	340	54	303	194	139	134
53+00	460	298	294	318	187	316
54+10	1147	531	760	673	339	1122

NOTES:

1. THE SOIL PROPERTIES WERE PROVIDED BY EN-GS AND WERE BASED ON BORINGS MC-30, MC-32, MC-33, MC-52 AND MC-34.
2. THE REQUIRED SECTION MODULUS IS BASED ON THE CONTROLLING MAXIMUM MOMENTS AND ALLOWABLE STRESSES EQUAL TO 0.5Fy FOR USUAL LOADS, 0.665Fy FOR UNUSUAL LOADS AND 0.875Fy FOR EXTREME LOADS.

GRAPHIC SCALE

50' 0 50' 100'

FILE NAME: puerto2/fdm2/ds/pnf2s02.dgn

DESIGN ENG.: DAD

DWN. BY: CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL

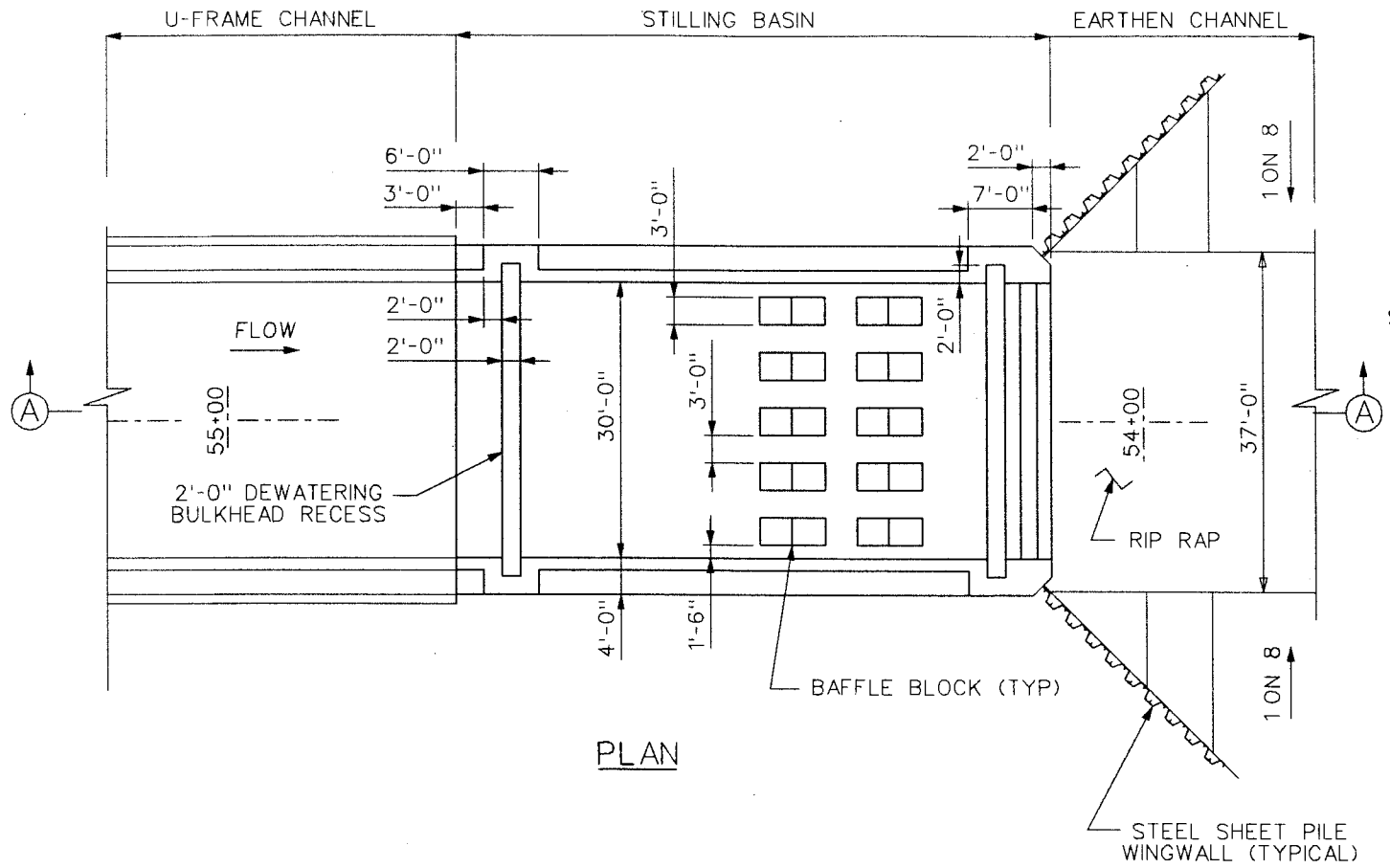
DE DIEGO EXPRESSWAY WALL
ELEVATION, SECTIONS, LOADING CONDITIONS

STRUCTURAL

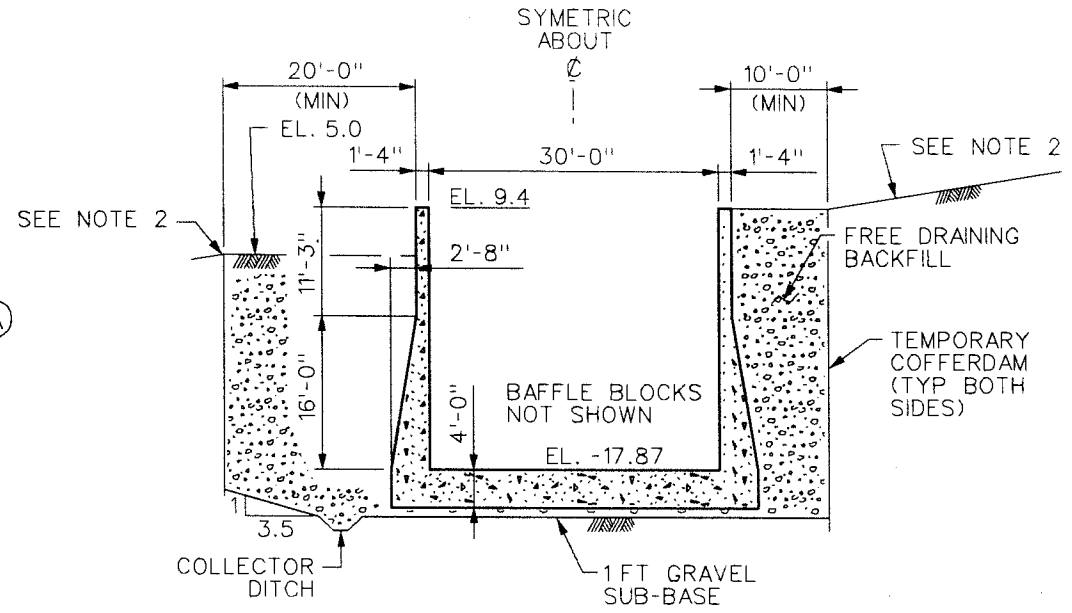
DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

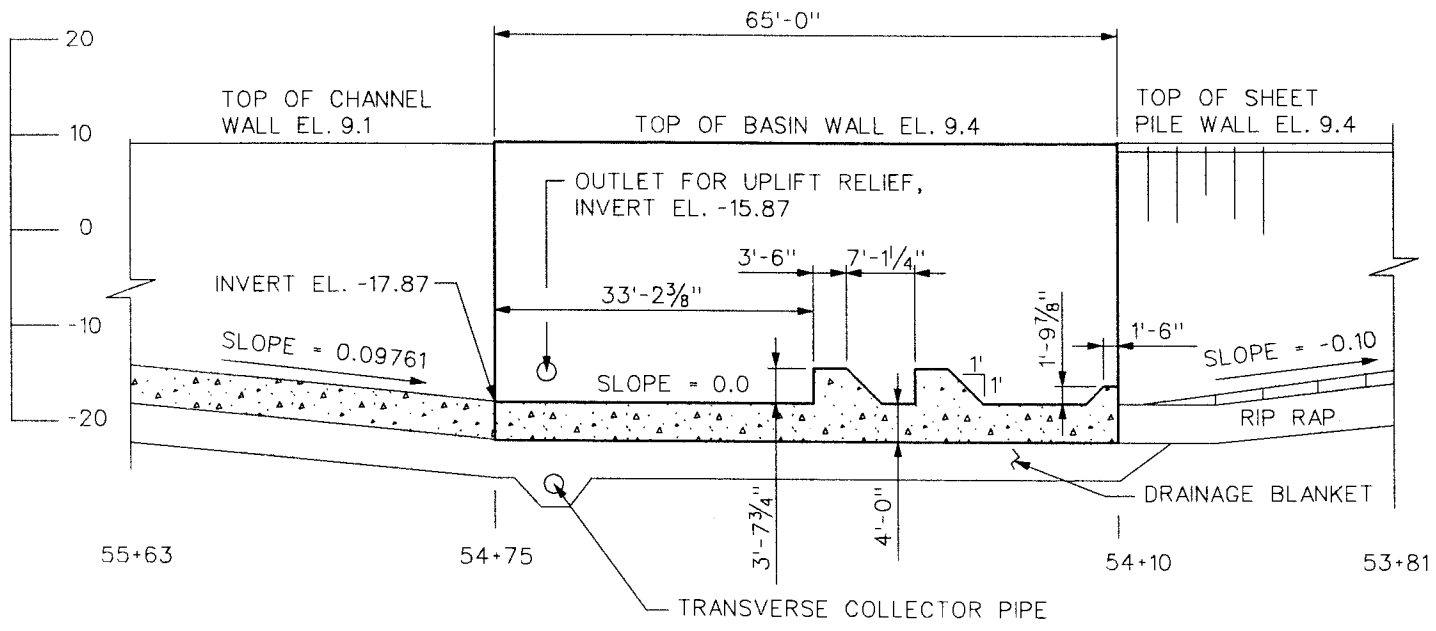
D.O. FILE NO. 101-37,451 NOVEMBER 1997



PLAN



STA 54+10 - 54+75
(LOOKING UPSTREAM)



SECTION A

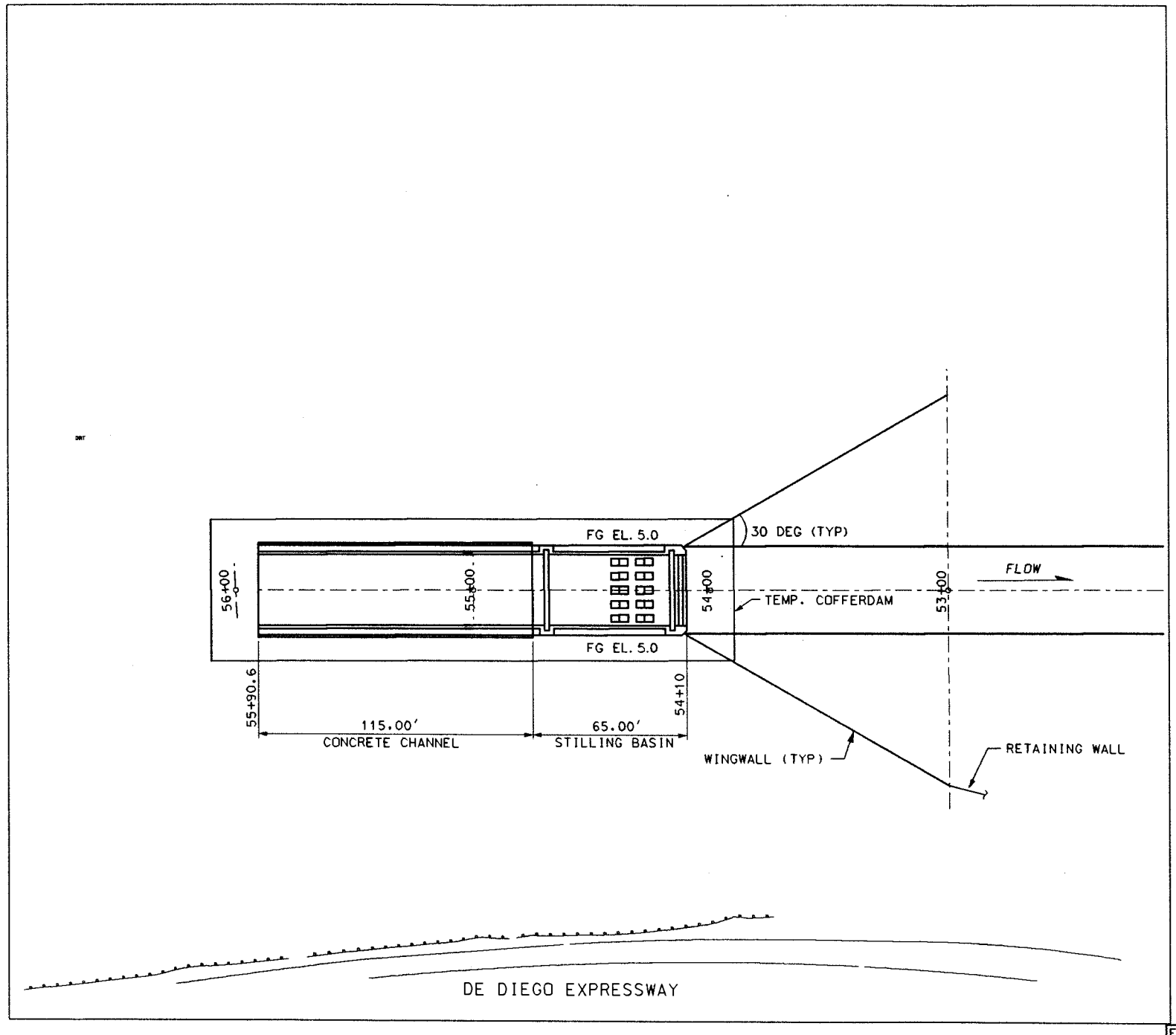
NOTES:

1. ELEVATIONS ARE WITH RESPECT TO NATIONAL GEODETIC VERTICAL DATUM (NGVD).
2. GRADE TO MATCH EXISTING CONTOURS.

GRAPHIC SCALE

20' 0 20' 40'

FILE NAME: puerto2/fdm2/ds/pnf2s03.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 MARGARITA CHANNEL - STA. 54+10 TO 54+75 STILLING BASIN PLAN, PROFILE, AND SECTION STRUCTURAL
DESIGN ENG.: MWW	DEPARTMENT OF THE ARMY
DWN. BY: MWW / CKD. BY:	JACKSONVILLE DISTRICT, CORPS OF ENGINEERS D.O. FILE NO. 101-37,451 NOVEMBER 1997



SITE PLAN

CONSTRUCTION SEQUENCE:

1. CONSTRUCT COFFERDAM AS INDICATED. ACTUAL LIMITS WILL BE BASED ON CONTRACTOR PROVIDED DEWATERING SYSTEM.
2. DIVERT EXISTING CHANNEL FLOW SOUTH OF COFFERDAM INTO COMPLETED CHANNEL.
3. CONSTRUCT BASIN AND CHANNEL FROM STA. 54+10 TO 56+00.
4. CUT PARTIAL TEMPLATE AT MOUTH OF BASIN. DIVERT FLOW THRU CONSTRUCTED CHANNEL.
5. CONSTRUCT WINGWALLS FOR BASIN.
6. COMPLETE TEMPLATE AND INSTALL RIP RAP.
7. GRADE AS INDICATED ON GRADING PLANS.

NOTES:

1. EXISTING CONTOURS ARE SHOWN. FINISHED GRADE (FG) ELEVATIONS ARE THOSE ASSUMED IN STRUCTURAL DESIGN. ALL ELEVATIONS ARE NATIONAL GEODETIC VERTICAL DATUM (NGVD).
2. UTILITIES AND SOIL BORING LOCATIONS NOT SHOWN.

GRAPHIC SCALE

60' 0 60' 120'

FILE NAME: puerto2/fdm2/ds/pnf2s04.dgn

DESIGN ENG.: MWW

DWN. BY: MWW | CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL - STA 54+10 TO 54+75

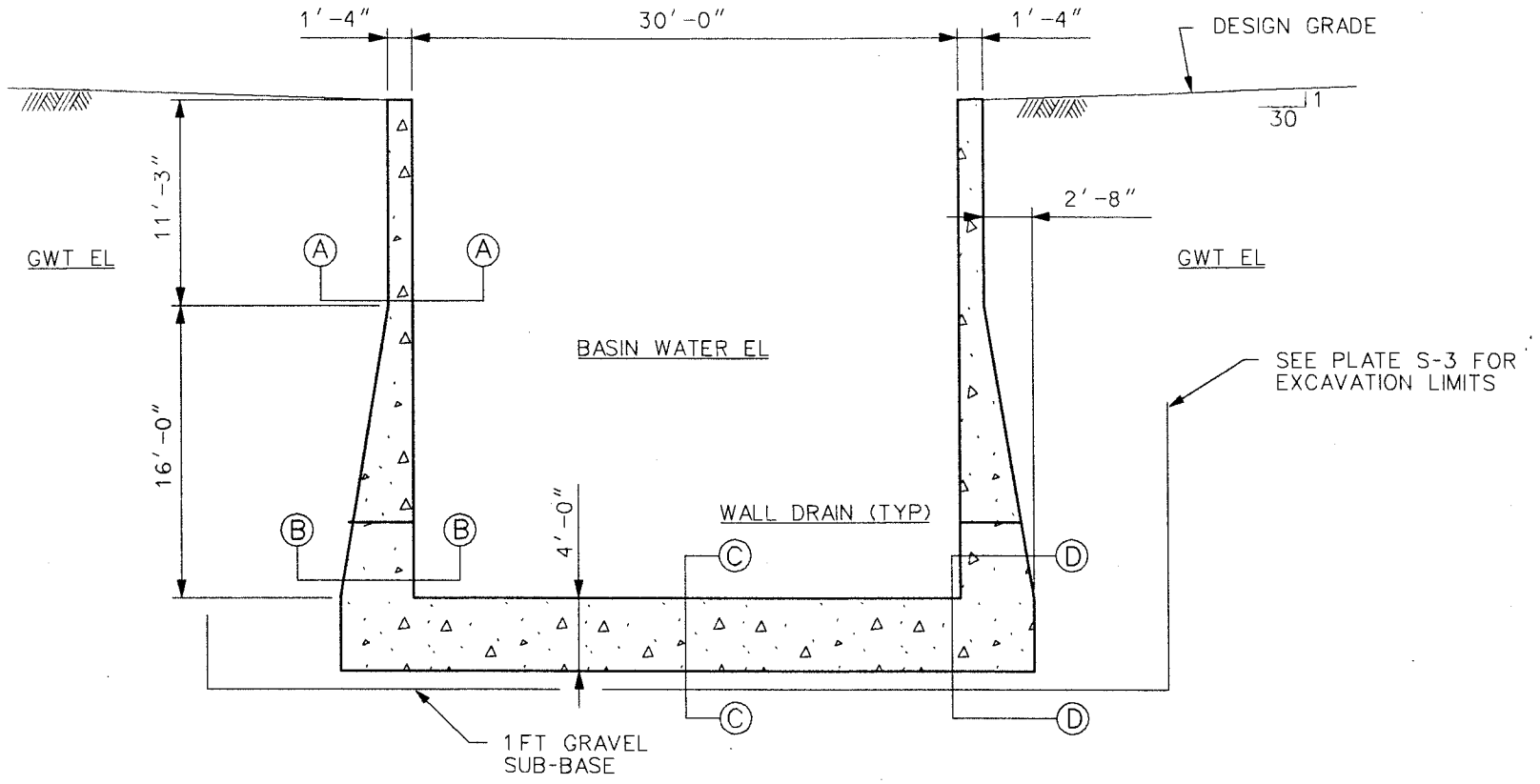
STILLING BASIN
CONSTRUCTION SEQUENCE

STRUCTURAL

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997



STA 54+10 - 54+75

STATION	LOCATION	VU (KIPS)	MU (K-FT)	A(ST) (SQ IN)	LOAD CASE
54+10	A	4.42	11.05	0.06	3
	B	46.41	448.63	2.49	3
	C	1.65	232.05	1.25	1(SHEAR)/3(MOMENT)
	D	28.73	477.36	2.66	3
54+75	A	4.42	11.05	0.06	2
	B	55.25	475.15	2.65	2
	C	0	238.68	1.29	2
	D	33.15	510.51	2.86	2

LOAD CASE DESCRIPTIONS:

1: POST-CONSTRUCTION CONDITION: UNUSUAL; BASIN EMPTY STRUCTURE COMPLETE WITH BACKFILL NOT IN PLACE; WIND LOAD 50 PSF, Q-STATE SOILS.

2: SPF CONDITION: USUAL; BASIN WATER VARIES WITH HYDRAULIC JUMP, GWT EL. 6.0 NGVD, WALL DRAINS 50% EFFECTIVE, S-STATE SOILS.

3: DRAWDOWN CONDITIONS: UNUSUAL, BASIN WATER EL -1.0 NGVD, GWT EL 7.0 NGVD, WALL DRAINS 50% EFFECTIVE; S-STATE SOILS.

NOTES:

1. SHEAR FORCES AND BENDING MOMENTS SHOWN ARE MAXIMUM FOR ALL LOAD CASES.
2. REQUIRED REINFORCING STEEL BASED ON EM 1110-2-2104, ASSUMING 28-DAY CONCRETE STRENGTH OF 3000 PSI AND ASTM A615 GR 60 STEEL. MINIMUM REINFORCEMENT FOR TEMPERATURE AND SHRINKAGE REQUIRED AT ALL OTHER SECTIONS.

LEGEND:
VU = FACTORED SHEAR FORCE
MU = FACTORED MOMENT BENDING
A(ST) = AREA OF TENSION REINFORCING STEEL REQUIRED

GRAPHIC SCALE

10' 0 10' 20'

FILE NAME: puerto2/fdm2/ds/pnf2s05.dgn

DESIGN ENG.: MWW

DWN. BY: MWW | CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

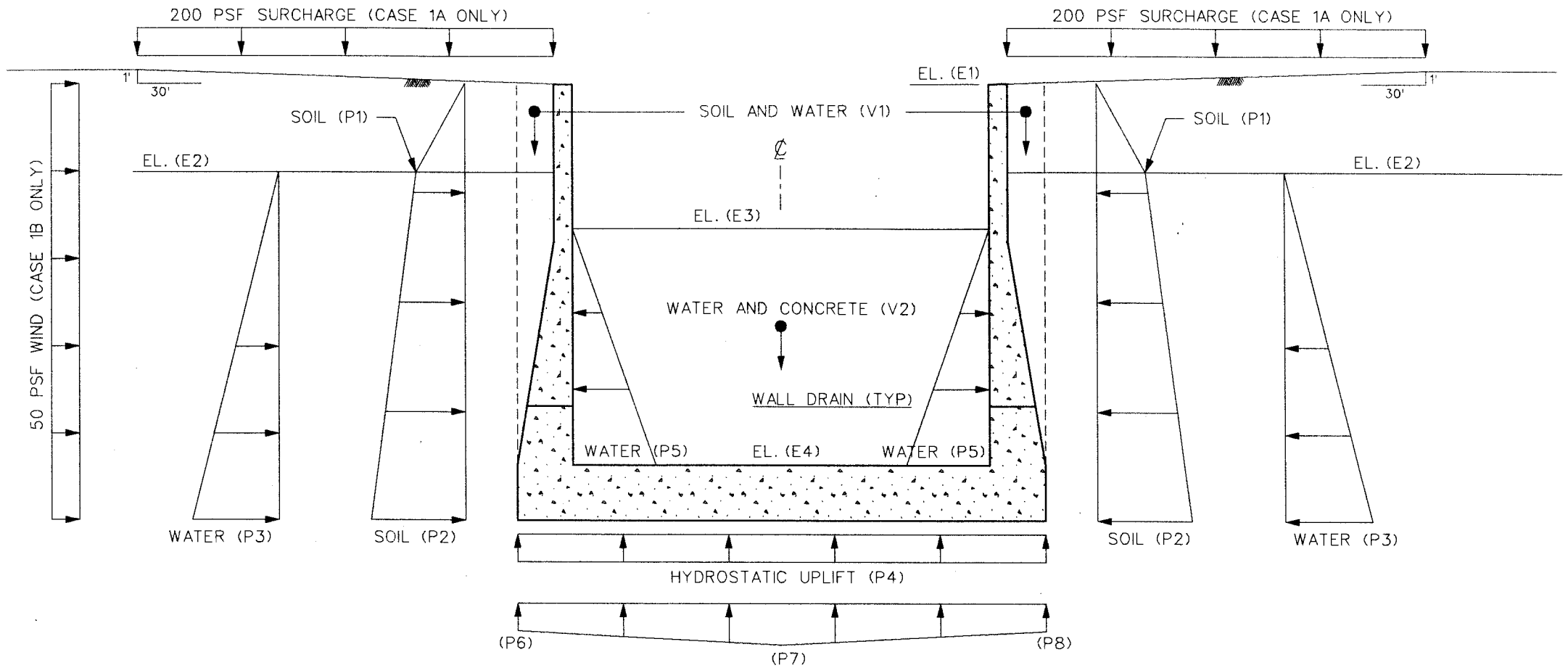
MARGARITA CHANNEL - STA 54+10 TO 54+75

STILLING BASIN
STRUCTURAL ANALYSIS

STRUCTURAL

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-37,451 NOVEMBER 1997



STA	LOAD CASE	ELEVATION E1 FT	E2 FT	E3 FT	E4 FT	PRESSURE P1 KSF	P2 KSF	P3 KSF	P4 KSF	P5 KSF	P6 KSF	P7 KSF	P8 KSF	LOAD V1 KIP	V2 KIP	FS: CALCULATED / ALLOWABLE BEARING	FLOTATION
54+10	1	9.40	-17.87	-17.87	-17.87	1.50	0.94	-1.12	-1.12	0.00	1.04	1.56	1.04	10.77	14.59	5.00 / 2.0	5.87 / 1.30
	1	9.40	-17.87	-17.87	-17.87	1.50	0.94	-1.12	-1.12	0.00	1.82	1.44	1.97	10.77	14.59	3.97 / 2.0	5.76 / 1.30
	2	9.40	6.00	6.40	-17.87	0.19	0.37	0.38	0.38	1.52	0.80	1.19	0.80	11.97	60.10	6.55 / 3.0	1.58 / 1.50
	2	9.40	6.00	9.30	-17.87	0.19	0.37	0.38	0.38	1.70	1.08	1.18	1.08	11.97	65.54	6.63 / 2.0	1.67 / 1.30
	3	9.40	6.00	-1.00	-17.87	0.19	0.37	0.38	0.38	1.05	0.52	1.20	0.52	11.97	46.22	6.51 / 3.0	1.55 / 1.50
	3	9.40	7.00	-1.00	-17.87	0.13	0.35	0.44	0.44	1.05	0.47	1.18	0.47	12.05	46.22	6.60 / 2.0	1.52 / 1.30
	3	9.40	7.00	-1.00	-17.87	0.13	0.35	0.44	0.44	1.05	0.28	1.11	0.28	12.05	46.22	7.05 / 1.0	1.41 / 1.10
54+75	2	9.40	6.00	-8.10	-17.87	0.19	0.37	0.38	0.38	0.61	0.36	1.10	0.36	11.97	32.91	7.12 / 3.0	1.53 / 1.50

LOAD CASE DESCRIPTIONS:

1: POST-CONSTRUCTION CONDITION: UNUSUAL; BASIN EMPTY STRUCTURE COMPLETE WITH BACKFILL NOT IN PLACE; WIND LOAD 50 PSF, Q-STATE SOILS.

2: SPF CONDITION: USUAL; BASIN WATER VARIES WITH HYDRAULIC JUMP, GWT EL. 6.0 NGVD, WALL DRAINS 50% EFFECTIVE, S-STATE SOILS.

3: DRAWDOWN CONDITIONS: UNUSUAL, BASIN WATER EL -1.0 NGVD, GWT EL 7.0 NGVD, WALL DRAINS 50% EFFECTIVE; S-STATE SOILS.

GRAPHIC SCALE

10' 0 10'

FILE NAME: puerto2/fdm2/ds/pnf2s06.dgn

DESIGN ENG.: MWW

DWN. BY: MWW | CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

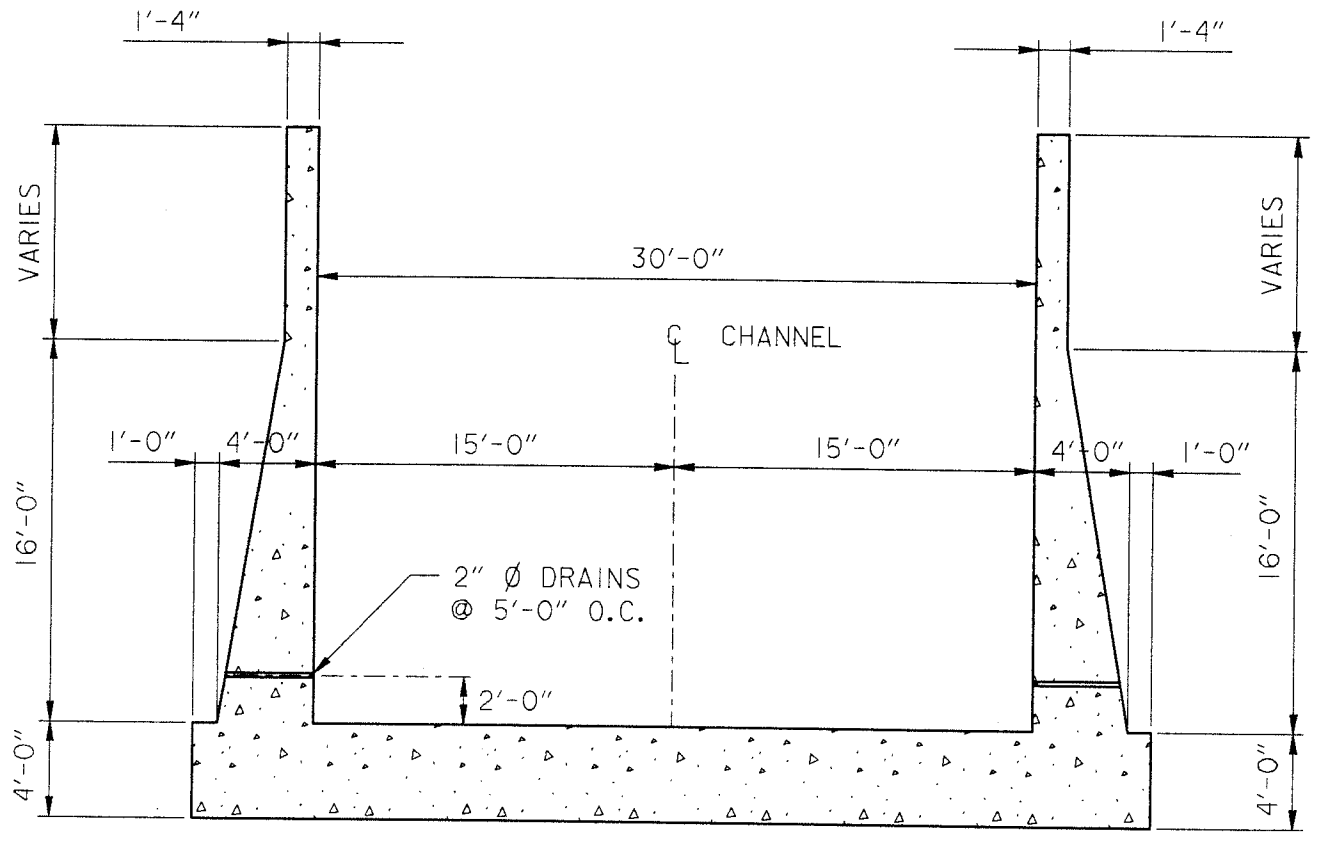
MARGARITA CHANNEL - STA 54+10 TO 54+75

STILLING BASIN
STABILITY ANALYSIS
STRUCTURAL

DEPARTMENT OF THE ARMY

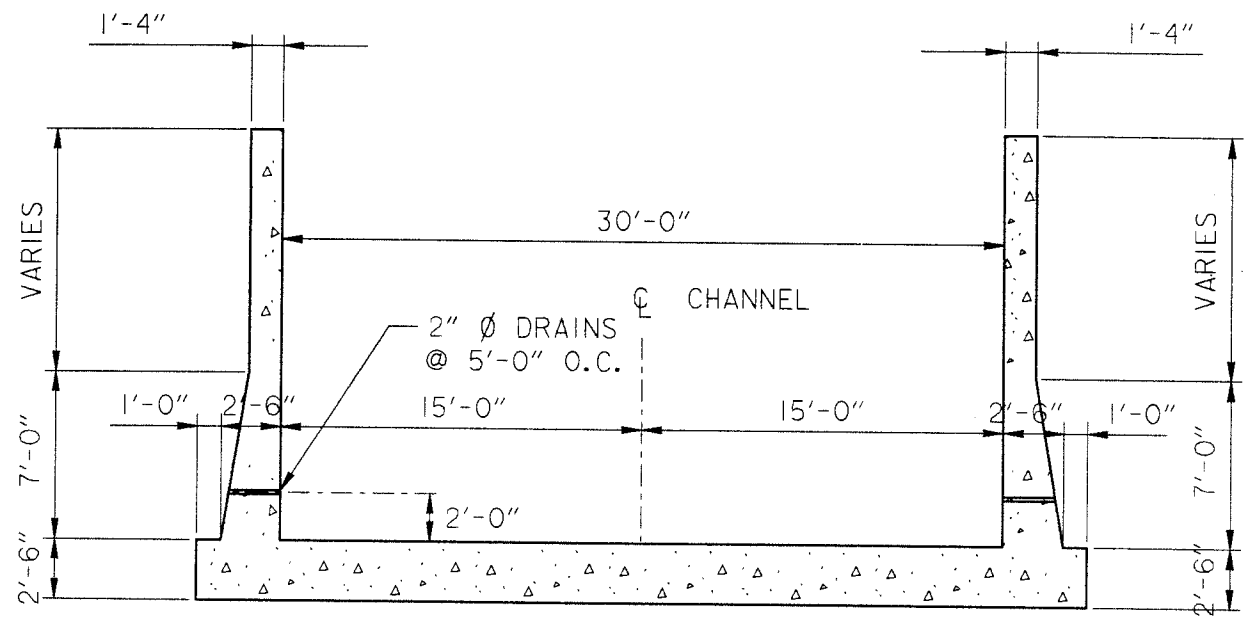
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMVBER 1997



STA 54+75.00 - STA 55+90.56

SCALE: "A"



STA 55+90.56 - STA 89+60.00

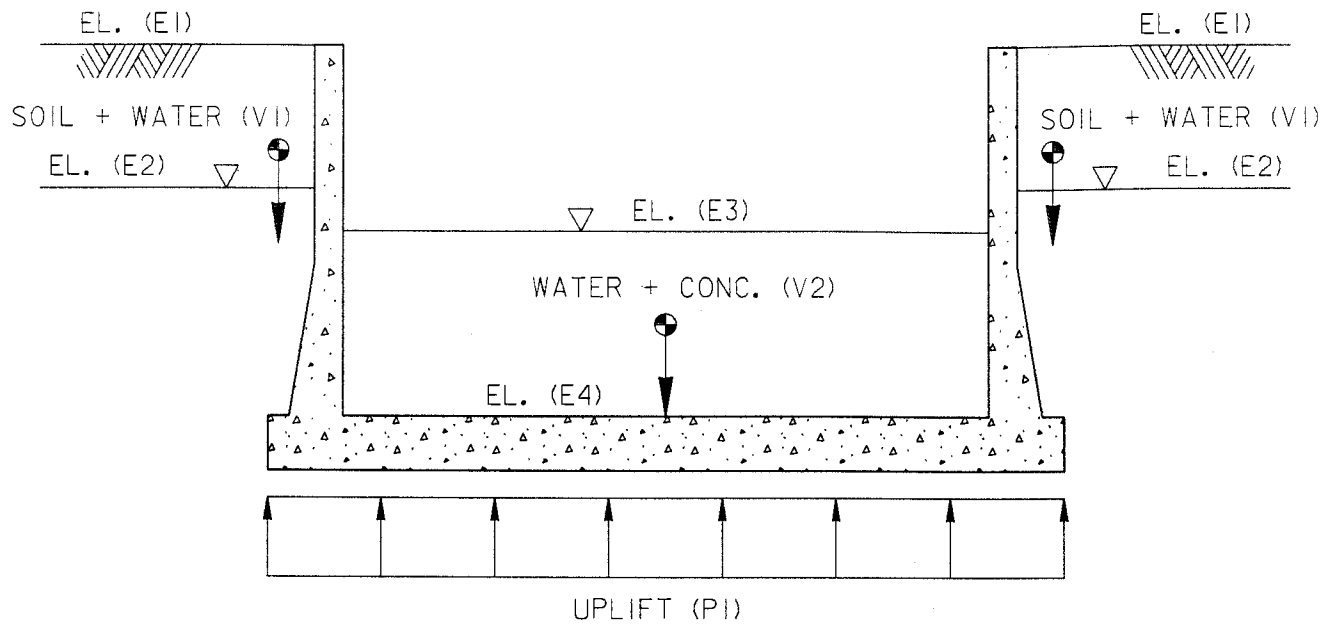
SCALE: "A"

GRAPHIC SCALE

"A" 6' 0 6' 12' 18'

FILE NAME: puerto2/fdm/ds/pnf2s07.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 MARGARITA CHANNEL - STA 54+75 TO 89+00 U-FRAME TYPICAL SECTIONS STRUCTURAL
DESIGN ENG.: EER	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: EER / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997

PLATE S-7



STATION	LOAD CASE	ELEVATION E1 FT	E2 FT	E3 FT	E4 FT	PRESSURE P1 KSF	LOAD V1 KIPS	V2 KIPS	FACTOR OF SAFETY CALCULATED / ALLOWABLE
54+75	1A	9.10	-21.87	-17.87	-17.87	0.00	3.17	41.2	9999 / 1.30
	1B	-21.87	-21.87	-17.87	-17.87	0.00	0.0	41.2	9999 / 1.30
	2A	9.10	-8.10	-8.10	-17.87	0.86	6.71	59.5	2.12 / 1.50
	2B	9.10	9.10	9.10	-17.87	1.94	9.92	91.9	1.44 / 1.30
	3A	9.10	3.50	1.00	-17.87	1.59	8.50	76.6	1.48 / 1.50 *
	3B	9.10	4.00	1.00	-17.87	1.62	8.68	76.6	1.45 / 1.30
	3C	9.10	7.00	1.00	-17.87	1.80	8.76	76.6	1.30 / 1.10
	4A	9.10	3.50	1.00	-17.87	1.59	8.50	76.6	1.48 / 1.30
55+90.56	1A	10.30	-9.09	-6.59	-6.59	0.00	2.06	21.8	9999 / 1.30
	1B	-9.09	-9.09	-6.59	-6.59	0.00	0.0	21.8	9999 / 1.30
	2A	10.30	6.00	7.30	-6.59	0.94	3.87	47.9	1.60 / 1.50
	2B	10.30	10.30	10.30	-6.59	1.21	4.09	53.6	1.38 / 1.30
	3A	10.30	3.50	1.00	-6.59	0.79	3.54	35.9	1.48 / 1.50 *
	3B	10.30	4.00	1.00	-6.59	0.82	3.59	35.9	1.42 / 1.30
	3C	10.30	7.00	1.00	-6.59	1.01	3.68	35.9	1.15 / 1.10
	4A	10.30	3.50	1.00	-6.59	0.79	3.54	35.9	1.48 / 1.30

FILE NAME: puerto2/fdm/ds/pnf2s08.dgn

DESIGN ENG.: EER

DWN. BY: EER

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL - STA 54+75 TO 89+60

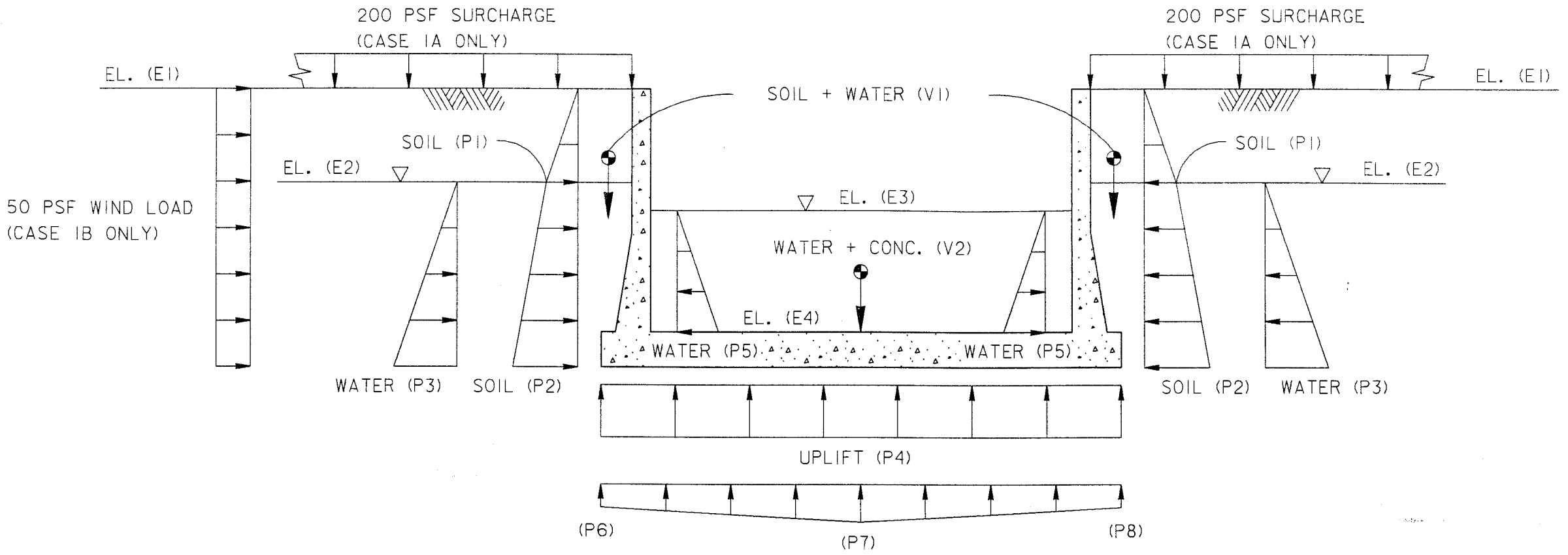
U-FRAME

FLOTATION STABILITY

STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997



EFFECTIVE FOUNDATION PRESSURE

STATION	LOAD CASE	ELEVATION				PRESSURE								LOAD		FACTOR OF SAFETY CALCULATED / ALLOWABLE
		E1 FT	E2 FT	E3 FT	E4 FT	P1 KSF	P2 KSF	P3 KSF	P4 KSF	P5 KSF	P6 KSF	P7 KSF	P8 KSF	V1 KIPS	V2 KIPS	
54+75	1A	9.10	-21.87	-17.87	-17.87	2.16	2.16	0.00	0.00	0.00	0.00	1.58	0.00	3.17	41.2	4.55 / 2.00 *
	1B	-21.87	-21.87	-17.87	-17.87	0.00	0.00	0.00	0.00	0.00	1.07	0.94	1.27	0.0	41.2	5.64 / 2.00
	2A	9.10	-8.10	-8.10	-17.87	1.10	1.66	0.86	0.86	0.61	0.02	1.35	0.02	6.71	59.5	5.34 / 3.00
	2B	9.10	9.10	9.10	-17.87	0.00	1.16	1.94	1.94	1.68	0.26	0.98	0.26	9.92	91.9	7.32 / 2.00
	3A	9.10	3.50	1.00	-17.87	0.29	1.32	1.59	1.59	1.18	0.00	1.10	0.00	8.50	76.6	6.51 / 3.00
	3B	9.10	4.00	1.00	-17.87	0.26	1.30	1.62	1.62	1.18	0.00	1.08	0.00	8.68	76.6	6.62 / 2.00
	3C	9.10	7.00	1.00	-17.87	0.10	1.22	1.80	1.80	1.18	0.00	0.96	0.00	8.76	76.6	7.51 / 1.00
	4A	9.10	3.50	1.00	-17.87	0.29	1.32	1.59	1.59	1.18	0.00	1.15	0.09	8.50	76.6	6.05 / 3.00
55+90.56	1A	10.30	-9.09	-6.59	-6.59	1.39	1.39	0.00	0.00	0.00	0.08	0.77	0.08	2.06	21.8	4.07 / 2.00
	1B	-9.09	-9.09	-6.59	-6.59	0.00	0.00	0.00	0.00	0.00	0.72	0.47	0.84	0.0	21.8	3.73 / 2.00 *
	2A	10.30	6.00	7.30	-6.59	0.22	0.84	0.94	0.94	0.87	0.31	0.59	0.31	3.87	47.9	5.32 / 3.00
	2B	10.30	10.30	10.30	-6.59	0.00	0.72	1.21	1.21	1.05	0.25	0.47	0.25	4.09	53.6	6.63 / 2.00
	3A	10.30	3.50	1.00	-6.59	0.36	0.91	0.79	0.79	0.47	0.00	0.50	0.00	3.54	35.9	6.25 / 3.00
	3B	10.30	4.00	1.00	-6.59	0.33	0.90	0.82	0.82	0.47	0.00	0.48	0.00	3.59	35.9	6.56 / 2.00
	3C	10.30	7.00	1.00	-6.59	0.17	0.81	1.01	1.01	0.47	0.00	0.33	0.00	3.68	35.9	9.60 / 1.00
	4A	10.30	3.50	1.00	-6.59	0.36	0.91	0.79	0.79	0.47	0.00	0.54	0.00	3.54	35.9	5.76 / 3.00

FILE NAME: puerto2/fdm/ds/pnf2s09.dgn

DESIGN ENG.: EER

DWN. BY: EER

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL - STA 54+75 TO 89+60

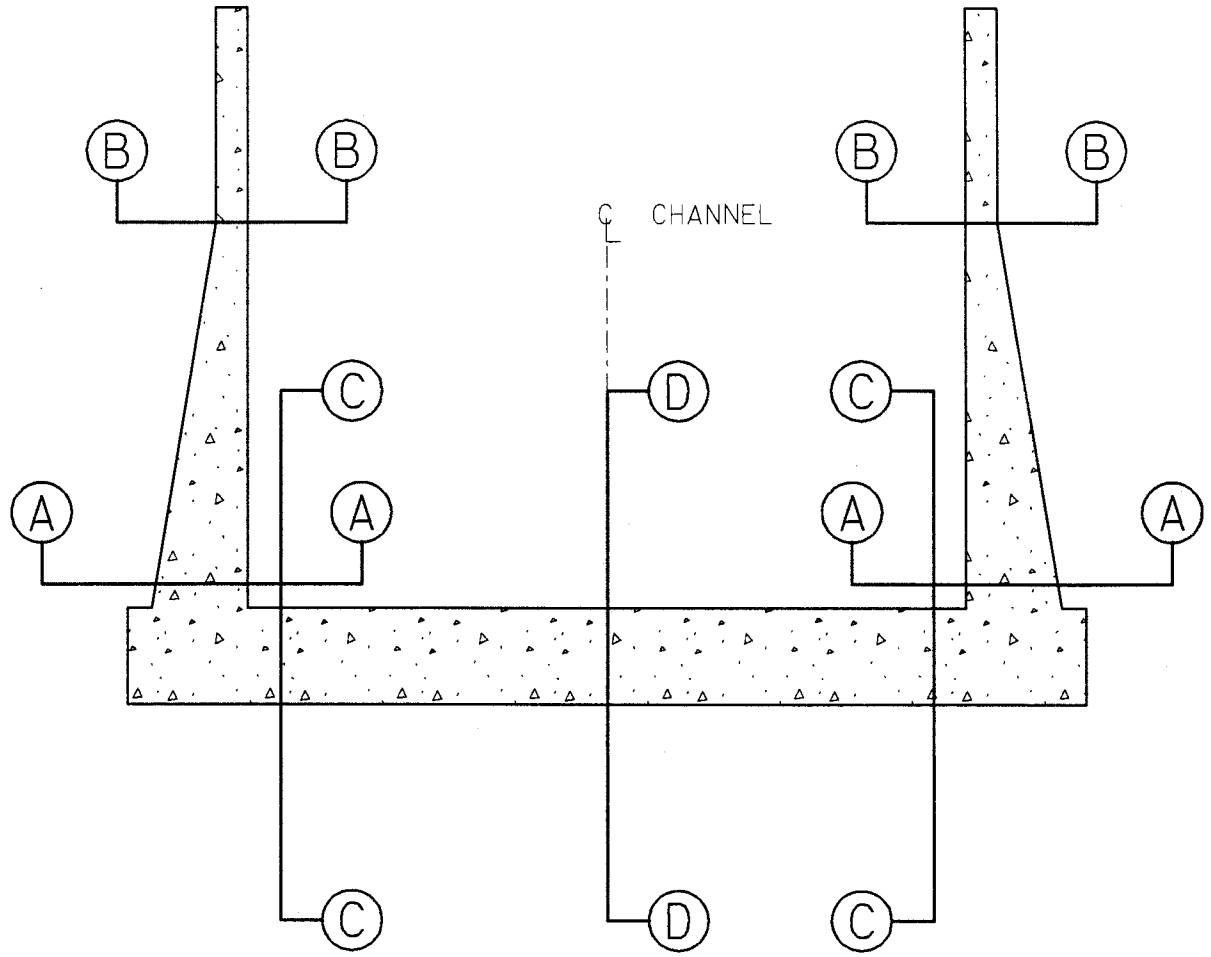
U-FRAME

BEARING CAPACITY

STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997



NOTES:

1. SHEARS AND MOMENTS SHOWN ARE MAXIMUM FOR ALL LOAD CASES.
2. MINIMUM REINFORCEMENT FOR TEMPERATURE SHRINKAGE REQUIRED AT ALL OTHER SECTIONS.

LEGEND

Vu = MAXIMUM ULTIMATE SHEAR FORCE

Mu = MAXIMUM ULTIMATE MOMENT

Ast = AREA OF TENSION REINFORCEMENT REQUIRED

STATION	LOCATION	Vu (kips)	Mu (ft-kips)	Ast (si/ft)	GOVERNING LOAD CASE
54+75	(A)	44.24	471.1	2.34	1AB
	(B)	11.29	54.28	1.10	1AB
	(C)	18.41	507.0	2.79	4A
	(D)	7.01	281.3	1.70	4A
55+90.56	(A)	20.37	150.4	1.28	1AB
	(B)	10.34	44.67	0.89	1AB
	(C)	12.00	154.9	1.32	1AB
	(D)	3.10	19.59	1.00	1AB

FILE NAME: puerto2/fdm/ds/pnf2s10.dgn

DESIGN ENG.: EER

DWN. BY: EER

CKD. BY:

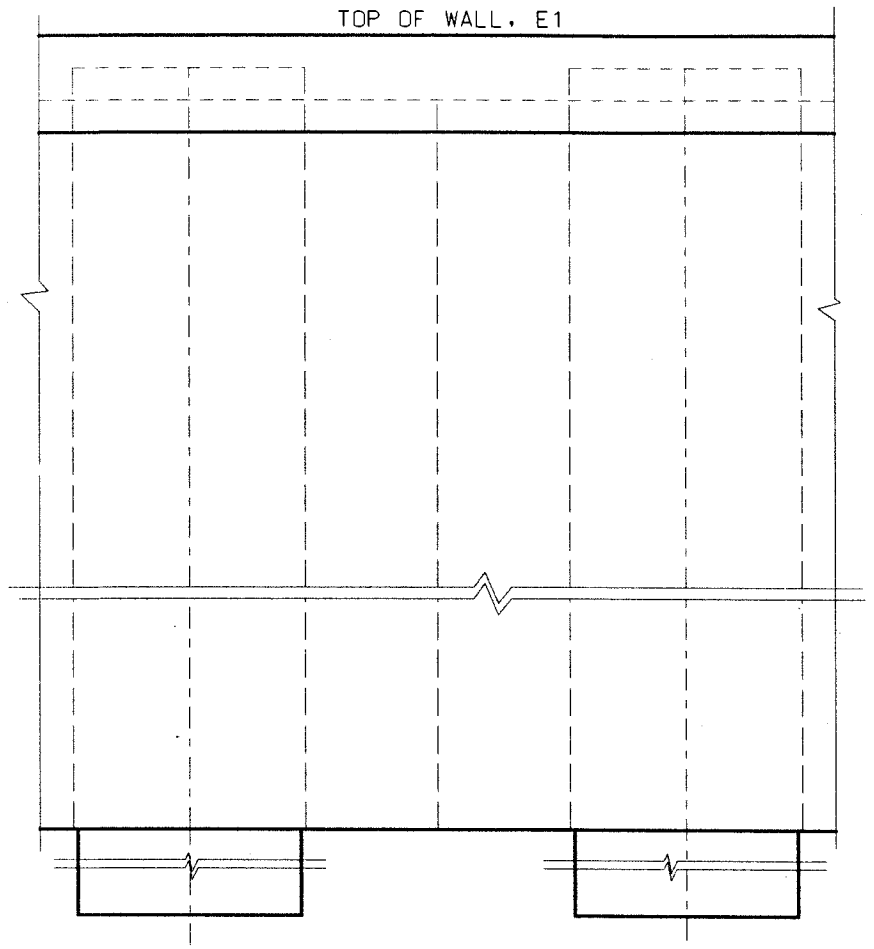
RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL - STA 54+75 TO 89+60

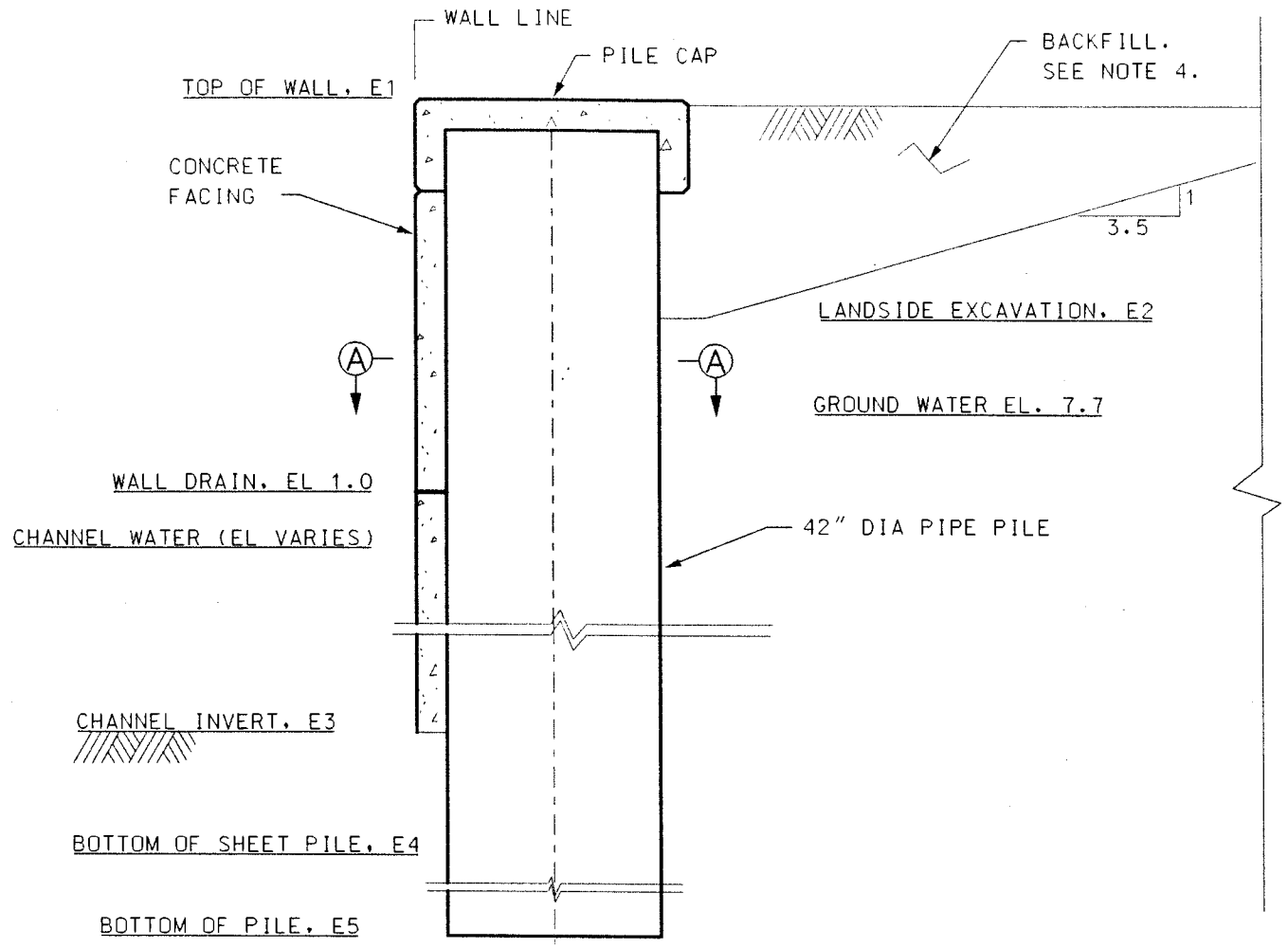
U-FRAME
REINFORCEMENT
STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

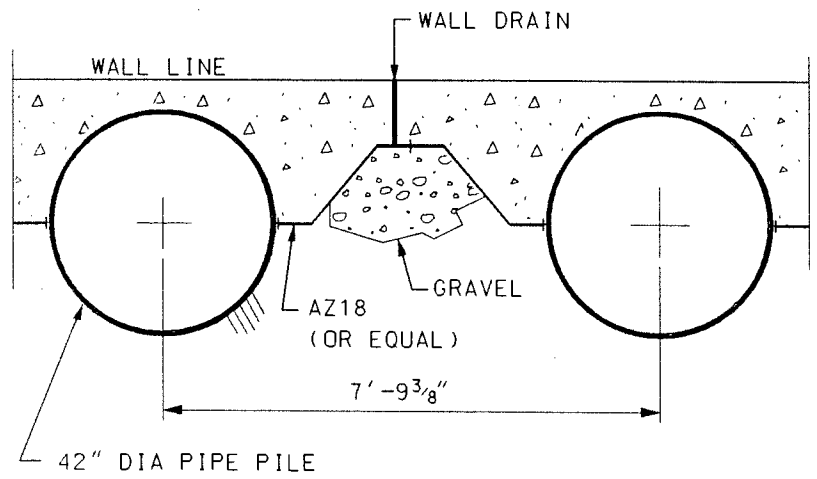
D.O. FILE NO. 101-37,451 NOVEMBER 1997



CHANNEL SIDE ELEVATION



TYPICAL WALL SECTION



SECTION A

NOTES:

1. ALL ELEVATIONS WITH RESPECT TO NATIONAL GEODETIC VERTICAL DATUM (NGVD).
2. INTERMEDIATE ELEVATIONS MAY BE DETERMINED BY INTERPOLATION.
3. DESIGN BASED ON ASTM A252 (GRADE 3) 42" O.D. PIPE WITH 1" WALL THICKNESS. LARGER PILES WITH EQUAL OR GREATER SECTION PROPERTIES MAY ALSO BE USED.
4. WALL DESIGN IS BASED ON LANDSIDE SOIL TO THE TOP OF WALL. ACTUAL LANDSIDE FINISH GRADE ELEVATIONS MAY BE LOWER THAN THE TOP OF WALL, AND WILL BE SET IN ACCORDANCE WITH THE GRADING PLAN FOR THE SECONDARY DRAINAGE SYSTEM.

STATION	E1	E2	E3	E4	E5
88+33	9.2	6.2	-15.9	-18.9	-70.8
92+00	9.0	6.0	-15.5	-18.5	-71.0
98+00	10.0	7.0	-15.0	-18.0	-70.0
114+00	11.0	8.0	-14.5	-17.5	-59.0
140+50	14.0	11.0	-13.0	-16.0	-59.0
147+40	14.5	11.5	-12.7	-15.7	-59.0

FILE NAME: puerto2/fdm2/ds/pnf2s11.dgn

DESIGN ENG.: MWW

DWN. BY: MWW | CKD. BY:

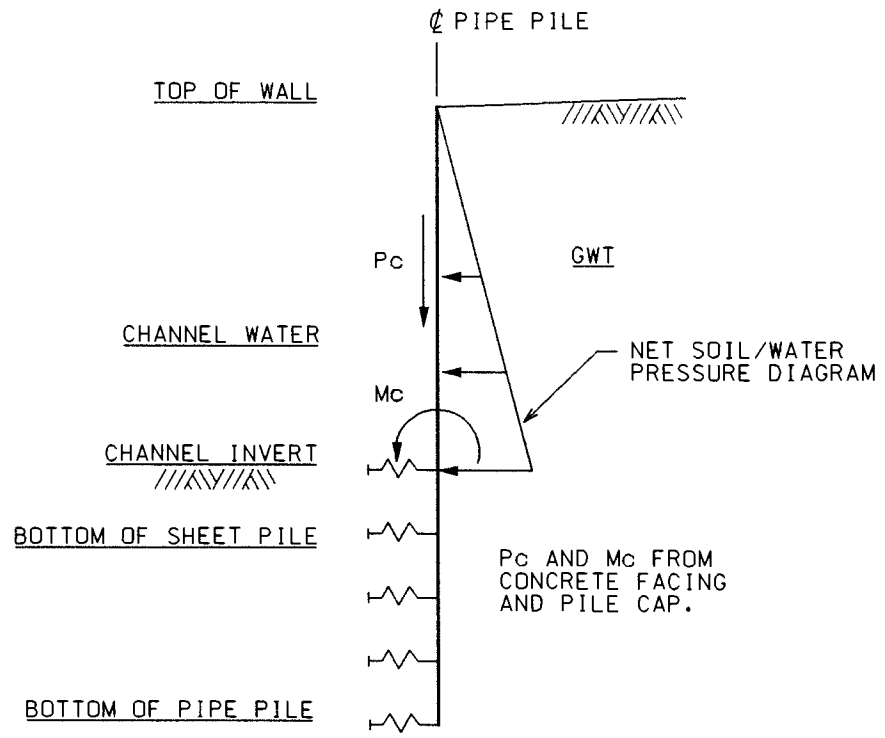
RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MAIN CHANNEL - STA 88+33 TO 147+40

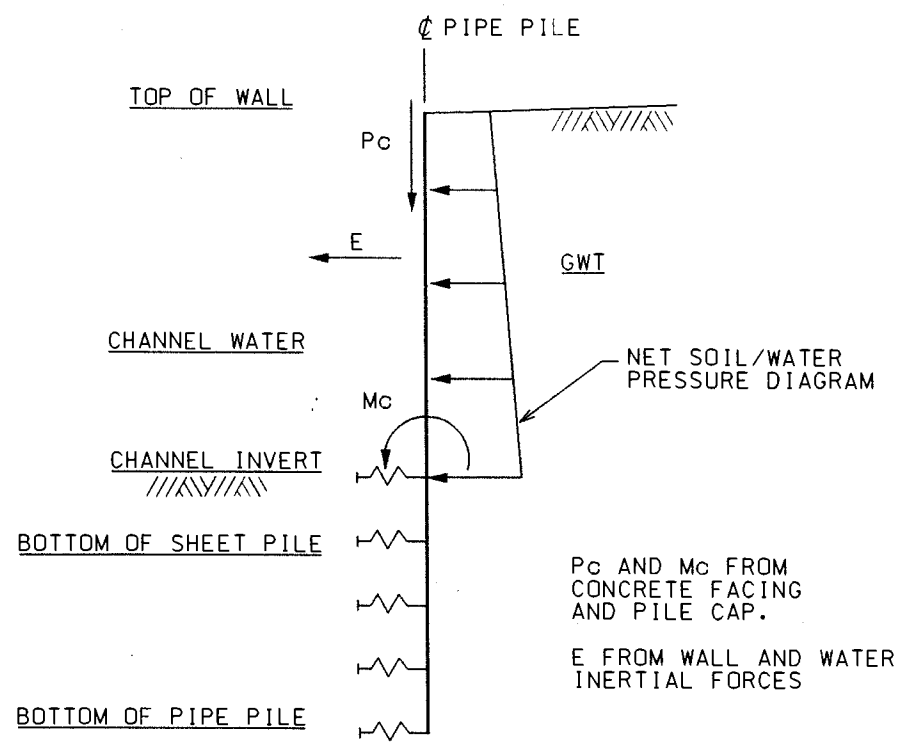
RETAINING WALL
PLAN, ELEVATION, AND SECTION
STRUCTURAL

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-37,451 NOVEMBER 1997



STATIC LOADING DIAGRAM



SEISMIC LOADING DIAGRAM

SOIL BORING	STATION	LOAD CASE	DEFL (IN)	BENDING MOMENT (K-IN)	PILE CSR
CB-PNB-7	92+00	2	6.7	28100	0.87
CB-PNB-4	98+00	2	6.8	28210	0.88
		3	3.6	22990	0.71
CB-PNM-45	114+00	2	6.0	28280	0.88
CB-PNM-48	140+50	2	6.7	30790	0.96
		1	1.1	9467	0.29
		3	12.7	51760	0.92

LOAD CASE DESCRIPTIONS:

1: POST-CONSTRUCTION CONDITION: UNUSUAL; CHANNEL WATER EL. 0. NGVD, GWT EL 7.7 NGVD, WALL DRAINS 50% EFFECTIVE, SURCHARGE = 200 PSF, Q-STATE SOILS.

2: DAILY CONDITION: USUAL; CHANNEL WATER EL. 0 NGVD, GWT EL. 7.7 NGVD, WALL DRAINS 50% EFFECTIVE, S-STATE SOILS.

3: SEISMIC CONDITION: UNUSUAL, CHANNEL WATER EL 0. NGVD, GWT EL 7.7 NGVD, WALL DRAINS 50% EFFECTIVE; R-STATE SOILS, WALL SYSTEM SUBJECT TO INERTIAL FORCES. 75% INCREASE IN ALLOWABLE STEEL STRESSES.

NOTES:

1. DEFLECTIONS ARE THE MAXIMUM LATERAL DEFLECTIONS AT THE TOP OF WALL
2. BENDING MOMENTS ARE THE MAXIMUM PILE BENDING MOMENTS, TYPICALLY OCCURING IN THE MIDDLE THIRD OF THE PILE.
3. PILE COMBINED STRESS RATIOS (CSR) INCLUDE AXIAL AND BENDING STRESSES.

FILE NAME: puerto2/fdm2/ds/pnf2s12.dgn

DESIGN ENG.: MWW

DWN. BY: MWW | CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MAIN CHANNEL - STA 88+33 TO 147+40

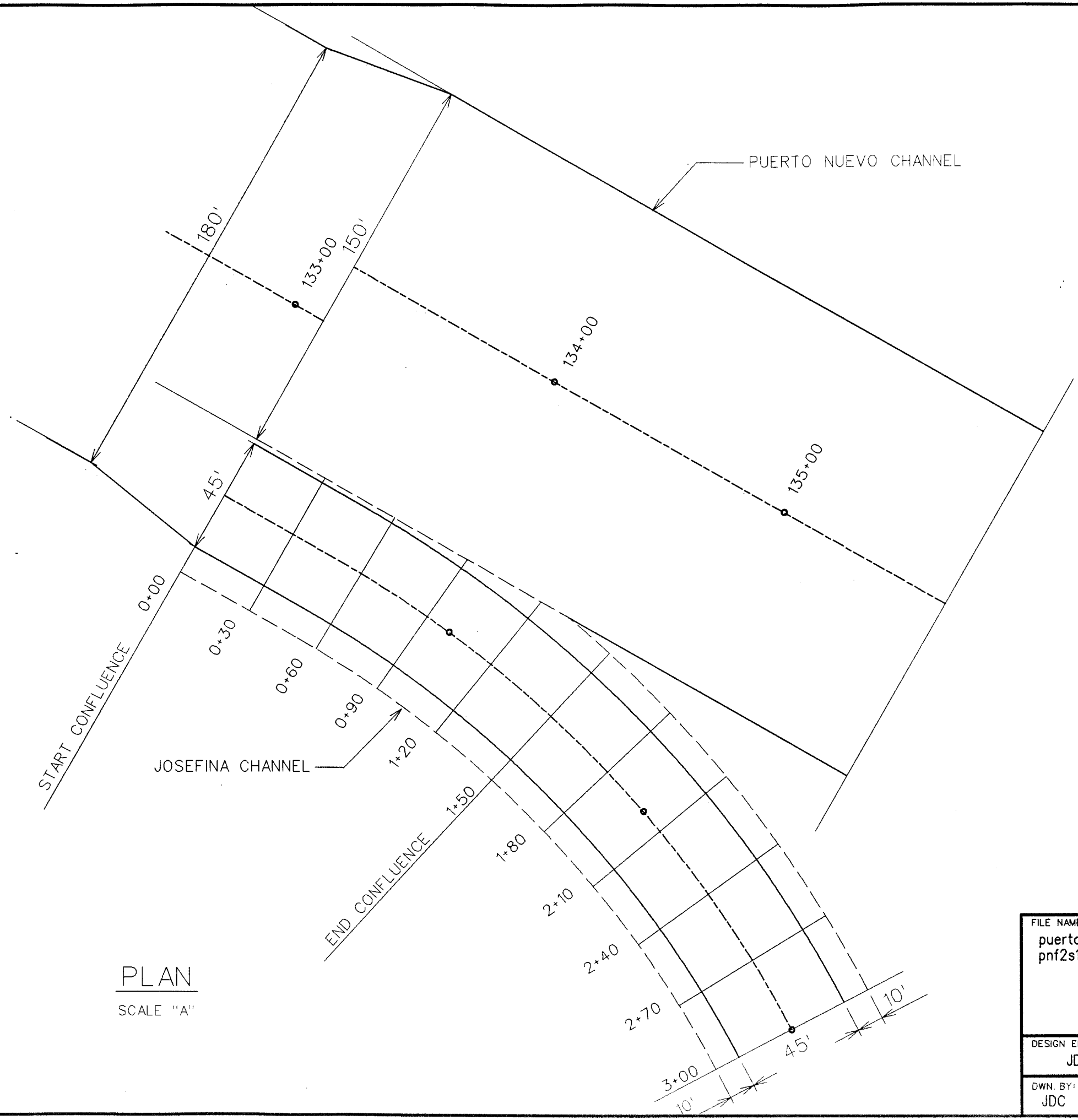
RETAINING WALL
WALL ANALYSIS

STRUCTURAL

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997



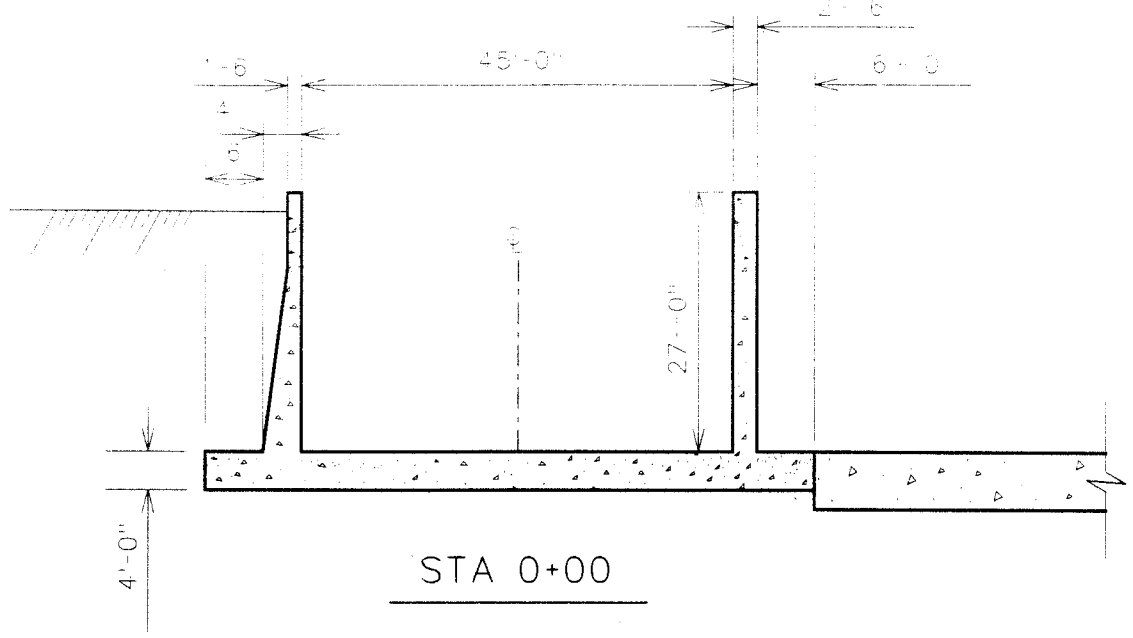
PLAN

SCALE "A"

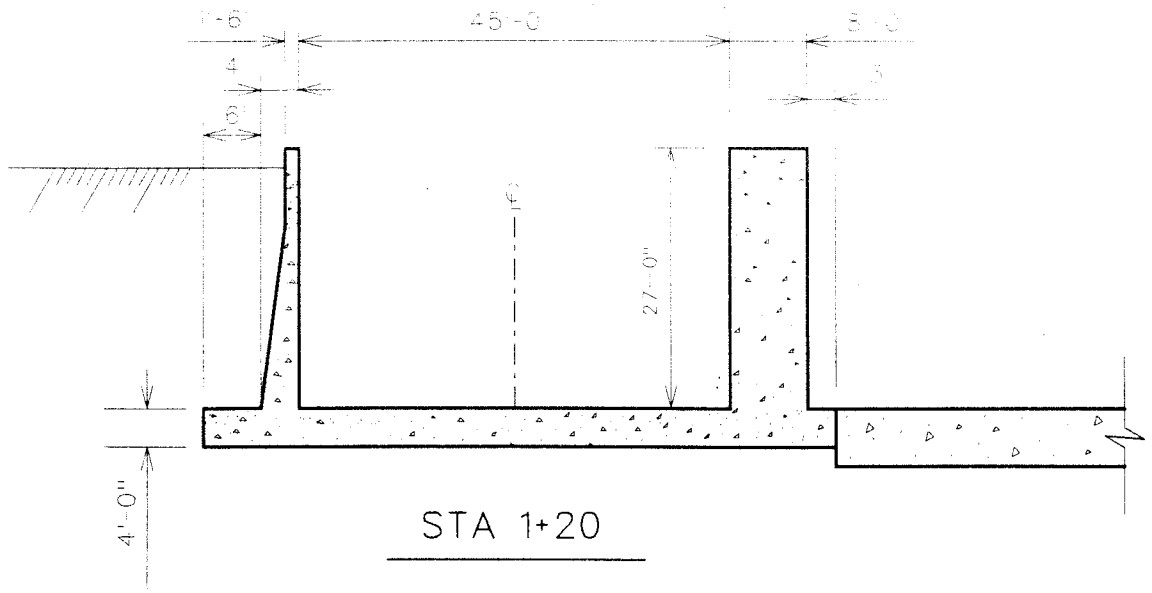
GRAPHIC SCALE

"A" 40' 0 40'

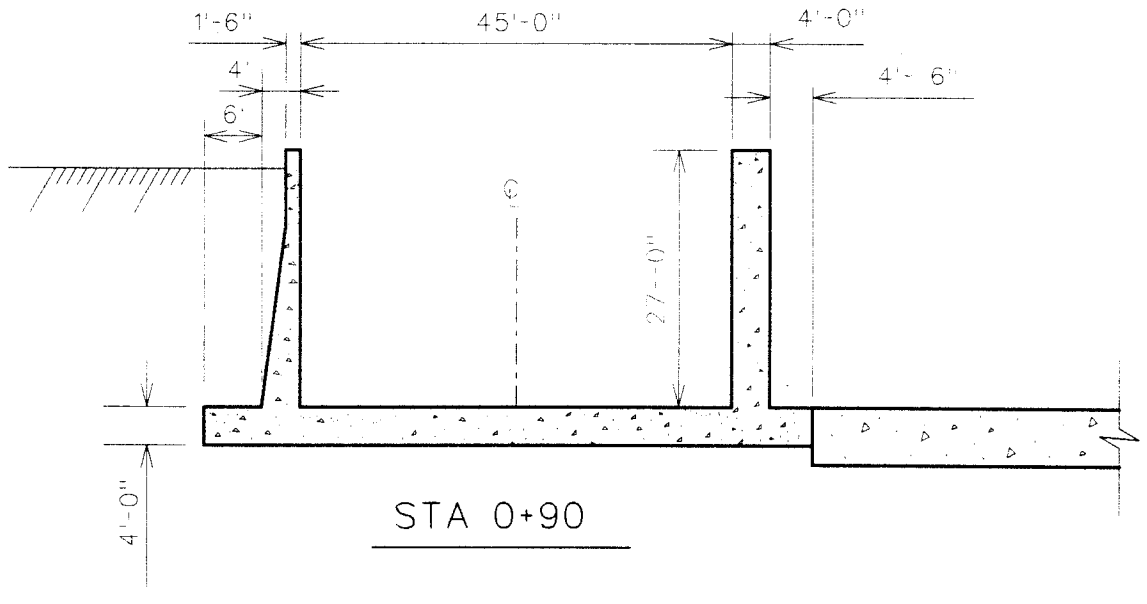
FILE NAME: puerto2/fdm2/ds pnf2s13.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 PUERTO NUEVO CHANNEL JOSEFINA CONFLUENCE PLAN STRUCTURAL
DESIGN ENG.: JDC	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: JDC / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997



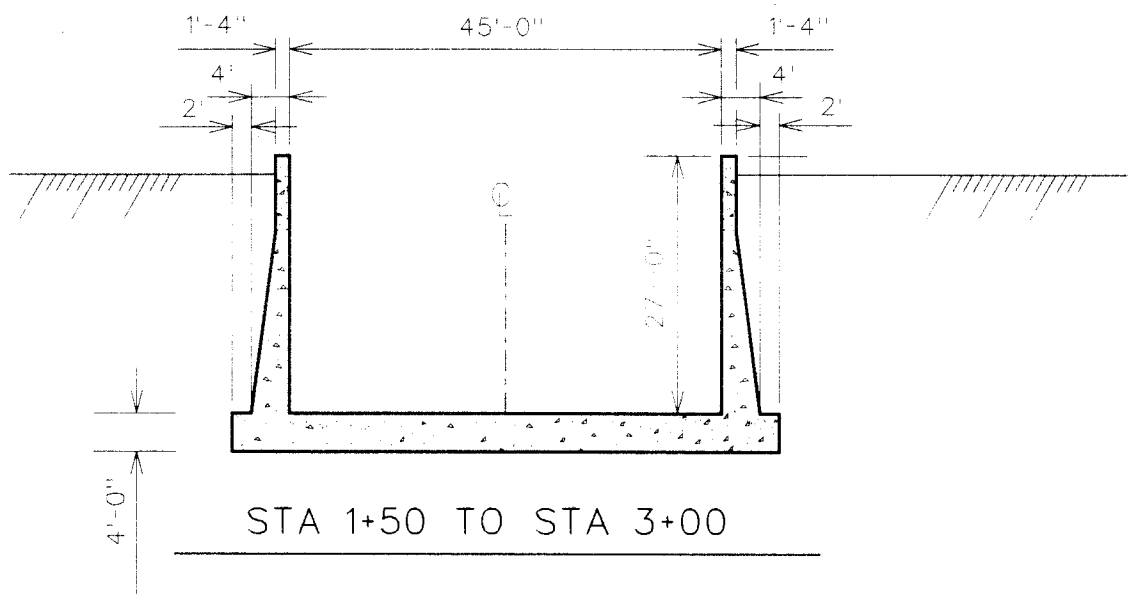
STA 0+00



STA 1+20



STA 0+90



STA 1+50 TO STA 3+00

SECTIONS

SCALE "A"

GRAPHIC SCALE

A' 20' 0 20'

FILE NAME: puerto2/fdm2/ds/pnf2s14.dgn

DESIGN ENG.: JDC

DWN. BY: EEB

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL

JOSEFINA CONFLUENCE

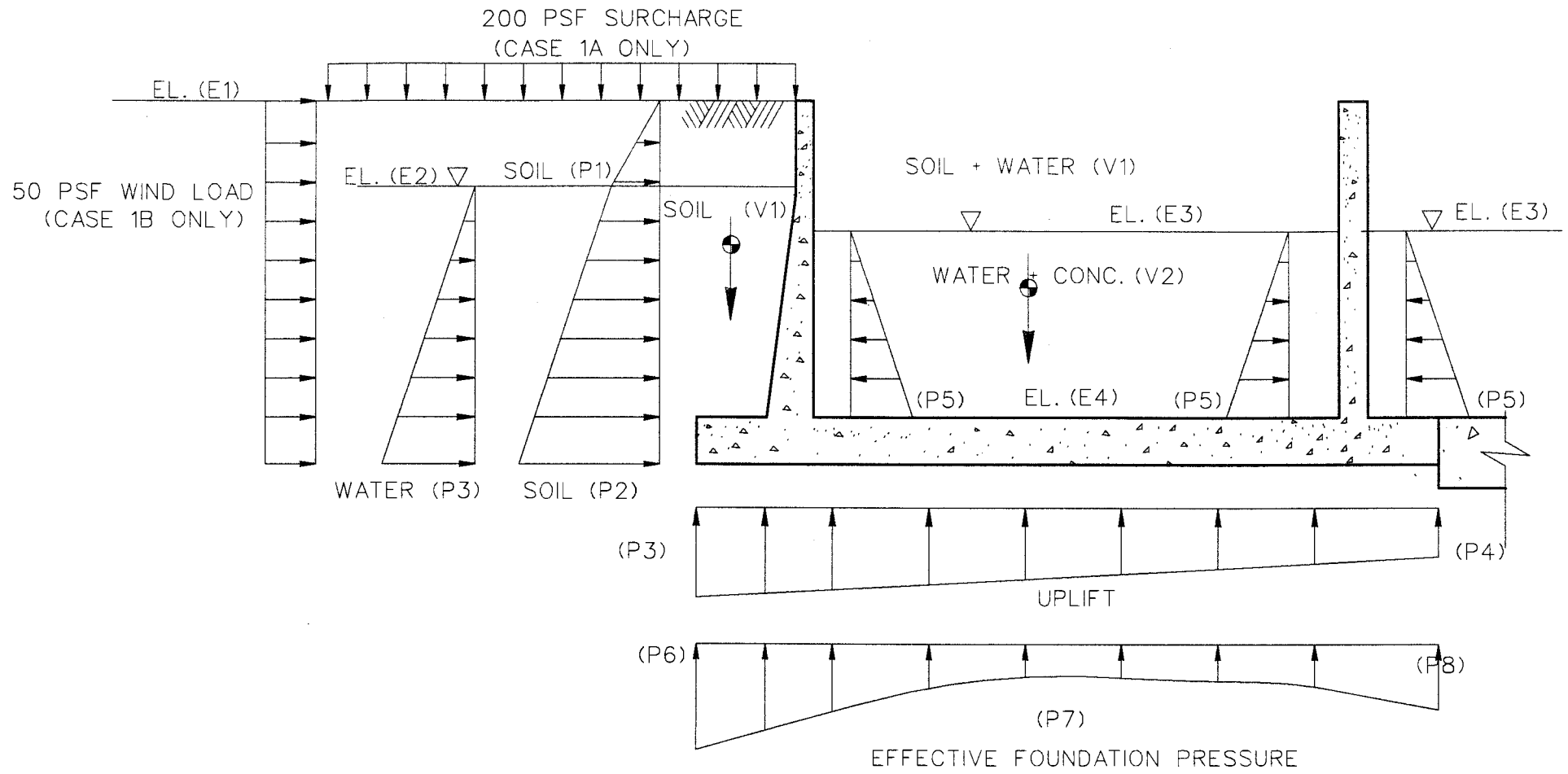
SECTIONS - STA. 0+00 TO STA. 3+00

STRUCTURAL

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37-451 NOVEMBER 1997



STATION	LOAD CASE	ELEVATION				PRESSURE								LOAD		FACTORS OF SAFETY			
		E1 FT	E2 FT	E3 FT	E4 FT	P1 KSF	P2 KSF	P3 KSF	P4 KSF	P5 KSF	P6 KSF	P7 KSF	P8 KSF	V1 KIPS	V2 KIPS	FLOATATION CALCULATED/MIN	BEARING CALCULATED/MIN	SLIDING	PERCENT IN COMPRESSION
0+00	1A	13.10	-13.55	-13.55	-13.55	——	1.65	0.25	0.25	0.00	1.58	0.69	0.89	22.59	57.82	5.06 / 1.30	5.06 / 2.0	1.25	100.0%
	1B	-17.55	-17.55	-13.55	-13.55	0.00	0.00	0.00	0.00	0.00	1.02	0.73	1.33	0.00	57.82	9999 / 1.30	6.02 / 2.0	13.11	100.0%
	2A	13.10	6.0	10.10	-13.55	0.32	1.11	1.47	1.73	1.48	1.56	0.60	0.70	24.73	124.34	1.64 / 1.50	5.14 / 3.0	2.87	100.0%
	2B	13.10	6.0	13.10	-13.55	0.32	1.11	1.47	1.89	1.67	1.95	0.60	0.73	24.73	132.77	1.65 / 1.30	4.10 / 2.0	4.73	100.0%
	3A	13.10	6.0	-1.0	-13.55	0.33	1.19	1.25	1.03	0.78	0.97	1.02	0.79	24.73	93.12	1.79 / 1.50	7.81 / 3.0	1.42	100.0%
	3B	13.10	10.0	-1.0	-13.55	0.33	1.37	1.38	1.03	0.78	0.80	0.91	0.79	25.29	93.12	1.70 / 1.30	8.78 / 2.0	1.33	100.0%
	3C	13.10	6.0	-1.0	-13.55	0.32	1.48	1.47	1.03	0.78	0.65	0.84	0.80	24.73	93.12	1.63 / 1.10	9.41 / 1.0	1.27	100.0%
	4A	13.10	6.0	-1.0	-13.55	0.19	1.26	1.25	1.03	0.78	0.53	0.99	0.78	24.73	93.12	1.79 / 1.30	8.05 / 2.0	1.38	100.0%

FILE NAME: puerto2/fdm2/ds/pnf2s15.dgn

DESIGN ENG.: JDC

DWN. BY: JDC

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL

JOSEFINA CONFLUENCE

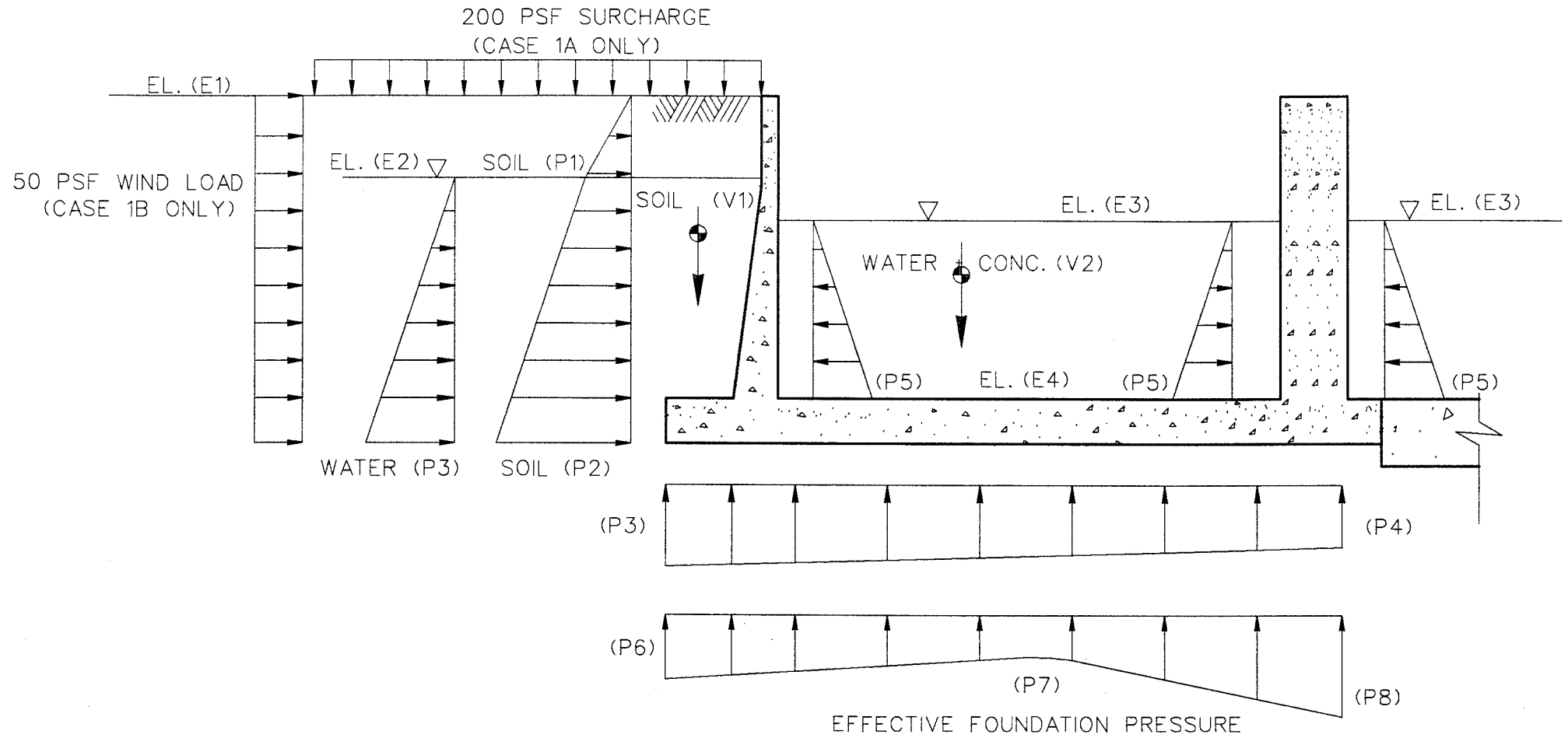
STABILITY ANALYSIS STA 0+00

STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997

PLATE S-1



STATION	LOAD CASE	ELEVATION				PRESSURE								LOAD		FACTORS OF SAFETY			
		E1 FT	E2 FT	E3 FT	E4 FT	P1 KSF	P2 KSF	P3 KSF	P4 KSF	P5 KSF	P6 KSF	P7 KSF	P8 KSF	V1 KIPS	V2 KIPS	FLOATATION CALCULATED/MIN	BEARING CALCULATED/MIN	SLIDING	PERCENT IN COMPRESSION
1+20	1A	13.10	-13.55	-13.55	-13.55	0.10	0.10	0.25	0.25	0.00	1.50	0.87	2.51	22.59	72.27	6.32 / 1.30	3.20 / 2.0	1.26	100%
	1B	-17.55	-17.55	-13.55	-13.55	0.00	0.00	0.00	0.00	0.00	0.94	0.73	2.93	0.0	72.27	9999 / 1.30	2.73 / 2.0	13.62	100%
	2A	13.10	6.0	10.10	-13.55	0.24	1.11	1.47	1.73	1.48	1.50	0.73	1.73	26.53	138.79	1.78 / 1.50	4.62 / 3.0	2.97	100%
	2B	13.10	6.0	13.10	-13.55	0.24	1.11	1.47	1.89	1.67	1.90	0.73	1.70	26.53	147.22	1.77 / 1.30	4.20 / 2.0	4.89	100%
	3A	13.10	6.0	-1.0	-13.55	0.34	1.26	1.25	1.03	0.78	0.90	0.67	2.05	26.53	107.57	2.02 / 1.50	3.91 / 3.0	1.48	100%
	3B	13.10	10.0	-1.0	-13.55	0.34	1.37	1.38	1.03	0.78	0.73	0.63	2.05	27.03	107.57	1.92 / 1.30	3.91 / 2.0	1.38	100%
	3C	13.10	6.0	-1.0	-13.55	0.32	1.48	1.47	1.03	0.78	0.59	0.59	2.05	26.53	107.57	1.85 / 1.10	3.91 / 1.0	1.32	100%
	4A	13.10	6.0	-1.0	-13.55	0.19	0.66	1.25	1.03	0.78	0.47	0.78	2.05	26.53	107.57	2.02 / 1.30	3.95 / 2.0	1.43	100%

FILE NAME: puerto2/fdm/ds/pnf2s16.dgn

DESIGN ENG.: JDC

DWN. BY: JDC

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL

JOSEFINA CONFLUENCE

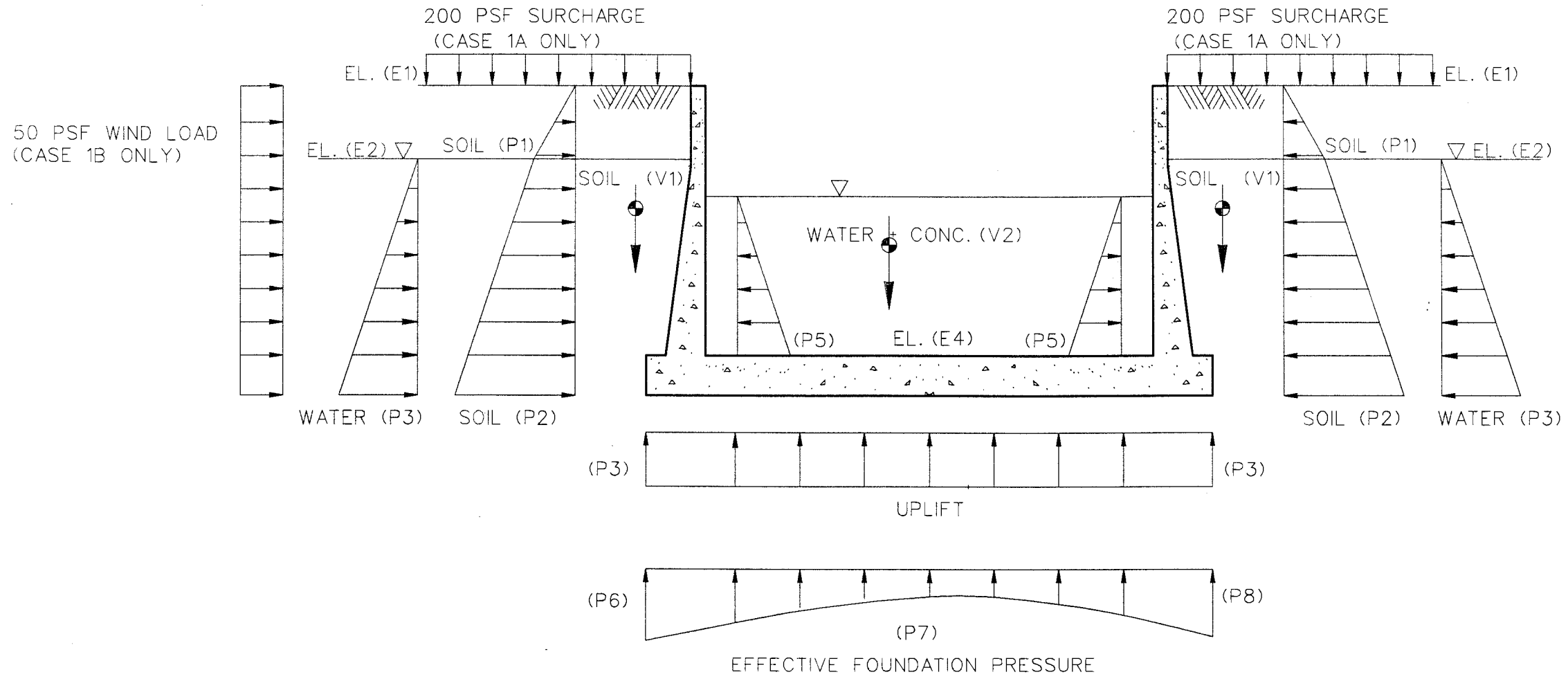
STABILITY ANALYSIS STA 1+20

STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997

PLATE C-1



STATION	LOAD CASE	ELEVATION				PRESSURE								LOAD		FACTORS OF SAFETY			
		E1 FT	E2 FT	E3 FT	E4 FT	P1 KSF	P2 KSF	P3 KSF	P4 KSF	P5 KSF	P6 KSF	P7 KSF	P8 KSF	V1 KIPS	V2 KIPS	FLOATATION CALCULATED/MIN	BEARING CALCULATED/MIN	SLIDING	PERCENT IN COMPRESSION
1+50	1A	13.64	-13.36	-13.36	-13.36	——	1.08	0.25	0.25	0.0	0.88	0.53	1.02	21.47	52.60	3.69 / 1.30	7.76 / 2.0	8.75	100.0%
	1B	-13.36	-13.36	-13.36	-13.36	0.0	0.0	0.0	0.0	0.0	1.14	0.72	1.39	0.0	52.60	9999 / 1.30	5.75 / 2.0	11.61	100.0%
	2A	13.64	6.0	10.64	-13.36	0.33	1.09	1.46	1.46	1.50	1.14	0.97	1.14	24.09	120.10	1.81 / 1.50	7.08 / 3.0	9999	100.0%
	2B	13.64	6.0	13.64	-13.36	0.33	1.09	1.46	1.46	1.69	1.62	0.96	1.62	24.09	128.54	1.92 / 1.30	4.98 / 2.0	9999	100.0%
	3A	13.64	6.0	0.0	-13.36	0.33	1.15	1.27	1.27	0.84	0.29	0.84	0.29	24.09	90.18	1.61 / 1.50	9.57 / 3.0	9999	100.0%
	3B	13.64	10.0	0.0	-13.36	0.33	1.10	1.40	1.40	0.84	0.10	0.75	0.10	24.25	90.18	1.47 / 1.30	10.67 / 2.0	9999	100.0%
	3C	13.64	6.0	0.0	-13.36	0.33	1.09	1.46	1.46	0.84	0.0	0.71	0.0	24.09	90.18	1.40 / 1.10	11.21 / 1.0	9999	96.5%
	4A	13.64	6.0	0.0	-13.36	0.18	0.65	1.27	1.27	0.84	0.0	1.09	0.0	24.09	90.18	1.61 / 1.30	7.37 / 2.0	9999	86.0%

FILE NAME: puerto2/fdm/ds/pnf2s17.dgn

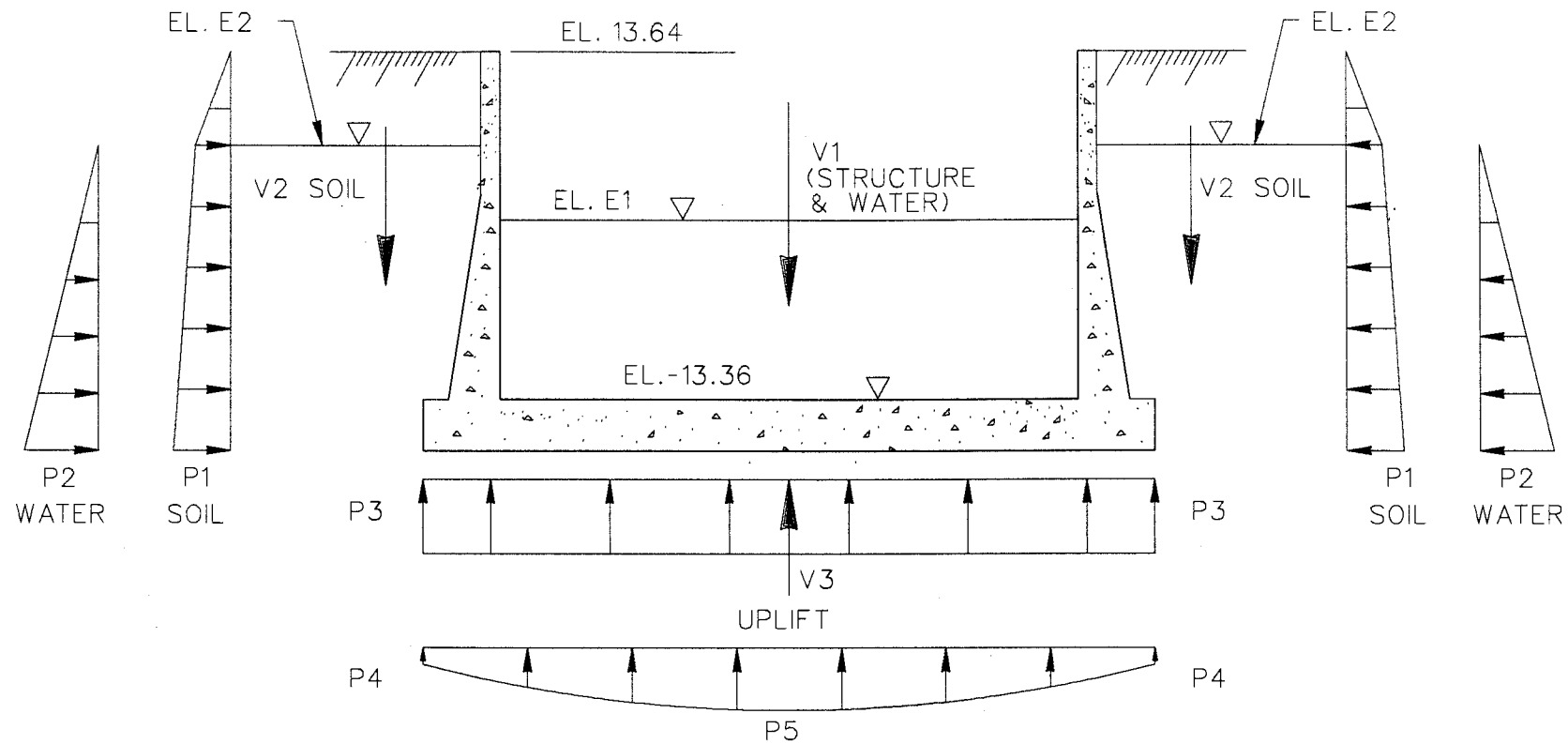
DESIGN ENG.: JDC

DWN. BY: JDC

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2
PUERTO NUEVO CHANNEL
JOSEFINA CONFLUENCE
STABILITY ANALYSIS
STA 1+50 TO 3+00
STRUCTURAL
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-37,451 NOVEMBER 1997

PLATE S-1



CASE 3A, 3B & 3C

FORCES AND PRESSURES

LOAD CASE	ELEVATION			LOAD			PRESSURE				
	E1 FT	E2 FT	DRAINS % EFFECTIVE	V1 KIPS	V2 KIPS	V3 KIPS	P1 KSF	P2 KSF	P3 KSF	P4 KSF	P5 KSF
3A	0.00	6.00	50.00	92.18	25.10	72.39	1.13	1.27	1.27	0.28	0.84
3B	0.00	10.00	50.00	92.18	25.10	79.80	1.08	1.40	1.40	0.09	0.75
3C	0.00	6.00	0.00	92.18	25.10	83.22	1.06	1.46	1.46	0.00	0.71

LOAD CASE	FACTORS OF SAFETY			
	FLOTATION CALCULATED /ALLOWABLE	BEARING CALCULATED /ALLOWABLE	SLIDING	PERCENT IN COMPRESSION
3A	1.61 / 1.50	9.57 / 3.0	∞	100%
3B	1.47 / 1.30	10.67 / 2.0	∞	100%
3C	1.40 / 1.10	11.28 / 1.0	∞	100%

DESIGN ENG.: puerto2/fdm/ds/pnf2s18.dgn

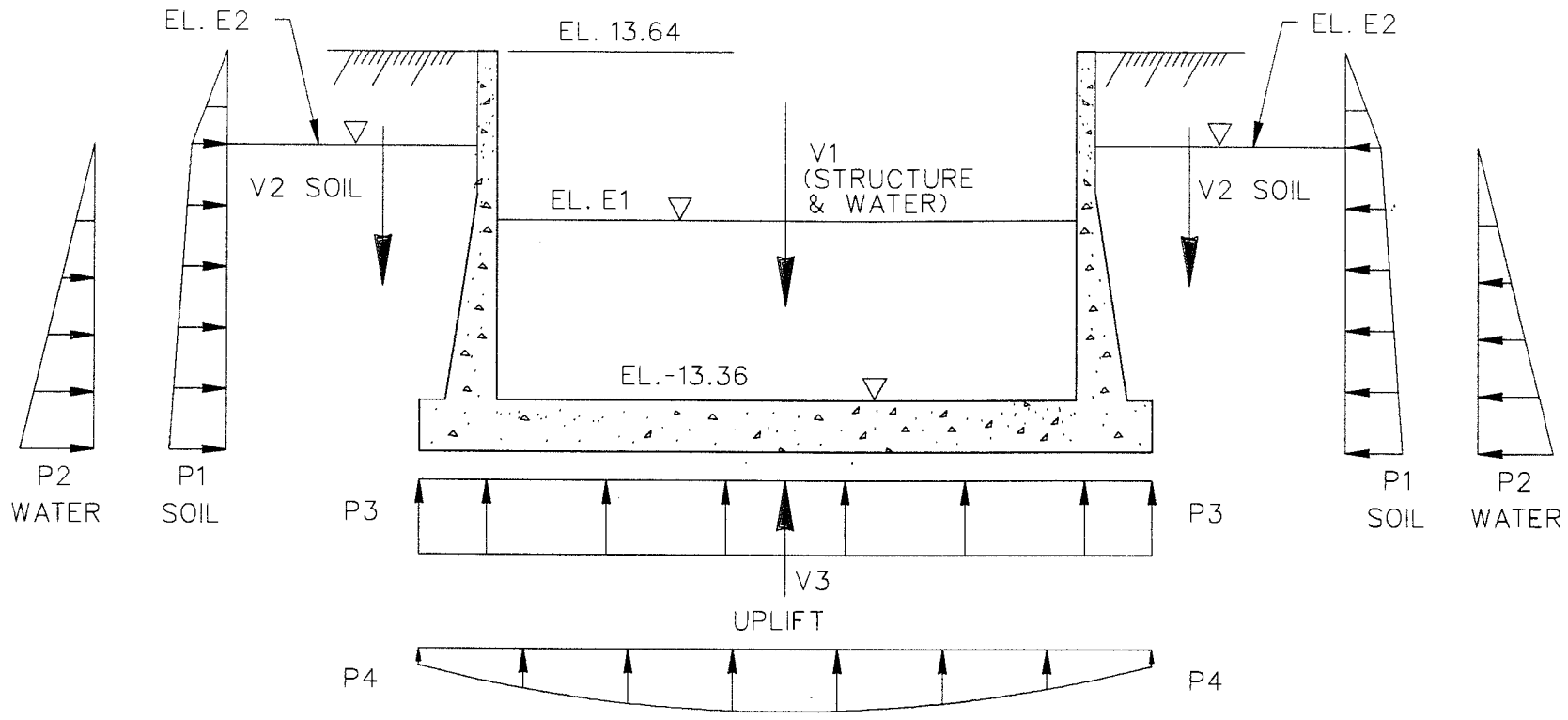
DESIGN ENG.: JDC

DWN. BY: EEB

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2
PUERTO NUEVO CHANNEL
JOSEFINA CHANNEL CONFLUENCE
STABILITY ANALYSIS
STA 1+50 TO STA 3+00
STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-37,451 NOVEMBER 1997



EFFECTIVE FOUNDATION PRESSURE

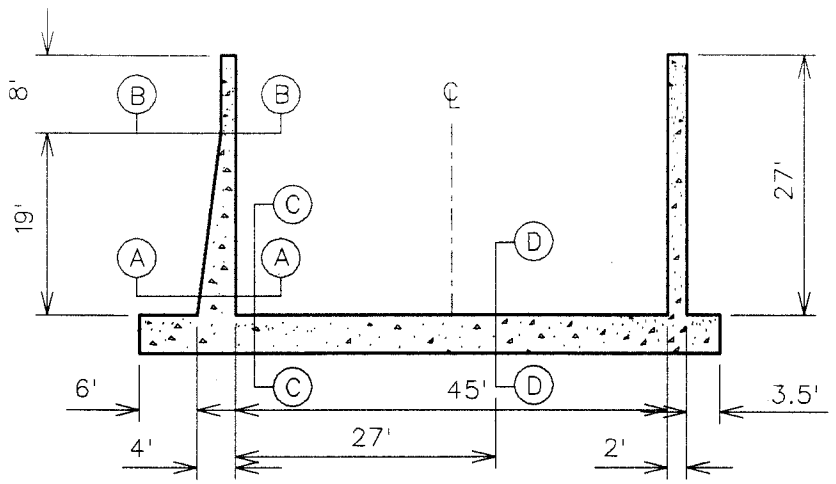
CASE 4A

FORCES AND PRESSURES

LOAD CASE	ELEVATION			LOAD			PRESSURE							
	E1 FT	E2 FT	DRAINS % EFFECTIVE	V1 KIPS	V2 KIPS	V3 KIPS	P1 KSF	P2 KSF	P3 KSF	P4 KSF	P5 KSF	P6 KSF	P7 KSF	P8 KSF
4A	0.00	6.00	50.00	92.18	25.10	72.39	0.63	1.27	1.27	0.28	0.84			

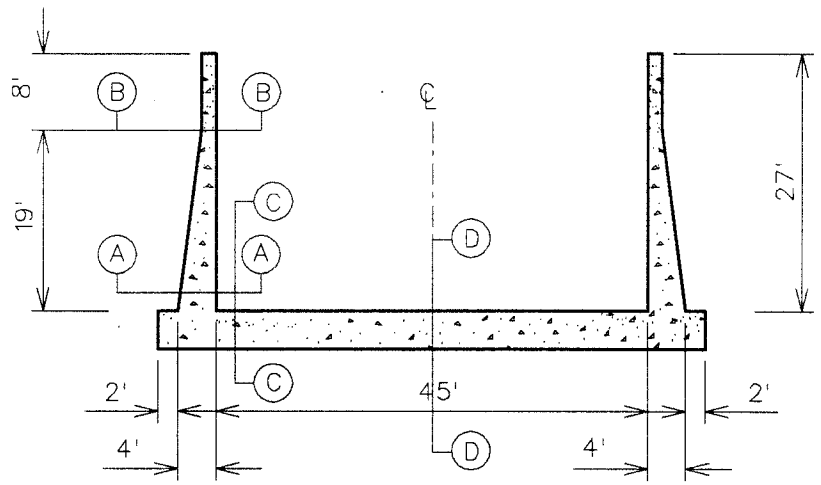
FACTORS OF SAFETY			
FLOTATION CALCULATED /ALLOWABLE	BEARING CALCULATED /ALLOWABLE	SLIDING	% INCOMP
1.61 / 1.50	7.37 / 3.0	∞	100%

FILE NAME: puerto2/fdm/ds/pnf2s19.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 PUERTO NUEVO CHANNEL JOSEFINA CHANNEL CONFLUENCE STABILITY ANALYSIS STA 1+50 TO STA 3+00 STRUCTURAL
DESIGN ENG.: JDC	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: EEB / CKD. BY:	D.O. FILE NO. 101-37.451 NOVEMBER 1997



STA 0+00

STATION	LOCATION	Vu	Mu	Ast	GOVERNING LOAD CASE
0+00	A	41.7	491.3	2.53	4A
	B	8.91	33.8	0.61	4A
	C	38.2	404.3	1.86	4A
	D	42.1	99.1	0.33	1A
1+50	A	41.0	491.7	2.53	4A
	B	8.84	34.0	0.61	4A
	C	30.6	482.4	2.28	4A
	D	3.93	82.9	0.33	1B



STA 1+50 TO STA 3+00

SECTIONS

SCALE "A"

LEGEND

Vu = MAXIMUM ULTIMATE SHEAR FORCE (KIPS/FT)
Mu = MAXIMUM ULTIMATE MOMENT (FT-KIPS/FT)
Ast = AREA OF TENSION REINFORCEMENT REQUIRED

NOTES

1. SHEARS AND MOMENTS SHOWN ARE MAXIMUM FOR ALL LOAD CASES.
2. MINIMUM REINFORCEMENT FOR TEMPERATURE AND SHRINKAGE REQUIRED AT ALL OTHER SECTIONS.

GRAPHIC SCALE

"A" 20' 0 20'

DESIGN ENG.: puerto2/fdm/ds/pnf2s20.dgn

DESIGN ENG.: JDC

DWN. BY: JDC

CKD. BY:

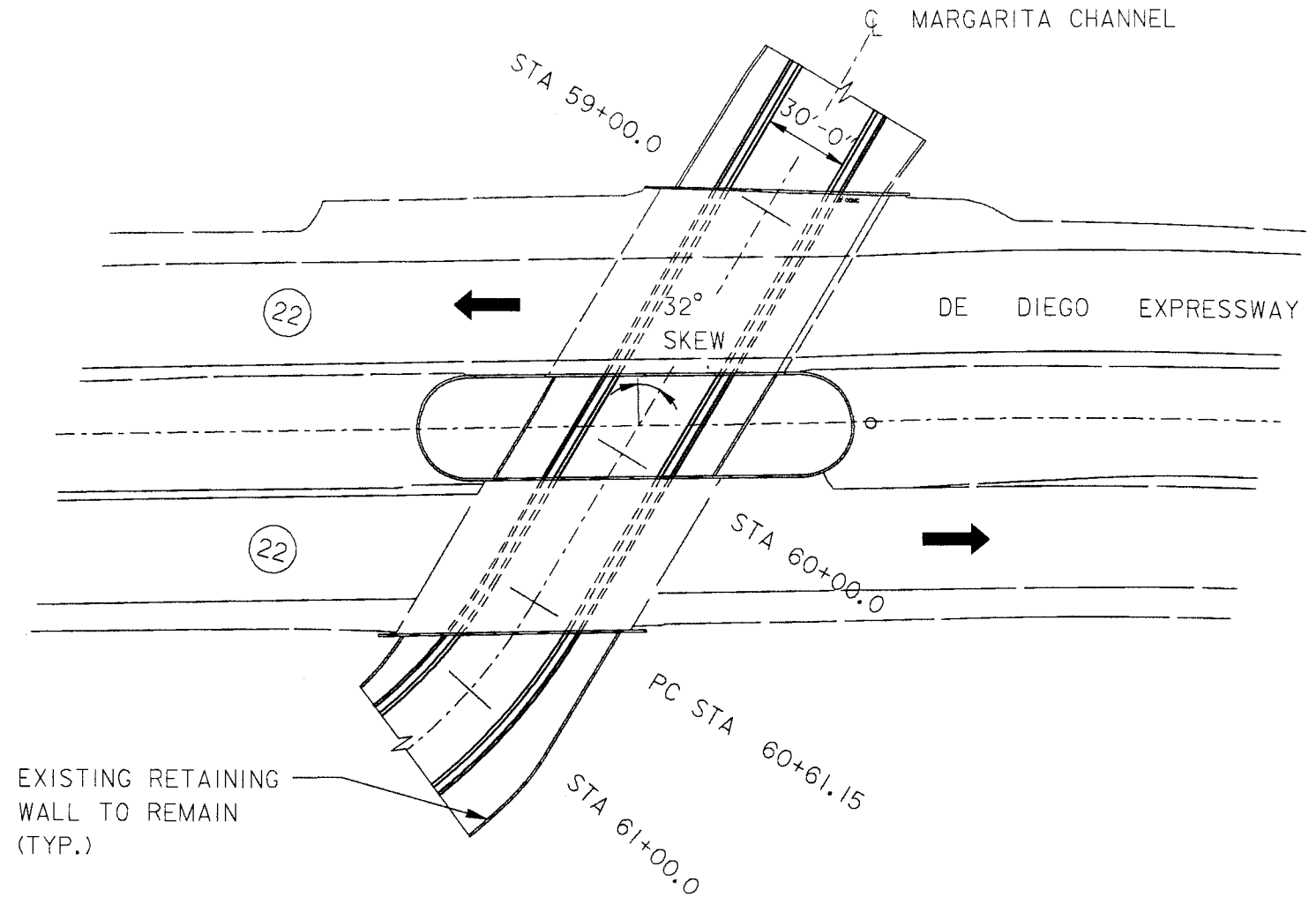
RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL
JOSEFINA CONFLUENCE
REINFORCEMENT
STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

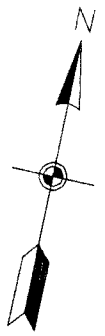
D.O. FILE NO. 101-37,451 NOVEMBER 1997

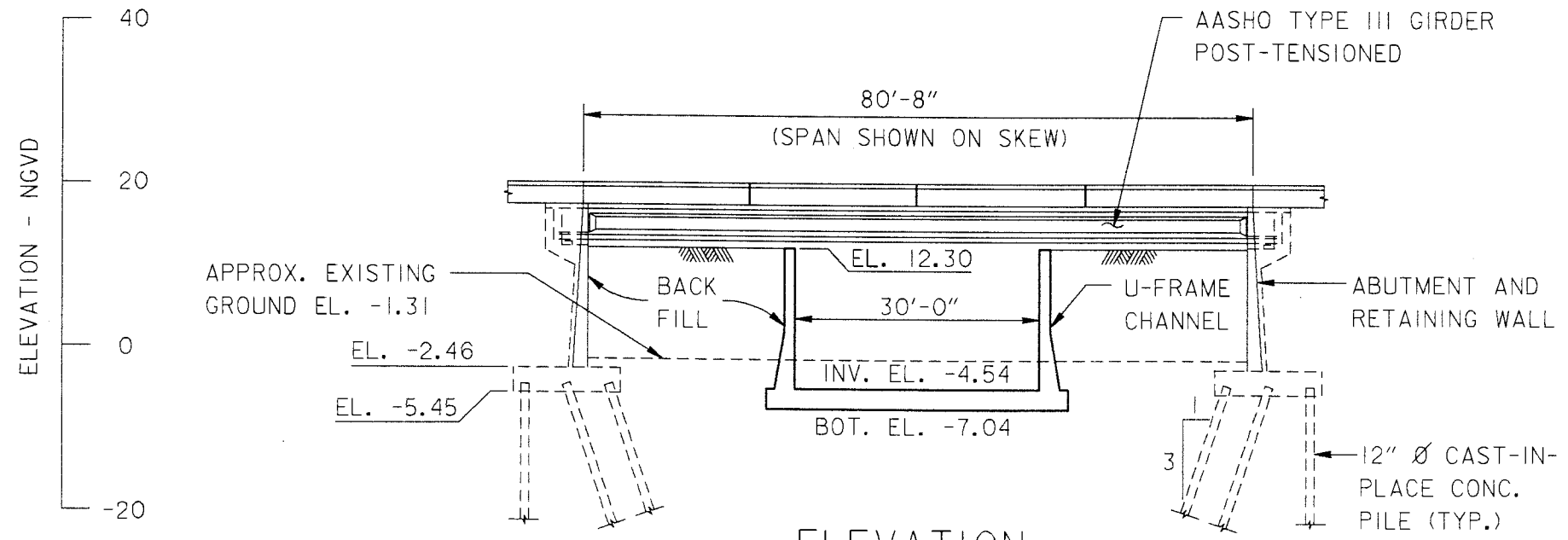
PLATE S-2



PLAN

SCALE: "B"





ELEVATION

SCALE: "A"

GRAPHIC SCALES

"A" 20' 0 20'

"B" 60' 0 60'

FILE NAME: puerto2/fdm/ds/pnf2s21.dgn

DESIGN ENG.: EER

DWN. BY: EER

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

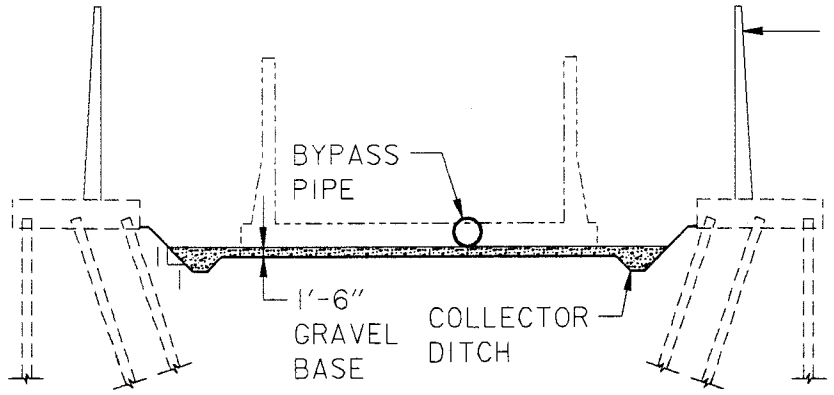
MARGARITA CHANNEL

DE DIEGO BRIDGE MODIFICATION
PLAN AND ELEVATION

STRUCTURAL

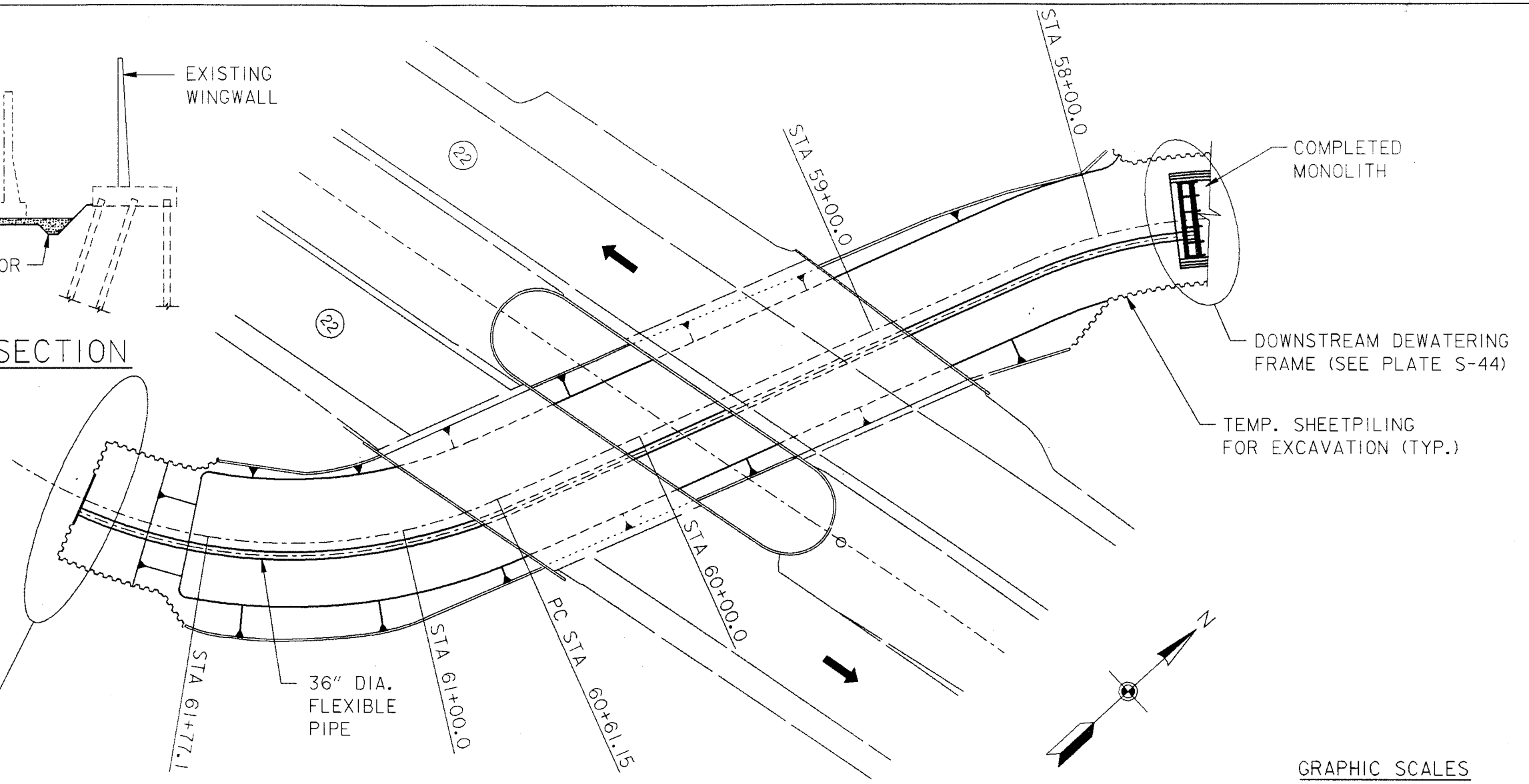
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997



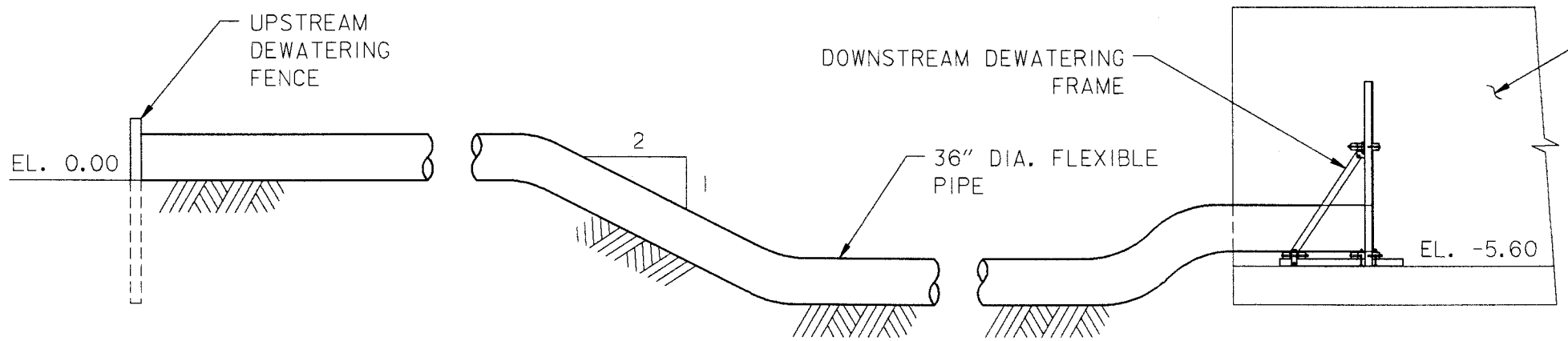
TYPICAL CROSS-SECTION

SCALE: "C"



PLAN

SCALE: "A"



SECTION ALONG CENTERLINE

SCALE: "B"

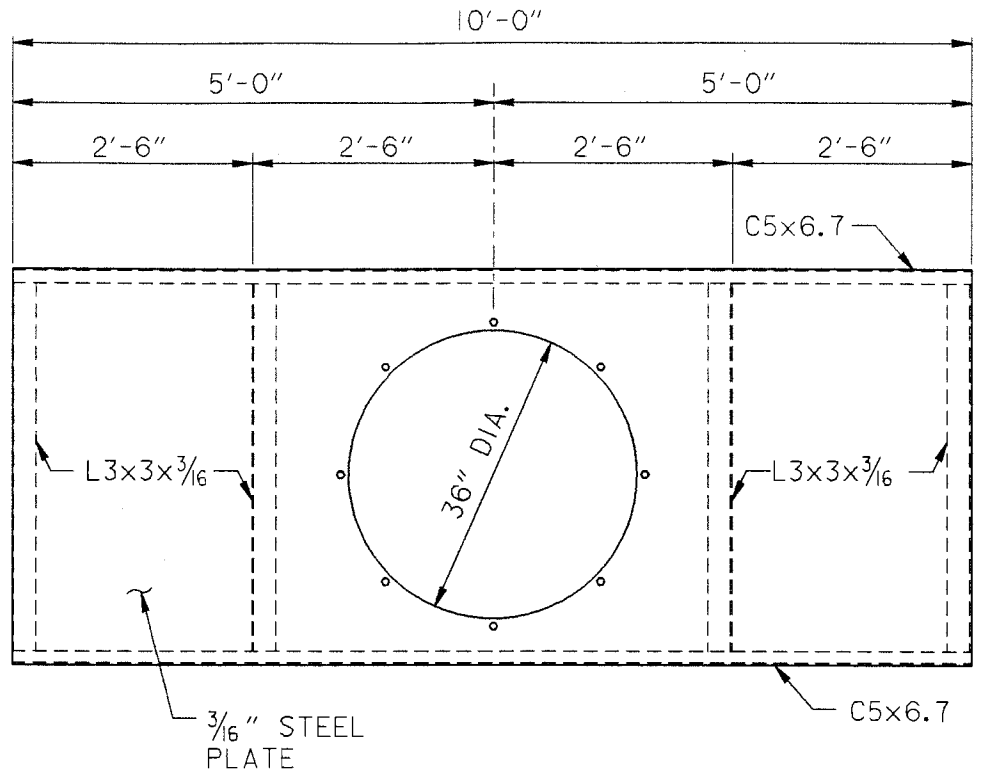
GRAPHIC SCALES

"A" 50' 0 50'

"B" 10' 0 10'

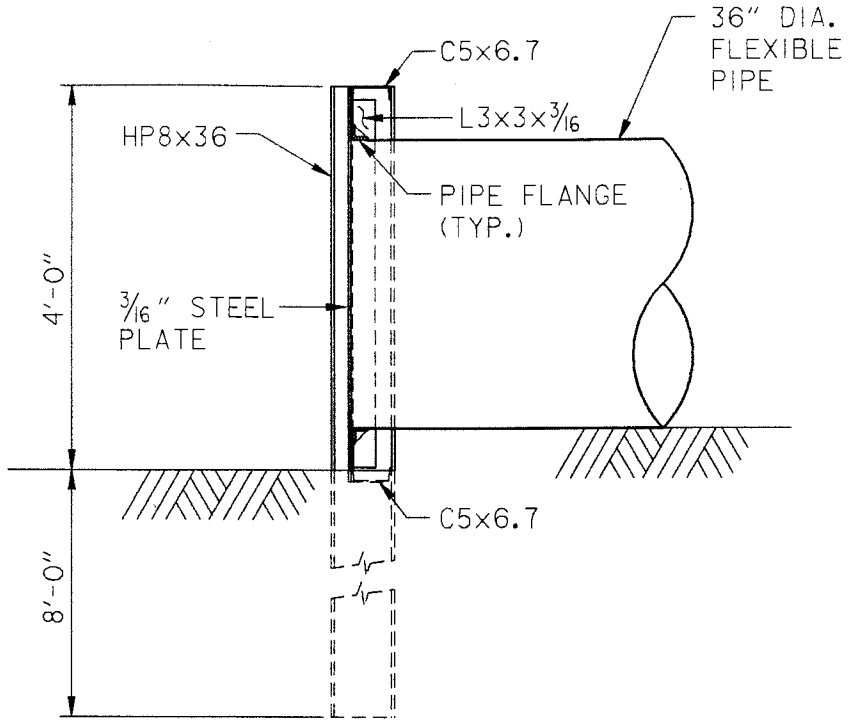
"C" 20' 0 20'

FILE NAME: puerto2/fdm/ds/pnf2s22.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 MARGARITA CHANNEL DE DIEGO BRIDGE MODIFICATION DEWATERING AND BYPASS PLAN STRUCTURAL DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DESIGN ENG.: EER	
DWN. BY: EER / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997



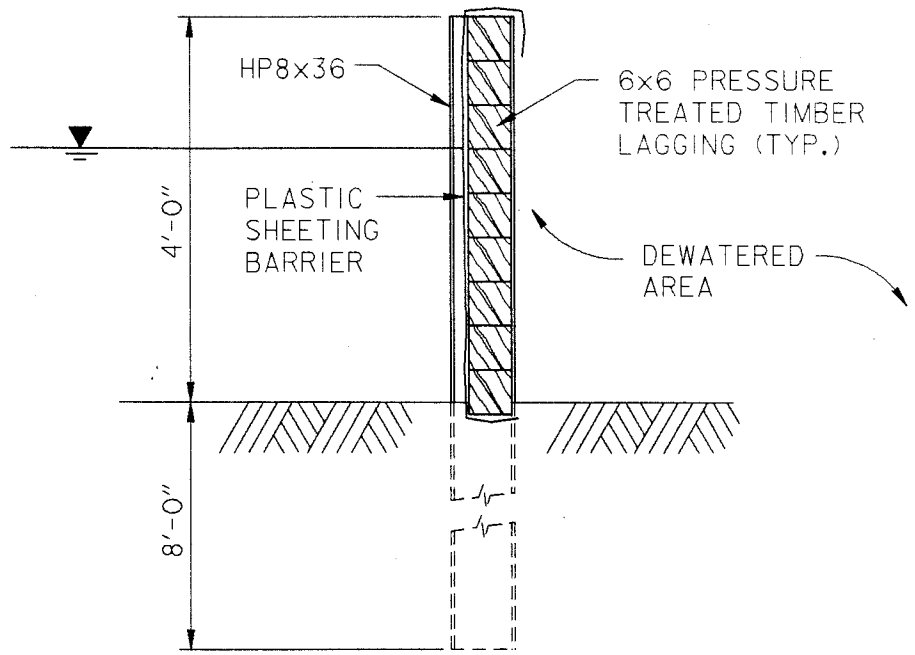
INTAKE FRAME

SCALE: "B"



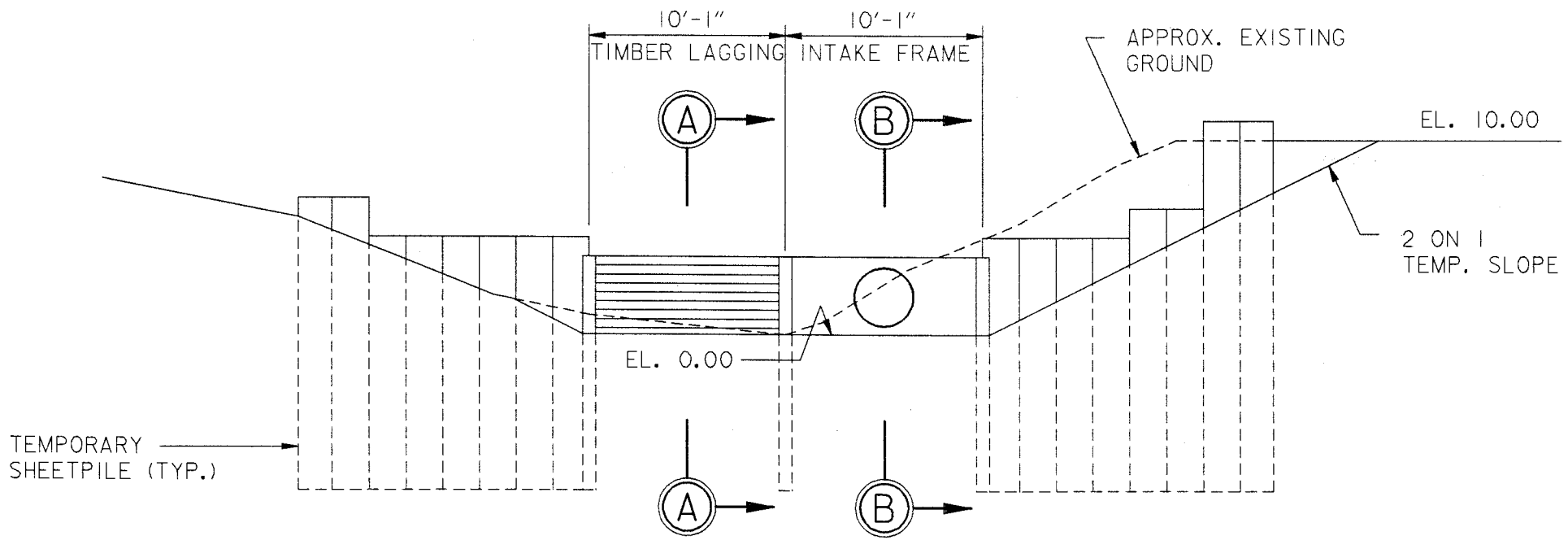
SECTION B-B

SCALE: "B"



SECTION A-A

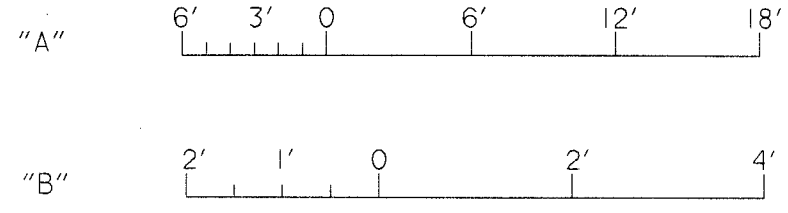
SCALE: "B"



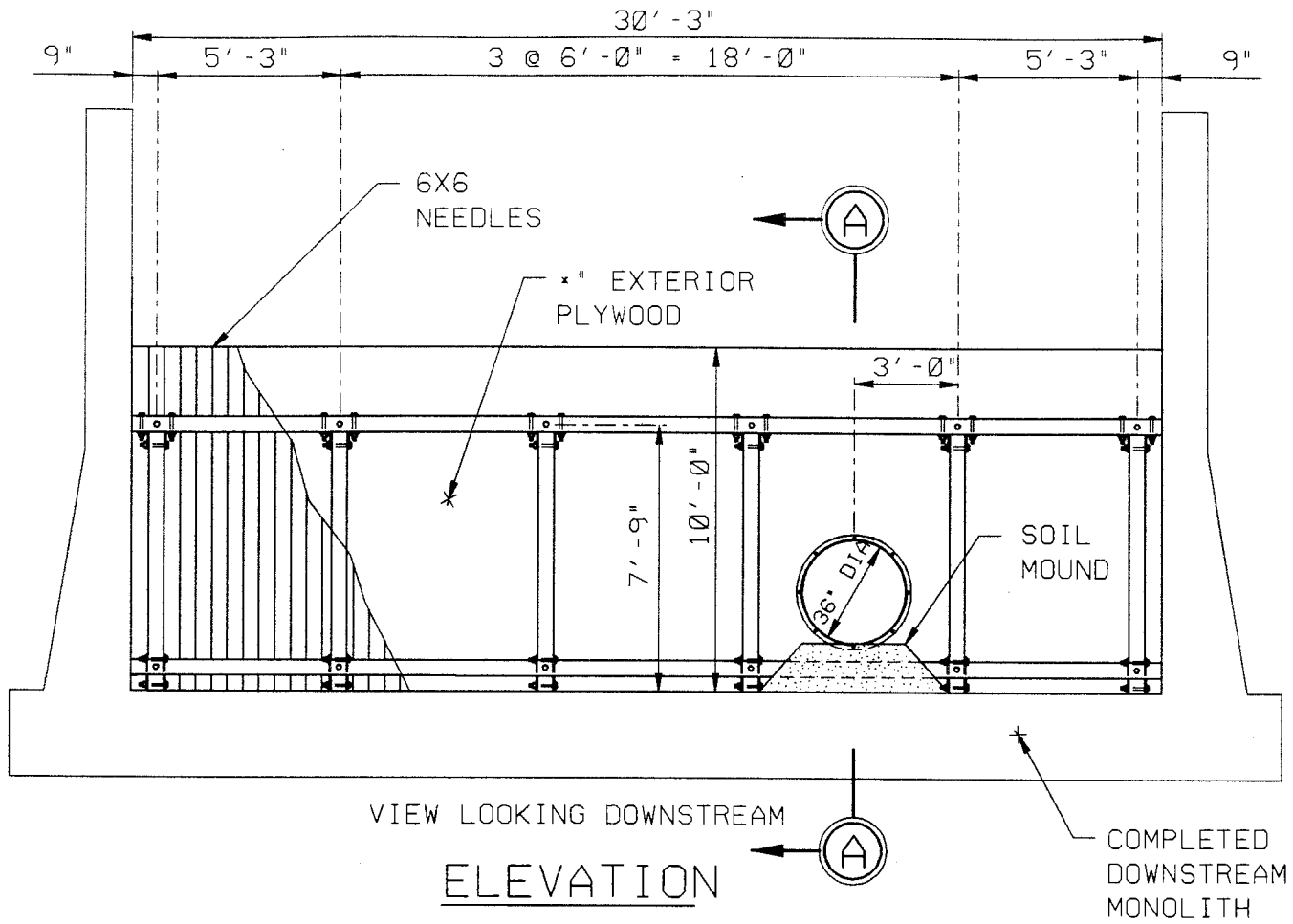
ELEVATION

SCALE: "A"

GRAPHIC SCALES

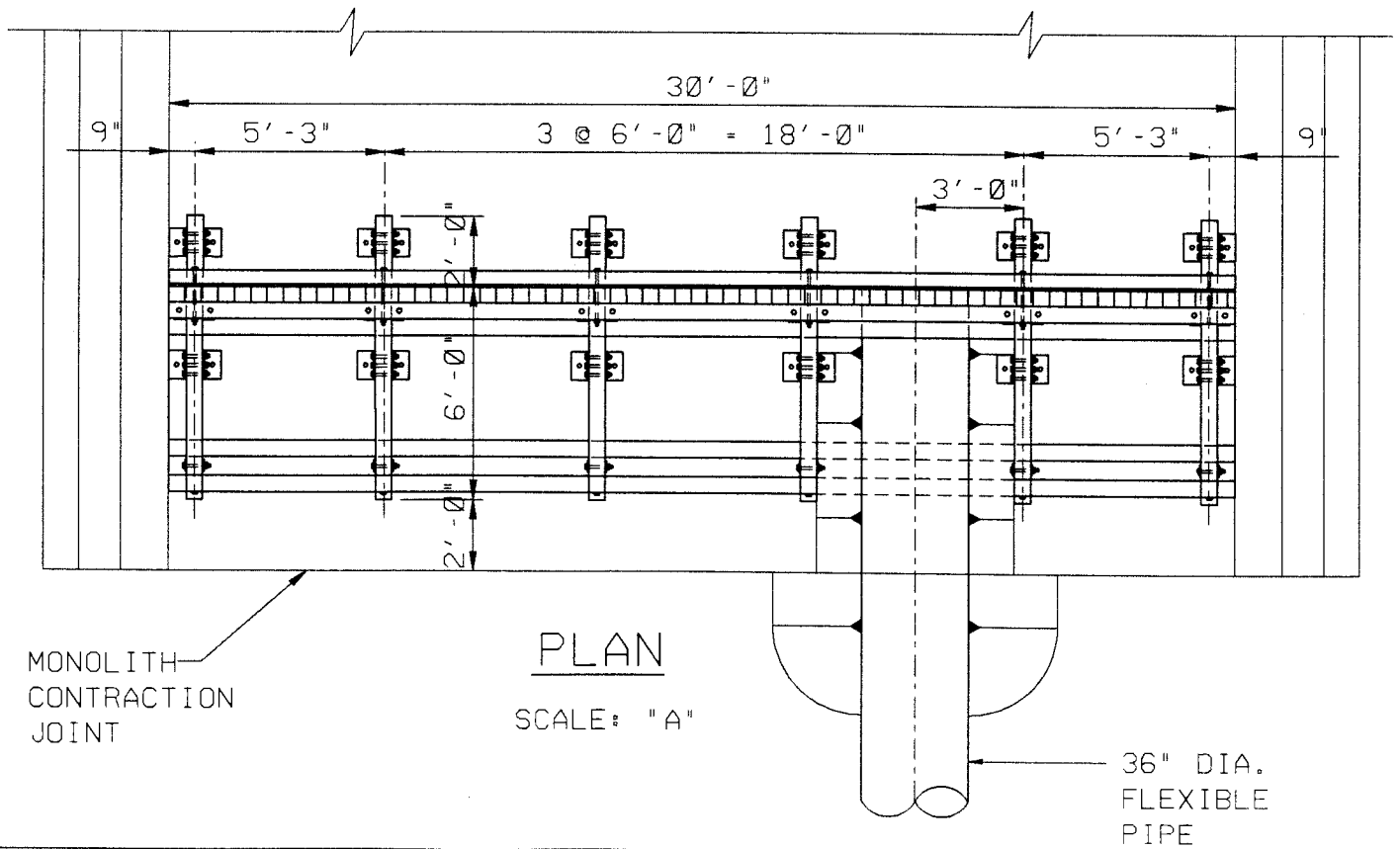


FILE NAME: puerto2/fdm/ds/pnf2s23.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 MARGARITA CHANNEL DE DIEGO BRIDGE MODIFICATION UPSTREAM DEWATERING FENCE STRUCTURAL
DESIGN ENG.: EER	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: EER / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997



ELEVATION

SCALE: "A"



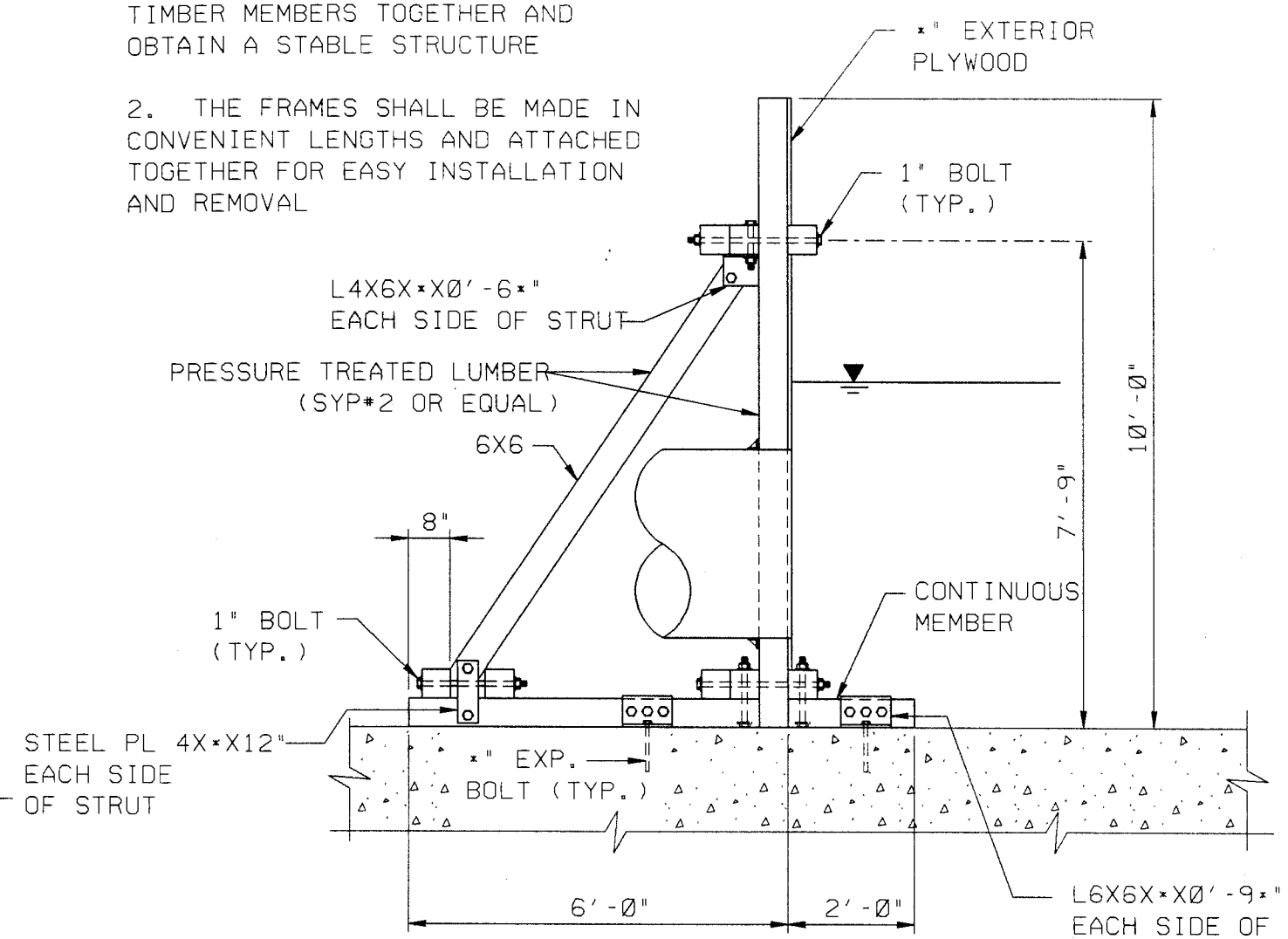
PLAN

SCALE: "A"

NOTES:

1. NAILS SHALL BE USED IN ADDITION TO THE BOLTS SHOWN TO ATTACH THE TIMBER MEMBERS TOGETHER AND OBTAIN A STABLE STRUCTURE

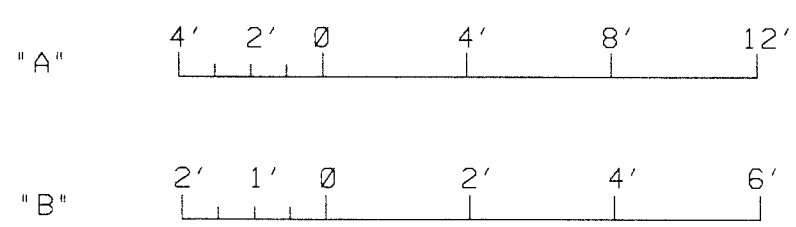
2. THE FRAMES SHALL BE MADE IN CONVENIENT LENGTHS AND ATTACHED TOGETHER FOR EASY INSTALLATION AND REMOVAL



SECTION A-A

SCALE: "B"

GRAPHIC SCALES



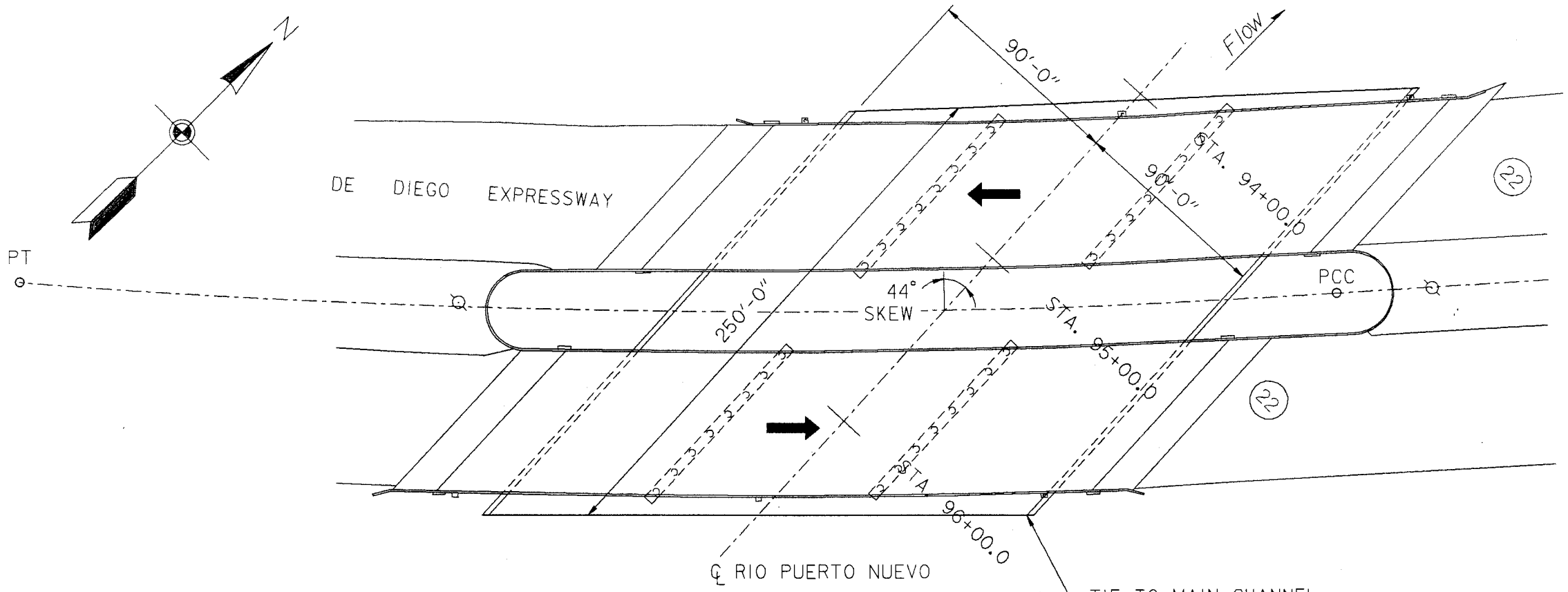
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	DWN. BY: EER	CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL
DE DIEGO BRIDGE MODIFICATION
DOWNSTREAM DEWATERING FRAME
STRUCTURAL

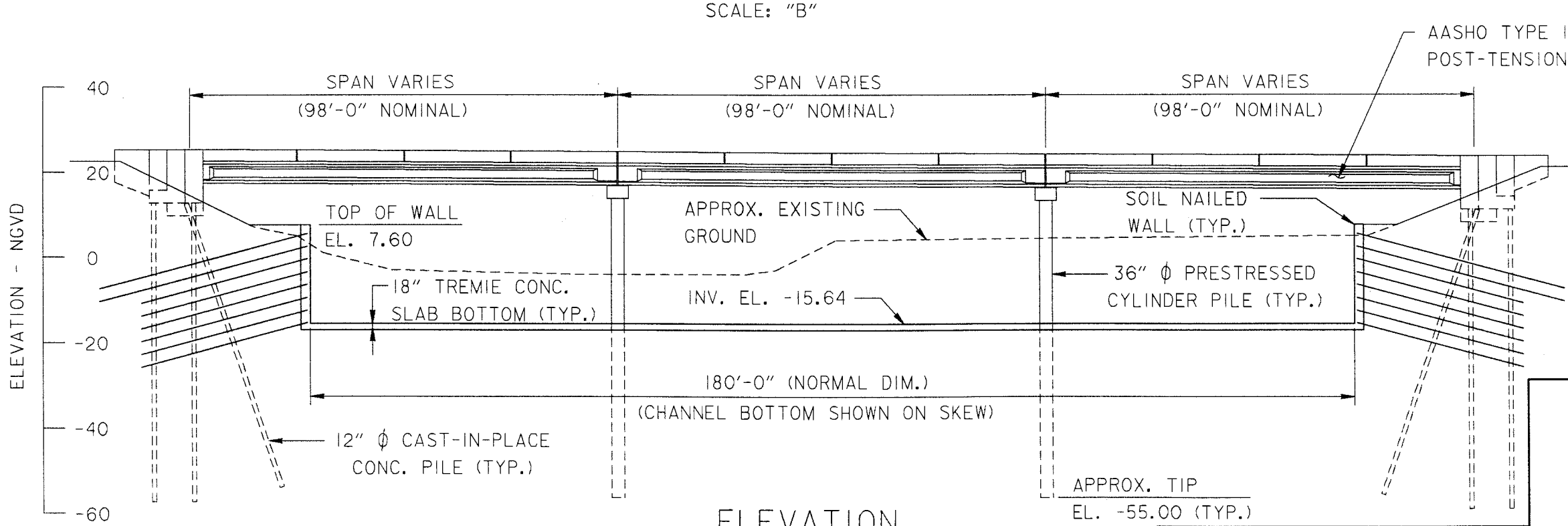
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997



PLAN

SCALE: "B"



ELEVATION

SCALE: "A"

VIEW: LOOKING DOWNSTREAM

GRAPHIC SCALES

"A" 30' 0 30'

"B" 60' 0 60'

FILE NAME: puerto2/fdm2/ds pnf2s25.dgn	DESIGN ENG.: EER		
	DWN. BY: EER	CKD. BY:	

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

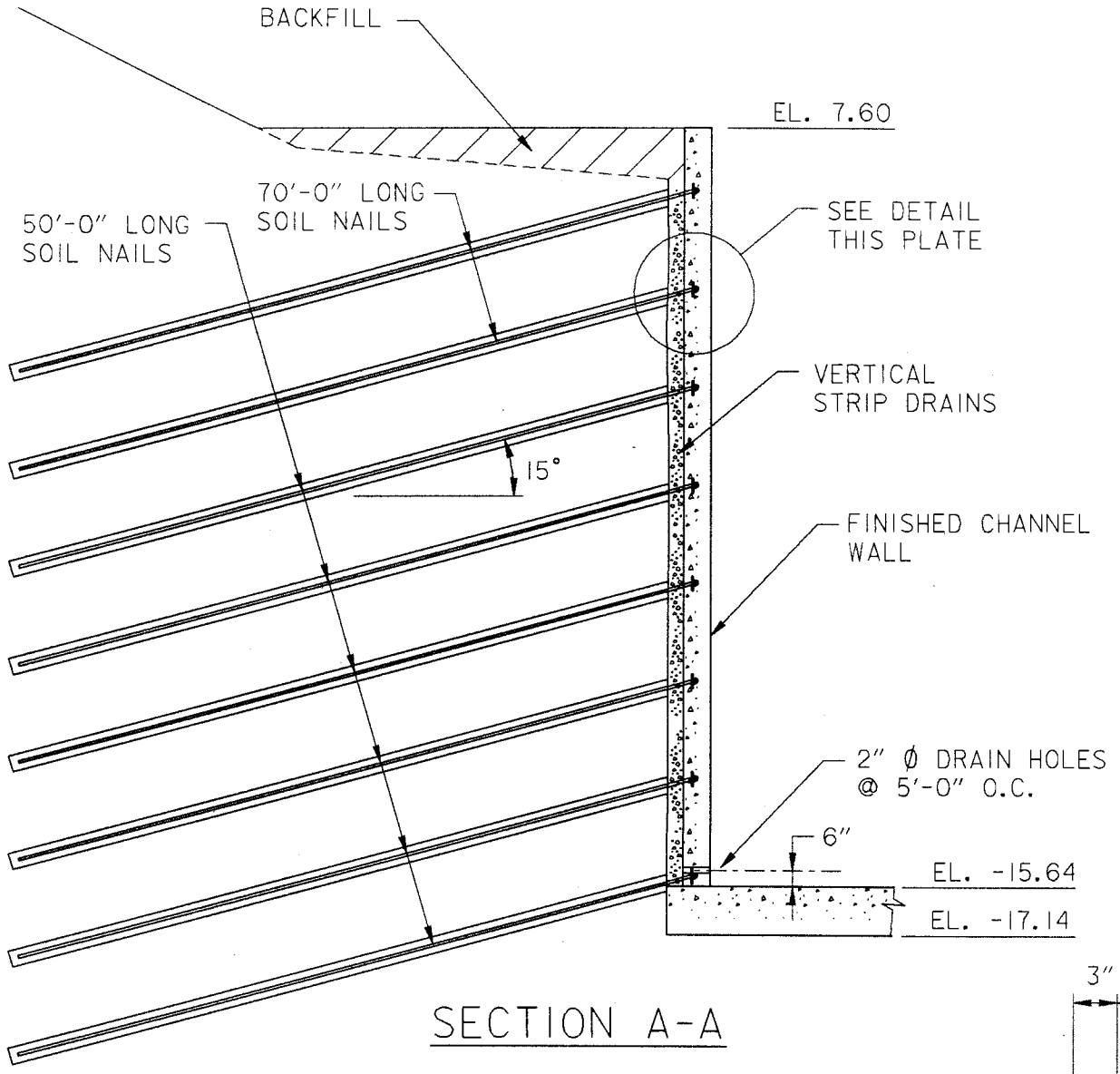
PUERTO NUEVO CHANNEL

DE DIEGO EXPRESSWAY BRIDGE
PLAN AND ELEVATION

STRUCTURAL

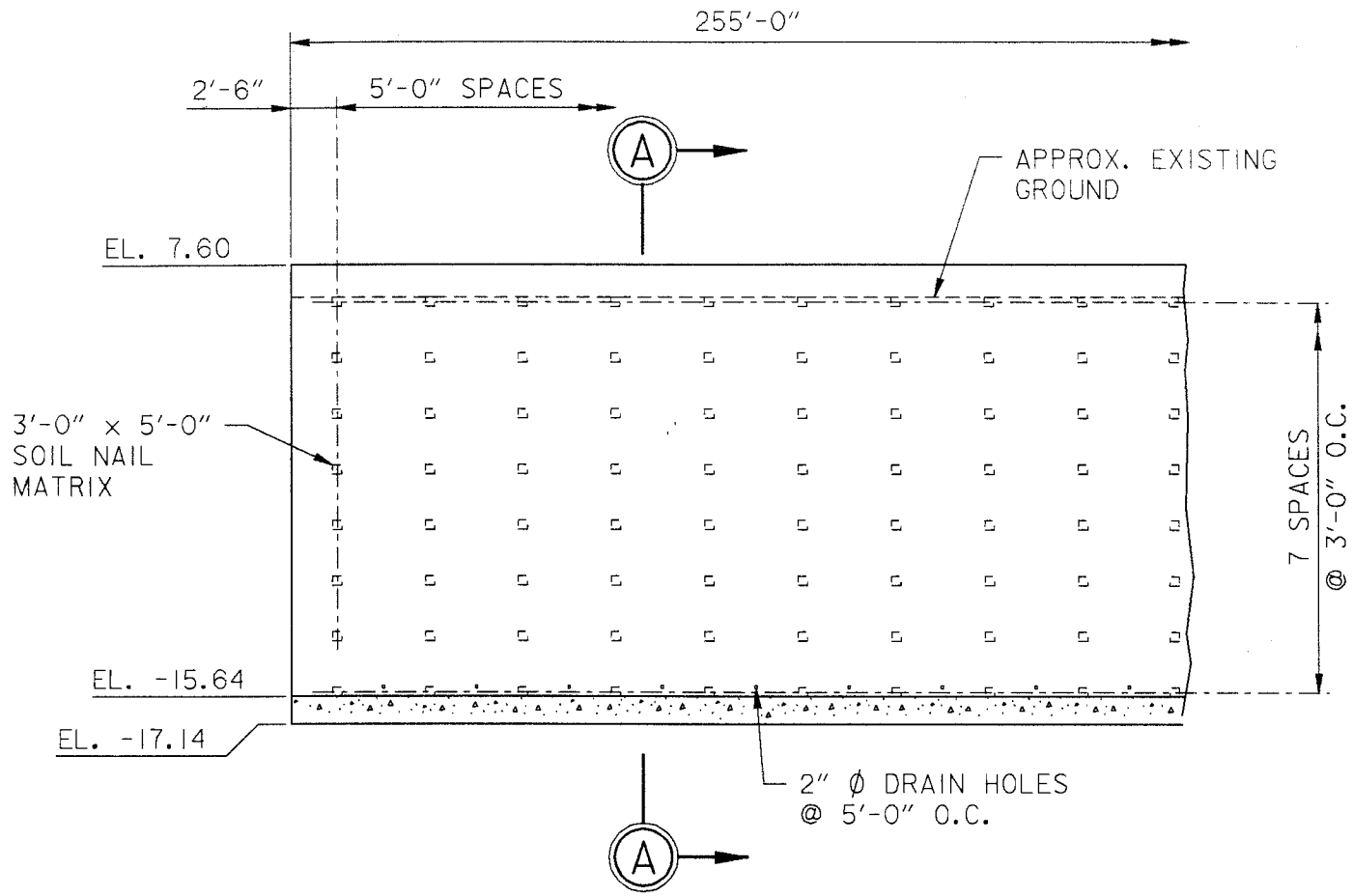
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997



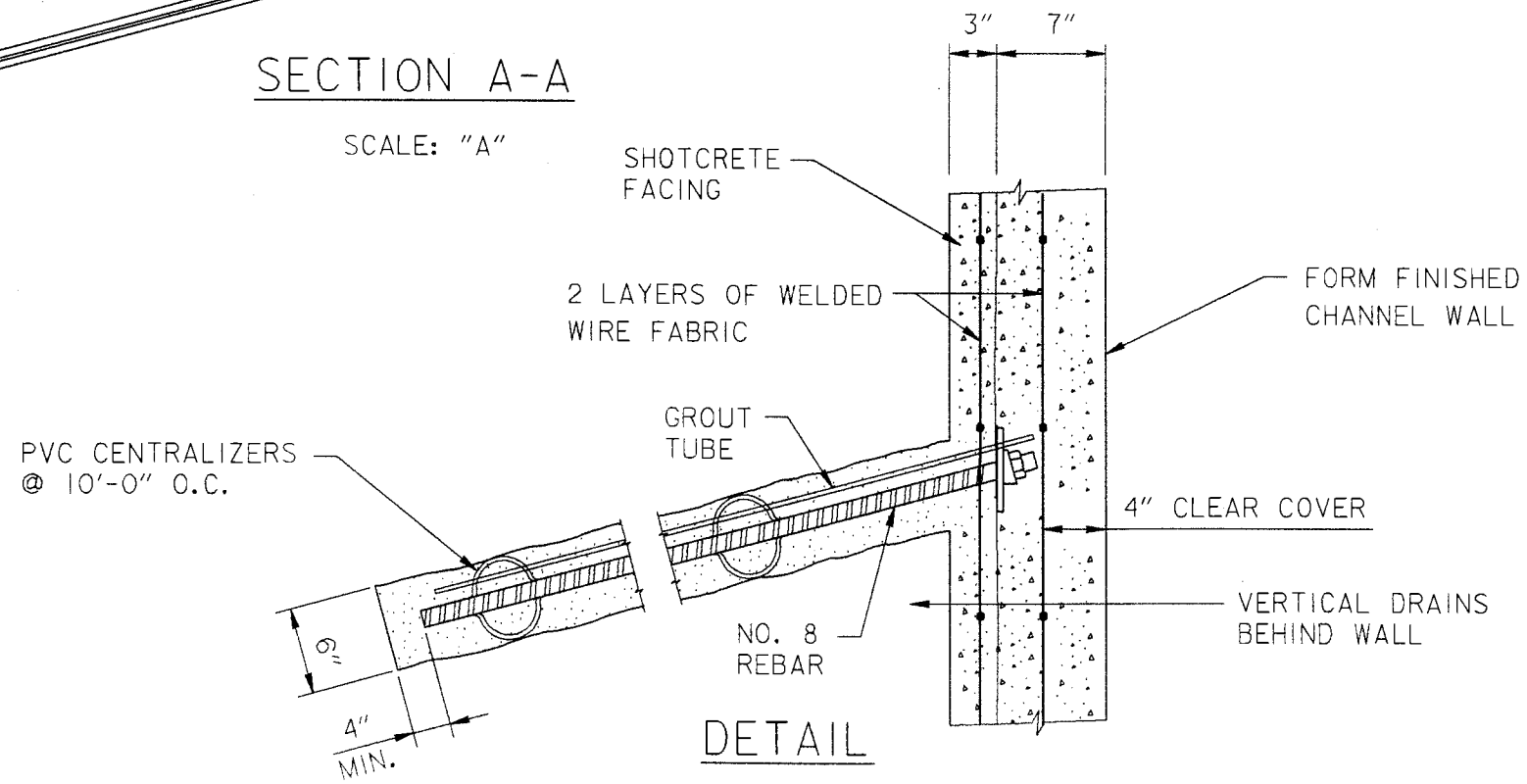
SECTION A-A

SCALE: "A"



ELEVATION

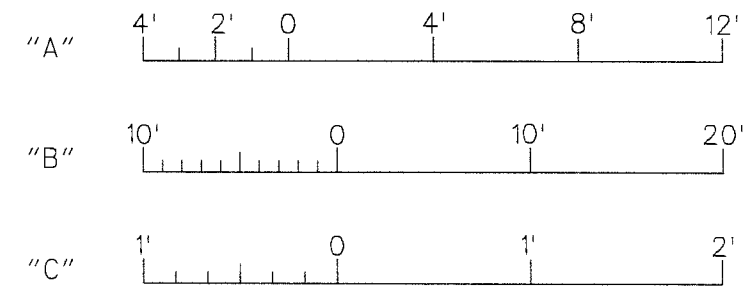
SCALE: "B"



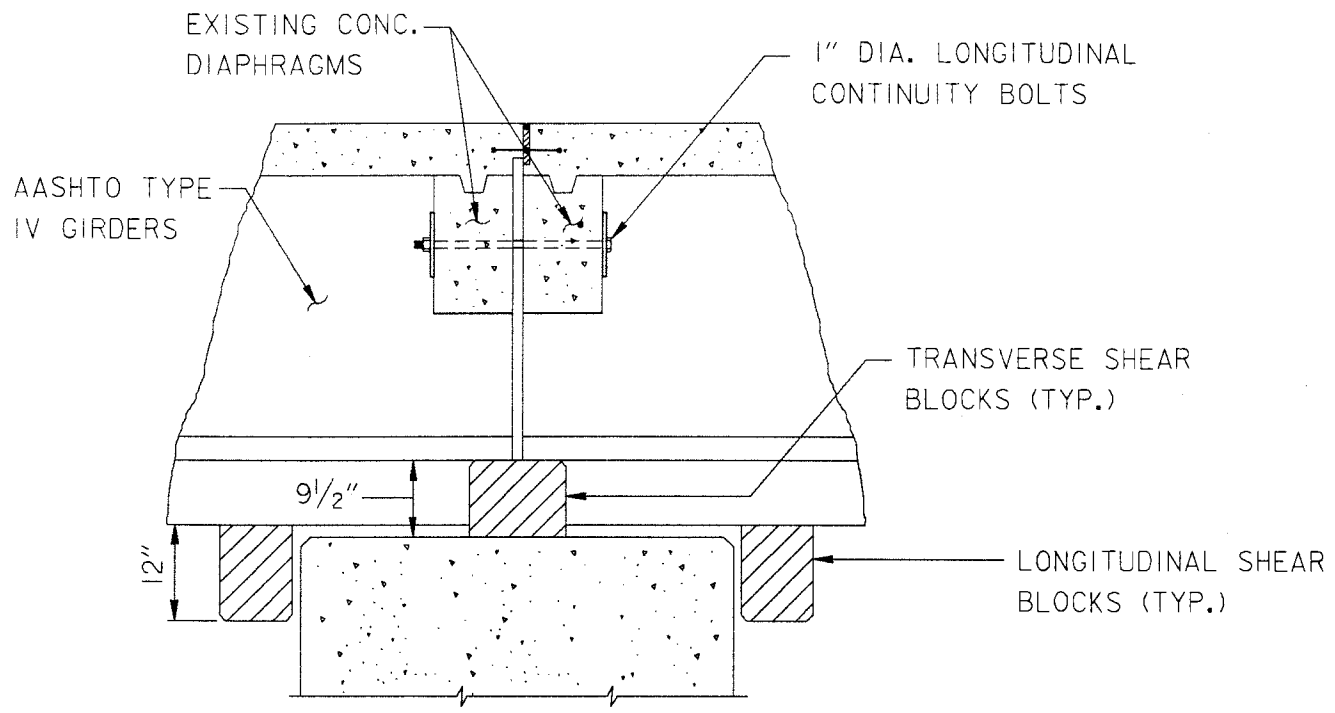
DETAIL

SCALE: "C"

GRAPHIC SCALES

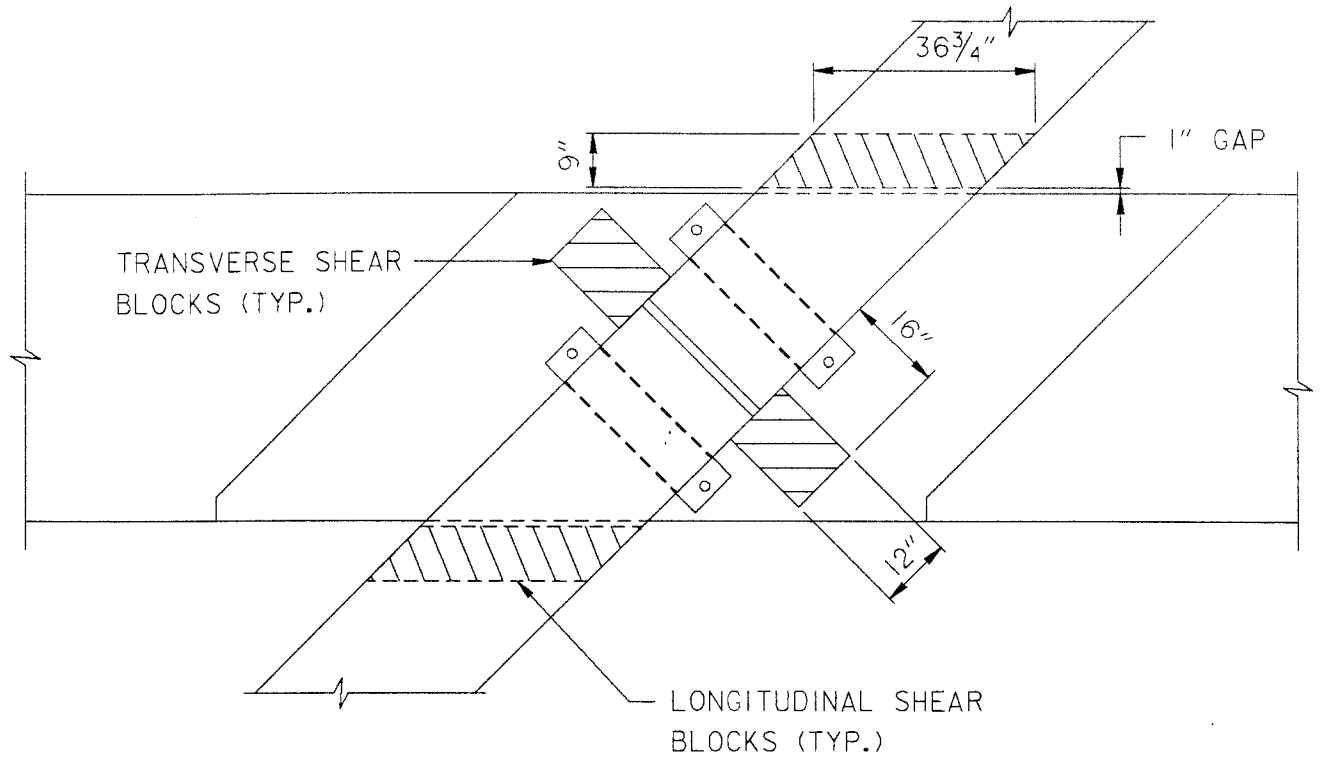


FILE NAME: puerto2/fdm2/ds/pnf2s26.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 PUERTO NUEVO CHANNEL DE DIEGO EXPRESSWAY BRIDGE SOIL-NAILED WALL DETAILS STRUCTURAL DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DESIGN ENG.: EER	
DWN. BY: EER / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997



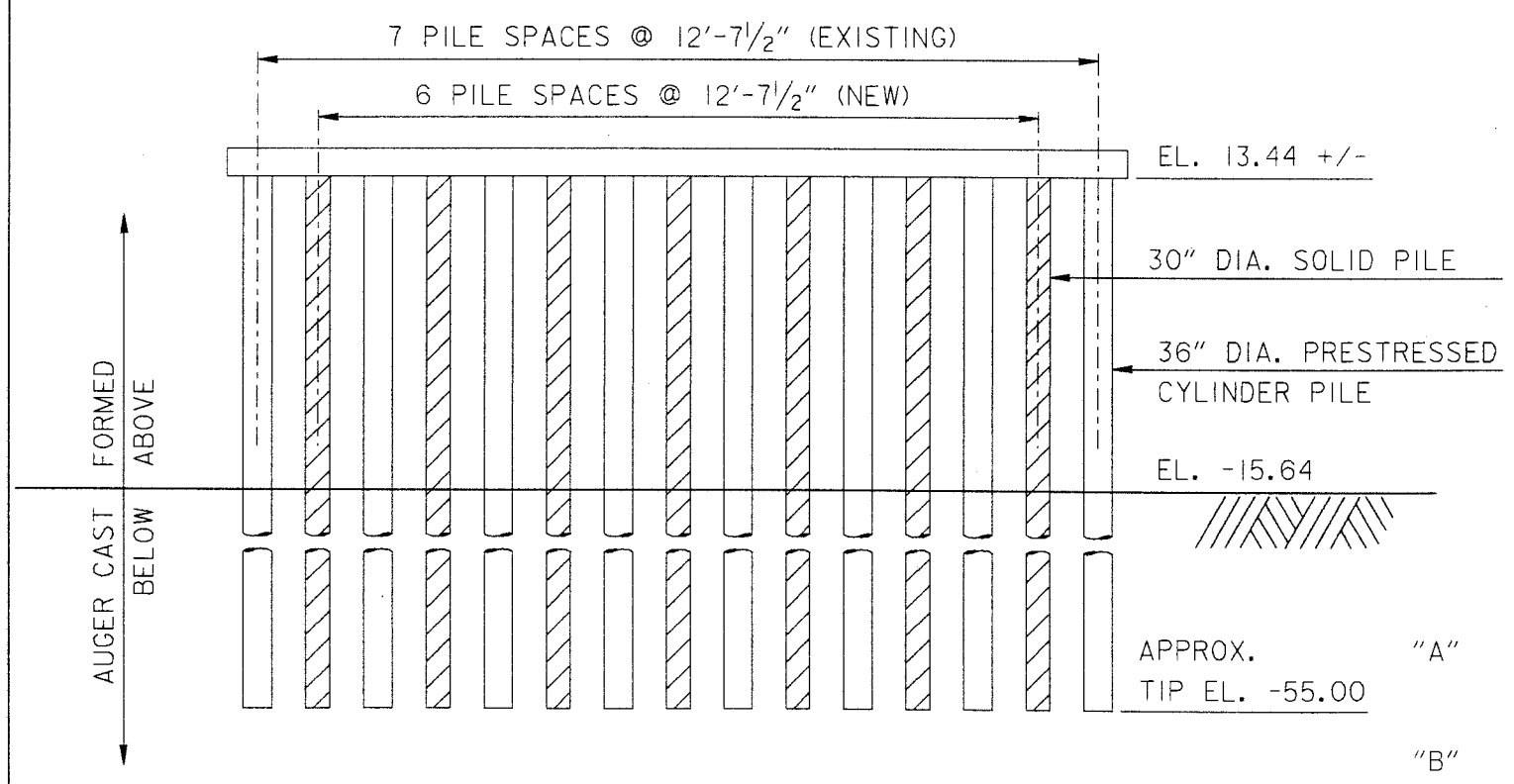
SECTION @ INTERMEDIATE BENT

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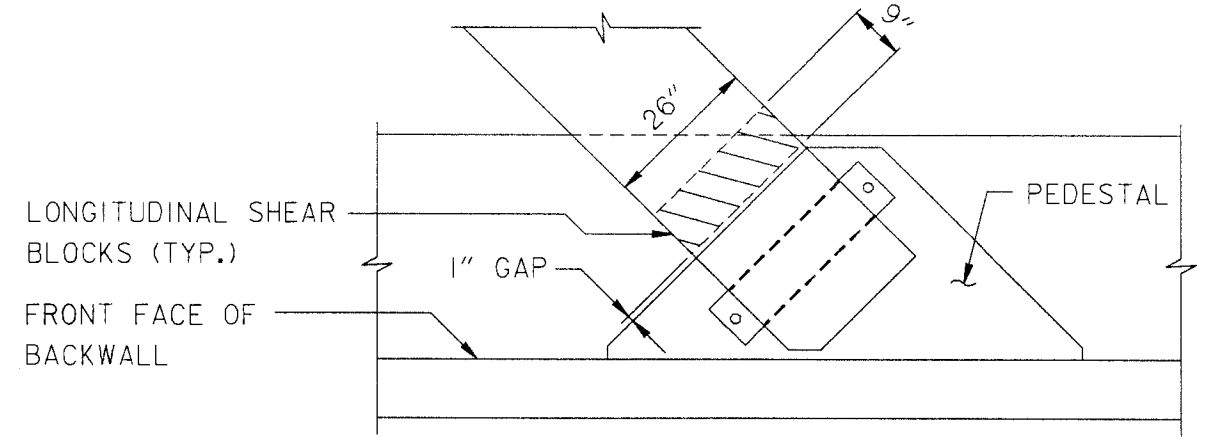
PART PLAN @ INTERMEDIATE BENT

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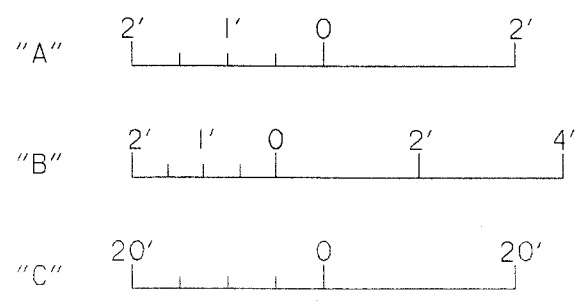
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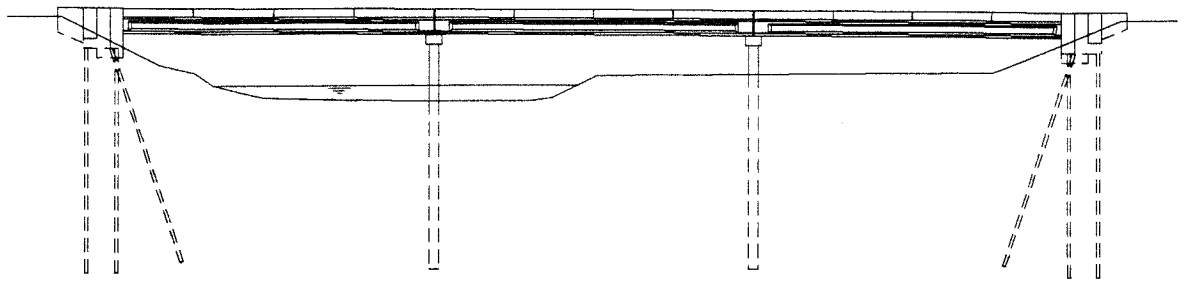
PART PLAN @ ABUTMENT

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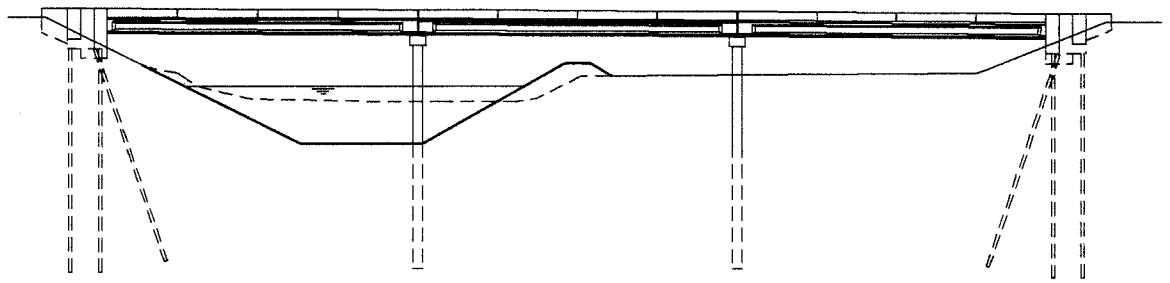
GRAPHIC SCALES



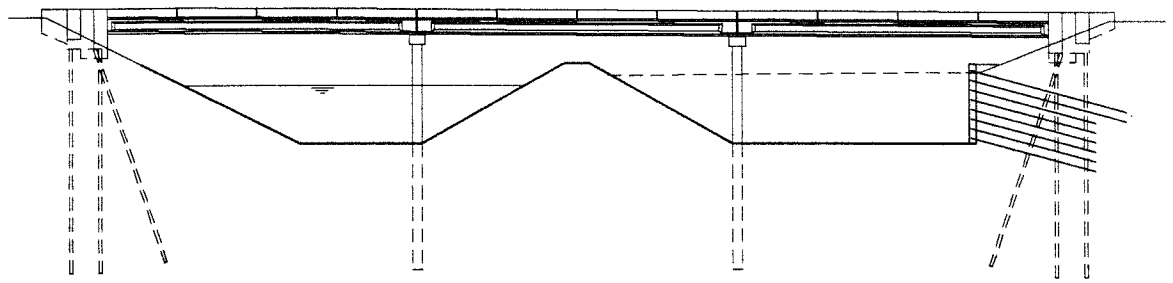
FILE NAME: puerto2/fdm/ds/pnf2s27.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 PUERTO NUEVO CHANNEL DE DIEGO EXPRESSWAY BRIDGE RETROFITTING DETAILS STRUCTURAL DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DESIGN ENG.: EER	
DWN. BY: EER / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997



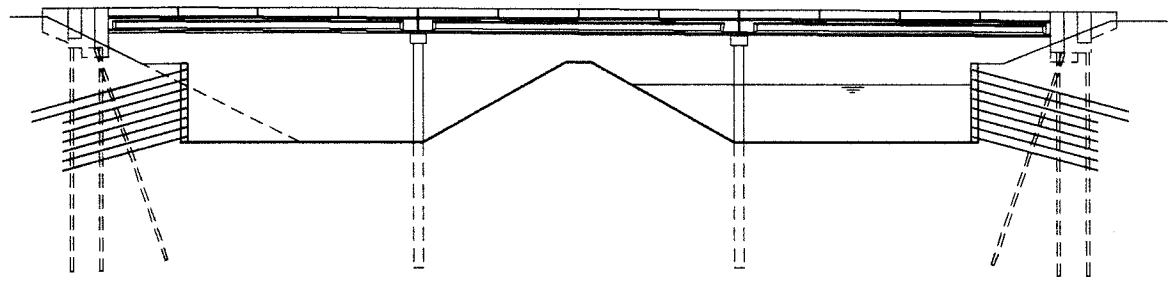
EXISTING CONDITION



STAGE 1



STAGE 2



STAGE 3

STAGE 4

CONSTRUCTION SEQUENCE

1. EXCAVATE NATURAL CHANNEL ON THE WEST SIDE TO EL. -17.14. SLOPE EXCAVATION AT INTERIOR PILE BENTS UP TO EXISTING GROUND. CONSTRUCT DEWATERING DIKE TO EL. 8.00, CONFIGURED TO PROTECT EAST SIDE CHANNEL CONSTRUCTION AT UPSTREAM AND DOWNSTREAM END OF BRIDGE.

2. PERFORM SOIL NAILING OPERATION TO BUILD EAST CHANNEL WALL. SLOPE EXCAVATION AT INTERIOR PILE BENTS UP TO CROWN OF DEWATERING DIKE DURING SOIL NAILING. INSTALL NEW 30" PILES AT EAST INTERIOR BENTS.

3. CONFIGURE DEWATERING DIKE AT UPSTREAM AND DOWNSTREAM END OF BRIDGE TO PROTECT WEST SIDE CHANNEL CONSTRUCTION. PERFORM SOIL NAILING OPERATION TO BUILD WEST CHANNEL WALL. INSTALL 30" PILES AT WEST INTERIOR BENTS.

4. REMOVE DEWATERING DIKE AND INSTALL TREMIE BOTTOM SLAB TO COMPLETE CHANNEL.

GRAPHIC SCALE

60' 0 60'

FILE NAME: puerto2/fdm2/ds/pnf2s28.dgn

DESIGN ENG.: EER

DWN. BY: EER

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL

DE DIEGO EXPRESSWAY BRIDGE
CONSTRUCTION SEQUENCE

STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

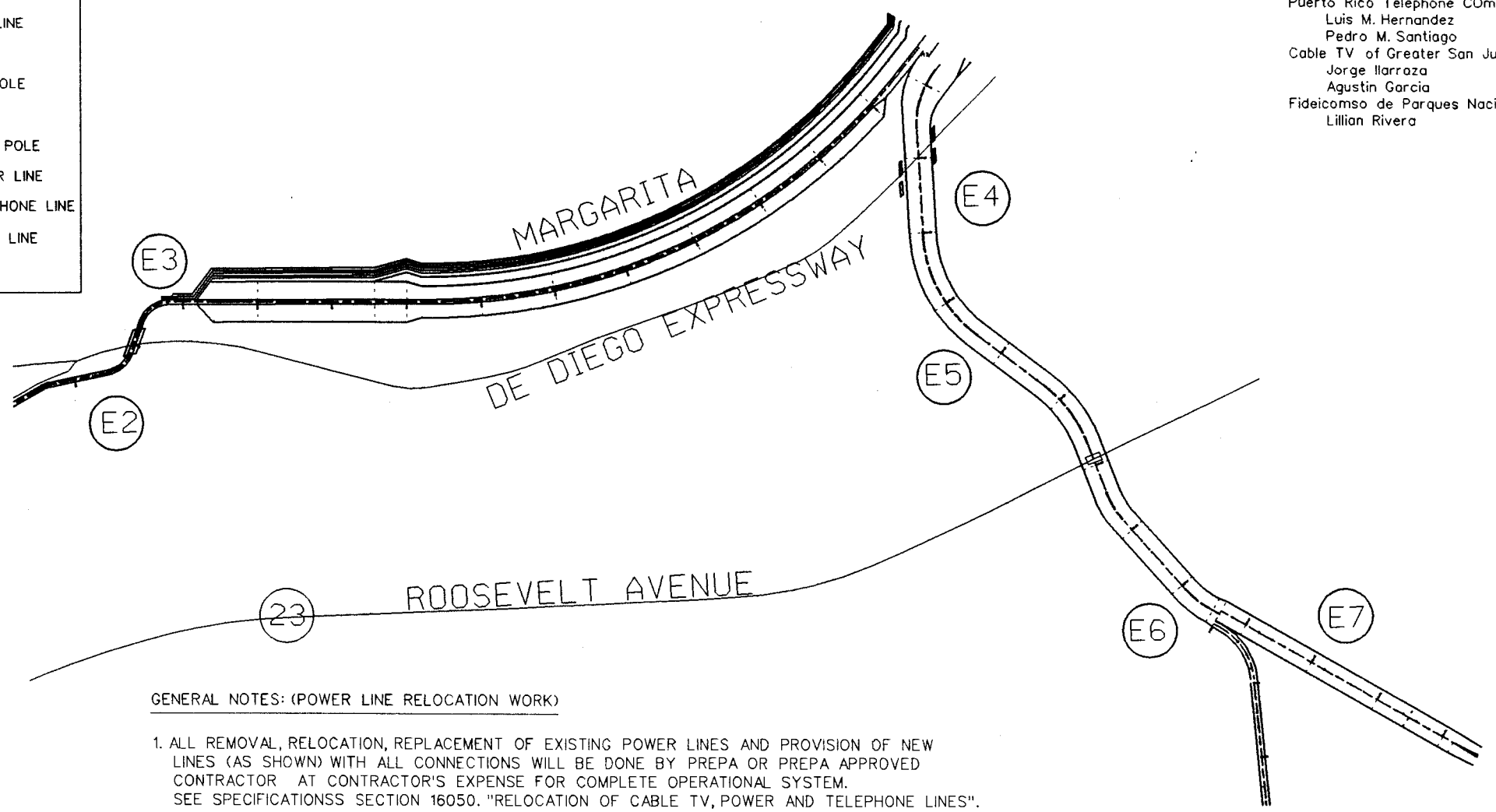
D.O. FILE NO. 101-37,451 NOVEMBER 1997

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MECHANICAL AND ELECTRICAL
PLATES

LEGEND

- TEMPORARY EASEMENT
- PERMANENT EASEMENT
- PROPOSED CHANNEL EDGE
- P — EXISTING POWER LINE
- T — EXISTING TELEPHONE LINE
- C — EXISTING CABLE LINE
- EXISTING POLE
- EXISTING LIGHT POLE
- PROPOSED POLE
- PROPOSED LIGHT POLE
- NP — PROPOSED POWER LINE
- NT — PROPOSED TELEPHONE LINE
- NC — PROPOSED CABLE LINE
- X X X X X TO BE REMOVED



UTILITY POINTS OF CONTACT:

Puerto Rico Electric Power Authority	(PREPA)
Tamas E. Veles	(787) 289-3060
Puerto Rico Telephone COmpany	(PRTC)
Luis M. Hernandez	(787) 749-3116
Pedro M. Santiago	(787) 749-2219
Cable TV of Greater San Juan	(CATV)
Jorge Ilarraza	(787) 766-0909
Agustin Garcia	(787) 766-0909
Fideicomso de Parques Nacionales de Puerto Rico	
Lillian Rivera	(787) 763-0568

GENERAL NOTES: (POWER LINE RELOCATION WORK)

1. ALL REMOVAL, RELOCATION, REPLACEMENT OF EXISTING POWER LINES AND PROVISION OF NEW LINES (AS SHOWN) WITH ALL CONNECTIONS WILL BE DONE BY PREPA OR PREPA APPROVED CONTRACTOR AT CONTRACTOR'S EXPENSE FOR COMPLETE OPERATIONAL SYSTEM. SEE SPECIFICATIONSS SECTION 16050. "RELOCATION OF CABLE TV, POWER AND TELEPHONE LINES".
2. CONTRACTOR SHALL COORDINATE WITH PREPA AHEAD OF TIME FOR CLEAR UNDERSTANDING OF PORTION OF WORK PREPA WILL DO AND WORK THAT CONTRACTOR WILL DO AND SCHEDULING REQUIREMENTS OF ADVANCE NOTIFICATION AND CONTRUCTION TIME FOR TIMELY COMPLETION OF POWER LINE WORK CAUSING NO DELAYS TO CONTRACT COMPLETION.
3. CONTRACTOR SHALL COORDINATE WITH PREPA THROUGH CONTRACTING OFFICER FOR ENERGIZATION AND DEENERGIZATION OF LINES FOR SAFETY OF PERSONNEL AND EQUIPMENT DURING CONSTRUCTION AND POWER LINE WORK.
4. ALL OSHA, NESC, PREPA RULES AND REGULATIONS SHALL BE FOLLOWED FOR SAFETY DURING CONSTRUCTION AND POWER LINE WORK.
5. ALL REMOVED MATERIAL SHALL BE DISPOSED BY THE CONTRACTOR AT PREPA'S DESCRETION.
6. BOTTOM OF CONDUCTORS' SAG SHALL CLEAR ROADWAY BY 18'-6" MINIMUM. SIZE POLE HEIGHTS ACCORDINGLY. FINAL CLEARANCE REQUIREMENTS SHALL BE COORDINATED WITH PREPA, PRTC, AND CATV.
7. POWER LINE CONSTRUCTION PLANS SHALL BE APPROVED BY PREPA IN ACCORDANCE WITH PREPA STANDARDS AND REGULATIONS. CONTRACTOR SHALL PREPARE PLANS AND SUBMIT PLANS THROUGH AN ENGINEER REGISTERED IN PUERTO RICO FOR PREPA APPROVAL PRIOR TO ELECTRICAL CONSTRUCTION.
8. CONTRACTOR SHALL FIELD VERIFY AND COORDINATE WORK REQUIRED FOR PROVIDING SECONDARY SERVICES.

LEGEND

(EX) ELECTRICAL, PLATE E-X

FILE NAME: PNF2E01.DGN

DESIGN ENG.: B.D.S.

DWN. BY: B.D.S.

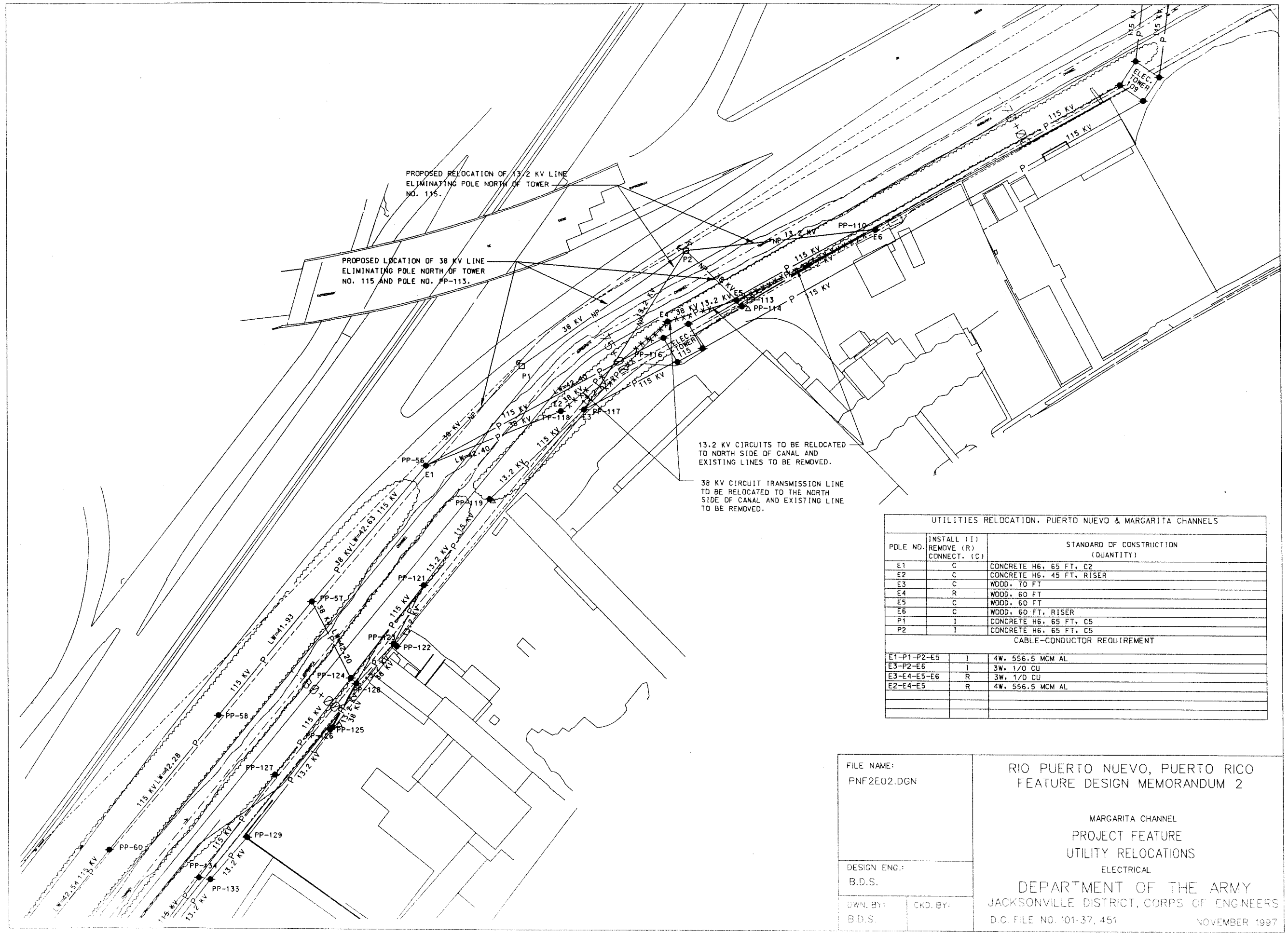
CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO & MARGARITA CHANNELS

PROJECT FEATURE
UTILITY CONFLICT SITE MAP
ELECTRICAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-37, 451 NOVEMBER 1997



UTILITIES RELOCATION, PUERTO NUEVO & MARGARITA CHANNELS		
PDLE NO.	INSTALL (I) REMOVE (R) CONNECT. (C)	STANDARD OF CONSTRUCTION (QUANTITY)
E1	C	CONCRETE H6, 65 FT, C2
E2	C	CONCRETE H6, 45 FT, RISER
E3	C	WOOD, 70 FT
E4	R	WOOD, 60 FT
E5	C	WOOD, 60 FT
E6	C	WOOD, 60 FT, RISER
P1	I	CONCRETE H6, 65 FT, C5
P2	I	CONCRETE H6, 65 FT, C5
CABLE-CONDUCTOR REQUIREMENT		
E1-P1-P2-E5	I	4W, 556.5 MCM AL
E3-P2-E6	I	3W, 1/0 CU
E3-E4-E5-E6	R	3W, 1/0 CU
E2-E4-E5	R	4W, 556.5 MCM AL

FILE NAME:
PNF2E02.DGN

DESIGN ENG.:
B.D.S.

DWN. BY: B.D.S.

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL

PROJECT FEATURE

UTILITY RELOCATIONS

ELECTRICAL

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.C. FILE NO. 101-37, 451

NOVEMBER 1997

REMOVE AND DISPOSE OF LINES, POLES, AND HARDWARE FROM POLE NO. PP-182 EAST TO POLE NO. PP-187.

LIGHT POLES LP-79 AND LP-80 TO BE RELOCATED AS SHOWN. NECESSARY CONDUITS AND CIRCUITS TO BE PROVIDED TO MATCH EXISTING.

LW=20.21
LW=38.48
LW=22.52
LW=15.69
LW=20.11
LW=10.55
LW=27.21
LW=10.64
LW=48.82
LW=18.37
LW=15.94
LW=12.42
LW=13.86
LW=18.72
LW=17.98

E1
E2 PP-182
E3 PP-183
E4 PP-186
E5 PP-187

LP-79
PP-178
LP-208
LP-206
PP-160
PP-158
PP-157
PP-156
PP-155
PP-154
LP-80
LP-81
LP-83
PP-153
PP-152
PP-150
PP-165
PP-164
PP-163
PP-161
LP-78
PP-100
PP-98
PP-99
PP-102

UTILITIES RELOCATION, PUERTO NUEVO & MARGARITA CHANNELS		
POLE NO.	INSTALL (I) REMOVE (R) CONNECT, (C)	STANDARD OF CONSTRUCTION (QUANTITY)
LP-78	C	WOOD, 45 FT. HPS COBRA FIXTURE
LP-79	R	WOOD, 45 FT. HPS COBRA FIXTURE
LP-80	R	WOOD, 45 FT. HPS COBRA FIXTURE
LP-81	C	WOOD, 45 FT. HPS COBRA FIXTURE
E1	R	WOOD, 65 FT. C2
E2	R	WOOD, 65 FT. C2
E3	R	WOOD, 65 FT. C2
E4	R	WOOD, 65 FT. C2
E5	R	WOOD, 65 FT. C2
CABLE-CONDUCTOR REQUIREMENT		
E1-E2-E3-E4-E5	556.5 MCM	

FILE NAME: PNF2E03.DGN

DESIGN ENG.: B.D.S.

DWN. BY: B.D.S.

CKD. BY:

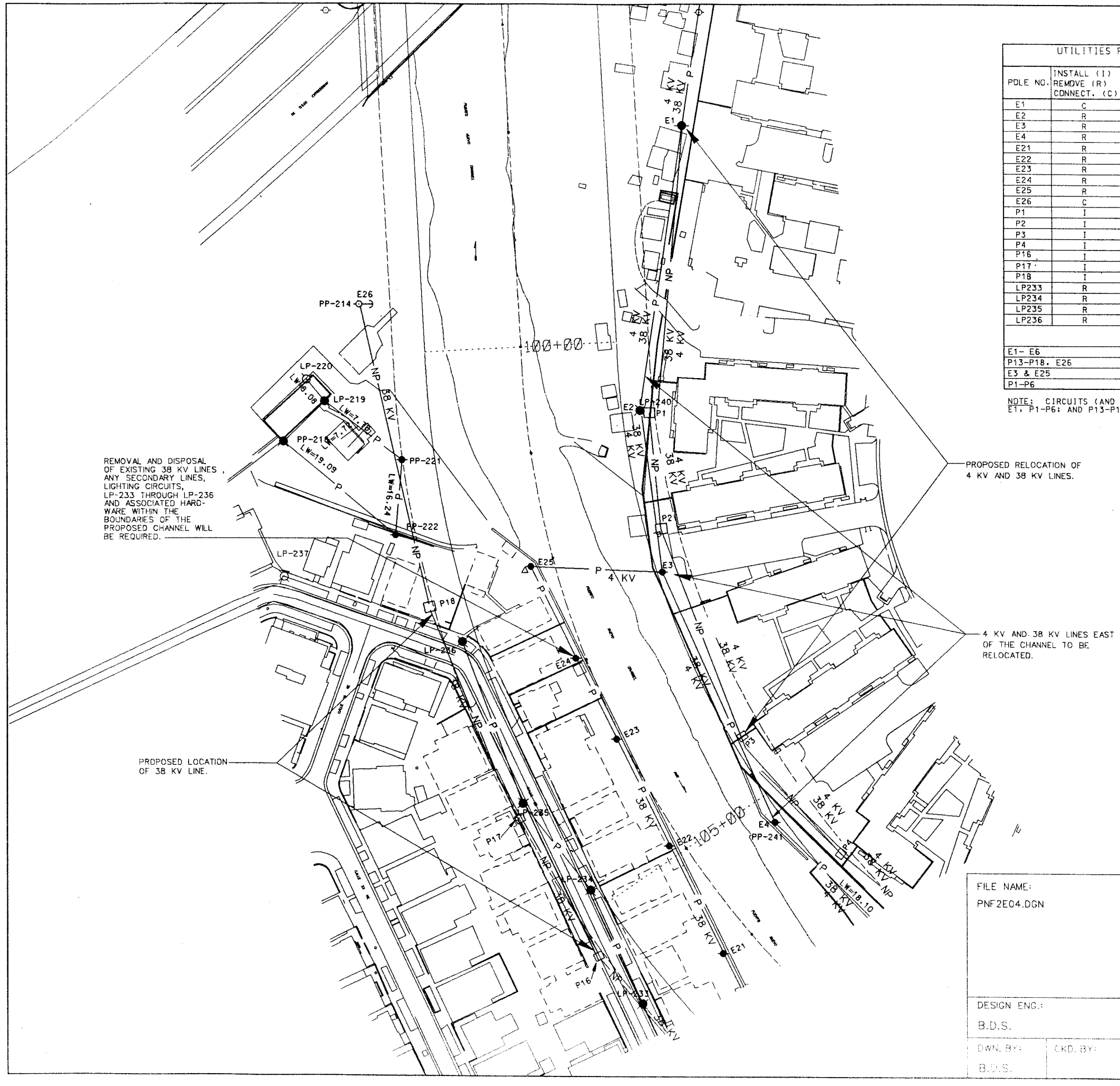
RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL

PROJECT FEATURE
UTILITY RELOCATIONS
ELECTRICAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37, 451 NOVEMBER 1997



UTILITIES RELOCATION, PUERTO NUEVO & MARGARITA CHANNELS		
POLE NO.	INSTALL (I) REMOVE (R) CONNECT. (C)	STANDARD OF CONSTRUCTION (QUANTITY)
E1	C	WOOD, 65 FT, C2
E2	R	WOOD, 65 FT, C2
E3	R	WOOD, 65 FT, C2
E4	R	WOOD, 65 FT, C2
E21	R	WOOD, 65 FT, C2
E22	R	WOOD, 65 FT, C2
E23	R	WOOD, 65 FT, C2
E24	R	WOOD, 65 FT, C2
E25	R	WOOD, 65 FT, C2
E26	C	WOOD, 65 FT, C2
P1	I	CONCRETE, 65 FT, C2
P2	I	CONCRETE, 65 FT, C2
P3	I	CONCRETE, 65 FT, C2
P4	I	CONCRETE, 65 FT, C2
P16	I	CONCRETE, 65 FT, C2
P17	I	CONCRETE, 65 FT, C2
P18	I	CONCRETE, 65 FT, C2
LP233	R	CONCRETE, 45 FT, COBRA HEAD FIXTURE
LP234	R	WOOD, 45 FT, COBRA HEAD FIXTURE
LP235	R	WOOD, 45 FT, COBRA HEAD FIXTURE
LP236	R	CONCRETE, 45 FT, COBRA HEAD FIXTURE
CABLE-CONDUCTOR REQUIREMENT		
E1- E6		38 kV - 556.5 MCM, 4.16 kV - 1/0 CU
P13-P18, E26		556.5 MCM
E3 & E25		1/0 CU
P1-P6		38 kV - 556.5 MCM, 4.16 kV - 1/0 CU

NOTE: CIRCUITS (AND ASSOCIATED POLES) E1-E6; E17-E26; E1, P1-P6; AND P13-P18, E26 ARE CONTINUED ON PLATE E-5.

FILE NAME: PNF2E04.DGN	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 PUERTO NUEVO CHANNEL PROJECT FEATURE UTILITY RELOCATIONS ELECTRICAL
DESIGN ENG.: B.D.S.	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: B.D.S. / CKD. BY:	D.O. FILE NO. 101-37, 451 NOVEMBER 1997

REMOVE AND DISPOSE OF EXISTING 38 KV LINES , ANY SECONDARY LINES, LIGHTING CIRCUITS, LP-233 THROUGH LP-236 AND ASSOCIATED HARD-WARE WITHIN THE BOUNDARIES OF THE PROPOSED CHANNEL.

4 KV AND 38 KV LINES EAST OF THE CHANNEL. TO BE RELOCATED.

PROPOSED RELOCATION OF 4 KV AND 38 KV LINES.

4 KV CROSSING TO BE RELOCATED.

PROPOSED RELOCATION OF 38 KV LINE.

PROPOSED RELOCATION OF 4 KV AND 38 KV LINES.

LIGHTING FIXTURES AND ASSOCIATED CIRCUITS TO BE RELOCATED.

PROPOSED LOCATION OF 38 KV LINE AND NEW CHANNEL CROSSING.

105+00

115+00

UTILITIES RELOCATION. PUERTO NUEVO & MARGARITA CHANNELS		
POLE NO.	INSTALL (I) REMOVE (R) RELOCATE (RL) CONNECT. (C)	STANDARD OF CONSTRUCTION (QUANTITY)
E5	R	WOOD. 65 FT. C2
E6	R	WOOD. 65 FT. C2
E7	R	WOOD. 65 FT. C2
E8	C	WOOD. 65 FT. C2
E9	R	WOOD. 65 FT. C2
E10	R	WOOD. 65 FT. C2
E11	R	WOOD. 65 FT. C2
E12	C	CONCRETE. 65 FT. C2
E13	C	WOOD. 65 FT. C2
E14	R	WOOD. 65 FT. C2
E15	R	WOOD. 65 FT. C2
E16	R	WOOD. 65 FT. C2
E17	R	WOOD. 65 FT. C2
E18	R	WOOD. 65 FT. C2
E19	R	WOOD. 65 FT. C2
P5	I	CONCRETE. 65 FT. C2
P6	I	CONCRETE. 65 FT. C2
P7	I	CONCRETE. 65 FT. C2
P8	I	CONCRETE. 65 FT. C2
P9	I	CONCRETE. 65 FT. C2
P10	I	CONCRETE. 65 FT. C2
P11	I	CONCRETE. 65 FT. C2
P12	I	CONCRETE. 65 FT. C2
P13	I	CONCRETE. 65 FT. C2
P14	I	CONCRETE. 65 FT. C2
P15	I	CONCRETE. 65 FT. C2
LP1	RL	20 FT. METALLIC LIGHT POLE. HPS FIXTURE
LP2	RL	20 FT. METALLIC LIGHT POLE. HPS FIXTURE

CABLE-CONDUCTOR REQUIREMENT (38 KV - 3PH. 3W & 4.16 KV 3PH. 4W)	
E1- E6	38 kV - 556.5 MCM & 4.16 kV - 1/0 CU
E6-E8	1/0 CU
E7 & E17	1/0 CU
E17-E26	556.5 MCM
E14-E17	38 kV - 556.5 MCM & 4.16 kV - 1/0 CU
E6, E9-E13	556.5 MCM
E1, P1-P6	38 kV - 556.5 MCM & 4.16 kV - 1/0 CU
P6- P10, E13	556.5 MCM
E13, P11-P13	38 kV - 556.5 MCM & 4.16 kV - 1/0 CU
P13- P18, E26	556.5 MCM
P6 & P13	1/0 CU

NOTE: CIRCUITS (AND ASSOCIATED POLES) E1-E6; E17-E26; E1, P1-P6; AND P13-P18, E26 ARE CONTINUED ON PLATE E-4.

FILE NAME: PNF2E05.DGN

DESIGN ENG.: B.D.S.

DWN. BY: B.D.S.

CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

PUERTO NUEVO CHANNEL

PROJECT FEATURE

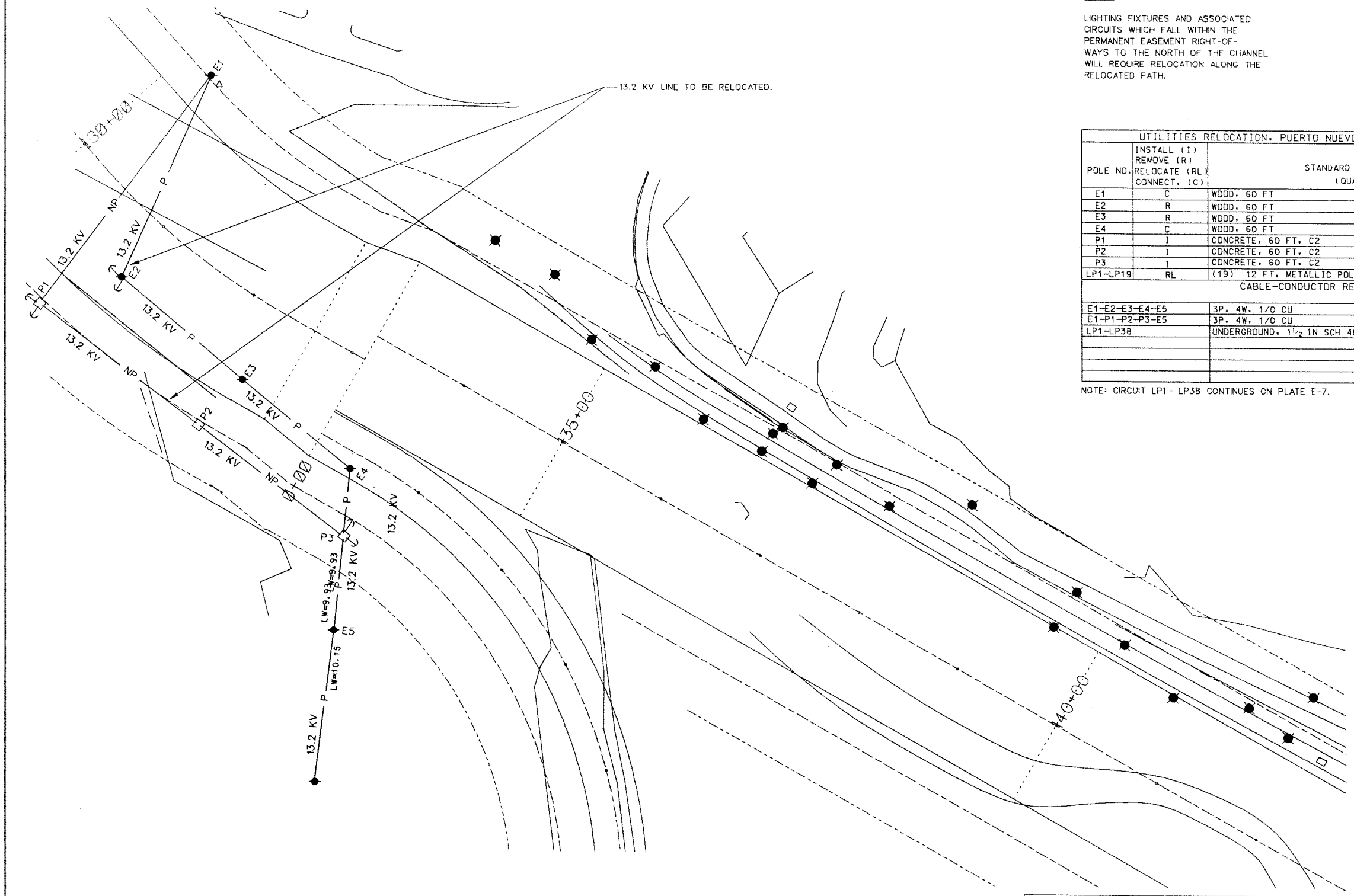
UTILITY RELOCATIONS

ELECTRICAL

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997



NOTE:

LIGHTING FIXTURES AND ASSOCIATED CIRCUITS WHICH FALL WITHIN THE PERMANENT EASEMENT RIGHT-OF-WAYS TO THE NORTH OF THE CHANNEL WILL REQUIRE RELOCATION ALONG THE RELOCATED PATH.

UTILITIES RELOCATION, PUERTO NUEVO & MARGARITA CHANNELS		
POLE NO.	INSTALL (I) REMOVE (R) RELOCATE (RL) CONNECT. (C)	STANDARD OF CONSTRUCTION (QUANTITY)
E1	C	WOOD, 60 FT
E2	R	WOOD, 60 FT
E3	R	WOOD, 60 FT
E4	C	WOOD, 60 FT
P1	I	CONCRETE, 60 FT, C2
P2	I	CONCRETE, 60 FT, C2
P3	I	CONCRETE, 60 FT, C2
LP1-LP19	RL	(19) 12 FT, METALLIC POLE, HPS FIXTURE
CABLE-CONDUCTOR REQUIREMENT		
E1-E2-E3-E4-E5		3P, 4W, 1/0 CU
E1-P1-P2-P3-E5		3P, 4W, 1/0 CU
LP1-LP38		UNDERGROUND, 1 1/2 IN SCH 40 PVC, #3 CU

NOTE: CIRCUIT LP1 - LP38 CONTINUES ON PLATE E-7.

FILE NAME: PNF2E06.DGN	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 PUERTO NUEVO CHANNEL PROJECT FEATURE UTILITY RELOCATIONS ELECTRICAL
DESIGN ENG.: B.D.S.	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: B.D.S. / CKD. BY:	D.O. FILE NO. 101-37, 451 NOVEMBER 1997

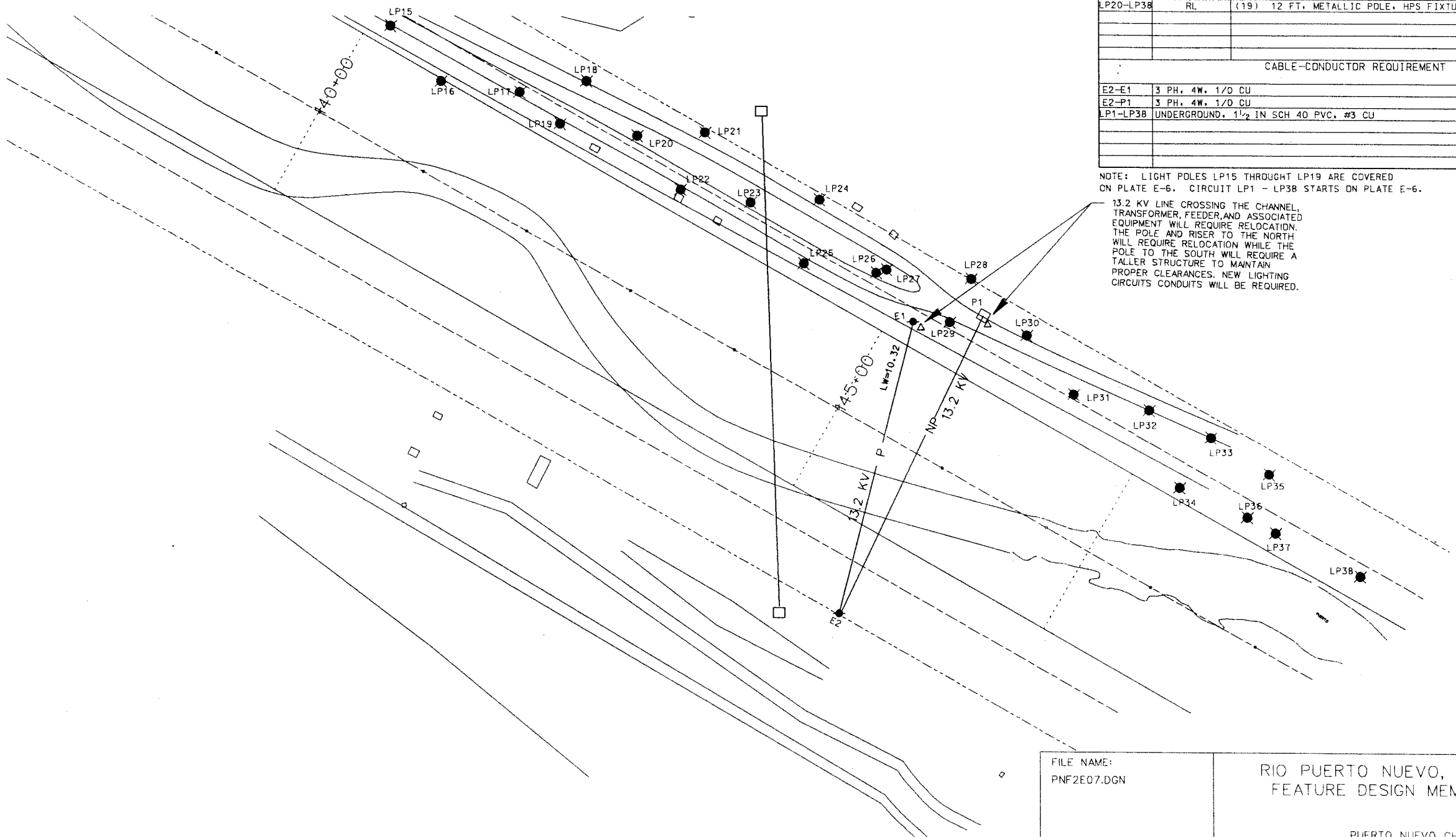
NOTE:

LIGHTING FIXTURES AND REQUIRED CIRCUITS WHICH FALL WITHIN THE PERMANENT EASEMENT RIGHT-OF-WAYS TO THE CHANNEL WILL REQUIRE RELOCATION.

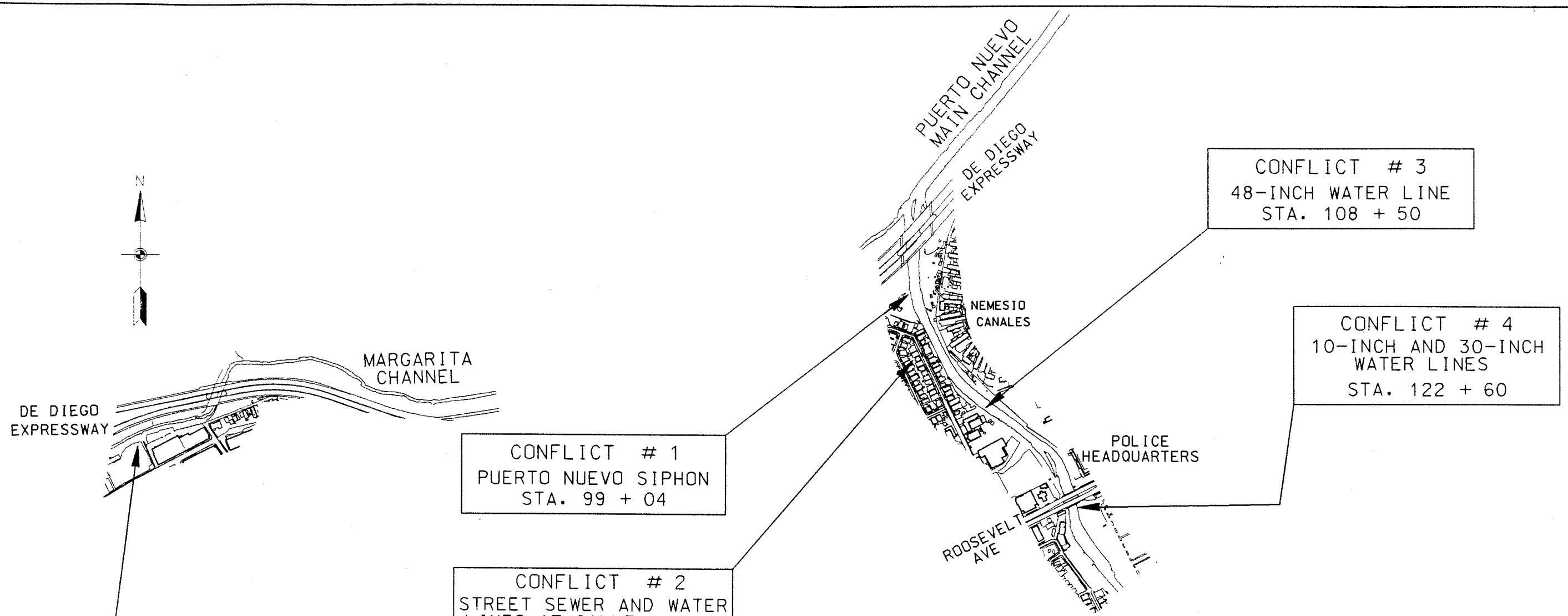
UTILITIES RELOCATION, PUERTO NUEVO & MARGARITA CHANNELS		
POLE NO.	INSTALL (I) REMOVE (R) CONNECT. (C)	STANDARD OF CONSTRUCTION (QUANTITY)
E1	R	CONCRETE, 40 FT, RISER
E2	C	CONCRETE, 40 FT
P1	I	CONCRETE, 40 FT
LP20-LP38	RL	(19) 12 FT, METALLIC POLE, HPS FIXTURE
CABLE-CONDUCTOR REQUIREMENT		
E2-E1	3 PH, 4W, 1/0 CU	
E2-P1	3 PH, 4W, 1/0 CU	
LP1-LP38	UNDERGROUND, 1 1/2 IN SCH 40 PVC, #3 CU	

NOTE: LIGHT POLES LP15 THROUGHT LP19 ARE COVERED ON PLATE E-6. CIRCUIT LP1 - LP38 STARTS ON PLATE E-6.

13.2 KV LINE CROSSING THE CHANNEL, TRANSFORMER, FEEDER, AND ASSOCIATED EQUIPMENT WILL REQUIRE RELOCATION. THE POLE AND RISER TO THE NORTH WILL REQUIRE RELOCATION WHILE THE POLE TO THE SOUTH WILL REQUIRE A TALLER STRUCTURE TO MAINTAIN PROPER CLEARANCES. NEW LIGHTING CIRCUITS CONDUITS WILL BE REQUIRED.



FILE NAME: PNF2E07.DGN	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 PUERTO NUEVO CHANNEL PROJECT FEATURE UTILITY RELOCATIONS ELECTRICAL
DESIGN ENG.: B.D.S.	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: B.D.S. / CKD. BY:	D.O. FILE NO. 101-37, 451 NOVEMBER 1997



LEGEND

EXISTING GRADE	EXISTING MANHOLE
CHANNEL CENTERLINE	NEW MANHOLE
SS EXISTING SEWER	AIR RELEASE VALVE
W EXISTING WATER	VALVE
W NEW WATER	INV. INVERT
SS NEW SEWER	TOC TOP OF CONCRETE
FM SANITARY FORCE MAIN	
TOP OF CONCRETE	
ROW RIGHT OF WAY	
TO BE DEMOLISHED	

FILE NAME: pnf2me01.dgn

DESIGN ENG: EB3

DWN BY: EB3 CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

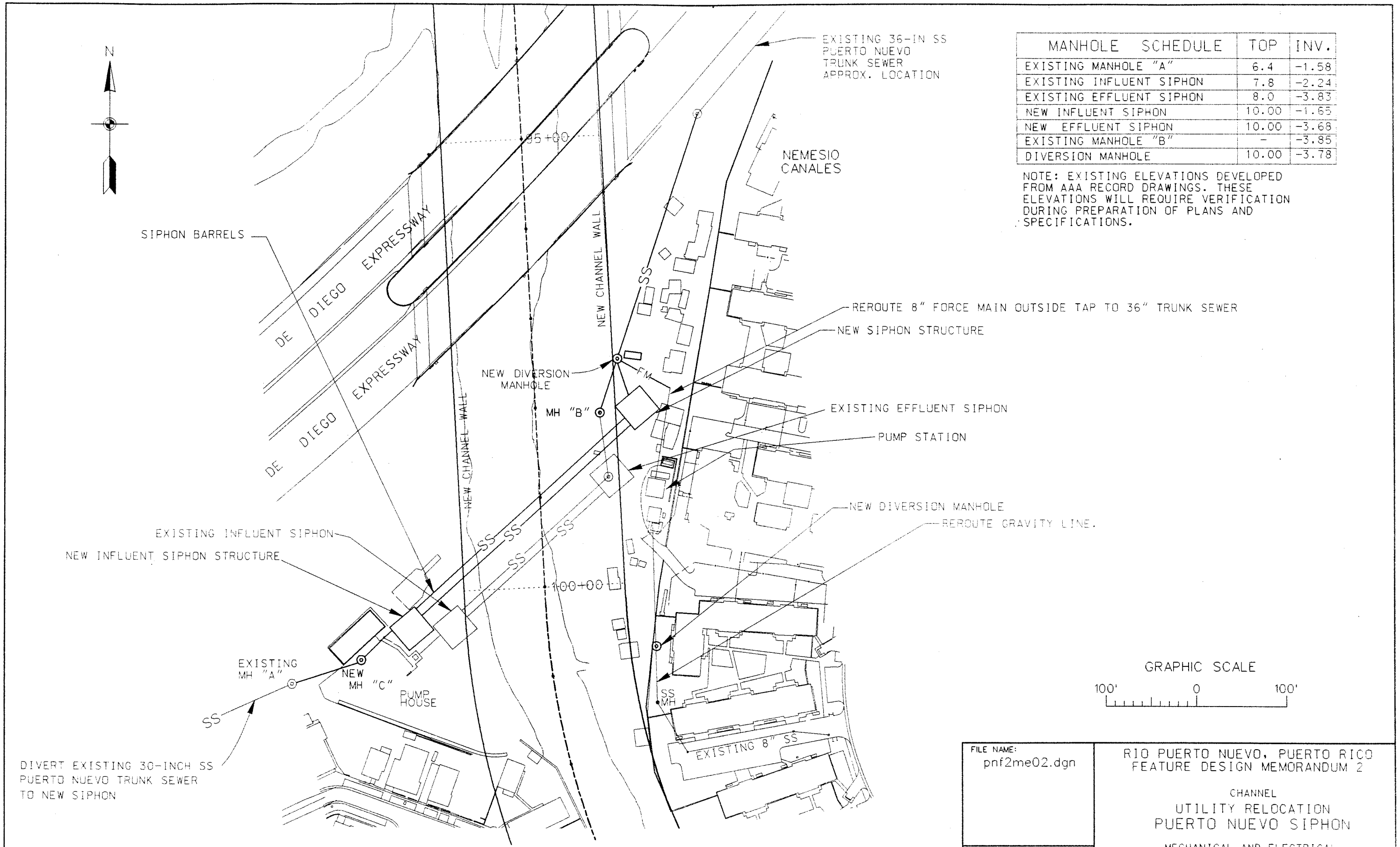
CHANNEL
UTILITY RELOCATION
VICINITY PLAN & LEGEND

MECHANICAL AND ELECTRICAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 161-37-451 NOVEMBER 1987

PLATE NO. 1



MANHOLE SCHEDULE	TOP	INV.
EXISTING MANHOLE "A"	6.4	-1.58
EXISTING INFLUENT SIPHON	7.8	-2.24
EXISTING EFFLUENT SIPHON	8.0	-3.83
NEW INFLUENT SIPHON	10.00	-1.65
NEW EFFLUENT SIPHON	10.00	-3.68
EXISTING MANHOLE "B"	-	-3.85
DIVERSION MANHOLE	10.00	-3.78

NOTE: EXISTING ELEVATIONS DEVELOPED FROM AAA RECORD DRAWINGS. THESE ELEVATIONS WILL REQUIRE VERIFICATION DURING PREPARATION OF PLANS AND SPECIFICATIONS.

GRAPHIC SCALE

100' 0 100'

FILE NAME: pnf2me02.dgn

DESIGN ENG.: F.J.G.

DWN. BY: F.J.G. CKD BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

CHANNEL
UTILITY RELOCATION
PUERTO NUEVO SIPHON

MECHANICAL AND ELECTRICAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-37.451 NOVEMBER 1987

DE DIEGO EXPRESSWAY

DE DIEGO EXPRESSWAY

95+00

ROW

NEW CHANNEL WALL

℄ NEW CHANNEL

NEW CHANNEL WALL

ROW

NEW DIVERSION MANHOLE

NEW EFFLUENT SIPHON

EXISTING MANHOLE "B"

DIVERT EXISTING 30-INCH SS TO NEW SIPHON FROM MH "A"

CONC. FENCE

REROUTE 8" FORCE MAIN TAP TO 36" TRUNK SEWER

GRAPHIC SCALE

50' 0 50'

NEW INFL SIPHON

TWIN HDPE SIPHON BARRELS

SS

SS

PUMP HOUSE

EXISTING INFLUENT SIPHON

SS

SS

EXISTING EFFLUENT SIPHON

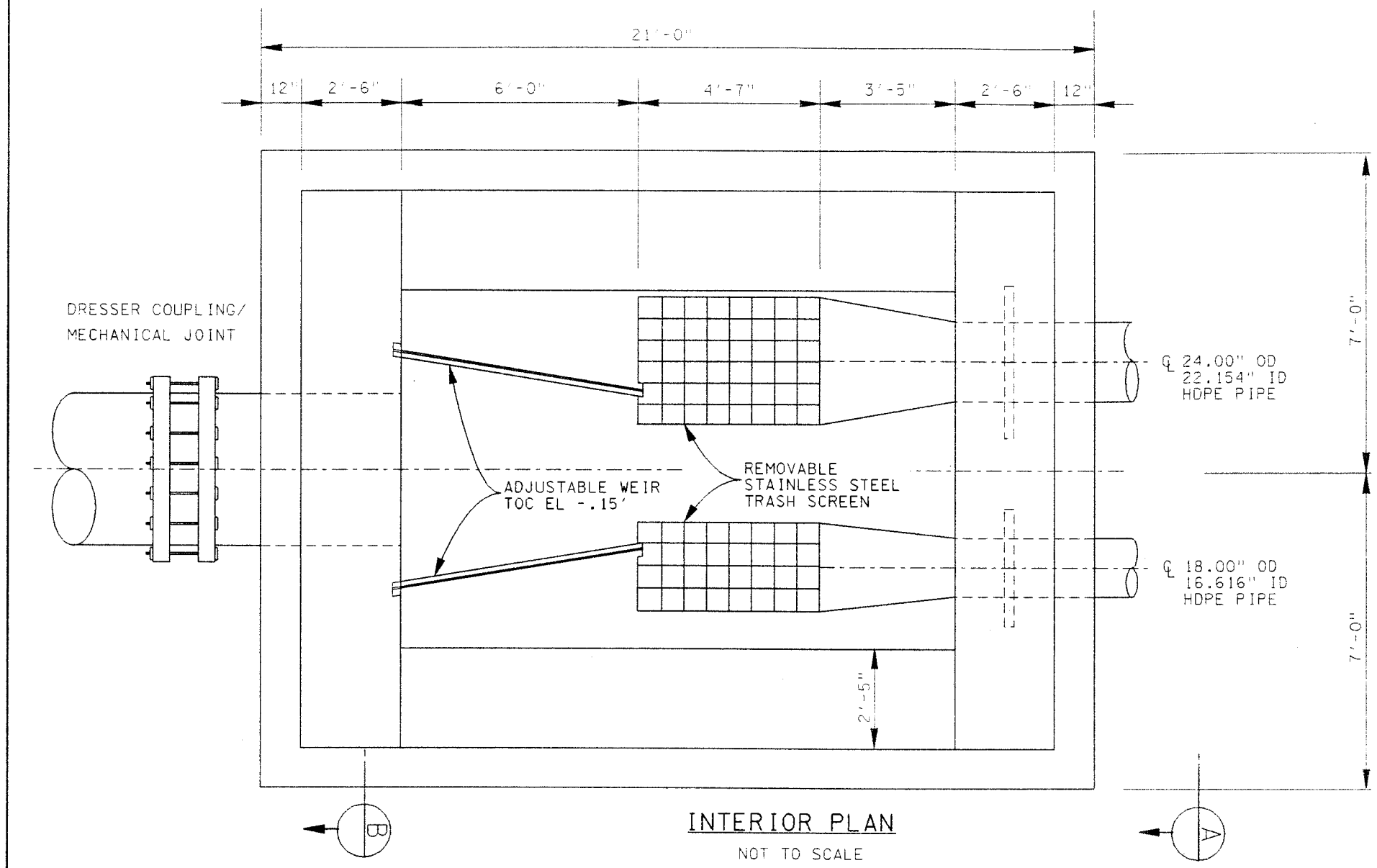
CONC. FENCE

PUMP STATION

100+00

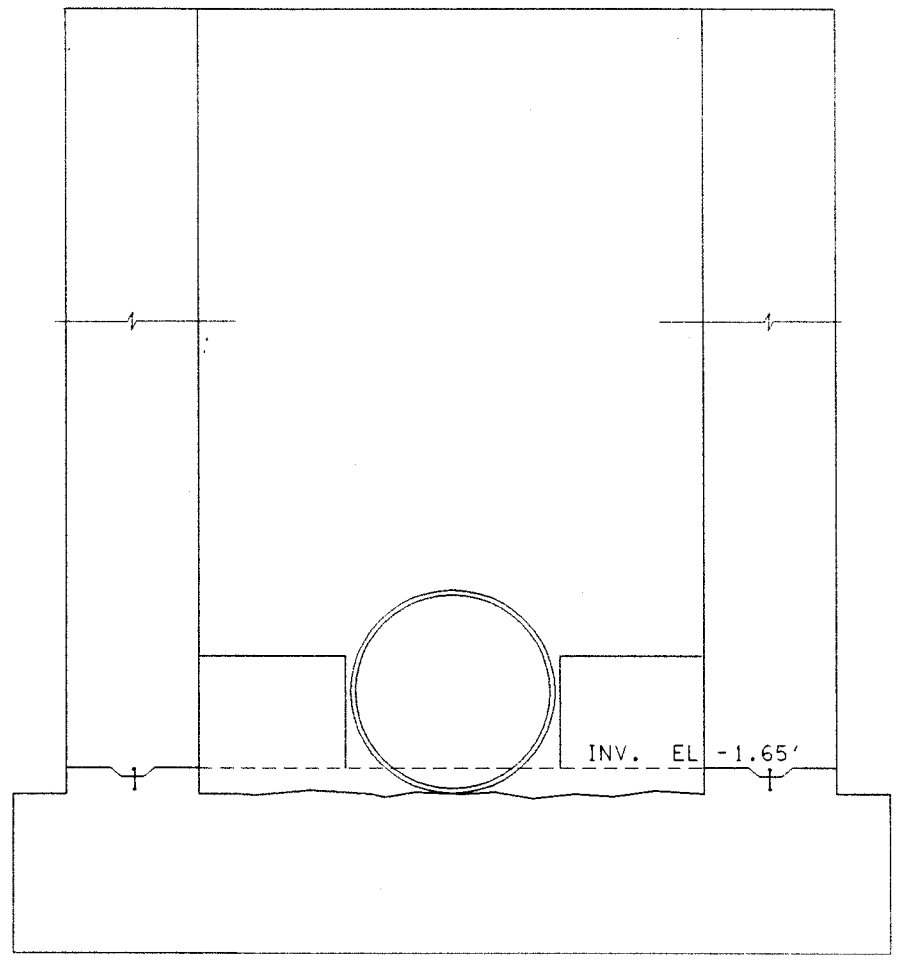
CONFLICT #1

FILE NAME: pnf2me03.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 CHANNEL UTILITY RELOCATION ENLARGED SIPHON PLAN MECHANICAL AND ELECTRICAL
DESIGN ENG.: F J G / E B 3	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN BY: F J G / E B 3 CKD BY:	D.O. FILE NO. [illegible] DRAWING [illegible]



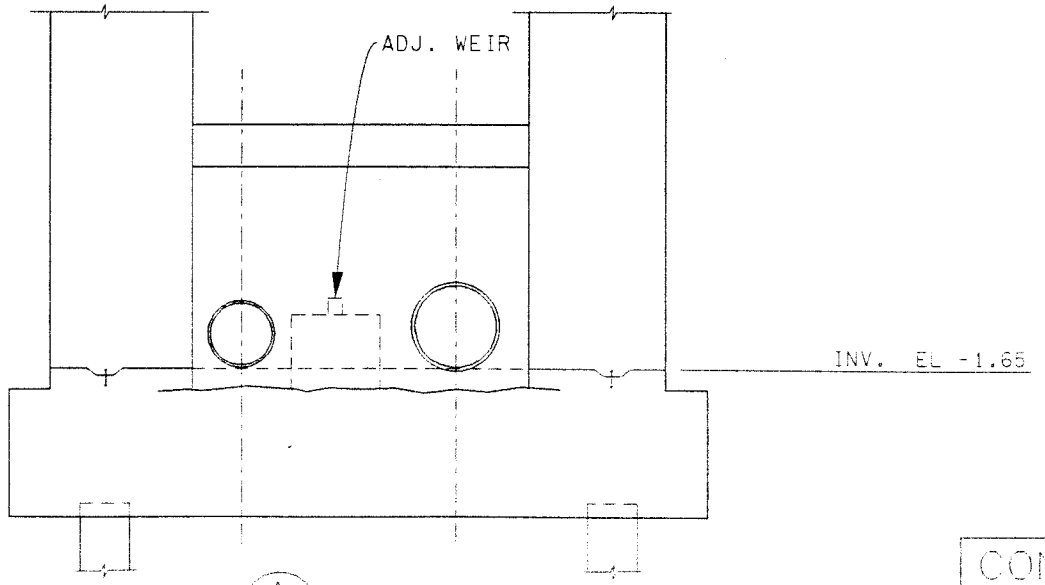
INTERIOR PLAN

NOT TO SCALE



B SECTION

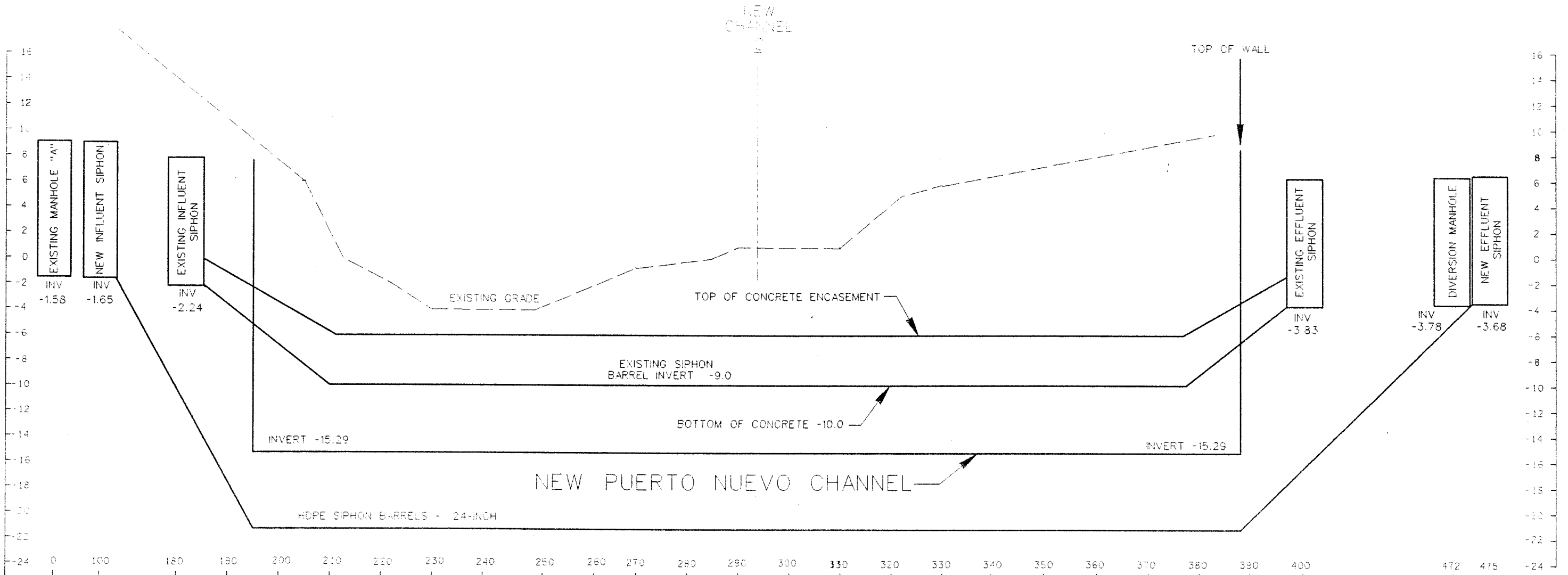
NOTE: EFFLUENT SIPHON WILL NOT HAVE AN ADJUSTIBLE WEIR NOR THE TRASH RACK FEATURE.



A SECTION

CONFLICT #1

FILE NAME: pnf2me04.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 PUERTO NUEVO CHANNEL UTILITY RELOCATION PUERTO NUEVO SIPHON
DESIGN ENG.: EB3	MECANICAL/ELECTRICAL SECTION DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN BY: EB3 / CHD BY:	D.O. FILE NO. 101-87.451 / SHEET NO. 94



SIPHON PROFILE STATION 99 + 04

GRAPHIC SCALES

0 2 4 6 8 10'
VERTICAL SCALE

0 5 10 15 20 25'
HORIZONTAL SCALE

CONFLICT #1

FILE NAME:
PNF2ME05.DGN

DESIGN ENG.:
EES

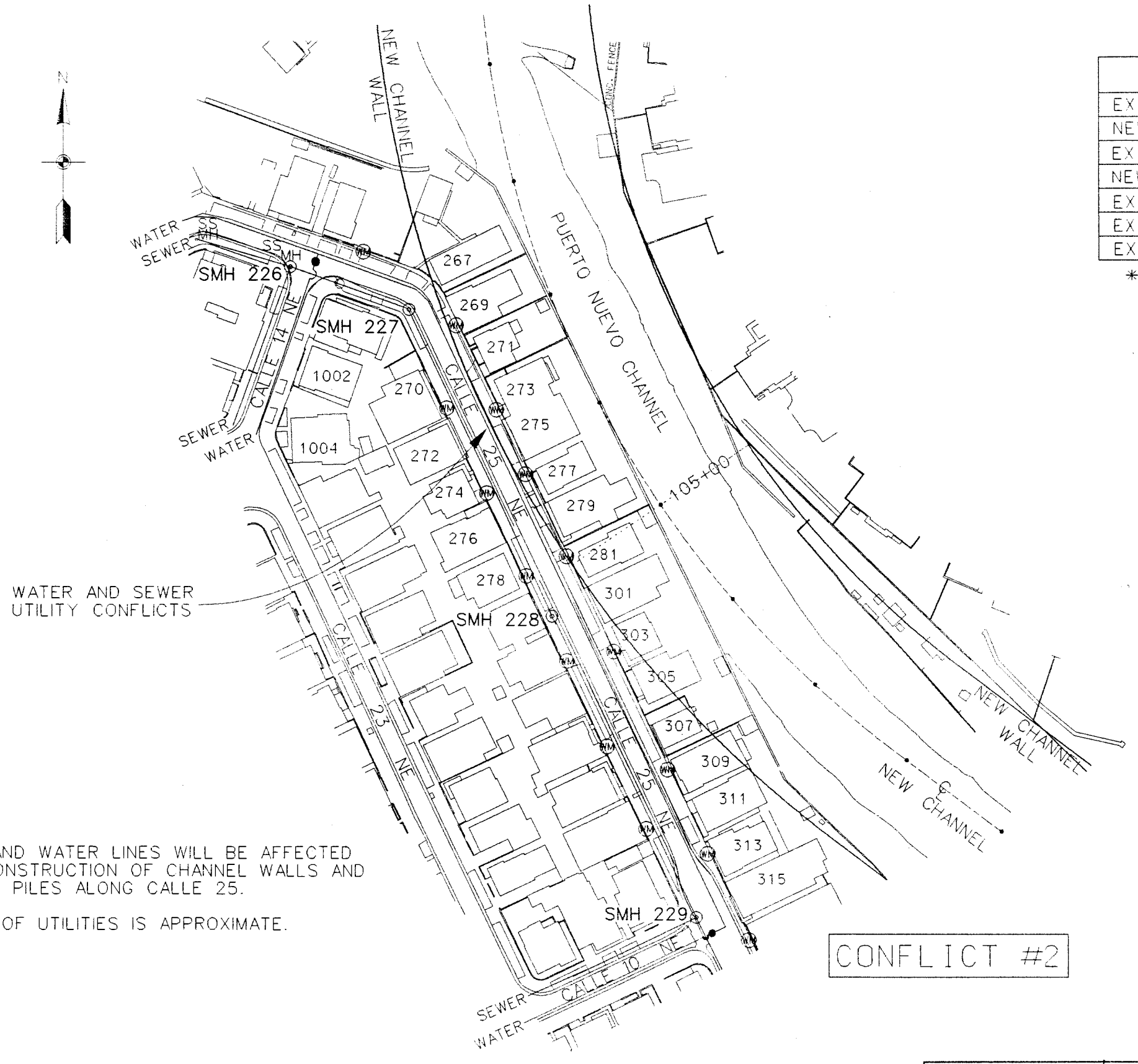
RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

CHANNEL

UTILITY RELOCATION
SIPHON PROFILE

MECHANICAL AND ELECTRICAL

DEPARTMENT OF THE ARMY



MANHOLE SCHEDULE	TOP	INV.
EXISTING MANHOLE SMH 228	10.00*	6.41
NEW MANHOLE SMH 228A	10.00	6.38
EXISTING MANHOLE SMH 227	10.00*	6.025
NEW MANHOLE 227A	10.00	6.028
EXISTING MANHOLE SMH 226		5.79
EXISTING MANHOLE 229	9.87	7.22
EXISTING MANHOLE 226	8.14	5.14

* EXISTING IS RAISED TO THIS ELEVATION

NOTES

1. SANITARY AND WATER LINES WILL BE AFFECTED BY THE CONSTRUCTION OF CHANNEL WALLS AND DRIVING OF PILES ALONG CALLE 25.
2. LOCATION OF UTILITIES IS APPROXIMATE.

GRAPHIC SCALE

100' 0 100'

CONFLICT #2

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

CHANNEL
UTILITY RELOCATION
ENLARGED SIPHON PLAN

MECHANICAL AND ELECTRICAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.C. FILE NO. [illegible] NOVEMBER 1994
PLATE [illegible]

FILE NAME:	DESIGN ENG.:	
pnf2me06.dgn	FJG/EBS	
	DRAWN BY: FJG	CHK'D BY:

MANHOLE SCHEDULE	TOP	INV.
EXISTING MANHOLE SMH 228	10.00*	6.41
NEW MANHOLE SMH 228A	10.00	6.38
EXISTING MANHOLE SMH 227	10.00*	6.025
NEW MANHOLE 227A	10.00	6.028
EXISTING MANHOLE SMH 226	7.99	5.79
EXISTING MANHOLE 229	9.87	7.22
EXISTING MANHOLE 226	8.14	5.14

* EXISTING IS RAISED TO THIS ELEVATION

SMH-227A
STATION 2+67

TEMPORARY SEWAGE BYPASS FROM SMH-228 TO SMH-227

NEW SEWER LINE FROM SMH-228 TO SMH-228A TO SMH-227A

SMH-227

SMH-226

ROW

CENTERLINE

12-IN DIA.

SMH-228A
STATION 0+00

PUERTO NUEVO CHANNEL

NEW CHANNEL WALL

CALLE 18 NE

CALLE 14 NE

CALLE 25

CALLE 23 NE

SEWER

WATER

267 269 271 273 275 277 279 281 301 303 305 307 309 311 313 315

1000 1002 1004 270 272 274 276 278 300 302 304

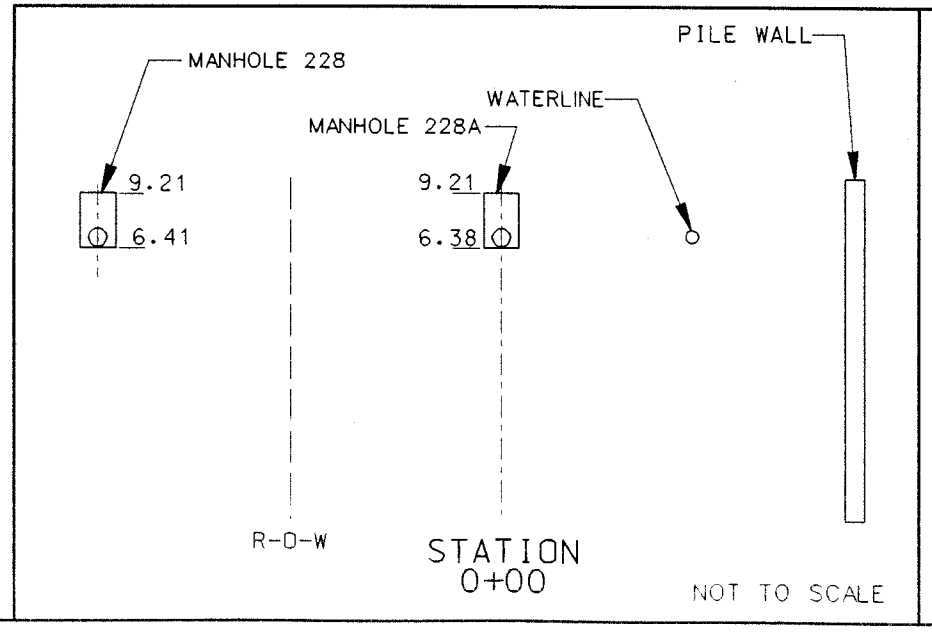
SMH-228

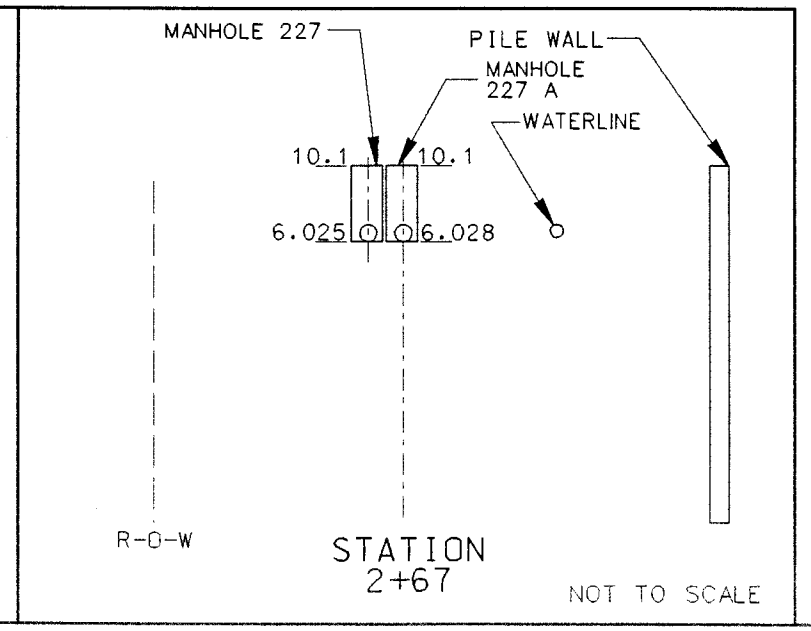
SMH-229

CONFLICT # 2

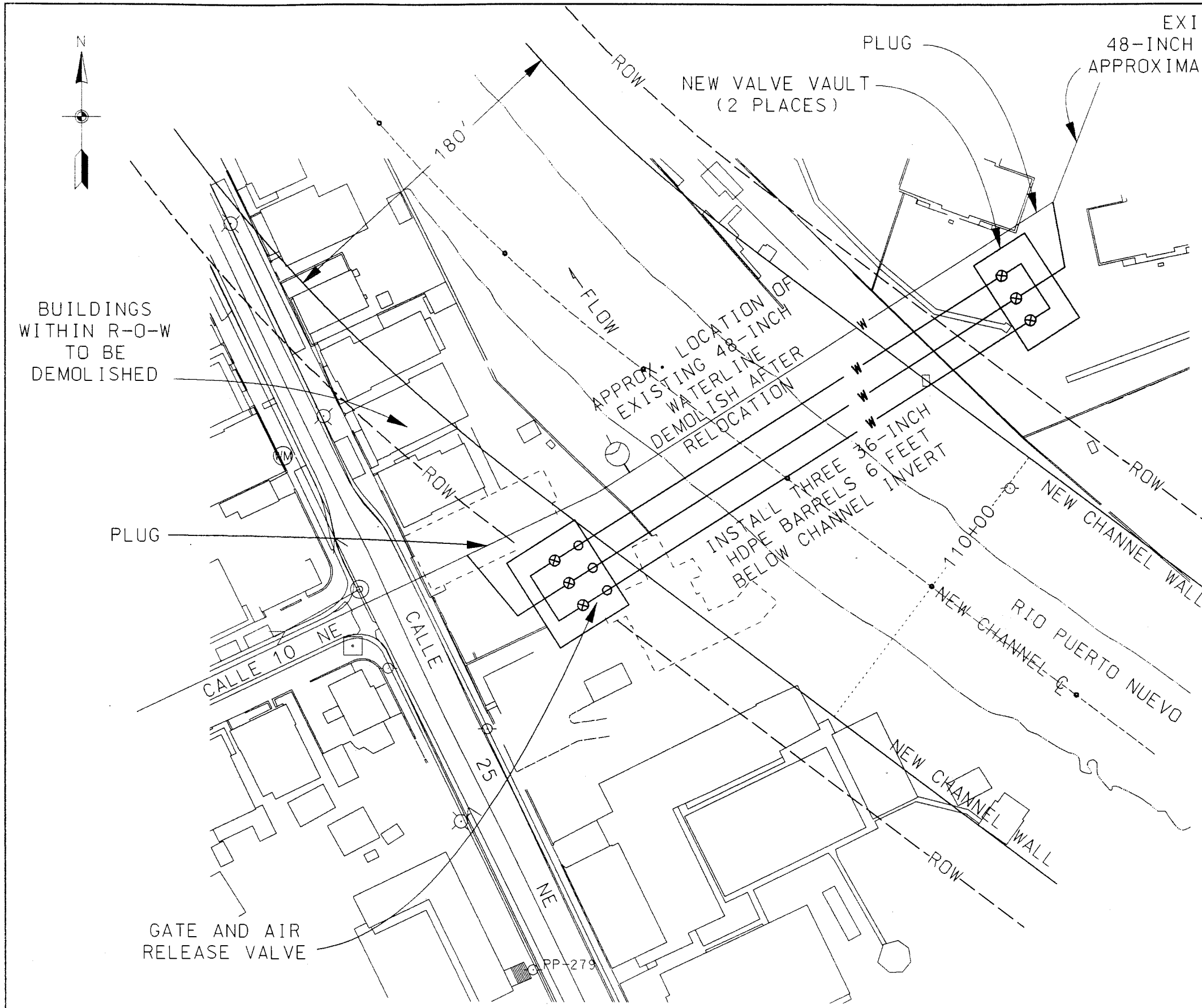
GRAPHIC SCALE

60' 0 60'





FILE NAME: pnf2me07.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 CHANNEL UTILITY RELOCATION ENLARGED PLAN MECHANICAL AND ELECTRICAL
DESIGN ENG.: EB3	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: EB3 / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997



CONFLICT #3

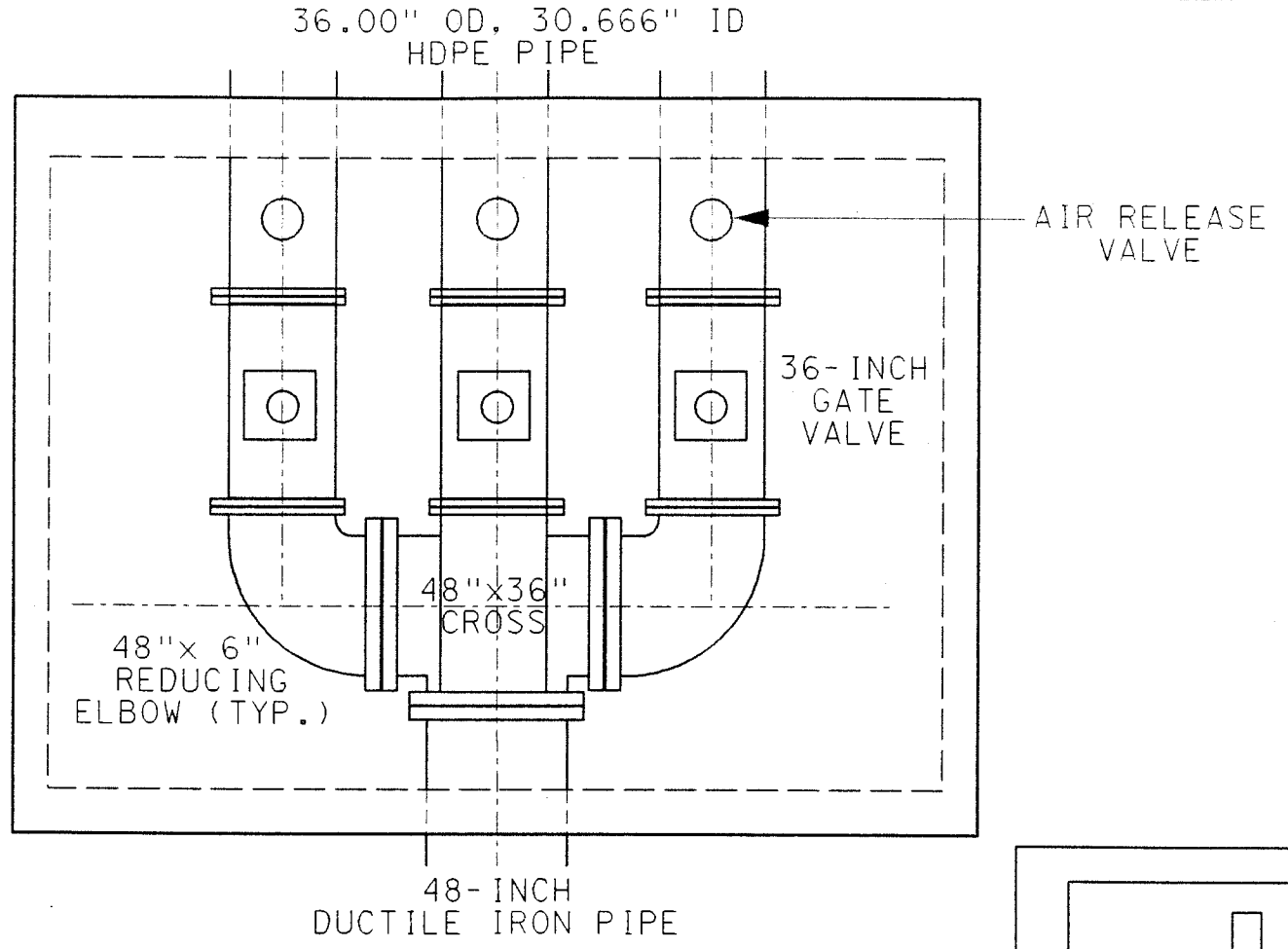
NOTES

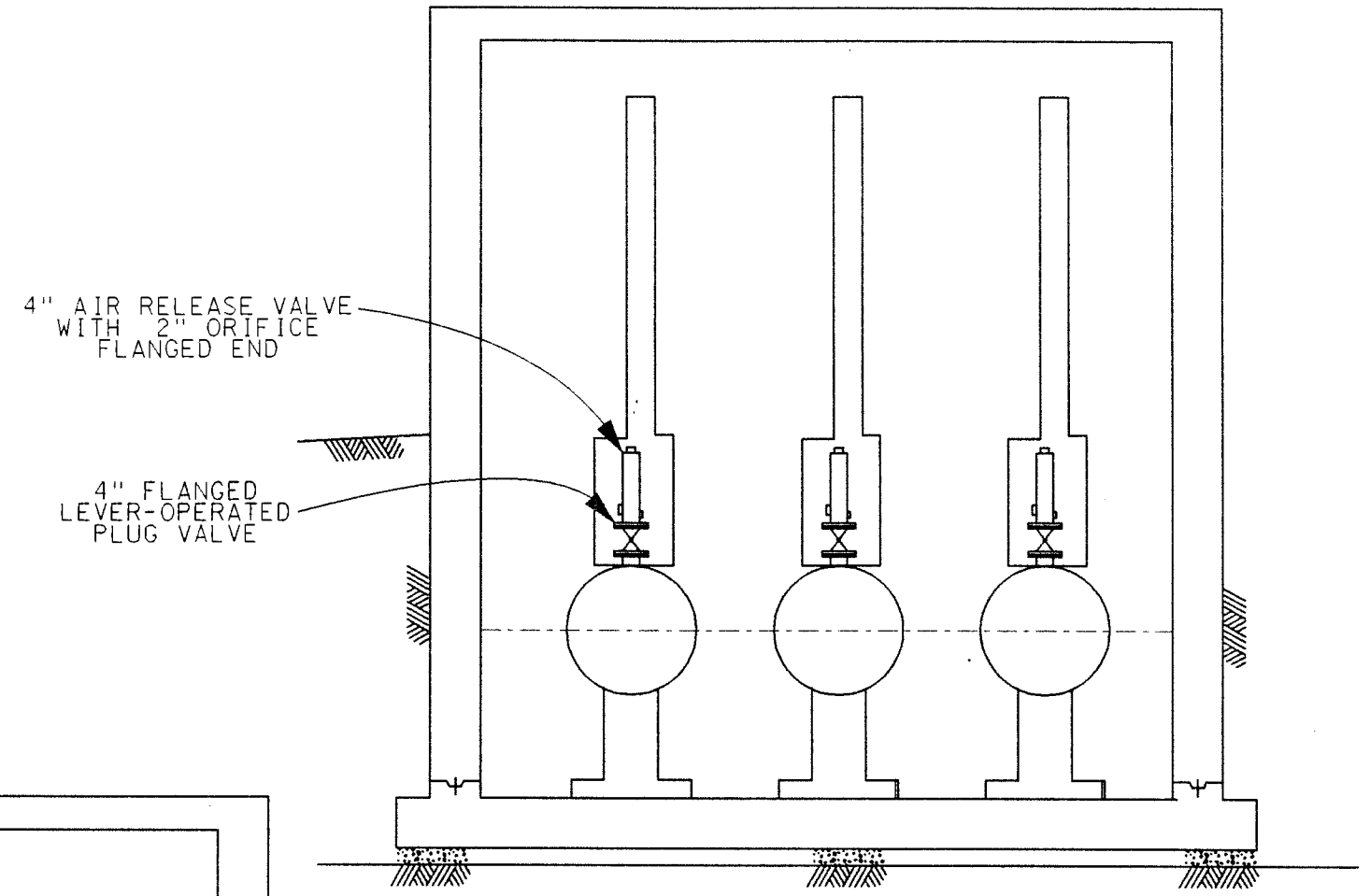
1. WATER LINE TO BE INSTALLED 6 FEET BELOW CHANNEL INVERT OF EL. -14.
2. EXCAVATION OF CHANNEL WILL LOWER THE INVERT FROM +1 FT TO -14 FT.
3. PIPE TO BE HDPE 30-INCH SDR 11 (160 PSI TEST).
4. WATER LINES TO BE ROUTED BETWEEN 42-INCH PIPE PILES. SEE PLATE S-11.

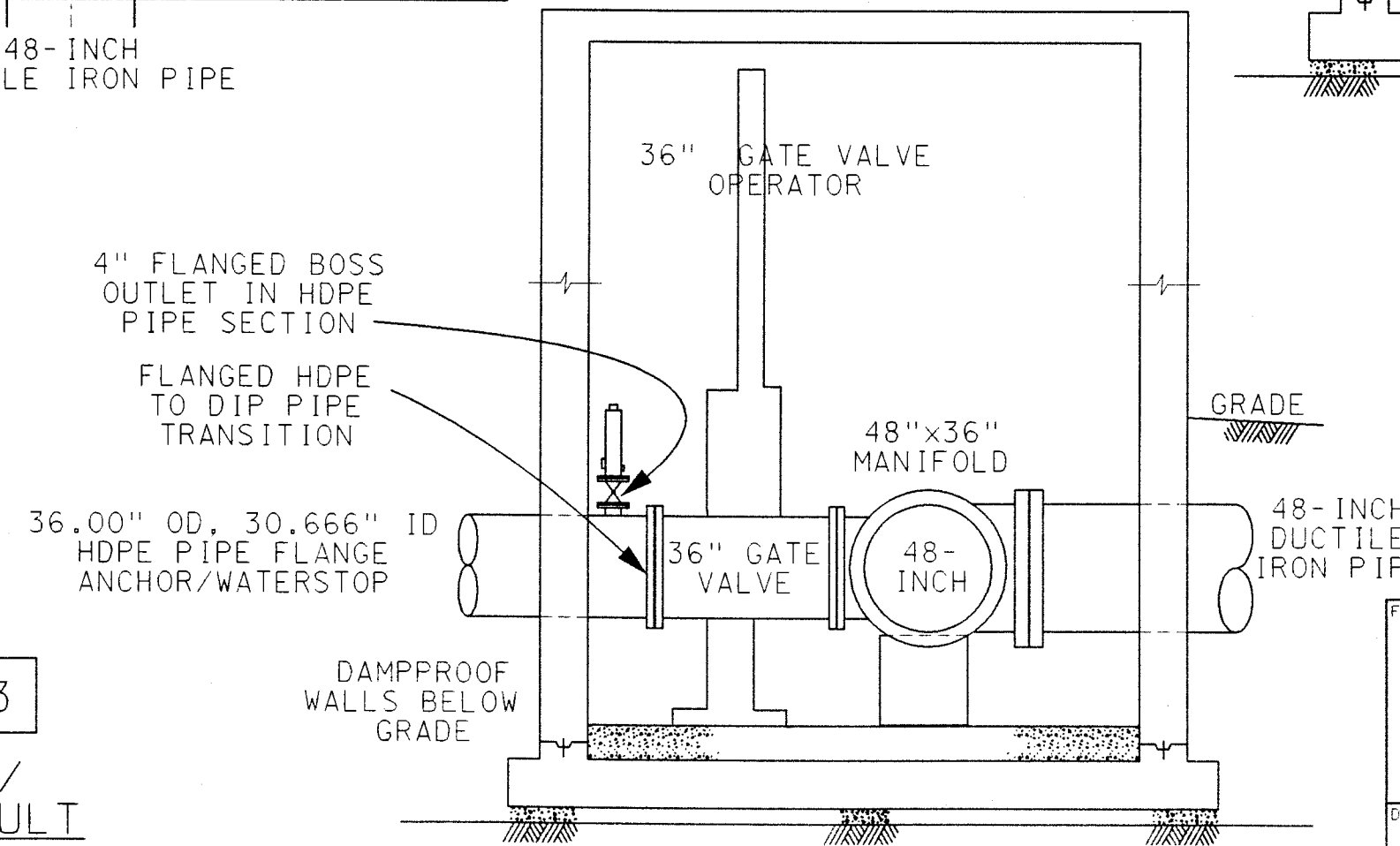
GRAPHIC SCALE

60' 0 60'

FILE NAME: pnf2me08.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 CHANNEL UTILITY RELOCATION 48-INCH WATERLINE RELOCATION MECHANICAL AND ELECTRICAL
DESIGN ENG.: FJG/EB3	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: FJG/EB3 / CKD. BY:	D.O. FILE NO. 101-37.451 NOVEMBER 1997







GRAPHIC SCALE

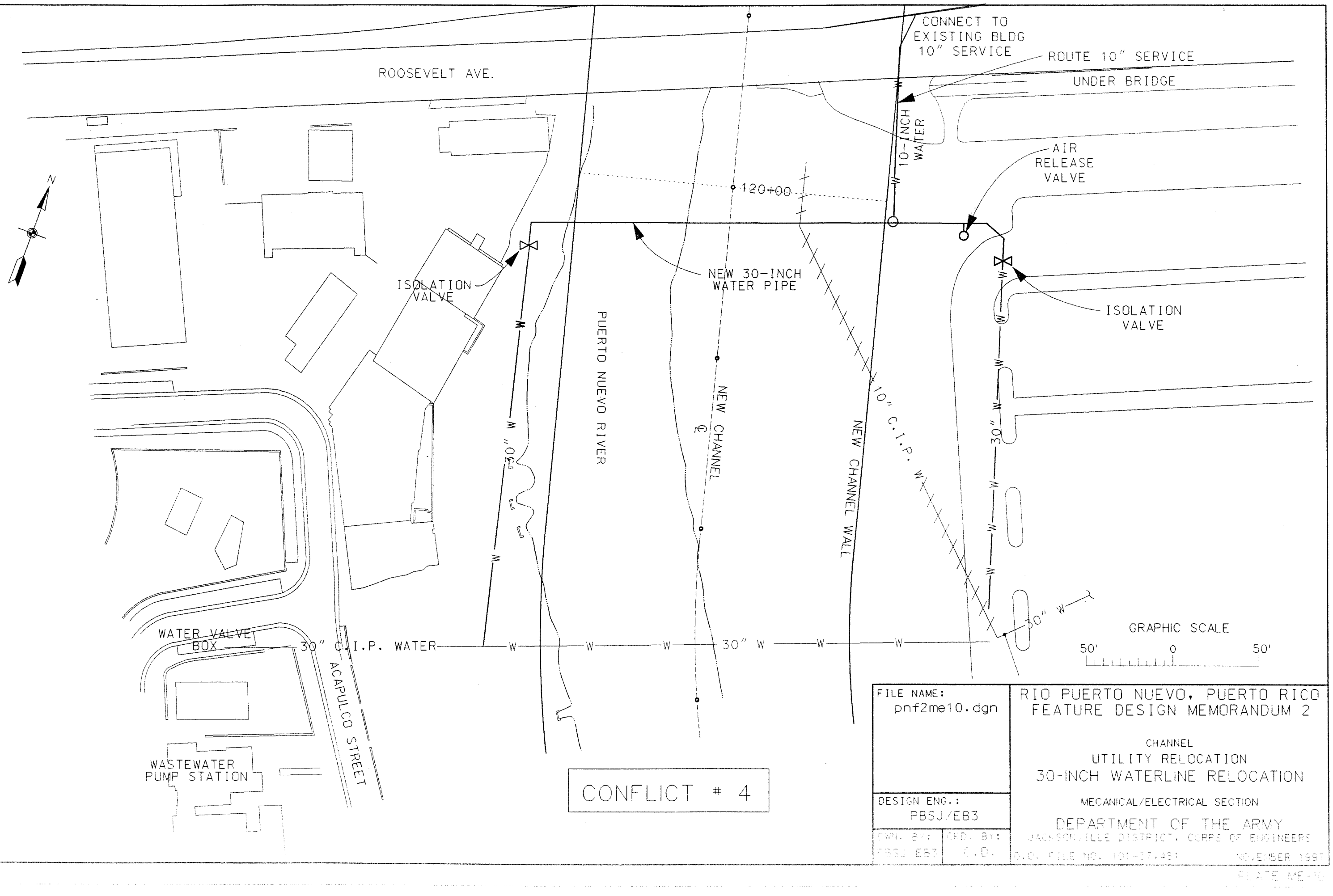
12"0 5' 10'

CONFLICT # 3

AIR RELEASE/
GATE VALVE VAULT

FILE NAME: pnf2me09.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 CHANNEL UTILITY RELOCATION 48" WATER LINE VALVE VAULT MECHANICAL AND ELECTRICAL
DESIGN ENG.: EB3	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN BY: FJG/EB3 / CHD BY:	D.O. FILE NO. 101-3T.451 NOVEMBER 1997

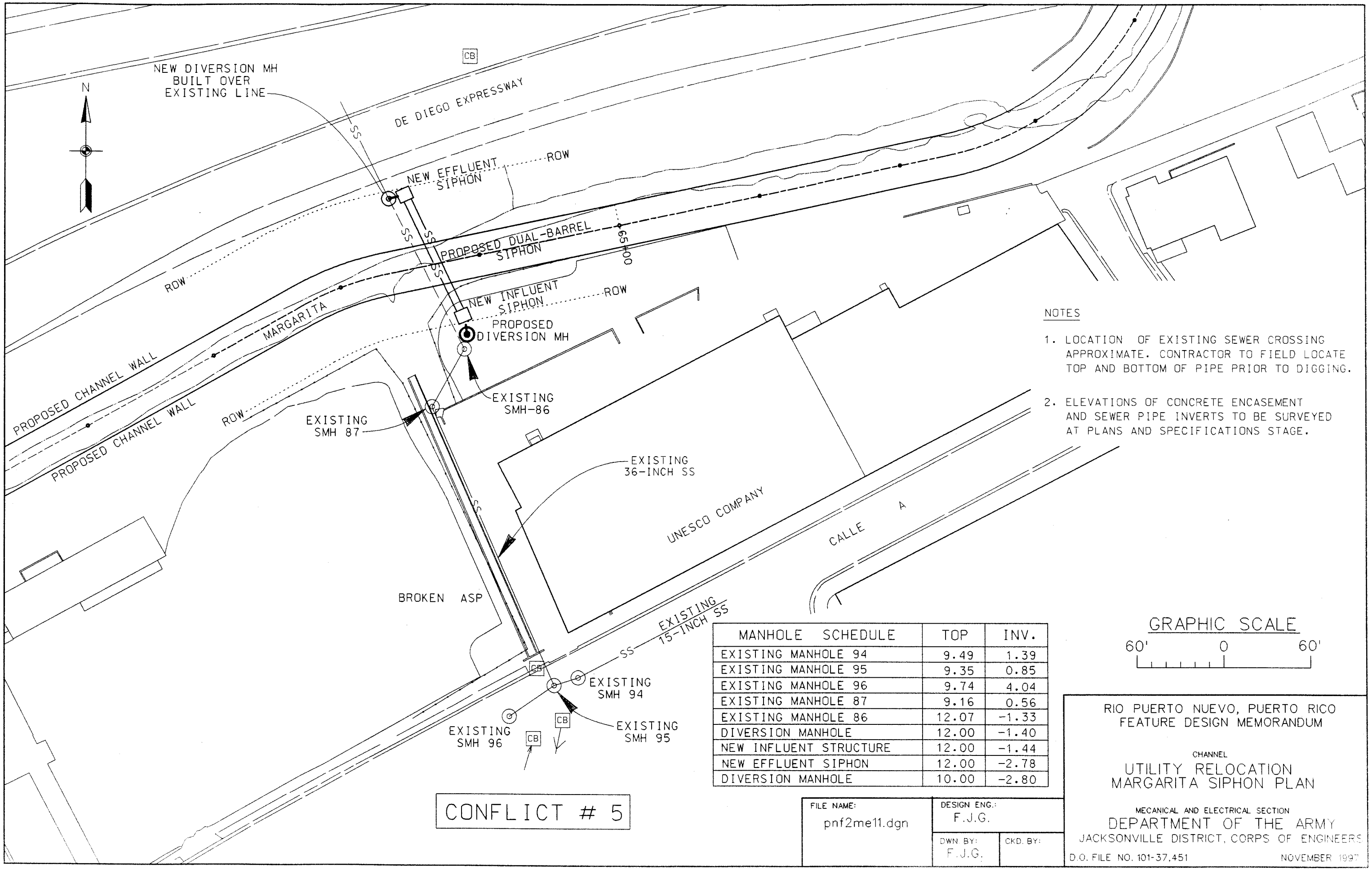
PLATE NO. 9



CONFLICT # 4

FILE NAME: pnf2me10.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 CHANNEL UTILITY RELOCATION 30-INCH WATERLINE RELOCATION MECANICAL/ELECTRICAL SECTION DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DESIGN ENG.: PBSJ/EB3	
DWN. BY: PBSJ EB3 / CHK. BY: C.D.	D.O. FILE NO. 101-97.481 NOVEMBER 1997

PLATE ME-10



CONFLICT # 5

NOTES

1. LOCATION OF EXISTING SEWER CROSSING APPROXIMATE. CONTRACTOR TO FIELD LOCATE TOP AND BOTTOM OF PIPE PRIOR TO DIGGING.

2. ELEVATIONS OF CONCRETE ENCASEMENT AND SEWER PIPE INVERTS TO BE SURVEYED AT PLANS AND SPECIFICATIONS STAGE.

MANHOLE SCHEDULE	TOP	INV.
EXISTING MANHOLE 94	9.49	1.39
EXISTING MANHOLE 95	9.35	0.85
EXISTING MANHOLE 96	9.74	4.04
EXISTING MANHOLE 87	9.16	0.56
EXISTING MANHOLE 86	12.07	-1.33
DIVERSION MANHOLE	12.00	-1.40
NEW INFLUENT STRUCTURE	12.00	-1.44
NEW EFFLUENT SIPHON	12.00	-2.78
DIVERSION MANHOLE	10.00	-2.80

GRAPHIC SCALE

60' 0 60'

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM

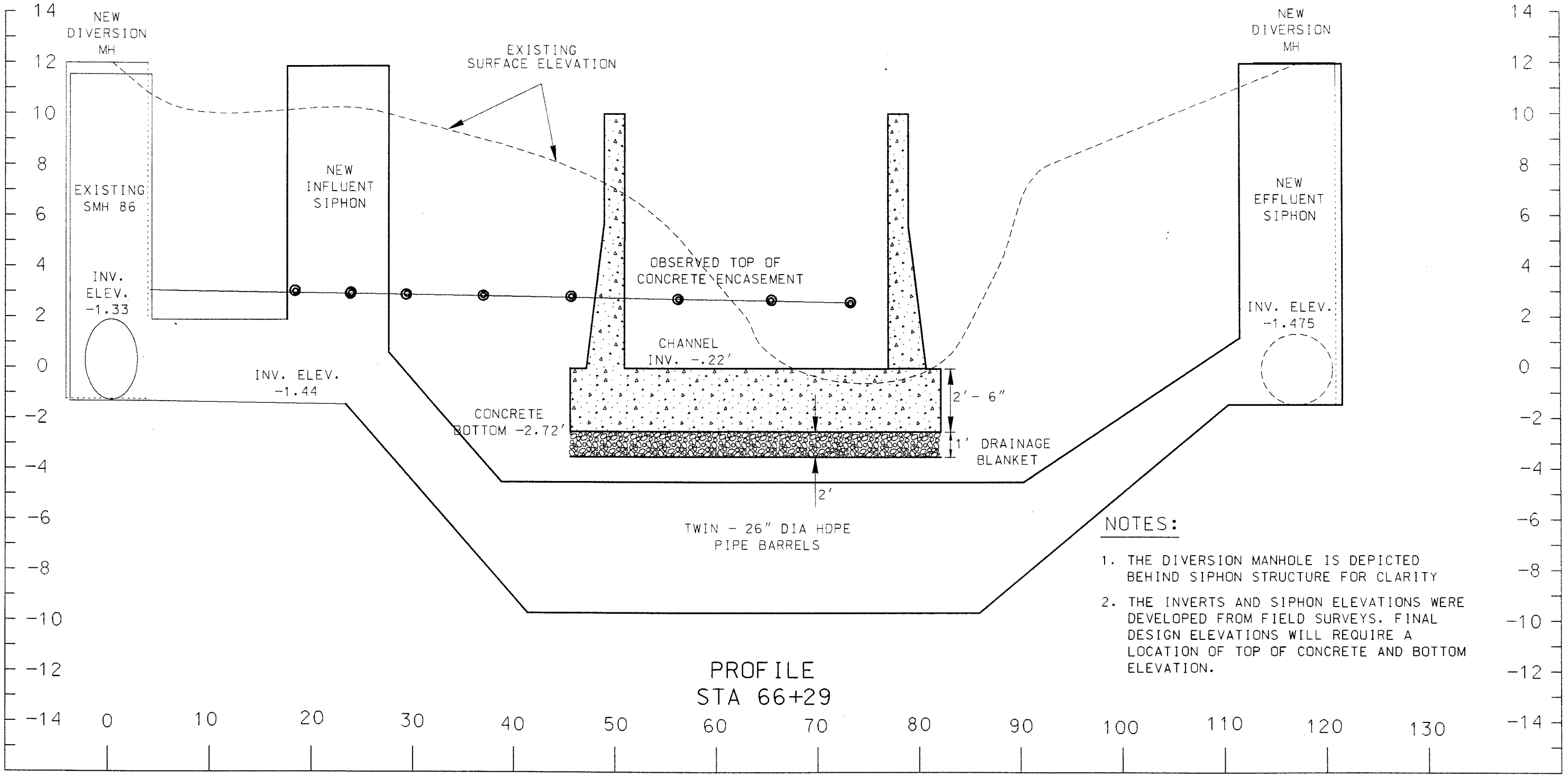
CHANNEL

UTILITY RELOCATION
MARGARITA SIPHON PLAN

MECANICAL AND ELECTRICAL SECTION
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-37,451 NOVEMBER 1997

FILE NAME:	DESIGN ENG.:	
pnf2me11.dgn	F.J.G.	
	DWN BY: F.J.G.	CKD. BY:



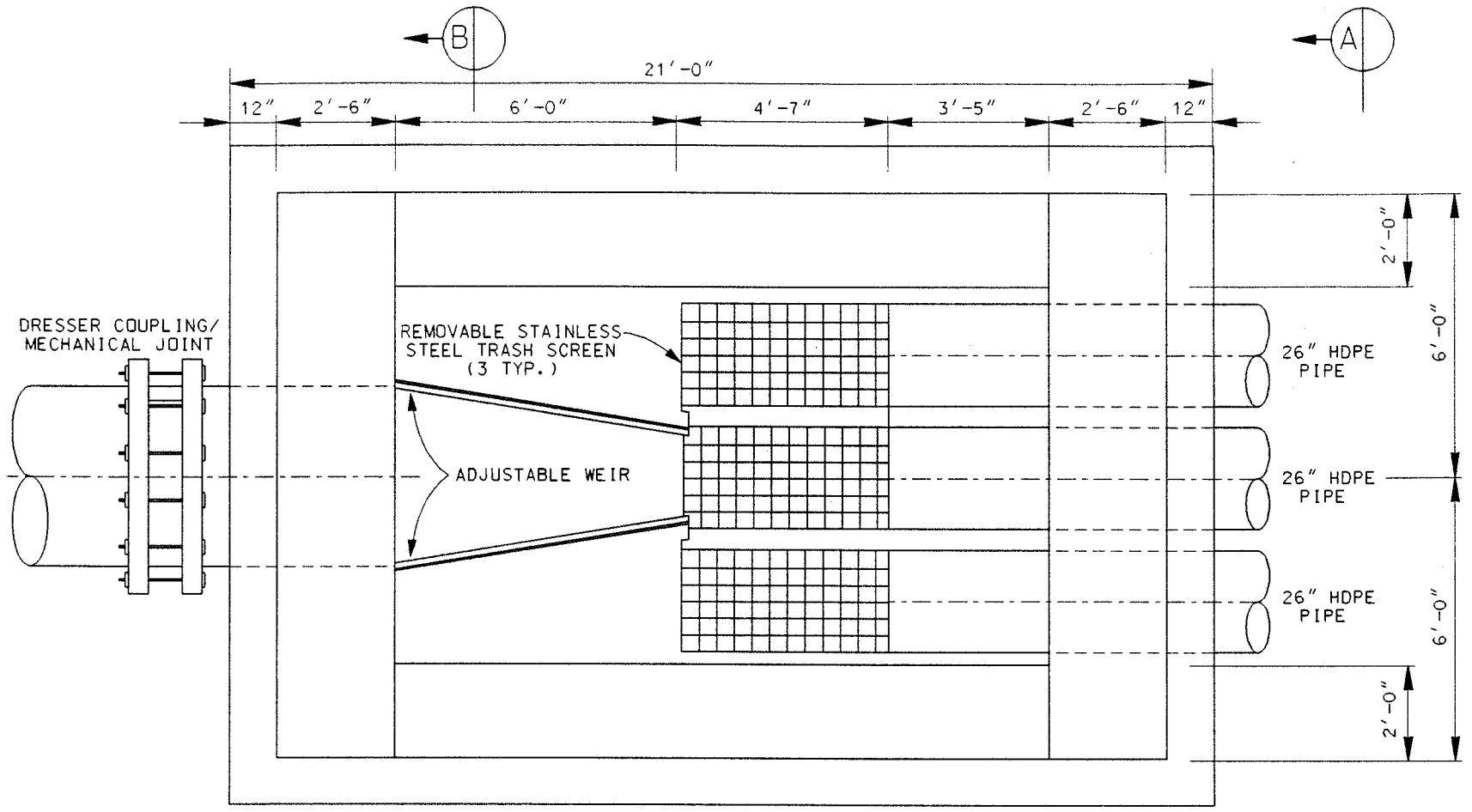
PROFILE
STA 66+29

NOTES:

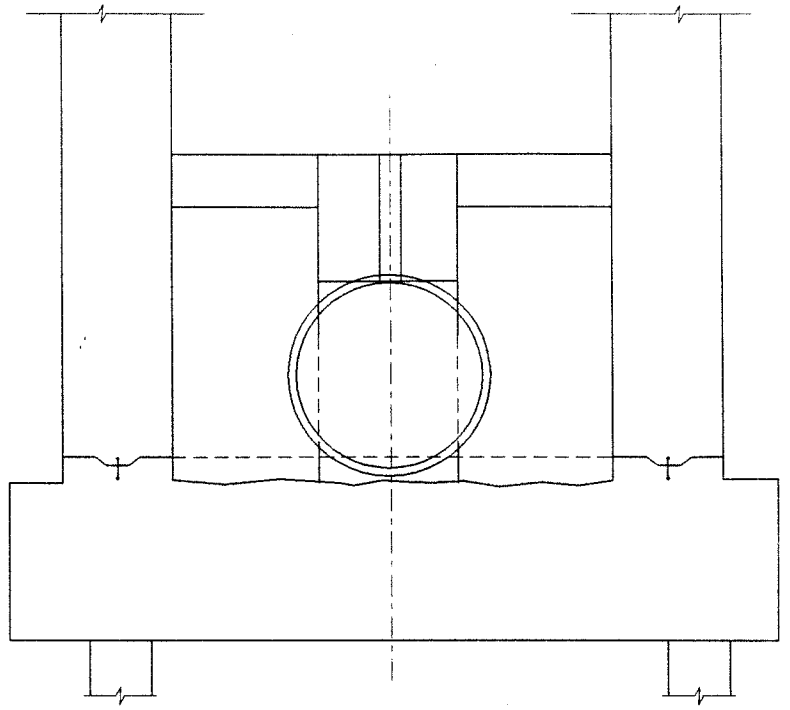
1. THE DIVERSION MANHOLE IS DEPICTED BEHIND SIPHON STRUCTURE FOR CLARITY
2. THE INVERTS AND SIPHON ELEVATIONS WERE DEVELOPED FROM FIELD SURVEYS. FINAL DESIGN ELEVATIONS WILL REQUIRE A LOCATION OF TOP OF CONCRETE AND BOTTOM ELEVATION.

CONFLICT # 5

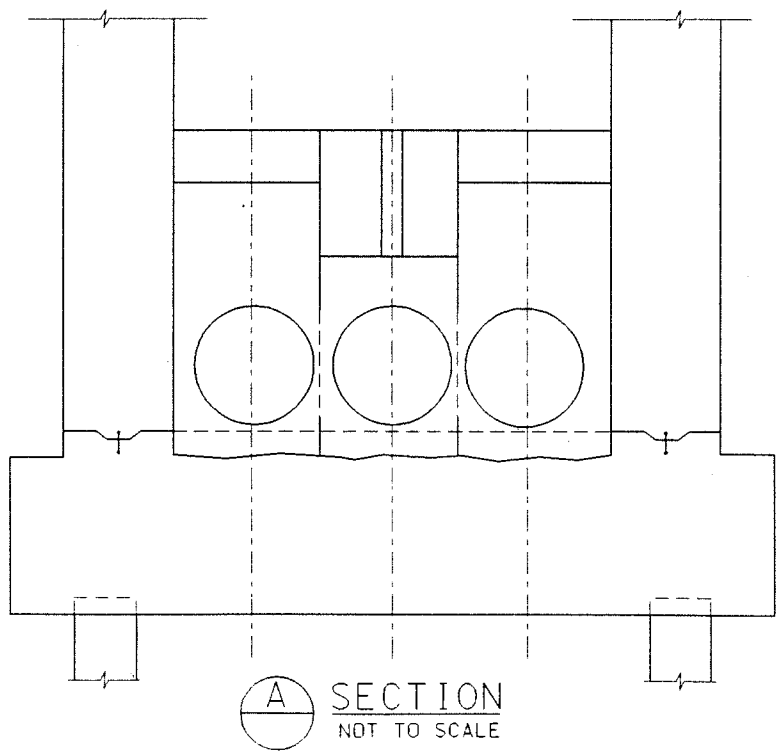
FILE NAME: pnf2me12.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 CHANNEL UTILITY RELOCATION MARGARITA SIPHON MECHANICAL AND ELECTRICAL
DESIGN ENG.:	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997



INTERIOR PLAN
NOT TO SCALE



B SECTION
NOT TO SCALE



A SECTION
NOT TO SCALE

NOTE: EFFLUENT SIPHON WILL NOT HAVE AN ADJUSTABLE WEIR AND TRASH RACK FEATURE

CONFLICT # 5

MARGARITA INFLUENT/ EFFLUENT SIPHONS

FILE NAME: pnf2me13.dgn	RIO PUERTO NUEVO, PUERTO RICO FEATURE DESIGN MEMORANDUM 2 MARGARITA CHANNEL UTILITY RELOCATION MARGARITA SIPHON
DESIGN ENG.: EB3	MECANICAL/ELECTRICAL SECTION DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
DWN. BY: EB3 / CKD. BY:	D.O. FILE NO. 101-37,451 NOVEMBER 1997

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

APPENDICES

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

APPENDIX A

REAL ESTATE

(DRAFT) APPENDIX A

REAL ESTATE APPENDIX
RIO PUERTO NUEVO FLOOD CONTROL PROJECT, PR
FEATURE DESIGN MEMORANDUM NO. 2

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Refer to Plates L-17 - L21 in Report

8/99 bm

(DRAFT) APPENDIX A
REAL ESTATE APPENDIX

1. STATEMENT OF PURPOSE.

This Real Estate Plan is tentative in nature for planning purposes only and both the final real property acquisition lines and the estimated value are subject to change even after approval of this report.

2. PROJECT AUTHORIZATION.

The Rio Puerto Nuevo Survey Investigation was initiated in 1978 at the request of the Commonwealth of Puerto Rico. Flood Control studies were conducted under the authority of Section 204 of the Flood Control Act of 1970, Public Law 91-611. The Rio Puerto Nuevo Flood Control Project, Puerto Rico was authorized for construction as a part of the Water Resources Development Act of 1986, Public Law 99-662, November 17, 1986.

3. PROJECT DESCRIPTION.

The Rio Puerto Nuevo Flood Control Project is designed to provide 100-year flood control protection for the areas adjacent to the Puerto Nuevo Channel and its tributaries. The project consists of 11.2 miles of channel improvements to the existing Rio Puerto Nuevo and Rio Piedras and to five tributaries: Margarita, Josefina, Dona Ana, Buena Vista, and Guaracanal. The proposed improvements would require the construction of eight different channel sections, the replacement of 20 bridges (16 highway and 4 pedestrian), the modification of 8 bridges, and the construction of 2 new bridges.

The scope of Feature Design Memorandum (FDM) Number 2 is the Margarita Channel from Station **54+10** to Station 89+60 and the main Puerto Nuevo Channel from Station 88+33 to Station 147+40.

a. Margarita Channel Segment

The segment of the Margarita Channel known as Contract 2A begins at Station 80+00 and extends to Station **54+10**. It consists of the channelization and associated temporary work areas located contiguous to the north and west of P.R.

22. Acquisition is within one large, low lying tract which contains a high percentage of wetlands.

The excavated material from the Margarita would be placed in an upland disposal area located northeast of the main channel from about Station 27+00 to Station 56+00. This area has not been valued and was not included as part of the real estate cost.

The segment of the Margarita Channel known as Contract 2C begins at Station **54+10** and extends west to Station 89+60 at the western end of the Julia Industrial Park. Temporary easements for construction may have some effect on the loading docks, and parking areas within the park; however, the permanent channel right-of-way will not impact the area.

b. Puerto Nuevo Channel Segment

The segment of the Puerto Nuevo Channel between Station 88+33 from the De Diego Expressway to Station 147+40 within the Munoz Marin Park is known as Contracts 2D and 2E. It consists of the channelization and associated temporary work areas. East of the bank from De Diego Expressway and the police station are several parking lots and large high-rise public housing units. There is a flood wall between the high-rise units and the channel and there are several squatters living in shacks between the wall and the channel. On the west side going north from the parking lot, the channel will take several small buildings behind a Catholic school. From that point, it will take 30 plus or minus single-family residences between the school and the De Diego Expressway. The existing bridge at the De Diego Expressway will remain with channel improvements around it.

Dredged material from the main channel would be disposed of in an ocean disposal area located approximately six miles from San Juan Harbor. It is unknown how much area is required; therefore, it is not included as part of the real estate costs.

Contract 2B consists of the channelization and the temporary work area associated with the construction of the channel and the temporary relocation of Roosevelt Avenue during construction of the new Roosevelt Avenue Bridge. The permanent right-of-way and temporary work areas would lie within four land classifications including small commercial, large commercial, single family residential and Commonwealth owned land immediately contiguous to the riverbed which would be classified as a large low lying parcel containing

wetlands. To the east of the riverbed is the police station which will not be affected. The channel will be expanded to the west and will require full acquisition of a gas station and its parking lot, and a large commercial parking lot currently used by personnel from the police station.

The lands, easements, and rights-of-way needed for the construction, operation, and maintenance of the project will be acquired by the Department of Natural Resources of the Commonwealth of Puerto Rico pursuant to Public Law 99-662. Relocation of families and businesses involved in the acquisition will be performed in accordance with P.L. 91-646, as amended.

Acquisition for the project will involve an estimated ____ parcels. The acquisition includes approximately **190** acres (not including existing riverbed lands) and 24 structures more or less for a total cost, not including severance damages or cost of structures located within Roosevelt Avenue Bridge (Contract 2B), of **$49,847,000**. The combined Federal/non-Federal administration cost to acquire this land is estimated at $1,259,000. The relocation cost, in accordance with P.L. 91-646, is estimated at $539,500. This results in a total combined cost of **$64,558,000**, which includes a 25% contingency of **$12,912,000**.

4. GOVERNMENT-OWNED LANDS.

There are no Federal government land ownerships in the project area.

5. SPONSOR OWNED LANDS.

It appears that all lands required for construction of Contract 2A and some within Contract 2B immediately contiguous to the riverbed are owned either by Commonwealth Agencies or the Municipality of San Juan.

6. ESTATES.

a. Standard Estates. The following standard estates will be required.

Fee - The fee simple title to (what land) (Tracts __ & __) subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Perpetual Channel Improvement Easement - A perpetual and assignable right and easement to construct, operate, and maintain channel improvement works on, over and across (the land described in Schedule A) (Tracts Nos. ___ and ___) for the purposes as authorized by the Act of Congress approved _____, including the right to clear, cut, fell, remove and dispose of any and all timber, trees, underbrush, buildings, improvements and/or other obstructions therefrom; to excavate, dredge, cut away, and remove any or all of said land and to place thereon dredge or spoil material; and for such other purposes as may be required in connection with said work of improvement; reserving, however, to the owners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Temporary Work Area Easement - A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. ___ and ___), for a period not to exceed _____, beginning with date possession of the land is granted to the Project Sponsor, for use by the Project Sponsor, its representatives, agents, and contractors as a (borrow area) (work area), including the right to borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the _____ Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Perpetual Disposal Easement - A perpetual and assignable easement and right-of-way in, on, over, and across the land, to construct, operate, maintain, repair, replace, and remove pipelines used in connection with the transmission of dredged materials to or across said tract of land, and for the purpose of depositing waste material or excavated materials on said land; the right to excavate ditches and construct dikes, mounds and control works to provide for drainage of the easement areas at all times and prevent creation of a flooding condition to adjacent areas in connection with the construction and operation of said

project as described in said congressional authorization and to use for the future maintenance and any future enlargement of said project as may be authorized by Congress; together with the right to clear, cut, fell, remove, and dispose of any and all timber, trees, underbrush, buildings, improvements and/or other obstructions therefrom; the right to alter the grade of said land from time to time; to plant thereon trees, grass, shrubs, and other vegetation with the right to cut and remove, protect, maintain and otherwise control vegetation and prevent the construction of or maintenance of structures; to install, maintain and service aids to navigation together with the right to install and maintain electric power lines to serve the same, and for such other purposes as may be required in connection with the use of said tract as a disposal area; reserving, however, to the owners, their heirs and assigns all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads, and pipelines.

b. Non-Standard Estates. Due to the lengthy process required to segregate public lands and record legal documents to secure easements, lands to be transferred between Commonwealth of Puerto Rico agencies or Municipalities is usually accomplished by first executing a Right-of-Entry with Intent to Acquire or a letter permit whereby each entity agrees on the conditions of the transfer, estates and acreage to be transferred and timeframe for completion of transfer. These documents vary in format but are always perpetual, irrevocable and assignable. In Puerto Rico, they are considered legal, binding documents.

7. NAVIGATION SERVITUDE.

Navigation servitude will be exercised over the land below the mean high water level for construction of the project.

8. PROJECT MAP.

Refer to Plates L17 - L21 in the report.

9. INDUCED FLOODING.

It has been determined that project implementation will cause no significant increase in duration or frequency of flooding as compared to existing conditions and no economic

impact due to the project as compared to existing conditions.

10. REAL ESTATE BASELINE COST ESTIMATE.

Margarita Segment (Contract 2A):

Lands and Damages:	
Lands	
Easement:	
Temporary Work Area (10 acs)	$ 24,597
Perpetual Channel (100 acs)	$204,853
Sub-Total	$229,450
Improvements	
Severance Damages	
Minerals	
Total Lands and Damages (Rounded)	$230,000
Acquisition/Administrative Costs	
Federal	
Project Planning	$ 30,000
Review of Acquisitions (15)	$ 22,500
Review of Appraisals (15)	$ 22,500
Review of Condemnations (10)	$ 25,000
Review of PL 91-646	
Review of Draft PCA	$ 1,000
Total Federal Acquisition/ Admin Costs	$101,000
Non-Federal	
Acquisitions (15)	$ 45,000
Appraisals (15)	$ 45,000
Condemnations (10)	$220,000
PL 91-646	
Total Non-Federal Acquisition/ Admin Costs	$310,000
Public Law 91-646 Payments	
Contingency (25%) (RD)	$160,000
TOTAL REAL ESTATE COST FOR CONTRACT 2A (RD)	**$801,000**

Roosevelt Avenue Bridge (2B):

Lands and Damages:

Lands	
Fee (.44 acs)	$862,400
Easement:	
Temporary Work Area (3.23 acs)	$1,254,568
Perpetual Channel (1.8 acs)	$2,914,180
Sub-Total	$5,031,148
Improvements(4 structures)*	
(*Excludes improvement costs prepared by CESAJ-DS-PD which have not been made available to us.)	
Severance Damages	
Minerals	
Total Lands and Damages (RD)	$5,031,000
Acquisition/Administrative Costs	
Federal	
Project Planning	$ 30,000
Review of Acquisitions (12)	$ 18,000
Review of Appraisals (12)	$ 18,000
Review of Condemnations (1)	$ 1,500
Review of PL 91-646 (4)	$ 4,000
Review of PCA	$ 1,000
Total Federal Acquisition/ Admin Costs	$ 72,500
Non-Federal	
Acquisitions (12)	$ 36,000
Appraisals (12)	$ 24,000
Condemnations (1)	$ 22,000
PL 91-646 (4)	$ 12,000
Total Non-Federal Acquisition/ Admin Costs	$ 94,000
Public Law 91-646 Payments	$ 80,000
Contingency (25%)(RD)	$1,320,000
TOTAL REAL ESTATE COST FOR CONTRACT 2B (RD)	**$6,598,000**

Margarita Segment (Contract 2C):

Lands and Damages:	
Lands	
Easement:	
Temporary Work Area (**2.59** acs)	$ **406,371**
Perpetual (**7.48** acs)	$**3,912,040**
Sub-Total	$**4,318,411**
Improvements (chain link fence & parking surface)	$ 5,600
Severance Damages	
Minerals	
Total Lands and Damages (RD)	$**4,324,000**
Acquisition/Administrative Costs	
Federal	
Project Planning	$ 30,000
Review of Acquisitions (10)	$ 15,000
Review of Appraisals (10)	$ 15,000
Review of Condemnations (1)	$ 2,500
Review of PL 91-646	
Review of Draft PCA	$ 1,000
Total Federal Acquisition/ Admin Costs	$ 63,500
Non-Federal	
Acquisitions (10)	$ 30,000
Appraisals (10)	$ 30,000
Condemnations (1)	$ 22,000
PL 91-646	
Total Non-Federal Acquisition/ Admin Costs	$ 82,000
Public Law 91-646 Payments	
Contingency (25%) (RD)	$**1,117,000**
TOTAL REAL ESTATE COST FOR CONTRACT 2C (RD)	**$5,587,000**

Rio Puerto Nuevo Segment (2D & 2E):

Lands and Damages:

-Lands	
Easement:	
Temporary Work Area (**36.28** acs)	**$11,054,796**
Perpetual (**28.83** acs)	**$28,407,090**
Sub-Total	**$39,461,886**
Improvements (20 structures)	$ 800,000
Severance Damages	
Minerals	
Total Lands and Damages (RD)	**$40,262,000**
Acquisition/Administrative Costs	
Federal	
Project Planning	$ 30,000
Review of Acquisitions (20)	$ 30,000
Review of Appraisals (20)	$ 30,000
Review of Condemnations (10)	$ 25,000
Review of PL 91-646 (20)	$ 20,000
Review of Draft PCA	$ 1,000
Total Federal Acquisition/ Admin Costs	$136,000
Non-Federal	
Acquisitions (20)	$ 60,000
Appraisals (20)	$ 60,000
Condemnations (10)	$220,000
PL 91-646 (20)	$ 60,000
Total Non-Federal Acquisition/ Admin Costs	$400,000
Public Law 91-646 Payments (20)	$459,500
Contingency (25%) (RD)	**$10,314,000**
TOTAL REAL ESTATE COST FOR CONTRACT 2D & 2E (RD)	**$51,572,000**

*Contingencies of 25% are estimated to cover uncertainties associated with such elements as valuation variance, negotiation latitude, condemnation awards and interest, and refinement of boundary lines during ownership verification.

11. RELOCATION ASSISTANCE BENEFITS.

It is estimated that 17 residences, 3 squatter structures, and 3-4 commercial structures will be displaced by the project.

The project sponsor has coordinated the availability on housing and there is more than an adequate supply of decent, safe and sanitary housing available within the City of San Juan or the neighboring communities.

12. MINERALS.

There are no mining operations within the lands required for this phase of the project.

The Commonwealth of Puerto Rico owns the subsurface "commercial minerals" on the Island of Puerto Rico as present sovereign successor of Spain (through the United States). "Commercial minerals" are defined by Section 111 of Title 28 of the laws of Puerto Rico as being "the metallic and combustible substances, petroleum and all natural hydrocarbon compounds that compose, found therein or are derived therefrom; natural gas, precious stones and such other substances as may from time to time be declared commercial minerals by the Secretary of Natural Resources..."

13. NON-FEDERAL SPONSOR'S AUTHORITY TO PARTICIPATE.

The Department of Natural Resources of the Commonwealth of Puerto Rico is the local sponsor for all flood control projects in Puerto Rico. They have provided all lands required to date for the on-going Portugues and Bucana Flood Control Project since 1974. They provided all necessary lands for the Sabana Grande Project and for the Rio Cibuco Project, Vega Baja, Puerto Rico.

The Department of Natural Resources contracts directly for surveys, title evidence and appraisals and generally utilizes other Puerto Rican agencies for the acquisition effort; such as the Puerto Rican Highway Authority or private contractors. There is a team similar to the Corps Life Cycle Project Management Division which handles the different on-going and major authorized flood control projects in the planning stages.

All condemnations are handled by the Puerto Rican Department of Justice in the local Puerto Rican courts. Condemnation assemblies are prepared by counsel or contractor for the agency which is under contract with the

Department of Natural Resources to acquire lands. Puerto Rican law provides for condemnation of right-of-entry for survey and exploration during the planning stages. In condemnation for title, there is a 90-day period after an order of possession is filed before the owner is required to vacate the property.

14. REAL ESTATE MILESTONES.

The estimated work schedule on Contract 2A is underway and should take two years to complete. The remaining work schedule on Feature Design Memorandum 2 is expected to start in the year 2000. All lands needed for the project must be acquired and certified to the Federal Government 60 days prior to contract advertisement. It is estimated to take approximately one to five years to acquire project lands.

15. RELOCATIONS.

Facilities to be relocated include streets, electric transmission lines, and local drainage structures. While generally it is standard practice for the local sponsor to relocate all affected facilities in advance of construction activities, this is not practical or economically feasible for the proposed project. With the exception of temporary relocation of electric transmission lines, all other relocation items would be accomplished under the project construction contract. All costs related to these items would still be paid by the local sponsor. For affected utilities which cannot be relocated by the local sponsor in advance of construction activities, some interruption in utility service would occur. To keep these interruptions to a minimum, close coordination and cooperation would be necessary between the Corps of Engineers, the Commonwealth of Puerto Rico, and the construction contractor.

An Attorney's Opinion of Compensability is being prepared in support of the utility relocations and will be finalized prior to crediting.

Two bridges will be impacted by the construction of the project under FDM 2. One bridge will require replacement of the Roosevelt Avenue Bridge. The other bridge which is the De Diego Expressway Bridge will remain with channel modifications.

No towns or cemeteries to be relocated as a result of this project.

16. PRESENCE OF CONTAMINANTS (HAZARDOUS, TOXIC AND RADIOACTIVE WASTES).

No hazardous or toxic waste problems have been identified for this project. Project design has eliminated potential problems with the San Juan Municipal landfill.

17. ATTITUDE OF LANDOWNERS.

The Department of Natural Resources, as the sponsor and representative of the Commonwealth of Puerto Rico, has held several public meetings with the landowners, most of which are involved and supportive of the project. There are some landowners who are unhappy, but nevertheless accept the recommended plan.

18. M-CACES ESTIMATE FOR REAL ESTATE.

Total Estimated Project Costs
PROJECT: RIO PUERTO NUEVO FLOOD CONTROL PROJECT, PR
FEATURE DESIGN MEMORANDUM NUMBER 2
CONTRACTS 2A, 2B, 2C, 2D, and 2E
DATE: 23 APRIL 1999

01	LANDS AND DAMAGES		
01AA	PROJECT PLANNING	$120,000	
01B--	ACQUISITIONS		
01B20	BY LOCAL SPONSOR (LS)	$171,000	
01B40	REVIEW OF LS	$ 85,500	
01C--	CONDEMNATIONS		
01C20	BY LS	$484,000	
01C40	REVIEW OF LS	$ 54,000	
01E--	APPRAISALS		
01E30	BY LS	$159,000	
01E50	REVIEW OF LS	$ 85,500	
01F--	PL 91-646 ASSISTANCE		
01F20	BY LS	$ 72,000	
01F40	REVIEW OF LS	$ 24,000	
01G--	TEMPORARY PERMITS/LICENSES RIGHTS-OF-ENTRY		
01G20	BY LS		
01G40	REVIEW OF LS		
01G60	DAMAGE CLAIMS		
01M00	PROJECTED RELATED ADMINISTRATION REAL ESTATE REVIEW OF PCA	$ 4,000	
01R--	REAL ESTATE PAYMENTS		
01R1	LAND PAYMENTS		
01R1B	BY LS	**$49,847,000**	
01R2	PL 91-646 ASSISTANCE PAYMENTS		
01R2B	BY LS	$539,500	
TOTAL REAL ESTATE COST EXCLUDING CONTINGENCY (RD)			**$51,646,000**
REAL ESTATE CONTINGENCY (25%) COST (RD)			**$12,912,000**
TOTAL PROJECT REAL ESTATE COST (RD)			**$64,558,000**

PROJECT: RIO PUERTO NUEVO FLOOD CONTROL PROJECT, PR
FEATURE DESIGN MEMORANDUM NUMBER 2
CONTRACT 2A
DATE: **18 AUGUST 1999**

01 LANDS AND DAMAGES

01AA	PROJECT PLANNING	$ 30,000
01B--	ACQUISITIONS	
01B20	BY LOCAL SPONSOR (LS)	$ 45,000
01B40	REVIEW OF LS	$ 22,500
01C-	CONDEMNATIONS	
01C20	BY LS	$220,000
01C40	REVIEW OF LS	$ 25,000
01E--	APPRAISALS	
01E30	BY LS	$ 45,000
01E50	REVIEW OF LS	$ 22,500
01F--	PL 91-646 ASSISTANCE	
01F20	BY LS	
01F40	REVIEW OF LS	
01G--	TEMPORARY PERMITS/LICENSES RIGHTS-OF-ENTRY	
01G20	BY LS	
01G40	REVIEW OF LS	
01G60	DAMAGE CLAIMS	
01M00	PROJECTED RELATED ADMINISTRATION	
	REAL ESTATE REVIEW OF PCA	$ 1,000
01R--	REAL ESTATE PAYMENTS	
01R1	LAND PAYMENTS	
01R1B	BY LS	$230,000
01R2	PL 91-646 ASSISTANCE PAYMENTS	
01R2B	BY LS	

TOTAL REAL ESTATE COST EXCLUDING CONTINGENCY (RD)	**$641,000**
REAL ESTATE CONTINGENCY (25%) COST (RD)	**$160,000**
TOTAL PROJECT REAL ESTATE COST (RD)	**$801,000**

PROJECT: RIO PUERTO NUEVO FLOOD CONTROL PROJECT, PR
FEATURE DESIGN MEMORANDUM NUMBER 2
CONTRACT 2B - Roosevelt Avenue Bridge
DATE: **18 AUGUST 1999**

01	LANDS AND DAMAGES	
01AA	PROJECT PLANNING	$ 30,000
01B--	ACQUISITIONS	
01B20	BY LOCAL SPONSOR (LS)	$ 36,000
01B40	REVIEW OF LS	$ 18,000
01C-	CONDEMNATIONS	
01C20	BY LS	$ 22,000
01C40	REVIEW OF LS	$ 1,500
01E--	APPRAISALS	
01E30	BY LS	$ 24,000
01E50	REVIEW OF LS	$ 18,000
01F--	PL 91-646 ASSISTANCE	
01F20	BY LS	$ 12,000
01F40	REVIEW OF LS	$ 4,000
01G--	TEMPORARY PERMITS/LICENSES RIGHTS-OF-ENTRY	
01G20	BY LS	
01G40	REVIEW OF LS	
01G60	DAMAGE CLAIMS	
01M00	PROJECTED RELATED ADMINISTRATION	
	REAL ESTATE REVIEW OF PCA	$ 1,000
01R--	REAL ESTATE PAYMENTS	
01R1	LAND PAYMENTS	
01R1B	BY LS	$5,031,000
01R2	PL 91-646 ASSISTANCE PAYMENTS	
01R2B	BY LS	$ 80,000

TOTAL REAL ESTATE COST EXCLUDING CONTINGENCY (RD)	**$5,278,000**
REAL ESTATE CONTINGENCY (25%) COST (RD)	**$1,320,000**
TOTAL PROJECT REAL ESTATE COST (RD)	**$6,598,000**

PROJECT: RIO PUERTO NUEVO FLOOD CONTROL PROJECT, PR
FEATURE DESIGN MEMORANDUM NUMBER 2
CONTRACT 2C
DATE: **18 AUGUST 1999**

01 LANDS AND DAMAGES

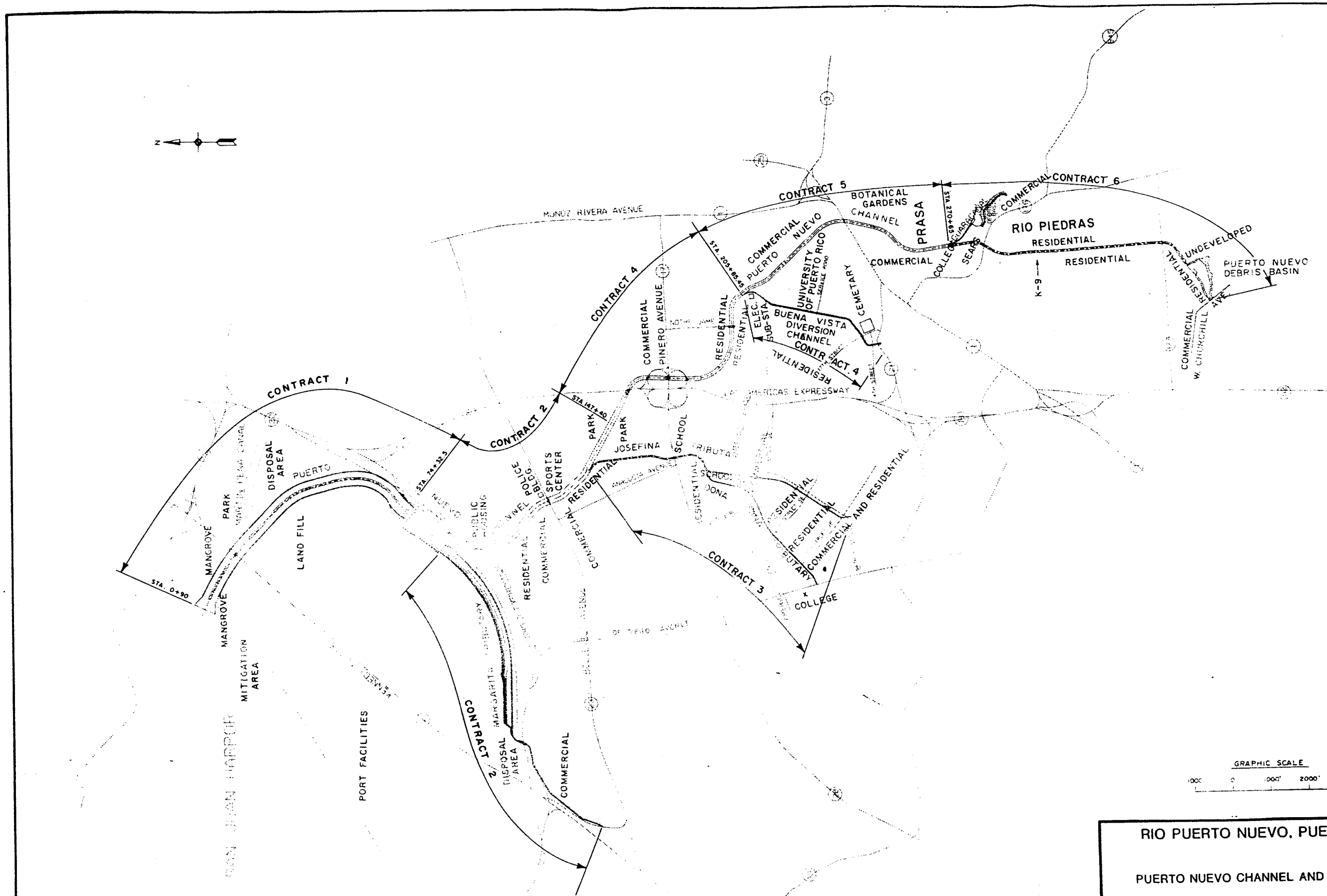
01AA	PROJECT PLANNING	$ 30,000
01B--	ACQUISITIONS	
01B20	BY LOCAL SPONSOR (LS)	$ 30,000
01B40	REVIEW OF LS	$ 15,000
01C-	CONDEMNATIONS	
01C20	BY LS	$ 22,000
01C40	REVIEW OF LS	$ 2,500
01E--	APPRAISALS	
01E30	BY LS	$ 30,000
01E50	REVIEW OF LS	$ 15,000
01F--	PL 91-646 ASSISTANCE	
01F20	BY LS	
01F40	REVIEW OF LS	
01G--	TEMPORARY PERMITS/LICENSES RIGHTS-OF-ENTRY	
01G20	BY LS	
01G40	REVIEW OF LS	
01G60	DAMAGE CLAIMS	
01M00	PROJECTED RELATED ADMINISTRATION	
	REAL ESTATE REVIEW OF PCA	$ 1,000
01R--	REAL ESTATE PAYMENTS	
01R1	LAND PAYMENTS	
01R1B	BY LS	**$4,324,000**
01R2	PL 91-646 ASSISTANCE PAYMENTS	
01R2B	BY LS	

TOTAL REAL ESTATE COST EXCLUDING CONTINGENCY (RD)	**$4,470,000**
REAL ESTATE CONTINGENCY (25%) COST (RD)	**$1,118,000**
TOTAL PROJECT REAL ESTATE COST (RD)	**$5,588,000**

PROJECT: RIO PUERTO NUEVO FLOOD CONTROL PROJECT, PR
FEATURE DESIGN MEMORANDUM NUMBER 2
CONTRACT 2D & 2E
DATE: **18 AUGUST 1999**

01	LANDS AND DAMAGES	
01AA	PROJECT PLANNING	$ 30,000
01B--	ACQUISITIONS	
01B20	BY LOCAL SPONSOR (LS)	$ 60,000
01B40	REVIEW OF LS	$ 30,000
01C-	CONDEMNATIONS	
01C20	BY LS	$ 220,000
01C40	REVIEW OF LS	$ 25,000
01E--	APPRAISALS	
01E30	BY LS	$ 60,000
01E50	REVIEW OF LS	$ 30,000
01F--	PL 91-646 ASSISTANCE	
01F20	BY LS	$ 60,000
01F40	REVIEW OF LS	$ 20,000
01G--	TEMPORARY PERMITS/LICENSES RIGHTS-OF-ENTRY	
01G20	BY LS	
01G40	REVIEW OF LS	
01G60	DAMAGE CLAIMS	
01M00	PROJECTED RELATED ADMINISTRATION	
	REAL ESTATE REVIEW OF PCA	$ 1,000
01R--	REAL ESTATE PAYMENTS	
01R1	LAND PAYMENTS	
01R1B	BY LS	**$40,262,000**
01R2	PL 91-646 ASSISTANCE PAYMENTS	
01R2B	BY LS	$ 459,500

TOTAL REAL ESTATE COST EXCLUDING CONTINGENCY (RD)	**$41,258,000**
REAL ESTATE CONTINGENCY (25%) COST (RD)	**$10,314,000**
TOTAL PROJECT REAL ESTATE COST (RD)	**$51,572,000**



GRAPHIC SCALE

1000 0 1000' 2000' 3000'

RIO PUERTO NUEVO, PUERTO RICO

PUERTO NUEVO CHANNEL AND TRIBUTARIES

PROJECT LOCATION MAP

REAL ESTATE

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 102-35,578

DECEMBER 1990

PLATE C-1

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 10.27 feet | Hole No. CB-PNB-5

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft)a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL Bls/6"
-34.73	45.0'					
				89	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 12 / 9 / 8
-36.73	47.0'					
			CLAY, stiff to very stiff, red, little silt, trace sand, occ. black mottled (CH)	100	32	8 / 8 / 8
				94	33	7 / 8 / 10
-39.23	49.5'					
			from 49.5' to 51' partly sandy, red, gray, reddish brown and brownish yellow mottled	100	34	10 / 14 / 20
-40.73	51.0'					
				100	35	W = 30% PI= 45% LL= 62% PL= 17% 7 / 12 / 15
-42.23	52.5'					
				100	36	7 / 15 / 20
			from 51' to 52.5' sandy	100	37	7 / 11 / 15
-45.73	56.0'					
			from 56' to 58.5' some gravel sub-angular to angular, partly decomposed	100	38	14 / 22 / 28
				100	39	8 / 11 / 12
-48.23	58.5'					
			clay, very stiff, some sand, yellowish brown, occ. gray and reddish brown mottled	100	40	10 / 11 / 15
-49.73	60.0'					
			END 60.0'			

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 O-F - 626-683

PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO. CB-PNB-5

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=621,645 Y=214,562
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-5D
5. NAME OF DRILLER: JOSE AYALA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 90.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.
9. TOTAL DEPTH OF HOLE: 90 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: ACKER AD-II
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 21 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 0.49 Ft.
16. DATE HOLE STARTED: 10-03-95 COMPLETED: 10-04-95
17. ELEVATION TOP OF HOLE: 12.31 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 62 %
19. SIGNATURE OF ENGINEER: IVAN JACKSON

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
12.3	.0					12.3	
			Augered from elevation 12.3 to -44.9 Feet. (For description and classification see companion log CB-PNB-5)				
						(continued)	

0
2.5
5
7.5
10
12.5
15
17.5
20
22.5

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 12.31 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-10.2	22.5						

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5
50

(continued)

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-PNE-5D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 12.31 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
-37.7	50.0						50
							52.5
							55
							57.5
-46.7	59.0					-46.7	
			SAND, clayey, well graded, wet, brown, (SC).	72	1	Split Spoon Sampler	19 / 14 / 17
-48.2	60.5					-48.2	60
			CLAY, very stiff, yellowish-brown, (CH).	78	2	"	10 / 12 / 15
						-49.7	
				83	3	"	11 / 10 / 13
						-51.2	62.5
				89	4	"	15 / 12 / 22
-52.7	65.0					-52.7	65
			SILT, hard, some limestone gravel, yellowish-brown, (ML).	83	5	"	14 / 35 / 75
-54.2	66.5					-54.2	
			LIMESTONE, impure, unconsolidated, highly weathered, sampled as SILT, yellowish-brown. (ML)	67	6	"	30 / 16 / 60
						-55.7	67.5
				67	7	"	36 / 75
						-57.2	
				100	8	"	38 / 57 / 80
						-58.7	70
			(sampled as silt, yellowish-brown and white)	100	9	"	40 / 60 / 70
						-60.2	72.5
				44	10	"	50 / 85/3
						-61.7	
				100	11	"	20 / 20 / 10
						-63.2	75
				72	12	"	20 / 26 / 34
						-64.7	
				100	13	"	15
							77.5

(continued)

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 12.31 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ 5"
-65.2	77.5						
			(sampled as gravel and sand, yellowish-brown)	100	13	" -66.2	6 11
				67	14	Split Spoon Sampler -67.7	10 17 11
				33	15	" -69.2	28 75/3
				33	16	" -70.7	40 75/3
				44	17	" -72.2	50 75/2
				33	18	" -73.7	53 80/2
				28	19	" -75.2	90/6
-76.7	89.0			22	20	" -76.7	75/4
-77.7	90.0		No Recovery	0	21	" -77.7	75/1
			End of test hole.				

140# HAMMER WITH 30" DROP USED ON 2.0"O.D. SPLIT SPOON (1-3/8" I.D.)

Ground water elevation at the time of drilling was -17.7 feet.

LAB CLASSIFICATIONS

Elev. (Ft.)	Class.	Wn	LL	PL	PI
-48.2	SC	21%	39	23	16

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 23.47 feet | Hole No. CB-PNB- 6

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
						BIT OR BARREL	
-21.53	45.0'						Bls/6"
-23.03	46.5'		CLAY, medium, silty, some sand brown and gray, very sandy silt, friable (CH)	100	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	3 4 5
-24.53	48.0'		SAND, fine to medium, clayey, yellowish brown little silt, gray mottled (SC)	67	32	W = 32%	2 2 4
-26.03	49.5'		CLAY, stiff to very stiff, sandy, trace silt, oxidized nodules, brown and gray, occ. black mottled (CH)	100	33		5 7 9
-27.53	51.0'		from 49.5' to 51' silty, black oxidized veins	100	34		4 5 7
-29.03	52.5'		from 51' to 52.5' silty sand, fine	100	35		7 9 11
			CLAY, stiff, silty, some sand, pebbles, yellowish brown, occ. gray mottled (CL)	12	36	W = 32% PI= 18% LL= 36% PL= 18%	1 5 6
				NR	37		4 4 5
-33.53	57.0'			100	38		3 4 6
-35.03	58.5'		CLAY, stiff, little sand, red, trace silt, occ. light gray and black mottled (CH)	100	39		4 4 6
-36.53	60.0'		from 58.5' to 60' stiff to very stiff	100	40	W = 30% PI= 40% LL= 58% PL= 18%	8 9 11
			END 60.0'				

ENG FORM 1836-A (ER 1110-1-1801) GPO 1986 OP - 620 - 603

PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB- 6

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 23.3 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ 5"
-26.7	50.0						50
							52.5
							55
							57.5
-36.2	59.5					-36.2	
			CLAY, silty, stiff, reddish-brown, (CL).	100	28	Split Spoon Sampler	6, 6, 8
						-37.7	
				100	29	"	7, 7, 8
-39.2	62.5					-39.2	62.5
			SAND, clayey, reddish-brown, (SC).	100	30	"	6, 14, 19
						-40.7	
				100	31	"	9, 17, 22
						-42.2	65
				100	32	"	14, 21, 32
						-43.7	
			(trace clay, poorly graded, yellowish-brown)	100	33	"	16, 21, 29
						-45.2	67.5
				100	34	"	19, 25, 29
-46.7	70.0					-46.7	70
			CLAY, silty, stiff, reddish-brown, (CL).	100	35	"	16, 21, 32
						-48.2	
			(very plastic, yellowish-brown)	78	36	"	14, 19, 30
-49.7	73.0					-49.7	72.5
			SILT, hard, friable, light yellowish-brown and cream, (ML).	78	37	"	19, 28, 36
						-51.2	
			(yellow)	100	38	"	21, 32, 43
						-52.7	75
				100	39	"	25, 32, 38
						-54.2	77.5
						(continued)	

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 23.3 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ 5"
-54.2	77.5					-54.2	
			(little coarse limestone sand)	100	40	"	28 / 38 / 45
-55.7	79.0					-55.7	
			CLAY, sandy, some silt, wet, yellowish-brown, (CL).	78	41	"	11 / 3 / 51
			(little limestone gravel)			-57.2	
				67	42	"	45 / 36 / 16
-58.7	82.0					-58.7	
			LIMESTONE, impure, highly weathered, sampled as gravel, clayey, wet, yellowish-brown. (GC)	89	43	Split Spoon Sampler	16 / 21 / 32
						-60.2	
				67	44	"	17 / 21 / 32
						-61.7	
				100	45	"	50 / 18 / 32
						-63.2	
				33	46	"	61 / 2 / 12
						-64.7	
				78	47	"	40 / 37 / 30
						-66.2	
				56	48	"	18 / 38 / 45
						-67.7	
				67	49	"	18 / 24 / 30
						-69.2	
				56	50	"	18 / 20 / 32
						-70.7	
				44	51	"	12 / 18 / 20
						-72.2	
				67	52	"	18 / 25 / 31
						-73.7	
			(sampled as silt, little angular limestone inclusions)	78	53	"	18 / 24 / 30
						-75.2	
				78	54	"	16 / 12 / 21
						-76.7	
			(sampled as clay, decomposed limestone)	67	55	"	21 / 32 / 45
						-78.2	
-78.7	102.0		(sampled as gravel)	22	56	-78.7 "	100/4
			End of test hole.				

140# HAMMER WITH 30" DROP USED ON 2.0" O.D. SPLIT SPOON (1-3/8" I.D.)

Ground water elevation at the time of drilling was -6.7 feet.

LAB Classifications

Elev. (Ft.)	Class.	Wn	LL	PL	PI
-42.2	SC	20%	35	22	13

Hole No. CB-PNB- 7

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT: PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT: See remarks	
2. LOCATION (Coordinates or Station): X= 621850.77 Y= 214783.12		11. DATUM FOR ELEVATION SHOWN (MSL or MLL): MSL	
3. DRILLING AGENCY: GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55	
4. HOLE NO. (As shown on drawing title and file number): CB-PNB- 7		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED	UNDISTURBED
5. NAME OF DRILLER: P. Robles		14. TOTAL NUMBER CORE BOXES: 2 feet	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: -2.40 feet	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE: STARTED 3-15-89	COMPLETED 3-16-89
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE: 9.60	
9. TOTAL DEPTH OF HOLE: 60 feet		18. TOTAL CORE RECOVERY FOR BORING: 83.0 %	
		19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	Blows/6"
+ 9.60	0.0					BIT OR BARREL	
+ 8.10	1.5'		TOP SOIL, organic, dark gray, with clay, medium, brown and gray organic, trace silt (CL)	67	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	3 3 4
			FILL material, mixture of rock fragments, gravel size, and clay, little silt, trace sand, brown and gray, from 1.5' to 11' (GC)	56	2		6 5 6
				78	3		3 3 6
				100	4		3 4 3
				67	5		2 3 2
				33	6		2 2 2
				56	7		1 1 1
- 1.40	11.0			44	8		3 1 1
- 3.90	13.5		CLAY, very soft, organic, very dark gray, little silt, trace sand (OH)	67	9		1 1 2
- 5.40	15.0		SAND, organic, fine to medium grained, trace clay, dark gray occ. shell fragments (SP)	72	10	W = 32%	WH 1 1
- 6.90	16.5		CLAY, very soft, organic, very sandy, very dark gray, some silt, pebbles (OL)	44	11		WH WH 1
- 8.90	18.5		CLAY, very soft, organic, gray & very dark gray, little silt, trace sand, occ. fibrous matter and shell frags. (OH)	100	12		1 WH 1
-11.40	21.0		CLAY, stiff, possibly slightly organic, olive gray, little sand, trace silt, occ. pebbles, yellowish brown and olive mottled (CH)	100	13		2 4 5
				94	14		3 5 7

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 9.60 feet | Hole No. CB-PNB- 7

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
						BIT OR BARREL Bls/6"	
-11.40	21.0'		from 21' to 24' rust colored oxidized veins and nodules	100	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	3 4 6
-14.40	24.0'			100	16		3 4 5
-15.90	25.5'		from 24' to 25.5' sand, fine to medium grained	100	17	W = 35% PI= 35% LL= 54% PL= 19%	3 5 9
				100	18		4 6 9
				100	19		3 7 9
				100	20		4 6 8
				89	21		4 6 6
				100	22		3 5 7
-24.90	34.5'			NR	23		3 6 6
-26.40	36.0'		from 34.5' to 36' partly sandy	100	24		4 6 9
-27.90	37.5'		from 36' to 37.5' sand, black mottled	72	25		4 5 7
			clay, stiff, silty, yellowish brown, some sand, occ. pebbles gray mottled	100	26		4 6 8
				83	27		4 6 10
-32.40	42.0'			100	28	W = 26% PI=33% LL= 55% PL= 22%	5 6 10
-35.40	45.0'		from 42' to 46.5' red to reddish brown	67	29		6 7 9
				89	30		6 6 9

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 9.60 feet | Hole No. CB-PNB-7

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc. - if significant) g
						BIT OR BARREL Bls/6"
-35.40	45.0					
			from 45' to 46.5' very silty	100	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 4 4 6
-36.90	46.5					
			from 46.5' to 48' some sand, fine grained, silty	100	32	5 7 12
-38.40	48.0					
			SAND, fine to medium grained, clayey, trace silt, occ. pebbles (SW)	100	33	9 18 24
-39.90	49.5					
			from 49.5' to 54' trace to little silt	89	34	W = 28% 2 2 11
				100	35	10 15 19
				94	36	9 15 20
-44.40	54.0					
			from 54' to 57' very silty	78	37	7 11 17
				100	38	6 10 15
-47.40	57.0					
			from 57' to 58.5' some clay, trace gravel angular	94	39	7 14 14
-48.90	58.5					
			from 58.5' to 60' trace silt	78	40	14 21 20
-50.40	60.0					
			END 60.0'			

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 OF - 620 - 603

PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB-7

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=621,851 Y=214,783
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-7D
5. NAME OF DRILLER: Nicolas Andino
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 90.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.
9. TOTAL DEPTH OF HOLE: 90 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: BK-51
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 20 undisturbed: 2
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: -2.6 Ft.
16. DATE HOLE STARTED: 9-30-95 COMPLETED: 9-30-95
17. ELEVATION TOP OF HOLE: 8.24 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 100 %
19. SIGNATURE OF ENGINEER: IVAN JACKSON

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
8.2	.0					8.2	
			Augered from elevation 8.2 to -52.3 Feet. (For description and classification see companion log CB-PNB-7)				
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 8.24 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
-14.3	22.5						

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5
50

(continued)

Hole No. CB-PNB- 6

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT See remarks	
2. LOCATION (Coordinates or Station) X= 621882.99 Y= 214540.73		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL CME - 45B	
4. HOLE NO. (As shown on drawing title and file number) CB-PNB- 6		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED	UNDISTURBED
5. NAME OF DRILLER H. González		14. TOTAL NUMBER CORE BOXES 2	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 2.47 feet	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED 3-16-89 COMPLETED 3-16-89	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE 23.47	
9. TOTAL DEPTH OF HOLE 60 feet		18. TOTAL CORE RECOVERY FOR BORING 64.0 %	
		19. SIGNATURE OF INSPECTOR Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	Blows/6"
23.47	0.0					BIT OR BARREL	Bls/6"
21.47	2.0		FILL material, 6" asphalt and clay, stiff some rock frags. little silt, trace sand, brown and gray (GC)	67	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	64 9 6
				33	2		8 6 5
			FILL material, silt, stiff, clayey, some rock fragments, brown, little sand, gray and yellow mottled (SM)	33	3	W = 11%	4 3 5
			from 3' to 7.5' sandy	33	4		3 7 3
15.97	7.5			33	5		3 5 5
14.47	9.0		some clay, medium to stiff, some rock frags. gravel size, little sand and silt	67	6	W = 19%	2 2 2
12.97	10.5		FILL material, clay medium to stiff and rock fragments, gravel size, brown, occ. yellow mottled, little sand and silt (GC)	67	7		2 4 8
				67	8		3 4 5
9.97	13.5			67	9		2 4 7
8.47	15.0		from 13.5' to 15' much more rock fragments, gravel size, angular, some clay, little silt	67	10		7 6 4
				67	11		5 5 7
				33	12		3 5 9
				67	13		7 8 8
2.47	21.0			67	14		4 9 10

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 23.47 feet | Hole No. CB-PNB- 6

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH h	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc.; if significant) g	
						BIT OR BARREL	
+ 2.47	21.0						Bls/6"
			rock fragments, gravel size, gray, some sandy clay, little silt, brown, occ. yellow mottled from 21' to 29'	33	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	12 16 16
				33	16		12 12 14
				33	17		7 7 7
				33	18		2 3 4
				56	19		6 4 4
- 5.53	29.0						
			CLAY, soft, organic, gray to dark gray little fibrous matter, trace silt, occ. shell fragments, trace sand (OH)	67	20		3 2 1
				61	21		1 2 3
- 8.53	32.0						
			CLAY, stiff, slighlty organic, reddish brown and gray, little sand, trace silt, occ. olive mottled (CL)	67	22	W = 30% PI= 30% LL= 48% PL= 18%	2 4 5
				NR	23		3 4 4
-11.03	34.5						
			from 34.5' to 36' olive gray, trace pebbles, brown mottled	100	24		3 6 7
-12.53	36.0						
			CLAY, medium, sandy, some silt, nodules, brown mottled (CH)	100	25		3 4 4
				100	26		3 4 6
-15.53	39.0						
			from 39' to 45' little to trace weathered rock frags.	100	27	W = 30% PI= 38% LL= 55% PL= 17%	3 6 6
				100	28		5 6 7
				67	29		3 4 4
				67	30		2 3 5
-21.53	45.0						

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=621,883 Y=214,541
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-6D
5. NAME OF DRILLER: Pablo Andino
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 102.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.
9. TOTAL DEPTH OF HOLE: 102 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: BK-51
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 56 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: -11.2 Ft.
16. DATE HOLE STARTED: 9-27-95 COMPLETED: 9-29-95
17. ELEVATION TOP OF HOLE: 23.3 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 84 %
19. SIGNATURE OF ENGINEER: IVAN JACKSON

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
23.3	.0					23.3	
			Augered from elevetion 23.3 to -36.2 Feet. (For description and classification see companion log CB-PNB-6)				
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 23.3 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ 5'
.8	22.5						

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5
50

(continued)

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 8.24 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-41.8	50.0						
							50
							52.5
							55
							57.5
							60
-52.3	60.5					-52.3	
			SAND, little silt, poorly graded, dense, brown, (SP).	100	1	SPLIT SPOON SAMPLER	17, 20, 22
						-53.8	
				100	2	"	12, 15, 20
-55.3	63.5					-55.3	62.5
			SAND, silty, little clay, trace angular gravel, brown, (SM).	100	3	"	10, 15, 30
						-56.8	
				100	4	"	16, 17, 18
-58.3	66.5					-58.3	65
			CLAY, little fine sand, little silt, stiff, very plastic, brown, (CH).	100	5	"	9, 15, 27
						-59.8	
				100	6	"	7, 12, 14
						-61.3	
				100	7	"	5, 9, 13
						-62.8	67.5
				100	8	"	12, 14, 16
						-64.3	
				100	9	"	9, 13, 18
-65.8	74.0					-65.8	
			CLAY, sandy, some silt, stiff, brown, (CL).	100	10	"	13, 17, 19
						-67.3	
			(trace fine rounded gravel)	100	11	"	17, 18, 22
						-68.8	70
-69.3	77.5		(wet, very soft)	100	12		7
							72.5
							75
							77.5

(continued)

Hole No.CB-PNB-7D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 8.24 Ft.

SHEET 4 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-69.3	77.5						
			CLAY, some fine sand, soft, brown, (CH).	100	12	" -70.3	7 9
				100	13	SPLIT SPOON SAMPLER -71.8	9 12 14
-71.8	80.0						
			CLAY, silty, some sand, stiff, yellowish-brown and light gray, (CL).	100	14	" -73.3	10 24 37
				100	15	" -74.8	19 29 43
				100	16	" -76.3	23 37 48
-76.3	84.5						
			LIMESTONE, impure, weathered, sampled as SAND, trace fine gravel, yellowish-brown. (SM)	100	17	" -77.8	17 24 38
			(sampled as clay, some weathered limestone inclusions)	100	18	" -79.3	21 43 62
				100	19	" -80.8	34 46 19
			(sampled as gravel, highly weathered limestone, yellowish-brown)	100	20	" -81.8	29 57
-81.8	90.0						
			End of Test Hole				

140# HAMMER WITH 30" DROP USED ON 2.0"O.D. SPLIT SPOON (1-3/8" I.D.)

Ground water elevatio at the time of drilling was -11.8 feet.

Once this boring was finished, another one was drilled close to this and two undisturbed soil samples were recovered from elevations -7' to -9'Feet and from -25' to -27'Feet.

LAB Classifications

Elev. (Ft.)	Class.	Wn	LL	PL	PI
-56.8	SC	21%	34	18	16
-68.8	CH	23%	68	27	41

77.5 80 82.5 85 87.5 90 92.5 95 97.5 100 102.5 105

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PROJECT RIO PUERTO NUEVO PROJECT

HOLE NUMBER CB-PNB-7D

Hole No. CB-PNM-43

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: PUERTO NUEVO CHANNELS
2. LOCATION (Coordinates or Station): X = 621670 Y = 214125
3. DRILLING AGENCY: GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number): CB-PNM-43
5. NAME OF DRILLER: H. González
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 30.0'
10. SIZE AND TYPE OF BIT: See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 20 UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 2
15. ELEVATION GROUND WATER: -4.46 feet
16. DATE HOLE: STARTED 2-19-90 COMPLETED 2-19-90
17. ELEVATION TOP OF HOLE: 13.54 feet
18. TOTAL CORE RECOVERY FOR BORING: 70 %
19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
13.54	0.0'					BIT OR BARREL Bls/6"
			FILL, clay, soft reddish brown, red and gray, some rock frags. gravel size, little sand and silt, occ. decayed fibrous matter (CL)	67	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 1 1 1
10.54	3.0'		medium	78	2	3 5 3
			trace concrete waste	44	3	3 3 6
7.54	6.0'		some concrete waste, slightly organic	56	4	6 4 4
			partly sandy and silty	61	5	3 4 5
				67	6	2 3 6
4.04	9.5'			56	7	2 3 5
			Clay, stiff, reddish brown, and gray little sand and silt, occ. pebbles and thin roots dark brown mottled (CH)	100	8	2 3 6
				94	9	2 4 7
-1.46	15.0'			94	10	3 4 4
			Clay, stiff partly silty some sand (CL) gray, occ brown and olive mottled	100	11	W=43% PI=30% LL=49% (CL) PL=19% 4 5 4
-4.46	18.0'		very soft, rust colored oxidized veins	78	12	1 2 1
			Clay, very dark gray, silty, some sand (OL)	67	13	PUSH 1 1
-7.46	21.0'			78	14	W=55% PI=32% LL=57% (CH) PL=25% 0 0 1

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 13.54 feet	Hole No. CB-PNM-43
PROJECT PUERTO NUEVO CHANNELS	INSTALLATION JACKSONVILLE DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling rate, water loss, depth of weathering, etc., if significant) g
						BIT QR BARREL
	21.0					Bls/6"
-8.96	22.5			44	15	140# hammer with 30" drop on 1-3/8" ID & 2" OD std. spl. spoon 0 0 1
			Clay, stiff dark olive gray, little sand, and silt, occ. pebbles, very dark gray mottled (CH)	28	16	3 5 7
-11.96	22.5		some sand, oxidized veins	56	17	2 5 7
			Clay, stiff olive gray, sandy, partly very sandy (CL)	83	18	LL=48.2% (CL) PL=19.3% PI=28.9% 4 5 8
				78	19	2 5 7
-16.46	30.0			78	20	3 6 7
			Soils are field visually classified in accordance with the Unified Soils Classification System. After visual classification was performed, Atterberg Limits and Water Contents were obtained from the requested samples and the results and final USCS classifications are shown. Lab classification takes precedence over visual classification.			

Hole No. CB-PNM-44

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 2 OF 2 SHEETS 1

1. PROJECT	PUERTO NUEVO CHANNELS
2. LOCATION (Coordinates or Station)	X = 621802 · Y = 213639
3. DRILLING AGENCY	GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number)	CB-PNM-44
5. NAME OF DRILLER	H. González
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	45.0'
10. SIZE AND TYPE OF BIT	See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-45C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 30 / UNDISTURBED
14. TOTAL NUMBER CORE BOXES	2
15. ELEVATION GROUND WATER	-1.73 feet
16. DATE HOLE	STARTED 2-5-90 / COMPLETED 2-5-90
17. ELEVATION TOP OF HOLE	8.27 feet
18. TOTAL CORE RECOVERY FOR BORING	84.0 %
19. SIGNATURE OF INSPECTOR	Kermit Schmidt, PE

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
8.27	0.0'					Bls/6"
			FILL, 6" asphalt and concrete with clay, soft to medium, red and gray, little sand and silt. (CH)	17	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon * 1 2
			dark gray, some concrete waste slightly organic.	28	2	2 2 2
5.27	3.0'					
			Clay, very soft, dark gray; slightly organic, little sand and silt, light gray mottled. (CH)	67	3	1 1 1
3.77	4.5'					
			olive and gray	100	4	1 2 2
			medium to stiff, some sand, gray, olive and red	78	5	W=31% PI=54% LL=79% (CH) PL=25% 2 3 4
			trace weathered rock	100	6	2 2 4
			red and gray occ. brownish yellow	100	7	2 4 4
			reddish brown and gray	100	8	4 6 7
				100	9	3 5 5
			rust colored oxidized veins, trace pebbles	100	10	3 5 7
-6.73	15.0'					
			some silt	100	11	3 4 6
-8.23	16.0'					
			trace intensely weathered rock, oxidized veins	100	12	3 4 5
			silty sand, medium grained, brown	100	13	3 4 6
				56	14	3 5 5
-12.73	21.0'					
						* = Asphalt

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PROJECT PUERTO NUEVO CHANNELS | HOLE NO. CB-PNM-44

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 8.27 feet | Hole No. CB-PNM-44

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
-12.73	21.0'					BIT OR BARREL Bls/6"	
-14.23	22.5'			100	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon	5 7 7
-15.73	24.0'		some sand, partly sandy.	89	16		2 5 6
-18.73	27.0'		Clay, medium to stiff, sandy some silt, yellowish brown and gray, trace pebbles, oxidized veins. (CL)	100	17	W=26% PI=19% LL=38% (CL) PL=19%	2 3 4
				100	18		4 6 7
-21.73	30.0'		Sand, very clayey, fine to medium grained, some silt, yellowish brown, some silt. (SC)	100	19		3 3 4
				100	20		5 5 5
-26.23	34.5'		Clay, stiff, silty, some sand, yellowish brown and gray, partly sandy, fine grained. (CL)	78	21		4 4 4
				78	22	W=20% PI=26% LL=43% (CL) PL=17%	4 5 7
			reddish brown, sandy.	67	23		4 5 9
-32.23	40.5'		Clay, very stiff, reddish brown and brown, little sand and silt, occ. pebbles, black and gray mottled. (CH)	100	24		7 9 11
			hard, partly sandy	100	25		11 14 19
			very stiff to hard	100	26		7 12 14
				78	27		4 7 9
-36.73	45.0'		Clay, sandy, brown, some silt, gray and yellow mottled, occ. rust colored oxidized veins. (CL)	50	28		9 11 15
				56	29		7 10 10
				78	30		3 3 5

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=621,802 Y=213,639
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNM-44D
5. NAME OF DRILLER: Nicolas Andino
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 67.5 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 67.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: BK-51
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 35 undisturbed: 1
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 5.1 Ft.
16. DATE HOLE STARTED COMPLETED: 09/25/95 09/26/95
17. ELEVATION TOP OF HOLE: 8.6 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 53.4 %
19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
8.6	.0					8.6	
			Augered from elevation 8.6 to -35.4 feet. (For description and classification see companion log CB-PNM-44)				

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

(continued)

Hole No.CB-PNM-44D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 8.6 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
-13.9	22.5						
-35.4	44.0					-35.4	
			From 44 to 46.5 feet weight of rods.	0			
-37.9	46.5					-37.9	
			CLAY, some silt, little sand, high plasticity, light brown. (CH)	100	22	SPLIT SPOON	WH WH WH
						-39.4	
				56	23	"	2
-40	49.5					-40.9	3
				100	24	"	2
						(continued)	

Hole No.CB-PNM-44D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 8.6 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-41.4	50.0		~~SAND, clayey, coarse grained,~~				
			quartz, yellowish brown. (SC)	100	24	"	4
-42.4	51.0					-42.4	6
			CLAY, silty, medium plasticity, laminated, yellowish brown. (CL)	100	25	"	7
							7
						-43.9	9
				78	26	"	9
							9
						-45.4	9
			Few fossils with gravel size limestone fragments at 54 feet.	100	27	"	10
							8
-46.9	55.5					-46.9	26
			SAND, silty, fine to medium grained, quartz, yellowish brown. (SM)	100	28	"	13
							18
-48.4	57.0					-48.4	24
			LIMESTONE, granular, slightly fossiliferous, highly weathered, (saprolite) sampled as SAND, clayey, calcareous, and gravel size limestone fragments, yellowish brown. (SC)	67	29	"	24
							100/6
						-49.9	
				33	30	"	100/6
						-51.4	
				100	31	"	76
							55
						-52.9	70
			Sampled as SILT, sandy, slightly calcareous, light olive. (ML)	89	32	"	27
							38
						-54.4	47
				100	33	"	30
							36
-55.9	64.5					-55.9	49
			SANDSTONE, medium to coarse grained, highly weathered to decomposed, saprolite sampled as SAND, clayey, light olive. (SC)	100	34	"	23
							32
						-57.4	38
				100	35	"	25
							35
-58.9	67.5					-58.9	50
			END OF HOLE, 67.5 FEET				

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)

Ground water elevation at the time of drilling was 5.7 feet.

LAB CLASSIFICATIONS

Elev. (Ft.)	Class.	Wn	LL	PL	PI
-39.4	CH	41%	70	28	42
-43.9	CH	45%	71	31	40
-46.9	ML	45%			
-54.4	MH	32%	60	32	28

Hole No. CB-PNB- 8

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT: PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT: See remarks	
2. LOCATION (Coordinates or Station): X= 622208.65 Y= 213223.96		11. DATUM FOR ELEVATION SHOWN (MSL or MSL): MSL	
3. DRILLING AGENCY: GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME - 45B	
4. HOLE NO. (As shown on drawing title and file number): CB-PNB- 8		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED	
5. NAME OF DRILLER: H. González		14. TOTAL NUMBER CORE BOXES: 2	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: -4.31 feet	
7. THICKNESS OF OVERBURDEN: -		16. DATE HOLE: STARTED 5-11-89 COMPLETED 5-11-89	
8. DEPTH DRILLED INTO ROCK:		17. ELEVATION TOP OF HOLE: 9.69	
9. TOTAL DEPTH OF HOLE: 50 feet		18. TOTAL CORE RECOVERY FOR BORING: 85.0 %	
		19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
9.69	0.0					BIT OR BARREL Bls/6"
8.19	1.5'		FILL material, concrete waste & clay, some sand, little silt, occ. thin roots (GC)	33	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 9 9 5
			FILL material, clay reddish brown and gray, sandy, stiff, occ. roots (CL)	33	2	4 4 4
			red, brown and gray	67	3	4 6 8
3.69	6.0'			67	4	15 27 14
			CLAY, stiff, gray little sand and silt, occ. pebbles, yellowish brown and occ. dark brown mottled (CH)	100	5	3 4 5
			yellowish brown and gray occ. red mottled	100	6	3 4 5
				100	7	3 4 6
				100	8	3 3 6
				100	9	2 3 4
				100	10	2 3 4
- 5.31	15.0'					
			some brown silty, sand, fine grained	100	11	3 5 5
- 8.31	18.0'		stiff, some sand, olive gray, little silt, occ. pebbles, rust colored oxidized veins	100	12	3 5 8
			trace weathered rock, highly decomposed	100	13	2 4 6
-11.31	21.0		partly sandy, olive gray, yellowish brown mottled	100	14	1 6 7

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 9.69 feet | Hole No. CB-PNB- 8

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-11.31	21.0'					BIT OR BARREL Bls/6"
-12.81	22.5'		CLAY, sandy, stiff, yellowish brown and gray, little silt, pebbles, oxidized veins (CL)	100	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 2 5 8
-15.31	25.0'		very stiff, black oxidized veins	100	16	5 8 12
-16.81	26.5'		SAND, fine to medium grained, clayey, little silt, some clay (SC)	100	17	5 10 16
-18.81	28.5'		CLAY, sandy, very stiff, reddish brown and red, little silt, occ. gray and black mottled (CL)	44	18	3 4 7
-23.31	33.0'		CLAY, very stiff, reddish brown, little sand and silt, occ. pale yellow mottled (CH)	100	19	4 8 10
				89	20	4 9 9
				100	21	7 9 14
				56	22	14 15 17
-24.81	34.5'		CLAY, very sandy, very stiff, some rock, decomposed, gravel size, ltt silt, reddish bwn (CL)	67	23	4 9 15
-29.81	39.5'		CLAY, very stiff, reddish brown and olive gray, little sand and silt, occ. brown mottled (CH) some limestone, highly decomposed	100	24	4 7 8
				100	25	11 12 15
				67	26	4 10 18
-33.81	43.5'		SILT, sandy, very stiff, brown and brownish yellow, some clay occ. limestone, gravel size (ML) olive gray and brownish yellow, hard	78	27	7 10 14
				100	28	3 7 13
				100	29	8 12 20
-35.31	45.0'		LIMESTONE, hard, highly decomposed and clayey silt, some sand, olive & white	67	30	14 36 50/4

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 9.69 feet | Hole No. CB-PNB- 8

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc. of significance) g
						BIT OR BARREL
-35.31	45.0'					B1s/6"
-36.81	46.5'		LIMESTONE, hard, highly decomposed, and silt clay, olive & brown, some sand	83	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 28 / 38 / 50/5"
			SILT, clayey, hard, olive and yellowish brown, some sand, little limestone, decomposed (ML)	100	32	30 / 37 / 40
-40.31	50.0'			100	33	17 / 22 / 27
			END 50.0'	28	34	50/5"

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PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB-8

Hole No. CB-PNB- 9

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT: PUERTO NUEVO CHANNEL BRIDGES
2. LOCATION (Coordinates or Station): X= 622263.84 Y= 213201.31
3. DRILLING AGENCY: GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number): CB-PNB- 9
5. NAME OF DRILLER: P. Robles
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: -
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 51 feet
10. SIZE AND TYPE OF BIT: See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES: 2
15. ELEVATION GROUND WATER: -0.74 feet
16. DATE HOLE: STARTED 5-11-89 COMPLETED 5-11-89
17. ELEVATION TOP OF HOLE: 4.76
18. TOTAL CORE RECOVERY FOR BORING: 87.0 %
19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
4.76	0.0					BIT OR BARREL Bls/6"
			FILL material, clay, silty, medium, dark brown, some sand trace rock fragment, gravel size (CL)	100	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 1 2 3
1.76	3.0'			44	2	2 1 1
0.26	4.5'		SILT, sandy, very soft, dark olive gray, some clay, thin roots slightly organic (CL)	39	3	1 WH WH
			CLAY, very soft organic, dark olive gray and black, some silt, little sand (OH)	56	4	WH WH WH
- 2.74	7.5'			50	5	WH WH WH
			CLAY, medium to stiff, slightly organic, little sand and silt, occ. pebbles, black mottled (CH)	100	6	1 2 4
- 5.74	10.5'		some sandy silt & weathered rock, highly decomposed	100	7	3 4 5
			clay, stiff, olive gray some sand, little silt, occ. pebbles, yellowish brown and olive mottled	100	8	4 5 7
			partly sandy, occ. oxidized veins	100	9	3 7 8
				100	10	3 5 7
-11.74	16.5'			100	11	2 5 5
-13.24	18.0'		CLAY, sandy stiff, to very stiff, ltt. silt, trace rock, decomposed, gravel size, brown and gray (CL)	100	12	5 7 8
-14.74	19.5'		black oxidized veins, yellowish brown, browish yellow and brown mottled	72	13	6 8 10
-16.24	21.0'		very sandy, some sand, fine to medium grained	67	14	4 8 9

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 4.76 feet | Hole No. CB-PNR- 9

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-16.24	21.0					Bls/6"
			stiff, reddish brown, little silt, with sand, fine to medium grained, yellow mottled	56	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 5 8 10
				100	16	4 7 10
-19.74	24.5			100	17	2 7 9
-20.74	25.5		CLAY, very stiff, reddish bwn, ltt sand & silt, trace sand(CH)			
-22.24	27.0		SAND, fine to medium grained, partly clayey, some silt, reddish brown (SC)	100	18	5 7 8
			CLAY, very stiff, red and yellowish brown, little sand and silt, black mottled (CH)	100	19	6 8 14
-26.74	31.5			100	20	7 10 14
				100	21	5 9 12
				100	22	10 14 19
-31.24	36.0		hard	100	23	9 16 21
				100	24	7 14 20
				56	25	13 11 9
			reddish brown, gray and brown mottled	100	26	5 10 13
				100	27	6 11 15
				100	28	5 7 9
				100	29	5 6 10
-40.24	45.0			50	30	5 8 10

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 4.76 feet | Hole No. CB-PNB-9

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft)$_a$	DEPTH h	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-40.24	45.0'					Bls/6"
			SAND, fine to coarse grained and silty clay, brown, some rock, decomposed, olive mottled (SC)	50	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 13 10 13
-43.24	48.0'			100	32	16 34 40
			SILT, sandy, very hard, yellowish brown, and olive, some clay little limestone, gravel size (ML)	100	33	44 56 61
-46.24	51.0'			100	34	29 29 35
			END 51.0'			

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PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB-9

Hole No. CB-PNB- 10

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT: PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT: See remarks	
2. LOCATION (Coordinates or Station): X= 622370.94 Y= 213310.29		11. DATUM FOR ELEVATION SHOWN (MSL or MLL): MSL	
3. DRILLING AGENCY: GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55	
4. HOLE NO. (As shown on drawing title and file number): CB-PNB- 10		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED	UNDISTURBED
5. NAME OF DRILLER: P. Robles		14. TOTAL NUMBER CORE BOXES: 2	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: 4.43 feet	
7. THICKNESS OF OVERBURDEN: -		16. DATE HOLE: STARTED 4-21-89	COMPLETED 4-24-89
8. DEPTH DRILLED INTO ROCK:		17. ELEVATION TOP OF HOLE: 14.43	
9. TOTAL DEPTH OF HOLE: 66 feet		18. TOTAL CORE RECOVERY FOR BORING: 83.0 %	
		19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
14.43	0.0					BIT OR BARREL	Bls/6"
12.93	1.5		FILL material, clay, stiff, brown and gray, some sand, little silt, roots, partly organic, pebbles (CL)	67	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	2 2 4
			higher plasticity from 1.5' to 6'	50	2		2 5 7
				67	3		2 4 5
8.43	6.0			67	4		3 3 4
6.93	7.5		sandy, some rock fragments, gravel size from 6' to 7.5'	89	5		5 3 3
			CLAY, soft to medium, dark gray, organic, partly sandy, little silt and fibrous matter (OH)	56	6		1 2 1
3.93	10.5			78	7		2 1 2
2.43	12.0		CLAY, medium, yellowish brown and gray, little sand and silt, slightly organic (CH)	94	8		1 1 1
0.93	13.5		medium to stiff, occ. olive mottled from 12' to 13.5'	100	9		1 2 2
				100	10		1 2 3
				100	11		1 2 3
- 3.57	18.0			94	12		1 3 7
			partly sandy from 18' to 22.5'	67	13		3 6 8
- 6.57	21.0		some oxidized nodules from 19.5' to 21'	100	14		6 8 8

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 14.43 feet | Hole No. CB-PNB- 10

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
						Bls/6"
- 6.57	21.0'					
				67	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 3 / 6 / 10
- 8.07	22.5'					
			CLAY, stiff to very stiff, sandy, some silt, gray mottled, sand, clayey (CL)	100	16	3 / 7 / 14
- 9.57	24.0'					
			SAND fine to medium grained, silty, little clay, reddish brown occ. pebbles (SM)	100	17	8 / 12 / 13
-11.57	26.0'					
			clayey from 26' to 27'	89	18	7 / 7 / 8
-12.57	27.0'					
			CLAY, very stiff, sandy, little silt, reddish brown, some sand fine-grained (CL)	89	19	3 / 6 / 11
-14.07	28.5'					
			SAND, clayey, stiff, reddish brown, some silt, gray mottled sand, medium grained (SC)	89	20	3 / 5 / 10
-16.07	30.5'			100	21	4 / 7 / 13
			CLAY, very stiff, red and brownish yellow, little sand and silt (CH)	72	22	6 / 9 / 15
-18.57	33.0'					
			partly sandy from 33' to 39'	89	23	5 / 10 / 14
				100	24	10 / 13 / 15
				100	25	6 / 12 / 14
-24.57	39.0'			100	26	8 / 11 / 15
				39	27	12 / 15 / 18
-26.07	40.5'					
			some sand, grayish brown and reddish brown	100	28	10 / 14 / 17
				100	29	13 / 16 / 21
-29.07	43.5'					
			CLAY, stiff, sandy, brown, some silt, occ. gray mottled (CL)	83	30	4 / 5 / 8
-30.57	45.0'					

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 14.43 feet | Hole No. CB-PNB-10

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
						Bls/6"
-30.57	45.0'			100	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 3 4 7
				100	32	4 7 8
				100	33	3 9 9
-35.07	49.5'					
-36.57	51.0'		SILT, stiff, clayey, some sand, brown, olive and white, some weathered rock (ML)	100	34	2 2 10
-38.07	52.5'		very stiff to hard, olive and brown	100	35	16 22 23
-39.57	54.0'		some weathered rock frags.	100	36	13 17 40
			CLAY, hard, gravel size rock frags., little sand and silt, brown and olive, white mottled (CL)	61	37	31 70/5"
				61	38	30 70/5"
-44.07	58.5'			89	39	27 50 70
			SILT, hard, sandy, some clay, yellowish brown and olive gray, little gravel size rock fragments (ML)	61	40	30 50/5"
				100	41	32 41 50
-48.57	63.0'			50	42	16 50/3"
			SAND, silty, fine to medium grained, some clay, yellowish brown and olive, very dense (SM)	67	43	33 70
-51.57	66.0'			28	44	75/5"
			END 66.0'			

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PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB-10

Hole No. CB-PNM-45

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT: PUERTO NUEVO CHANNELS
2. LOCATION (Coordinates or Station): X = 622640 Y = 213062
3. DRILLING AGENCY: GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number): CB-PNM-45
5. NAME OF DRILLER: H. González
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 45.0'
10. SIZE AND TYPE OF BIT: See remarks
11. DATUM FOR ELEVATION SHOWN (TBM = MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 30; UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 2
15. ELEVATION GROUND WATER: 5.87 feet
16. DATE HOLE: STARTED 1-2-90; COMPLETED 1-2-90
17. ELEVATION TOP OF HOLE: 9.87 feet
18. TOTAL CORE RECOVERY FOR BORING: 77.7 %
19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
9.87	0.0					BIT OR BARREL Bls/6"
			FILL, concrete and asphalt waste, rock fragments, some sandy clay, brown and gray. (GC)	56	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 17/10/12
6.87	3.0			17	2	14/10/10
5.37	4.5		Clay, stiff, slightly organic, dark olive gray, little sand and silt, olive mottled. (CH)	94	3	2/3/4
				67	4	1/2/3
			gray, brown and olive gray.	78	5	3/3/3
			yellowish brown and gray	100	6	W=43% PI=60% LL=90% (CH) PL=30% 2/3/4
-2.13	10.5			78	7	1/3/3
-3.63	12.0		partly silty	67	8	2/2/3
-5.13	13.5			67	9	3/3/4
-6.63	15.0		Clay, medium, silty, yellowish brown, some sand, oxidized veins gray mottled. (CL)	100	10	1/2/3
-8.13	16.5		soft	100	11	1/1/2
-9.63	18.0			100	12	1/1/2
			clay, very soft, slightly organic, gray, some sand, yellowish brown mottled, partly sandy	100	13	W=44% PI=24% LL=50% (CL) PL=25% 0/0/1
-12.63	21.0		sandy, fine to medium grained.	100	14	1/2/2

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 9.87 feet | Hole No. CB-PNM-45

PROJECT PUERTO NUEVO CHANNELS | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL Bls/6"
-12.63	21.0		sand, silty fine grained, some decayed wood, little clay, olive gray. (SM)	100	15	140# hammer with 30" drop on 1-3/8" ID x 2" OD std. spl. spoon 1 1 1
-15.63	24.0		fine to medium grained, some silty clay, embedded.	56	16	1 1 1
-17.13	25.5		Clay, soft to medium, dark olive gray, little sand and silt. (CH)	44	17	1 1 1
-18.63	27.0		Clay, stiff, silty, reddish brown, gray and olive, some sand, sandy silt, embedded. (CL)	100	18	W=32% PI=25% LL=44% (CL) PL=20% 1 1 3
			sandy	78	19	3 5 7
-21.63	30.0			28	20	3 3 3
-23.13	31.5		stiff	56	21	3 4 6
-24.63	33.0			78	22	4 6 6
-26.13	34.5		very sandy, clayey sand, fine to medium grained, embedded.	78	23	4 5 7
				67	24	4 6 8
				100	25	6 6 9
				100	26	4 6 7
-32.13	40.5		very stiff	72	27	4 7 10
-33.63	42.0		clayey sand, fine grainded	100	28	9 9 9
				50	29	4 4 5
-36.63	45.0		stiff to very stiff.	100	30	6 7 9

ENG FORM 1836-A (ER 1110-1-1801) GPO 1980 OF - 626 - 603

PROJECT PUERTO NUEVO CHANNELS | HOLE NO. CB-PNM-45

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=622,639 Y=213,062
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNM-45D
5. NAME OF DRILLER: PABLO ANDINO
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 70.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 70.0 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: ACKER AD-II
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 22 undisturbed: 1
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 4.5 Ft.
16. DATE HOLE STARTED COMPLETED: 10/06/95 10/06/95
17. ELEVATION TOP OF HOLE: 13.07 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 80.0 %
19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5
13.1	.0					13.1	
			Augered from elevation 13.1 to -32.9 feet. (For description and classification see companion log CB-PNM-45)				
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-PNM-45D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 13.07 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-9.4	22.5						
-32.9	46.0					-32.9	
			SAND, silty, clay traces, medium grained, yellowish olive. (SM)	100	1	SPLIT SPOON	3 5 8
			Trace mica at 48 feet.			-34.4	
				100	2		10 20 30
-[illegible]	48.0					-35.9	
			SAND, coarse grained, quart... pale reddish brown. (SP)	100	3		8 12
						(continued)	

Hole No.CB-PNM-45D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 13.07 Ft.

SHEET 3 OF 3

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/6"
-36.9	50.0						
				100	3	-37.4 "	21
				33	4	"	4 2
						-38.9	2
				100	5	"	6 11
-40.4	53.5					-40.4	23
			LIMESTONE, unconsolidated, highly weathered to decomposed, (sparolite) granular, moderately fossiliferous, sampled as SILT, clayey, little sand, white. (MH)	100	6	"	14 27
			Some gravel size limestone fragments at 55 feet.			-41.9	33
				100	7	"	28 48
-43.4	56.5					-43.4	67
			SANDSTONE, calcareous, medium grained, abundant quartz content, highly weathered to decomposed (saprolite), trace microfossils, some calcite concretions, sampled as SAND, clayey, pale yellow to white. (SC)	100	8	"	24 60 42
						-44.9	
				100	9	"	26 32
						-46.4	40
-47.4	60.5			100	10	"	26 25
			SAND, little silt, highly quartzose, coarse grained, light yellowish olive. (SP)			-47.9	32
			Calcareous at 61 feet.	100	11	"	20 25
			Medium grained quartz sand, moderately calcareous and few microfossils at 63 feet.			-49.4	30
				100	12	"	12 14
						-50.9	14
				100	13	"	14 18
						-52.4	21
-53.4	66.5			100	14	"	19 28
			SANDSTONE, calcareous, medium grained, intermittent weathered, (saprolite) sampled as SAND, clayey, fine to medium grained, moderately quartz, calcareous, pale yellow. (SC)			-53.9	33
				100	15	"	18 30
			Moderately consolidated and higly calcareous at 69 feet.			-55.4	36
				100	16	"	28 36
-56.9	70.0					-56.9	45
			END OF HOLE 70 Ft.				
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)	
						Ground water elevation at the time of drilling was 7.3 feet.	
						LAB CLASSIFICATIONS Elev. (Ft.) Wn LL PL PI	

50 52.5 55 57.5 60 62.5 65 67.5 70 72.5 75 77.5

ENG FORM 1838 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-PNM-45D

Hole No. CB-PNB- 11

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT: PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT: See remarks	
2. LOCATION (Coordinates or Station): X= 622878.55 Y= 212423.87		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME - 45B	
4. HOLE NO. (As shown on drawing title and Site number): CB-PNB- 11		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED	UNDISTURBED
5. NAME OF DRILLER: H. González		14. TOTAL NUMBER CORE BOXES: 2	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: -2.06 feet	
7. THICKNESS OF OVERBURDEN: -		16. DATE HOLE: STARTED 4-25-89 COMPLETED 4-25-89	
8. DEPTH DRILLED INTO ROCK:		17. ELEVATION TOP OF HOLE: 14.94	
9. TOTAL DEPTH OF HOLE: 60 feet		18. TOTAL CORE RECOVERY FOR BORING: 61.0 %	
		19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
14.94	0.0					BIT OR BARREL Bls/6"
13.44	1.5		FILL material, sand, some gravel size rock frags, ltt. clay silt, occ. roots (SM)	17	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 17 12 3
			FILL material, clay, some sand, reddish brown and red, little silt, occ. pebbles (CH)	67	2	3 3 6
			very poor recovery	17	3	6 6 4
				100	4	3 4 5
7.44	7.5			100	5	2 3 6
			CLAY, stiff, dark olive gray, organic, little sand and silt, pebbles black mottled (OH)	100	6	3 4 6
				100	7	2 4 6
2.94	12.0			100	8	2 3 4
			CLAY, medium to stiff, some sand and silt, brown and gray, occ. reddish brown mottled (CH)	100	9	3 3 3
- 0.06	15.0			100	10	2 2 3
- 1.56	16.5		partly sandy	100	11	2 3 3
			SAND, medium to coarse grained, clayey, gray, little silt, trace fine gravel (SC)	67	12	2 6 6
- 4.56	19.5		poor recovery	17	13	1 1 3
			CLAY, soft to medium, dark gray, some sand, little silt, organic (OH)	67	14	1 2 3
- 6.06	21.0					

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 14.94 feet | Hole No. CB-PNB-11

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
						BIT OR BARREL
- 6.06	21.0					B1s/6"
- 7.56	22.5		CLAY, medium, slightly organic, dark olive gray, little sand and silt, occ. pebbles (CH)	67	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 1 / 1 / 2
- 9.06	24.0		some fibrous matter	67	16	1 / 1 / 2
-10.56	25.5			NR	17	WH / WH / 1
-12.06	27.0		SILT, very stiff, sandy, some clay, brownish yellow, trace weathered rock frags. (ML)	68	18	4 / 10 / 11
-13.56	28.5		CLAY, stiff, silty, yellowish brown & olive gray, little sand, occ. pebbles, white mottled (CH)	67	19	2 / 4 / 4
-15.06	30.0		CLAY, very stiff, brownish yellow, weathered rock, frags some sand, gray mottled (CL)	67	20	10 / 16 / 17
-16.56	31.5		SAND, fine to medium grained, very silty, gray and yellow, some clay (SM)	NR	21	7 / 30 / 42
				67	22	17 / 23 / 44
-19.56	34.5			39	23	17 / 24 / 32
			SILT, very hard, sandy, olive gray and yellowish brown, some clay (ML)	39	24	44 / 50/3"
				89	25	12 / 24 / 36
-24.06	39.0			78	26	17 / 31 / 50/4"
-28.56	43.5		little weathered rock frags	44	27	17 / 50/2"
				50	28	18 / 50/3"
				100	29	15 / 22 / 32
-30.06	45.0			100	30	19 / 29 / 34

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 14.94 feet | Hole No. CB-PNB-11

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
						BIT OR BARREL
-30.06	45.0'					Bls/6"
				100	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 24 / 34 / 49
				67	32	29 / 48 / 50/3"
				NR	33	19 / 39 / 50/5"
-34.56	49.5'					
-36.06	51.0'		some weathered rock, partly clayey	56	34	38 / 50/4"
			CLAY, very hard, very sandy, white and very pale yellow, some silt (CL)	67	35	18 / 39 / 50/4"
				11	36	50/2"
				56	37	39 / 50/5"
-40.56	55.5'					
			some weathered rock	11	38	50/3"
				11	39	50/2"
-43.56	58.5'					
-45.06	60.0'		SAND, fine grained, silty, some clay, olive brown and gray, trace pebbles (SM)	56	40	20 / 50/4"
			END 60.0'			

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 OF - 676-603

PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB-11

Hole No.CB-PNB-11D

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 4

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=622,879 Y=212,424
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-11D
5. NAME OF DRILLER: JOSE AYALA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 85.5 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 85.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: ACKER AD-II
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 49 undisturbed: 1
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 9.2 Ft.
16. DATE HOLE STARTED COMPLETED: 09/22/95 09/25/95
17. ELEVATION TOP OF HOLE: 14.91 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 53.4 %
19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
14.9	.0					14.9	
			Augered from elevation 14.9 to -44.6 feet. (For description and classification see companion log CB-PNB-11)				
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

ENG FORM 1838 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT | HOLE NUMBER: CB-PNB-11D

Hole No.CB-PNB-11D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 14.91 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
-7.6	22.5						

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5
50

(continued)

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

APPENDIX B

GEOTECHNICAL DATA

APPENDIX B-1

CORE BORING LOGS AND LABORATORY TESTING RESULTS

Hole No.CB-MC-30

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: MARGARITA CHANNEL, PUERTO NUEVO
2. LOCATION (Coordinates or Station): X=617,252 Y=213,428
3. DRILLING AGENCY: GEO CIM. INC.
4. HOLE NO. (As shown on drawing title and file number): CB-MC-30
5. NAME OF DRILLER: SANTOS RODRIGUEZ
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 67.4 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 67.4 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45D
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 45 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 2
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 7/11/88 COMPLETED: 7/14/88
17. ELEVATION TOP OF HOLE: 9.77 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 82.6 %
19. SIGNATURE OF GEOLOGIST: ALBERTO R. BARRERA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/6"
9.8	.0					9.8	0
			CLAY, little to trace sand, trace gravel, trace roots, medium to stiff, dark yellowish brown. (CL)	100	1	SPLIT SPOON	2, 2, 3
						8.3	
				78	2	"	4, 5, 6 — 2.5
						6.8	
				72	3	"	3, 3, 3
						5.3	
				89	4	"	3, 5, 5 — 5
3.8	6.0					3.8	
			CLAY, trace sand, trace organic matter, soft, dark yellowish brown and olive. (CH)	78	5	"	2, 2, 2 — 7.5
						2.3	
				100	6	"	2, 1, 2
						.8	
				100	7	"	WH, WH, 3 — 10
-.7	10.5					-.7	
			CLAY, little organic matter, very soft, fibrous peat fragments, dark brown to dark gray. (CH)	100	8	"	WH, 1, 1
						-2.2	
				100	9	"	2, 1, 1 — 12.5
						-3.7	
				100	10	"	1, 1, 1
						-5.2	
				100	11	"	WH, WH, 1 — 15
						-6.7	
				100	12	"	WH, 1, 1
						-8.2	
				100	13	"	WH, 1, 1 — 17.5
						-9.7	
				100	14	"	WH, WH, 1 — 20
						-11.2	
				100	15	"	WH, 1, 1
						-12.7	22.5
						(continued)	

Hole No.CB-MC-30

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE 9.77 Ft. | SHEET 2 OF 3

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/6"
-12.7	22.5					-12.7	
						" -13.7	WH 1
				83	16	" -15.2	WH WH 1
			-Medium stiff	78	17	" -16.7	2 3 6
-16.7	26.5						
			CLAY, little to some medium sand, stiff, yellowish brown. (CH)	100	18	" -18.2	4 5 7
				100	19	" -19.7	4 5 8
				100	20	" -21.2	3 4 7
				78	21	" -22.7	5 10 12
-22.7	32.5						
			Clayey medium Sand, medium dense, yellowish brown, oxidized stains. (SC)	67	22	" -24.2	4 5 10
				78	23	" -25.7	5 6 12
				67	24	" -27.2	4 4 5
				78	25	" -28.7	5 7 8
-28.7	38.5						
				78	26	" -30.2	4 5 6
				89	27	" -31.7	5 7 8
			-some medium sand, gray stains.	100	28	" -33.2	3 4 5
-33.2	43.0						
			CLAY, little sand, oxidized stains, brownish yellow, stiff. (CH)	100	29	" -34.7	5 7 9
				100	30	" -36.2	5 8 8
			-some fine to medium sand.	100	31	" -37.7	5 10 10
-37.7	47.5						
			Clayey sand, oxidized stains, loose, yellow. (SC)	100	32	" -39.2	3 3 4
-39.2	49.0						
			Clayey Silt, some calcareous gravel (limestone fragments), little sand, pale yellow. (ML)	39	33	"	3 4
						(continued)	

22.5 · 25 · 27.5 · 30 · 32.5 · 35 · 37.5 · 40 · 42.5 · 45 · 47.5 · 50

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO | HOLE NUMBER: CB-MC-30

Hole No.CB-MC-30

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 9.77 Ft. | SHEET 3 OF 3

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-40.2	50.0						
				39	33	-40.7 "	5
				50	34	" -42.2	2 3 3
				44	35	" -43.7	3 4 7
-43.7	53.5		Clayey Silt, compact but friable, some gravel (limestone fragments), pale yellow. (ML)	78	36	" -45.2	35 49 36
				78	37	" -46.7	15 25 20
				78	38	" -48.2	5 6 37
-48.2	58.0		Calcareous gravel (limestone fragments), little sand and clay, pale yellow. (GC)	50	39	" -49.7	10 32 100
				39	40	" -51.2	40 50 100
				50	41	" -52.7	15 29 40
				50	42	" -54.2	28 30 45
				100	43	" -55.7	100
				100	44	" -57.2	100
-57.6	67.4			100	45	-57.6 "	100

NOTE:
Soils are field visually classified in accordance with the Unified Soil Classification System.

140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)

50 52.5 55 57.5 60 62.5 65 67.5 70 72.5 75 77.5

Hole No.CB-MC-31

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

SHEET 1 OF 1

1. PROJECT: MARGARITA CHANNEL, PUERTO NUEVO
2. LOCATION (Coordinates or Station): X=617,209 Y=213,462
3. DRILLING AGENCY: GEO CIM. INC.
4. HOLE NO. (As shown on drawing title and file number): CB-MC-31
5. NAME OF DRILLER: SANTOS RODRIGUEZ
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 21.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 21.0 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45D
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 14 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 7/14/88 COMPLETED: 7/14/88
17. ELEVATION TOP OF HOLE: 8.88 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 88.5 %
19. SIGNATURE OF GEOLOGIST: ALBERTO R. BARRERA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
8.9	.0					8.9	
			CLAY, trace sand, trace roots, medium stiff, brown. (CL)	100	1	SPLIT SPOON	1, 2, 2
						7.4	
			-little subangular gravel.	44	2	"	1, 2, 3
						5.9	
				50	3	"	2, 2, 2
						4.4	
				44	4	"	2, 3, 2
2.9	6.0					2.9	
			CLAY, soft to very soft, trace roots, brown. (CH)	100	5	"	WH, 1, 1
						1.4	
				100	6	"	1, 1, 1
						-.1	
				100	7	"	WH, WH, WH
-1.6	10.5					-1.6	
			CLAY, trace shell fragments, trace sand, trace organic matter, very soft, olive gray to gray. (CH)	100	8	"	WH, WH, WH
						-3.1	
				100	9	"	WH, WH, WH
						-4.6	
				100	10	"	WH, WH, WH
						-6.1	
				100	11	"	WH, WH, WH
						-7.6	
			-brown	100	12	"	WH, WH, WH
-9.1	18.0					-9.1	
			PEAT, little clay, very soft, dark brown. (PT)	100	13	"	WH, WH, WH
-10.6	19.5					-10.6	
			CLAY, little organic matter, soft, brown. (CH)	100	14	"	WH, 1, 1
-12.1	21.0					-12.1	
			NOTE: Soils are field visually classified in accordance with the Unified Soil Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

HOLE NUMBER: CB-MC-31

Hole No.CB-MC-32

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: MARGARITA CHANNEL, PUERTO NUEVO
2. LOCATION (Coordinates or Station): X=617,172 Y=213,487
3. DRILLING AGENCY: GEO CIM. INC.
4. HOLE NO. (As shown on drawing title and file number): CB-MC-32
5. NAME OF DRILLER: SANTOS RODRIGUEZ
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 51.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 51.0 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45D
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 2
15. ELEVATION GROUND WATER: -2.15
16. DATE HOLE STARTED: 7/28/88 COMPLETED: 7/29/88
17. ELEVATION TOP OF HOLE: 8.35 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 72.2 %
19. SIGNATURE OF GEOLOGIST: ALBERTO R. BARRERA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'	
8.4	.0					8.4		0
			CLAY, little fine sand, trace roots, soft to medium stiff, dark brown. (CL)	33	1	SPLIT SPOON	WH 1 1	
						6.8		
				39	2	"	2 2 3	2.5
5.3	3.0					5.3		
			Fine Sand, some clay, trace roots, loose, olive brown. (SC)	100	3	"	WH WH WH	
3.8	4.5					3.8		
			CLAY, trace fibrous organic matter, soft, dark, yellowish brown. (CL)	100	4	"	WH WH WH	5
2.3	6.0					2.3		
			Medium to coarse Sand, very loose, olive gray. (SP)	39	5	"	WH WH WH	
						.9		7.5
				56	6	"	WH 1 1	
						-.6		
				66	7	"	WH WH WH	10
-2.2	10.5					-2.2		
			CLAY, very soft, trace to little organic matter, little shell fragments, olive gray. (CH)	100	8	"	WH WH 1	
						-3.7		
				100	9	"	WH WH WH	12.5
-5.2	13.5					-5.2		
			PEAT, some clay, fibrous, black. (PT)	78	10	"	WH WH 2	
						-6.6		15
				78	11	"	WH WH 1	
-8.1	16.5					-8.1		
			CLAY, little organic matter, soft, gray. (CH)	100	12	"	2 2 2	
-9.6	18.0					-9.6		17.5
			CLAY, trace to little sand, stiff to very stiff, red and olive, mixed to yellowish brown. (CH)	100	13	"	3 5 7	
-11.1	19.5					-11.1		
			CLAY, little sand, very stiff, yellowish brown red and olive mixed. (CH)	78	14	"	5 7 8	20
						-12.6		
				100	15	"	7 11 17	
						-14.1		22.5
						(continued)		

Hole No.CB-MC-32

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE 8.35 Ft. | SHEET 2 OF 3

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-14.1	22.5					-14.1	22.5
				100	16	"	5, 7, 10
						-15.6	
			-dusky red, oxidized stains.	100	17	"	7, 12, 13 — 25
						-17.1	
				100	18	"	7, 10, 12
						-18.6	
				100	19	"	6, 10, 14 — 27.5
						-20.1	
				100	20	"	7, 10, 12
						-21.6	
				100	21	"	7, 11, 11 — 30
						-23.1	
				100	22	"	5, 7, 10
-24.6	33.0					-24.6	32.5
			CLAY, trace to little sand, stiff to very stiff, brownish yellow. (CH)	100	23	"	5, 9, 13
						-26.1	
				100	24	"	4, 5, 6 — 35
						-27.6	
			-oxidized stains.	100	25	"	5, 5, 8
-29.1	37.5					-29.1	37.5
			CLAY, trace silt, little medium sand, oxidized stains, soft brownish yellow. (CL)	67	26	"	1, 1, 1
-30.6	39.0					-30.6	
			Fine to medium sandy Clay, little silt, oxidized stains, soft to very soft, brownish yellow. (CL)	56	27	"	WH, 1, 1
						-32.2	
				22	28	"	WH, WH, WH
						-33.7	
				44	29	"	WH, WH, WH — 42.5
						-35.2	
				44	30	"	WH, WH, WH
						-36.7	
				39	31	"	WH, WH, WH — 45
						-38.2	
				44	32	"	WH, WH, WH
						-39.7	
				33	33	"	WH, WH, WH — 47.5
						-41.2	
				39	34	"	WH — 50
						(continued)	

Hole No.CB-MC-32

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 8.35 Ft.

SHEET 3 OF 3

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.6"
-41.7	50.0						
				39	34	"	WH
-42.7	51.0					-42.7	WH

NOTE:
Soils are field visually classified in accordance with the Unified Soil Classification System.

140# HAMMER WITH 30" DROP
USED ON 2.0" SPLIT SPOON
(1-3/8 I.D. X 2" O.D.)

50
52.5
55
57.5
60
62.5
65
67.5
70
72.5
75
77.5

Hole No.CB-MC-33

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 3

1. PROJECT: MARGARITA CHANNEL, PUERTO NUEVO
2. LOCATION (Coordinates or Station): X=617,107 Y=213,477
3. DRILLING AGENCY: GEO CIM. INC.
4. HOLE NO. (As shown on drawing title and file number): CB-MC-33
5. NAME OF DRILLER: SANTOS RODRIGUEZ & MARCELINO NEGRON
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 50.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 50.0 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45D
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 2
15. ELEVATION GROUND WATER: -3.49
16. DATE HOLE STARTED: 7/12/88 COMPLETED: 7/13/88
17. ELEVATION TOP OF HOLE: 8.01 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 86.8 %
19. SIGNATURE OF GEOLOGIST: ALBERTO R. BARRERA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.6'
8.0	.0					8.0	
			CLAY, trace sand, trace roots, soft, yellowish brown. (CH)	100	1	SPLIT SPOON	1 1 2
6.5	1.5					6.5	
			CLAY, medium stiff, some subangular gravel, little sand, yellowish brown. (CH)	44	2	"	2 2 3
5.0	3.0					5.0	
			CLAY, trace sand, soft, dark brown. (CH)	44	3	"	2 2 1
3.5						3.5	
				50	4	"	2 1 2
2.0	6.0					2.0	
			CLAY, some silt, little fine sand, trace gravel, soft to medium stiff, red gray and yellowish brown stains. (CL)	44	5	"	2 1 3
.5						.5	
				39	6	"	3 2 2
-1.0	9.0					-1.0	
			CLAY, trace organic matter, soft, brownish olive. (CH)	100	7	"	2 1 1
-2.5	10.5					-2.5	
			CLAY, trace fine sand, soft, trace organic matter, dark brown. (CH)	100	8	"	1 1 1
-4.0						-4.0	
				100	9	"	WH 1 2
-5.5						-5.5	
				100	10	"	1 2 2
-7.0	15.0					-7.0	
			CLAYEY SAND, little organic matter, loose, dark gray and brown. (SC)	100	11	"	2 2 3
-8.5						-8.5	
				100	12	"	2 1 3
-10.0	18.0					-10.0	
			CLAY, some medium sand, oxidized stains, stiff gray. (CH)	100	13	"	3 5 5
-11.5						-11.5	
				83	14	"	WH WH 4
-13.0	21.0		-soft, olive gray.			-13.0	
			CLAY, little to some sand, very stiff, yellow and gray. (CH)	89	15	"	5 6 8
						-14.5	
						(continued)	

0 · 2.5 · 5 · 7.5 · 10 · 12.5 · 15 · 17.5 · 20 · 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO | HOLE NUMBER: CB-MC-33

Hole No.CB-MC-33

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 8.01 Ft.

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5	
-14.5	22.5					-14.5		
				89	16	"	2 5 12	22.5 17
-16.0	24.0					-16.0		
			CLAY, trace gravel, very stiff to hard, red and yellow, gray stains. (CH)	89	17	"	8 10 15	25 25
						-17.5		
				89	18	"	14 15 16	31
-19.0	27.0					-19.0		
			Fine to Medium Sand, little some clay, dense, residual, brownish yellow and gray. (SC)	100	19	"	13 15 19	27.5 34
						-20.5		
				89	20	"	10 16 20	36
-22.0	30.0					-22.0		30
			CLAY, trace sand, very stiff to hard gray, yellow stains to yellowish brown. (CH)	83	21	"	13 15 11	26
						-23.5		
				67	22	"	8 14 17	32.5 31
						-25.0		
				100	23	"	11 15 21	36
						-26.5		
			-oxidized stains.	100	24	"	11 16 17	35 33
						-28.0		
				100	25	"	22 23 25	48
						-29.5		37.5
			-relict structures	89	26	"	10 15 14	29
-31.0	39.0					-31.0		
			CLAY, little medium sand, very stiff, brownish yellow, oxidized stains. (CH)	89	27	"	16 15 14	40 29
-32.5	40.5					-32.5		
			CLAY, very stiff, oxidized stains, yellowish brown. (CH)	83	28	"	10 11 17	28
-34.0	42.0					-34.0		
			Medium Sand, trace clay, medium dense, yellowish brown. (SP)	100	29	"	12 13 12	42.5 25
-35.5	43.5					-35.5		
			Clayey fine to medium Sand, medium dense, yellowish brown. (SC)	100	30	"	6 8 13	21 45
						-37.0		
				100	31	"	7 12 14	26
						-38.5		
				100	32	"	12 12 12	47.5 24
						-40.0		
				100	33	"	7 9 10	19
						-41.5		
-42.0	50.0			100	34	-42.0	" 12	50
						(continued)		

Hole No.CB-MC-33

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 8.01 Ft.

SHEET 3 OF 3

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-42.0	50.0					-42.0	50
			NOTE: Soils are field visually classified in accordance with the Unified Soil Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)	WH WH

52.5 55 57.5 60 62.5 65 67.5 70 72.5 75 77.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

HOLE NUMBER: CB-MC-33

Hole No. CB-MC-41

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT: PUERTO NUEVO CHANNELS
2. LOCATION (Coordinates or Station): x = 617200 y = 213628
3. DRILLING AGENCY: GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number): CB-MC-41
5. NAME OF DRILLER: H. González
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 50.0'
10. SIZE AND TYPE OF BIT: See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 34; UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 2
15. ELEVATION GROUND WATER: -6.59AM -3.09PM
16. DATE HOLE: STARTED 2-20-90; COMPLETED 2-20-90
17. ELEVATION TOP OF HOLE: 11.91 feet
18. TOTAL CORE RECOVERY FOR BORING: 83 %
19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
11.91	0.0					BIT OR BARREL Bls/6"
			FILL rock frags.. gravel size, angular, brown and gray, some sandy clay, little silt, occ. thin roots (GC)	56	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 4 4 4
				44	2	4 5 16
				78	3	7 12 12
5.91	6.0			11	4	9 9 4
4.41	7.5		Clay stiff red and dark gray, little sand and silt, occ. rock frags. gravel size (CL)	89	5	W=29% PI=37% LL=59% (CH) PL=22% 3 4 5
			Clay medium dark grayish brown, little sand and silt, occ. thin roots olive gray mottled, slighlty organic (CH)	100	6	1 2 2
				100	7	1 1 2
			Soft, very dark gray olive mottled	100	8	2 2 2
-0.09	12.0					
			organic verysoft, peat	100	9	1 1 1
			very dark grayish brown and olive	100	10	1 1 1
-3.09	15.0					
			Clay, very soft, slightly organic, olive gray, some silt little sand, occ. shell fragment	100	11	1 1 1
				100	12	1 1 1
-6.09	18.0					
			Clay, soft red and gray little and silt, ox. nodules olive mottled	100	13	W=35% PI=40% LL=67% (CH) PL=27% PUSH PUSH 1
				67	14	PUSH 1 3
-9.09	21.0					

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: 11.91 feet | Hole No. CB-MC-41

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
						Bls/6"
-9.09	21.0					
			red and gray, rust colored oxidized veins (CH) stiff	100	15	140# hammer with 30" drop on 1-3/8" ID :: 2" OD std. spl. spoon 5 7 7
				100	16	4 5 9
			gray, occ. red and olive mottled.	100	17	4 6 8
			very stiff, silty	56	18	8 8 10
-15.09	27.0					
			sandy, some silt	100	19	4 8 8
-16.59	28.5					
			Clay, very stiff, red gray and olive, little sand and silt, partly sandy	100	20	3 5 10
				68	21	2 8 10
				56	22	8 12 16
				100	23	10 12 14
				100	24	8 10 10
-24.09	36.0					
			partly sandy, yellowish brown, red mottled, black veins.	100	25	10 12 14
-25.59	37.5					
				100	26	6 7 19
				78	27	4 6 9
-28.59	40.5					
			some sand, trace calcareous dust (CH)	100	28	4 4 5
-30.09	42.0					
			Clay, soft to medium, sandy brown and yellow some silt, occ. pebbles (CL)	100	29	2 2 4
-31.59	43.5					
			Limestone frags. decomp. yellow sandy silt some clay, occ. black veins.	100	30	6 8 9
-33.09	45.0					

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 11.91 feet | Hole No. CB-MC-41

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-33.09	45.0'					Bls/6"
				67	31	140# hammer with 30" drop on 1-3/8" ID 2" OD std. spl. spoon 22 / 30 / 12
			Some silty clay, very hard	56	32	3 / 50/6"
				44	33	16 / 50/6"
-38.09	50.0'			33	34	50/6"

NOTES:

A. Soils are field visually classified in accordance with the Unified Soils Classification System.

B. After visual classification was performed, Atterberg Limits and Water Contents were obtained from the requested samples and final USCS classifications are shown. Laboratory classification takes precedence over visual classification.

Hole No.CB-MC-51

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=617,062 Y=213,672
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-MC-51
5. NAME OF DRILLER: NICOLAS ANDINO
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 82.5 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 82.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: ACKER AD-II
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 55 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: -0.5 Ft.
16. DATE HOLE STARTED: 10/17/95 COMPLETED: 10/18/95
17. ELEVATION TOP OF HOLE: 0.35 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 78 %
19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
.3	.0					.3	
			SILT, little clay, few roots and other organic matter, dark brown. (ML)	67	1	SPLIT SPOON	1 1 1
						-1.1	
				78	2	"	1 1 1
						-2.7	
-3.7	4.0			89	3	"	1 2 2
			SILT, organic, some peat inclusions, some decayed roots and grass pieces, very dark brown. (OL)			-4.2	
				100	4	"	1 2 3
						-5.7	
				100	5	"	1 WH WH
						-7.1	
-8.6	9.0			100	6	"	WH WH WH
						-8.6	
			SILT, clayey, few decayed roots, olive and light gray. (ML)	100	7	"	WH WH WH
-10.6	11.0					-10.1	
				100	8	"	WH WH 2
			CLAY, silty, red stained, occasional indurated clay pockets, red and light olive gray. (CL)			-11.6	
				78	9	"	4 6 7
						-13.1	
				38	10	"	5 6 8
						-14.6	
				100	11	"	6 10 11
						-16.1	
				100	12	"	7 10 15
						-17.6	
				100	13	"	4 6 10
						-19.1	
				100	14	"	7 9 [illegible]
						-20.6	
				100	15	"	4 8 15
			Some indurated clay pockets at 17 feet.			-22.1	
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-MC-51

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 0.35 Ft.

SHEET 2 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ 5'
-22.1	22.5		~~Trace coarse sand at 23 feet.~~			-22.1	
				100	16	"	10 14 16
						-23.6	
				100	17	"	4 4 5
			Some oxidated particles from 25 to 28 feet.			-25.1	
				78	18	"	4 5 6
						-26.6	
				100	19	"	5 6 7
			Trace oxidation from 29 to 32 feet.			-28.1	
				78	20	"	5 7 10
						-29.6	
				100	21	"	7 9 10
						-31.1	
				100	22	"	11 12 15
						-32.7	
				100	23	"	7 11 13
			Little sand at 35 feet.			-34.2	
				78	24	"	7 8 14
			Sandy from 36 to 38 feet.			-35.7	
				78	25	"	4 6 7
						-37.2	
				58	26	"	5 5 6
-38.7	39.0					-38.7	
			SAND, silty, calcareous, coarse grained, with fine gravel size limestone fragments, brown. (SM)	78	27	"	12 16 21
						-40.2	
				50	28	"	12 27 44
						-41.7	
				39	29	"	16 33 62
						-43.2	
				100	30	"	17 10 12
						-44.7	
				100	31	"	30 19 19
						-46.2	
				100	32	"	21 18 21
						-47.7	
				100	33	"	10 16 12
						-49.2	
				100	34	"	9
						(continued)	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER

Hole No.CB-MC-51

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 0.35 Ft.

SHEET 3 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-49.7	50.0						
			Calcite concretions from 51 to 53 feet.	100	34	-50.7	11 8
				100	35	-52.2	9 9 9
-52.7	53.0						
-53.7	54.0		CLAY, silty, little fine sand, moderately calcareous, brown. (CL)	100	36	-53.7	7 10 11
			LIMESTONE, marly, impure, moderately granular, unconsolidated, few microfissils, sampled as SAND, silty, little clay, calcareous with gravel size limestone fragments, pale yellow to white. (SM)	100	37	-55.2	10 14 24
				100	38	-56.7	21 32 61
				100	39	-58.2	12 16 23
				100	40	-59.7	10 12 14
				100	41	-61.2	12 17 22
			Granular from 61 to 82.5 feet.	100	42	-62.7	18 33 24
				100	43	-64.2	12 23 34
			Calcareous sand pockets at 65 feet.	100	44	-65.7	27 39 47
				100	45	-67.2	32 51 67
				22	46	-68.7	47 50/4
				44	47	-70.2	49 50/2
				22	48	-71.7	50/4
				33	49	-73.2	50/6
				17	50	-74.7	50/3
				17	51	-76.2	50/3
				11	52		50/2

(continued)

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-MC-51

Hole No.CB-MC-51

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 0.35 Ft.

SHEET 4 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.6'
-77.2	77.5						
			Highly impure unconsolitated limestone at 78 feet.	11	52	-77.7 "	
				17	53	" -79.2	50/3
				22	54	" -80.7	50/4
				33	55	" -82.2	50/6
-82.2	82.5		END OF HOLE, 82.5 Ft.				

Soils are field visually classified in accordance with the Unified Soil Classification System.

140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)

Ground water elevation at the time of drilling was -3 feet.

LAB CLASSIFICATIONS

Elev. (Ft.)	Class.	Wn	LL	PL	PI
-1.1	MH	77%	83	39	44
-5.7	MH	83%	85	39	46
-8.6	CH	66%	71	31	40
-13.1	CH	29%	62	28	34

Hole No.CB-MC-52

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

SHEET 1 OF 4

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=616,885 · Y=213,580
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-MC-52
5. NAME OF DRILLER: WILFREDO ANDINO
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 82.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 82 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 55 undisturbed: 1
14. TOTAL NUMBER OF CORE BOXES: 2
15. ELEVATION GROUND WATER: -4.2 Ft.
16. DATE HOLE STARTED: 01/22/96 COMPLETED: 01/22/96
17. ELEVATION TOP OF HOLE: 3.0 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 85.7 % %
19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
3.0	.0					3.0	
1.5	1.5		CLAY, silty, little sand, abundant roots, brown. (CL)	78	1	SPLIT SPOON	3 3 4
			SAND, clayey, little silt, medium to coarse grained, brown. (SC) Few gravel size rock fragments at 2 feet. Some roots at 3 feet.	89	2	1.5 " .0	5 4 3
			Reddish brown	100	3	" -1.5	2 2 4
-3.0	6.0			22	4	" -3.0	4 5 5
-4.5	7.5		CLAY, sandy and gravel size rock fragments, brownish red (CL)	39	5	" -4.5	4 4 4
			SILT, clayey, slightly to moderately organic, few decayed roots, dark gray (MH)	61	6	" -6.0	1 2 1
-7.5	10.5		SAND, silty, little clay, slightly to moderately organic, few decayed roots, dark gray to black. (SM)	100	7	" -7.5	1 1 1
			SILT, sandy, moderately organic, dark gray to black (ML) Damp at 12 feet.	100	8	" -9.0	WH 3 3
			Trace shell fragments at 14 feet.	100	9	" -10.5	3 1 3
				100	10	" -12.0	1 WH 1
				100	11	" -13.5	WH WH 1
-15.0	18.0		Few peat thin lenses and some shell fragments at 17 feet.	100	12	" -15.0	1 1 WH
			SILT, clayey, few peat inclusions, few decayed roots, light gray. (MH)	100	13	" -16.5	WH WH 1
			Trace sand at 21 feet.	100	14	" -18.0	WH 1 1
				100	15	" -19.5	2 1 2
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-MC-52

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 3.0 Ft.

SHEET 2 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ 5"
-19.5	22.5					-19.5	
-21.0	24.0			100	16	"	1 1 2
			SAND, clayey, medium grained, yellowish brownish red (SC)	100	17	-22.5 "	2 5 10
				100	18	-24.0 "	8 12 16
			Trace fine gravel from 28 to 31 feet.	100	19	-25.5 "	9 10 12
				100	20	-27.0 "	7 10 12
				100	21	-28.5 "	8 13 16
-30.0	33.0			100	22	-30.0 "	15 26 22
			CLAY, little silt, red stained, olive and light gray. (CL)	100	23	-31.5 "	3 5 8
			Sandy from 33 to 36 feet.	100	24	-33.0 "	7 10 13
			Trace fine gravel at 36 feet.	100	25	-34.5 "	9 10 12
			Trace sand at 38 feet.	100	26	-36.0 "	10 12 13
			Highly oxidated at 40 feet.	100	27	-37.5 "	4 7 9
				100	28	-39.0 "	6 7 9
				100	29	-40.5 "	7 9 11
				100	30	-42.0 "	8 10 11
			Little sand at 46 feet.	100	31	-43.5 "	10 10 13
-45.0	48.0			100	32	-45.0 "	10 11 8
			SILT, clayey, few decayed roots, light brown. (MH)	100	33	-46.5 "	3 5 6
				100	34	"	5
						(continued)	

Hole No.CB-MC-52

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 3.0 Ft.

SHEET 3 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-47.0	50.0		~~Trace sand at 50 feet.~~				
-48.0	51.0			100	34	" -48.0	6 8
			CLAY, trace fine sand, few decayed roots, yelowish brown. (CL)	100	35	" -49.5	5 7 10
-51.0	54.0		Strongly black mottled with some oxidation at 53 feet.	100	36	" -51.0	6 8 11
			SILT, sandy, calcareous, with gravel size weathered limestone fragments, pale yellow. (ML)	44	37	" -52.5	7 6 5
-54.0	57.0			55	38	" -54.0	6 7 10
			LIMESTONE, impure, granular, unconsolidated, highly weathered to decomposed, sampled as SAND, silty, calcareous, coarse grained, and gravel size limestone fragments, to gray. (SM) Highly weathered from 59 to 63 feet.	100	39	" -55.5	10 10 12
				100	40	" -57.0	15 58 70
				100	41	" -58.5	28 58 40
				77	42	" -60.0	20 40 60
				100	43	" -61.5	24 24 36
				100	44	" -63.0	20 26 38
			Sample as SAND, silty, calcareous, coarse grained, with gravel size limestone fragments. (SM)	100	45	" -64.5	24 32 45
				77	46	" -66.0	28 39 58
				100	47	" -67.5	32 48 56
				100	48	" -69.0	24 38 60
				22	49	-70.5	75/4
				16	50	-71.0 SPLIT SPOON	75/1
				0		CORE DRILLING PULL # 1 RAN=38", REC=0", LOSS=38" WATER LOSS 10% HYD. PRESS. 150 POUNDS	
						(continued)	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-MC-52

Hole No.CB-MC-52

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 3.0 Ft.

SHEET 4 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-74.5	77.5						
			Highly impure limestone with few calcite concretions from 78 to 82 feet.	0		-75.0 "	
				88	53	"	24
							40
						-76.5	55
				77	54	"	32
							43
						-78.0	60
-79.0	82.0			50	55		100/6
						-79.0	
			End of Hole, 82.0 Ft.				
			Soils are field visually classified in accordance with the Unified Soils Classification System.				

140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)

Undisturb-sample was recovered from elevation -19 to -21 feet.

Ground water elevation at the time of drilling was -5.5 ft.

LAB CLASSIFICATIONS

Elev. (Ft.)	Class.	Wn	LL	PL	PI
-36.0	CH	43%	93	39	54
-45.0	MH	51%	93	41	52
-51.0	SC	23%	29	14	15

77.5 80 82.5 85 87.5 90 92.5 95 97.5 100 102.5 105

DRILLING LOG

DIVISION: South Atlantic
INSTALLATION: Jacksonville District

1. PROJECT: MARGARITA CHANNEL, PUERTO NUEVO
2. LOCATION (Coordinates or Station): X=616,786 Y=213,542
3. DRILLING AGENCY: GEO CIM. INC.
4. HOLE NO. (As shown on drawing title and file number): CB-MC-34
5. NAME OF DRILLER: ANTONIO COTTO
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 51.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 51.0 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55D
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 0.00
16. DATE HOLE STARTED: 9/6/88 COMPLETED: 9/7/88
17. ELEVATION TOP OF HOLE: 6.00 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 92.5 %
19. SIGNATURE OF GEOLOGIST: ALBERTO R. BARRERA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
6.0	.0					6.0	
			CLAY, some organic matter, soft, dark brown. (CH)	83	1	SPLIT SPOON	1 2 1
4.5	1.5					4.5	
			Organic Clay, some fibrous organic matter, soft, dark gray. (OH)	100	2	"	1 2 2
						3.0	
			No Recovery	0	3	"	2 2 1
						1.5	
				83	4	"	1 2 1
						.0	
			-very soft.	22	5	"	1 WH 1
						-1.5	
			-little peat, stiff	100	6	"	2 5 7
-3.0	9.0					-3.0	
			Coarse Sand, trace clay, loose, olive gray. (SP)	100	7	"	1 4 2
-4.5	10.5					-4.5	
			CLAY, trace fine sand, soft to very soft, gray. (CH)	56	8	"	1 2 2
						-6.0	
				100	9	"	WH WH WH
						-7.5	
				100	10	"	WH WH WH
						-9.0	
				100	11	"	WH WH WH
						-10.5	
				100	12	"	WH 1 1
						-12.0	
				100	13	"	1 1 1
-13.5	19.5					-13.5	
			CLAY, trace sand, oxidized stains, olive brown to brownish red, stiff to hard. (CH)	100	14	"	2 4 5
						-15.0	
				100	15	"	4 6 9
						-16.5	
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-MC-34

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 6.00 Ft.

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-16.5	22.5					-16.5	
				100	16	" -18.0	9 12 12
				100	17	" -19.5	7 13 14
				100	18	" -21.0	9 13 17
				100	19	" -22.5	11 14 14
				100	20	" -24.0	8 10 13
				100	21	" -25.5	9 11 13
				100	22	" -27.0	10 12 14
				100	23	" -28.5	11 14 16
				100	24	" -30.0	6 8 10
				100	25	" -31.5	10 11 13
-31.5	37.5		SAND, medium dense, clayey fine to medium, oxidized stains, olive yellow. (SC)	100	26	" -33.0	11 11 10
-33.0	39.0		CLAY, trace fine sand, oxidized stains and planes, stiff, yellowish. (CH)	100	27	" -34.5	4 4 4
				100	28	" -36.0	4 5 5
				100	29	" -37.5	4 3 4
-37.5	43.5		Silty Clay, little fine sand, oxidized stains, very soft, pale olive yellowish brown. (CL)	100	30	" -39.0	WH WH 2
				100	31	" -40.5	WH WH 1
-40.5	46.5		CLAY, trace sand, little calcareous gravel, medium to stiff, yellowish brown and pale yellow. (CH)	100	32	" -42.0	2 2 3
				100	33	" -43.5	2 3 3
				100	34	"	5
						(continued)	

Hole No.CB-MC-34

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 6.00 Ft.

SHEET 3 OF 3

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-44.0	50.0						
				100	34	"	8
-45.0	51.0					-45.0	11

NOTE:
Soils are field visually classified in accordance with the Unified Soil Classification System.

140# HAMMER WITH 30" DROP
USED ON 2.0" SPLIT SPOON
(1-3/8 I.D. X 2" O.D.)

50
52.5
55
57.5
60
62.5
65
67.5
70
72.5
75
77.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

HOLE NUMBER: CB-MC-34

Hole No.CB-MC-42

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 3

1. PROJECT: MARGARITA CHANNEL, PUERTO NUEVO
2. LOCATION (Coordinates or Station): X=616,688 Y=213,590
3. DRILLING AGENCY: GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number): CB-MC-42
5. NAME OF DRILLER: T. CABAN
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 55.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45B
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 37 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 2
15. ELEVATION GROUND WATER: -5.49
16. DATE HOLE STARTED: 2/20/90 COMPLETED: 2/20/90
17. ELEVATION TOP OF HOLE: 11.51 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 75.0 %
19. SIGNATURE OF GEOLOGIST: KERMIT SCHMIDT, PE

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
11.5	.0					11.5	
			FILL rock frags., gravel size, brown and gray clay, little sand and silt. (GC)	72	1	SPLIT SPOON	8, 9, 17
						10.0	
				89	2	"	7, 18, 20
8.5	3.0					8.5	
			CLAY, medium, dark olive gray, slightly organic, little sand and silt, trace rock frags. (CH)	72	3	"	2, 3, 4
						7.0	
				89	4	"	2, 2, 6
			trace waste			5.5	
				56	5	"	3, 3, 4
						4.0	
				67	6	"	2, 2, 3
						2.5	
			Clay, soft dark gray, slightly organic, little sand and silt, occ. thin roots brown mottled. (CH)	89	7	"	1, 1, 1
						1.0	
				100	8	"	1, 2, 1
						-.5	
			Clay, soft to medium, gray, some fibrous matter decayed organic	78	9	"	1, 2, 4
-2.0	13.5					-2.0	
			SAND, fine to medium grained, clayey slightly organic, little silt sandy clay occ. fibrous matter. (SC)	100	10	"	2, 3, 4
						-3.5	
				89	11	"	PUSH, PUSH, 3
-5.0	16.5		Very clayey, occ. shell fragments			-5.0	
			CLAY, very soft, sandy, dark gray, slightly organic, some silt. (CH)	17	12	"	1, 1, 1
						-6.5	
				100	13	"	1, 2, 1
			some peat fibrous, partly shelly			-8.0	
				100	14	"	PUSH, 2, 1
						-9.5	
			occ. yellowish brown mottled	100	15	"	PUSH, 2, 1
						-11.0	
						(continued)	

0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO | HOLE NUMBER: CB-MC-42

Hole No.CB-MC-42

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE 11.51 Ft. | SHEET 2 OF 3

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-11.0	22.5					-11.0	22.5
			yellowish brown, olive and gray mottled stiff	100	16	" -12.5	2 3 3 — 6
				78	17	" -14.0	PUSH 2 2 — 25 4
				100	18	" -15.5	4 5 6 — 11
				78	19	" -17.0	6 6 8 — 27.5 14
				78	20	" -18.5	5 6 8 — 14 — 30
				100	21	" -20.0	2 3 5 — 8
			yellowish brown and olive, very stiff, occ. gray mottled red and olive mottled	78	22	" -21.5	6 8 8 — 32.5 16
				78	23	" -23.0	10 10 12 — 22
			some sand	89	24	" -24.5	5 7 10 — 35 17
				67	25	" -26.0	6 8 14 — 22 — 37.5
			stiff	67	26	" -27.5	4 3 8 — 11
				56	27	" -29.0	5 6 8 — 40 14
				39	28	" -30.5	3 5 5 — 10
				89	29	" -32.0	4 5 6 — 42.5 11
-33.5	45.0			72	30	" -33.5	4 6 5 — 11
			CLAY, yellowish brown, stiff sandy, some silt, occ. pebbles. (CL)	56	31	" -35.0	1 3 4 — 45 — 7
-36.5	48.0			56	32	" -36.5	5 6 7 — 47.5 13
			CLAY, very stiff, red, little sand and silt, occ. pebbles, olive mottled. (CH)	56	33	" -38.0	PUSH 5 10 — 15
				61	34	"	5 — 50
						(continued)	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO | HOLE NUMBER: CB-MC-42

Hole No.CB-MC-42

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 11.51 Ft.

SHEET 3 OF 3

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-38.5	50.0						
			some sand	61	34	"	9 10
				56	35	"	5 7 8
			yellowish brown and red.	72	36	"	10 7 7
				44	37	"	10 7 7
-44.0	55.5						

NOTE:

Soils are field visually classified in accordance with the Unified Soil Classification System.

140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)

50 — 52.5 — 55 — 57.5 — 60 — 62.5 — 65 — 67.5 — 70 — 72.5 — 75 — 77.5

19 15 14 14

Hole No. CB-PNB- 37

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT	PUERTO NUEVO CHANNEL BRIDGES	10. SIZE AND TYPE OF BIT	See remarks
2. LOCATION (Coordinates or Station)	X= 616488.44 Y= 213405.76	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
3. DRILLING AGENCY	GLOCONSULT	12. MANUFACTURER'S DESIGNATION OF DRILL	CME - 45B
4. HOLE NO (As shown on drawing title and file number)	CB-PNB- 37	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED	
5. NAME OF DRILLER	H. González	14. TOTAL NUMBER CORE BOXES	2
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER	2.83 feet
7. THICKNESS OF OVERBURDEN	-	16. DATE HOLE: STARTED / COMPLETED	3-20-89 / 3-21-89
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE	16.33
9. TOTAL DEPTH OF HOLE	66 feet	18. TOTAL CORE RECOVERY FOR BORING	64.0 %
		19. SIGNATURE OF INSPECTOR	Kermit Schmidt, PE

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
16.33	0.0					BIT OR BARREL Bls/6"
			FILL material, clay, silty and limestone fragments, gravel size, some sand, light gray and yellow from 0' to 18' (GC)	100	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 3 6 5
				67	2	5 4 3
				28	3	6 5 3
				39	4	2 2 3
				61	5	3 4 3
				33	6	3 3 2
				61	7	1 2 3
				67	8	2 3 4
			from 13.5' to 16.5' brownish yellow and gray	67	9	2 3 4
				67	10	3 5 8
				33	11	3 4 5
- 1.67				28	12	4 4 4
			limestone fragments, gravel size, brownish yellow and gray, some sandy silt, trace clay	33	13	10 100/5"
- 4.67	21.0			44	14	3 100/2"

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 16.33 feet | Hole No. CB-PNB-37

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
						BIT OR BARREL	
- 4.67	21.0'						Bls/6"
- 6.17	22.5'			NR	15	140# hammer with 30/00/0" drop on 1-3/8" ID X 2" OD std. split spoon	
			CLAY, very soft, possibly slightly organic, gray, trace sand and silt, occ. fine gravel and shell fragments (CH)	NR	16		WH WH 1
				100	17		WH WH 1
			from 25.5' to 31.5' soft to medium, olive brown and gray, occ. fibrous matter	100	18	W = 60% LL= 83% PL= 25% PI= 58%	1 1 1
				100	I9		WH WH 1
				100	20		1 1 1
-15.17	31.5'			67	21		1 1 2
			from 31.5' to 37.5' brown and gray, medium to stiff	NR	22		2 3 5
				100	23		2 2 4
			from 34.5' to 36' little sand	100	24		2 2 5
-21.17	37.5'		from 36' to 37.5' partly sandy	100	25		2 4 5
-22.67	39.0'		CLAY, very sandy, medium to stiff, little fine gravel, trace silt, brown, olive (CL)	100	26		6 8 8
			SAND, fine to medium grained, little clay, trace silt, olive gray and browish yellow (SC)	100	27	W = 24%	4 10 10
-25.67	42.0'			100	28		4 8 8
			CLAY, stiff, brown, olive and gray. little sand, trace silt, occ. dark gray mottled (CH)	67	29		6 6 7
-28.67	45.0'			33	30		3 6 8

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 16.33 feet | Hole No. CB-PNB- 37

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
						BIT OR BARREL	
-28.67	45.0'					Bls/6"	
			from 45' to 48' occ. red mottled, stiff to very stiff	67	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	4 12 15
			from 46.5' to 48' sand, fine grained	67	32	W = 26% PI= 36% LL= 54% PL= 18%	5 6 10
-31.67	48.0'						
			clay, stiff, sandy, red and olive, trace silt, trace fine sand	NR	33		4 5 6
			from 51' to 54' medium to stiff	33	34		2 5 8
				6	35		3 3 4
				67	36		4 6 8
-37.67	54.0'						
-39.17	55.5'		from 54' to 55.5' very stiff reddish brown and olive	94	37		4 7 14
-40.67	57.0'		from 55.5' to 57' partly sandy, yellowish brown, trace fine gravel olive gray and black mottled	100	38	W = 36% PI= 43% LL= 61% PL= 18%	6 11 14
				67	39		4 6 11
-43.67	60.0'			67	40		5 12 15
			CLAY, stiff. olive and light gray, some limestone, gravel size, trace sand and silt (GC)	100	41		10 14 22
				100	42	W = 15%	14 20 33
			from 63' to 66' more gravelly	100	43		20 25 28
				67	44		21 24 31
-49.67	66.0'						
			END 66.0'				

Hole No. CB-PNR-38

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT See remarks	
2. LOCATION (Coordinates or Station) X= 616585,.25 Y= 213421.77		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL CME - 45 B	
4. HOLE NO. (As shown on drawing title and file number) CB-PNR- 38		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED	UNDISTURBED
5. NAME OF DRILLER L. Olivo		14. TOTAL NUMBER CORE BOXES 2	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 0.26 feet	
7. THICKNESS OF OVERBURDEN 62.0 feet		16. DATE HOLE STARTED 3-17-89 COMPLETED 3-20-89	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE 18.26	
9. TOTAL DEPTH OF HOLE 66 feet		18. TOTAL CORE RECOVERY FOR BORING 63.0 %	
		19. SIGNATURE OF INSPECTOR Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
+18.26	0.0					BIT OR BARREL B1s/6"
			FILL material, limestone fragments, gravel size, some clay, medium, brown, little silt, trace sand. (GC) from 0' to 24'	50	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 3 4 5
				33	2	3 6 10
				50	3	17 21 17
+13.76	4.5'		clay, medium to stiff and limestone fragments, gravel size, trace sand and silt, reddish brown from 4.5' to 7.5'	39	4	9 18 9
				39	5	5 10 50/4
+10.76	7.5'		rock fragments, gravel size gray, little clay, brown, trace sand from 7.5' to 18'	39	6	10 12 15
				28	7	8 6 6
				33	8	6 6 20
+ 6.26	12.0'		from 12' to 18' more clayey	28	9	6 9 9
				100	10	4 7 6
				83	11	6 7 10
				33	12	12 9 6
+ 0.26	18.0'		rock fragments, gravel size some sandy clay, soft, slightly organic, little silt, gray and brown from 19.5' to 21' very wet	44	13	6 15 12
- 1.24	19.5'			50	14	5 10 9
- 2.74	21.0'					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT PUERTO NUEVO CHANNEL BRIDGES HOLE NO. CB-PNR- 38

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 18.26 feet | Hole No. CB-PNB- 38

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc.; if significant) g
						BIT OR BARREL Bls/6"
- 2.74	21.0					
			rock fragments, gravel size, gray and dark gray, some sandy clay, little silt, occ. yellow mottled, organic	61	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 3 / 33 / 50
- 5.74	24.0			NR	16	8 / 10 / 7
			CLAY, very soft, possibly organic, gray, trace sand and silt, trace fibrous matter, occ. shell fragments (OH)	83	17	W = 53% PI= 51% LL= 75% PL= 24% 1 / 1 / 1
- 8.74	27.0			NR	18	WH / 1/12 / 1
			from 27' to 28.5' sandy, possibly slightly organic	56	19	1 / 1 / 3
-10.24	28.5					
			from 28.5' to 31.5' very sandy	94	20	1 / 5 / 3
-11.74	30.0					
			from 30' to 30.5' sand, fine to medium, gray	50	21	1 / 2 / 1
-13.24	31.5					
			CLAY, medium, olive brown and gray, trace sand and silt, dark gray and dark brown mottled (CH)	44	22	1 / 2 / 3
				61	23	1 / 2 / 3
-16.24	34.5					
			from 34.5' to 37.5' partly sandy, medium to stiff	56	24	1 / 3 / 5
				83	25	2 / 2 / 6
-19.24	37.5					
				61	26	6 / 9 / 10
-20.74	39.0					
			from 39' to 45' olive and red, occ. gray mottled, very stiff	50	27	5 / 9 / 10
				94	28	6 / 12 / 15
				67	29	10 / 16 / 20
				83	30	6 / 12 / 15
-26.74	45.0					

ENG FORM 1836-A JUN 67 (EN 1110-1-1801) GPO 1967 O-628-603

PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB-38

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 18.26 feet | Hole No. CB-PNB- 38

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft)$_a$	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV ERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc. - if significant) g
						BIT OR BARREL
						Bls/6"
-26.74	45.0'					
			from 45' to 48' some sand, fine to medium grained, stiff	89	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 3 6 8
				100	32	3 3 4
-29.74	48.0'					
			from 48' to 51' partly sandy, stiff	83	33	3 4 5
				100	34	3 4 5
-32.74	51.0'					
			clay, stiff, little silt and, sand, olive brown, occ. red mottled, pebbles	100	35	3 5 9
				94	36	W = 25% PI= 35% LL= 56% PL= 21% 4 4 7
				NR	37	4 6 7
-37.24	55.5'					
			from 55.5' to 58.5' sandy, red mottled	94	38	5 10 14
-38.74	57.0'					
				100	39	8 12 15
-40.24	58.5'					
			clay, very stiff, little sand, trace sand, olive, olive gray and brownish yellow mottled, occ. black oxidized veins, from 58.5' to 62'	100	40	7 8 12
				89	41	5 10 15
-43.74	62.0'					
			LIMESTONE, gravel size, highly decomposed, gray and brownish yellow	100	42	6 15 20
				67	43	W = 20% 20 10 25
-47.74	66.0'					
				83	44	20 22 34
			END 66.0'			

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 OF - 620 - 603

PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB-38

Hole No. CB-PNB-39

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT: PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT: See remarks	
2. LOCATION (Coordinates or Station): X= 616412.51 Y= 213217.94		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): NSL	
3. DRILLING AGENCY: GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME - 45B	
4. HOLE NO. (As shown on drawing title and file number): CB-PNB- 39		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED	
5. NAME OF DRILLER: L. Olivo		14. TOTAL NUMBER CORE BOXES: 3	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: 1.59 feet	
7. THICKNESS OF OVERBURDEN: 63.0 feet		16. DATE HOLE: STARTED 3-21-89 / COMPLETED 3-22-89	
8. DEPTH DRILLED INTO ROCK:		17. ELEVATION TOP OF HOLE: 18.59	
9. TOTAL DEPTH OF HOLE: 66 feet		18. TOTAL CORE RECOVERY FOR BORING: 69.0 %	
		19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	Blows/6"
+18.59	0.0					BIT OR BARREL	Bls/6"
+17.09	1.5		FILL material, asphalt and rock frags. gravel size, some sand black and gray (GP)	89	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	15 39 8
+14.09	4.5		FILL material, clay, medium, and rock frags. gravel size, some sand, trace silt, yellowish brown, occ. gray mottled, from 1.5' to 4.5' (GC)	67	2		9 9 5
				67	3		5 4 9
+ 9.59	9.0		limestone frags. gravel size, some clay, red & yellowish brown from 6' to 9' yellowish brown, occ. gray mottled	39	4		7 8 9
				89	5		8 5 8
+ 6.59	12.0		from 9' to 12' more clayey	89	6		9 4 6
				89	7		3 4 5
+ 5.09	13.5		rock frags. gravel size, clean from 12' to 13.5'	56	8		11 9 11
				11	9		17 11 11
			rock frags. gravel size, dark brown, some sandy clay, trace silt from 13.5' to 19.5'	44	10		7 8 7
				39	11		3 4 5
				44	12	W = 23%	4 4 4
- 0.91	19.5		from 18' to 19.5' more clayey slightly organic, gray, soft	33	13		2 1 1
- 2.41	21.0		CLAY, soft, very dark brown and gray, some peat, fibrous, trace sand and silt (OH)	100	14		WH 1 2

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 18.59 feet | Hole No. CB-PNB-39

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. If significant) g	
- 2.41	21.0'					BIT OR BARREL	Bls/6"
- 3.91	22.5'		as above, CLAY, slightly organic, soft, gray & brown, trace fibrous matter (CH)	17	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	1 1 1
- 5.41	24.0'		SAND, fine to coarse grained, little clay, gray, slightly organic (SC)	50	16		6 WH 1
			CLAY, soft, partly sandy and shelly, organic, trace sand, trace fibrous matter (OH)	100	17	W =56%	WH 1 1
- 8.41	27.0'		from 24' to 27'	100	18		WH WH 1
			CLAY, medium, olive and gray trace sand and silt, occ. pebbles (CH)	100	19		1 1 2
			from 27' to 34.5'	94	20	W = 41% PI= 35% LL= 59% PL= 24%	1 2 1
				100	21		2 2 2
				100	22		2 2 3
-15.91	34.5'			100	23		1 2 2
			from 34.5' to 36' gray, sandy occ. olive mottled	100	24		2 1 2
-17.91	36.5'		from 36.5' to 42' partly sandy, stiff to very stiff	100	25		2 2 4
				100	26		2 4 5
				100	27		2 5 7
				100	28	W = 23% PI= 34% LL= 57% PL= 23%	4 7 13
-23.41	42.0'		cl . sandy, stiff to very st. f olive and gray, little silt, occ. brown mottled	44	29		5 9 9
-24.91	43.5'						
-26.41	45.0'		SAND, fine to medium grained, clayey, little silt, yellowish brown & gray (SC)	100	30		3 4 4

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 18.59 feet | Hole No. CB-PNB- 39

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft)a	DEPTH h	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
						Bls/6"
-26.41	45.0'					
				28	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 2 2 3
			very clayey from 46.5' to 48'	67	32	3 4 8
-29.41	48.0'					
			SAND, fine to medium grained, brownish yellow, occ. gray mottled, trace silt, trace fine gravel (SP) from 49.5' to 52.5' little to some fine gravel	100	33	4 7 18
				67	34	6 6 7
				100	35	16 22 18
-33.91	52.5'					
			CLAY, very stiff, sandy, little limestone, gravel size, angular, trace silt, brown and gray (SC) from 52.5' to 55.5'	72	36	W = 18% 5 16 16
				56	37	13 16 19
-36.91	55.5'					
			CLAY, very stitt to hard, yellowish brown and red, some sand, trace silt, occ. pebbles (CH) from 57' to 61.5' sandy	44	38	8 15 22
				NR	39	8 9 13
				56	40	7 15 20
				100	41	9 18 24
-42.91	61.5'					
			clay, very stiff, yellow, partly sandy, trace silt, olive gray, and red mottled, from 61.5' to 63'	83	42	8 6 14
-44.41	63.0'					
			LIMESTONE, highly decomposed, white and yellow, some clay, trace sand, poor recovery	NR	43	50 50/2"
				17	44	100/3"
-46.16	64.75'					
			END 64.75'			

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 OF - 626 - 663

PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB-39

Hole No. CB-PNB-40

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT See remarks	
2. LOCATION (Coordinates or Station) X= 616544.30 Y= 213234.05		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL CME - 55	
4. HOLE NO. (As shown on drawing title and file number) CB-PNB-40		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED	UNDISTURBED
5. NAME OF DRILLER P. Robles		14. TOTAL NUMBER CORE BOXES 2	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 2.34 feet	
7. THICKNESS OF OVERBURDEN 63.0 feet		16. DATE HOLE STARTED 3-20-89 COMPLETED 3-23-89	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE 17.34	
9. TOTAL DEPTH OF HOLE 65 feet		18. TOTAL CORE RECOVERY FOR BORING 70.0 %	
		19. SIGNATURE OF INSPECTOR Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
+17.34	0.0					BIT OR BARREL Bls/6"
			FILL material, clay, silty & limestone frags., gravel size little sand, white & yellow (GC)	100	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 4 4 5
			rock frags. gravel size, brown, some sandy, clay, trace silt	100	2	14 10 11
			from 3' to 13.5' gray and brown	44	3	W = 11% 15 12 10
				67	4	4 4 5
				94	5	2 3 2
				33	6	2 4 7
				NR	7	3 3 2
			from 10.5' to 12' very poor recovery	17	8	3 2 2
			from 12' to 13.5' very clayey	56	9	4 5 5
+ 3.84	13.5		clay, medium, brown, some rock frags., gravel size, trace sand and silt	100	10	4 4 3
				89	11	2 3 2
			from 16.5' to 18' poor recovery	22	12	5 9 7
- 0.66	18.0		CLAY, dark gray, very soft, organic, some sand, medium grained, organic, little silt & fibrous matter from 18' to 21' (OH)	100	13	3 1 1
				89	14	1 1 1
- 3.66	21.0					

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PROJECT PUERTO NUEVO CHANNEL BRIDGES HOLE NO. CB-PNB-40

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 17.34 feet | Hole No. CB-PNB-40

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft), a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
						BIT OR BARREL
						Bls/6"
- 3.66	21.0'		SAND, fine to medium grained, gray, slightly organic, clayey, trace silt, little fibrous matter (SC)	56	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 4 4 11
- 7.16	24.5'		CLAY, very, soft, very sandy and shelly, organic, gray some silt (OH)	NR	16	4 7 6
- 9.66	27.0'		decayed fibrous matter	100	17	1 1 1
			CLAY, gray, soft to medium, possibly slightly organic, little sand, trace silt, dark gray mottled (CH)	100	18	WH 2 2
				100	19	1 1 3
				67	20	W = 55% PI= 46% LL= 68% PL= 22% WH 1 2
			from 30' to 31.5' partly sandy	100	21	WH WH 3
			from 31.5' to 33' olive and gray	44	22	2 2 3
			from 33' to 36' yellowish brown, medium to stiff, gray mottled	100	23	2 2 4
				100	24	3 3 6
			from 36' to 37.5' gray, stiff, brown and yellow mottled	100	25	3 4 5
-21.66	39.0'		from 37.5' to 39' yellowish brown and olive gray	100	26	4 5 9
			clay, very stiff, partly sandy, olive and red, little silt occ. pebbles	NR	27	3 6 10
-24.66	42.0'			100	28	4 6 10
-26.16	43.5'		SAND, medium grained, & clay, little silt, red, occ. pebbles olive mottled (SC)	100	29	6 6 6
-27.66	45.0'		CLAY, stiff, reddish brown & olive, sandy, little silt, occ pebbles (CL)	50	30	5 4 8

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 19.17 feet | Hole No. CB-PNB- 40

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc. - if significant) g
						BIT OR BARREL
-27.66	45.0'		from 45' to 51' some sand, medium grained	39	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 2 3 3
				33	32	3 3 4
				50	33	3 5 6
-33.66	51.0'			50	34	4 4 6
			CLAY, stiff, olive and gray, little sand, trace silt, brown mottled (CH)	100	35	W = 25% PI= 41% LL= 60% PL= 19% 4 5 8
				100	36	5 7 8
			from 54' to 55.5' some sand & partly sandy, red olive and gray, very stiff	100	37	8 14 22
			from 55.5' to 58.5' some sand medium grained black	44	38	8 12 8
				39	39	4 10 10
-41.16	58.5'					
			clay, very stiff, brownish yellow and olive gray, little sand and silt, black veins, from 60' to 63'	100	40	6 7 9
				100	41	5 7 10
				100	42	6 8 10
-45.66	63.0'					
			LIMESTONE, highly decomposed, and silty clay, white and yellow, little sand	83	43	8 15 50
-47.66	65.0'		from 63' to 65'			
			END 65.0'	28	44	50/5"

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PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB- 40

Hole No. CB-MC-43

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT	PUERTO NUEVO CHANNELS
2. LOCATION (Coordinates or Station)	X = 615881 Y = 213031
3. DRILLING AGENCY	GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number)	CB-MC-43
5. NAME OF DRILLER	H. Gonzalez
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	51.0'
10. SIZE AND TYPE OF BIT	See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-45
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 34 / UNDISTURBED
14. TOTAL NUMBER CORE BOXES	2
15. ELEVATION GROUND WATER	4.60 feet
16. DATE HOLE	STARTED 1-29-90 / COMPLETED 1-30-90
17. ELEVATION TOP OF HOLE	10.60 feet
18. TOTAL CORE RECOVERY FOR BORING	77 %
19. SIGNATURE OF INSPECTOR	Kermit Schmidt, PE

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
10.60	0.0					BIT OR BARREL Bls/6"	
			FILL, clay stiff, dark brown some limestone, gravel size little sand and silt, shells (CL)	44	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon	7 7 7
7.60	3.0		reddish brown	67	2		7 4 4
6.10	4.5		limestone frags., gravel size, light brown and clay, reddish brown, little sand and silt (GC)	33	3		4 5 2
4.60	6.0'		Clay, medium brown and gray, little sand and silt, clayey sand fine grained (CL)	61	4		2 2 3
			Clay, soft slightly organic, gray and dark gray, little sand and silt, olive mottled (CH)	78	5		1 1 2
1.60	9.0		very soft	22	6		0 0 1
			organic, decayed fibrous matter (OH)	100	7		0 0 1
-1.40	12.0		some sand, medium grained, gray and dark gray	100	8	W=76% PI=61% LL=92% (OH) PL=31%	0 0 1
			Clay very soft, gray and dark gray, little sand and silt, occ. decayed roots, brown mottled (CH)	100	9		0 0 1
-4.40	15.0			100	10		1 1 1
-5.90	16.5		brown, olive and gray	100	11	W=43% PI=57% LL=81% (CH) PL=24%	1 1 1
			medium	100	12		3 3 3
				100	13		2 3 4
-10.40	21.0			100	14	W=35% PI=46% LL=69% (CH) PL=23%	2 3 4

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PROJECT PUERTO NUEVO CHANNELS | HOLE NO. CB-MC-43

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 10.60 feet	Hole No. CB-MC-43
PROJECT PUERTO NUEVO CHANNELS	INSTALLATION JACKSONVILLE DISTRICT	SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL Bls/6"
-11.90	22.5		partly sandy	67	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 3 4 7
-13.40	24.0		clay, sandy, very stiff, brown, olive and gray, little silt, occ. red mottled. (CL)	78	16	5 8 12
			very sandy, red and olive	94	17	W=16% PL=15% LL=36% PI=21% 4 7 8
			some sand	78	18	5 10 7
-17.90	28.5		partly sandy	100	19	5 6 10
			sand, clayey, fine to medium grained, olive and gray, little silt, brown mottled. (SC)	100	20	4 3 5
			some very sandy clay, occ. rock fragments, gravelsize	100	21	4 4 11
-22.40	33.0		very clayey	78	22	6 12 12
			Clay, sandy, very stiff, reddish, brown and gray, little silt, occ. pebbles, olive mottled (CL)	100	23	7 7 12
			very sandy	72	24	7 7 10
-26.90	37.5		occ. black mottled.	67	25	10 12 15
			Clay, very stiff, yellow, little sand and silt, partly sandy, olive gray mottled (CH)	94	26	7 8 9
			stiff, yellowish brown and olive gray, occ. black veins.	100	27	3 4 5
				100	28	5 6 7
				67	29	6 8 8
-34.40	45.0			72	30	8 25 30

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 10.60 feet | Hole No. CB-MC-43

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-34.40	45.0					Bls/6"
-35.90	46.5		Clay, some limestone hard, highly decomposed, brown and and pale yellow, some sand, white mottled. (CL)	17	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 50/6"
-37.40	48.0		limestone, very hard, highly decomposed, gravel size, pale yellow and white, some clay little sand (GC)	6	32	50/1"
			Clay, hard silty yellowish brown, and intensely weathered rock, highly decomposed, little sand (CL)	33	33	50/6"
-40.40	51.0			100	34	15 15 35

Soils are field visually classified in accordance with the Unified Soils Classification System.

After visual classification was performed, Atterberg Limits and Water Contents were obtained from the requested samples and the results and final USCS classifications are shown. Laboratory classification takes precedence over visual classification.

Hole No. CB-MC-44

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT: PUERTO NUEVO CHANNELS
2. LOCATION (Coordinates or Station): X = 615530 Y = 212819
3. DRILLING AGENCY: GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number): CB-MC-44
5. NAME OF DRILLER: H. González
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 51.0'
10. SIZE AND TYPE OF BIT: See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 34; UNDISTURBED 1
14. TOTAL NUMBER CORE BOXES: 2
15. ELEVATION GROUND WATER: 4.27 am 2.27 pm
16. DATE HOLE: STARTED 1-30-90; COMPLETED 1-31-90
17. ELEVATION TOP OF HOLE: 7.91 feet
18. TOTAL CORE RECOVERY FOR BORING: 77 %
19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	Blows
7.91	0.0'					BIT OR BARREL	Bls/6"
			FILL clay, soft, sandy dark grayish brown, some silt trace pebbles occ. waste (CL)	72	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon	1 1 1
4.91	3.0'		soft to medium	67	2		1 2 2
			Clay, soft to medium, gray, some sand and silt, reddish yellow mottled. (CL)	89	3		2 2 2
1.91	6.0'		partly plastic, dark gray	78	4		2 2 2
			Clay, medium, some sand gray, little silt, occ. pebbles, brown, olive and dark gray mottled (CH)	100	5	W=39% PI=39% LL=66% (CH) PL=27%	2 2 2
				100	6		2 2 2
-2.59	10.5'		soft	78	7		1 1 1
			silty, partly sandy	100	8		1 1 1
-5.59	13.5'			67	9		0 0 1
			Clay, very soft, some sand gray, little silt, red and olive mottled (CH)	31	10		0 0 1
			Partly sandy, medium red and gray, occ. yellowish mottled	100	11		1 1 5
-10.09	18.0'		very stiff	78	12		5 7 12
			partly very sandy red and gray.	67	13		6 7 8
-11.59	19.5'						
-13.09	21.0'		Sand fine, to medium grained clayey, little silt, occ. pebbles (SC)	78	14		6 9 14

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 7.91 feet | Hole No. CB-MC-44

PROJECT PUERTO NUEVO CHANNELS | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-13.09	21.0					B1s/6"
-14.59	22.5		Clay stiff olive gray and yellow, some sand, littlesilt, trace gr. (CH)	78	15	140# hammer with 30" drop on 1-3/8" ID 2" OD std. spl. spoon 7 7 8
			Clay, stiff, silty, some weathered rock frags. gravel size, white and yellow, little sand, oxidized veins (CL)	78	16	4 4 7
				50	17	7 9 10
-19.09	27.0			72	18	7 10 12
			trace rock frags., grvel size	78	19	3 5 6
				67	20	6 7 8
-23.59	31.5			56	21	8 8 9
-25.09	33.0		Clay, very stiff, silty white and yellow, some rock frags., gravel size little sand	100	22	21 21 21
-26.59	34.5		very hard	33	23	50/6"
			Caliche decomposed into silt, hard clayey, highly cemented, some sand yellow occ. white mottled (ML)	100	24	13 29 34
				100	25	W=20% PI=25% LL=41% (CL) PL=16% 11 12 26
				100	26	26 30 41
-32.59	40.5			67	27	16 23 36
			gray and yellow, occ. white mottled, very hard	67	28	14 25 50/3"
-35.59	43.5		partly cemented	56	29	40 50/5"
-37.09	45.0		Sand silty, olive gray and brown, fine grained, some clay (SM)	31	30	(SM) 50/6"

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 7.91 feet | Hole No. CB-MC-44

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-37.09	45.0					BIT OR BARREL Bls/6"
-38.59	46.5		silt, very sandy gray and brownish yellow, some clay occ. pebbles (ML)			140# hammer with 30" drop on 1-3/8" ID x 2" OD std. spl. spoon 14 22 20
-41.59	49.5		Sand, silty fine grained partly cemented, little clay, brown and olive gray (SM)			19 33 38 17 30 38
-43.09	51.0		Silt, some sand and clay, olive, partly cemented, brownish yellow mot. (ML)			20 25 38
			An undisturbed sample was recovered at a depth of 11-13.5' with a 5-in. thin-walled sampler. Soils are field visually classified in accordance with the Unified Soils Classification System. After the visual classification was performed, Atterberg Limits and Water Contents were obtained from the requested samples and the results and final USCS classifications are shown. Lab classification takes precedence over visual classification.			

Hole No. CB-MC-45

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT: PUERTO NUEVO CHANNELS
2. LOCATION (Coordinates or Station): X = 615054 Y = 212529
3. DRILLING AGENCY: GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number): CB-MC-45
5. NAME OF DRILLER: J. Nieves
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 60.0'
10. SIZE AND TYPE OF BIT: See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45B
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 39; UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 2
15. ELEVATION GROUND WATER: 0.31 feet
16. DATE HOLE: STARTED 2-7-90; COMPLETED 2-8-90
17. ELEVATION TOP OF HOLE: 13.31 feet
18. TOTAL CORE RECOVERY FOR BORING: 72 %
19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
13.31	0.0					BIT OR BARREL Bls/6"
			Clay medium gray, little sand and silt, occ. pebbles, yellowish red and brown mottled (CH)	56	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 3 3 3
				NR		2 4 6
8.81	4.5		partly sandy, stiff	100	2	4 5 6
			medium	67	3	1 1 2
5.81	7.5			67	4	1 2 2
			Sand, fine grained, yellowish brown and gray, clayey, little silt (SC)	44	5	1 2 1
				44	6	1 1 3
				100	7	1 2 1
				56	8	1 4 4
				67	9	3 4 3
				67	10	3 2 2
-4.69	18.0			100	11	2 1 1
-6.19	19.5		trace fine gravel, sub-angular, occ. fibrous matter (SC)	56	12	2 1 1
-7.69	21.0		Clay, soft slightly org some sand, olive and gray sand fine gravel (CL)	67	13	2 1 2

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 13.31 feet | Hole No. CB-MC-45

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
						BIT OR BARREL	
-7.69	21.0					Bls/6"	
			Sand, fine grained, clayey gray little silt, olive mottled (SC)	67	14	140# hammer with 30" drop on 1-3/8" ID & 2" OD std. spl. spoon	2 1 1
-9.19	22.5						
			Caliche decomposed into silt, hard clayey, olive and yellow, some sand, partly cemented, occ. white mottled (ML)	67	15		4 18 22
				100	16	W=21% PI=25% LL=43% (CL) PL=18%	4 12 22
				100	17		9 15 22
				100	18		18 47 37
				100	19		8 18 19
-16.69	30.0						
			Sand, fine grained, clayey, olive and pale yellow, some silt, partly cemented, (SC)	100	20		5 22 50/2"
			poor recovery	28	21		50/5"
-19.69	33.0						
			Silt, hard very sandy olive and brownish yellow, some clay, occ. pebbles (ML)	100	22	W=18% PL=18% LL=32.4% PI=14.4% (CL)	12 22 22
			partly cemented	100	23		8 22 29
				100	24		18 22 40
				94	25		16 22 60/5"
-25.69	39.0						
			sand, fine grained	100	26		22 26 25
				67	27		13 21 30
				100	28		14 22 30
				100	29		7 22 50
-31.69	45.0						

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PROJECT: PUERTO NUEVO CHANNELS | HOLE NO. CB-MC-45

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 13.31 feet | Hole No. CB-MC-45

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-31.69	45.0'					Bls/6"
			highly cemented, pale olive, white mottled	28	30	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 50/3"
-34.69	48.0'		very hard	67	31	25 50/2"
			very hard, highly cemented white	17	32	50/3"
-37.69	51.0'			67	33	W=18% PI=25% LL=40% (CL) PL=15% 14 50/2"
			pale olive gray, occ. yellow mottled	28	34	50/5"
				17	35	50/3"
-42.19	55.5'		very sandy, olive	22	36	50/4"
-43.69	57.0'		Sand, silty, gray, partly cemented, shelly, little clay (SM)	56	37	30 50/3"
			Clay, very hard, silty dark gray little sand, slightly cemented, very dark gray mottled (CL)	100	38	20 32 50/5"
-46.69	60.0'		partly sandy, occ. white mottled	100	39	20 30 50/5"
			Soils are field visually classified in accordance with the Unified Soils Classification System. After visual classification was performed, Atterberg Limits and Water Contents were obtained from the requested samples and the results and final USCS classifications are shown. Lab classifications take precedence over visual classification.			

Hole No. CB-MC-46

DRILLING LOG | DIVISION: SOUTH ATLANTIC | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 1 OF 3 SHEETS

1. PROJECT	PUERTO NUEVO CHANNELS
2. LOCATION (Coordinates or Station)	X = 614770 Y = 212140
3. DRILLING AGENCY	GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number)	CB-MC-46
5. NAME OF DRILLER	H. González
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	55.5'
10. SIZE AND TYPE OF BIT	See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-55
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 37 / UNDISTURBED
14. TOTAL NUMBER CORE BOXES	2
15. ELEVATION GROUND WATER	-0.97(1-25) 11.03(1-26)
16. DATE HOLE	STARTED 1-25-90 / COMPLETED 1-26-90
17. ELEVATION TOP OF HOLE	11.03 feet
18. TOTAL CORE RECOVERY FOR BORING	65 %
19. SIGNATURE OF INSPECTOR	Kermit Schmidt, PE

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	Blows/6"
11.03	0.0					BIT OR BARREL	Bls/6"
9.53	2.0		FILL, clay, soft some rock fragments, dark grayish brown, little sand and silt brown mottled (CL)	67	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon	1 1 1
			Clay, soft to medium, gray little sand and silt, partly sandy, yellowish brown mottled	56	2		1 2 2
			dark brown mottled, medium	100	3		2 2 2
			Sandy brown, olive and gray mottled, occ. roots occ. dark gray	100	4		2 3 3
			Clay, soft to medium, gray and brown, little sand and silt, occ. olive mottled, oxidized veins (CH)	67	5		1 1 2
2.03	9.0		partly sandy, occ. fibrous matter	100	6		1 2 3
			Silt, very sandy, medium stiff, gray and brownish yellow, some clay, dark gray mottled (ML)	100	7		1 2 5
-0.97	12.0			100	8		5 6 8
			yellow, rust stiff colored and black oxidized veins, pale yellow mottled.	100	9	W=44% PI=31% LL=46% (CL) PL=15%	3 4 5
-3.97	15.0		very stiff to hard	100	10		5 13 18
			hard	100	11		10 15 26
				100	12		9 16 20
-8.47	19.5		very stiff	100	13		4 9 12
09.97	21.0			67	14		

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PROJECT: PUERTO NUEVO CHANNELS | HOLE NO. CB-MC-46

DRILLING LOG (Cont Sheet) — ELEVATION TOP OF HOLE: 11.03 feet — Hole No. CB-MC-46

PROJECT: PUERTO NUEVO CHANNELS — INSTALLATION: JACKSONVILLE DISTRICT — SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL Bls/6"
			Silt, olive, some sand and and clay, yellowish brown mottled.	100	15	140# hammer with 30" drop on 1-3/8" ID x 2" OD std. spl. spoon 7 9 12
-12.97	24.0'		hard, sandy	100	16	7 16 23
			hard, some wx. sandstone	100	17	10 16 40
				78	18	28 35 50/4"
			very pale yellow	67	19	10 35 50/3"
-18.97	30.0'			50	20	24 50/3"
			Sandstone, hard highly decomposed, very pale yellow gravel size, sandy silt, some clay, yellow mottled (GM)	33	21	50/6"
			Poor recovery	28	22	50/5"
-23.47	34.5'		Very poor recovery, pale yellow and yellow.	11	23	50/2"
			Silt, hard gray, very sandy, some clay, yellowish brown mottled (ML)	78	24	30 30 46
-26.47	37.5		Sand, fine grained, and clayey peat embedded	78	25	14 16 21
			Clay hard, saprolite, silty dark gray slightly organic some sand, occ. nodules (ML)	100	26	W=29% PI=29% LL=52% (CH) PL=23% 14 20 33
			olive gray, shelly	100	27	17 23 38
-30.97	42.0'		Sandy, some sandstone, decomposed, very poor recovery	11	28	75/2"
			Silt, very hard, sandy, gray many sandstone, highly decomposed some clay (ML)	11	29	50/2"
-33.97	45.0'		little sandstone, olive gray, occ. white mottled	61	30	40 50/5"

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PROJECT: PUERTO NUEVO CHANNELS — HOLE NO. CB_MC-46

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 11.03 feet | Hole No. CB-MC-46

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL Bls/6"
			partly clayey	11	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 50/1"
-35.47	40.5		silt, very hard, gray clayey partly cemented, some sand, occ. olive mottled (ML)	33	32	60/6"
-36.97	48.0		Siltstone fragments, very hard, highly decomposed, gray some clayey silt, little sand, occ. shell frags.	33	33	50/6"
				56	34	40 50/4"
			very poor recovery	11	35	50/4"
				11	36	50/2"
-44.47	55.5				37	50/1"
			Soils are field visually classified in accordance with the Unified Soils Classification System. After visual classification was performed, Atterberg Limits and Water Contents were obtained from requested samples and the results and final USCS classifications are shown. Laboratory classification takes precedence over visual classification.			

Hole No. CB-MC-47

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT PUERTO NUEVO CHANNELS		10. SIZE AND TYPE OF BIT See remarks	
2. LOCATION (Coordinates or Station) x = 614372 y = 211546		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL CME-45B	
4. HOLE NO. (As shown on drawing title and file number) CB-MC-47		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 37	UNDISTURBED
5. NAME OF DRILLER J. Nieves		14. TOTAL NUMBER CORE BOXES 2	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 7.05 feet	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED 1-25-90	COMPLETED 1-26-90
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE 17.05 feet	
9. TOTAL DEPTH OF HOLE 55.5'		18. TOTAL CORE RECOVERY FOR BORING 64 %	
		19. SIGNATURE OF INSPECTOR Kermit Schmidt, PE	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
17.05	0.0'					BIT OR BARREL Bls/6"
			FILL, clay, sandy, brown some rock fragments, gravel size, little silt, gray and yellow mottled (CL)	17	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 3 4 2
14.05	3.0'		Occ. roots, very poor recovery	11	2	3 3 2
			Sand, clayey fine to medium graines, gray and yellow, little silt, roots (SC)	44	3	4 3 6
11.05	6.0'			44	4	7 8 8
			Clay stiff, some sand, red gray and yellow, little silt, oxidized veins (CH)	67	5	4 4 5
8.05	9.0'			67	6	2 4 10
			Sand clayey, medium grained, reddish brown, little silt, gray and yellow mottled (SC)	67	7	7 6 9
				67	8	2 5 5
				100	9	12 15 21
				67	10	11 17 22
				67	11	17 17 18
				100	12	4 10 11
-2.45	19.5'			67	13	10 7 6
			Clay sandy stiff red and yellow, little silt, occ. pebbles. (CL)	67	14	4 5 7
-3.95	21.0'					

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: 17.05 feet | Hole No. CB-MC-47

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL Bls/6"
-5.45	22.5			50	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 3 5 6
			Clay, stiff, some sand, red and yellow, little silt, partly sandy, light gray and black mottled. (CH)	100	16	W=27% PI=45% LL=65% (CH) PL=20% 3 4 7
-8.45	25.5		red and brown, occ. gray mottled.	100	17	4 7 8
-9.95	27.0		Clay, very stiff, sandy red gray and yellow, little silt, partly very sandy.	100	18	4 6 10
-11.45	28.5		Clay, very stiff, silty olive, some sand, occ. pebbles, red mottled. (CL)	44	19	5 6 10
-12.95	30.0		Sand, clayey, medium grained olive and red, some silt, occ. pebbles, partly sandy clay (SC)	67	20	5 7 10
-14.45	31.5		Clay, medium brownish yellow, little sand and silt, black oxidized veins, partly sandy red and gray mottled (CH)	67	21	2 3 3
			Silt, medium sand, yellow some clay, occ. pebbles, oxidized veins, silty clay, embedded, brown mottled (ML)	67	22	W=36% PI=27% LL=45% (CL) PL=18% 2 2 3
			some intensely weathered siltstone, highly decomposed, stiff.	56	23	6 8 11
-18.95	36.0		very hard	100	24	6 8 11
-20.45	37.5		yellowish brown and olive	50	25	13 50/3"
				90	26	35 30 50/5"
-23.45	40.0			100	27	6 29 50/4"
			Sand cemented, fine grained, little silt, some sandstone, highly decomposed, brown mottled. (SP)	100	28	22 37 50/2"
				56	29	23 50/4"
-27.95	45.0			33	30	50/6"

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: 17.05 feet | Hole No. CB-MC-47

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOV. (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
						BIT OR BARREL
-27.95	45.0					Bls/6"
			Sand, cemented, fine grained, Olive some silt, little clay, yellowish brown mottled. (SM)	33	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 50/6"
				28	32	50/5"
			very silty	44	33	10 50/8"
-32.45	49.5					
			silty clay, embedded	100	34	25 43 40
-33.95	51.0					
			Silt saprolite sandy hard, little clay, brown and olive, occ. weathered rock, gravel size white mottled. (ML)	78	35	14 27 34
-35.45	52.5					
			Siltstone fragments, very hard weathered, decomposed into silt, clay and sand particles.	22	36	50/4"
-36.95	54.0					
				33	37	50/6"
-38.45	55.5					
			Soils are field visually classified in accordance with the Unified Soils Classification System. After visual classification was performed, Atterberg Limits and Water Contents were obtained from requested samples and the results and final USCS classification are shown. Laboratory classification takes precedence over visual classification.			

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PROJECT: PUERTO NUEVO CHANNELS | HOLE NO. CB-MC-47

Hole No.CB-MC-48

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 3

1. PROJECT: MARGARITA CHANNEL, PUERTO NUEVO	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=814,676 Y=211,678	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEOCONSULT	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45B
4. HOLE NO. (As shown on drawing title and file number): CB-MC-48	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 44 undisturbed: 0
5. NAME OF DRILLER: J. NIEVES	14. TOTAL NUMBER OF CORE BOXES: 2
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 5.55
7. THICKNESS OF BURDEN: Ft.	16. DATE HOLE STARTED: 1/29/90 COMPLETED: 1/31/90
8. DEPTH DRILLED INTO ROCK: 0 Ft.	17. ELEVATION TOP OF HOLE: 24.55 Ft.
9. TOTAL DEPTH OF HOLE: 66.0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 63.0 %
	19. SIGNATURE OF GEOLOGIST: KERMIT SCHMIDT, PE

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.6
24.5	.0				24.5	
		FILL, clay soft, silty rock fragments, gravel size, little sand, brown, occ. yellow mottled. (CL)	56	1	SPLIT SPOON	3 2 1
					23.0	
			56	2	"	3 6 6
					21.5	
		brown, gray and yellow stiff	56	3	"	5 9 11
					20.0	
		occ. decayed wood	67	4	"	5 5 7
18.5	6.0				18.5	
		CLAY, stiff little sand and silt, oxidized veins, dark brown mottled, occ. thin roots. (CH)	67	5	"	3 4 4
					17.0	
		partly sandy	100	6	"	2 4 5
					15.5	
		some sand, fine grained	44	7	"	2 4 5
14.0	10.5				14.0	
		SAND, fine to medium grained, some clay, gray little silt. (SC)	100	8	"	2 1 2
12.6	12.0				12.6	
		CLAY, soft slightly organic, little sand and silt, dark gray, occ. decayed fibrous matter. (CH)	67	9	"	1 2 1
					11.1	
		some fibrous matter	44	10	"	1 1 1
					9.5	
		partly sandy	44	11	"	1 1 1
8.0	16.5				8.0	
		CLAY, soft very sandy, yellowish brown, some silt, light gray mottled. (CL)	100	12	"	1 1 1
					6.5	
			67	13	"	1 2 2
					5.0	
		yellowish brown, gray and brownish yellow	67	14	"	2 3 5
3.5	21.0				3.5	
		CLAY, medium to stiff, brownish yellow, silty, some sand, light olive gray mottled. (CH)	67	15	"	1 3 4
					2.0	
					(continued)	

0 | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 | 17.5 | 20 | 22.5

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PROJECT: MARGARITA CHANNEL, PUERTO NUEVO | HOLE NUMBER: CB-MC-48

Hole No.CB-MC-48

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE 24.55 Ft. | SHEET 2 OF 3

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'	
2.0	22.5					2.0		
			occ. black oxidized veins	67	16	" .5	3 5 8	22.5
				56	17	" -1.0	2 3 4	25
-2.5	27.0		Sand clayey, fine to medium grained, brownish yellow, little silt, gray, mottled. (SC)	67	18	" -2.5	1 2 5	
				100	19	" -4.0	3 4 5	27.5
-5.5	30.0			67	20	" -5.5	5 9 9	30
-7.0	31.5		CLAY, stiff sandy yellow, some silt, partly clayey sand, fine grained, gray mottled. (CL)	100	21	" -7.0	3 4 4	
			Silt, very stiff pale brown, very sandy some clay, yellowish brown and gray mottled, friable. (SM)	67	22	" -8.5	6 8 10	32.5
				67	23	" -10.0	8 10 12	
			Sand, silty fine grained, brown pale yellow and dark gray little clay. (SM)	100	24	" -11.4	4 8 10	35
			very silty	67	25	" -12.9	7 13 28	37.5
-14.4	39.0			67	26	" -14.4	6 9 21	
-15.9	40.5		Silt, hard clayey, brown and olive, some sand, occ. rust colored oxidized veins. (ML)	78	27	" -15.9	8 16 16	40
			Sand, silty fine grained, pale yellow, little clay occ. brown mottled. (SM)	67	28	" -17.5	16 31 45	
				56	29	" -19.0	25 50	42.5
-20.5	45.0			78	30	" -20.5	28	45
-22.0	46.5		Silt saprolite, hard very sandy, yellowish brown, some clay, olive mottled. (ML)	67	31	" -22.0		
			Siltstone frags, very hard, intensely weathered, gravel size, some sandy silt little clay, gray mottled. (GM)	11	32	" -23.5		47.5
				11	33	" -25.0		
				100	34	"		50
						(continued)		

Hole No.CB-MC-48

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 24.55 Ft.

SHEET 3 OF 3

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
-25.5	50.0						50
			very hard, olive, whithe and yellow	100	34	" -26.5	
				67	35	" -28.0	52.5
			gray, olive and grayish brown	100	36	" -29.5	
				33	37	" -31.0	55
			olive brown, clayey hard	56	38	" -32.5	
				67	39	" -34.0	57.5
			sandy, gray, very poor recovery	17	40	" -35.5	
				50	41	" -37.0	60
				67	42	" -38.5	62.5
			sandy	22	43	" -40.0	
-41.5	66.0			17	44	" -41.5	65
			NOTE: Soils are field visually classified in accordance with the Unified Soil Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)	67.5 70 72.5 75 77.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: MARGARITA CHANNEL, PUERTO NUEVO

HOLE NUMBER: CB-MC-48

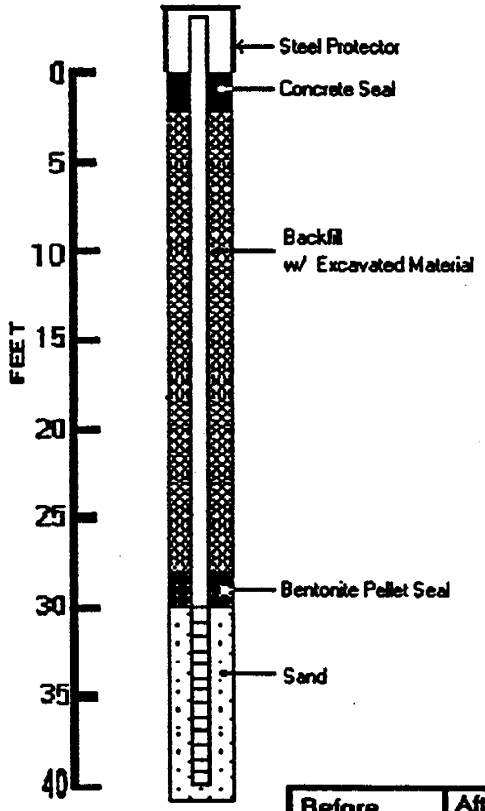
PIEZOMETER REPORT

PROJECT: Rio Puerto Nuevo

PIEZOMETER: PZ-1

LOCATION: x=616,885 y=213,580

GROUND ELEVATION: 3.01 Ft.



Top Elevation of Riser: 5.5 Ft.

Top Elevation of Bentonite Seal: -25.0 Ft.

Bottom Elevation of Bentonite Seal: -27.0 Ft.

Bottom Elevation of Monitored Zone: -37.0 Ft.

	Before Piezometer Installation	After Piezometer Installation	24 hr.	48 hr.	72 hr.	02/22/96
Elevation in Feet	-6.6	-6.2	-2.1	-1.9	-2.0	-2.0

Signature of Geologist

Luis Molina

SUELOS INC.

Soil & Construction Materials Laboratories and Environmental Drilling Services

Box 10208, Caparra Hts., San Juan, PR 00922

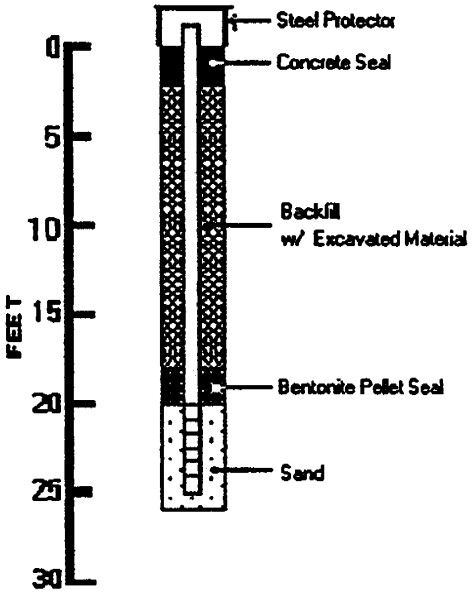
PIEZOMETER REPORT

PROJECT: Rio Puerto Nuevo

PIEZOMETER: PZ-2

LOCATION: x=614,755 y=212,138

GROUND ELEVATION: 9.34 Ft.



Top Elevation of Riser: 10.1 Ft.

Top Elevation of Bentonite Seal: -8.7 Ft.

Bottom Elevation of Bentonite Seal: -10.7 Ft.

Bottom Elevation of Monitored Zone: -15.7 Ft.

	Before Piezometer Installation	After Piezometer Installation	24 hr.	48 hr.	72 hr.	02/22/96
Elevation in Feet	-6.2	-5.5	5.6	5.8	6.0	5.5

Signature of Geologist

Luis Molina

SUELOS INC.

Soil & Construction Materials Laboratories and Environmental Drilling Services

Box 10208, Caparra Hts., San Juan, PR 00922

Hole No. CB-PNB-4

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT See remarks	
2. LOCATION (Coordinates or Station) X= 621633.36 Y= 214268.93		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL CME – 55	
4. HOLE NO. (As shown on drawing title and file number) CB-PNB-4		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED	UNDISTURBED
5. NAME OF DRILLER P. Robles		14. TOTAL NUMBER CORE BOXES 2 feet	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER -5.92 feet	
7. THICKNESS OF OVERBURDEN –		16. DATE HOLE STARTED 3-17-89 COMPLETED 3-20-89	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE 24.08	
9. TOTAL DEPTH OF HOLE 60 feet		18. TOTAL CORE RECOVERY FOR BORING 81.0. %	
		19. SIGNATURE OF INSPECTOR Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
+24.08	0.0					BIT OR BARREL Bls/6"
+21.08	3.0'		FILL material, clay, very sandy, brown, medium to silt, trace pebbles, occ. thin roots. (CL)	100	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 2 2 2
				33	2	3 4 4
			FILL material, clay, rock fragments, brown, little sand, trace silt, occ. brownish yellow, mottled (GC)	89	3	2 4 4
				44	4	4 5 4
				100	5	4 3 2
+15.08	9.0'			28	6	7 6 6
+13.58	10.5'		1.5" piece of rock from 9' to 10.5', trace clay	6	7	5 5 6
				50	8	3 2 2
				100	9	2 4 9
				44	10	5 11 25
				39	11	11 6 5
+ 6.08	18.0'		many rock fragments from 16.5' to 18'	33	12	6 5 2
			CLAY, possibly slighlty organic, dark gray and occ. brown, little silt, trace sand, occ. pebbles. (OH)	100	13	2 3 3
+ 3.08	21.0'			100	14	1 2 3

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE

PROJECT PUERTO NUEVO CHANNEL BRIDGES HOLE NO CB-PNB-4

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 24.08 feet | Hole No. CB-PNB-4

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft.) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERT e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., of significance) g
						BIT OR BARREL
+ 3.08	21.0'					Bls/6"
				100	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 1 3 3
- 1.58	22.5'					
			CLAY, little sand, olive gray, trace silt, occ. pebbles, yellowish brown mottled, medium (CH)	100	16	WH 2 3
- 0.08	24.0'					
			oxidized veins from 24' to 25.5'	100	17	1 3 6
- 1.42	25.5'					
			light gray and brown, stiff, from 25.5' to 31.5'	100	18	W = 36% PI= 33% LL= 55% PL= 22% 2 5 6
				100	19	4 6 8
				100	20	4 6 9
				100	21	4 7 10
- 7.42	31.5'					
			clay, stiff, olive gray, occ. brown mottled, trace silt, trace sand, occ. pebbles	100	22	4 6 7
- 8.92	33.0'					
			little pebbles from 33' to 34.5'	100	23	4 6 9
-10.42	34.5'					
			partially silty, some sand from 34.5' to 36'	100	24	4 6 7
-11.92	36.0'					
			CLAY, sandy, stiff, little pebbles yellowish brown and gray, sand, fine to coarse, silty (CL)	100	25	4 6 10
				100	26	4 6 7
				100	27	4 6 6
-16.42	40.5'					
				100	28	W = 28% PI= 17% LL= 44% PL= 27% 3 5 7
				67	29	3 4 5
				56	30	4 4 6
-20.92	45.0'					

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 24.08 feet | Hole No. CB-PNB- 4

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft), a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., of significance) g	
						BIT OR BARREL	Bls/6"
-20.92	45.0'			NR	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	3 5 6
-22.42	46.5'		SAND, fine to coarse, silty, yellowish brown, little sandstone, trace clay, from 46.5' to 49.5' (SM)	94	32	W = 21%	5 8 14
				89	33		7 7 9
-25.42	49.5'		CLAY, very silty, some fine sand, yellowish brown, trace pebbles, occ. gray mottled, from 49.5' to 51.5' (CL)	56	34	W = 31% PI= 14% LL= 36% PL= 22%	6 9 10
-28.42	52.5'			100	35		3 7 9
			CLAY, little silt, very stiff to hard, yellowish brown to red, trace sand dark gray mottled (CH)	100	36		8 10 13
				100	37		7 14 19
				100	38		8 14 19
				100	39		8 15 16
-34.42	56.5'		little limestone, decomposed, from 58.5' to 60'	100	40		14 19 21
-35.92	60.0'		END 60.0'				

Hole No.CB-PNB-4D

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=621,633 Y=214,269
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-4D
5. NAME OF DRILLER: JOSE AYALA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 105.5 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.
9. TOTAL DEPTH OF HOLE: 105.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: ACKER AD-II
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 59 undisturbed: 1
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: -2.12 Ft.
16. DATE HOLE STARTED: 9-27-95 COMPLETED: 10-02-95
17. ELEVATION TOP OF HOLE: 23.74 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 85 %
19. SIGNATURE OF ENGINEER: IVAN JACKSON

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
23.7	.0					23.7	
			Augered from elevation 23.7 to -38.3 Feet. (For description and classification see companion log CB-PNB-4)				

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

(continued)

Hole No. CB-PNB-4D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 23.74 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
1.2	22.5						

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5
50

(continued)

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 23.74 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
-26.3	50.0						50
							52.5
							55
							57.5
							60
-38.3	62.0					-38.3	
			CLAY, stiff, some limestone gravel, slickensided, yellowish-brown, (CH).	44	32	Split Spoon Sampler	31, 16, 21
						-39.8	62.5
				72	33	"	15, 27, 29
						-41.3	65
				100	34	"	16, 18, 16
						-42.8	
				44	35	"	15, 30, 22
						-44.3	67.5
				44	36	"	50, 47, 38
-45.8	69.5					-45.8	
			SILT, some clay, some fine limestone sand, light cream, (ML).	100	37	"	20, 40, 52
-47.3	71.0					-47.3	70
			LIMESTONE, impure, highly weathered, sampled as gravel, yellowish-brown, (GC).	17	38	"	14, 10, 8
						-48.8	72.5
				28	39	"	11, 24, 31
			(sampled as silt, clayey, highly weathered)			-50.3	
				100	40	"	51, 48, 19
						-51.8	75
				78	41	"	8, 17, 21
			(sampled as sand)			-53.3	
				39	42	"	20
						(continued)	77.5

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 23.74 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
-53.8	77.5						
				39	42	" -54.8	24 42
				22	43	" -56.3	75/4
				100	44	" -57.8	25 11 7
				72	45	" -59.3	12 27 21
				61	46	" -60.8	7 11 14
				28	47	" -62.3	31 10 12
				44	48	" -63.8	20 10 20
				28	49	" -65.3	7 11 9
				67	50	" -66.8	9 9 15
			(sampled as clay, silty, decomposed limestone)	50	51	" -68.3	10 13 13
-68.8	92.5						
			CAVITY	0		" -69.8	
-69.8	93.5						
				100	52	" -71.3	12 10 5
				100	53	" -72.8	5 2 7
				100	54	" -74.3	3 5 8
				50	55	" -75.8	18 16 7
				100	56	" -77.3	20 18 20
				33	57	" -78.8	40 30 36
				44	58	" -80.3	21 10 7
				39	59	"	6 7
						(continued)	

DRILLING LOG (Cont. Sheet)

HOLE NO. CB-PNP-4D

ELEVATION TOP OF HOLE 23.74 Ft.

SHEET 5 OF 5

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-81.3	105.0						
-81.8	105.5			39	59	-81.8 "	39
			End of test hole.				

140# HAMMER WITH 30" DROP USED ON 2.0" O.D. SPLIT SPOON (1-3/8" I.D.)

Ground water elevation at the time of drilling was -6.26 feet.

Once this boring was finished, another one was drilled close to this and a shelby sample was recovered from elevation -35' to -37' feet.

105
107.
110
112.5
115
117.5
120
122.
125
127.
130
132.

ENG FORM 1838 PREVIOUS EDITIONS ARE OBSOLETE MAR 71

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-PNP-4D

Hole No. CB-PNB- 5

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT: PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT: See remarks	
2. LOCATION (Coordinates or Station): X= 621645.03 Y= 214561.74		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME - 45 B	
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-5		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED	
5. NAME OF DRILLER: H. Gonzalez		14. TOTAL NUMBER CORE BOXES: 2	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: -3.23 feet	
7. THICKNESS OF OVERBURDEN: -		16. DATE HOLE: STARTED 3-14-89 / COMPLETED 3-15-89	
8. DEPTH DRILLED INTO ROCK:		17. ELEVATION TOP OF HOLE: 10.27	
9. TOTAL DEPTH OF HOLE: 60 feet		18. TOTAL CORE RECOVERY FOR BORING: 82.0 %	
		19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	Blows/6"
+10.27	0.0					BIT OR BARREL	Bls/6"
			FILL material, clay, grayish brown to brown, soft to medium little pebbles, trace sand and silt occ. roots (CH)	67	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	2 2 2
+ 7.27	3.0'		occ. rock fragments	67	2		2 2 3
			clay, medium, yellowish brown, little sand, trace silt, occ. pebbles, gray mottled	100	3		2 2 3
			occ. oxidized veins	100	4		2 2 3
+ 2.77	7.5'			100	5	W = 37% PI= 27% LL= 55% PL= 28%	2 2 4
			from 7.5' to 10.5' sandy	94	6		2 2 3
- 0.23	10.5'			100	7		1 2 3
- 1.73	12.0'		from 10.5' to 12' gray, soft	100	8		2 1 2
			SAND, fine to coarse grained, little fine gravel, sub-angular, trace clay and silt (SP)	67	9		5 5 7
- 4.73	15.0'			67	10		3 4 7
				61	11	W = 20%	3 3 5
			from 15' to 18' little silty clay, slightly organic	72	12		2 4 5
- 7.73	18.0'						
			from 18' to 19.5' very silty and gravelly	78	13		12 15 18
- 9.23	19.5'						
				50	14		7 4 3
-10.73	21.0'						

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 10.27 feet | Hole No. CB-PNB- 5

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (f.t) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant:) g	
						BIT OR BARREL	
-10.73	21.0'					Bls/6"	
-12.23	22.5'		CLAY, stiff, possibly slightly organic, little sand, trace silt, gray, occ. olive and brown mottled, pebbles (CH)	61	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon	3 5 5
-13.73	24.0'		from 22.5' to 24' little weathered rock, highly decomposed, rust colored	33	16		3 5 6
-15.23	25.5'		from 24' to 25.5' occ. black mottled	67	17		4 6 6
-16.73	27.0'		from 27' to 31.5' partly sandy	100	18	W = 35% PI= 39% LL= 62% PL= 23%	4 5 8
				39	19		2 3 4
				56	20		3 4 6
				33	21		3 4 6
-21.23	31.5'			NR	22		3 5 5
-22.73	33.0'		from 33' to 35' stiff to very stiff	94	23		5 8 10
-24.73	35.0'			100	24		4 6 8
-27.23	37.5'		CLAY, silty, stiff, some sand trace pebbles, yellowish brown, partly sandy, occ. gray mottled (CL)	100	25		4 6 6
-28.73	39.0'		CLAY, medium, yellowish brown, silty, little sand, occ. pebbles (CH)	94	26	W = 32% PI= 29% LL= 53% PL= 24%	2 3 4
-30.23	40.5'		from 39' to 40.5' sand, fine to medium	100	27		3 4 5
			SAND, fine to medium grained some silty clay, trace pebbles (SW)	100	28		3 3 8
-33.23	43.5'			100	29	W = 17%	4 6 8
-34.73	45.0'		from 43.5' to 47' little silt	100	30		20 18 12

Hole No.CB-PNB-11D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 14.91 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/6"
-35.1	50.0						
						-43.1	
-43.1	58.0		SAND, silty, fine to medium grained, highly quartzose, pale brownish yellow. (SP-SM)	100	31	SPLIT SPOON	4, 6, 11
						-44.6	
			Moderately organic with occasional peat thin layer at 60 feet.	100	32	"	23, 35, 54
						-46.1	
			Slightly cemented sands with occasional fossils at 61 feet.	100	33	"	25, 40, 60
						-47.6	
				72	34	"	32, 43, 60
			Some calcite veins at 64 feet.			-49.1	
				66	35	"	37, 50, 50/2
-50.6	65.5					-50.6	
			LIMESTONE, impure, granular, moderately fossiliferous, highly weathered, sampled as SAND, silty, calcareous, coarse grained, and gravel size limestone fragments, light olive to gray. (SM)	16	36	"	75/3
						-51.6	
				33	37	"	45, 75/2
						-53.1	
			Marly limestone, unconsolidated, highly weathered to decomposed from 68 to 80 feet.	55	38	"	43, 70, 75
						-54.6	
				33	39	"	75/6
						-56.1	
				16	40	"	75/3
						-57.6	
				66	41	"	40, 70, 85
			Occasional fossil at 74 feet.			-59.1	
				33	42	"	100/6
						-60.6	
				38	43	"	75/6
			Moderately fossiliferous at 77 feet.			-62.1	
				44	44	"	50
						(continued)	

Hole No.CB-PNB-11D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 14.91 Ft.

SHEET 4 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-62.6	77.5						
				44	44	"	75/4
						-63.6	
				55	45	"	50
							80
						-65.1	70
				77	46	"	43
							80
-66.6	81.5					-66.6	50/3
			SANDSTONE, calcareous, medium grained, moderately laminated, highly weathered to decomposed, sampled as SAND, silty, and gravel size sandstone fragments, light gray and olive. (SM)	66	47	"	49
							82
						-68.1	75
			Occacional microfossils at 83 feet.	66	48	"	50
							75
						-69.6	85
				50	49	"	43
-70.6	85.5					-70.6	80
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)	
						Ground water elevation at the time of drilling was 5.2 feet.	
						Undisturb sample was recovered from elevation -7 to -9 feet.	
						LAB CLASSIFICATIONS Elev. (Ft.) Class. Wn LL PL PI -46.1 SM 22% 41 26 15	

77.5 80 82.5 85 87.5 90 92.5 95 97.5 100 102.5 105

ENG FORM 1838 MAR 72 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-PNB-11D

Hole No. CB-PNB- 12

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT: PUERTO NUEVO CHANNEL BRIDGES		10. SIZE AND TYPE OF BIT: See remarks	
2. LOCATION (Coordinates or Station): X= 622969.26 Y= 212492.73		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55	
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-12		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED	UNDISTURBED
5. NAME OF DRILLER: P. Robles		14. TOTAL NUMBER CORE BOXES: 2	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: -2.60 feet	
7. THICKNESS OF OVERBURDEN: -		16. DATE HOLE: STARTED 5-25-89	COMPLETED 5-26-89
8. DEPTH DRILLED INTO ROCK:		17. ELEVATION TOP OF HOLE: 5.40	
9. TOTAL DEPTH OF HOLE: 58.67 feet		18. TOTAL CORE RECOVERY FOR BORING: 70.0 %	
		19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE	

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
+ 5.40	0.0					BIT OR BARREL Bls/6"
+ 3.90	1.5'		FILL material, sand, fine grained, brown, silty, little clay, occ. roots pebbles (SM)	28	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 1 1 1
+ 2.40	3.0'		concrete slab		2	concrete concrete concrete
			FILL material, clay, little silt, stiff, yellowish brown little sand, trace pebbles and rock fragments (CH)	100	3	2 3 4
				56	4	1 2 2
- 2.10	7.5'			100	5	2 3 3
- 3.60	9.0'		very poor recovery	22	6	1 2 2
			medium, slightly organic, gray and olive, little sand and silt, occ. brown mottled	100	7	1 1 2
				100	8	1 2 2
				100	9	1 1 2
- 8.60	14.0'					
			CLAY, stiff, silty, brown and some sand and limestone fragments, fine gravel size, occ. white and yellow mottled (CL)	100	10	3 5 8
				100	11	3 5 4
				100	12	3 4 5
-14.10	19.5'		very stiff, more silty, white and yellow	100	13	10 22 12
-15.60	21.0'		SILT, very stiff, sandy, yellowish brown, some clay & limestone frags (ML)	56	14	13 14 9

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 5.40 feet	Hole No. CB-PNB-12
PROJECT PUERTO NUEVO CHANNEL BRIDGES	INSTALLATION JACKSONVILLE DISTRICT	SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-15.60	21.0'					Bls/6"
			stiff, clayey, yellowish brown little sand, occ. limestone fragments, gravel size, silty clay	100	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 5 / 5 / 7
-17.10	22.5'		more sandy	44	16	6 / 8 / 6
-20.10	25.5'			100	17	18 / 43 / 37
			SAND, fine to medium grained and silt, yellowish brown and gray, little clay, occ. pebbles (SM)	100	18	21 / 28 / 50
				100	19	18 / 18 / 28
-23.60	29.0'			100	20	15 / 28 / 26
-24.60	30.0'		some sandstone, gravel size	100	21	14 / 22 / 34
-27.60	33.0'			44	22	12 / 18 / 24
			SILT, hard, some sand, olive, little clay, rust colored oxidized veins, trace wx rock, decomposed, rct structures (ML)	44	23	9 / 18 / 26
-29.60	35.0'			83	24	45 / 50 / 50/3"
			SAND, fine to medium grained and silt, little clay, brown mottled (SM)	100	25	19 / 15 / 19
-33.60	39.0'		some sandy silt	33	26	15 / 30 / 50
			SILT, hard, sandy, little clay, olive, trace pebbles, brownish yellow mottled (ML)	100	27	16 / 30 / 52
			very hard, some sandstone, highly decomposed, poor recovery	22	28	75/3"
				33	29	50 / 50/1"
-39.60	45.0'			44	30	75/2"

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 5.40 feet | Hole No. CB-PNB-12

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-39.60	45.0'					BIT OR BARREL Bls/6"
-42.60.	48.0'		SAND, fine grained and silt, hard, olive, some sandstone, little clay, brown mottled (SM)	100	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 18 30 50
				61	32	21 75/5"
-44.10	49.5'		SILT, very hard, olive and yellowish brown, some clay, partly sandy, trace pebbles, occ. white mottled (ML)	83	33	35 45 50/3"
-45.60	51.0'		some rock, highly decomposed	22	34	75/4"
-47.10	52.5'		SAND, fine to medium grained, gray, some silt, little clay, trace sandstone (SM)	78	35	20 40 50/2"
-48.60	54.0'		partly shelly	67	36	25 40 50/4"
-53.27	58.67'		CLAY, hard, silty, olive, some sand, little pebbles, dark olive gray mottled, relict structures (CL)	67	37	16 25 40
				56	38	40 50/4"
				44	39	16 75/4"
			END 58.67'	NR	40	75/2"

Hole No. CB-PNB- 13

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT	PUERTO NUEVO CHANNEL BRIDGES
2. LOCATION (Coordinates or Station)	X= 623002.81 Y= 212478.55
3. DRILLING AGENCY	GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number)	CB-PNB- 13
5. NAME OF DRILLER	H. González
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	-
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	60 feet
10. SIZE AND TYPE OF BIT	See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CME - 45B
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	3
15. ELEVATION GROUND WATER	-4.27 feet
16. DATE HOLE	STARTED 4-21-89 COMPLETED 4-24-89
17. ELEVATION TOP OF HOLE	14.73
18. TOTAL CORE RECOVERY FOR BORING	87.0 %
19. SIGNATURE OF INSPECTOR	Kermit Schmidt, PE

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
14.73	0.0					BIT OR BARREL Bls/6"
			FILL material, clay, red and brown, stiff, some sand, little rock fragments, trace silt (CH)	33	1.	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 2 1 2
				67	2	4 5 7
9.73	5.0			100	3	5 5 5
			CLAY, stiff, brown and gray, little sand and silt, occ. pebbles (CH)	100	4	2 3 4
				100	5	3 4 6
5.73	9.0			100	6	3 3 6
			yellowish brown and gray, medium to stiff	100	7	2 2 3
2.73	12.0			100	8	3 4 5
			olive gray and brown	100	9	1 3 3
				100	10	2 3 4
- 1.77	16.5			100	11	2 2 3
- 3.27	18.0		soft to medium	100	12	1 2 2
			soft, olive and gray slightly organic	100	13	1 1 1
- 6.27	21.0			100	14	1 1 2

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 14.73 feet | Hole No. CB-PNB- 13

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant:) g
						BIT OR BARREL
- 6.27	21.0'					Bls/6"
				100	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 2 3 4
				100	16	2 3 5
-10.27	25.0'			100	17	2 5 8
-12.27	27.0'		SILT, very stiff, sandy, yellowish brown & gray, some clay, trace weathered rock, decomposed (ML)	100	18	6 6 12
-13.77	28.5'		CLAY, stiff, brown, gray and white, some limestone (gravel size), ltt. sand and silt (CL)	100	19	5 7 8
-15.27	30.0'		CLAY, stiff to very stiff, brown and olive gray, little sand & silt, partly sandy (CH)	100	20	13 13 13
-16.77	31.5'		CLAY, very stiff, silty, yellowish brown, ltt limestone gravel size, partly sandy (CL)	100	21	4 8 8
-18.27	33.0'		GRAVEL, clayey, some sand and silt (GC)	100	22	12 15 20
			SAND, fine grained, very silty, olive gray and brownish yellow, some clay (SM)	94	23	7 15 20
				89	24	13 25 50/3"
				100	25	8 16 25
				28	26	50/5"
				100	27	20 30 38
-26.77	41.5'			100	28	14 20 30
			SILT, very clayey, hard, olive, some sand, brownish yellow mottled, relict structures (ML)	89	29	16 29 50/4
-30.27	45.0'		trace weathered rock	100	30	17 27 33

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 14.73 feet | Hole No. CB-PNB- 13

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-30.27	45.0'					Bls/6"
				100	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 12 18 21
-33.27	48.0'			100	32	8 27 45
			SAND, fine grained and silt, olive and brownish yellow, some clay, occ. pebbles (SM)	94	33	17 47 50/5"
				78	34	16 42 50/3"
-37.27	52.5'			67	35	12 50/6"
-39.27	54.0'		partly cemented, very poor recovery	17	36	50/5"
				83	37	17 27 50/3"
-42.27	57.0'		some weathered rock	50	38	47 50/3"
			SILT, very hard, sandy, partly clayey, some weathered rock, olive and brown (ML)	83	39	16 44 50/4"
-45.22	60.0'		very poor recovery	11	40	50/2"
			END 60.0'			

ENG FORM 1836-A (ER 1110-1-1801) GPO 1980 OF - 620-603

PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB- 13

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=623,003 Y=212,479
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-13D
5. NAME OF DRILLER: Nicolas Andino
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 83.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 83.0 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: BK-51
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 16 undisturbed: 3
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 2.55 Ft.
16. DATE HOLE STARTED: 10-2-95 COMPLETED: 10-2-95
17. ELEVATION TOP OF HOLE: 11.29 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 85 %
19. SIGNATURE OF ENGINEER: IVAN JACKSON

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
11.3	.0					11.3	
			Augered from elevation 11.3 to -48.7 Feet. (For description and classification see companion log CB-PNB-13)				
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-PNB-13D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 11.29 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-11.2	22.5						

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5
50

(continued)

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 11.29 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/6"
-38.7	50.0						
-48.7	60.0		LIMESTONE, unconsolidated, highly weathered, slighly fossiliferous, (saprolite) sampled as SILT, stiff, friable, greenish-gray, (ML).	100	1	SPLIT SPOON SAMPLER -50.2	18 32 40
			sampled as SAND, clayey, wet, light brown and light green, at 62 feet. (SC)	100	2	" -51.7	17 30 42
			sampled as SILT, hard, grayish-green, at 63 feet. (ML).	100	3	" -53.2	23 30 45
			sampled as CLAY, silty, little sand, moist, light gray, at 65 feet. (CL)	100	4	" -54.7	20 35 46
				100	5	" -56.2	27 38 50
			(Sampled as SILT, clayey, stiff, friable, trace sand, light gray, (MH))	100	6	" -57.7	24 32 45
				100	7	" -59.2	26 38 55
				100	8	" -60.7	30 40 53
				100	9	" -62.2	16 34 58
				100	10	" -63.7	22 36 51
				78	11	" -65.2	18 27 34
				78	12	"	38
						(continued)	

Hole No.CB-PNB-13D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 11.29 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-66.2	77.5						
			(Sampled as SAND, silty, well graded, wet, (SM).)	78	12	-66.7 "	47
				78	13	"	28 37 45
			(Sampled as SILT, stiff, friable, greenish-gray, brown mottled, (ML).)			-68.2	
				100	14	"	28 39 58
						-69.7	
				100	15	"	30 45 56
						-71.2	
-71.7	83.0			33	16	-71.7 "	100/6
			End of test hole.				

140# HAMMER WITH 30" DROP USED ON 2.0" O.D. SPLIT SPOON (1-3/8" I.D.)

Ground water elevation at the time of drilling was 2.3 feet.

Once this boring was finished, another one was drilled close to this and three shelby samples were recovered from elevations -.3 to -1.7, -5.2 to -7.2 ft., and -14.2 to -16.2 ft.

LAB Classifications

Elev. (Ft.)	Class.	Wn	LL	PL	PI
-50.2	SC	25%	40	21	19

77.5 80 82.5 85 87.5 90 92.5 95 97.5 100 102.5 105

Hole No.CB-PNB-61

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 4

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=622,820 Y=212,540
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-61
5. NAME OF DRILLER: PABLO ANDINO
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 83.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 83.0 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-750
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 56 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 3.7 Ft.
16. DATE HOLE STARTED COMPLETED: 09/30/95 10/01/95
17. ELEVATION TOP OF HOLE: 14.02 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 97.4 %
19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
14.0	.0					14.0	
			SAND, silty, fine grained, trace of clay, some asphalt, trace gravel size rock fragments, dark brown. (SM) (Fill)	100	1	SPLIT SPOON	2, 3, 3
12.5	1.5					12.5	
			CLAY, silty, little sand, quartz, brown. (CL)	100	2	"	2, 4, 5
						11.0	
			Some fine gravel at 4.0 feet	100	3	"	5, 4, 5
						9.5	
			Silty from 6 to 15 feet.	100	4	"	4, 3, 3
						8.0	
				100	5	"	2, 3, 3
						6.5	
				66	6	"	2, 2, 2
						5.0	
				66	7	"	WH, 2, 2
						3.5	
				55	8	"	2, 3, 4
						2.0	
			Few decayed roots from 11 to 15 feet.	100	9	"	2, 3, 3
						.5	
				100	10	"	2, 3, 3
			Sandy at 15 feet.			-1.0	
				100	11	"	WH, 1, 1
-2.5	16.5		Moderately organic at 16 feet.			-2.5	
			SAND, silty, little clay, fine grained, dark olive. (SM)	100	12	"	WH, 2, 2
-4.0	18.0					-4.0	
			CLAY, silty, trace sand, some decayed roots, light gray and and olive. (CL)	100	13	"	1, 1, 1
			Light gray			-5.5	
				100	14	"	1, 1, 1
			Olive mottled at 21 feet.			-7.0	
				100	15	"	1, 1, 1
						-8.5	
						(continued)	

Depth ticks: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT | HOLE NUMBER: CB-PNB-61

Hole No.CB-PNB-61

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 14.02 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-8.5	22.5					-8.5	
			Little organic content at 23 feet.	100	16	"	2 4
			Sandy at 24 feet.			-10.0	4
				100	17	"	3 4
-11.5	25.5					-11.5	3
			SAND, silty, little clay, coarse grained, some oxidation, pale yellow and gray. (SM)	100	18	"	4 7
						-13.0	8
				100	19	"	6 7
						-14.5	9
				100	20	"	13 18
						-16.0	18
				100	21	"	4 7
-17.5	31.5					-17.5	9
			LIMESTONE, stiff to very stiff, highly weathered, (saprolite) sampled as Clay, calcareous, medium plasticity, sandy, black mottled, to white (CL)	100	22	"	12 19
						-19.0	32
				100	23	"	30 37
						-20.5	55
				100	24	"	12 36
			Slightly laminated, yellowish brown.			-22.0	30
				100	25	"	9 12
						-23.5	13
				100	26	"	14 16
			Sandy from 39 to 43.5 feet			-25.0	19
				55	27	"	46 100/6
						-26.5	
				77	28	"	85 45
			Moderately laminated at 42 feet.			-28.0	50
				88	29	"	30 40
-29.5	43.5					-29.5	48
			SANDSTONE, (saprolite) sampled as Sand, fine to coarse grained, quartz, silty, high percent of quartz, pale yellow. (SM)	100	30	"	26 32
						-31.0	50
				100	31	"	20 29
						-32.5	37
				100	32	"	23 30
			Slightly oxicete particles at 48 feet.			-34.0	38
				100	33	"	32
						-35.5	
				77	34	"	4
						(continued)	

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 14.02 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-36.0	50.0						
			Few small clay pockets at 50 feet.	77	34	-37.0	36 / 48
				100	35	-38.5	28 / 38 / 46
				100	36	-40.0	12 / 21 / 26
-40.0	54.0			100	37	-41.5	18 / 26 / 32
			Sligthly calcareous from 55 to 58 feet. Occasional quartz gravel at 58 feet.	100	38	-43.0	26 / 36 / 45
				100	39	-44.5	25 / 32 / 46
			Medium grained quartz sand and trace clayey from 59 to 60 feet.	100	40	-46.0	21 / 36 / 51
				100	41	-47.5	18 / 30 / 42
			Highly calcareous from 62 to 66 feet.	100	42	-49.0	24 / 36 / 48
				100	43	-50.5	18 / 33 / 41
			Occasional limestone gravel at 65 feet. Little clayey, grayish blue.	100	44	-52.0	17 / 28 / 37
				100	45	-53.5	19 / 30 / 42
				100	46	-55.0	23 / 36 / 55
			Slightly calcareous from 69 to 72 feet.	77	47	-56.5	23 / 41 / 50
				100	48	-58.0	25 / 38 / 53
-58.0	72.0						
			LIMESTONE, unconsolidated, occasional microfossils, highly weathered, moderately laminated, (saprolite) sampled as CLAY, trace silt, calcareous, light gray to white. (CL) Moderately granular from 73 to 78 feet.	100	49	-59.5	28 / 40 / 55
				100	50	-61.0	26 / 33 / 45
				55	51	-62.5	3 / 41 / 55
				100	52		15 / 28
						(continued)	

Hole No.CB-PNB-61

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 14.02 Ft.

SHEET 4 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-63.5	77.5						
			Occasional calcite concretions at 80 feet.	100	52	-64.0 "	31
				100	53	"	18 24
						-65.5	35
			Slightly fossiliferous at 82 feet.	100	54	"	18 26
						-67.0	36
				100	55	"	31 42
						-68.5	55
				33	56	"	100/6
-70.0	84.0					-70.0	
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.) Ground water at the time of drilling was 3.5 feet.	

LAB CLASSIFICATIONS

Elev. (Ft.)	Class.	Wn	LL	PL	PI
3.5	CH	24%	52	28	24
-5.5	CH	30%	102	30	72
-13.0	SM				
-47.5	SM				

77.5 80 82.5 85 87.5 90 92.5 95 97.5 100 102.5 105

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-PNB-61

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=622,990 Y=212,625
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-62
5. NAME OF DRILLER: JOSE AYALA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 85.5 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 85.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: ACKER AD-II
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 58 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 3.2 Ft.
16. DATE HOLE STARTED COMPLETED: 09/18/95 09/21/95
17. ELEVATION TOP OF HOLE: 14.11 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 89.6 %
19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
14.1	.0					14.1	
			CLAY, sandy, little silt, brown, roots traces, rock fragments, brick, debris. (FILL)	77	1	SPLIT SPOON	3, 3, 4
						12.6	
				100	2	"	5, 5, 5
						11.1	
				72	3	"	4, 5, 5
						9.6	
			Clay, silty, medium plasticity, some decayed organic material brown and gray. (CL)	100	4	"	3, 5, 9
						8.1	
				100	5	"	10, 10, 12
						6.6	
				100	6	"	5, 5, 8
						5.1	
				100	7	"	4, 4, 6
						3.6	
			Some lamination at 11 feet.	100	8	"	8, 8, 11
						2.1	
			Few decayed roots, brown mottled, gray and brown from 12 to 16.5 feet.	100	9	"	3, 4, 4
						.6	
				100	10	"	4, 5, 7
			Trace coarse sand at 16 feet.			-.9	
				100	11	"	3, 3, 3
			Sandy, little silt, some decayed roots from 16.5 to 19 feet.			-2.4	
				100	12	"	4, 4, 7
						-3.9	
				100	13	"	WH, 2, 2
			Silty, olive mottled, from 19 to 22.5 feet.			-5.4	
				100	14	"	2, 4
						-6.9	
				100	15	"	3, 6
			Trace clayey sand.			-8.4	
-8.4	22.5					(continued)	

0 | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 | 17.5 | 20 | 22.5

Hole No.CB-PNB-62

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 14.11 Ft.

SHEET 2 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ 5"
-8.4	22.5					-8.4	
			SAND, clayey, little silt, fine grained, some fine sub-rounded gravel, olive brown. (SC)	100	16	" -9.9	4 6 10
				100	17	" -11.4	5 7 10
				100	18	" -12.9	6 8 11
				100	19	" -14.4	7 9 11
			Coarse grained sand from 28 to 31 feet.	100	20	" -15.9	5 5 7
-15.9	30.0						
			SAND, silty, coarse grained, quartz, pale yellow. (SM)	100	21	" -17.4	4 6 9
				100	22	" -18.9	6 8 11
				100	23	" -20.4	5 9 12
-20.4	34.5						
			CLAY, silty, stiff, medium plasticity, some oxidation, light yellowish brown. (CL)	100	24	" -21.9	8 11 13
				100	25	" -23.4	9 12 15
			Sandy at 38 feet.	100	26	" -24.9	8 13 16
			Some fine sand at 41 feet.	88	27	" -26.4	4 6 6
				83	28	" -27.9	6 8 10
				100	29	" -29.4	8 12 16
-29.4	43.5						
			SAND, silty, fine to coarse grained, quartz. Yellowish brown. (SM)	100	30	" -30.9	12 25 40
				83	31	" -32.4	24 35 55
				100	32	" -33.9	25 45 60
				100	33	" -35.4	30 3
-35.4	49.5						
			SILT, soft, sand traces.	83	34		2
						(continued)	

ENG FORM 1836 MAR 7... PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-PNB-62

Hole No.CB-PNB-62

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE 14.11 Ft. | SHEET 3 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5
-35.9	50.0						
			olive pale brown. (ML)	83	34	-36.9	21 30
-36.9	51.0		SAND, silty, medium grained, light gray. (SM)	100	35	-38.4	19 25 33
-38.4	52.5		SILT, stiff to very stiff yellowish brown and gray. (ML)	100	36	-39.9	20 30 40
-39.9	54.0		SAND, silty, coarse grained, quartz, light gray. (SM)	88	37	-41.4	29 49 54
-41.4	55.5		CLAY, silty, stiff, medium plasticity, olive gray and brown. (CL)	100	38	-42.9	25 39 50
-42.9	57.0		SAND, silty, medium grained, quartz, pale olive gray. (SM)	100	39	-44.4	22 35 54
				100	40	-45.9	23 46 60
				100	41	-46.9	76/4
				22	42	-48.4	80 61 40
			Coarse grained quartz sand with few microfossils from 63 to 65 feet.	83	43	-49.9	22 36 40
				100	44	-51.4	20 32 42
			Medium grained quartz sand and clay traces at 66 feet.	88	45	-52.9	33 46 53
				100	46	-54.4	25 45 60
			Tace of fine gravel from 68 to 71 feet.	66	47	-55.9	50 80 78
				100	48	-57.4	25 30 53
				38	49	-58.9	43 50/3
				38	50	-60.4	40 50/3
-67.9	76.0			66	51	-67.9	40 50 50
			LIMESTONE, granular, slightly fossiliferous, highly weathered.	33	52	-73.4	75/6
						(continued)	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT | HOLE NUMBER: CB-PNB-62

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 14.11 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-63.4	77.5					-63.4	
			(saprolite) sampled as SAND, silty, calcareous, and gravel size limestone fragments, light gray. (SM)	44	53	"	47 50/2
						-64.9	
				33	54	"	80/6
			Few microfossils at 80 feet.			-65.9	
				33	55	"	50/6
						-66.9	
				100	56	"	26 45 70
			Sampled as SILT, trace fine sand, olive gray. (ML)			-68.4	
				100	57	"	30 50 57
						-69.9	
				100	58	"	35 57 60
-71.4	85.5					-71.4	
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.) Ground water at the time of drilling was 3.8 feet.	

LAB CLASSIFICATIONS

Elev. (Ft.)	Class.	Wn	LL	PL	PI
-3.9	ML	24%			
-9.9	SC	23%	39	21	18

77.5 80 82.5 85 87.5 90 92.5 95 97.5 100 102.5 105

Hole No. CB-PNM-46

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT: PUERTO NUEVO CHANNELS		10. SIZE AND TYPE OF BIT: See remarks	
2. LOCATION (Coordinates or Station): X = 623013 Y = 212068		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL:	
4. HOLE NO. (As shown on drawing title and file number): CB-PNM-46		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 30 / UNDISTURBED	
5. NAME OF DRILLER: T. Cabán		14. TOTAL NUMBER CORE BOXES: 2	
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: -0.67 feet	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE: STARTED 2-6-90 / COMPLETED 2-6-90	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE: 12.33 feet	
9. TOTAL DEPTH OF HOLE: 45.0'		18. TOTAL CORE RECOVERY FOR BORING: 76 %	
		19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
12.33	0.0'					BIT OR BARREL Bls/6"	
			FILL, clay, medium, sandy, some silt, brown occ. fine rock fragments, gravel size, waste (CL)	11	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon	1 3 4
			stiff, brown occ. gray and dark brown mottled.	89	2		3 5 7
			occ. concrete waste	67	3		5 5 6
			some sand	89	4		7 6 6
4.83	7.5'		partly slightly organic, olive gray mottled.	61	5		4 6 8
3.33	9.0'		no recovery	NR	6		3 4 3
			Clay, stiff, some sand, brown little silt, occ. pebbles and concrete waste, gray mottled, partly slightly organic.	61	7		9 5 5
0.33	12.0'		dark gray, olive and red mottled.	67	8		3 4 4
			Clay, medium to stiff, slightly organic, olive and gray, little sand and silt, occ. pebbles, brown mottled (CL)	78	9	W=30% PI=27% LL=50% (CL) PL=23%	1 3 4
-2.67	15.0'		stiff	83	10		4 4 5
			Sand, medium to coarse grained, gray silty, some fine gravel, sub-angular to sub-rounded, little clay (SM)	83	11		3 1 PUSH
				67	12		2 1 5
-7.17	19.5'			100	13		5 9 5
			brown	67	14		5 4 10
-8.67	21.0'						

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE

PROJECT PUERTO NUEVO CHANNELS | HOLE NO. CB-PNM-46

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 12.33 feet | Hole No. CB-PNM-46

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL Bls/6"
-8.67	21.0			67	15	140# hammer with 30" drop on 1-3/8" ID x 2" OD std. spl. spoon 6 4 6
			more silty			
-11.67	22.5		brown, occ. medium gravel, sub-angular, olive gray mottled.	100	16	7 5 5
-13.17	24.0		Clay, very sandy, reddish yellow, some silt, with sand, coarse gravel, clayey, olive gray, embedded. (CL)	100	17	2 4 4
			Silt, very hard, sandy, some sand, reddish brown and pale yellow, partly very sandy, friable (ML)	100	18	6 11 10
			very pale olive	67	19	W=26% PI=14% LL=42% (ML) PL=28% 8 10 7
-17.67	30.0			83	20	10 12 20
			very sandy	89	21	3 11 13
			hard, pale olive and yellow	89	22	9 14 23
-22.17	34.5			83	23	16 29 45
			Silt, very hard, sandy some intensely weathered rock, highly decomposed, olive, little clay, white mottled.	78	24	W=13% PI=9% LL=32% PL=23% (ML) 29 67 58
			partly cemented, very sandy	89	25	17 24 77
-26.67	39.0			67	26	42 51 50/3"
-28.17	40.5		some intensely weathered rock highly decomposed.	67	27	19 31 50/3"
			Sand, silty, fine grained, pale olive and white, little clay, partly cemented (SM)	100	28	41 46 29
				100	29	16 29 65
-32.67	45.0		yellow, occ. gray mottled.	89	30	18 29 45

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=623,013 Y=212,068
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNM-46D
5. NAME OF DRILLER: JOSE AYALA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 72.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 72.0 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: BK-51
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 19 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 13.3 Ft.
16. DATE HOLE STARTED: 10/04/95 COMPLETED: 10/05/95
17. ELEVATION TOP OF HOLE: 11.24 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 53.4 %
19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
11.2	.0					11.2	
			Augered from elevation 23.2 to -20.8 feet. (For description and classification see companion log CB-PNM-46)				
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-PNM-46D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 11.24 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5
-11.3	22.5						
-32.8	44.0		SAND, silty,clay traces, medium grained, quartz, pale yellow to olive. (SM)	83	1	SPLIT SPOON -34.3	9, 15, 20
				72	2	-35.8	10, 13, 17
				67	3		14, 76
			LIMESTONE, unconsolidated, macerated fossiliferous, highly weathered, (saprolite) few microfossils.	39	4	-38.6 (continued)	

Hole No.CB-PNM-46D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 11.24 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-38.8	50.0					-38.8	
			sampled as CLAY, silty, little sand, calcareous, some calcite concretions, few gravel size limestone fragments, pale olive. (CL)	83	5	" -40.3	12 24 37
			Calcareous with very few fossils and gravel size limestone fragments from 48 to 54 feet.	44	6	" -41.8	19 37 40
				56	7	" -43.3	20 30 24
			Sampled as SILT, with gravel size limestone fragments, some calcareous sand, yellowish brown from 56 to 59 feet. (ML)	67	8	" -44.8	7 4 3
				78	9	" -46.3	2 2 2
			Sampled as SILT, sandy at 58 feet.	83	10	" -47.8	3 1 2
				72	11	" -49.3	6 29 50
			Higly fossiliferous and slighly granular at 61 feet.	83	12	" -50.8	30 50 76
				100	13	" -52.3	19 40 70
				89	14	" -53.8	36 57 80
				56	15	" -55.3	41 75 60
				67	16	" -56.8	52 79 80
				67	17	" -58.3	49 85 70
-58.3	69.5		SANDSTONE, calcareous, medium grained, unconsolidated, highly weathered, (saprolite) sampled as SAND, clayey, trace quartz sand, some subrounded limestone gravel, yellowish pale brown. (SC)	44	18	" -59.8	50 87
-60.8	72.0			39	19	" -60.8	47 75/3

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)

Ground water elevation at the time of drilling was 5.0 feet.

LAB CLASSIFICATIONS

Elev. (Ft.)	Class	WC	LL	PL	PI
-22.3	ML	34%			
-31.3	ML	55%	46	29	18

Hole No. CB-PNM-47

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT	PUERTO NUEVO CHANNELS
2. LOCATION (Coordinates or Station)	X=623552 Y= 211813
3. DRILLING AGENCY	GEOCONSULT
4. HOLE NO. (As shown on drawing title and file number)	CB-PNM-47
5. NAME OF DRILLER	H. González
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	45.0'
10. SIZE AND TYPE OF BIT	See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-45C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 30 / UNDISTURBED
14. TOTAL NUMBER CORE BOXES	2
15. ELEVATION GROUND WATER	-7.17 feet
16. DATE HOLE	STARTED 2-2-90 / COMPLETED 2-2-90
17. ELEVATION TOP OF HOLE	14.83 feet
18. TOTAL CORE RECOVERY FOR BORING	85 %
19. SIGNATURE OF INSPECTOR	Kermit Schmidt, PE

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
14.83	0.0					BIT OR BARREL Bls/6"
13.33	1.5		FILL, clay stiff, brown and gray, some sand, rock fragmts. and asphalt waste (CL)	72	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 6 6 5
10.33	4.5		Clay stiff, some sandy red, brown and gray, trace pebbles, occ. thin roots (CH)	50	2	4 6 8
			brown and gray, rust colored oxidized veins.	61	3	8 6 4
			Clay, medium to stiff, brown and gray, little sand and silt, occ. pebbles (CH)	83	4	2 3 4
				100	5	W=38% PI=46% LL=70% (CH) PL=24% 4 5 6
				94	6	2 3 4
				100	7	2 3 3
2.83	12.0			89	8	2 3 3
1.33	13.0		some silt, partly sandy	100	9	2 2 3
			clay, medium, yellowish brown, little sand and silt, gray mottled.	100	10	W=45% PI=31% LL=56% PL=26% (CH) 2 2 2
				44	11	2 2 2
-3.17	18.0			100	12	3 3 3
			olive and gray	100	13	1 2 2
-6.17	21.0			100	14	1 2 2

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 14.83 feet | Hole No. CB-PNM-47

PROJECT: PUERTO NUEVO CHANNELS | INSTALLATION: JACKSONVILLE DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL Bls/6"
-6.17	21.0'		some sand, occ. reddish brown mottled. (CH)	100	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. spl. spoon 4 4 4
-7.67	22.5'		sandy, some silt	72	16	3 3 5
-9.17	24.0'		Clay, stiff reddish brown, gray and olive, some sand, little silt, occ. pebbles	89	17	2 5 6
-10.67	25.5'		very stiff	100	18	7 8 10
-12.17	27.0'		red, gray and stiff olive, some sand.	100	19	2 3 3
-13.67	28.5'		Clay, stiff, sandy, gray, some silt, occ. pebbles, red and yellow mottled. (CL)	100	20	W=22% PI=19% LL=40% (CL) PL=21% 2 4 6
-16.67	31.5'			44	21	3 5 8
-18.17	33.0'		partly very sandy	78	22	3 5 5
-22.67	37.5'		Clay, stiff, olive gray and brown, little sand and silt (CH)	100	23	2 5 5
				78	24	3 4 7
			yellowish brown, very stiff, gray mottled.	100	25	7 9 10
-24.17	39.0'		partly sandy, stiff	100	26	4 6 7
-25.67	40.5'		Clay, sandy, stiff brown, some silt, trace fine gravel, sub-angular, oxidized veins, gray mottled (CL)	100	27	LL=40.4% PL=15.6% PI=24.8% (CL) 4 4 4
-30.17	45.0'		partly sandy, very stiff (CH)	100	28	6 10 10
			trace rock, decomposed, fine gravel size	28	29	4 5 5
				56	30	5 8 11
			Soils are field visually classified in accordance with the Unified Soils Classification System. After visual classifications, Atterberg Limits and Water Contents were obtained from the requested samples and the results are shown. Laboratory classification takes precedence over visual classifications.			

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=623,552 Y=211,813
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNM-47D
5. NAME OF DRILLER: Pablo Andino
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 76.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 76.0 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: BK-51
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 20 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: See Remarks
16. DATE HOLE STARTED: 10-2-95 COMPLETED: 10-2-95
17. ELEVATION TOP OF HOLE: 17.09 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 100 %
19. SIGNATURE OF ENGINEER: IVAN JACKSON

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
17.1	.0					17.1	
			Augered from elevation 17.1 to -28.9 Feet. (for description and classification see companion log CB-PNM-47)				
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-PNM-47D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 17.09 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-5.4	22.5						
-28.9	46.0		CLAY, stiff, high plasticity, trace fine sand, light gray, (CH)	100	1	-28.9 SPLIT SPOON SAMPLER -30.4	4, 7, 13
-31.9	49.0			100	2	-31.9	7, 8, 11
			SAND, clayey, wet, yellowish-brown, (SC)	100	3	(continued)	7, 11

22.5 25 27.5 30 32.5 35 37.5 40 42.5 45 47.5 50

Hole No.CB-PNM-47D

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 17.09 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/ .5'
-32.9	50.0						
	--		(little limestone gravel)	100	3	-33.4 "	10
				100	4	SPLIT SPOON SAMPLER	6 7 3
-34.9	52.0					-34.9	
			LIMESTONE, granular, highly weathered decomposed, (saprolite) sampled as SAND, and gravel size rock fragments, brown. (SW)	100	5	"	4 3 3
			Sampled as CLAY, some limestone sand and gravel, very soft, wet. (CL)	100	6	-36.4 "	2 2 3
			Sampled as SILT, soft, wet, yellowish-brown. (ML)	100	7	-37.9 "	2 3 5
				100	8	-39.4 "	10 18 32
				100	9	-40.9 "	12 3 4
				100	10	-42.4 "	6 9 12
				100	11	-43.9 "	10 17 26
				100	12	-45.4 "	14 29 43
				100	13	-46.9 "	22 36 47
				100	14	-48.4 "	17 32 43
				100	15	-49.9 "	13 26 57
-51.4	68.5					-51.4	
				100	16	"	16 24 39
			SAND, silty, dense, grayish-brown, (SM).	100	17	-52.9 "	21 41 36
-54.4	71.5					-54.4	
			SAND, clayey, some fine sand, moist, grayish-brown, (SC).	100	18	"	16 23 37
-55.9	73.0					-55.9	
			SANDSTONE, medium grained (saprolite) sampled as SAND, gray-brown mottled, dense, and dark gray. (SM)	100	19	"	22 41 46
			(dark gray)	100	20	"	17 29 40
-58.9	78.0					-56.9	

Soils are field visually classified accordance with the Unified Soils Classification System

140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8" ID)

Ground water elevation at drilling was -0.8 ft. After 24hrs. hole collapse

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-PNM-47D

Hole No.CB-PNM-55

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 3

1. PROJECT: RIO PUERTO NUEVO PROJECT	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=623,980 Y=211,325	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: SUELOS INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-750
4. HOLE NO. (As shown on drawing title and file number): CB-PNM-55	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 50 undisturbed: 0
5. NAME OF DRILLER: PABLO ANDINO	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 1.5 Ft.
7. THICKNESS OF BURDEN: 75.0 Ft.	16. DATE HOLE STARTED: 10/05/95 COMPLETED: 10/06/95
8. DEPTH DRILLED INTO ROCK: 0 Ft.	17. ELEVATION TOP OF HOLE: 7.49 Ft.
9. TOTAL DEPTH OF HOLE: 75 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 67.8 %
	19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
7.5	.0					7.5	
6.0	1.5		SILT, little sand, abundant roots content, brown. (ML)	44	1	SPLIT SPOON 6.0	1 2 2
			CLAY, sandy, light brown. (CL)	100	2	" 4.5	2 3 4
				100	3	" 3.0	2 3 4
			Trace fine gravel at 5 feet.	100	4	" 1.5	2 2 3
.0	7.5		SAND, silty, fine grained, light brown. (SM)	100	5	" .0	1 2 2
-1.5	9.0		SILT, organic, some roots and other organic material, gray. (OL)	66	6	" -1.5	2 7 2
			SAND, little silt, coarse grained, mostly wet, brownish light gray. (SP)	66	7	" -3.0	1 WH 1
				55	8	" -4.5	1 WH 1
-6.0	13.5			100	9	" -6.0	1 2 4
-7.5	15.0		CLAY, sandy, trace silt, yellowish brown. (CL)	100	10	" -7.5	2 3 6
			SAND, clayey, coarse grained, yellowish brown. (SC)	100	11	" -9.0	2 3 4
-10.5	18.0			100	12	" -10.5	3 5 7
			SAND, silty, little clay, light reddish brown. (SM) Medium grained quartz sands at 20 feet.	100	13	" -12.0	2 3 5
-13.5	21.0			100	14	" -13.5	1 3 5
			SAND coarse grained, highly quartzose, yellowish light brown. (SP)	100	15	" -15.0	1 2 4
						(continued)	

0 — 2.5 — 5 — 7.5 — 10 — 12.5 — 15 — 17.5 — 20 — 22.5

Hole No.CB-PNM-55

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 7.49 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/6"
-15.0	22.5					-15.0	
				100	16	"	2 3 5
-16.5	24.0					-16.5	
			SAND, clayey, little silt, brownish red. (SC)	100	17	"	2 2 5
						-18.0	
				100	18	"	4 5 7
						-19.5	
				100	19	"	4 5 8
			Occasional fine gravel at 29 feet.			-21.0	
				100	20	"	4 6 8
-22.5	30.0					-22.5	
			SAND, silty, little clay, coarse grained, highly quartzose, yellowish brown. (SM)	100	21	"	1 2 4
-24.0	31.5					-24.0	
			LIMESTONE, impure, granular, highly weathered to decomposed, sampled as SAND, coarse grained, calcareous with gravel size limestone fragments, pale yellow. (SW)	100	22	"	6 14 19
-25.5	33.0					-25.5	
			SAND, silty, little clay, coarse grained, highly quartzose, moderately consolidated, pale yellow. (SP-SM)	100	23	"	9 35 45
						-27.0	
			Quartz sand with calcareous matrix from 33 to 44 feet.	100	24	"	20 30 52
						-28.5	
				100	25	"	25 37 52
						-30.0	
				100	26	"	30 40 30
						-31.5	
				55	27	"	15 7 8
			Some cementation at 41 feet.			-33.0	
				77	28	"	12 25 50
						-34.5	
				88	29	"	12 22 44
						-36.0	
				100	30	"	11 17 22
			Non-calcareous from 44 to 54 feet.			-37.5	
				100	31	"	10 12 24
						-39.0	
				100	32	"	15 27 45
						-40.5	
				100	33	"	15 19 25
						-42.0	
				77	34		12
						(continued)	

Hole No.CB-PNM-55

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 7.49 Ft.

SHEET 3 OF 3

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/5"
-42.5	50.0						
				77	34	" -43.5	15 40
				100	35	" -45.0	50 75/2
				100	36	" -46.5	20 25 70
-46.5	54.0		LIMESTONE, impure, marly, granular, occasional re-crystalized fossils, unconsolidated, sampled as SAND, silty, with gravel size limestone fragments, yellowish brown. (SM)	100	37	" -48.0	15 31 65
				100	38	" -49.5	46 75/3
				100	39	" -51.0	24 31 65
				100	40	" -52.5	35 50 70
-53.5	61.0			100	41	" -54.0	40 52 79
			SAND, silty, little clay, coarse grained, with calcareous matrix, highly quartzose, moderately consolidated, pale yellow. (SP-SM)	100	42	" -55.5	26 49 71
				100	43	" -57.0	38 23 60
				100	44	" -58.5	40 56 80
-60.0	67.5			100	45	" -60.0	50 90
			LIMESTONE, marly, unconsolidated, some calcite concretions, sampled as SILT, sandy, little clay, calcareous, olive gray. (ML)	100	46	" -61.5	45 75
				77	47	" -63.0	10 15 23
				100	48	" -64.5	6 9 21
-64.5	72.0						
			CLAY, sandy, trace silt, moderately consolidated, moderately to slightly calcareous, light olive. (CL)	100	49	" -66.0	30 50 70
				100	50	" -67.5	25 38 50
-67.5	75.0						
			END OF HOLE. 75 Ft.				

140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8" I.D. X 2" O. D.)

Soils are field visually classified in accordance with the Unified Soils Classification System

Ground water elevation at the time of drilling was 3.5 feet.

LAB CLASSIFICATIONS

Elev. (Ft.)	Class.	Wn	LL	PL	PI
7.5	MH	49%	55	32	23
4.5	CH	34%	56	28	28
-18.0	CL	19%	38	18	20

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-PNM-55

Hole No.CB-PNM-56

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

SHEET 1 OF 3

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=624,922 Y=210,962
3. DRILLING AGENCY: SUELOS INC.
4. HOLE NO. (As shown on drawing title and file number): CB-PNM-56
5. NAME OF DRILLER: JOSE AYALA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 70.5 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 70.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: ACKER AD-II
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 47 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 2.3 Ft.
16. DATE HOLE STARTED: 10/09/95 COMPLETED: 10/10/95
17. ELEVATION TOP OF HOLE: 13.0 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 82 %
19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
13.0	.0					13.0	
			SAND, clayey, little silt, few roots, trace fine gravel, brown. (SC)	67	1	SPLIT SPOON	1, 3, 5
			Some large wood pieces at 2.0 feet.			11.5	
				56	2	"	3, 4, 2
						10.0	
				22	3	"	1, 2, 3
8.0	5.0					8.5	
			SAND, silty, medium grained, few roots and small wood pieces, olive brown. (SW-SM)	83	4	"	2, 2, 2
						7.0	
				100	5	"	2, 2, 3
			Fine grained from 6 to 9 feet.			5.5	
				61	6	"	1, 1, 1
4.0	9.0					4.0	
			SILT, little clay, slightly organic, trace fine sand, olive gray. (ML)	33	7	"	1, 1, 2
2.5	10.5					2.5	
			SAND, silty, moderately organic, fine grained, high water content, olive gray. (SM)	100	8	"	1, 2, 2
						1.0	
				100	9	"	2, 2, 3
						-.5	
				100	10	"	3, 4, 5
			Coarse grained and organic from 15 to 18 feet.			-2.0	
				100	11	"	1, 2, 3
						-3.5	
				89	12	"	6, 8, 10
			Some fine gravel at 19 feet.			-5.0	
				100	13	"	6, 8, 12
-6.5	19.5					-6.5	
			SAND, clayey, reddish brown. (SC)	100	14	"	6, 3, 4
						-8.0	
				100	15	"	6, 8, 12
-9.5	22.5					-9.5	
						(continued)	

Hole No.CB-PNM-56

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE 13.0 Ft. | SHEET 2 OF 3

PROJECT: RIO PUERTO NUEVO PROJECT | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-9.5	22.5					-9.5	
			CLAY, reddish brown and light gray. (CL)	100	16	" -11.0	5 8 11
				100	17	" -12.5	5 6 8
				83	18	" -14.0	6 8 10
				100	19	" -15.5	7 7 7
				100	20	" -17.0	3 5 7
				100	21	" -18.5	2 4 5
			Little silt at 32 feet.	100	22	" -20.0	3 4 5
-20.0	33.0		SAND, silty, little clay, medium grained, brown. (SW-SM)	100	23	" -21.5	2 3 5
			Trace fine gravel at 35 feet.	67	24	" -23.0	1 1 2
-23.0	36.0		SAND, clayey, medium grained, reddish brown. (SC)	83	25	" -24.5	2 2 3
				100	26	" -26.0	2 3 4
-26.0	39.0		CLAY, silty, trace fine sand, brown. (CL)	83	27	" -27.5	4 7 8
				56	28	" -29.0	5 6 4
-29.0	42.0		SILT, clayey, trace fine sand, brown. (MH)	72	29	" -30.5	6 10 10
-30.5	43.5		CLAY, light gray. (CL)	100	30	" -32.0	7 8 12
			Few sandy clay pockets from 43 to 47 feet.	39	31	" -33.5	3 6 11
				39	32	" -35.0	6 7 9
				100	33	" -36.5	6 9 11
				100	34	"	6
						(continued)	

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 13.0 Ft.

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
-37.0	50.0						
				100	34	"	9 12
						-38.0	
				100	35	"	8 9 15
						-39.5	
				100	36	"	6 8 14
-41.0	54.0					-41.0	
			SAND, clayey, medium grained, trace oxidation, brown. (SC) Quartzous at 54 feet.	69	37	"	2 4 6
						-42.5	
				83	38	"	4 7 10
						-44.0	
				69	39	"	5 7 9
						-45.5	
				83	40	"	6 8 12
-47.0	60.0					-47.0	
			CLAY, little sand, brown. (CL) Silty at 60 feet.	44	41	"	3 6 9
						-48.5	
				56	42	"	8 13 14
-50.0	63.0					-50.0	
			SAND, clayey, fine grained, slightly quartzous, reddish light brown and purple. (SC)	50	43	"	8 10 19
						-51.5	
				100	44	"	9 16 21
						-53.0	
				83	45	"	10 16 24
			Little silt at 68 feet.			-54.5	
				83	46	"	10 17 30
						-56.0	
				83	47	"	20 22 35
-57.5	70.5					-57.5	
			END OF HOLE, 70.5 Ft.				

Soils are field visually classified in accordance with the Unified Soil Classification System.

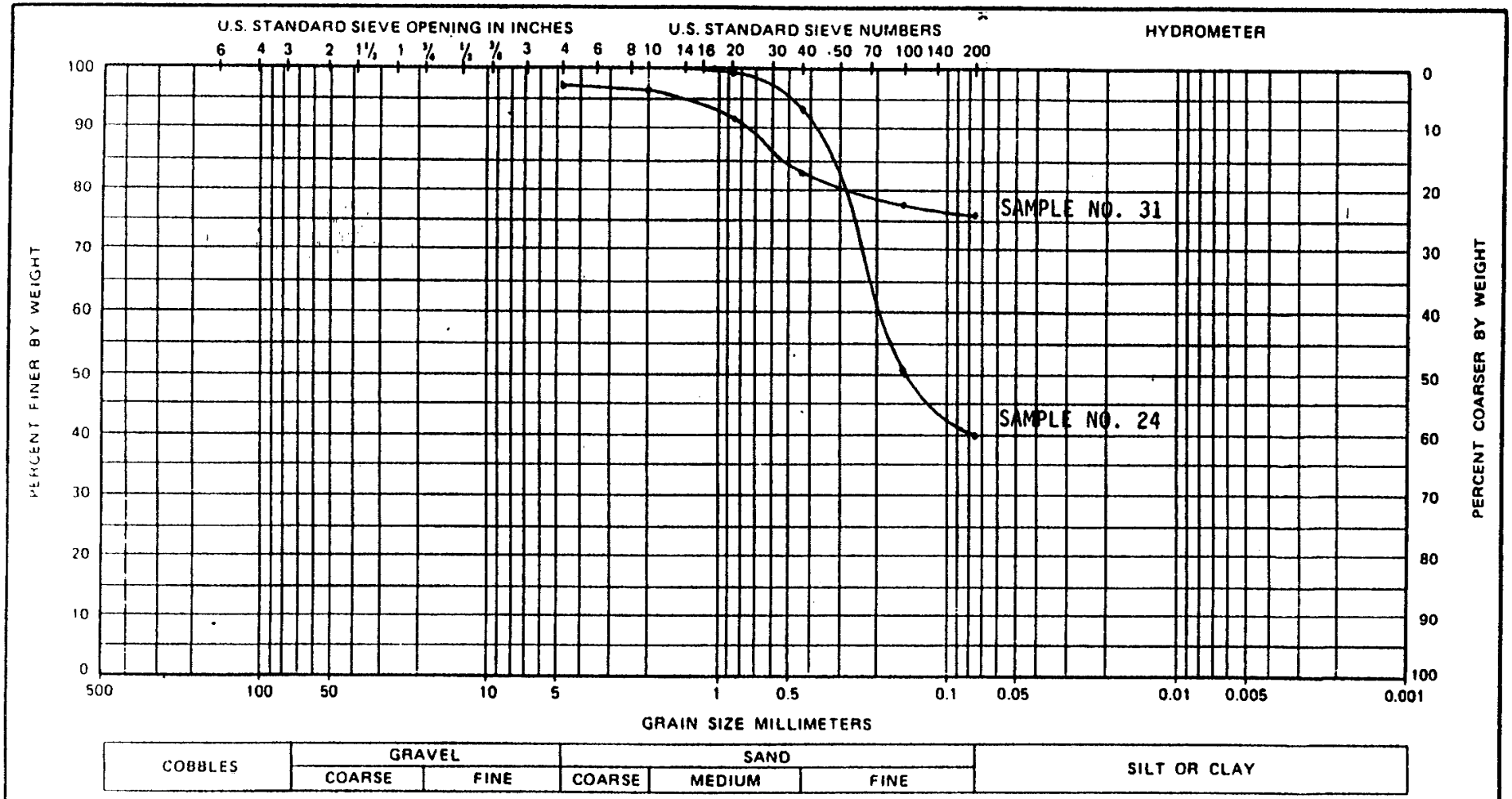
140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)

Ground water elevation at the time of drilling was -2 feet.

LAB CLASSIFICATIONS

Elev. (Ft.)	Class.	Wn	LL	PL	PI
11.0	ML	26%			
7.0	ML	46%			
4.0	ML	40%			
-20.0	ML	46%			

GRADATION CURVES



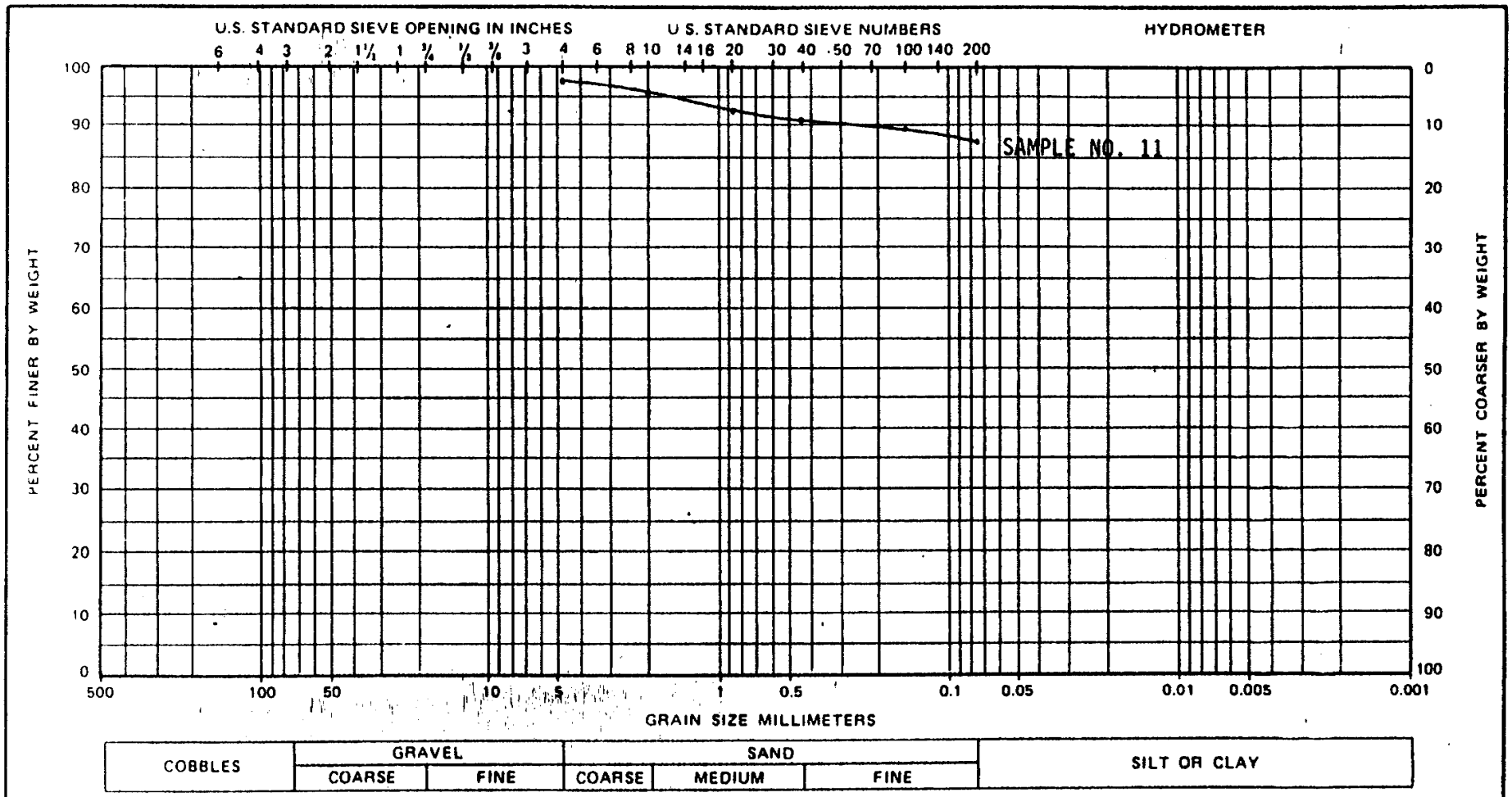
SAMPLE NO	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
15	21'-22.5'	CH		99.8	27.6	72.2
24	35.5'-37'	SC				
30	44.5'-46'	CH	38.0	100.0	29.9	70.1
31	46'-47.5'	CH				

PROJECT MARGARITA CHANNEL, PUERTO NUEVO CHANNELS PROJECT, SAN JUAN, P.R.

AREA CB-MC-30

GEO CIM
Geotechnical Testing Services
P. O. Box 447 Hato Rey, P. R. 00919

GRADATION CURVES



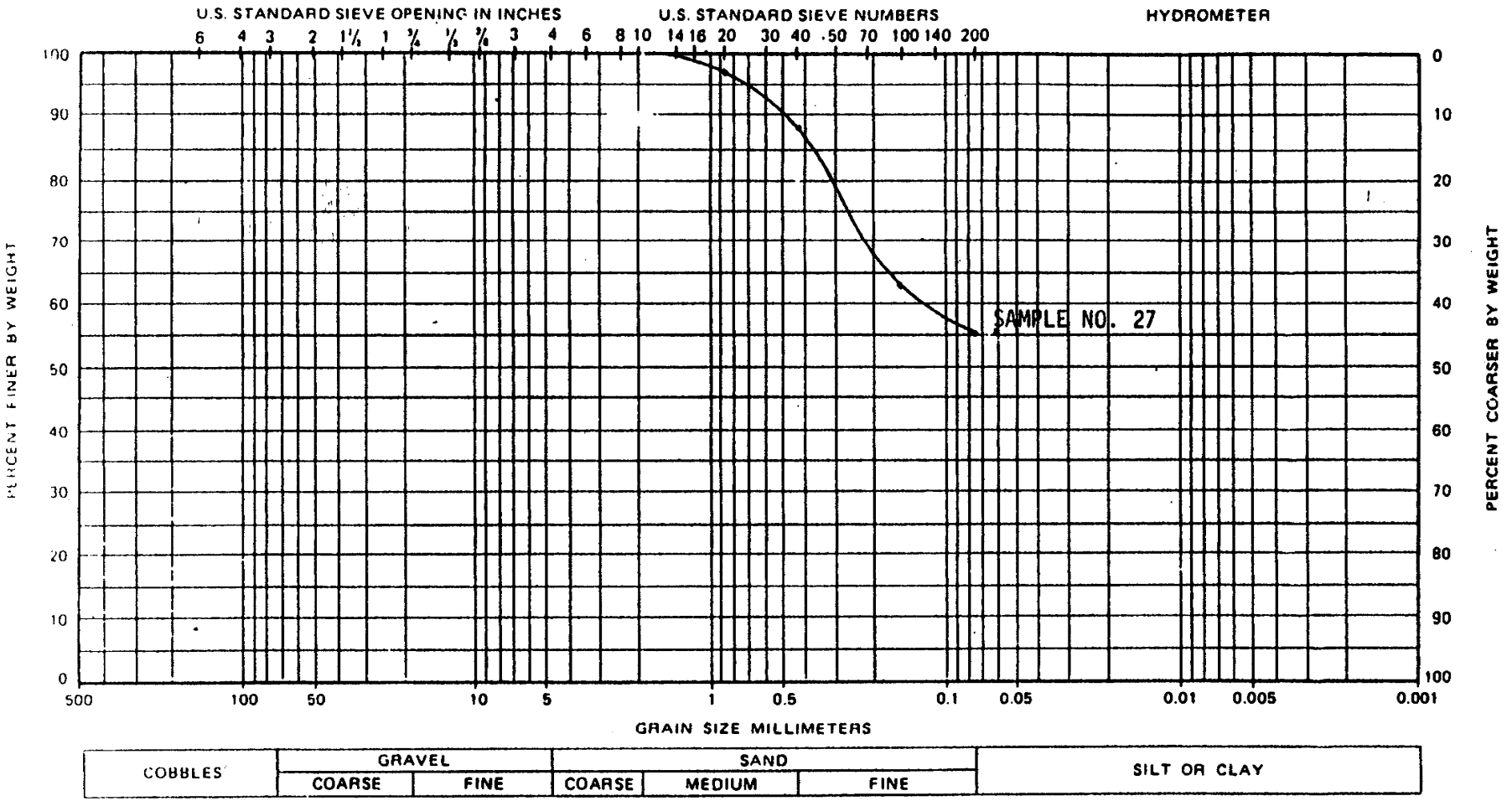
SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
6	7.5'-9'	CH	110.7	145.4	46.7	98.7
10	13.5-15'	CH	81.7	112.0	35.0	77.0
11	15'-16.5'	CH				

PROJECT MARGARITA CHANNEL, PUERTO NUEVO CHANNELS PROJECT, SAN JUAN, P.R.

AREA CB-MC-31

GEO CIM
Geotechnical Testing Services
P. O. Box 447 Hato Rey, P. R. 00919

GRADATION CURVES



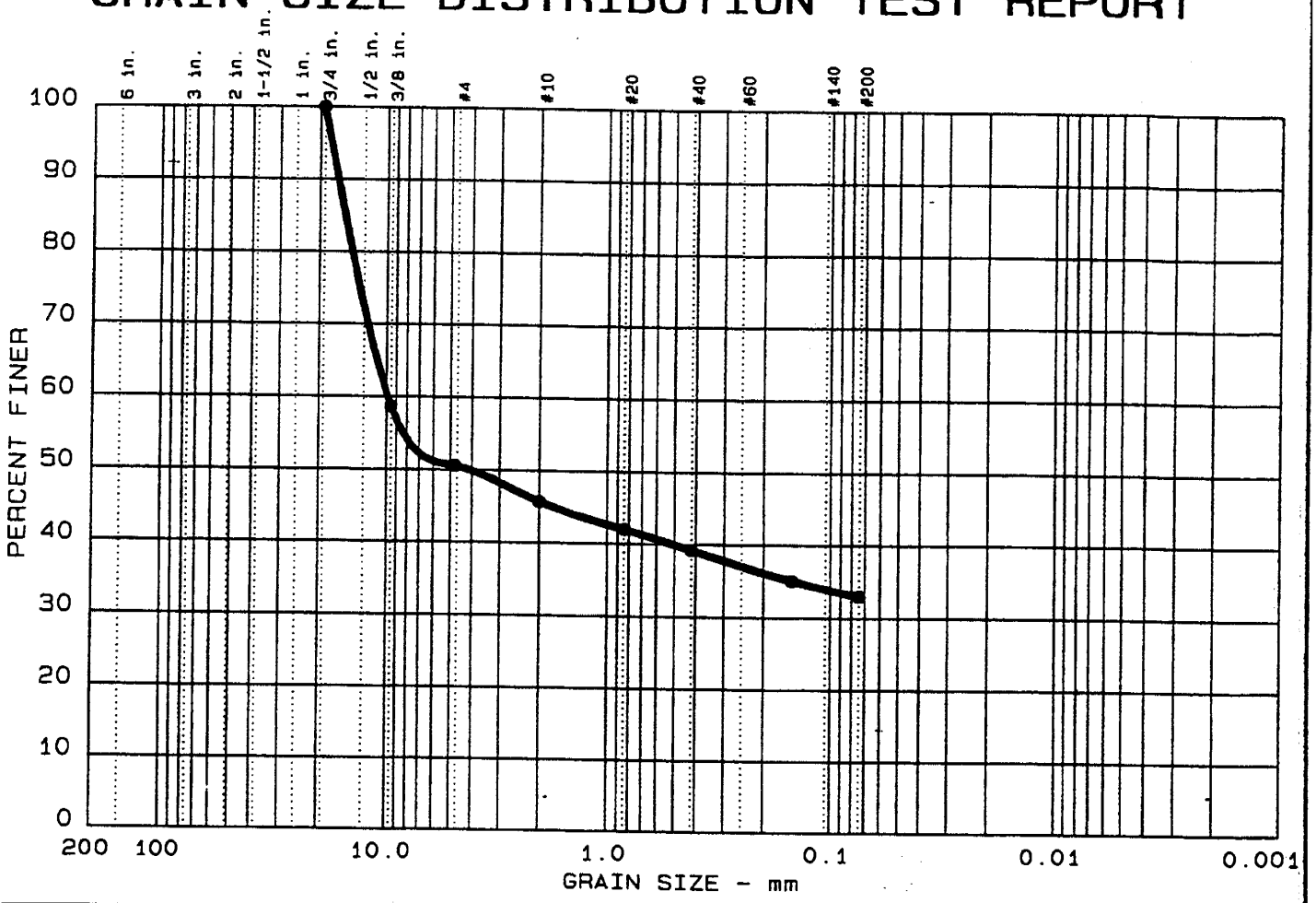
SAMPLE NO	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
18	25.5'-27'	CH		90.2	29.3	70.9
23	33'-34.5'	CH	32.0	106.0	27.0	79.0
27	39'-40.5'	CH-SC				

PROJECT MARGARITA CHANNEL, PUERTO NUEVO CHANNELS PROJECT, SAN JUAN, P.R.

AREA CB-MC-32

GEO CIM
Geotechnical Testing Services
P. O. Box 447 Hato Rey, P. R. 00919

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	49.5	17.5	33.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			15.40	9.83	4.05					

MATERIAL DESCRIPTION	USCS	AASHTO
● **GRAVEL, SOME SILT, LITTLE SAND, LIGHT BROWN**	**GM**	

Project No.:

Project: RIO PUERTO NUEVO

● Location: **CB-MC-32D**
SAMPLE 2

Date: 1-2-96

Remarks:

MOIST. CONT.: 38%

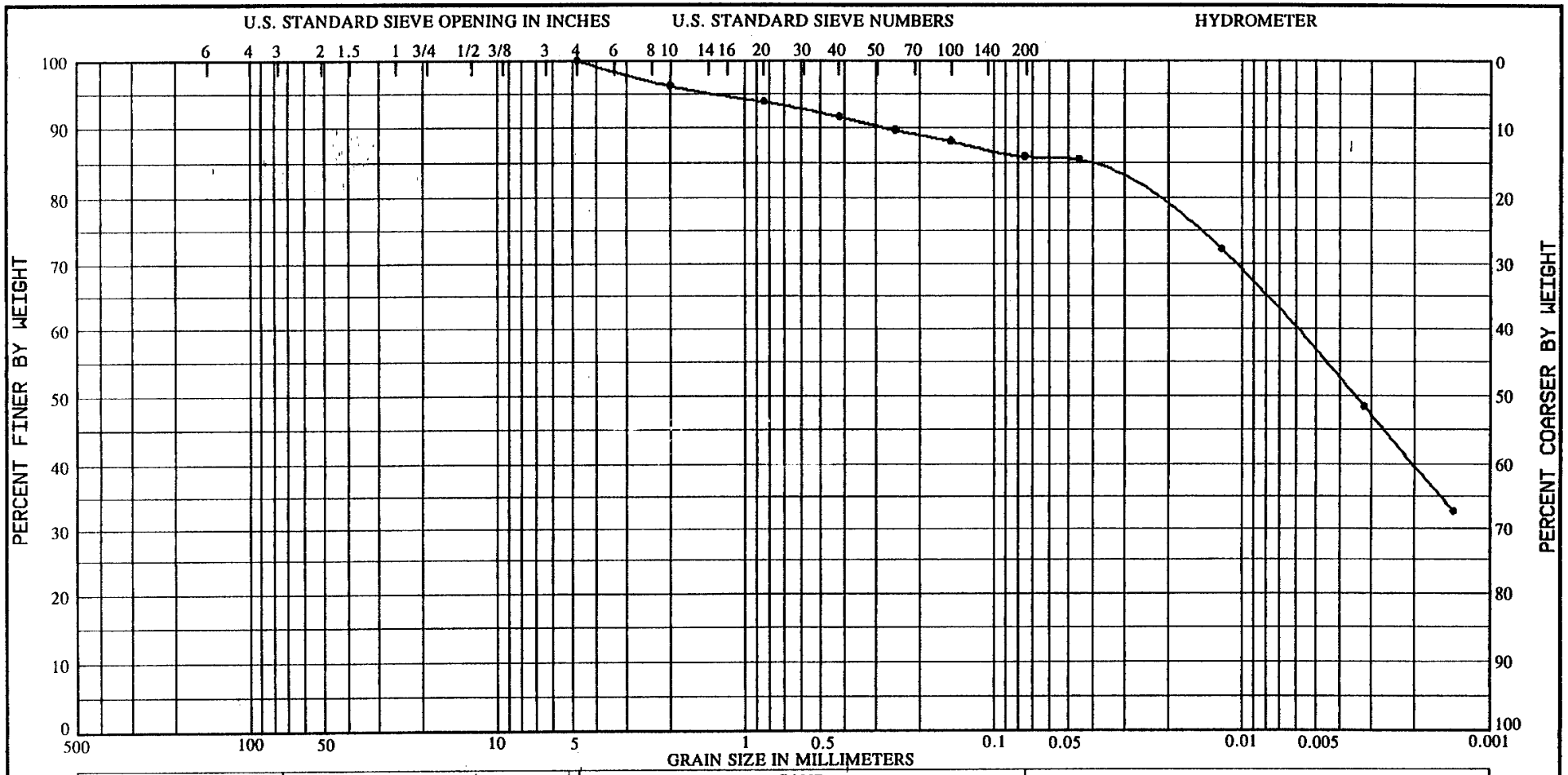
GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Figure No. _____

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
1	11.5-13.5	DK. GRAY, FAT CLAY (CH), WITH A LITTLE SAND SIZES AND A TRACE OF ORGANIC MATTER.	86.4	104	35	69

Project RIO PUERTO NEUVO

Lab No. 73/7151

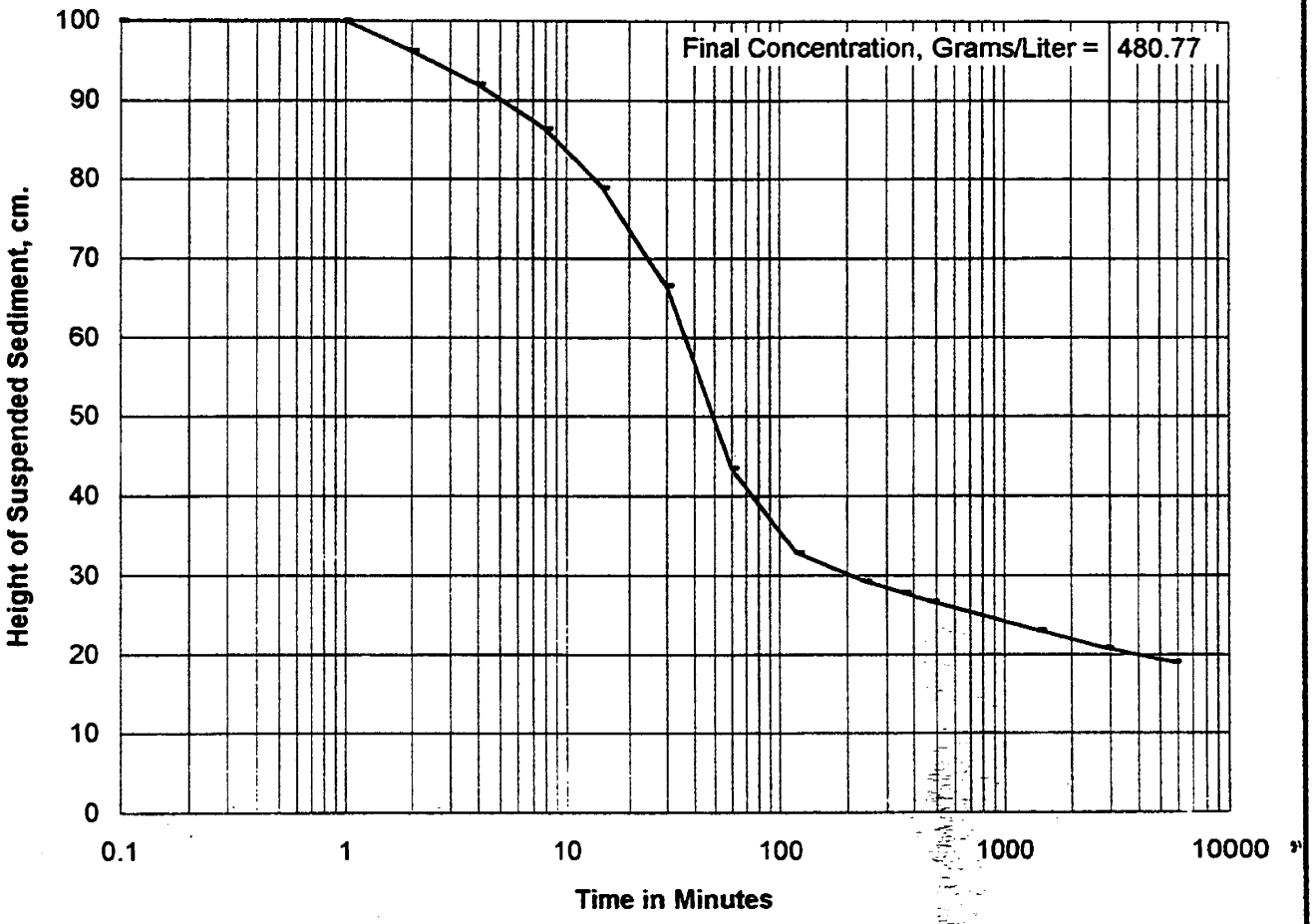
Boring No. CB-MC-32U

Date 11/08/95

GRADATION CURVES

U.S. ARMY CORPS OF ENGINEERS
SOUTH ATLANTIC DIVISION LABORATORY
MARIETTA, GEORGIA

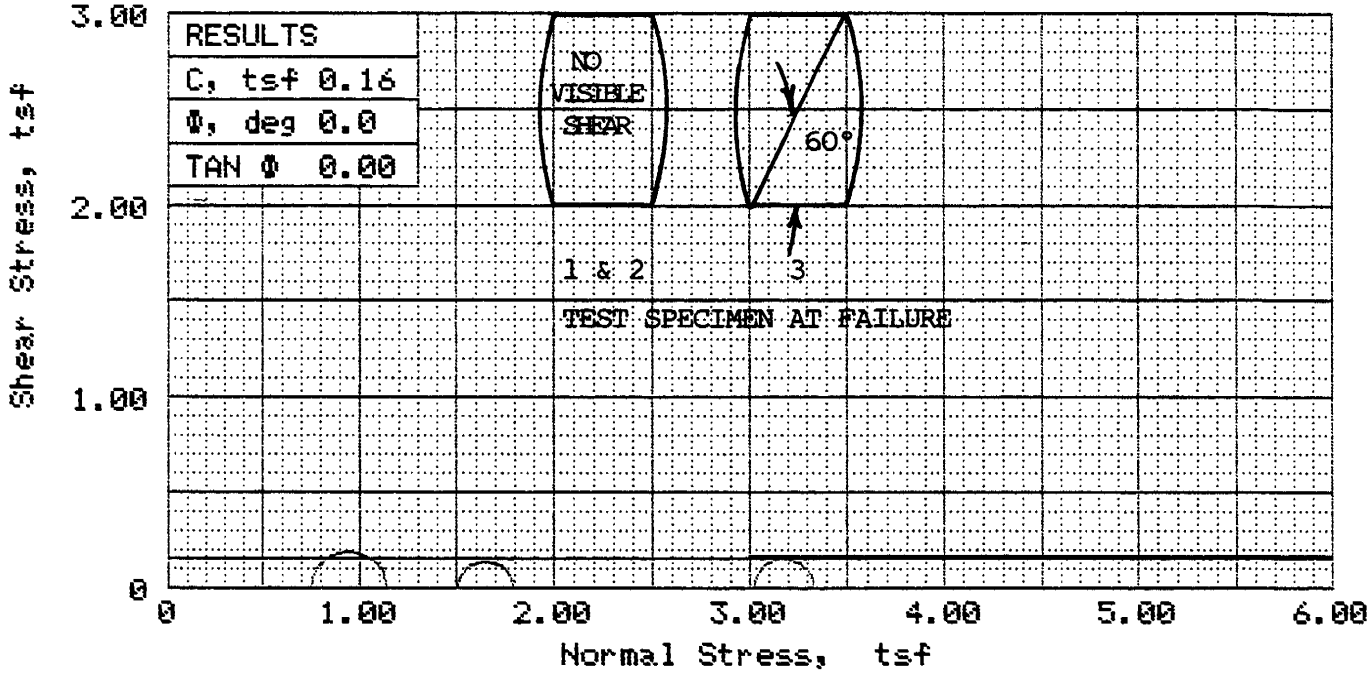
SUSPENDED SEDIMENT-TIME CURVE

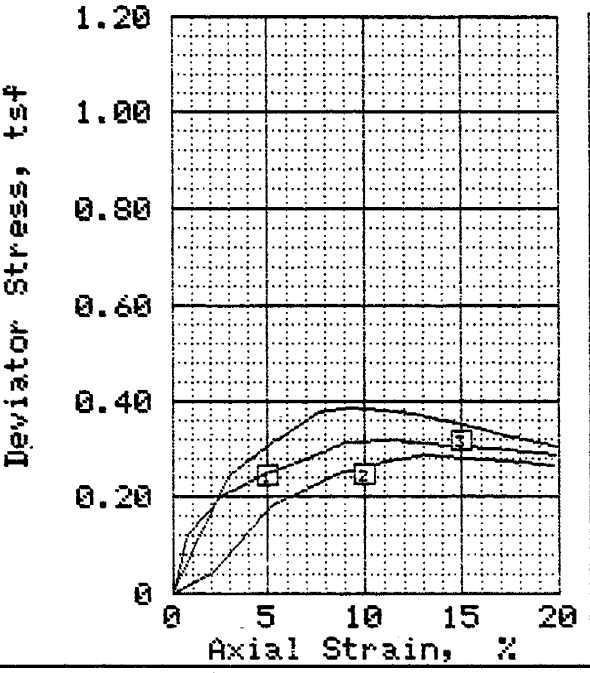


NOTES:
1. Test specimens (100 grams/ liter ,moist weight of specimen) suspended in sea water(salinity about 11 ppT) in 100 cm. long bottom withdrawal tubes.
2. Suspended sediment-time curves represent the contact surface between the sediment still in suspension and the "clear" water on top at the elapsed time indicated.
3. See grain-size data on enclosed gradation curve.
4. Percent Solids = 54.50

PROJECT	RIO PUERTO NEUVO	REQ'N NO.	RM-CW-96-0038
		W.O. NO.	7825
AREA		DATE RECEIVED	16 OCT. 1995
		DATE REPORTED	13-Nov-95
BORING NO.	CB-MC-32U	DEPTH	11.5 - 13.5'
SAMPLE NO.	1	LAB NO.	73/7151

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	83.0	83.3	84.2
	DRY DENSITY, pcf	51.1	50.4	50.5
	SATURATION, %	97.4	96.1	97.3
	VOID RATIO	2.301	2.343	2.337
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	83.0	83.3	84.2
	DRY DENSITY, pcf	51.1	50.4	50.5
	SATURATION, %	97.4	96.1	97.3
	VOID RATIO	2.301	2.343	2.337
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		0.76	1.51	3.02
MAX. DEV. STRESS, tsf		0.38	0.28	0.32
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		11	15	16
RATE, %/min.		0.85	0.87	0.72
ULT. DEV. STRESS, tsf		0.35	0.28	0.30

DESCRIPTION DK. GRAY, FAT CLAY (CH), WITH A LITTLE SAND SIZES AND A TRACE OF ORGANIC MATTER.

LL= 104	PL= 35	PI= 69	Gs= 2.70	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Q

REMARKS

PROJECT RIO PUERTO NEUVO

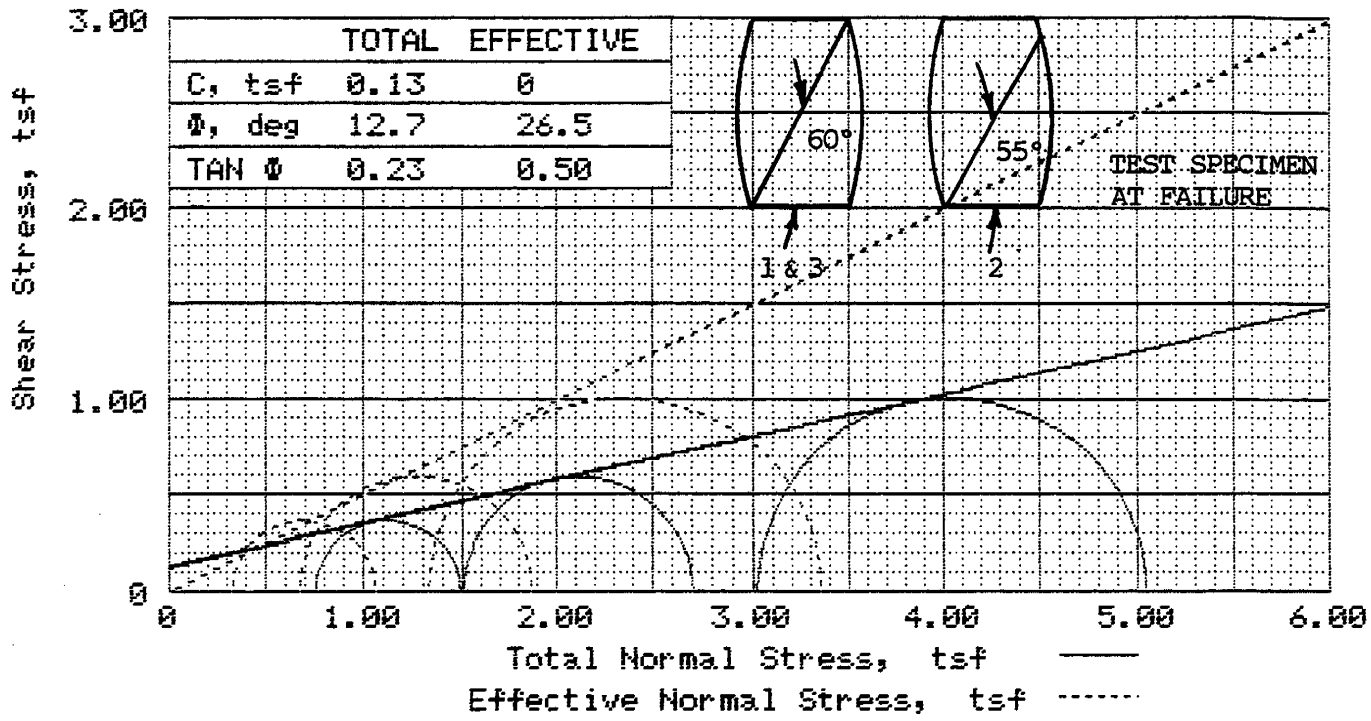
AREA

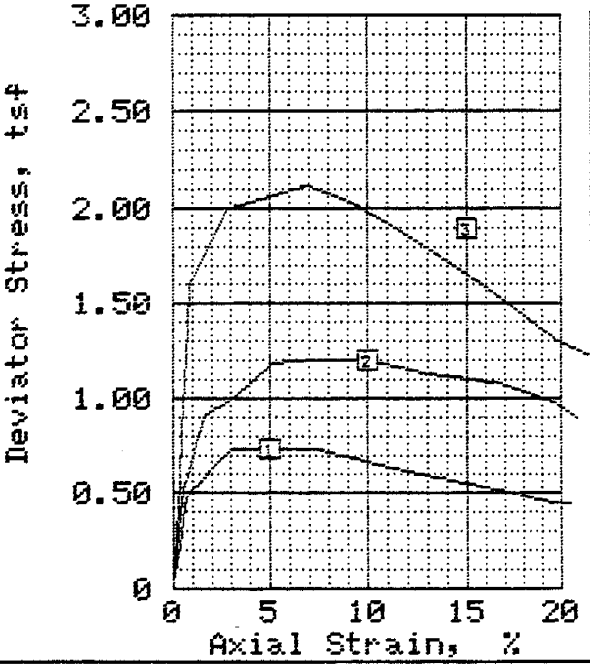
LAB NO. 73/7151

BORING NO. CB-MC-32U
SAMPLE NO. 1
DEPTH/~~ELEV~~ 11.5 - 13.5'
LABORATORY CESAD-EN-FL DATE 4 NOV. 1995

TRIAXIAL COMPRESSION TEST

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENG ERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	88.7	90.6	88.3
	DRY DENSITY, pcf	48.8	48.3	49.0
	SATURATION, %	97.5	98.2	97.6
	VOID RATIO	2.455	2.490	2.443
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	72.6	64.7	53.6
	DRY DENSITY, pcf	56.9	61.4	68.9
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.961	1.747	1.447
	DIAMETER, in	1.31	1.27	1.23
	HEIGHT, in	2.93	2.85	2.76
BACK PRESSURE, tsf		5.04	5.04	5.04
INIT. EFF. STR., tsf		0.76	1.51	3.02
MAX. DEV. STRESS, tsf		0.74	1.20	2.02
PORE PRESSURE, tsf		0.42	0.84	1.69
TIME TO FAILURE, min.		75	65	55
RATE, %/min.		0.10	0.11	0.
ULT. DEV. STRESS, tsf		0.54	1.10	1.65

DESCRIPTION DK. GRAY, FAT CLAY (CH), WITH A LITTLE SAND SIZES AND A TRACE OF ORGANIC MATTER.

LL= 104	PL= 35	PI= 69	Gs= 2.70	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST R w/pore pressures

REMARKS

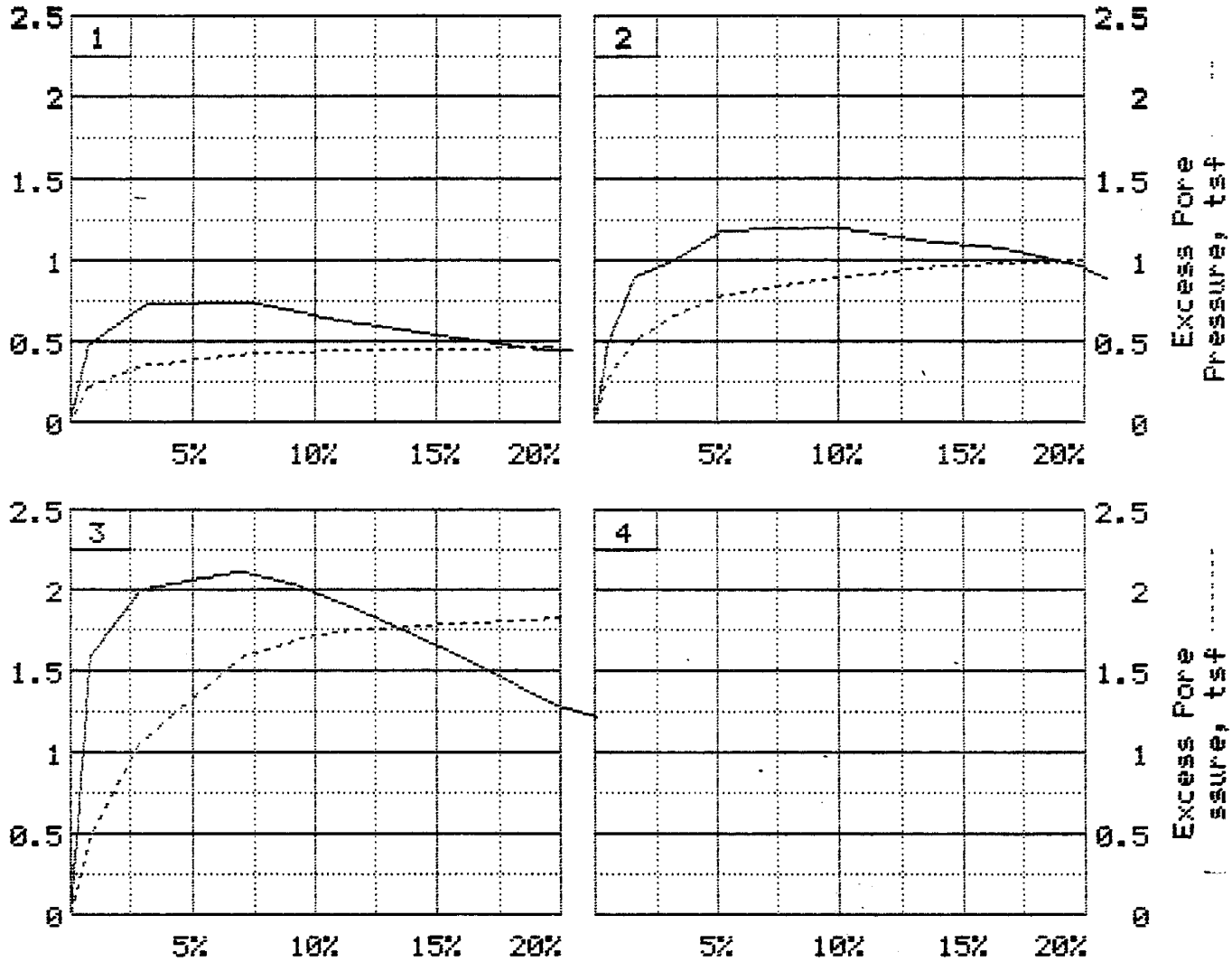
PROJECT RIO PUERTO NEUVO

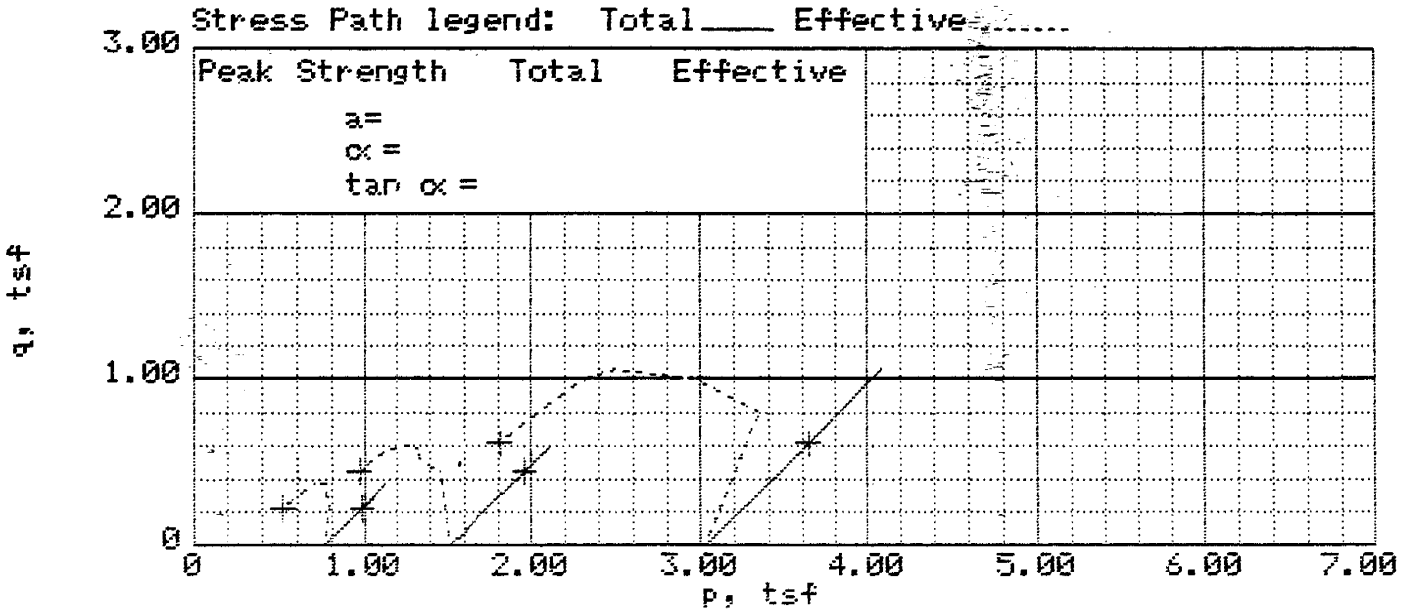
AREA

LAB NO. 73/7151

BORING NO. CB-MC-32U
SAMPLE NO. 1
DEPTH/~~ELEV~~ 11.5 - 13.5'
LABORATORY CESAD-EN-FL DATE 13 NOV. 1995

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825

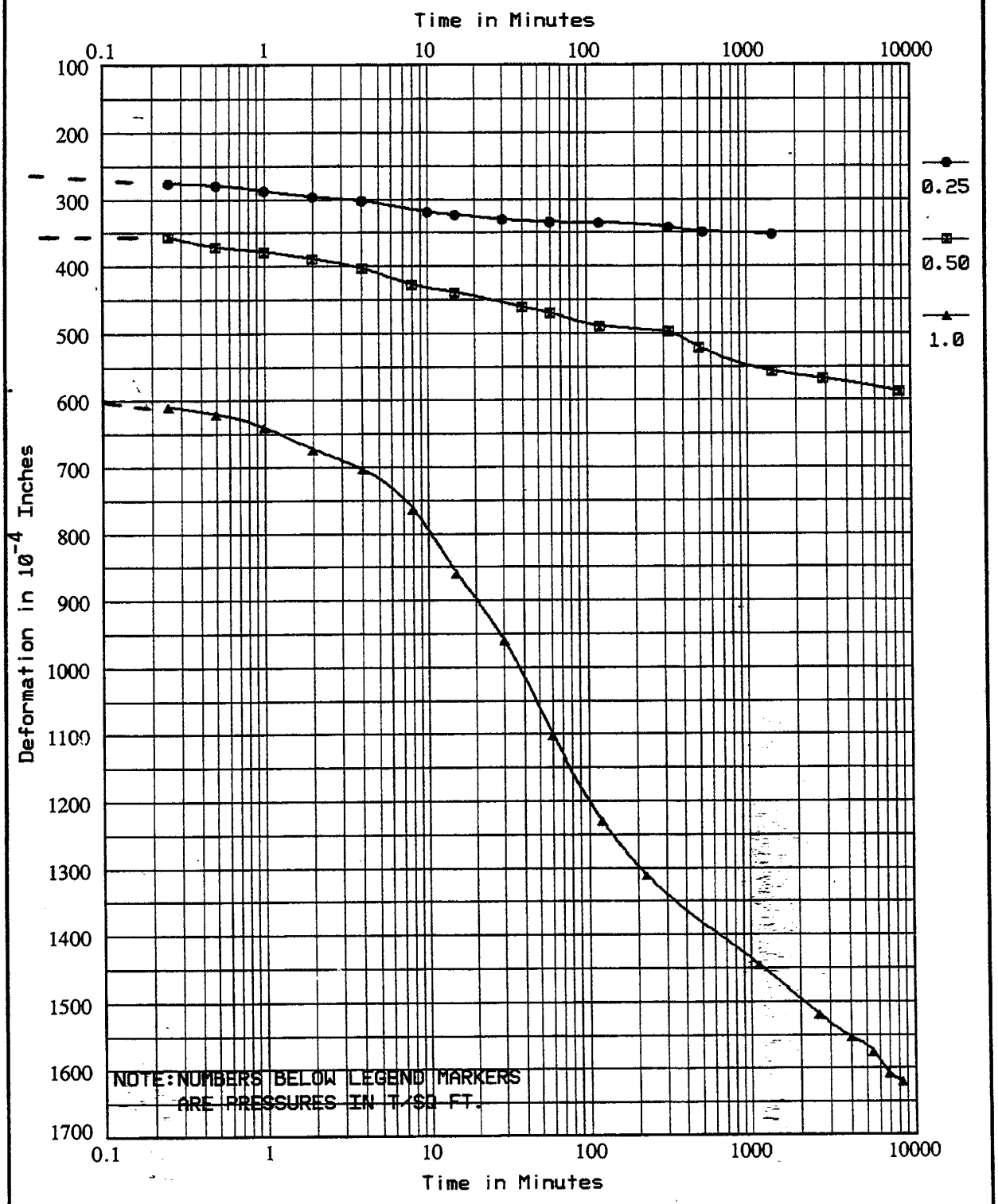




PROJECT RIO PUERTO NEUVO
BORING CB-MC-32U SAMPLE 1 DEPTH/~~ELEV~~ 11.5 - 13.5'
TYPE OF TEST R w/pore pressures LAB NO. 73/7151
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 13 NOV. 1995

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038

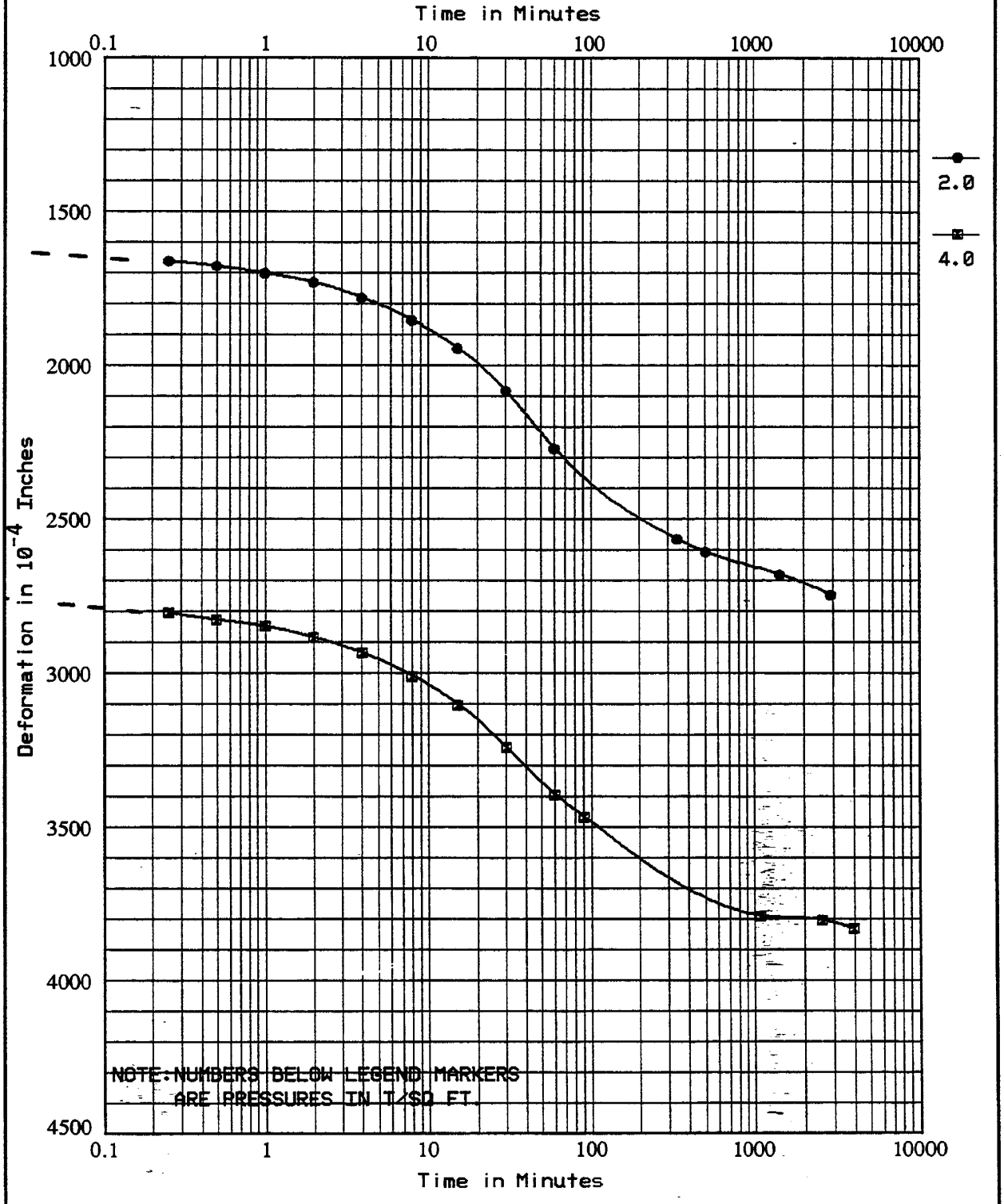


Project RIO PUERTO NEUVO			
Area			Lab No. 73/7151
Boring No. CB-MC-32U	Sample No. 1	Depth (ft) 11.5-13.5	Date 02/21/96

CONSOLIDATION TEST - TIME CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038



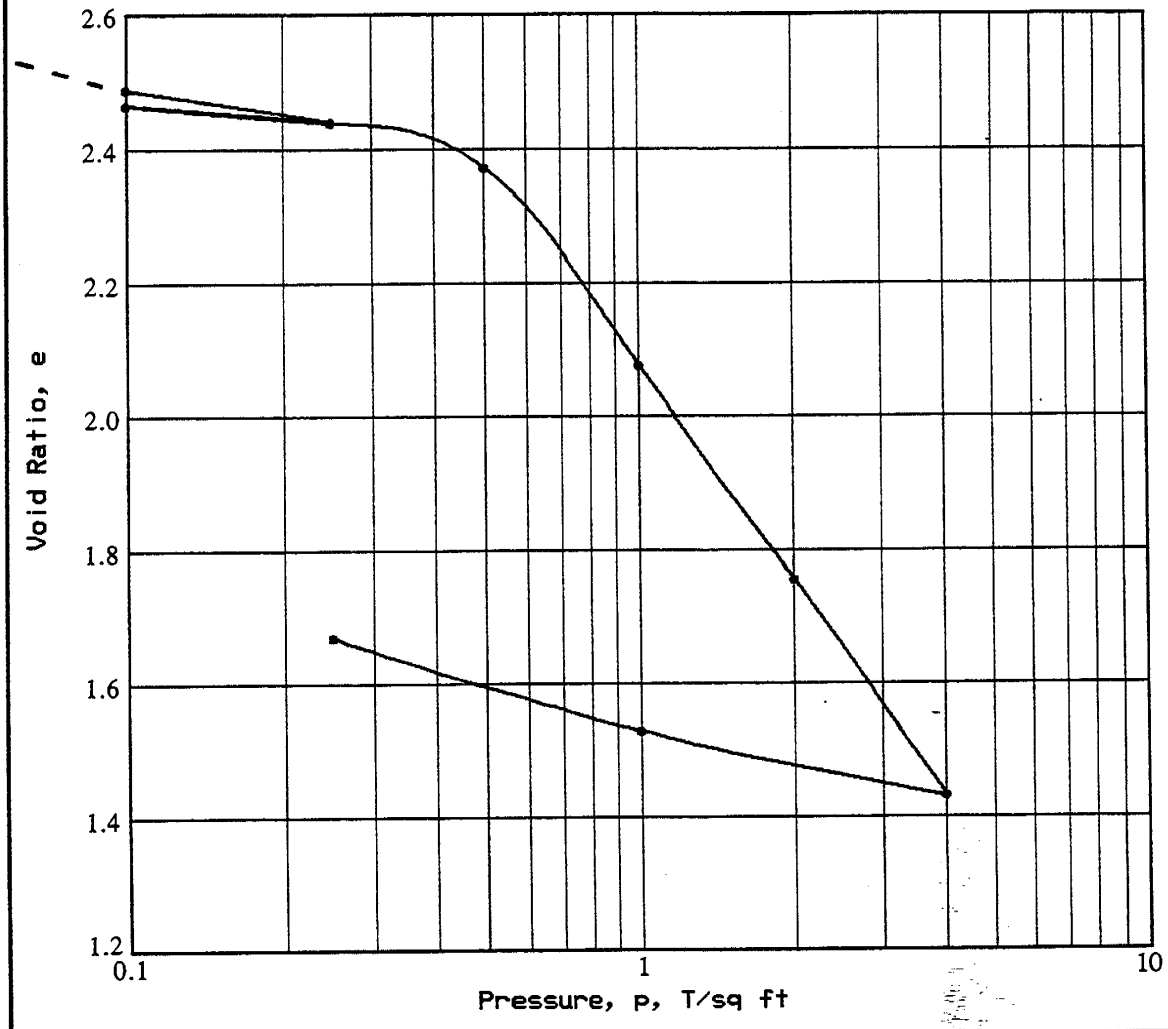
Project RIO PUERTO NEUVO			
Area			Lab No. 73/7151
Boring No. CB-MC-32U	Sample No. 1	Depth (ft) 11.5-13.5	Date 02/21/96

CONSOLIDATION TEST - TIME CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038

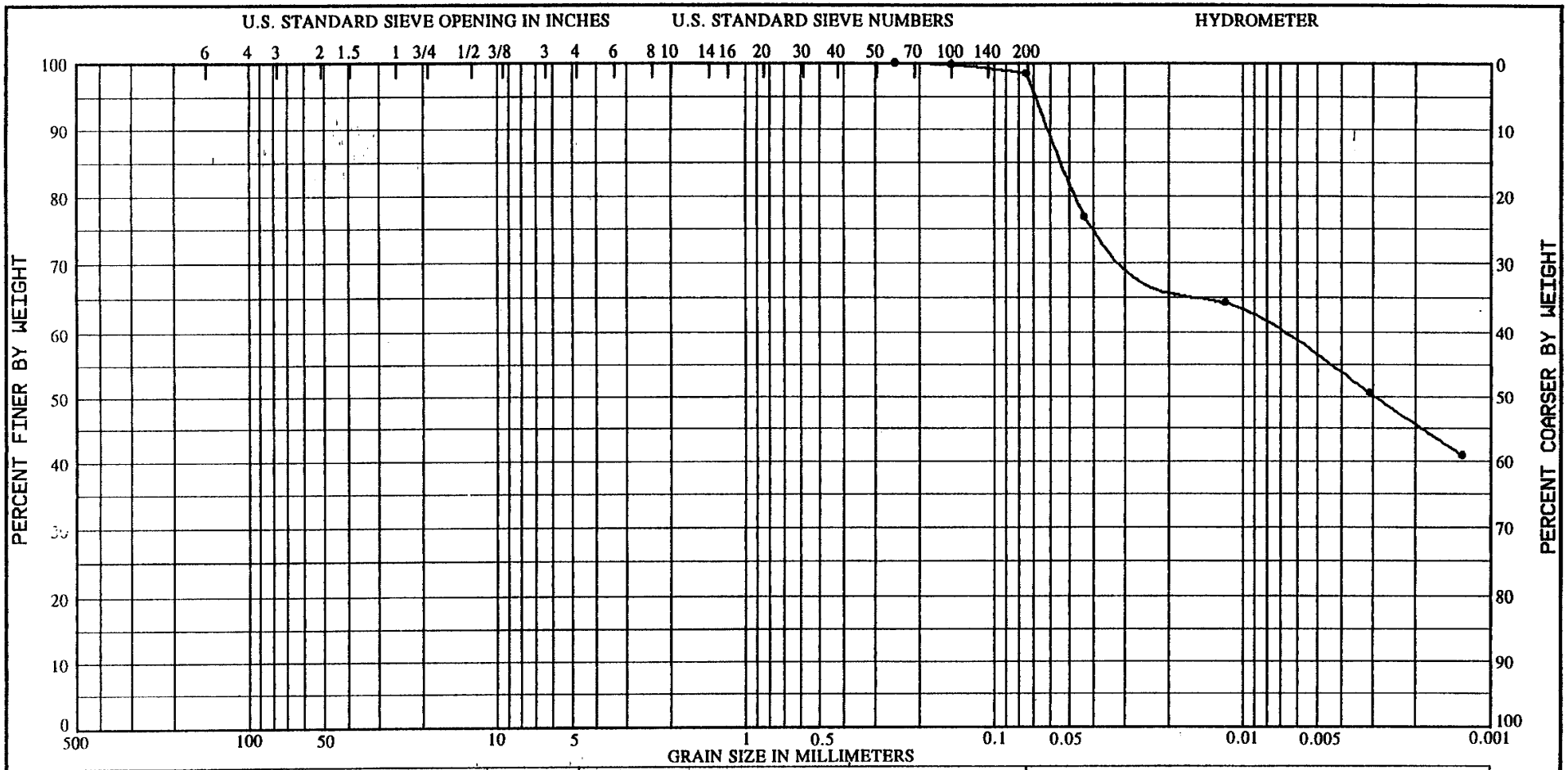
Coefficient of Permeability, k_{20}, 10^{-4} cm/sec



Type of Specimen UNDISTURBED			Before Test			After Test	
Diam. 3.990 in.	Height 1.240 in.		Water Content	w_o	93.3 %	w_f	61.8 %
Overburden Pressure, p_o	T/sq ft		Void Ratio	e_o	2.538	e_f	1.668
Preconsol. Pressure, p_c	T/sq ft		Saturation	S_o	99.2 %	S_f	100.0 %
Compression Index, C_c			Dry Density	γ_d	47.6 lb/ft^3		
Classification DK. GRAY, FAT CLAY (CH), W/ A LITTLE SAND & TRACE ORGANICS.							
LL 104	G_s 2.70	Project RIO PUERTO NEUVO					
PL 35	D_{10} <0.022MM						
Remarks 1. SPECIMEN FLOODED		Lab No. 73/7151					
OUT TEST. 2. TIME CURVES		Boring No. CB-MC-32U			Sample No. 1		
FURNISHED FOR LOADS OF 0.25,		Depth (ft) 11.5-13.5			Date 02/21/96		
0.5, 1.0, 2.0 & 4.0 T/SF.		**CONSOLIDATION TEST REPORT**					

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-98-0038



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
2	20.5-22.5	RED & GRAY, FAT CLAY (CH), WITH A TRACE	38.8	74	28	46
		OF SAND SIZES AND ORGANIC MATTER.				

Project RIO PUERTO NEUVO

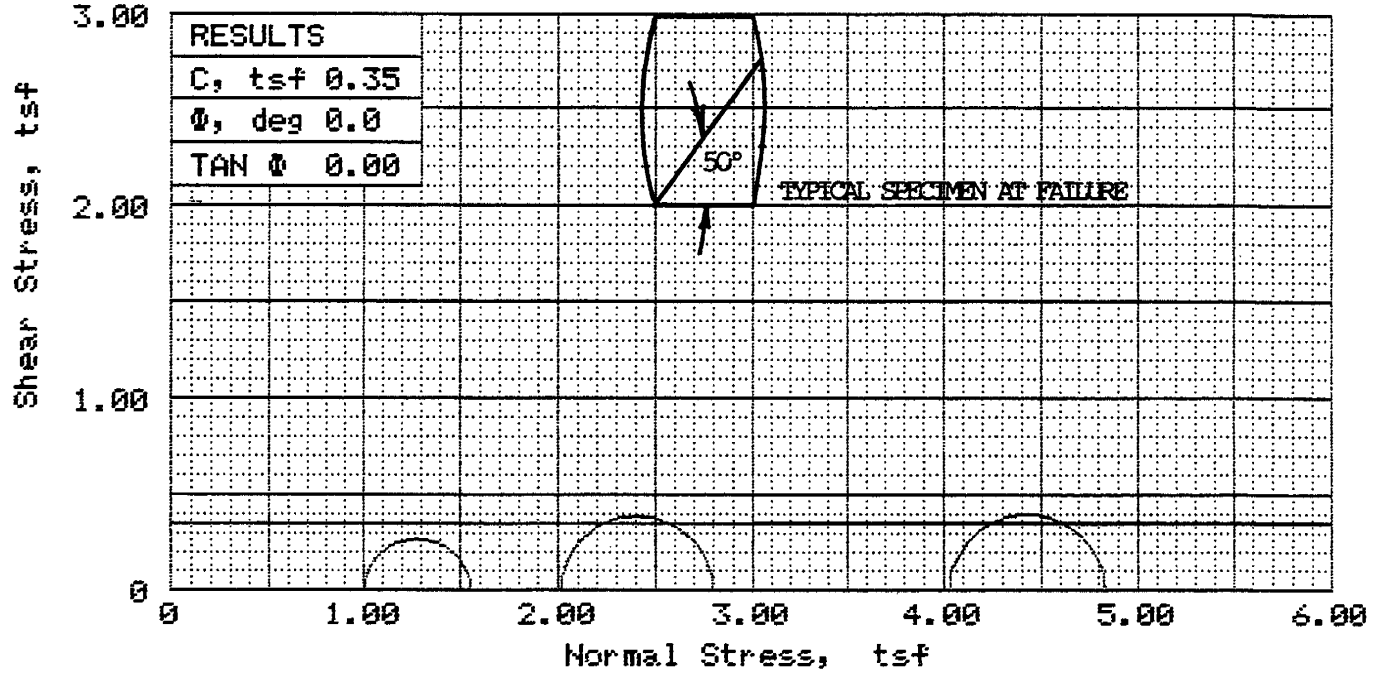
Lab No. 73/7152

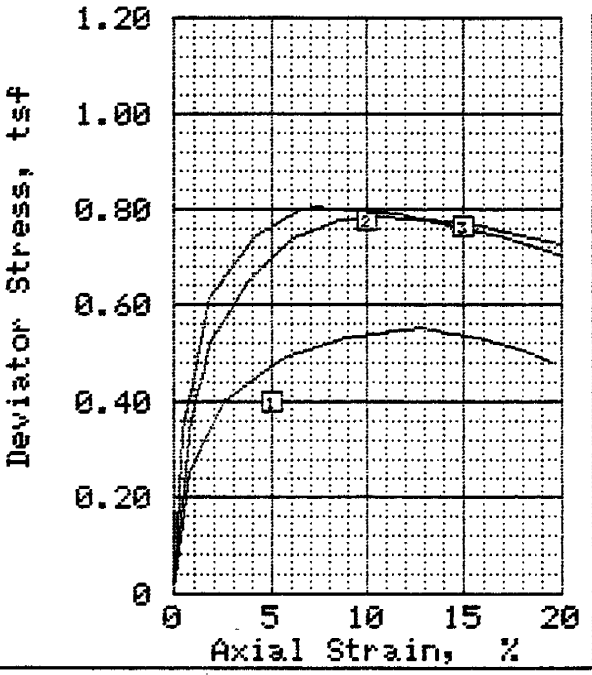
Boring No. CB-MC-32U

Date 11/07/95

GRADATION CURVES

SOUTH ANTIC DIVISION LABORATORY, CORPS OF ENG ERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	38.6	39.7	38.0
	DRY DENSITY, pcf	82.2	80.7	82.1
	SATURATION, %	96.9	96.2	95.1
	VOID RATIO	1.104	1.142	1.108
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	38.6	39.7	38.0
	DRY DENSITY, pcf	82.2	80.7	82.1
	SATURATION, %	96.9	96.2	95.1
	VOID RATIO	1.104	1.142	1.108
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		1.01	2.02	4.03
MAX. DEV. STRESS, tsf		0.55	0.78	0.80
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		17	12	9
RATE, %/min.		0.75	0.91	0.80
ULT. DEV. STRESS, tsf		0.53	0.77	0.76

DESCRIPTION RED & GRAY, FAT CLAY (CH), WITH A TRACE OF SAND SIZES AND ORGANIC MATTER.

LL= 74	PL= 28	PI= 46	Gs= 2.77	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Q

REMARKS

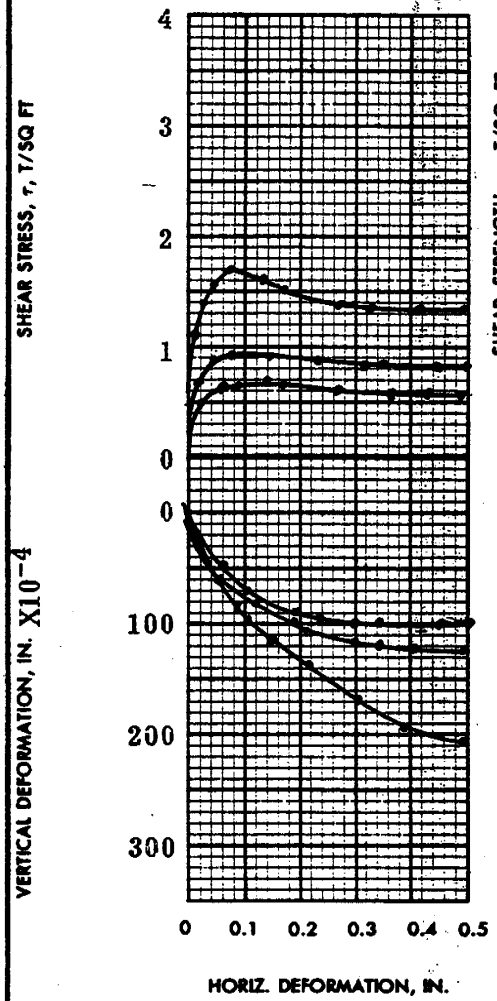
PROJECT RIO PUERTO NEUVO

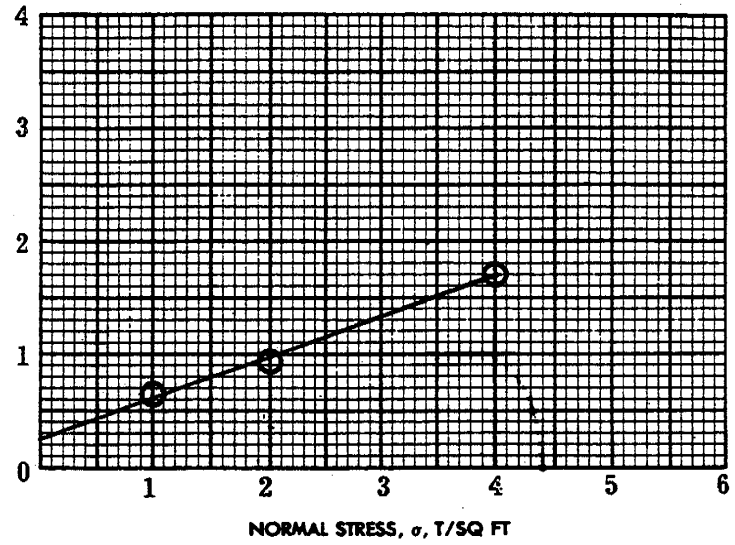
AREA

LAB NO. 73/7152

BORING NO. CB-MC-32U
SAMPLE NO. 2
DEPTH/~~ELEV~~ 20.5 - 22.5'
LABORATORY CESAD-EN-FL DATE 4 NOV. 1995

TRIAXIAL COMPRESSION TEST





TEST NO.			1	2	3	
INITIAL	WATER CONTENT	w_o	40.6 %	41.1 %	38.4 %	%
	VOID RATIO	e_o	1.064	1.138	1.083	
	SATURATION	S_o	98.4 %	100.0 %	98.5 %	%
	DRY DENSITY, LB/CU FT	γ_d	82.1	81.5	80.5	
VOID RATIO AFTER CONSOLIDATION		e_c	0.978	1.014	.882	
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	2.0	2.0	1.0	
FINAL	WATER CONTENT	w_f	32.1 %	31.8 %	34.6 %	%
	VOID RATIO	e_f	0.990	0.882	0.958	
	SATURATION	S_f	100.0 %	100.0 %	100.0 %	%
NORMAL STRESS, T/SQ FT		σ	1.00	2.00	4.00	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.63	0.90	1.69	
ACTUAL TIME TO FAILURE, MIN		t_f	75	90	75	
RATE OF STRAIN, IN./MIN			.0008	.0008	.0008	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}	0.55	0.81	1.31	

SHEAR STRENGTH PARAMETERS

$\phi' =$ 19.5

TAN $\phi' =$ 0.354

$c' =$ 0.25* T/SQ FT

*Apparent Cohesion Not Recommended for Design Computations

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TYPE OF SPECIMEN: Undisturbed — 3.00 IN. SQUARE — 0.49 IN. THICK

CLASSIFICATION: Red & Gray, Fat Clay (CH), w/a trace of sand sizes & organic matter.

LL	PL	PI		G_s
74	28	46	-	2.77

REMARKS

PROJECT: Rio Puerto Neuvo

Lab No. 73/7152

AREA

BORING NO. CB-MC-32U — SAMPLE NO. 2

DEPTH 20.5-22.5 — DATE 14 Dec 95

DIRECT SHEAR TEST REPORT

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER NO. 7825
Req. No. RM-CW-96-0038

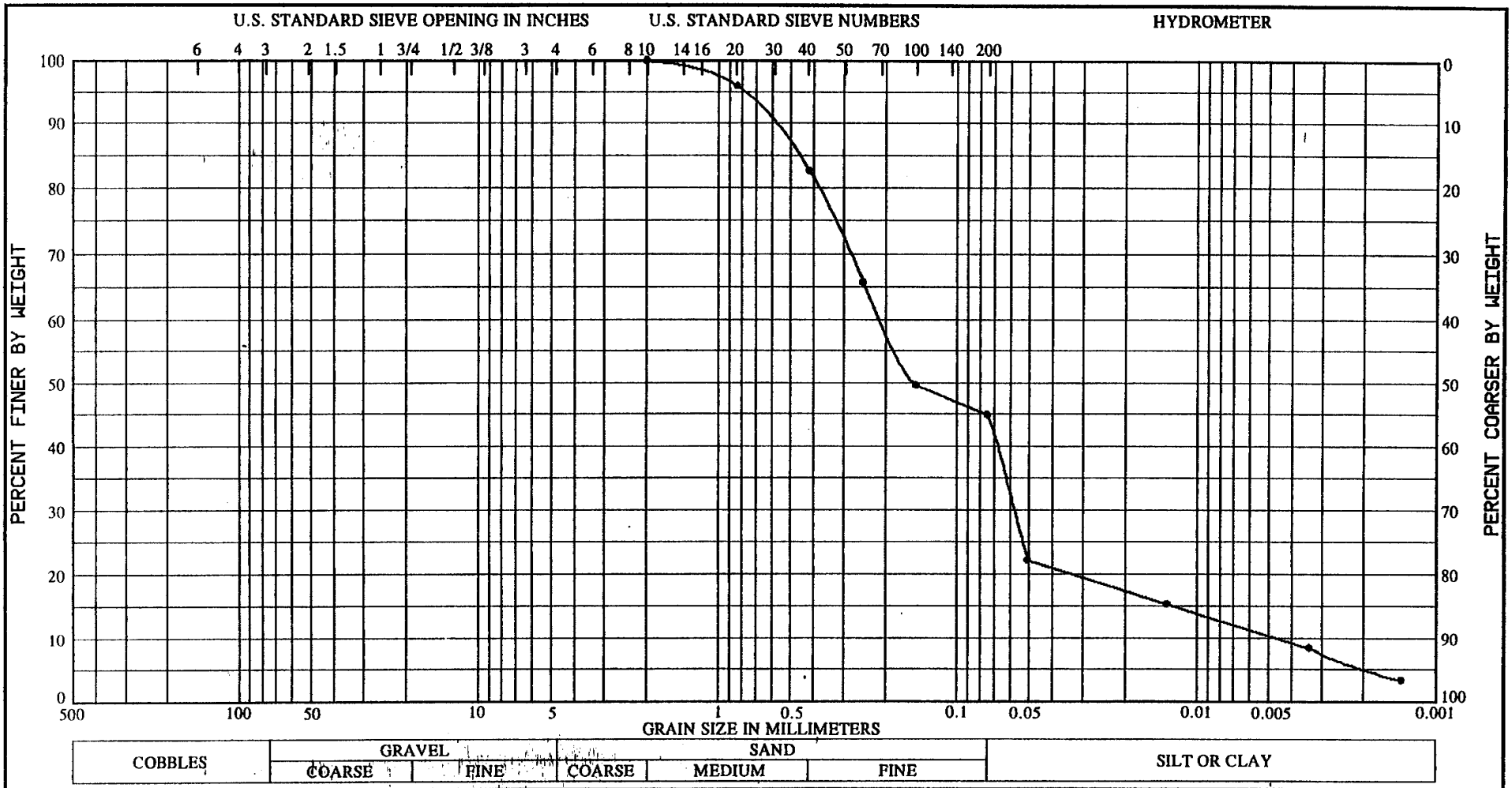
ENG FORM 2092 (EM 1110-2-1906) PREVIOUS EDITIONS ARE OBSOLETE

GPO : 1966 OF—214-945

PLATE IX-3

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
3	42.5-44.5	TAN, CLAYEY SAND HIGH LL (SC-H).	27.4	55	21	34

Project RIO PUERTO NEUVO

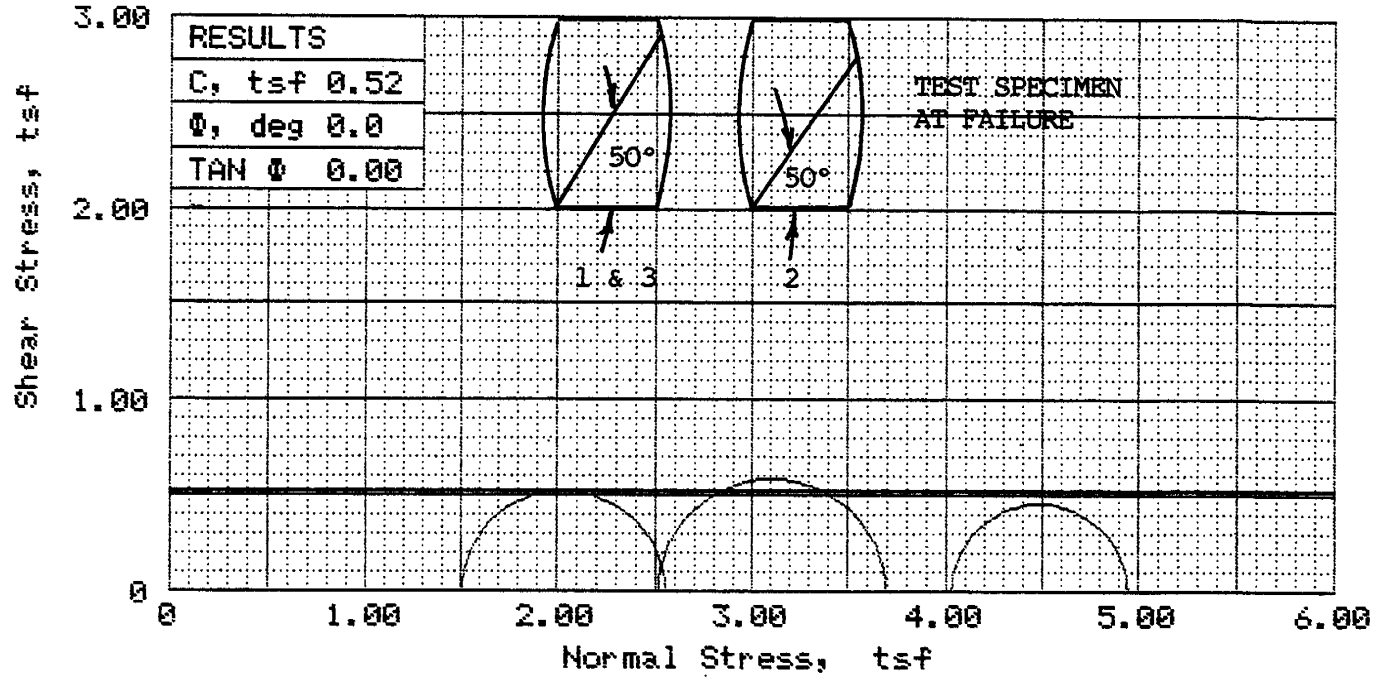
Lab No. 73/7153

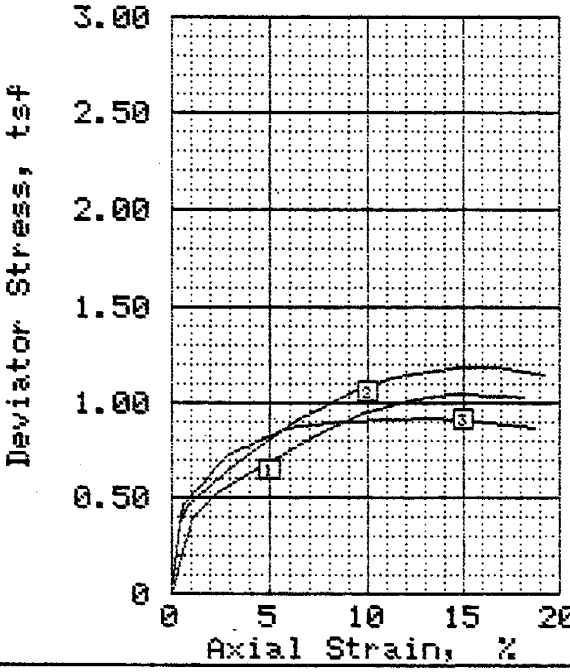
Boring No. CB-MC-32U

Date 11/07/95

GRADATION CURVES

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	28.2	27.0	27.0
	DRY DENSITY, pcf	90.1	92.2	92.0
	SATURATION, %	88.9	89.5	89.4
	VOID RATIO	0.842	0.801	0.804
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	31.7	30.1	30.2
	DRY DENSITY, pcf	90.1	92.2	92.0
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.842	0.801	0.804
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		1.51	2.52	4.03
MAX. DEV. STRESS, tsf		1.04	1.18	0.92
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		22	21	20
RATE, %/min.		0.65	0.70	0.67
ULT. DEV. STRESS, tsf		1.04	1.18	0.90

DESCRIPTION TAN, CLAYEY SAND HIGH LL (SC-H).

LL= 55	PL= 21	PI= 34	Gs= 2.66	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Sat Q

REMARKS

PROJECT RIO PUERTO NEUVO

AREA

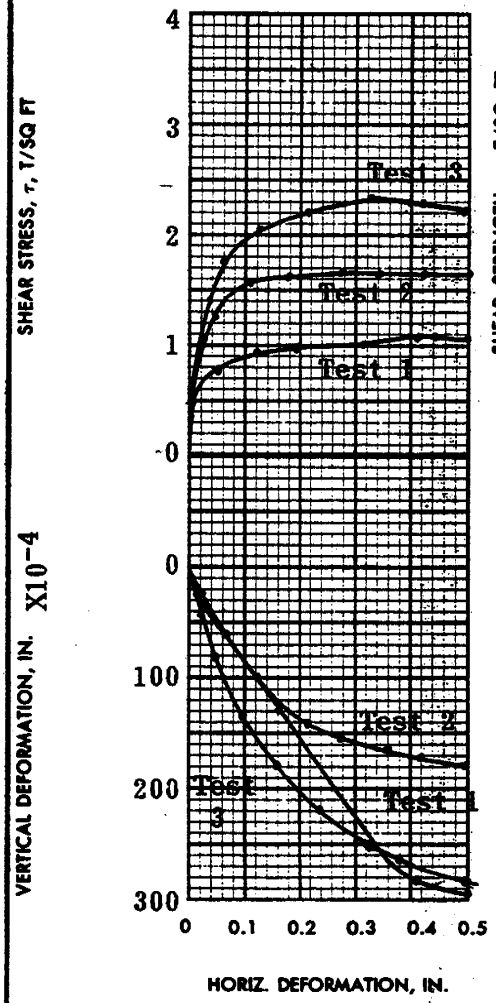
LAB NO. 73/7153

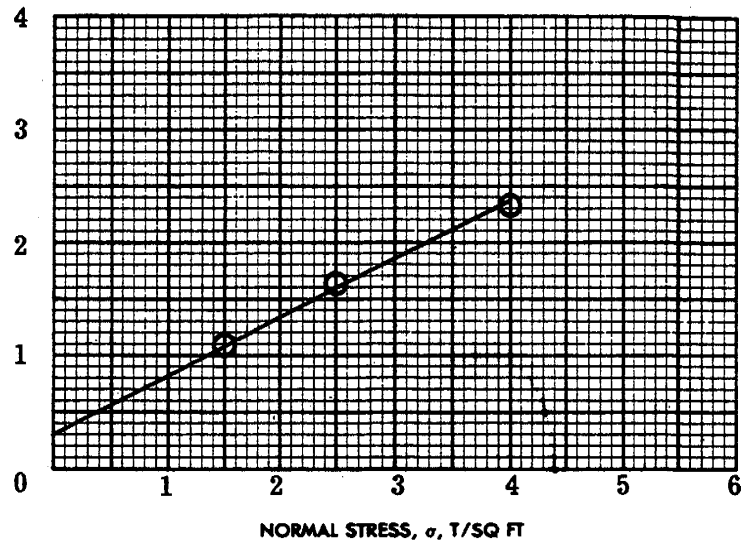
BORING NO. CB-MC-32U
SAMPLE NO. 3
DEPTH/~~ELEV~~ 42.5 - 44.5'
LABORATORY CESAD-EN-FL DATE 15 NOV. 1995

TRIAXIAL COMPRESSION TEST

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER NO. 7325
Req. No. RM-CW-96-0038





TEST NO.			1	2	3	
INITIAL	WATER CONTENT	w_o	32.5 %	30.2 %	30.8 %	%
	VOID RATIO	e_o	0.976	0.820	1.0541	
	SATURATION	S_o	88.5 %	97.9 %	77.6 %	%
	DRY DENSITY, LB/CU FT	γ_d	84.0	91.2	80.8	
VOID RATIO AFTER CONSOLIDATION		e_c	0.890	0.690	0.773	
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	1.0	6.0	8.0	
FINAL	WATER CONTENT	w_f	28.9 %	23.4 %	24.5 %	%
	VOID RATIO	e_f	0.768	0.622	0.651	
	SATURATION	S_f	100.0 %	100.0 %	100.0 %	%
NORMAL STRESS, T/SQ FT		σ	1.50	2.50	4.00	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	1.09	1.65	2.31	
ACTUAL TIME TO FAILURE, MIN		t_f	480	390	390	
RATE OF STRAIN, IN./MIN			0.0008	0.0008	0.0008	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}	1.07	1.64	2.26	

SHEAR STRENGTH PARAMETERS

ϕ' = 27.5

TAN ϕ' = 0.521

c' = 0.30* T/SQ FT

*Apparent Cohesion Not Recommended for Design Computations

☐ CONTROLLED STRESS
☒ CONTROLLED STRAIN

TYPE OF SPECIMEN: Undisturbed — 3.0 IN. SQUARE — 0.49 IN. THICK

CLASSIFICATION: Tan, Clayey Sand High LL (SC-H)

LL	PL	PI	–	G_s
55	21	34	–	2.66

REMARKS

PROJECT: Rio Puerto Neuvo

Lab No. 73/7153

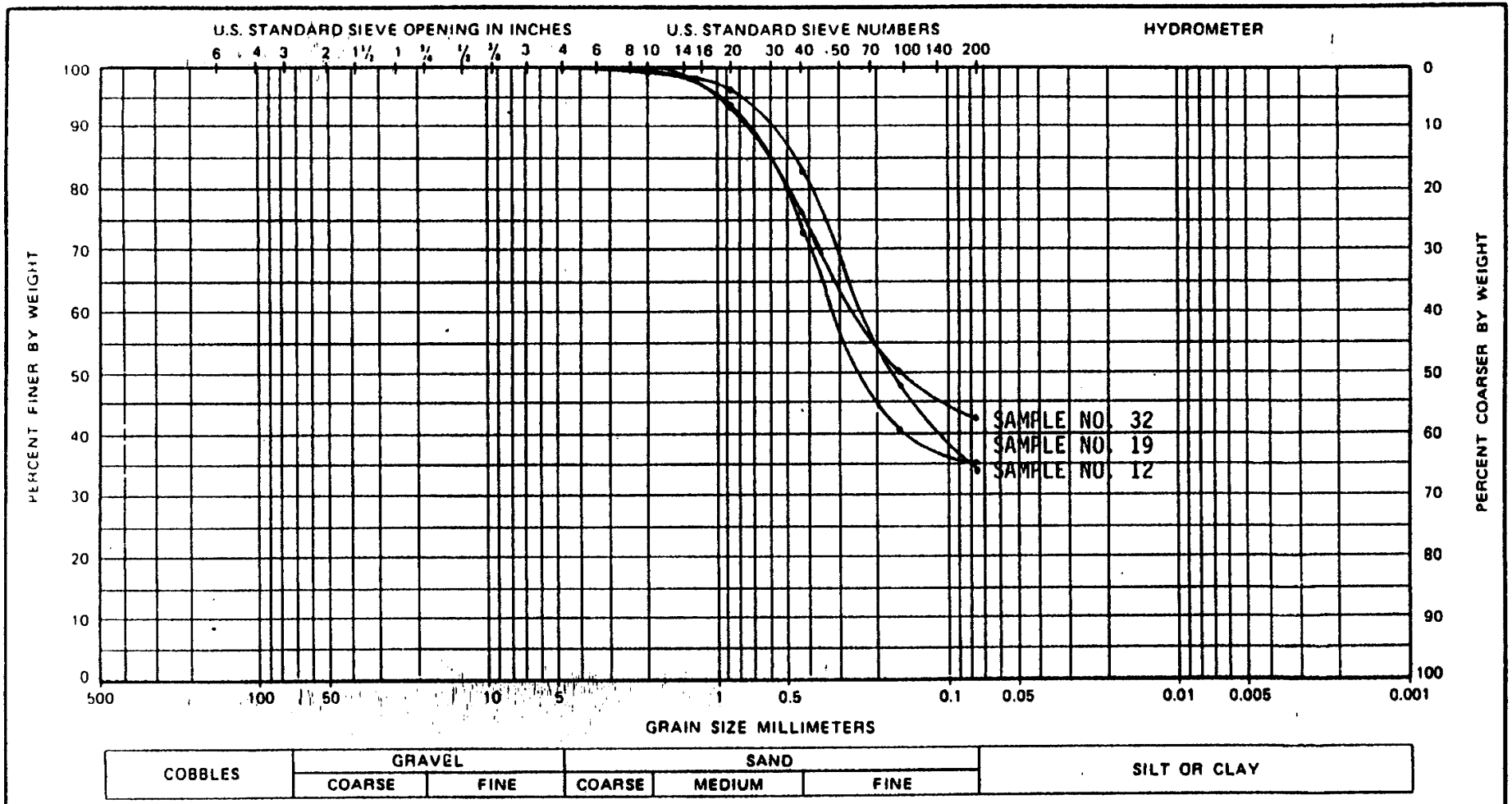
AREA

BORING NO. CB-MC-32U — SAMPLE NO. 3

DEPTH ~~FT~~ 42.5-44.5' — DATE 14 December 1995

DIRECT SHEAR TEST REPORT

GRADATION CURVES



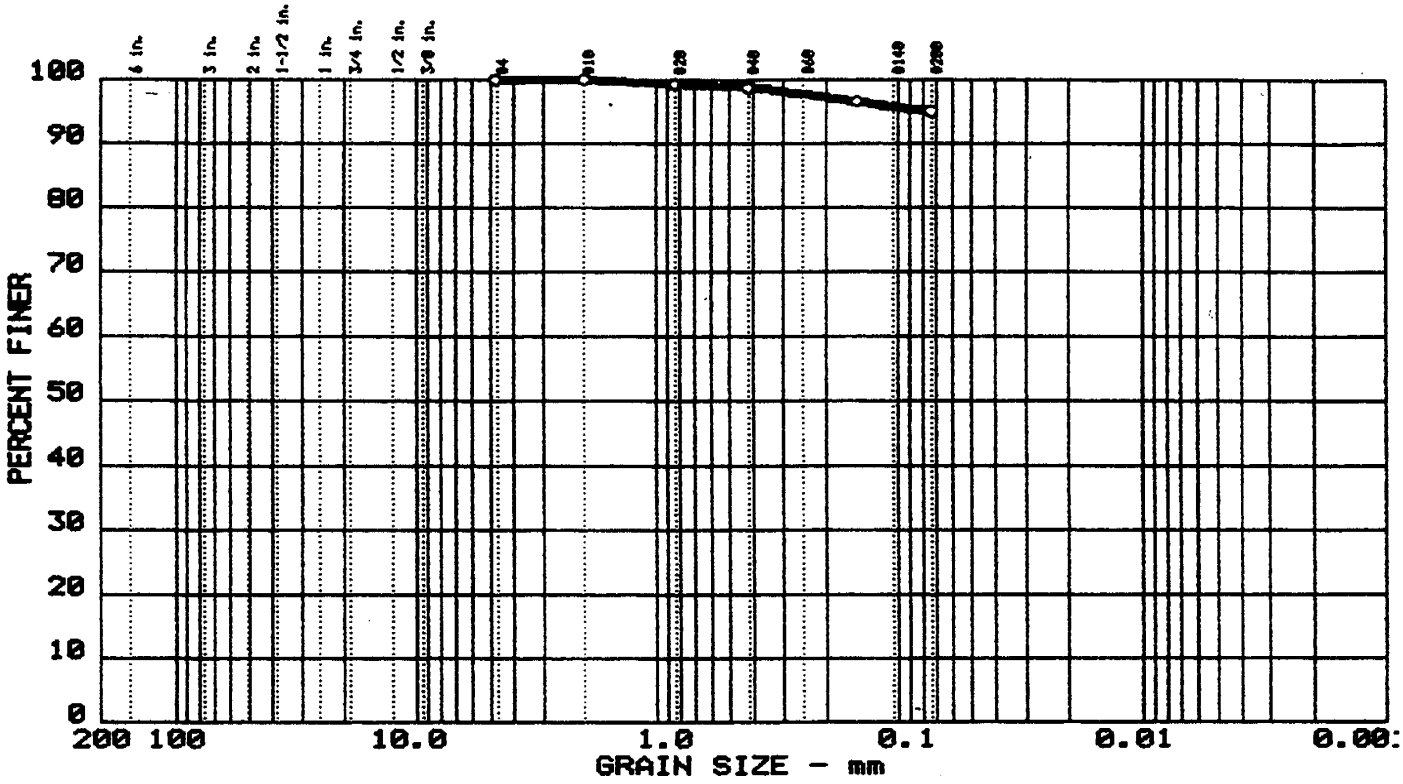
SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
10	13.5'-15'	CH		136.0	34.2	101.8
12	16.5'-18'	SC				
19	27'-28.5'	SC				
24	34.5'-36'	CH	27.0	70.7	22.8	47.9
32	46.5'-48'	SC				

PROJECT MARGARITA CHANNEL, PUERTO NUEVO CHANNELS PROJECT, SAN JUAN, P.R.

AREA CB-MC-33

GEO CIM
Geotechnical Testing Services
P. O. Box 447 Hato Rey, P. R. 00919

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	4.9	95.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	83	44								

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT, LITTLE CLAY, TRACE SAND, DARK BROWN	MH	A-7-5(51)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

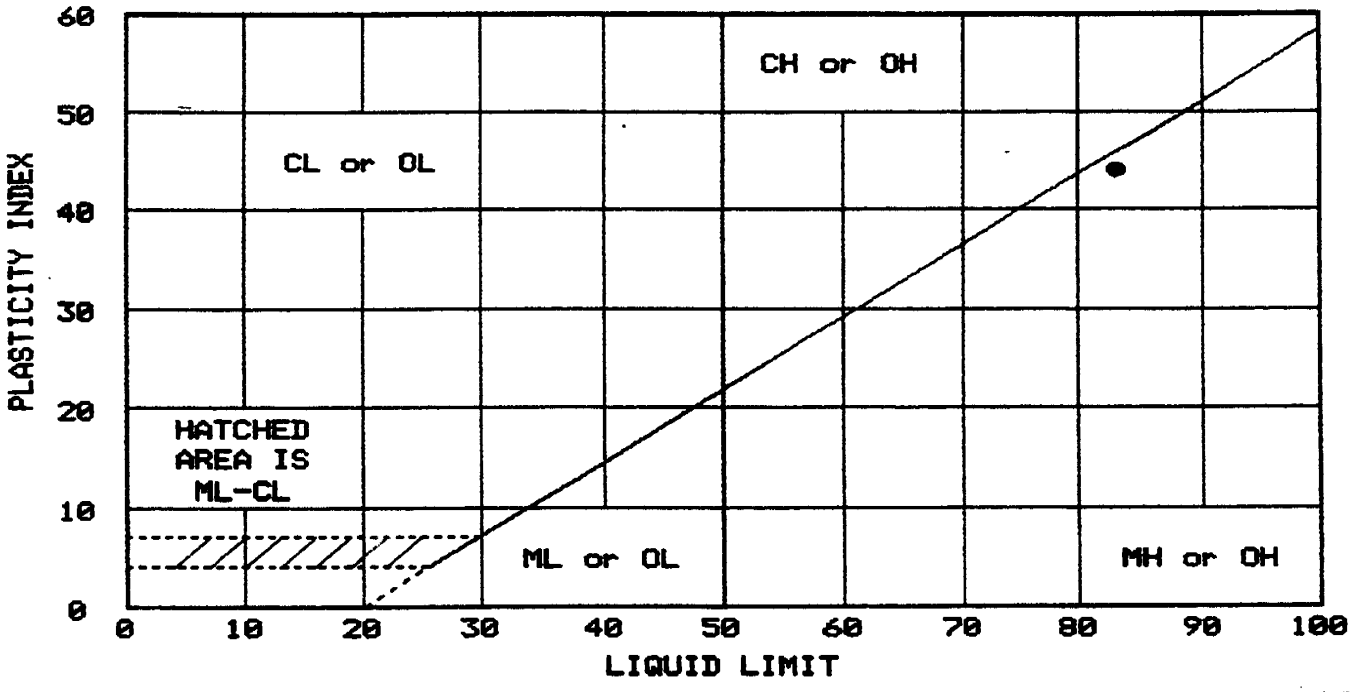
Date: 12-22-95

Remarks:
BOR. CB-MC-51
SAMPLE. 2

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SILT, LITTLE CLAY, TRACE SAND, DARK BROWN	83	39	44	95.0	MH	A-7-5(51)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

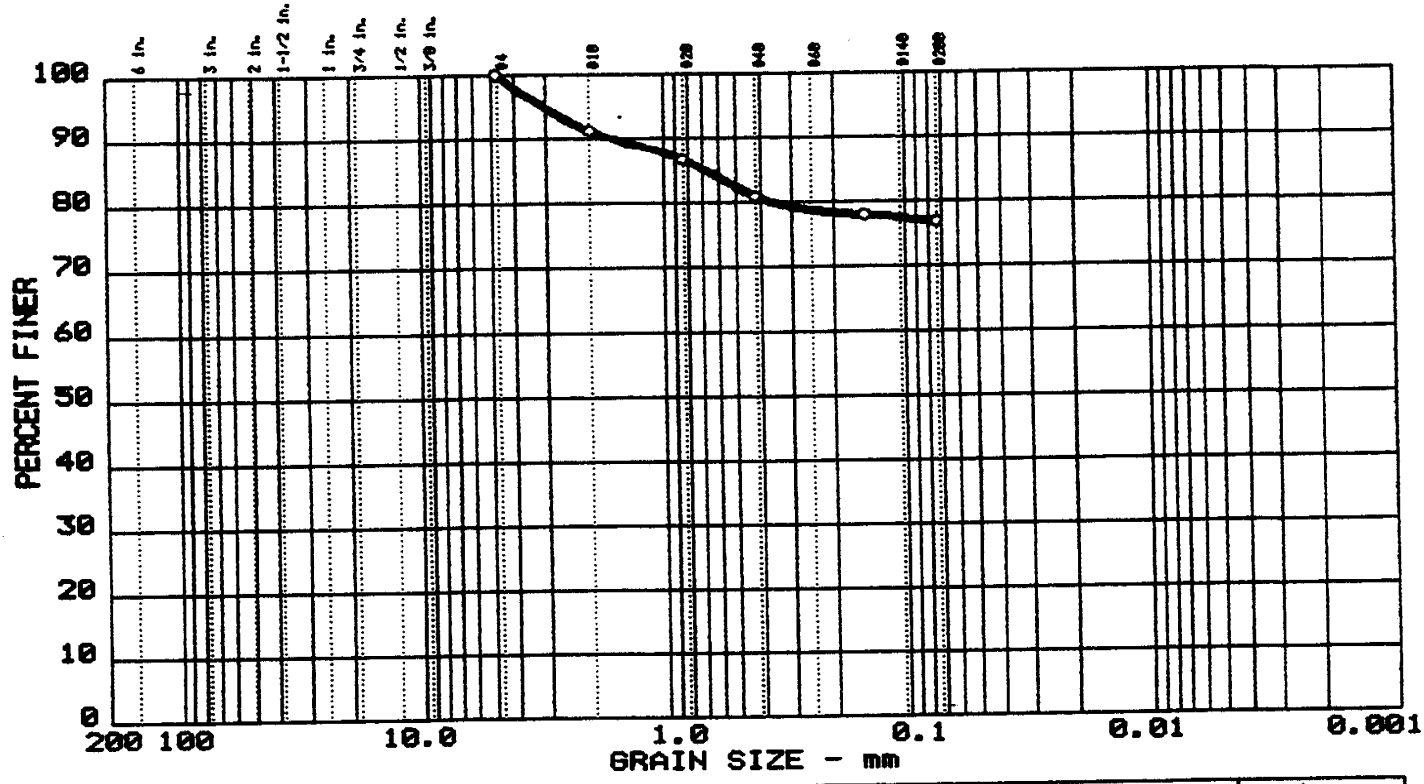
Date: 12-22-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MC-51
SAMPLE. 2
NAT. MOIST. 77%

Fig. No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	23.2	76.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	85	46	0.66							

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT, SOME SAND, VERY DARK BROWN	MH	A-7-5(40)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

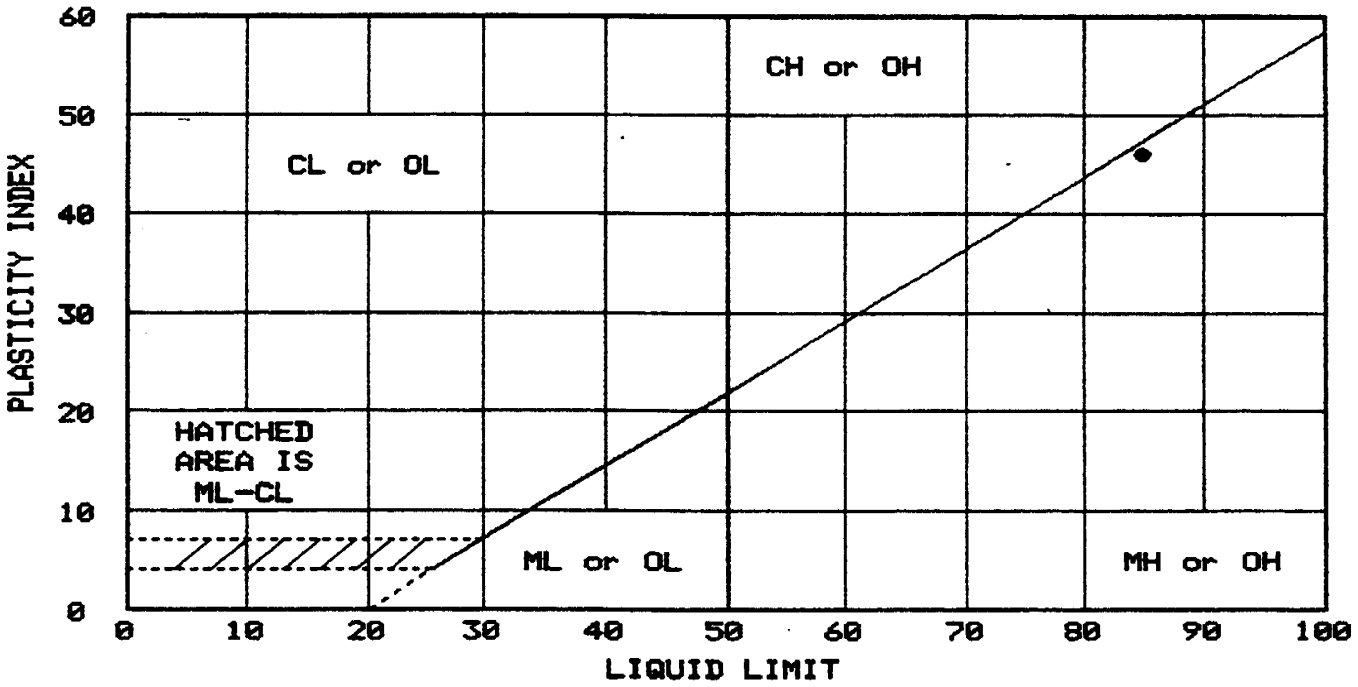
Date: 12-22-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MC-51
SAMPLE. 5
NAT. MOIST. 83%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● SILT, SOME SAND, VERY DARK BROWN	85	39	46	76.9	MH	A-7-5(40)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

Date: 12-22-95

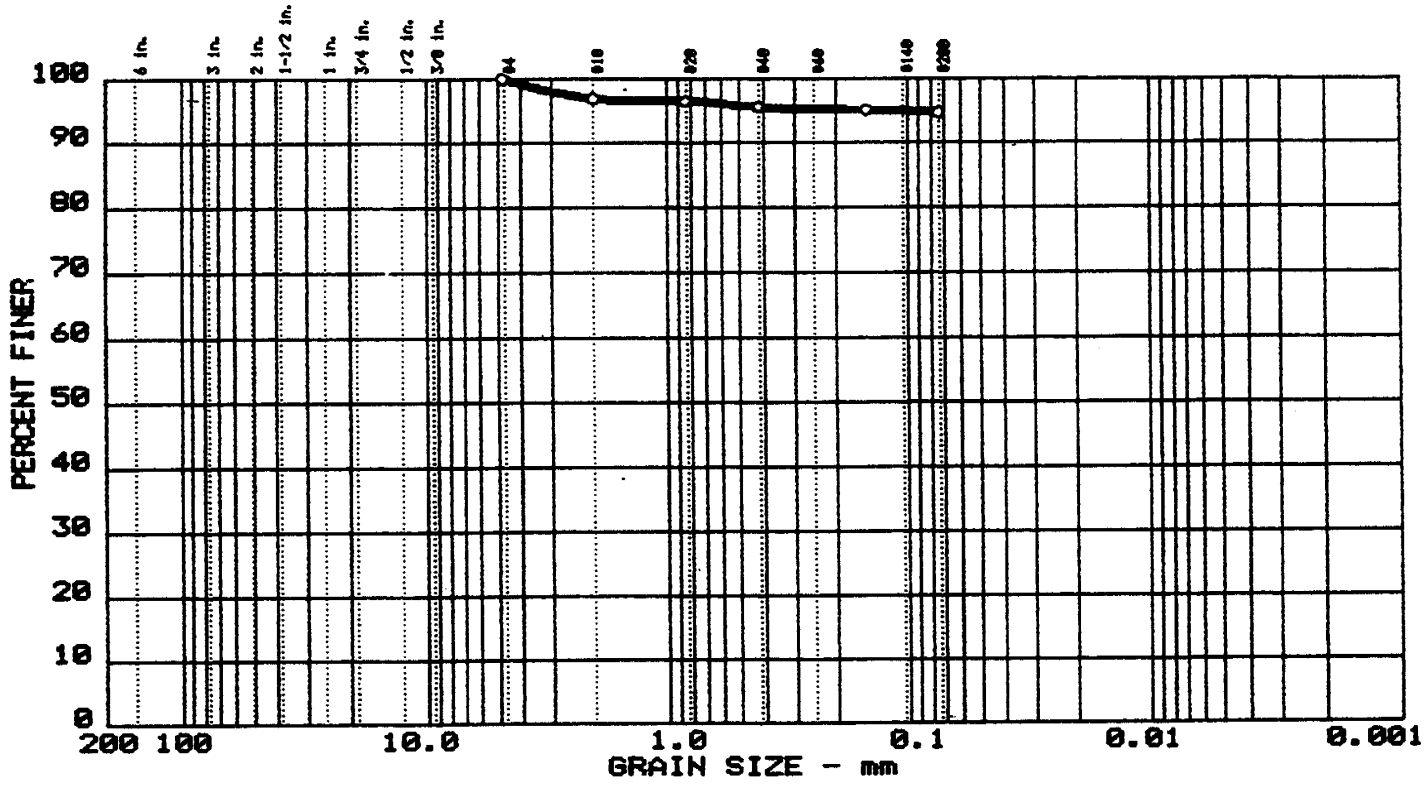
Remarks:
BOR. CB-MC-51

SAMPLE. 5

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Fig. No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	5.3	94.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	71	40								

MATERIAL DESCRIPTION	USCS	AASHTO
o CLAY, TRACE SAND, OLIVE AND LIGHT GRAY	CH	A-7-5(45)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

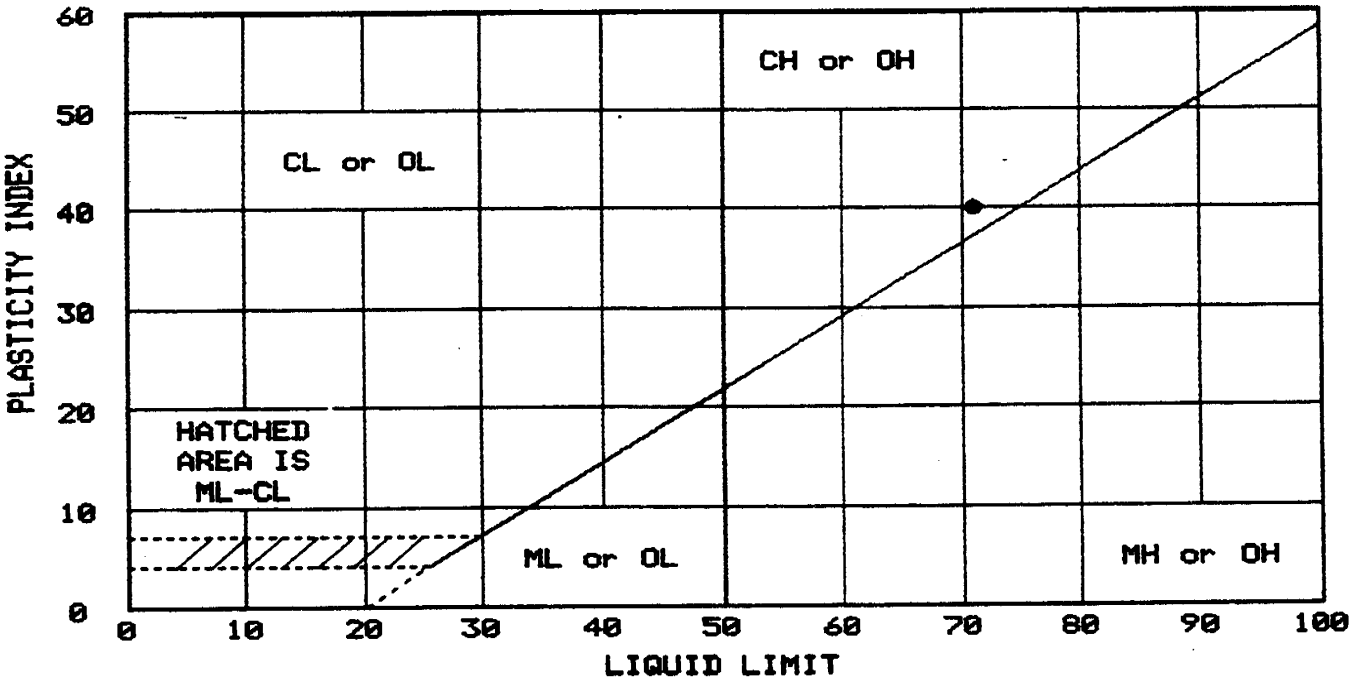
Date: 12-22-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MC-51
SAMPLE. 7
NAT. MOIST. 85%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● CLAY, TRACE SAND, OLIVE AND LIGHT GRAY	71	31	40	95.0	CH	A-7-5(45)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

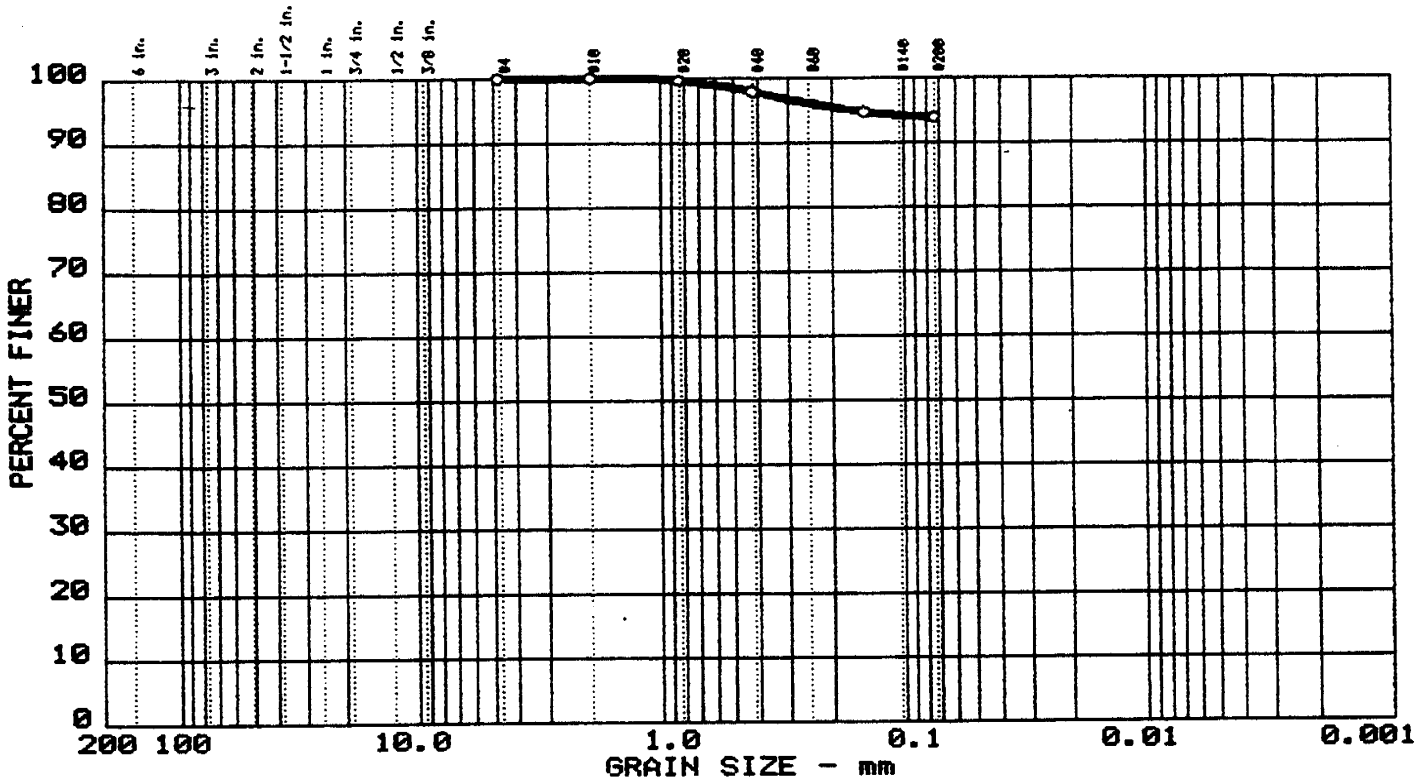
Date: 12-22-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MC-51
SAMPLE. 7

Fig. No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	6.1	93.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	62	34								

MATERIAL DESCRIPTION	USCS	AASHTO
o CLAY, SILTY, TRACE SAND, OLIVE GRAY	CH	A-7-6(37)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

Date: 12-22-95

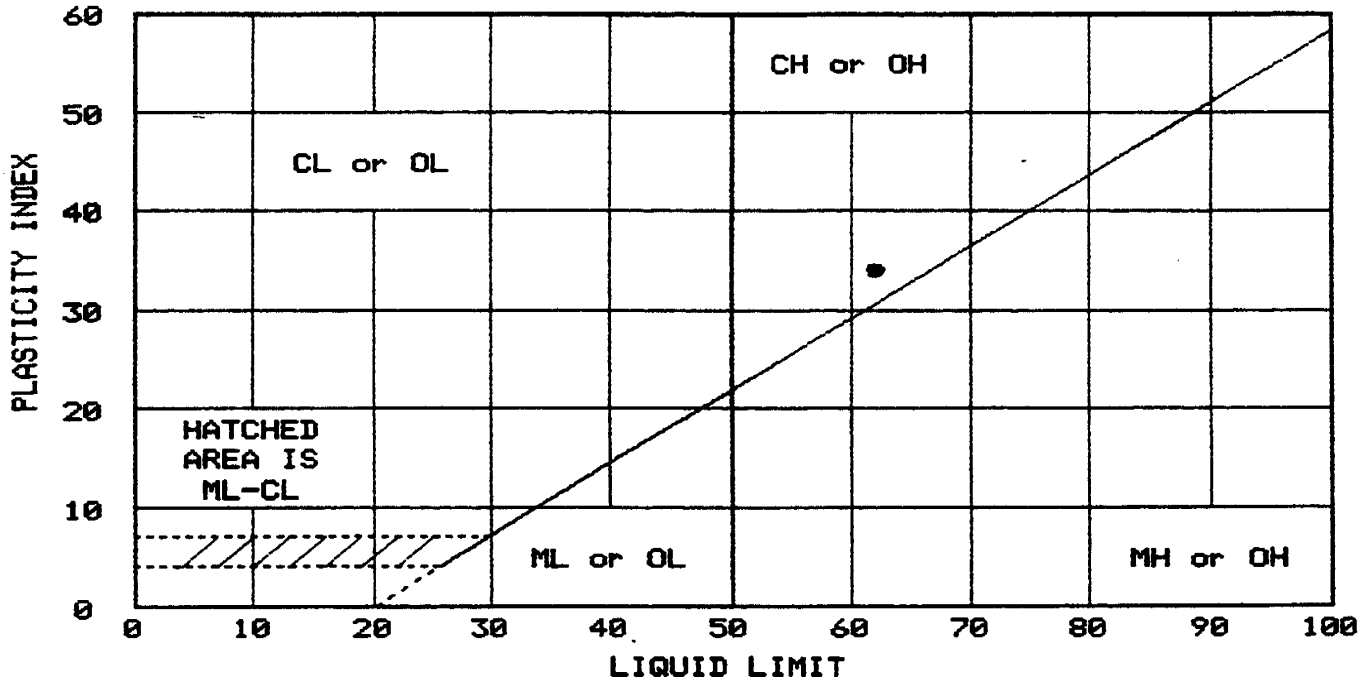
GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MC-51
SAMPLE. 10

NAT. MOIST. 29%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAY,SILTY, TRACE SAND, OLIVE GRAY	62	28	34	93.8	CH	A-7-6(37)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

Date: 12-22-95

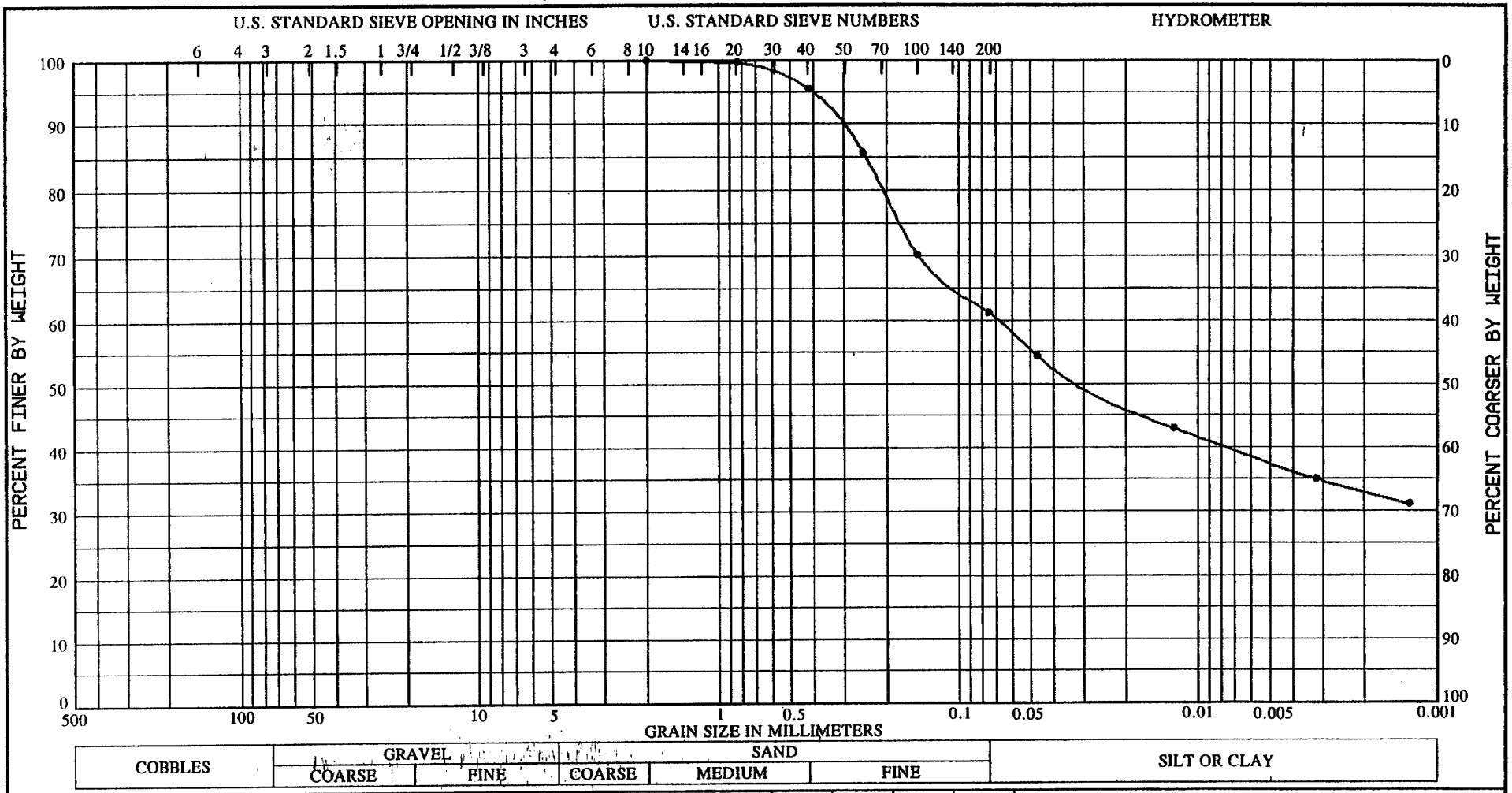
Remarks:
BOR. CB-MC-51
SAMPLE. 10

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Fig. No._____

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
-	31.0-33.0	LT. BROWN, REDDISH TAN & GRAY, SANDY FAT CLAY (CH).	23.7	72	21	51

Project RIO PUERTO NEUVO

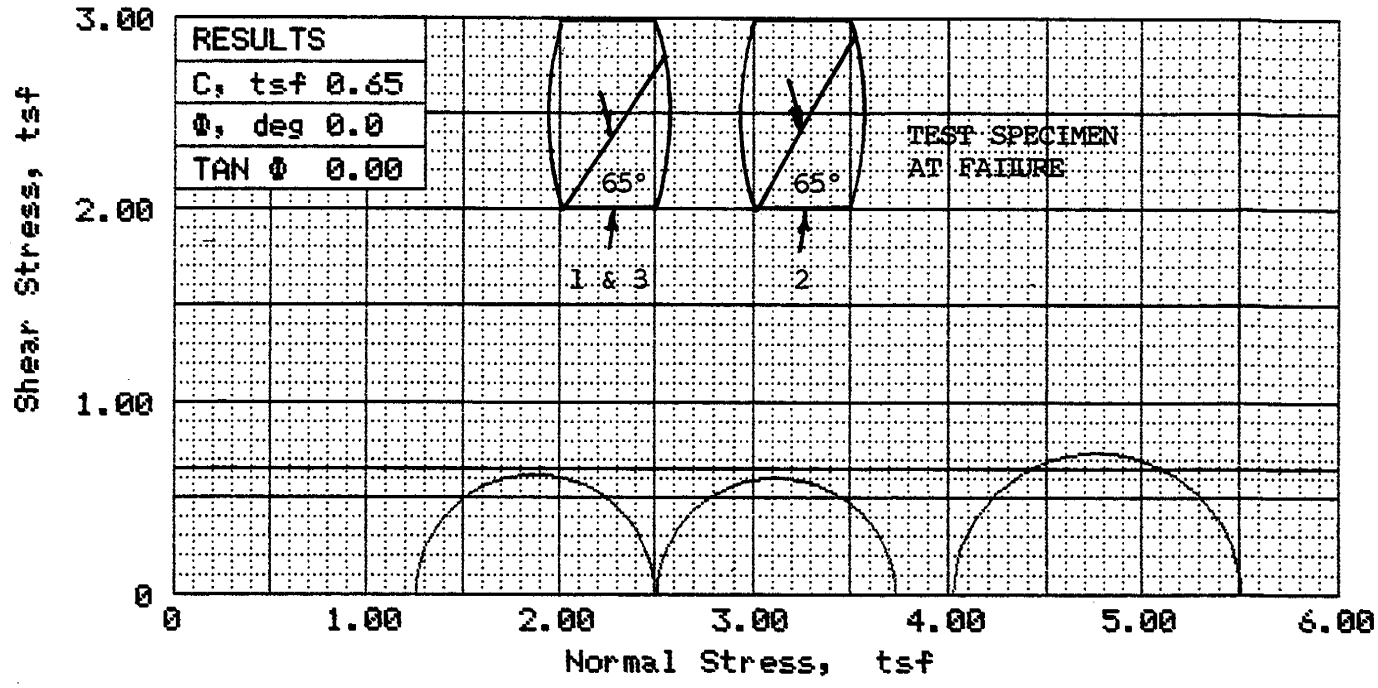
Lab No. 73/7184

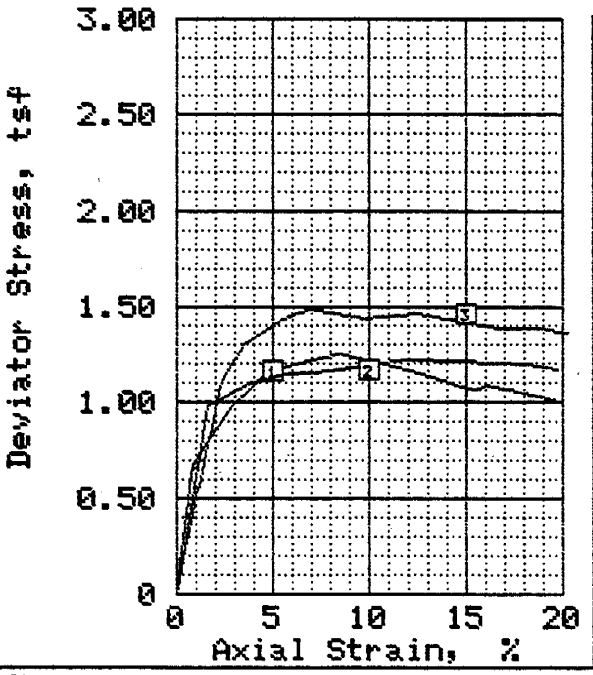
Boring No. CB-MC-52

Date 01/04/96

GRADATION CURVES

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7025





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	24.5	21.6	24.2
	DRY DENSITY, pcf	95.7	97.6	97.9
	SATURATION, %	84.9	78.1	88.4
	VOID RATIO	0.794	0.760	0.753
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	28.6	27.6	27.4
	DRY DENSITY, pcf	95.7	97.6	97.9
	SATURATION, %	98.9	100.0	100.0
	VOID RATIO	0.794	0.760	0.753
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		1.26	2.52	4.03
MAX. DEV. STRESS, tsf		1.24	1.22	1.48
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		12	11	8
RATE, %/min.		0.70	0.75	0.87
ULT. DEV. STRESS, tsf		1.07	1.21	1.41

DESCRIPTION LT. BROWN, REDDISH TAN & GRAY, SANDY FAT CLAY (CH).

LL= 72	PL= 21	PI= 51	Gs= 2.75	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Sat Q

REMARKS

PROJECT RIO PUERTO NEUVO

AREA

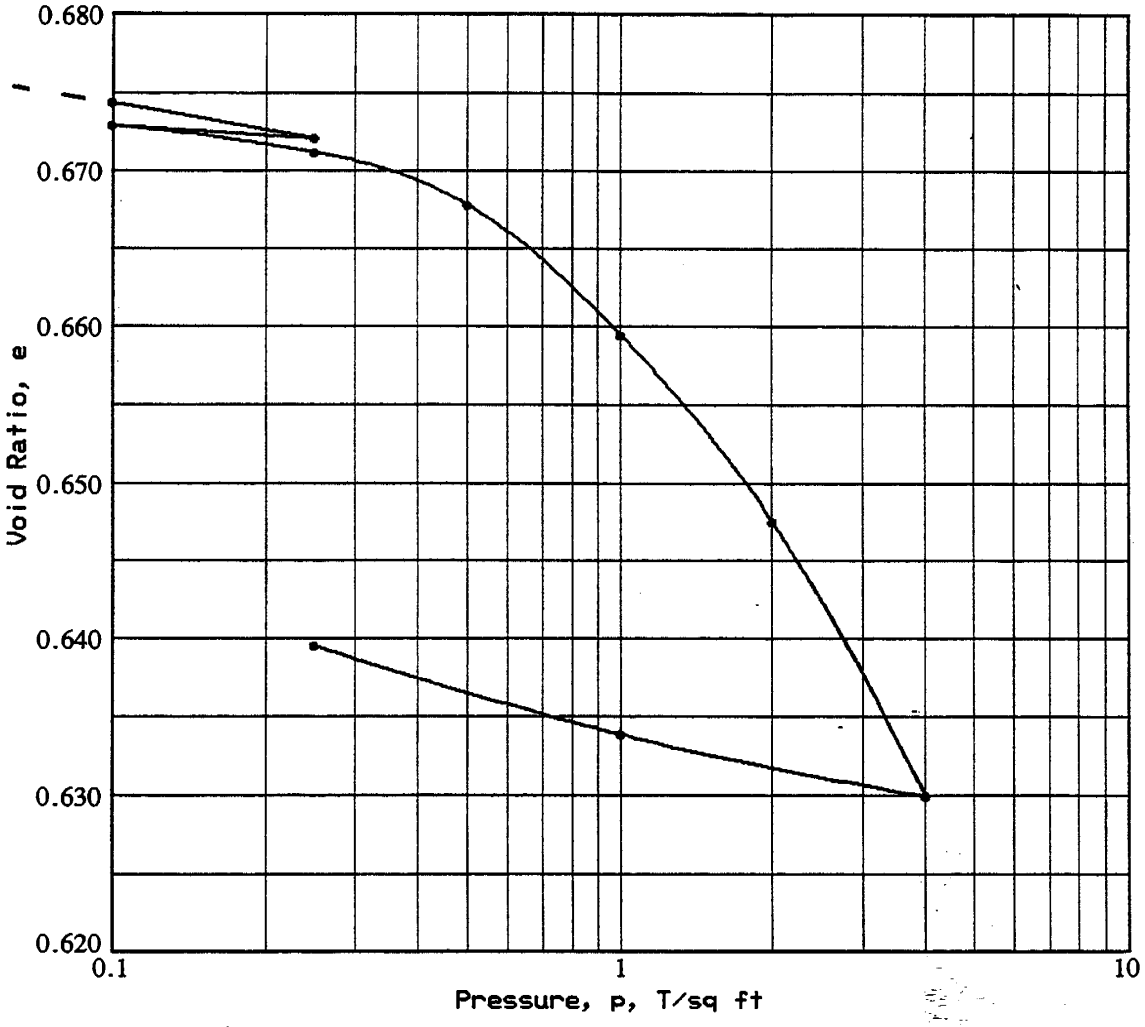
LAB NO. 73/7184

BORING NO. CB-MC-52
SAMPLE NO. --
DEPTH/~~ELEV~~ 31.0 - 33.0'
LABORATORY CESAD-EN-FL DATE 8 JAN. 1996

TRIAXIAL COMPRESSION TEST

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

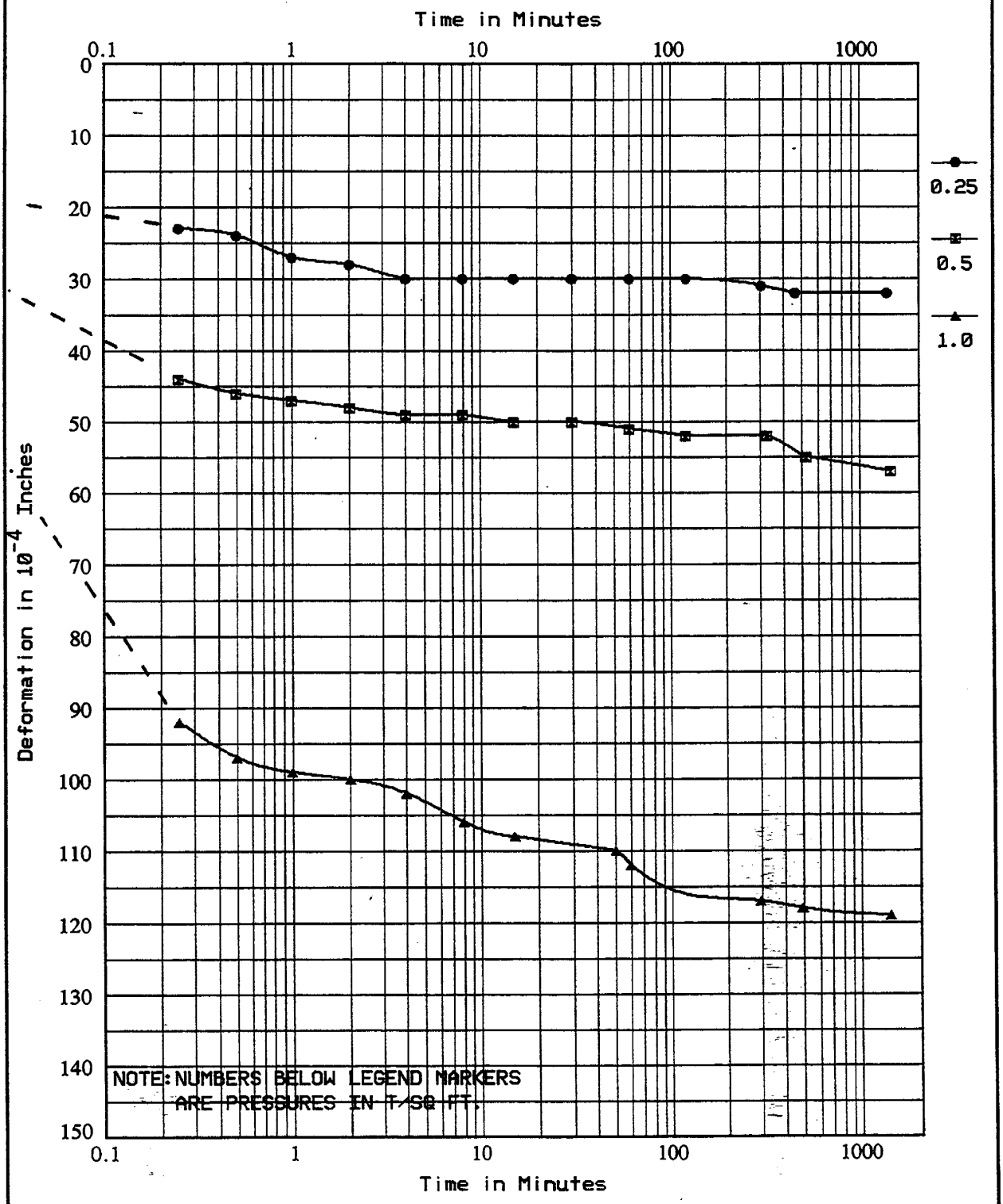
WORK ORDER: 7825
REQUSITION: RM-CW-96-0038



Type of Specimen UNDISTURBED				Before Test			After Test	
Diam. 3.990 in.	Height 1.240 in.			Water Content	w_o	23.8 %	w_f	23.3 %
Overburden Pressure, p_o		T/sq ft		Void Ratio	e_o	0.675	e_f	0.640
Preconsol. Pressure, p_c		T/sq ft		Saturation	S_o	96.9 %	S_f	100.0 %
Compression Index, C_c				Dry Density	γ_d	102.5 lb/ft^3		
Classification LT. BROWN, REDDISH TAN, & GRAY, SANDY FAT CLAY (CH).								
LL	72	G_s	2.75	Project RIO PUERTO NEUVO				
PL	21	D_{10}	< 0.002 MM					
Remarks 1. SPECIMEN FLOODED						Lab No. 73/7184		
THROUGHOUT TEST. 2. TIME CURVES				Boring No. CB-MC-52			Sample No. -	
FURNISHED FOR LOADS OF 0.25,				Depth (ft) 31.0-33.0			Date 01/06/96	
0.5, 1.0, 2.0, AND 4.0 T/SF.				**CONSOLIDATION TEST REPORT**				

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038

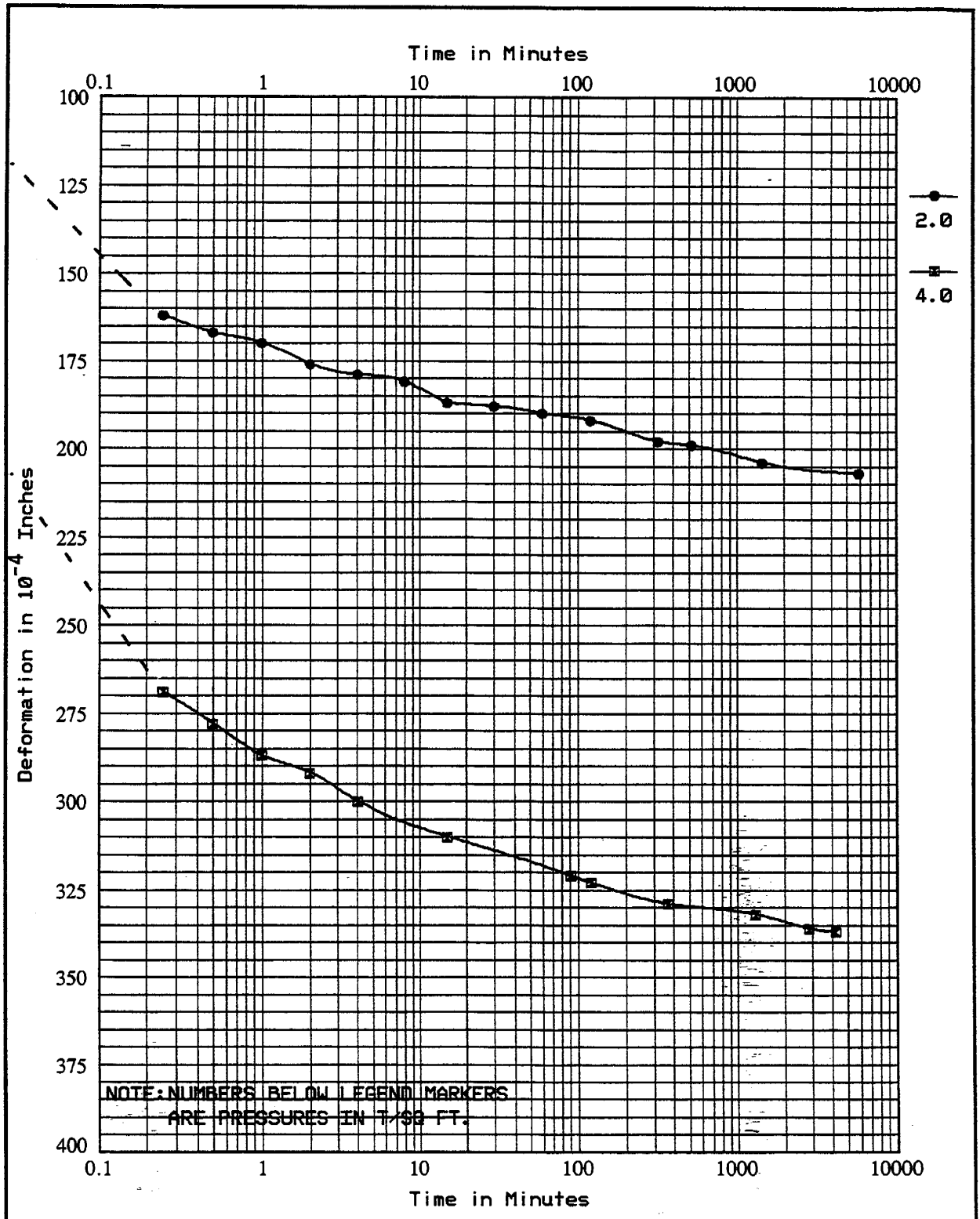


Project RIO PUERTO NEUVO			
Area			Lab No. 73/7184
Boring No. CB-CM-52	Sample No. ---	Depth (ft) 31.0-33.0	Date 01/06/96

CONSOLIDATION TEST - TIME CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038

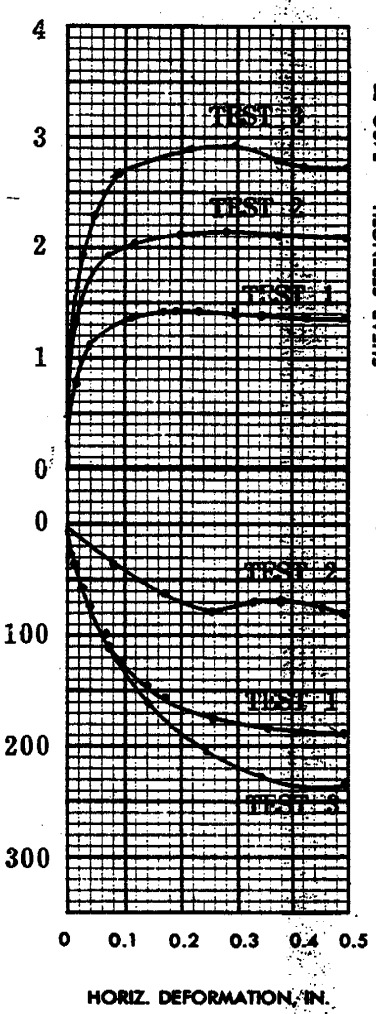


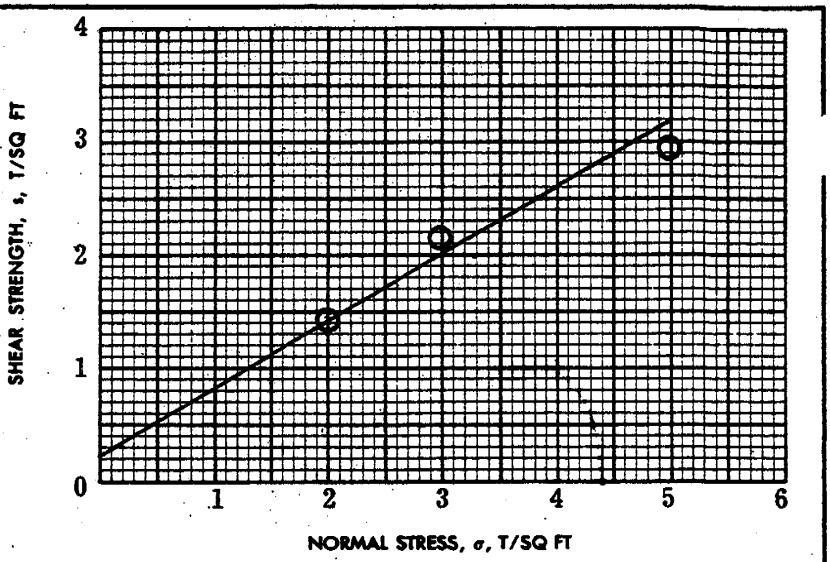
Project RIO PUERTO NEUVO			
Area			Lab No. 73/7184
Boring No. CB-CM-52	Sample No. ---	Depth (ft) 31.0-33.0	Date 01/06/96

CONSOLIDATION TEST - TIME CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER NO. 7825
Req. No. RM-CW-96-0038





TEST NO.			1	2	3	
INITIAL	WATER CONTENT	w_o	23.4%	22.8%	24.6%	%
	VOID RATIO	e_o	0.730	0.747	0.766	
	SATURATION	S_o	88.2%	83.9%	88.4%	%
	DRY DENSITY, LB/CU FT	γ_d	99.2	98.3	97.2	
VOID RATIO AFTER CONSOLIDATION		e_c	0.615	0.720	0.565	
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	1.0	<1.0	8.0	
FINAL	WATER CONTENT	w_f	19.9%	25.1%	17.4%	%
	VOID RATIO	e_f	0.547	0.691	0.478	
	SATURATION	S_f	100.0%	100.0%	100.0%	%
NORMAL STRESS, T/SQ FT		σ	2.00	3.00	5.00	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	1.40	2.13	2.91	
ACTUAL TIME TO FAILURE, MIN		t_f	210	360	300	
RATE OF STRAIN, IN./MIN			0.0008	0.0008	0.0008	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}	1.37	2.10	2.71	

SHEAR STRENGTH PARAMETERS

$\phi' =$ 30.5

TAN $\phi' =$ 0.589

$c' =$ 0.23* T/SQ FT

*Apparent Cohesion not recommended for design computations

☐ CONTROLLED STRESS
☒ CONTROLLED STRAIN

TYPE OF SPECIMEN Undisturbed — 3.0 IN. SQUARE — .482 IN. THICK

CLASSIFICATION Lt. Brown, Reddish Tan & Gray, Sandy Fat Clay (CH)

LL	PL	PI		G_s
72	21	51	–	2.75

REMARKS

PROJECT Rio Puerto Neuvo

Lab No. 73/7184

AREA

BORING NO. CB-MC-52 — SAMPLE NO. –

DEPTH 31.0-33.0' — DATE 5 Feb 95

DIRECT SHEAR TEST REPORT

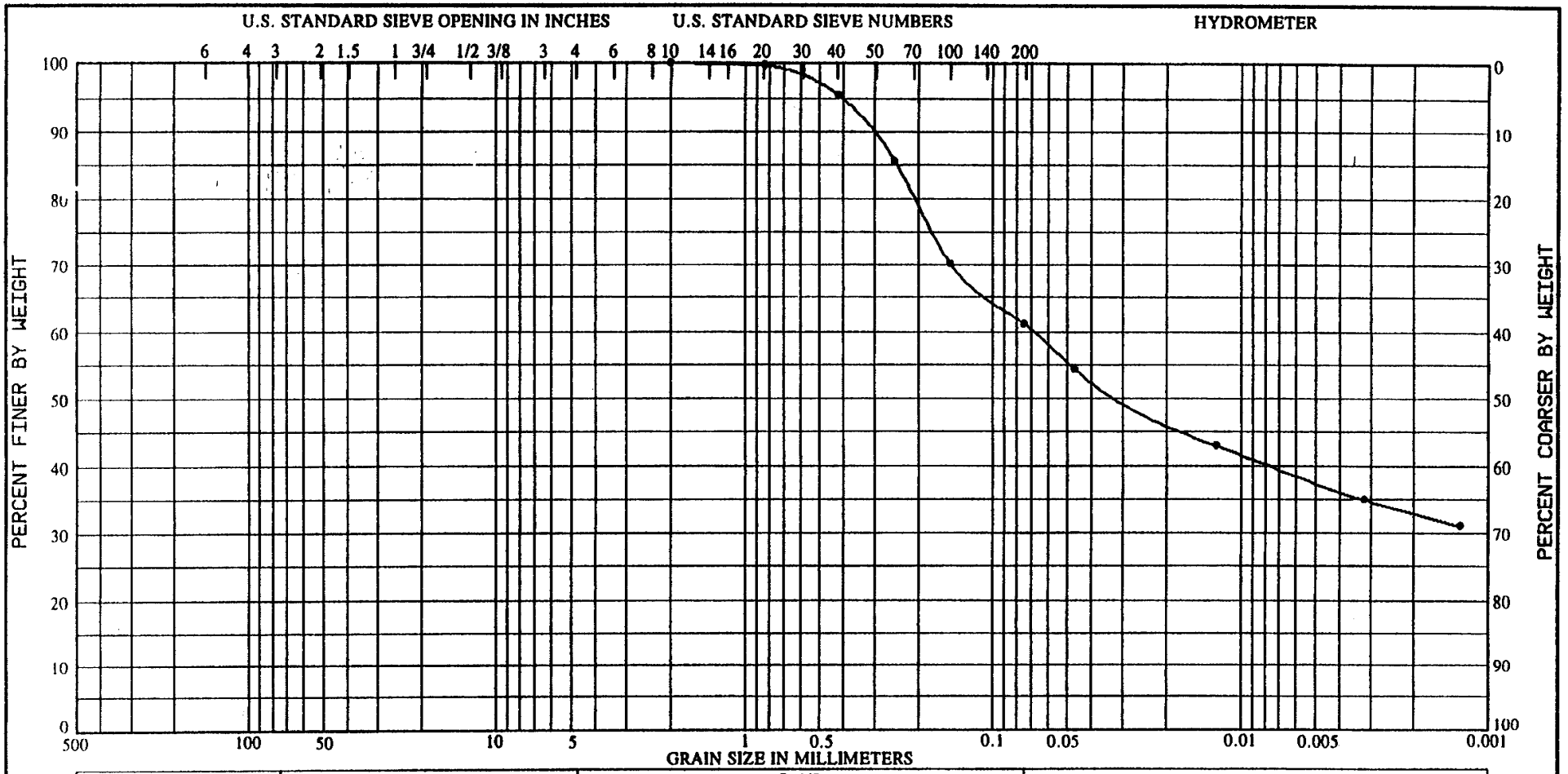
ENG FORM 2092 1 JUN 65 (EM 1110-2-1906) PREVIOUS EDITIONS ARE OBSOLETE

GPO : 1966 OF—214-945

PLATE IX-3

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

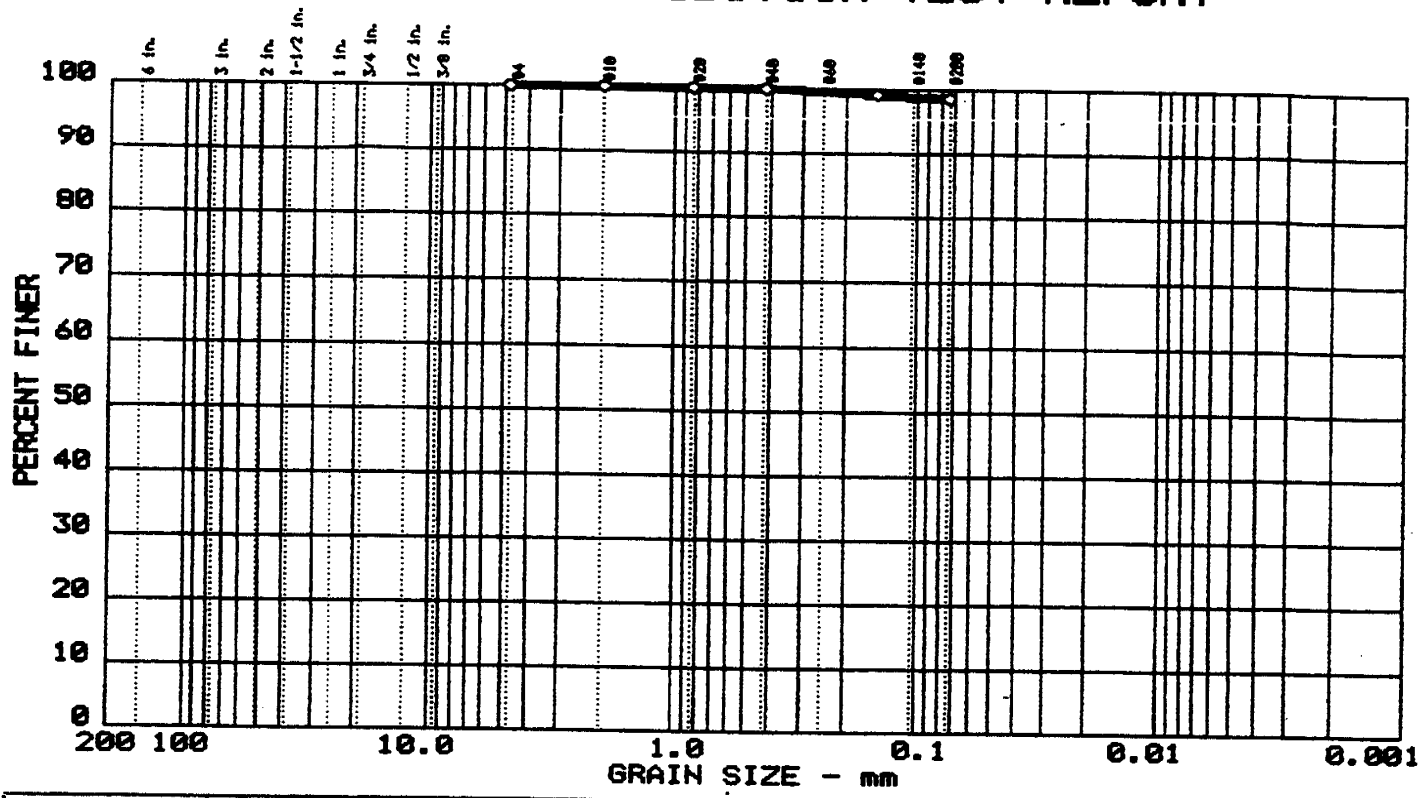
WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



Type of Specimen UNDISTURBED				Before Test			After Test		Project RIO PUERTO NEUVO
Diam. 1.52 in.	Height 2.00 in.			Water Content	w_o	23.7 %	w_f	25.2 %	
Class. LT. BROWN, REDDISH TAN & GRAY, SANDY FAT CLAY (CH).				Void Ratio	e_o	0.697	e_f	0.697	
				Saturation	S_o	93.3 %	S_f	100.0 %	Boring No. CB-MC-52
LL 72	PL 21	G_s 2.75	D_{10}<0.002MM	Dry Density	γ_d	101.2 lb/ft^3	k_{20}	0.0023 x10^{-4}cm/s	Sample No. - Lab No. 73/7184
									Depth (ft) 31.0-33.0 Date 01/12/96

Variable/~~Constant~~ Head PERMEABILITY TEST REPORT

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	1.3	98.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	93	54								

MATERIAL DESCRIPTION	USCS	AASHTO
o CLAY, TRACE SAND, OLIVE AND LIGHT GRAY	CH	A-7-5(67)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

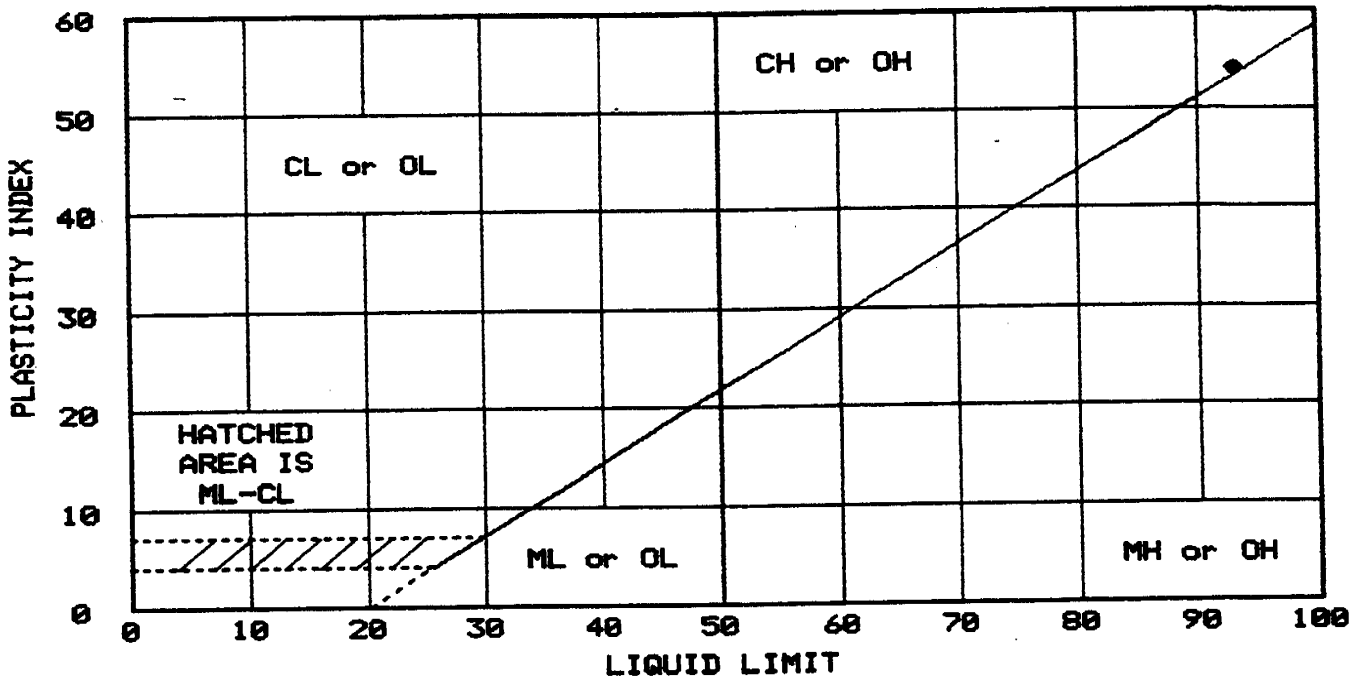
Date: 12-22-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MC-52
SAMPLE. 5
NAT. MOIST. 43%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAY, TRACE SAND, OLIVE AND LIGHT GRAY	93	39	54	98.6	CH	A-7-5(67)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

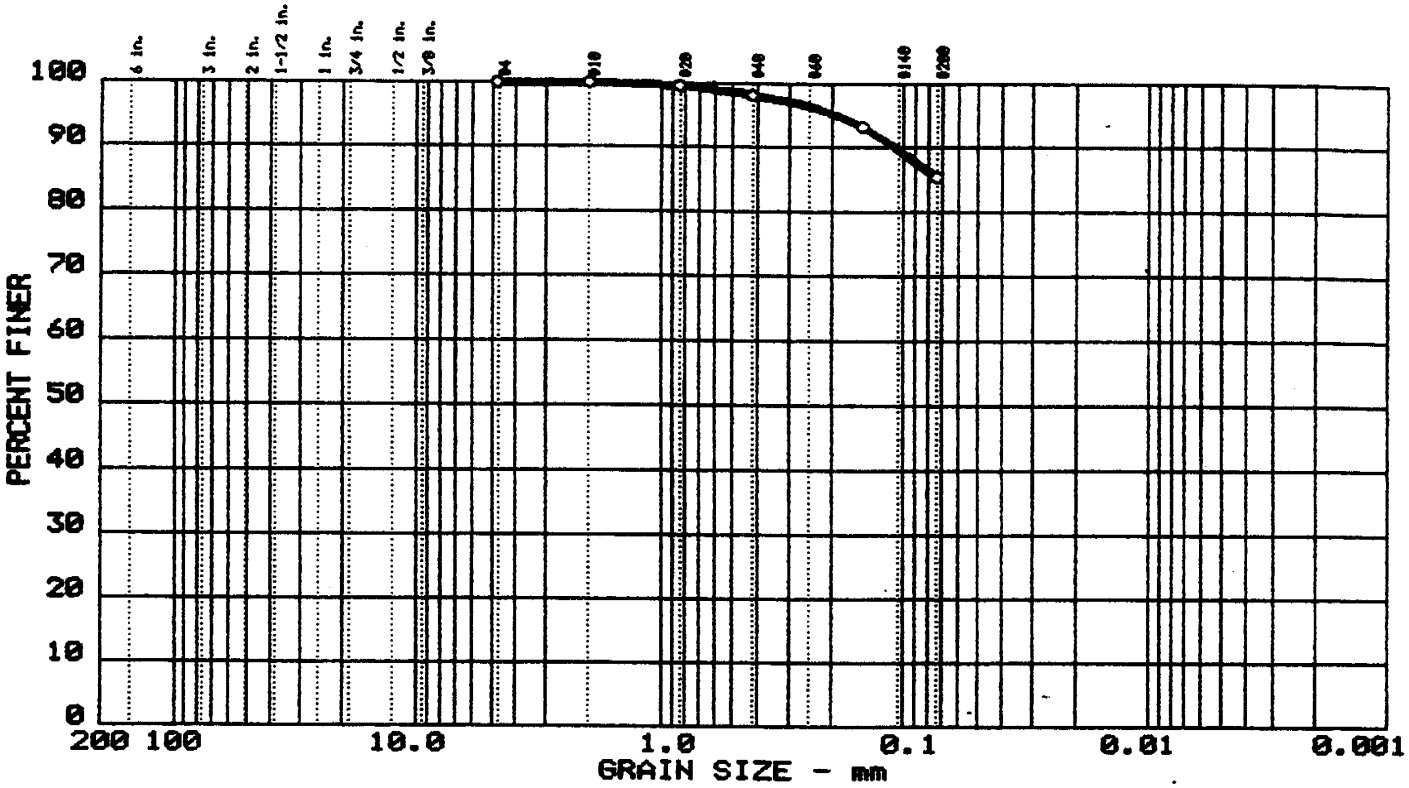
Date: 12-22-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MC-52
SAMPLE. 5

Fig. No.____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	14.6	85.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	93	52								

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT, CLAYEY, LITTLE SAND, LIGHT BROWN	MH	A-7-5(53)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

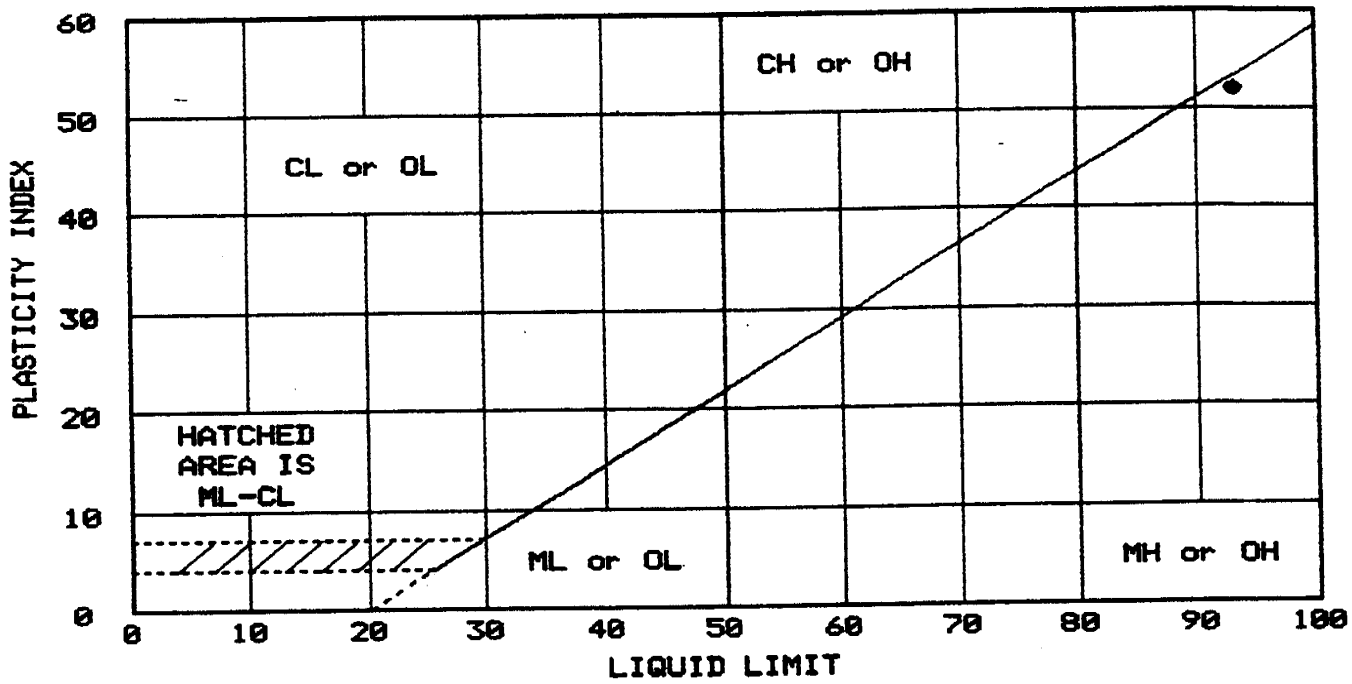
Date: 12-22-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MC-52
SAMPLE: 11
NAT. MOIST. 51%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SILT,CLAYEY, LITTLE SAND, LIGHT BROWN	93	41	52	85.3	MH	A-7-5(53)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

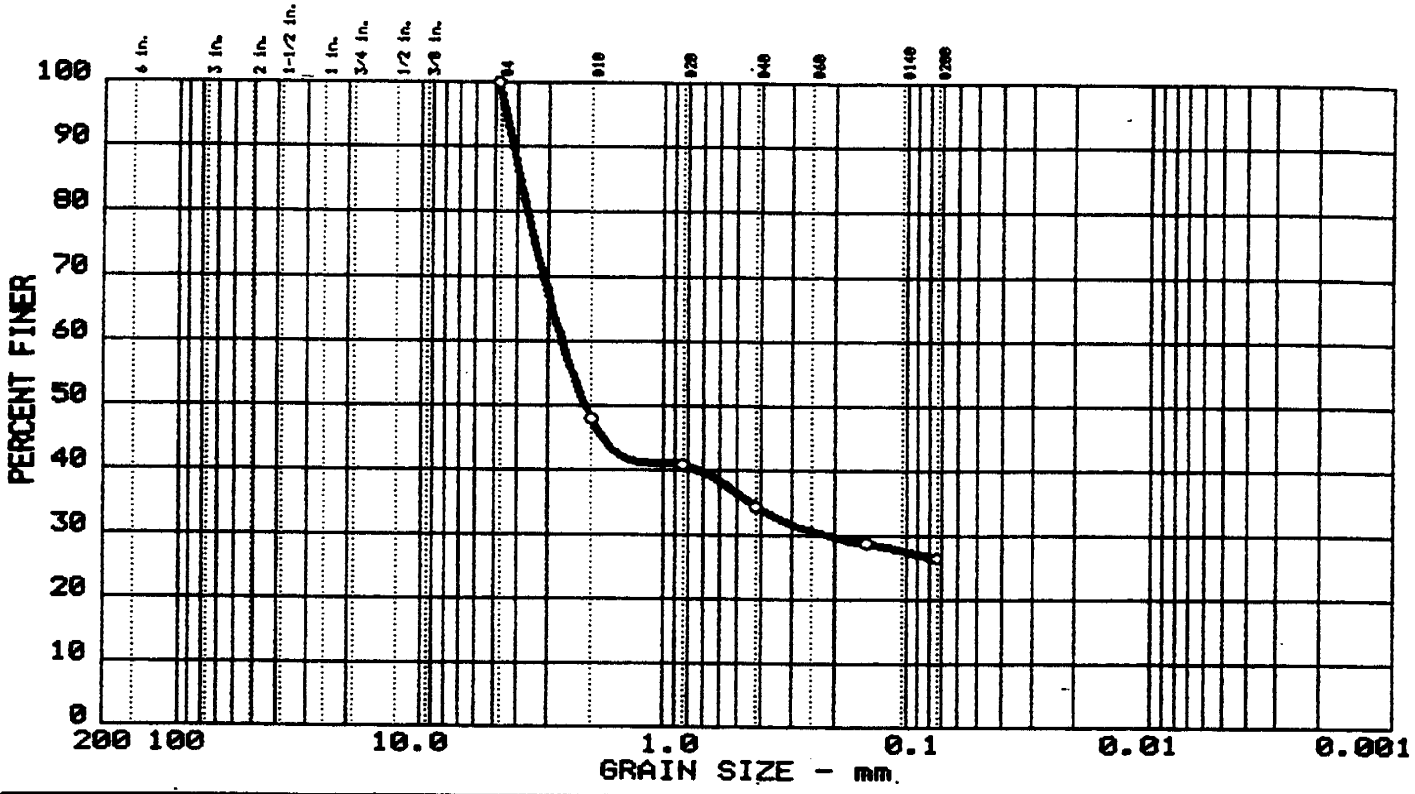
Date: 12-22-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MC-52
SAMPLE. 11

Fig. No.____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	73.5	26.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	29	15	3.88	2.63	2.12	0.209				

MATERIAL DESCRIPTION	USCS	AASHTO
o SAND,CLAYEY, PALE YELLOW	SC	A-2-6(1)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

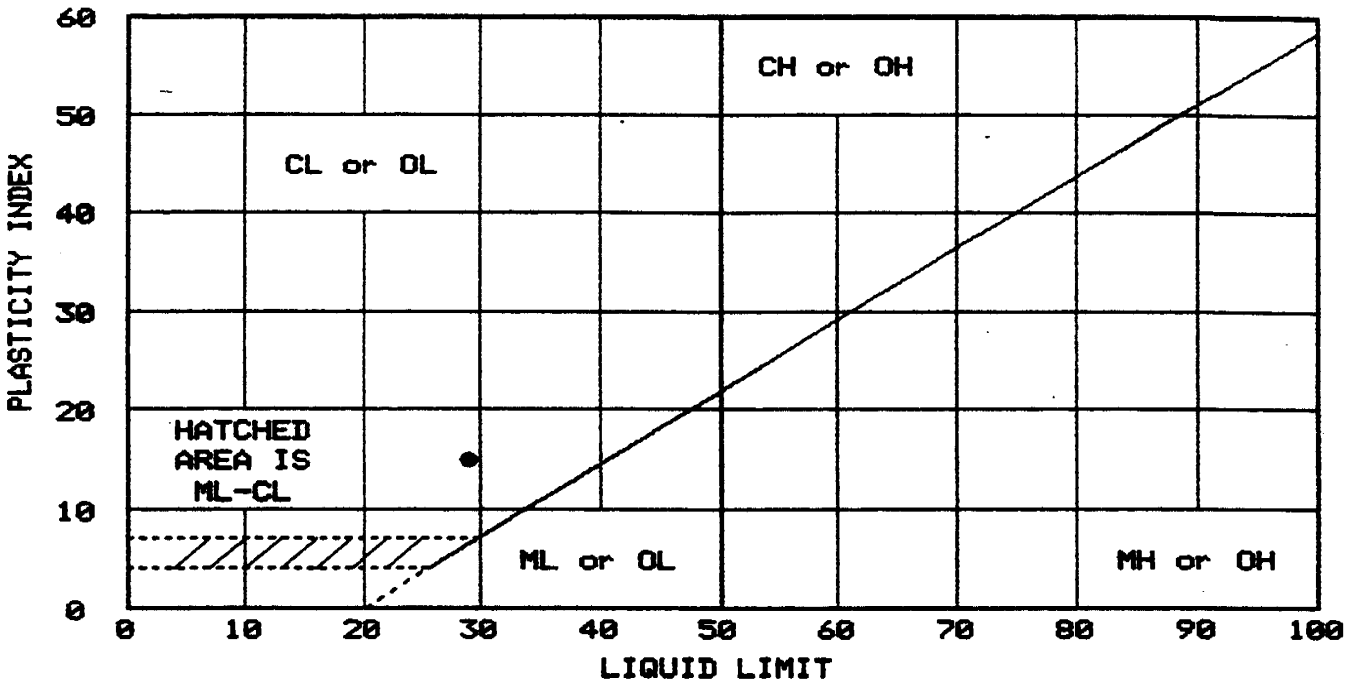
Date: 12-22-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MC-52
SAMPLE. 15
NAT. MOIST. 23%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SAND,CLAYEY, PALE YELLOW	29	14	15	26.5	SC	A-2-6(1)

Project No.:
Project: RIO PUERTO NUEVO

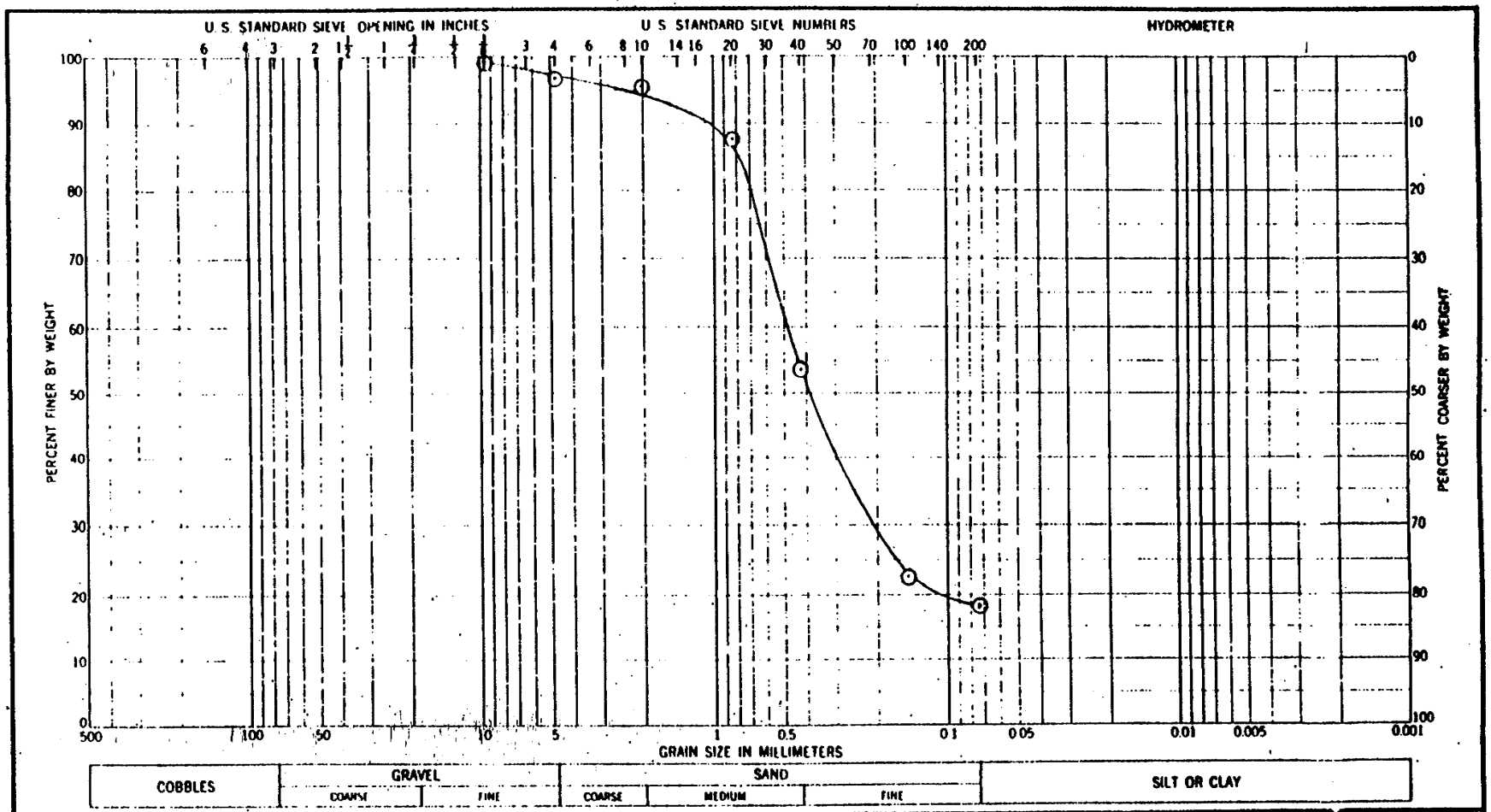
Client:
Location: HATO REY P.R.

Date: 12-22-95

Remarks:
BOR. CB-MC-52
SAMPLE. 15

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Fig. No.____



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
10	-1.99 to -3.49	SC				

GRADATION CURVES

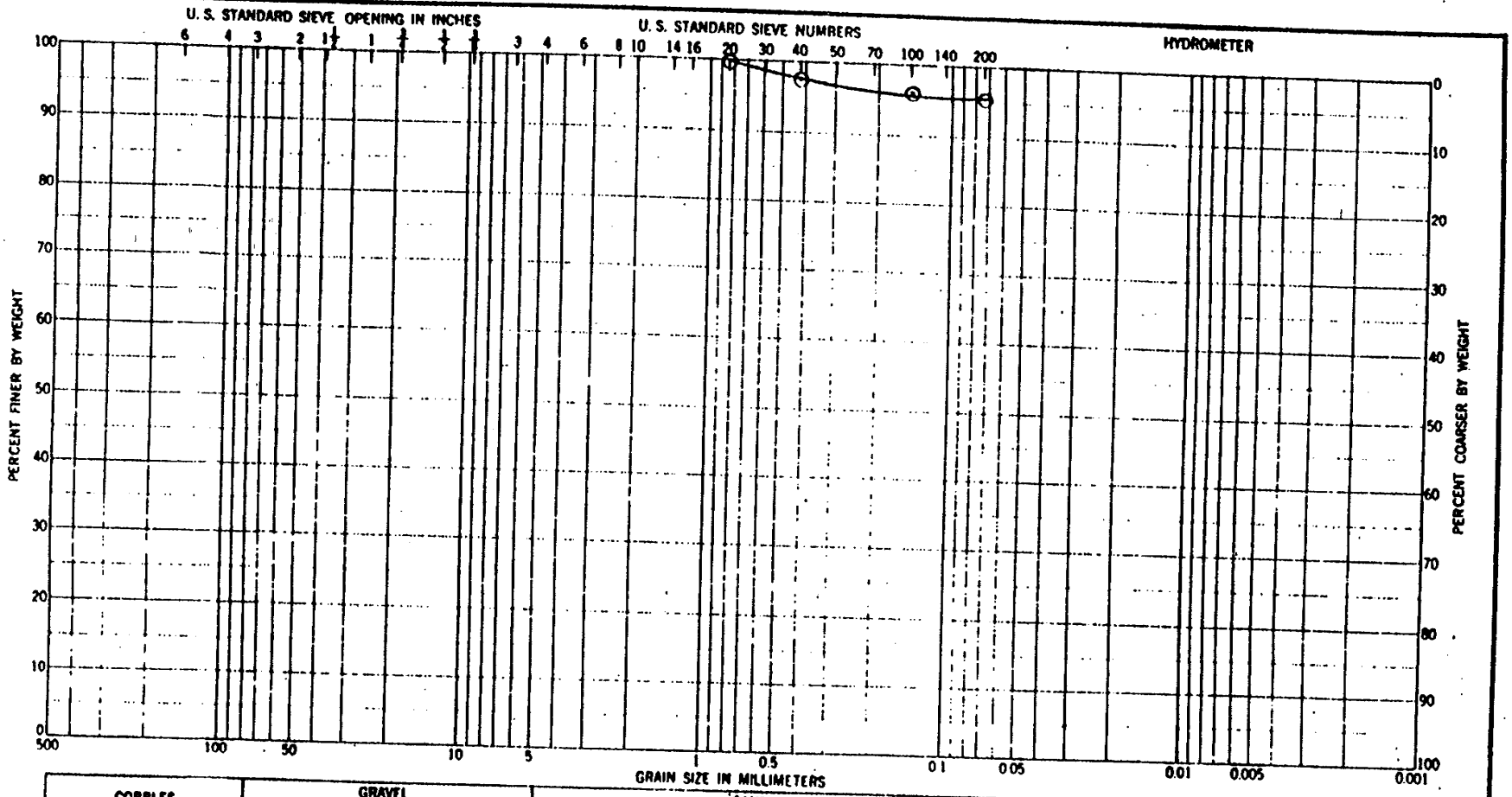
Project: Puerto Nuevo Channels
San Juan, Puerto Rico

Area

Boring No. CB-MC-42

Date 4-27-90

ENG FORM 1 MAY 63 2087

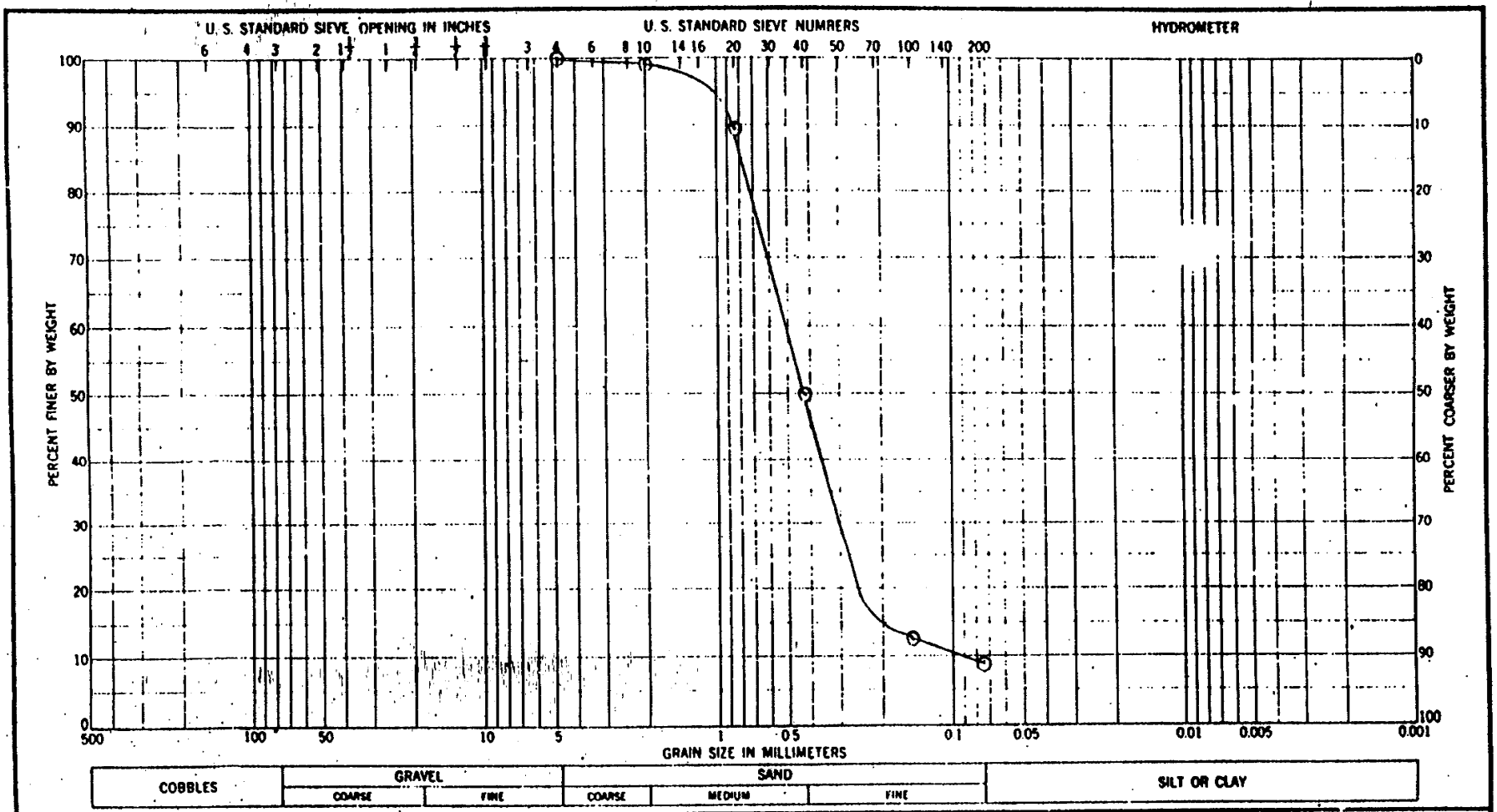


Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
18	25.5 to 27'	CH	60	83	25	58

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-37
Date: 05-15-89

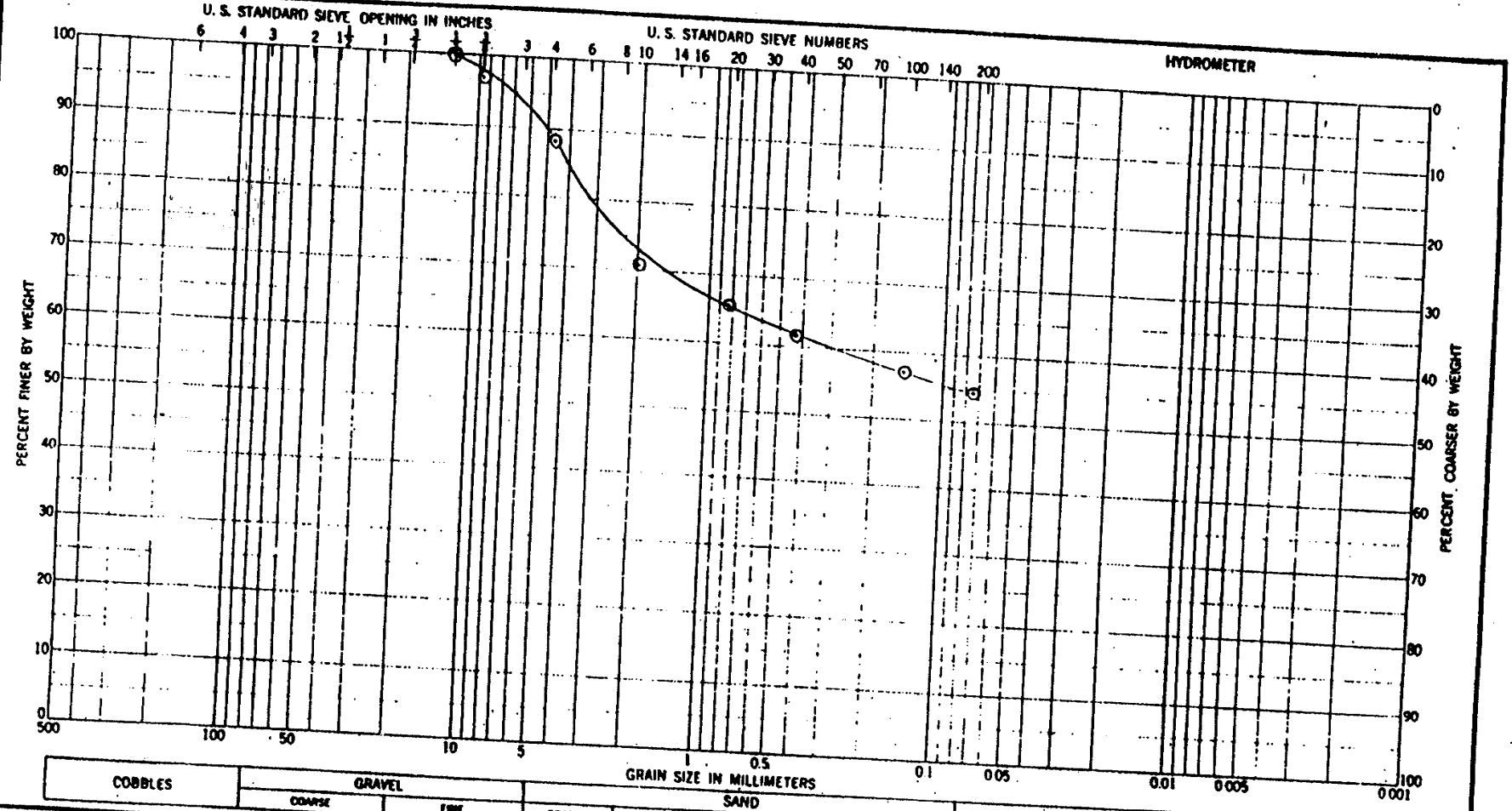
ENG FORM 1 MAY 83 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
27	39 to 40.5'	SC	24			

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-37
Date: 05-10-89

GRADATION CURVES

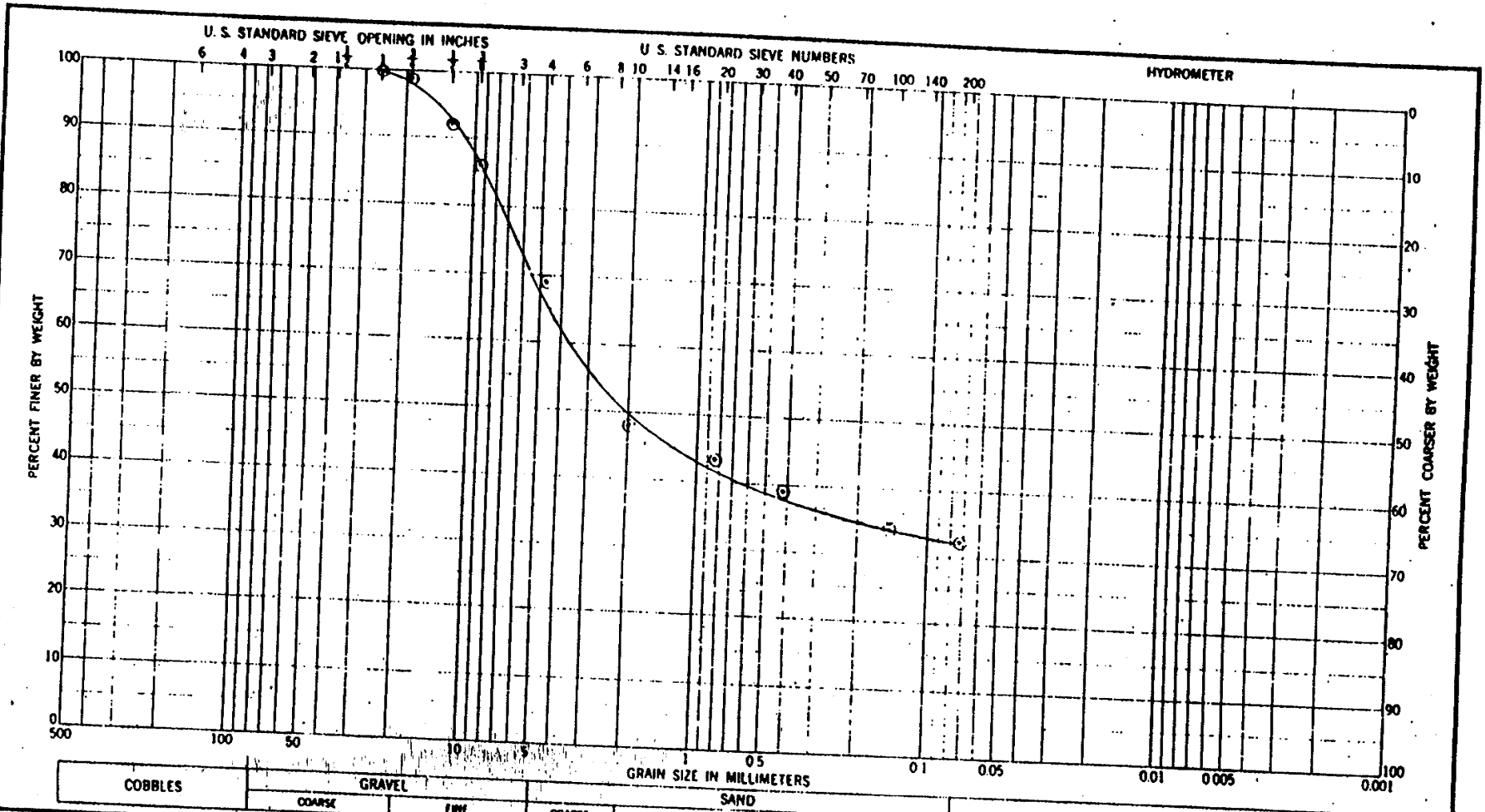


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
42	61.5 to 63'	GC	15			

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-37
Date: 05-10-89

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
43	63 to 64.5'	LIMESTONE FRAGMENTS, gravel and sand size	20			

GRADATION CURVES

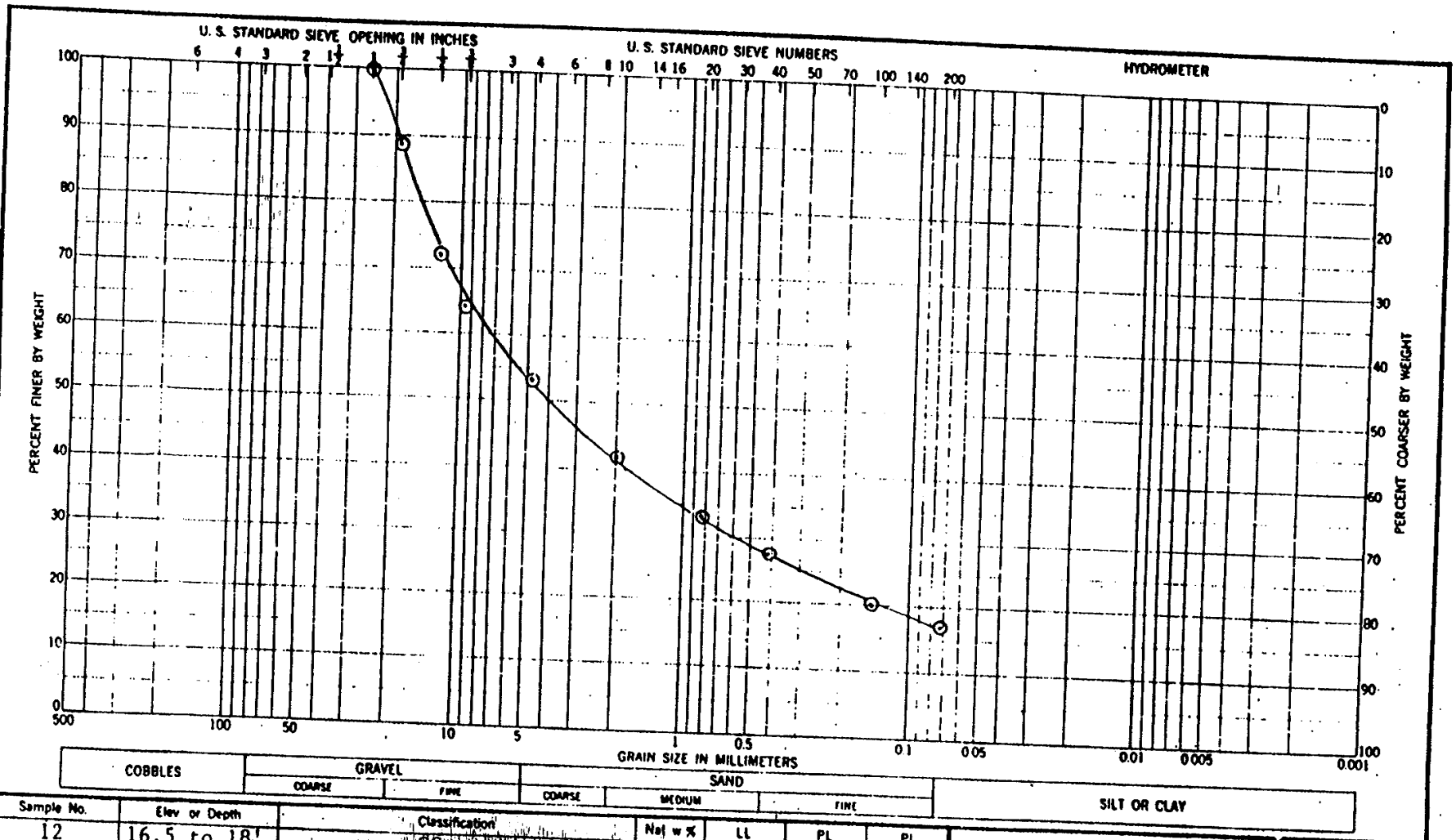
Project: Puerto Nuevo Channel Bridges
Assignment No. 1

Area: San Juan, Puerto Rico

Boring No.: CB-PNB-38

Date: 05-10-89

ENG FORM 1 MAY 63 2087

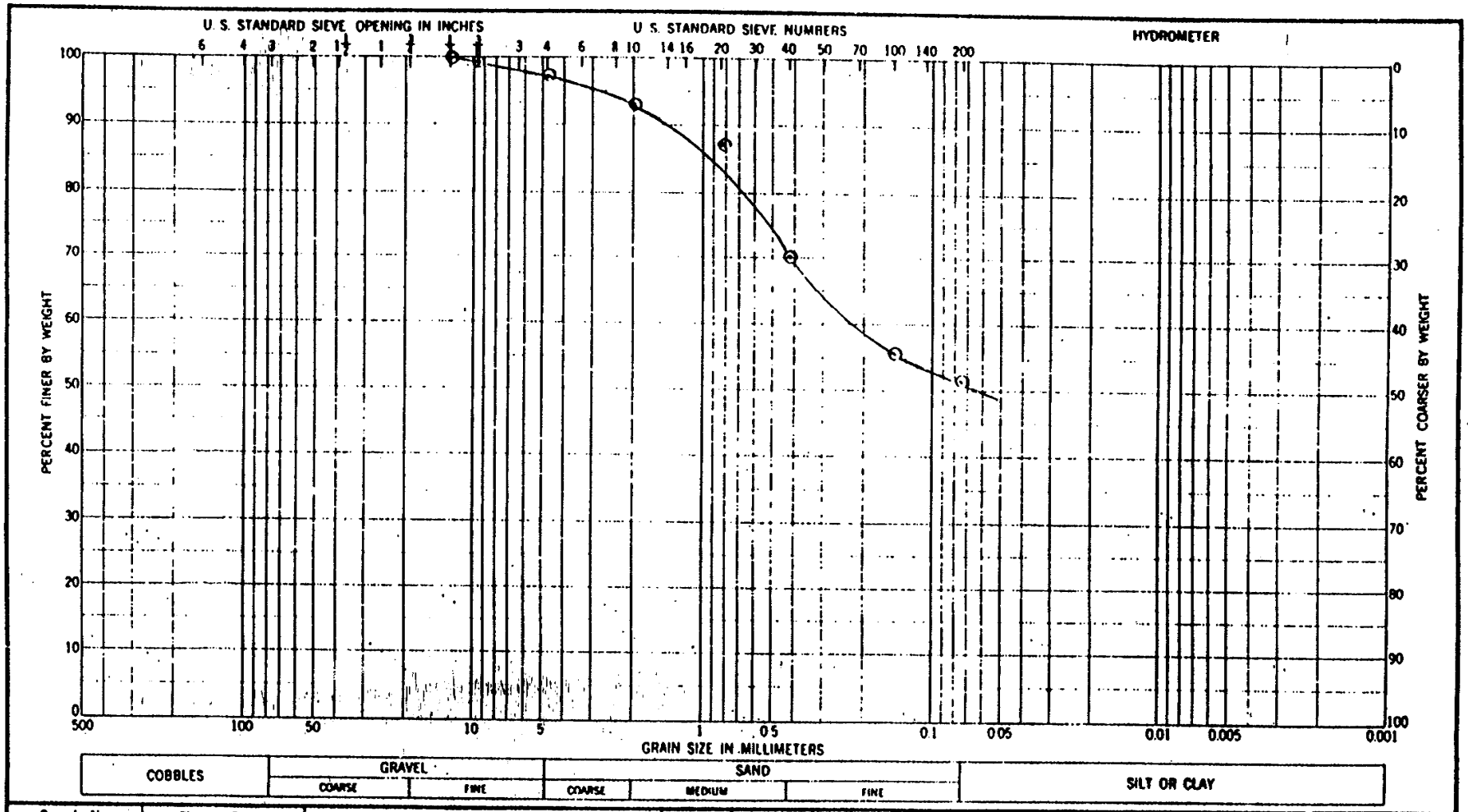


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
12	16.5 to 18'	GC	23			

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-39
Date: 05-10-89

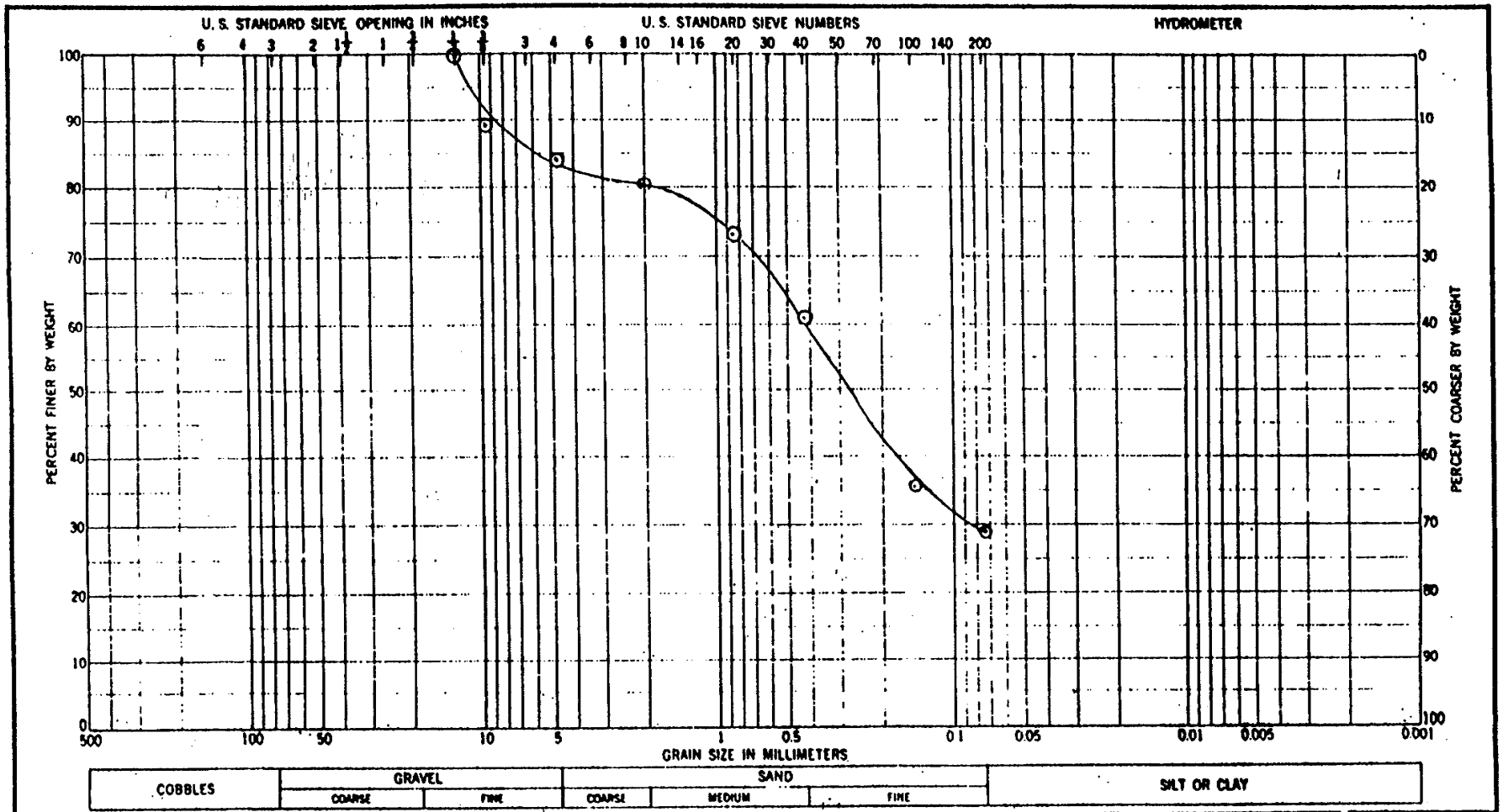
ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
17	24 to 25.5'	OH	56			

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-39
Date: 05-10-89



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
36	52.5 to 54	SC	18			

GRADATION CURVES

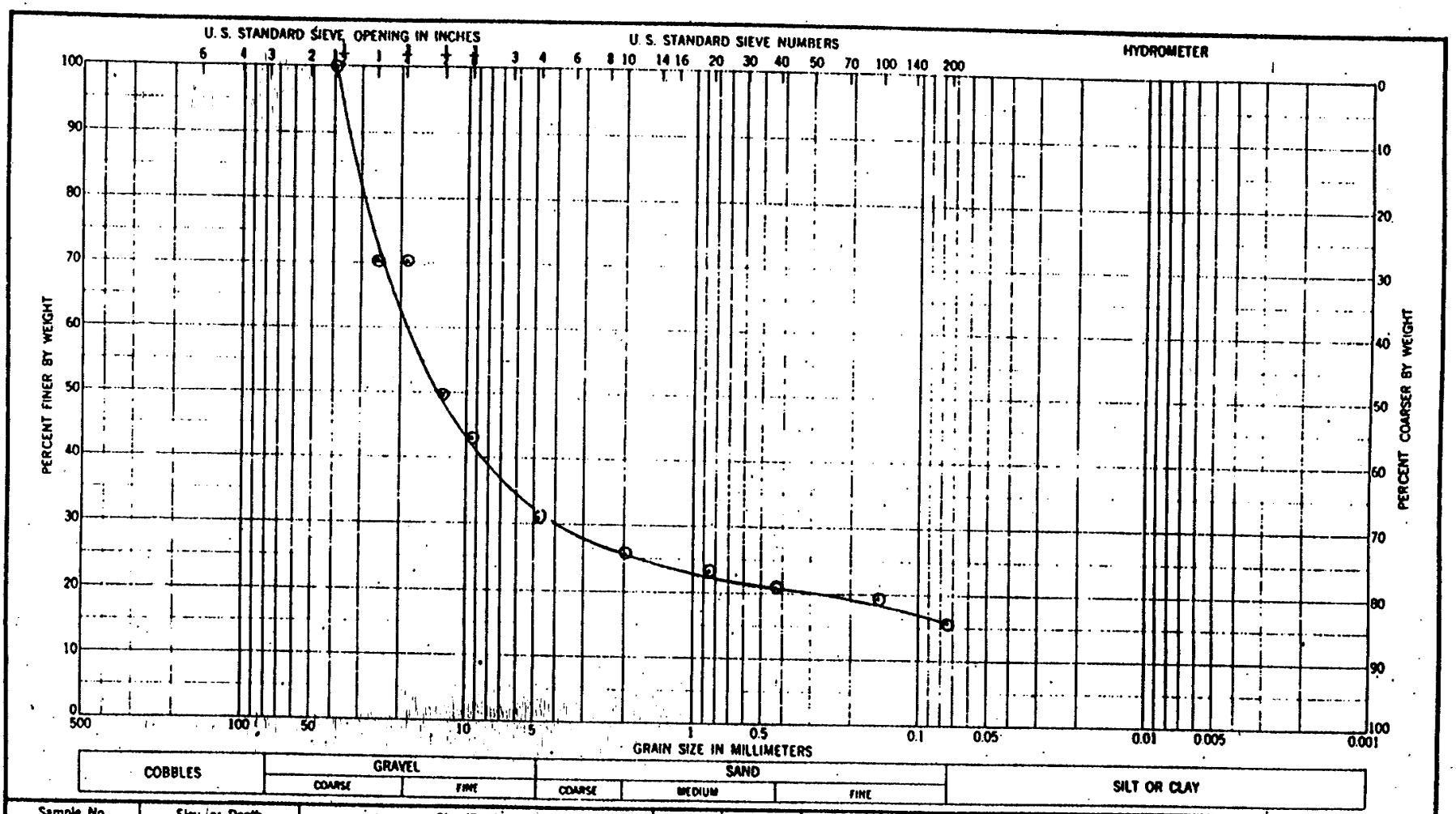
Project: Puerto Nuevo Channel Bridges
Assignment No. 1

Area: San Juan, Puerto Rico

Boring No.: CB-PNB-39

Date: 05-10-89

ENG FORM 1 MAY 63 2087

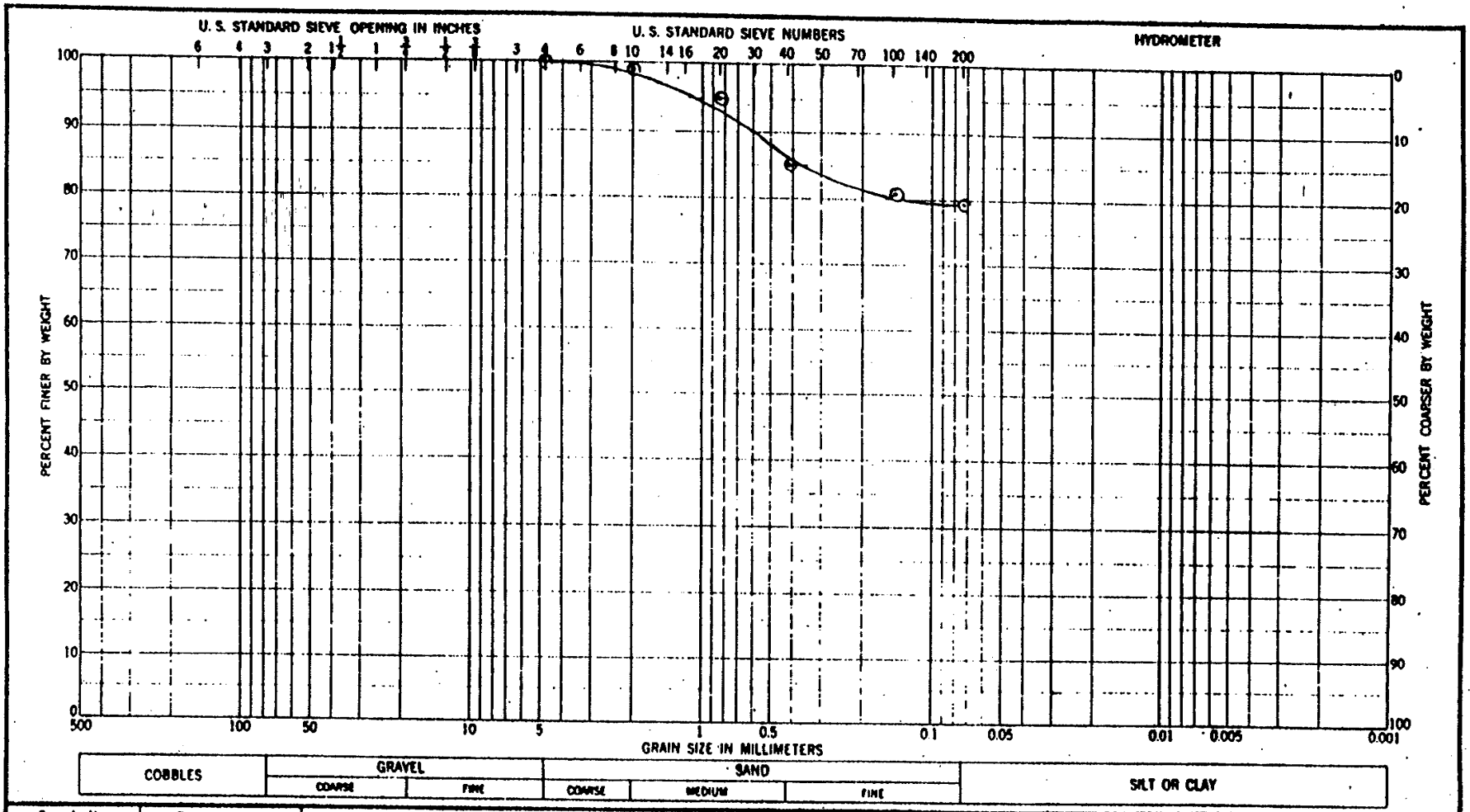


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
3	3 to 4.5'	GC	11			

GRADATION CURVES

Project Puerto Nuevo Channel Bridges
Assignment No. 1
Area San Juan, Puerto Rico
Boring No. CB-PNB-40
Date 05-17-89

FORM G 2087 1 MAY 63

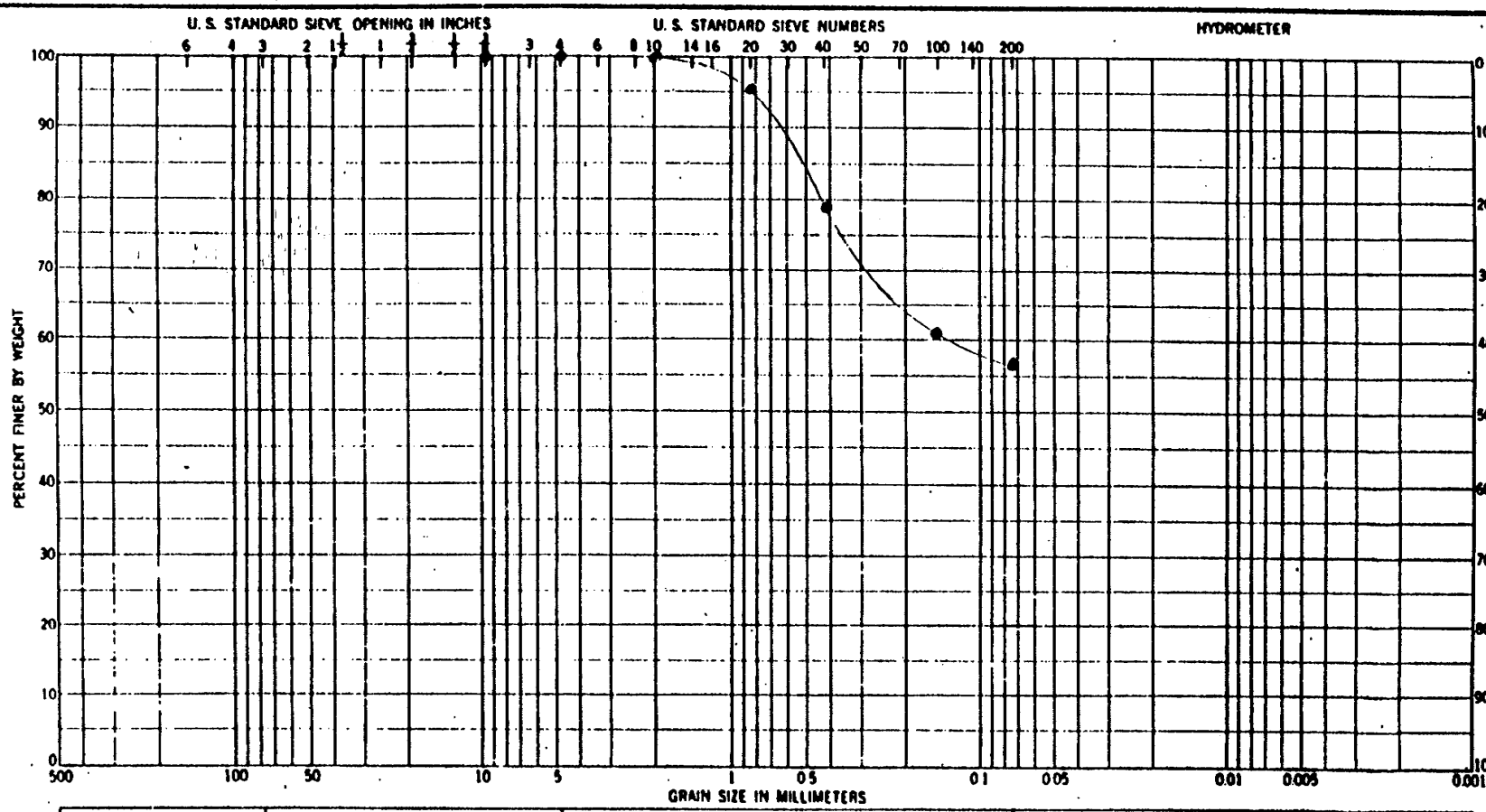


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
20	28.5 to 30'	CH	55	68	22	46

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-40
Date: 05-16-89

ENG FORM 1 MAY 83 2087

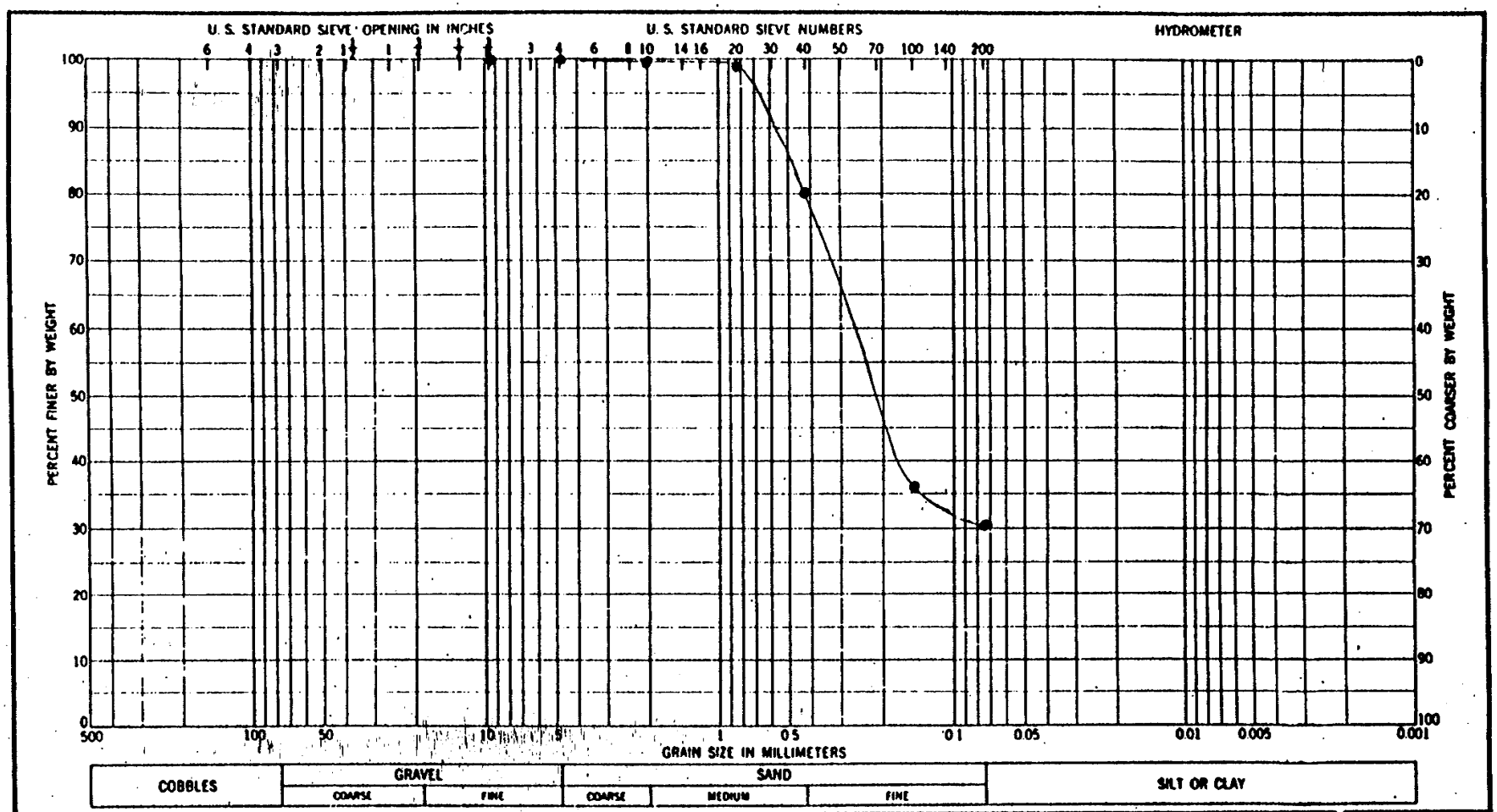


Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
8	10.5 to 12'	Organic clay, some sand, gray and dark gray. (OH)	76	92	31	61

GRADATION CURVES

Project: Puerto Nuevo Channels
Assignment #4
Area: San Juan, Puerto Rico
Boring No.: CB-MC-43
Date: 6/1/90

ENG FORM (MAY 61) 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
17	24 to 25.5'	Clay, very sandy, little silt, red and olive.	16	36	15	21

GRADATION CURVES

Project: Puerto Nuevo Channels Assignment #4

Area: San Juan, Puerto Rico

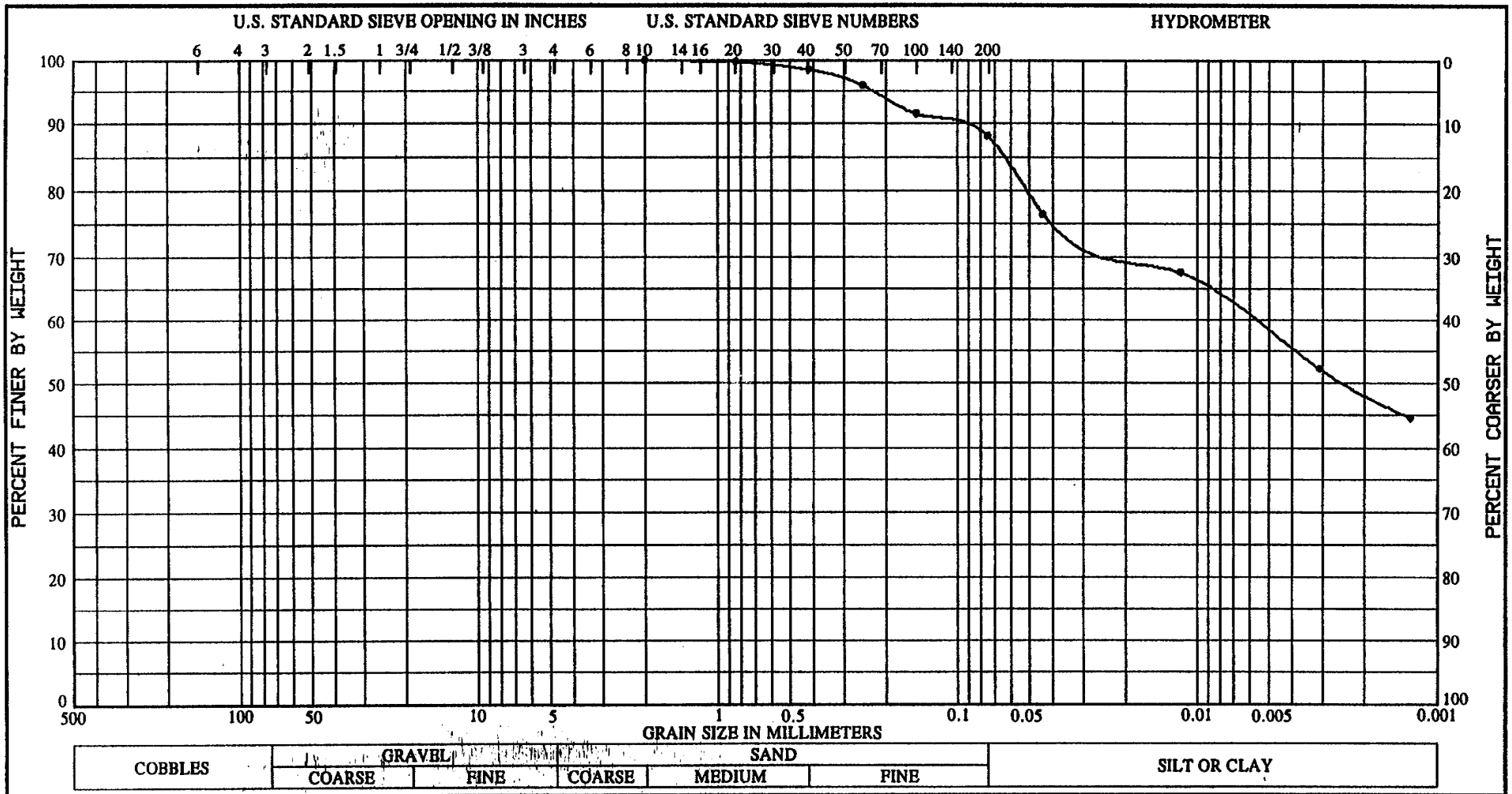
Boring No.: CB-MC-43

Date: 6/1/90

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
1	12.0-14.0	GRAY & TAN, FAT CLAY (CH), WITH A LITTLE SAND SIZES.	39.2	99	33	66

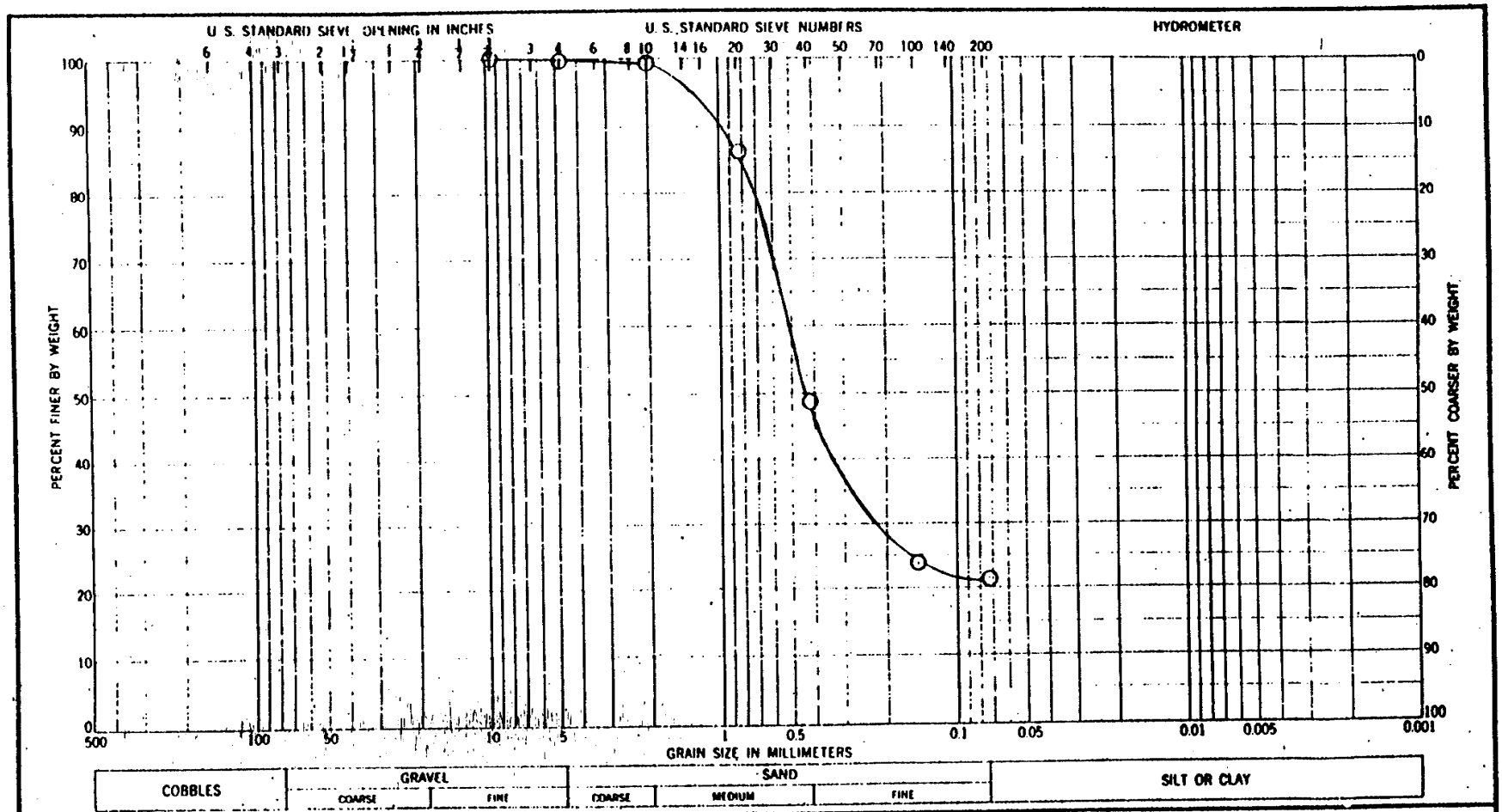
Project RIO PUERTO NEUVO

Lab No. 73/7215

Boring No. CB-MC-44

Date 01/08/96

GRADATION CURVES



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
14	-11.59 to -13.09	SC				

GRADATION CURVES

Project: Puerto Nuevo Channels
San Juan, Puerto Rico

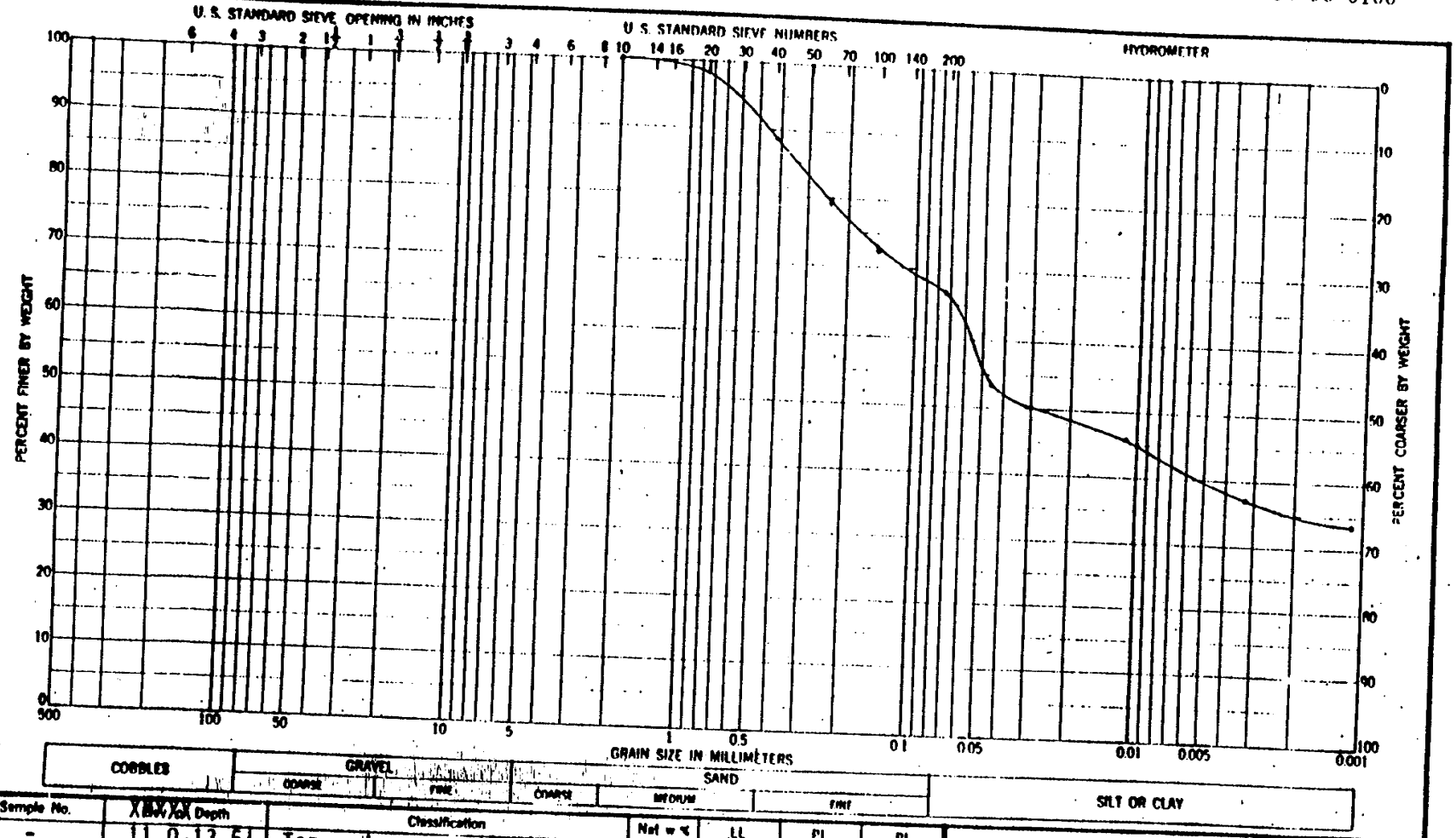
Area:

Boring No.: CB-MC-44

Date: 4-27-90

ENG FORM 1 MAY 63 2087

W.O. NO. 6141
REQ. NO. RM-CW-90-0160



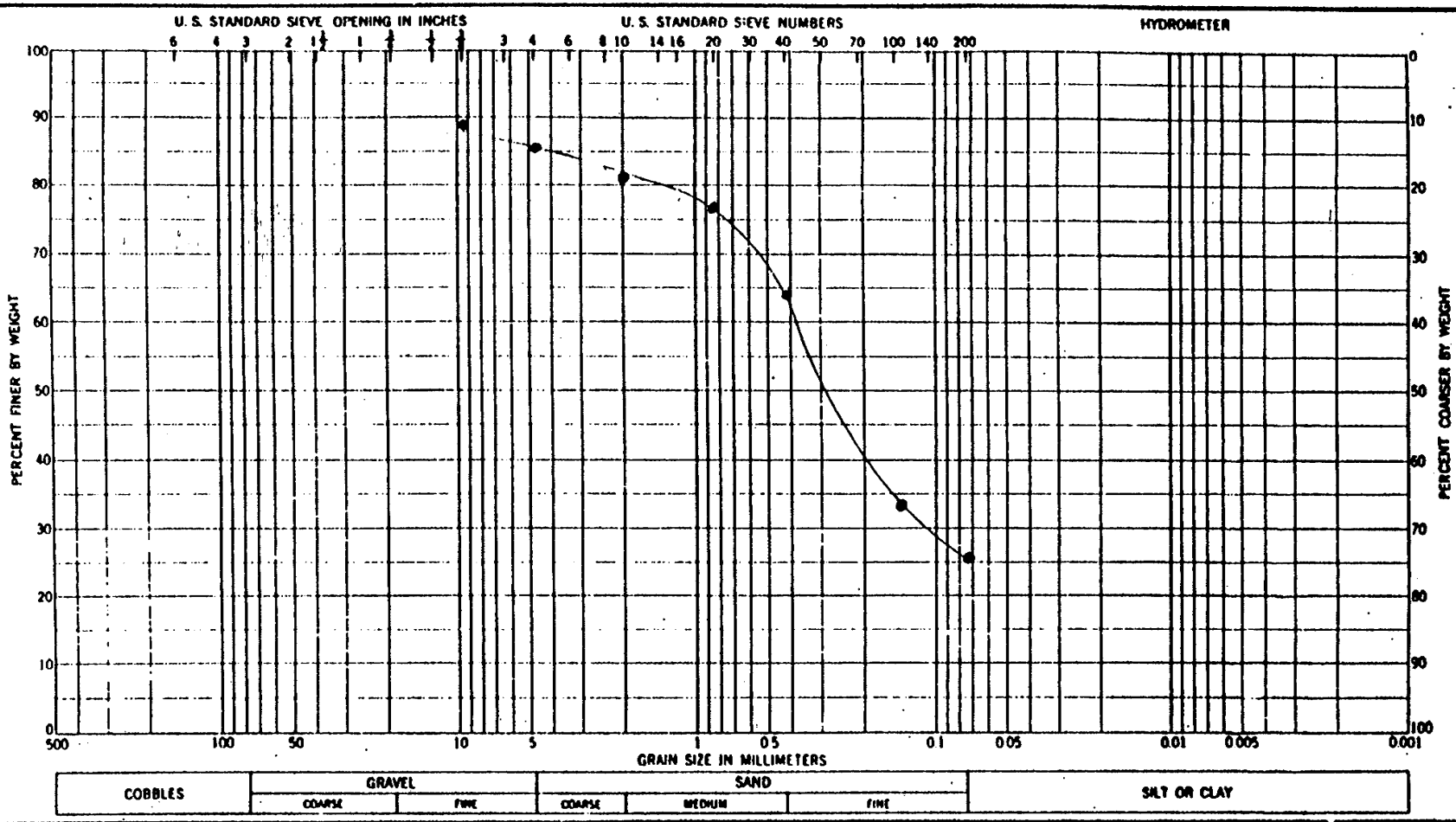
Sample No.	Depth	Classification	Nat w %	LL	PL	PI
-	11.0-13.5'	Tan and gray, fat clay (CH) with some sand	24.5	59	18	41

GRADATION CURVES

Project: Puerto Nuevo Channel
Lab. No. 258/806*
Area: --
Boring No: CB-MC-440
Date: 11 May 1990

ENG FORM 1 MAY 81 2087

*) & R Triaxial Tests

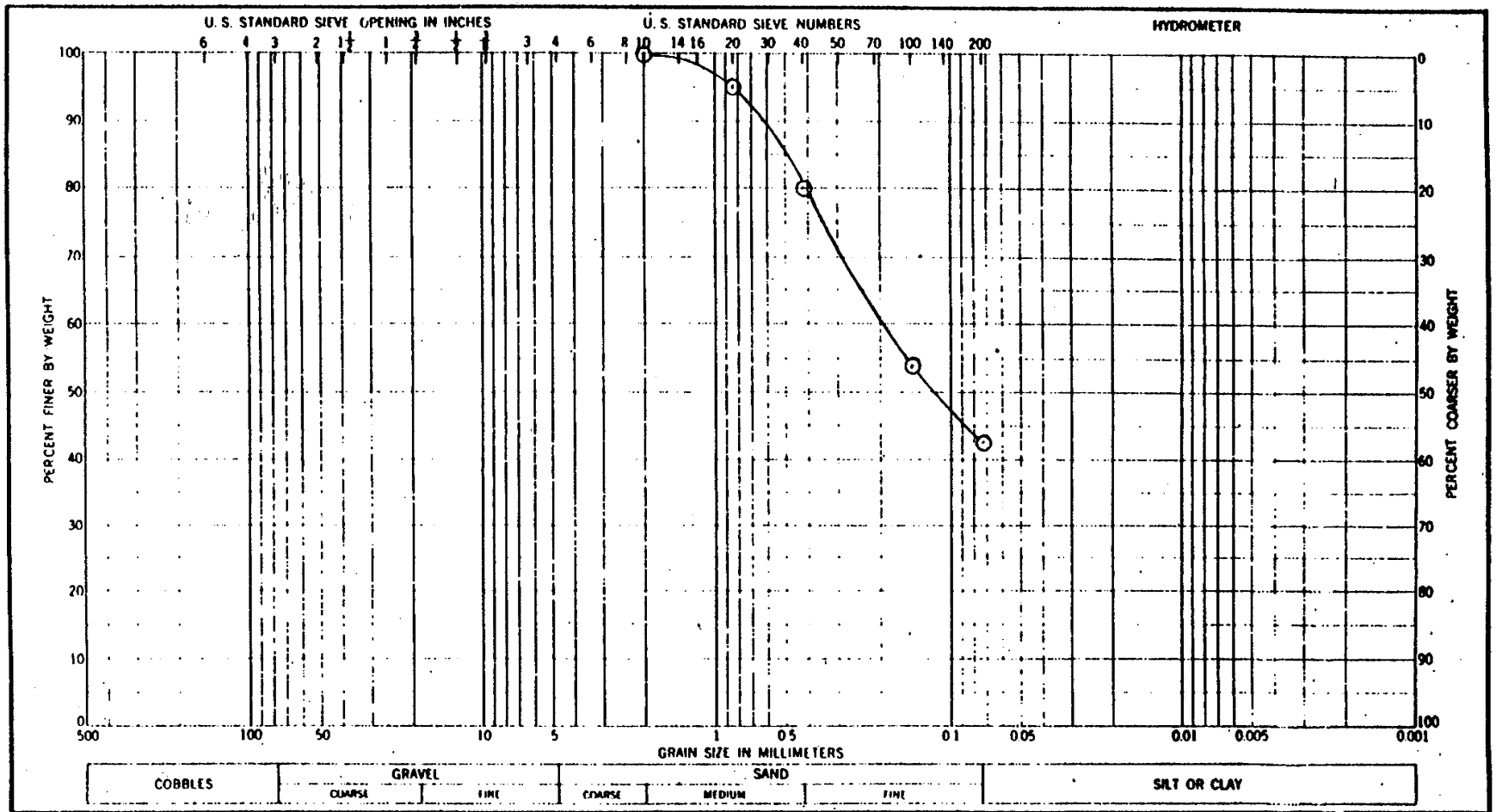


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
30	43.5 to 45	Sand, silty, fine grained, some clay, olive gray and brown (SM)				

GRADATION CURVES

Project: Puerto Nuevo Channels
Assignment #4
Area: San Juan, Puerto Rico
Boring No.: CB-MC-44
Date: 6/1/90

ENG FORM 1 MAY 63 2087



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
32	-38.59 to -40.09	SM				

GRADATION CURVES

Project: Puerto Nuevo Channels
San Juan, Puerto Rico

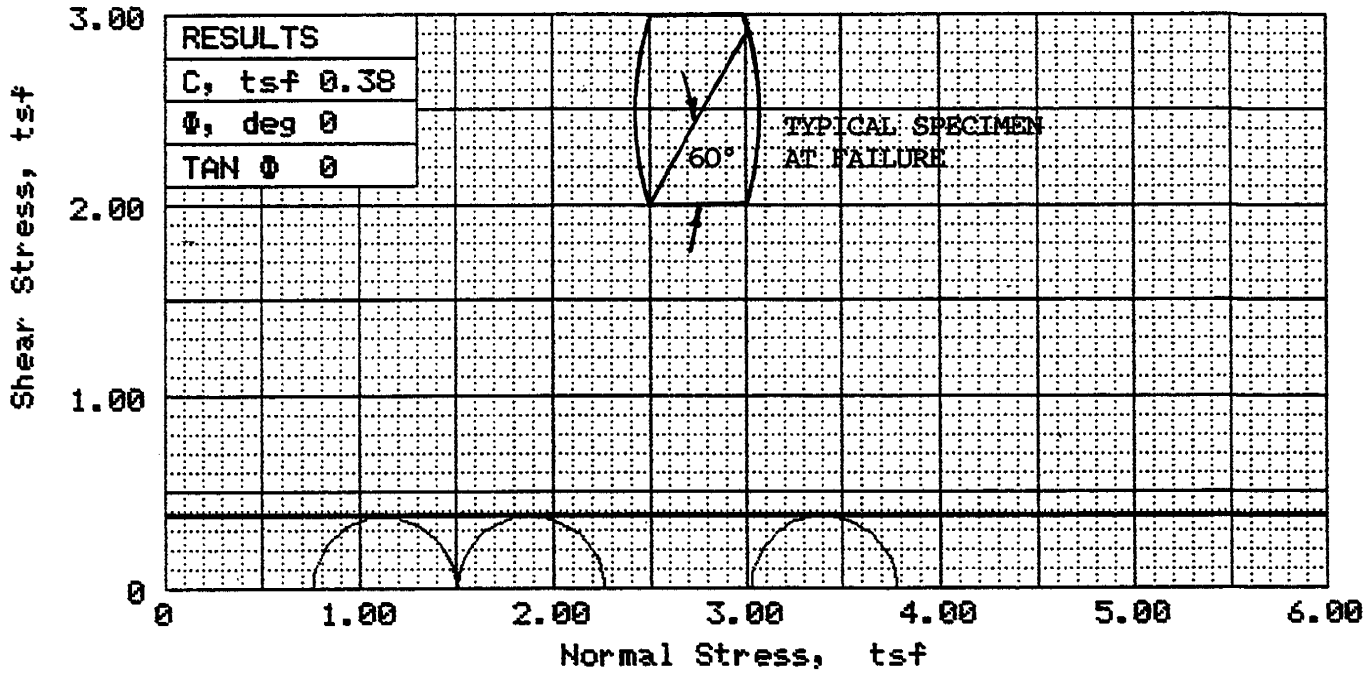
Area:

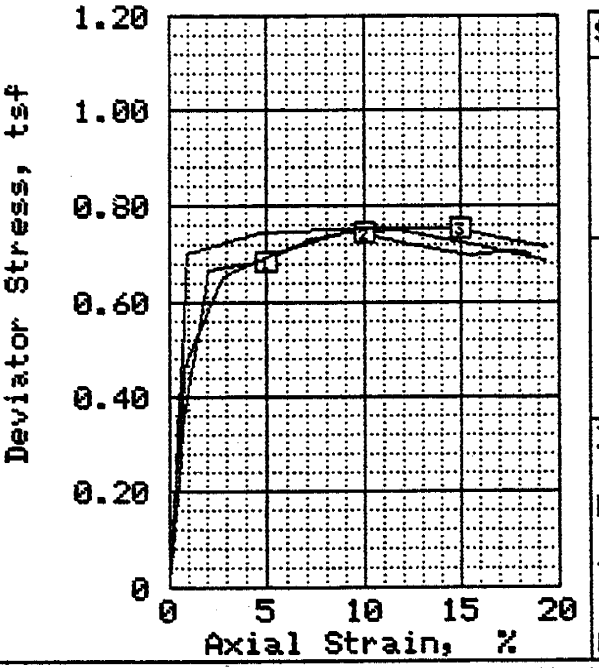
Boring No.: CB-MC-44

Date: 4-27-90

ENG FORM 1 MAY 63 2087

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0033 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	40.6	39.8	40.7
	DRY DENSITY, pcf	77.3	77.7	77.9
	SATURATION, %	92.2	91.4	93.8
	VOID RATIO	1.197	1.185	1.181
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	44.0	43.6	43.4
	DRY DENSITY, pcf	77.3	77.7	77.9
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.197	1.185	1.181
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		0.76	1.51	3.02
MAX. DEV. STRESS, tsf		0.75	0.75	0.76
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		15	17	16
RATE, %/min.		0.63	0.69	0.69
ULT. DEV. STRESS, tsf		0.70	0.72	0.75

DESCRIPTION GRAY & TAN, FAT CLAY (CH), WITH A LITTLE SAND SIZES.

LL= 99	PL= 66	PI= 33	Gs= 2.72	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Sat Q

REMARKS

PROJECT RIO PUERTO NEUVO

AREA

LAB NO. 73/7215

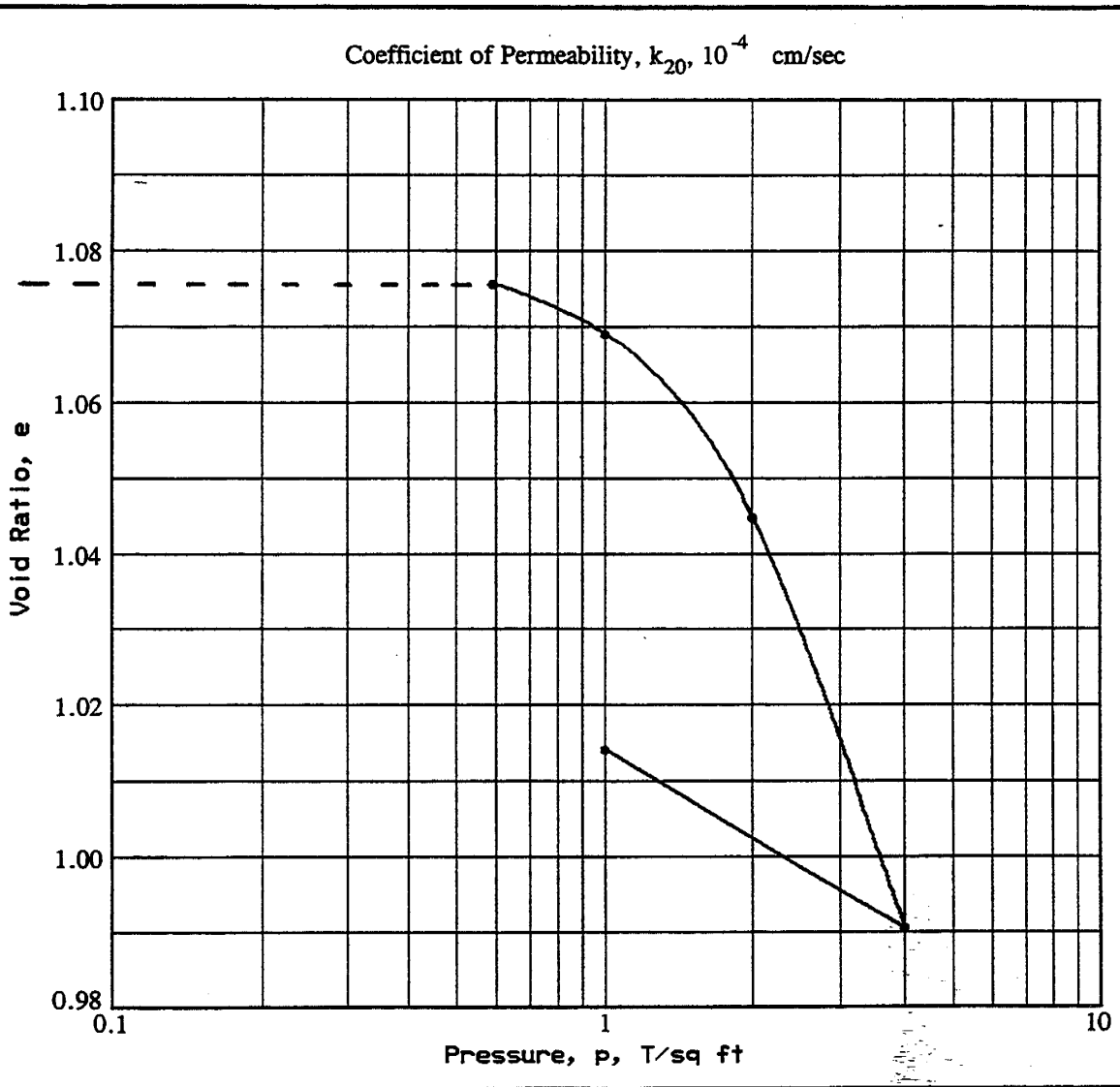
BORING NO. CB-MC-44
SAMPLE NO. 1
DEPTH/~~ELEV~~ 12.0 - 14.0'
LABORATORY CESAD-EN-FL DATE 20 JAN. 1996

TRIAXIAL COMPRESSION TEST

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038

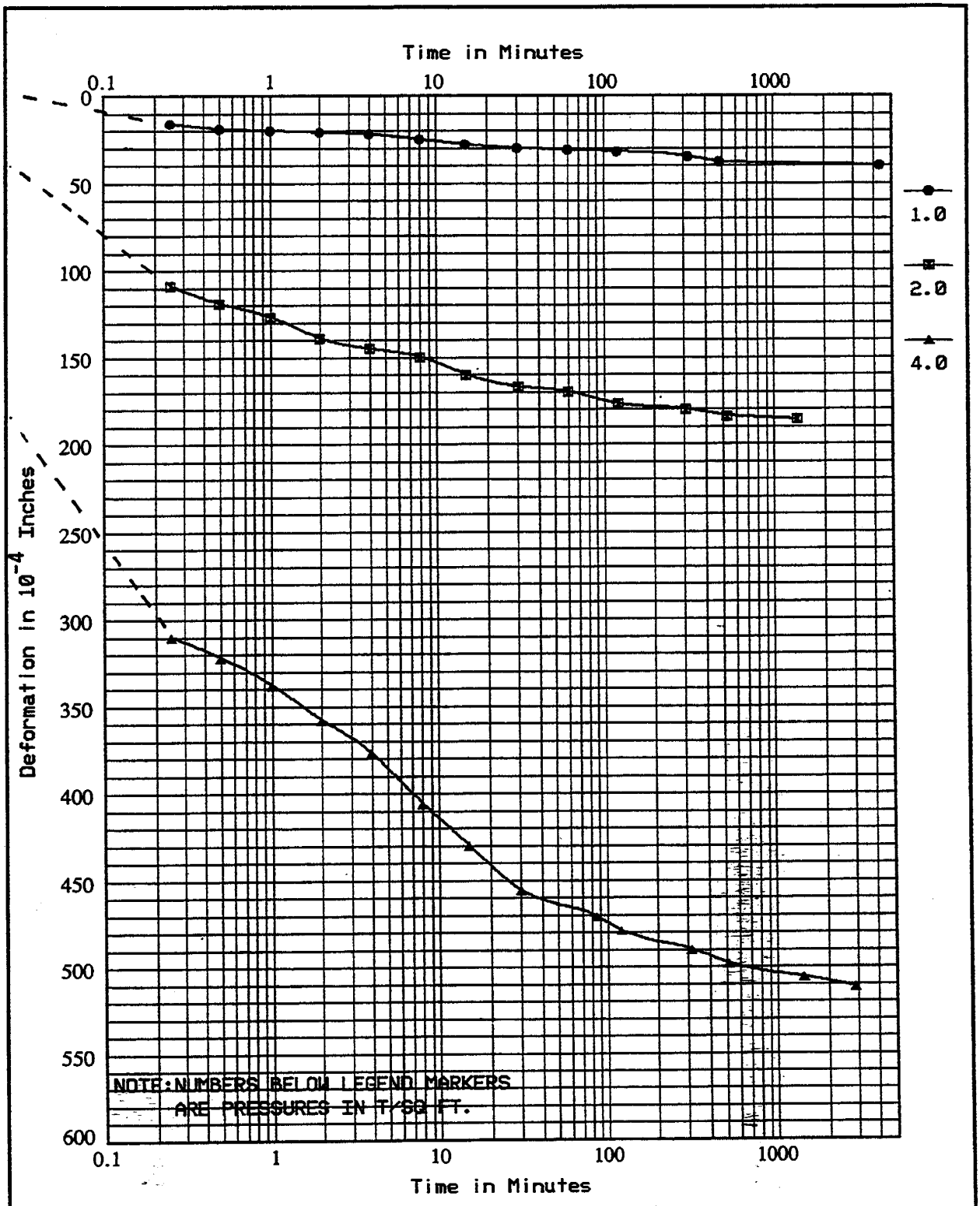




Type of Specimen UNDISTURBED			Before Test			After Test	
Diam. 3.990 in.	Height 1.250 in.		Water Content	w_o	36.7 %	w_f	37.3 %
Overburden Pressure, p_o	T/sq ft		Void Ratio	e_o	1.076	e_f	1.014
Preconsol. Pressure, p_c	T/sq ft		Saturation	S_o	92.8 %	S_f	100.0 %
Compression Index, C_c			Dry Density	γ_d	81.8 lb/ft^3		
Classification GRAY & TAN, FAT CLAY (CH), WITH A LITTLE SAND SIZES.							
LL 99	G_s 2.72	Project RIO PUERTO NEUVO					
PL 33	D_{10} < 0.002 MM						
Remarks 1. SPECIMEN FLOODED		Lab No. 73/7215					
THROUGHOUT TEST. 2. SPECIMEN		Boring No. CB-MC-44			Sample No. 1		
REQUIRED 0.59 T/SF TO PREVENT		Depth (ft) 12.0-14.0			Date 01/08/96		
SWELL WHEN INITIAL LOAD APPLIED.		**CONSOLIDATION TEST REPORT**					

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038

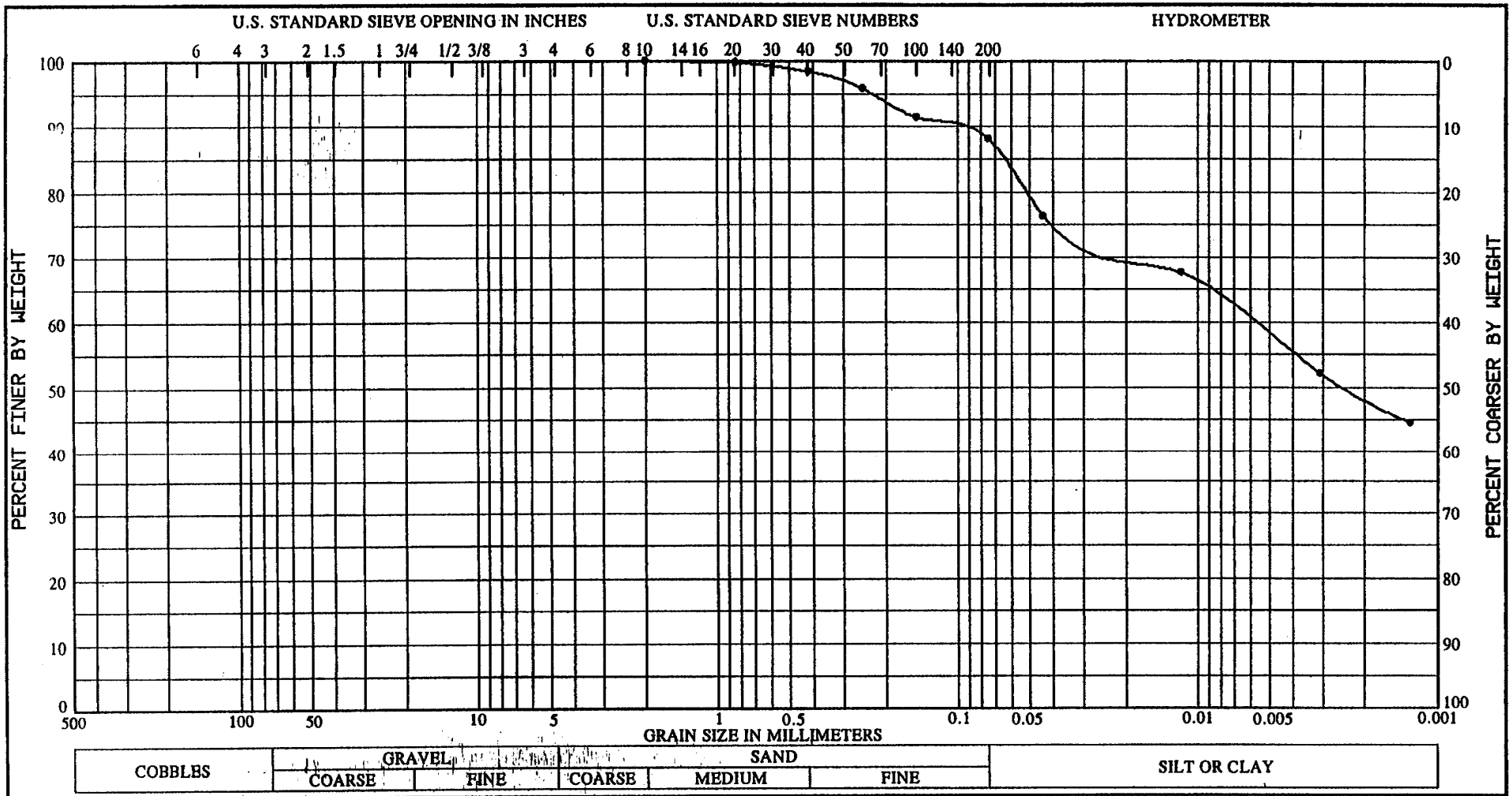


Project RIO PUERTO NEUVO			
Area			Lab No. 73/73/7215
Boring No. CB-MC-44	Sample No. 1	Depth (ft) 12.0-14.0	Date 01/09/96

CONSOLIDATION TEST - TIME CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



Type of Specimen UNDISTURBED				Before Test		After Test	
Diam. 1.52 in.	Height 2.00 in.			Water Content	w_o 39.8 %	w_f 42.5 %	
Class. GRAY & TAN, FAT CLAY (CH), WITH A LITTLE SAND SIZES.				Void Ratio	e_o 1.157	e_f 1.157	
				Saturation	S_o 93.0 %	S_f 100.0 %	
LL 99	PL 33	G_s 2.72	D_{10}<0.002MM	Dry Density	γ_d 78.7 lb/ft^3	k_{20} 0.0053 x10^{-4}cm/s	

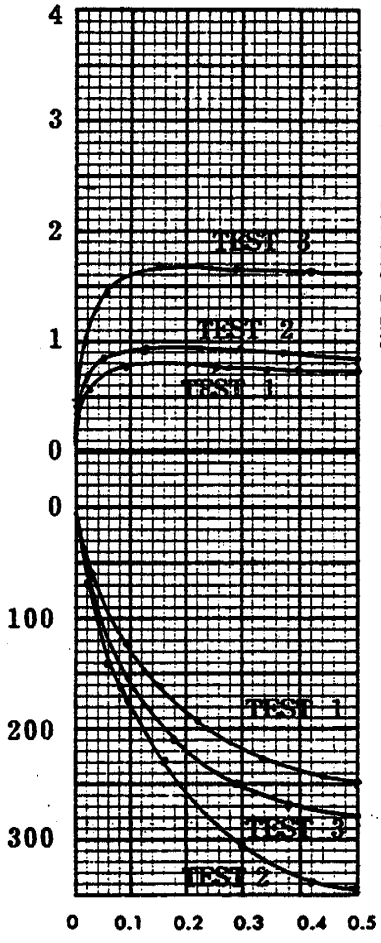
Project RIO PUERTO NEUVO

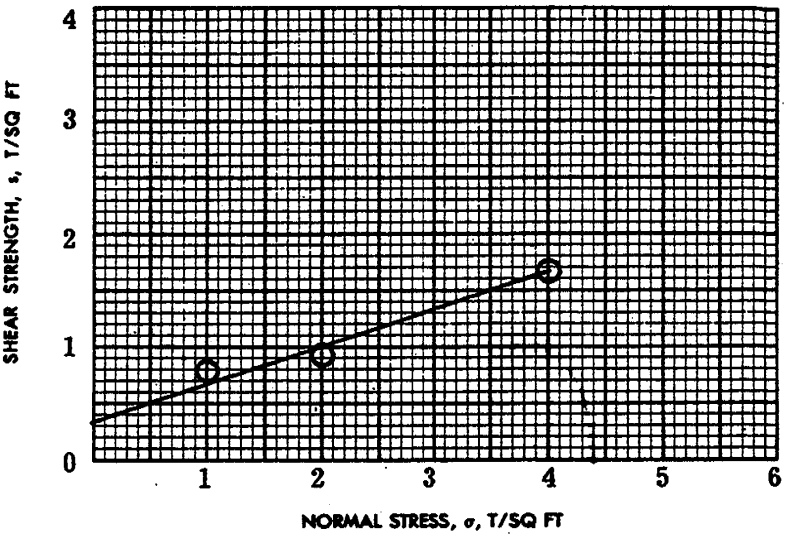
Boring No. CB-MC-44

Sample No. 1 | Lab No. 73/7215

Depth (ft) 12.0-14.0 | Date 01/12/96

Variable/~~Constant~~ Head PERMEABILITY TEST REPORT





TEST NO.			1	2	3	
INITIAL	WATER CONTENT	w_o	38.9 %	37.9 %	37.0 %	%
	VOID RATIO	e_o	1.119	1.128	1.127	
	SATURATION	S_o	94.6 %	91.4 %	89.3 %	%
	DRY DENSITY, LB/CU FT	γ_d	80.1	79.8	79.8	
VOID RATIO AFTER CONSOLIDATION		e_c	1.076	1.034	0.939	
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	6.0	<1.0	2.0	
FINAL	WATER CONTENT	w_f	35.5 %	32.2 %	30.0 %	%
	VOID RATIO	e_f	0.965	0.880	0.816	
	SATURATION	S_f	100.0 %	100.0 %	100.0 %	%
NORMAL STRESS, T/SQ FT		σ	1.00	2.00	4.00	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.77	0.91	1.65	
ACTUAL TIME TO FAILURE, MIN		t_f	75	120	180	
RATE OF STRAIN, IN./MIN			0.0008	0.0008	0.0008	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}	0.74	0.83	1.62	

SHEAR STRENGTH PARAMETERS

$\phi' =$ 18.0°

TAN $\phi' =$ 0.325

$c' =$ 0.33* T/SQ FT

*Apparent Cohesion Not Recommended for Design Computations

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TYPE OF SPECIMEN Undisturbed — 3.0 IN. SQUARE — 0.48 IN. THICK

CLASSIFICATION Gray & Tan, Fat Clay (CH), with a little sand sizes.

LL	PL	PI		G_s
99	33	66	-	2.72

REMARKS

PROJECT Rio Puerto Neuvo

Lab No. 73/7215

AREA

BORING NO. CB-MC-44 — SAMPLE NO. 1

DEPTH 12.0-14.0' — DATE 31 January 96

DIRECT SHEAR TEST REPORT

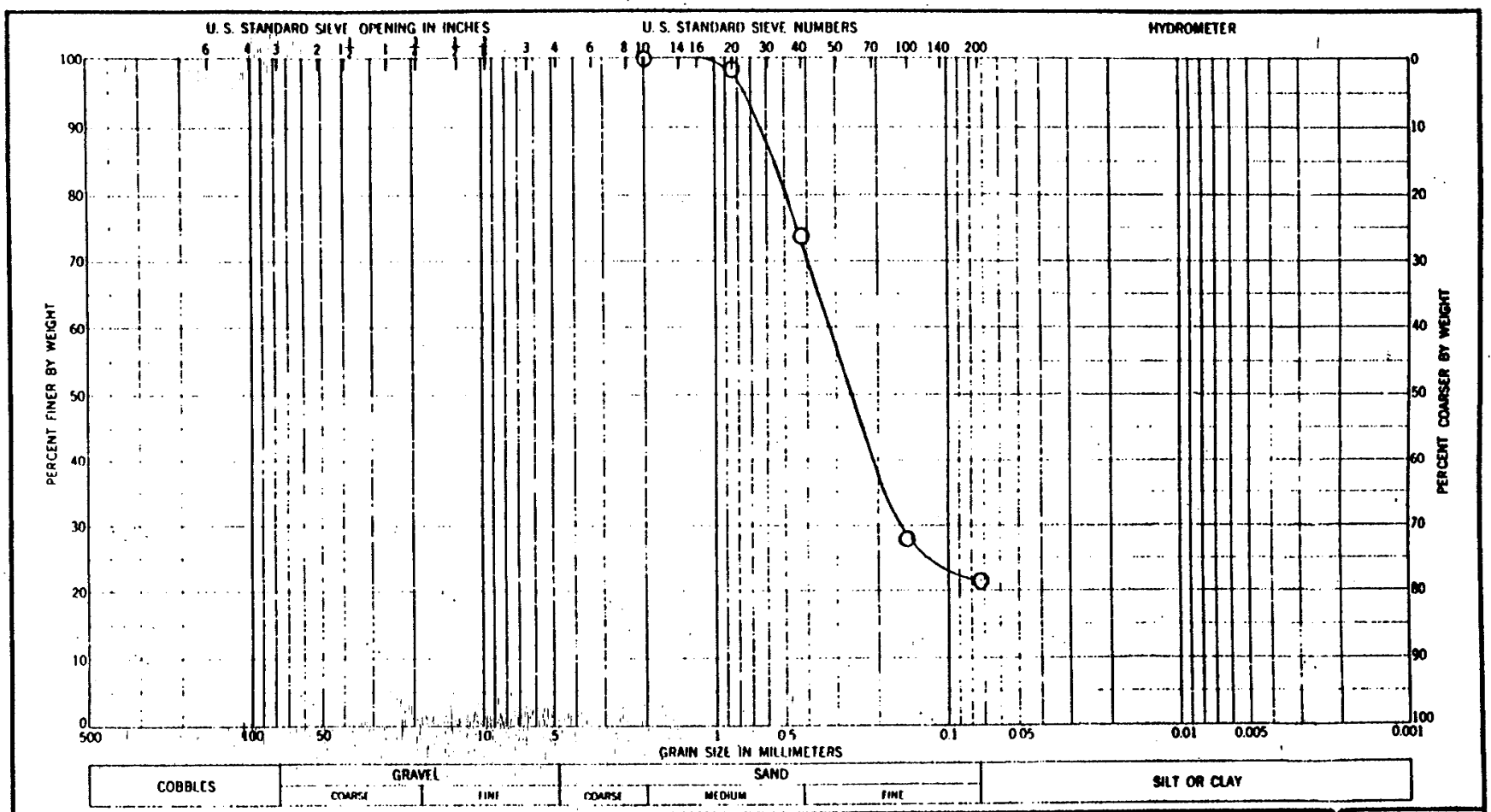
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER NO. 7825
Req. No. RM-CW-96-0038

ENG FORM 2092 1 JUN 65 (EM 1110-2-1906) PREVIOUS EDITIONS ARE OBSOLETE

GPO : 1966 OP—214-943

PLATE IX-3



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
7	2.81 to 1.31	SC				

GRADATION CURVES

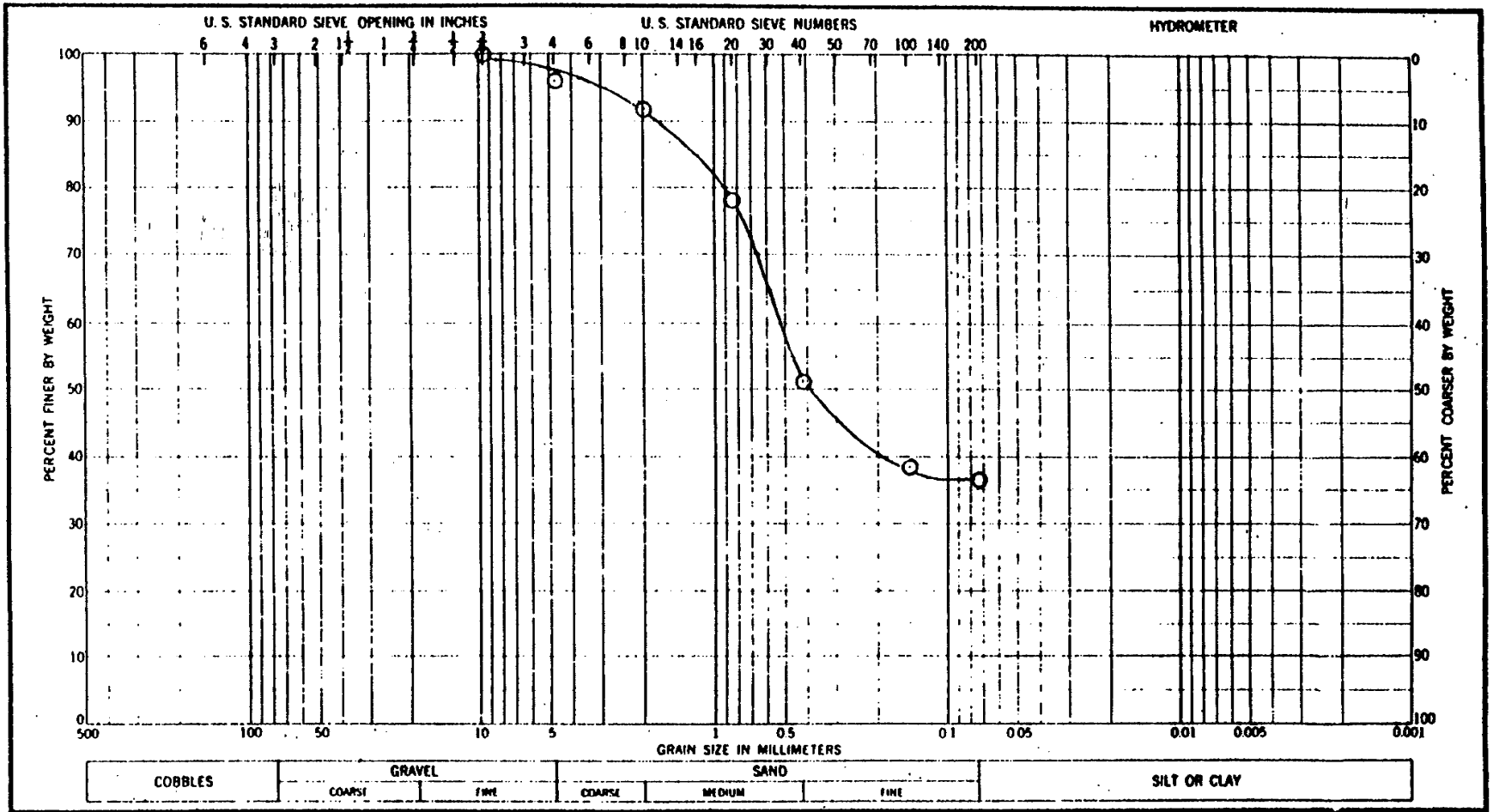
Project: Puerto Nuevo Channels
San Juan, Puerto Rico

Area:

Boring No.: CB-MC-45

Date: 4-27-90

ENG FORM 1 MAY 63 2087



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
20	-16.69 to -18.19	SC				

GRADATION CURVES

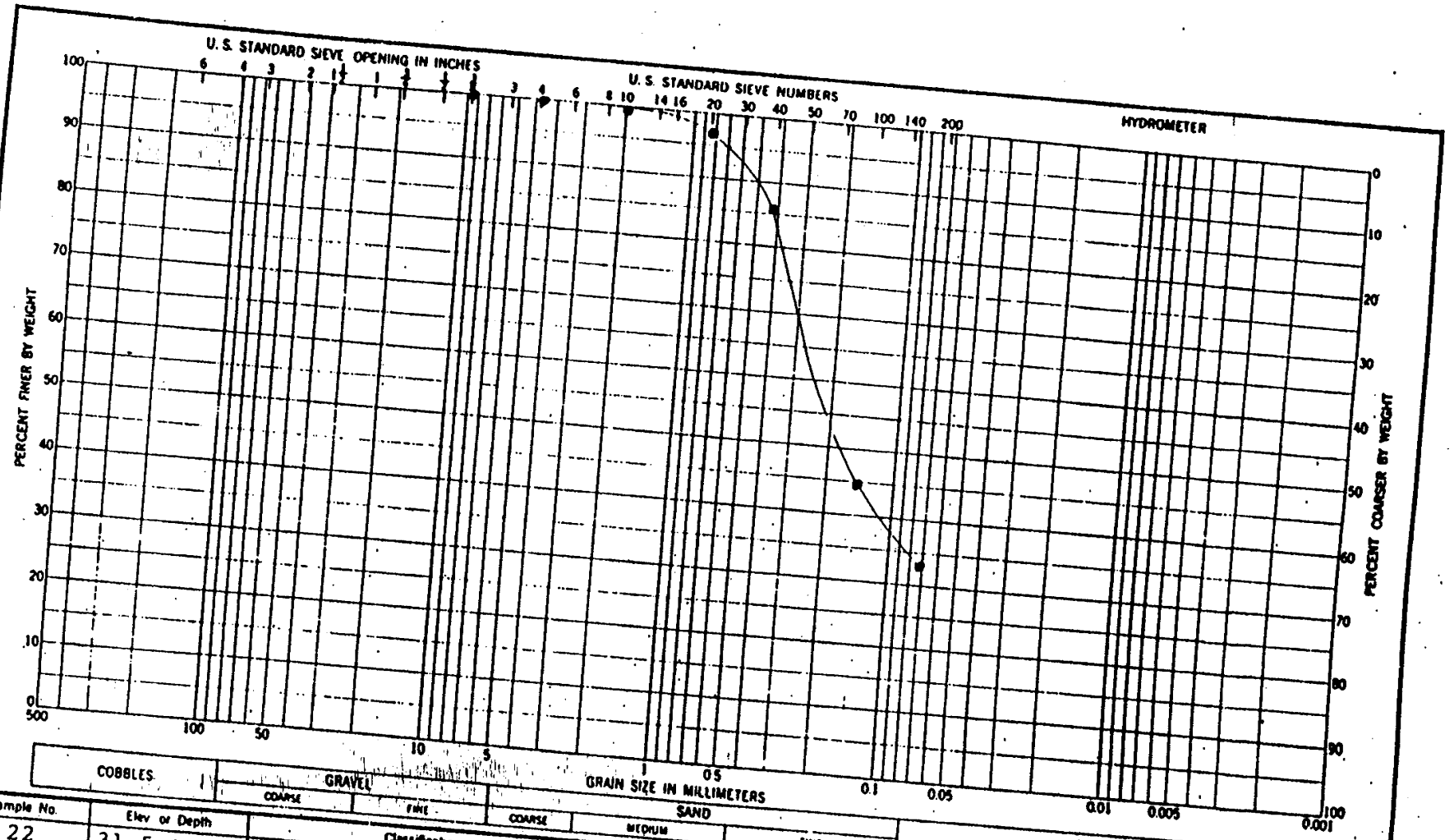
Project: Puerto Nuevo Channels
San Juan, Puerto Rico

Area:

Boring No.: CB-MC-45

Date: 4-27-90

ENG FORM 1 MAY 63 2087

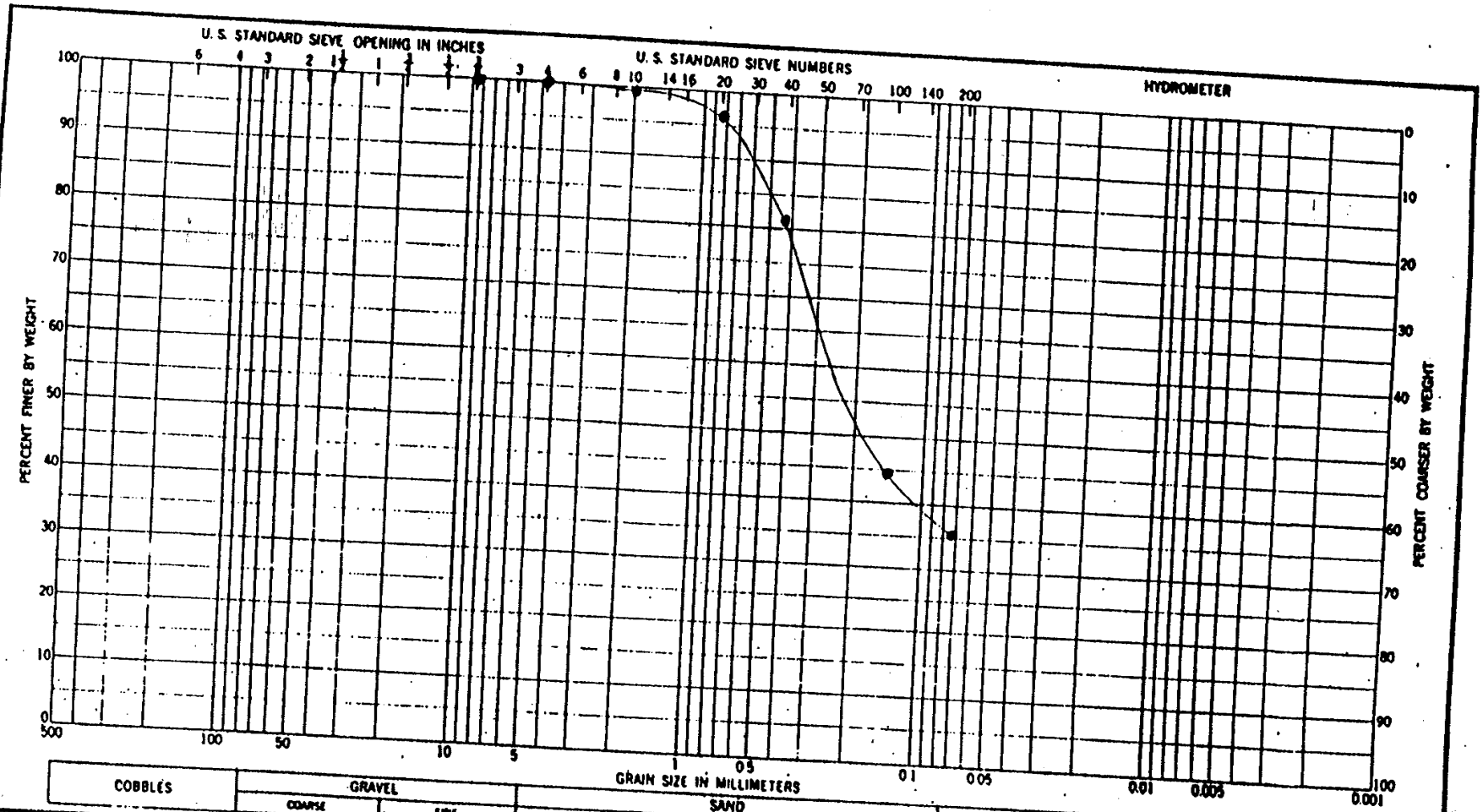


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
22	31.5 to 33'	Sand, fine grained, clayey, some silt, partly cemented, olive and pale yellow. (SC)	18			

GRADATION CURVES

Project: Puerto Nuevo Channels Assignment #4
Area: San Juan, Puerto Rico
Boring No.: CB-MC-45
Date: 6/1/90

ENG FORM 1 MAY 83 2087

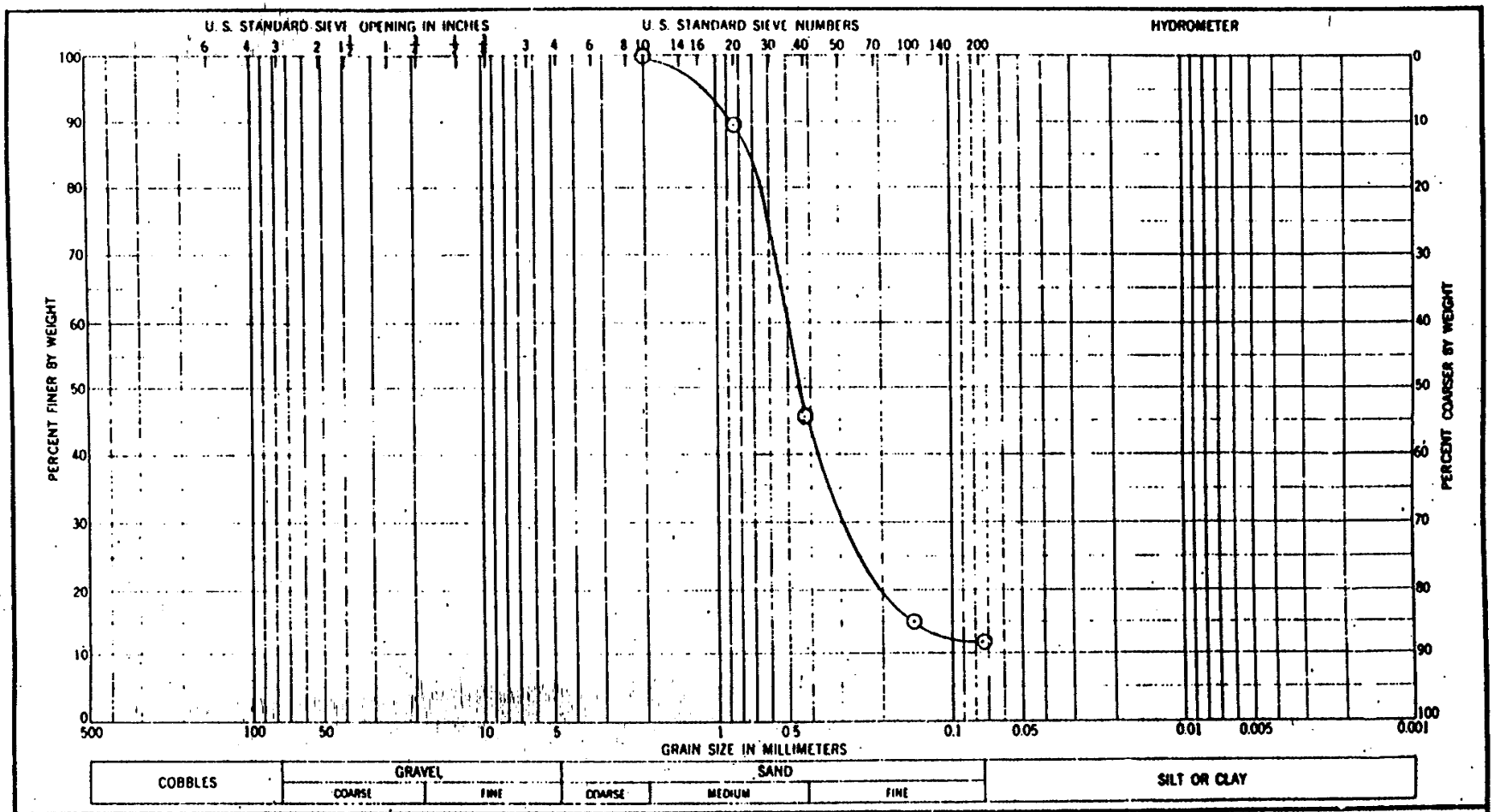


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
24	34.5 to 36	Silt, very sandy, some clay, hard, gray mottled yellowish brown.				

GRADATION CURVES

Project: Puerto Nuevo Channels
Assignment #4
Area: San Juan, Puerto Rico
Boring No.: CB-MC-46
Date: 6/1/90

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
9	5.05 to 3.55	SC				

GRADATION CURVES

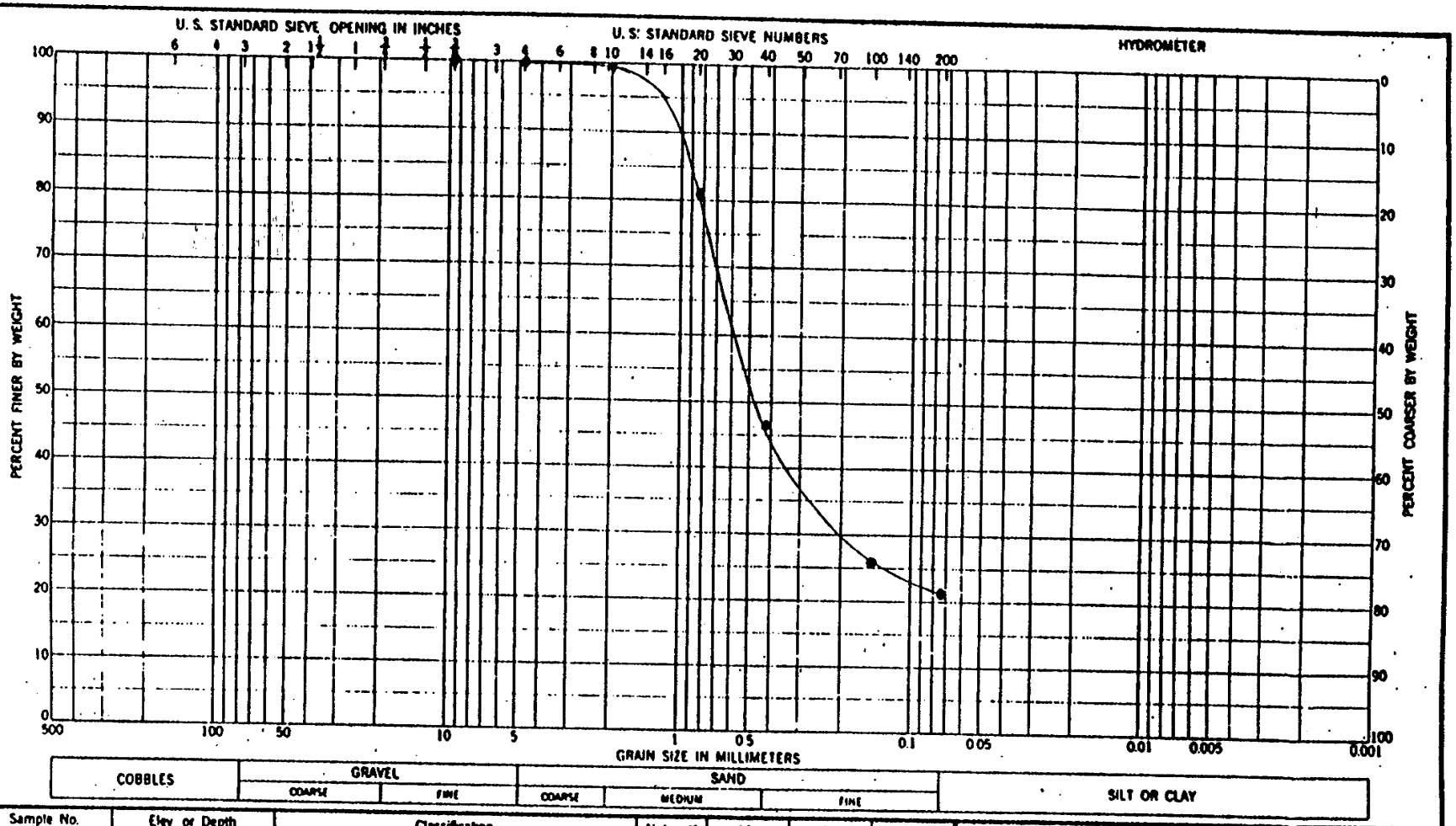
Project: Puerto Nuevo Channels
San Juan, Puerto Rico

Area:

Boring No.: CB-MC-47

Date: 4-27-90

ENG FORM 1 MAY 63 2087

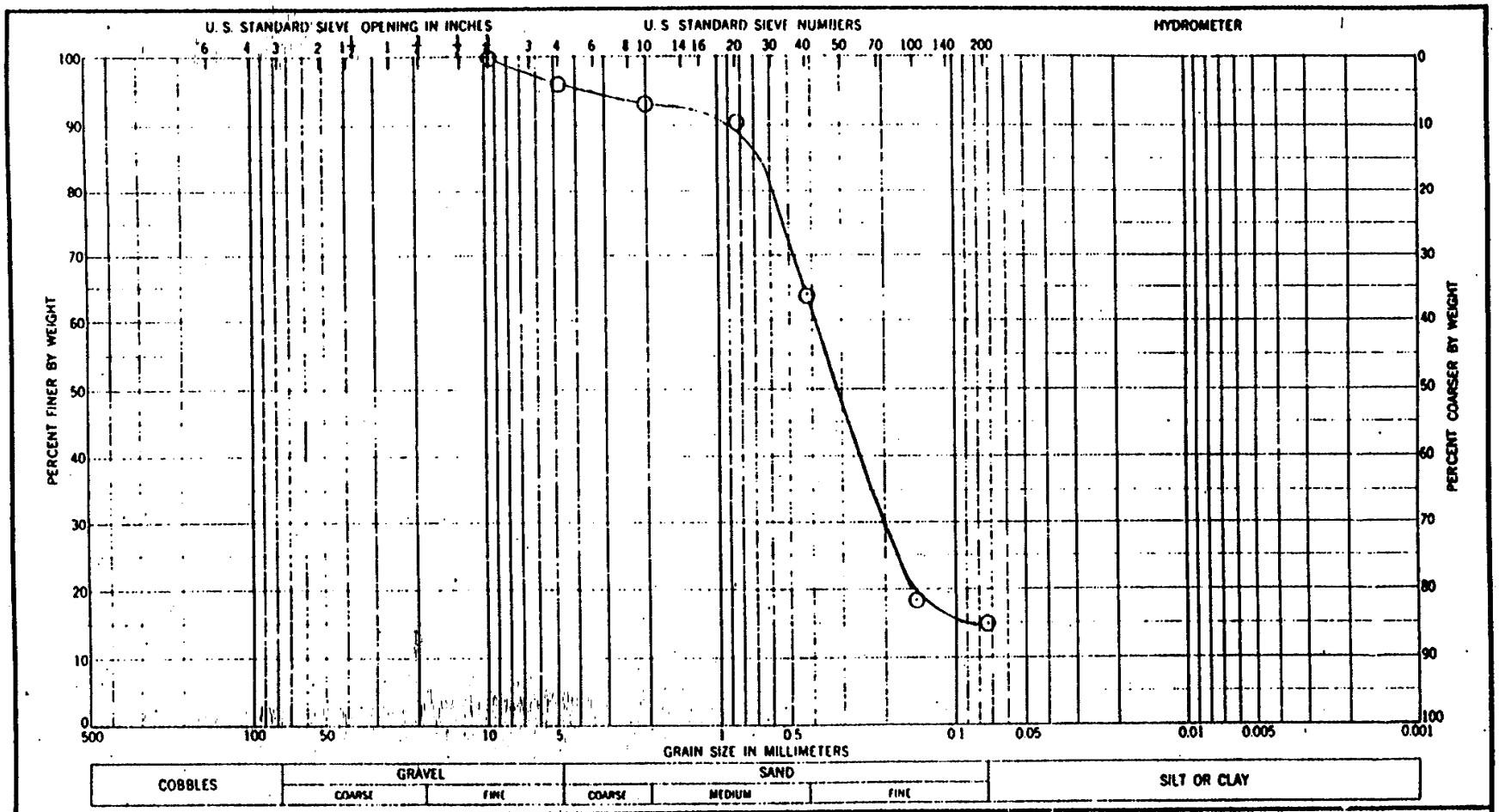


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
20	28.5 to 30	Sand, clayey, medium grained, some silt, occ. pebbles, olive and red				

GRADATION CURVES

Project: Puerto Nuevo Channels
Assignment #4
Area: San Juan, Puerto Rico
Boring No.: CB-MC-47
Date: 6/1/90

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
28	-23.45 to -24.95	SM NOTE: This sample appears classified as SP in the boring log.				

GRADATION CURVES

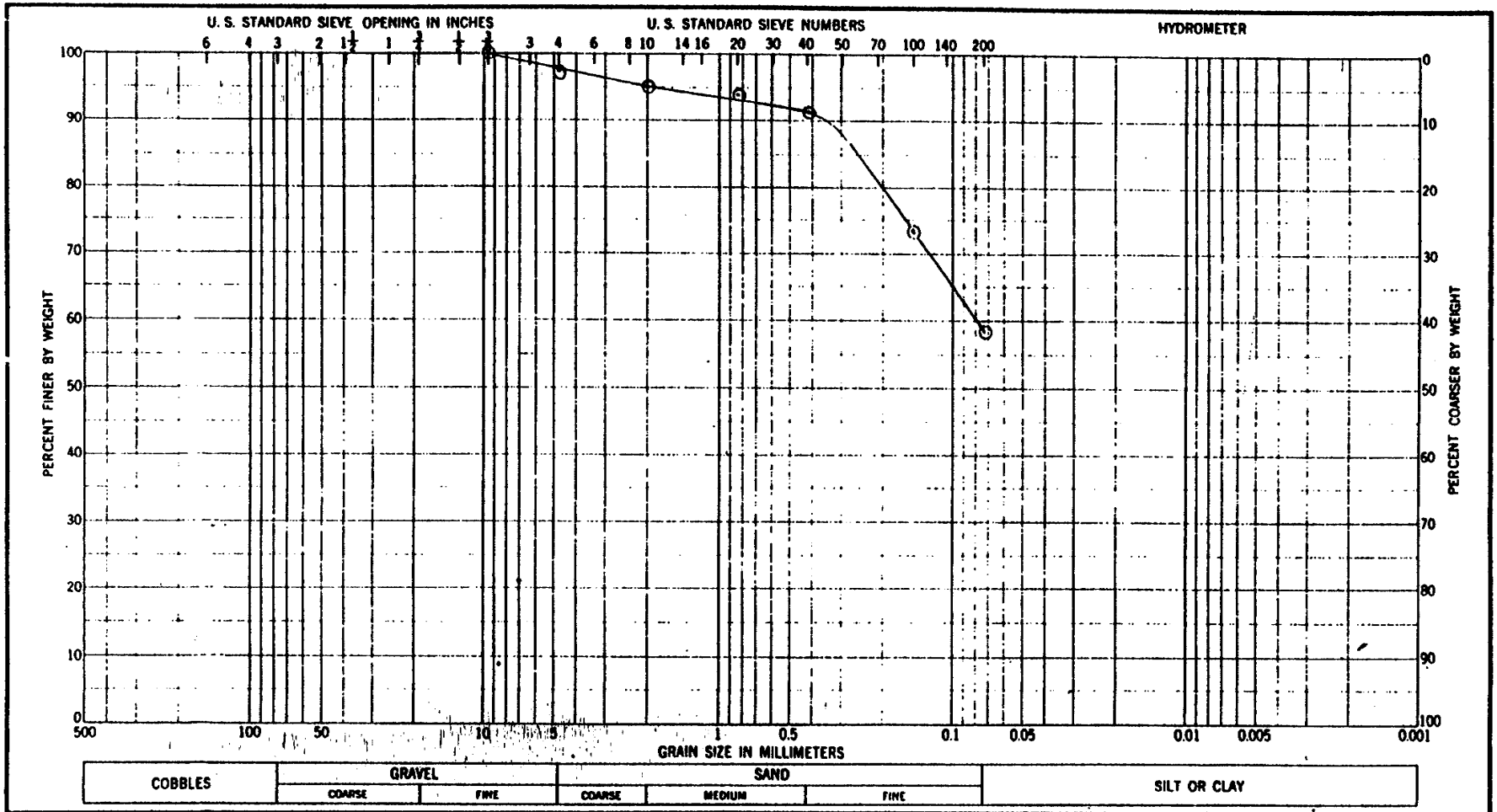
Project: Puerto Nuevo Channels
San Juan, Puerto Rico

Area:

Boring No.: CB-MC-47

Date: 4-28-90

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
34	49.5 to 51'	CL	31	36	22	14

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1

Area: San Juan, Puerto Rico

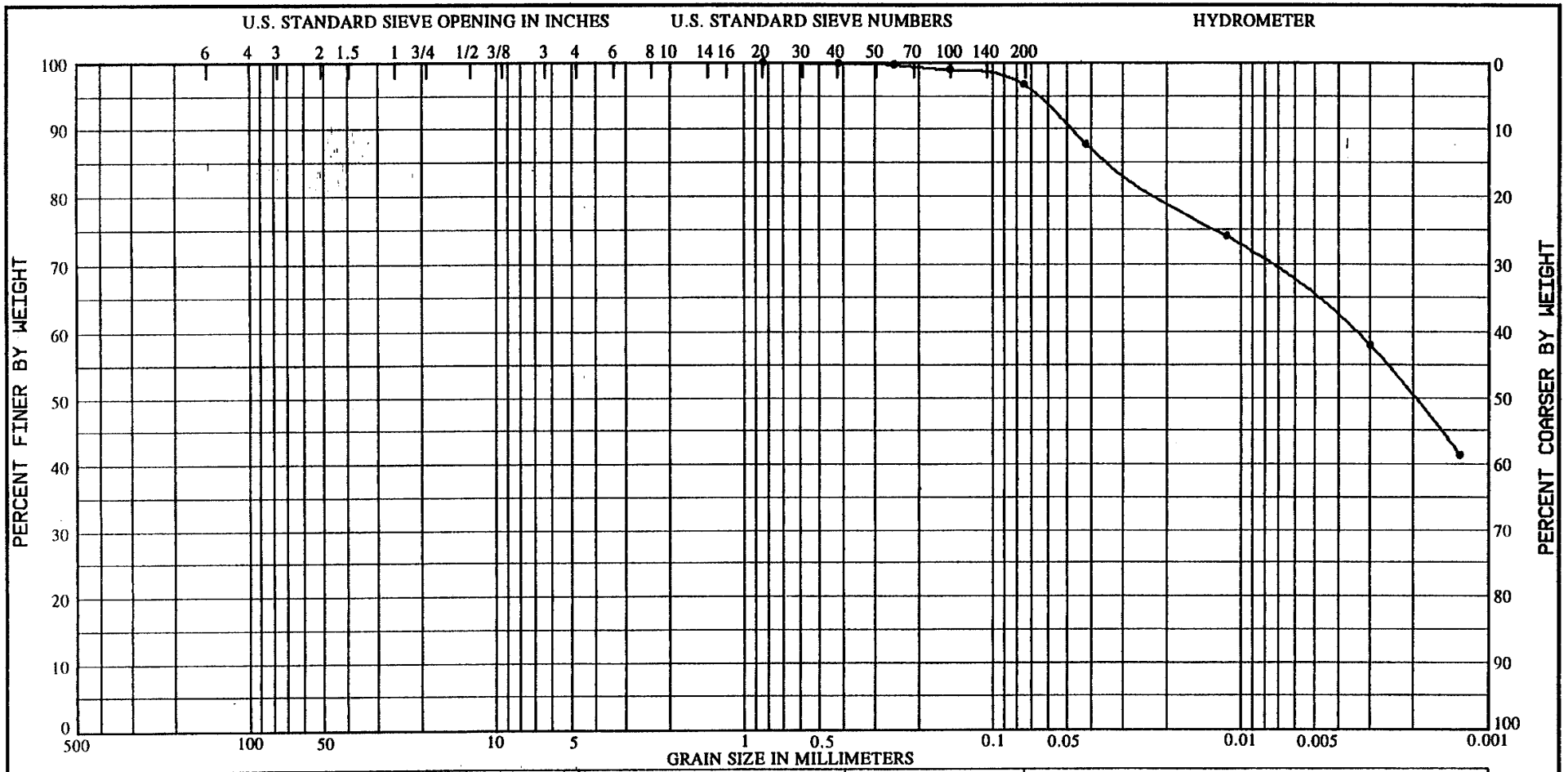
Boring No.: CB-PNB-4

Date: 05-15-89

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
1	59.0-60.2	REDDISH BROWN, FAT CLAY (CH), WITH A TRACE OF SAND SIZES.	41.1	86	35	51

Project RIO PUERTO NEUVO

Lab No. 73/7144

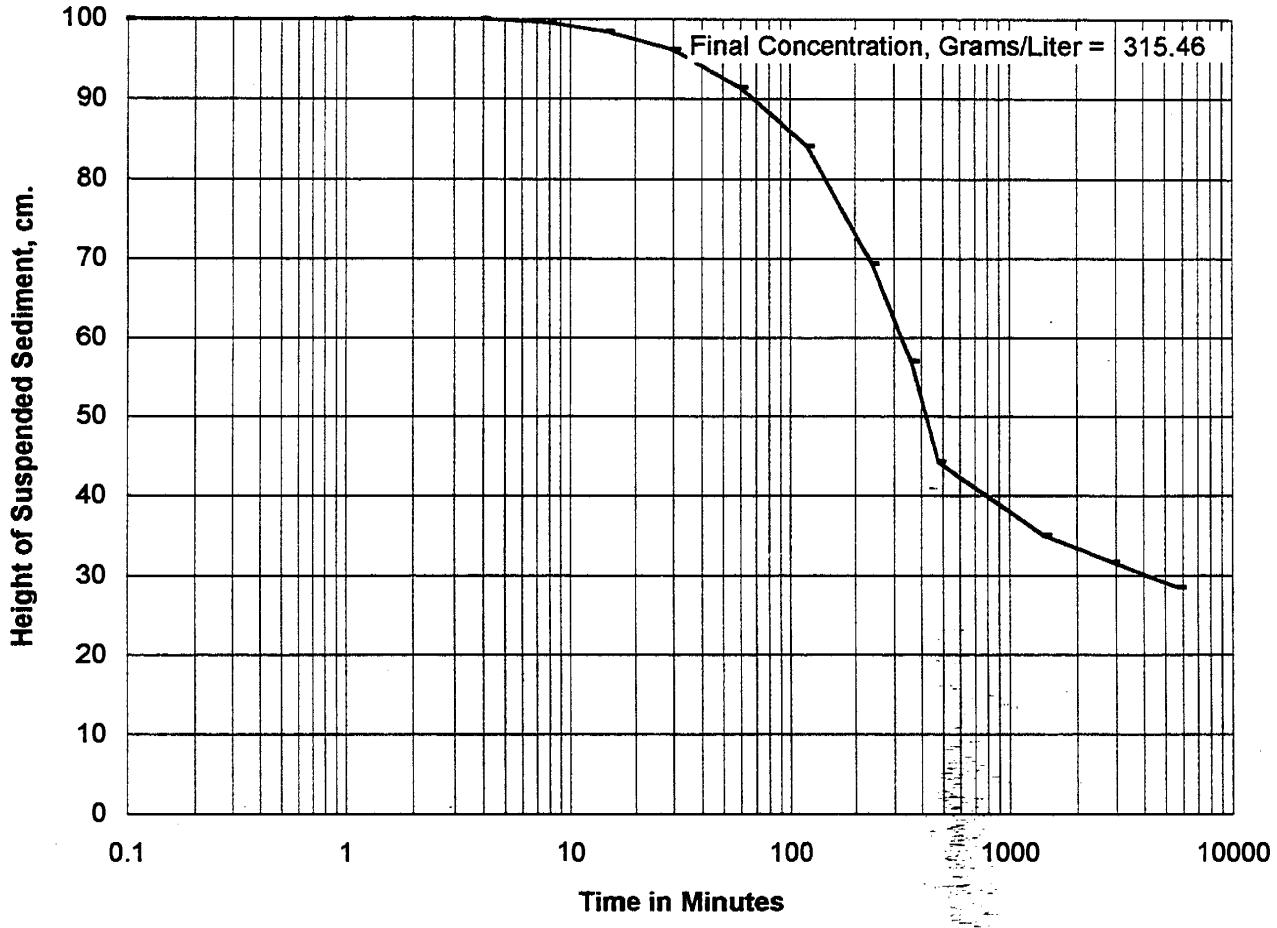
Boring No. CB-PNB-4U

Date 11/07/95

GRADATION CURVES

U.S. ARMY CORPS OF ENGINEERS
SOUTH ATLANTIC DIVISION LABORATORY
MARIETTA, GEORGIA

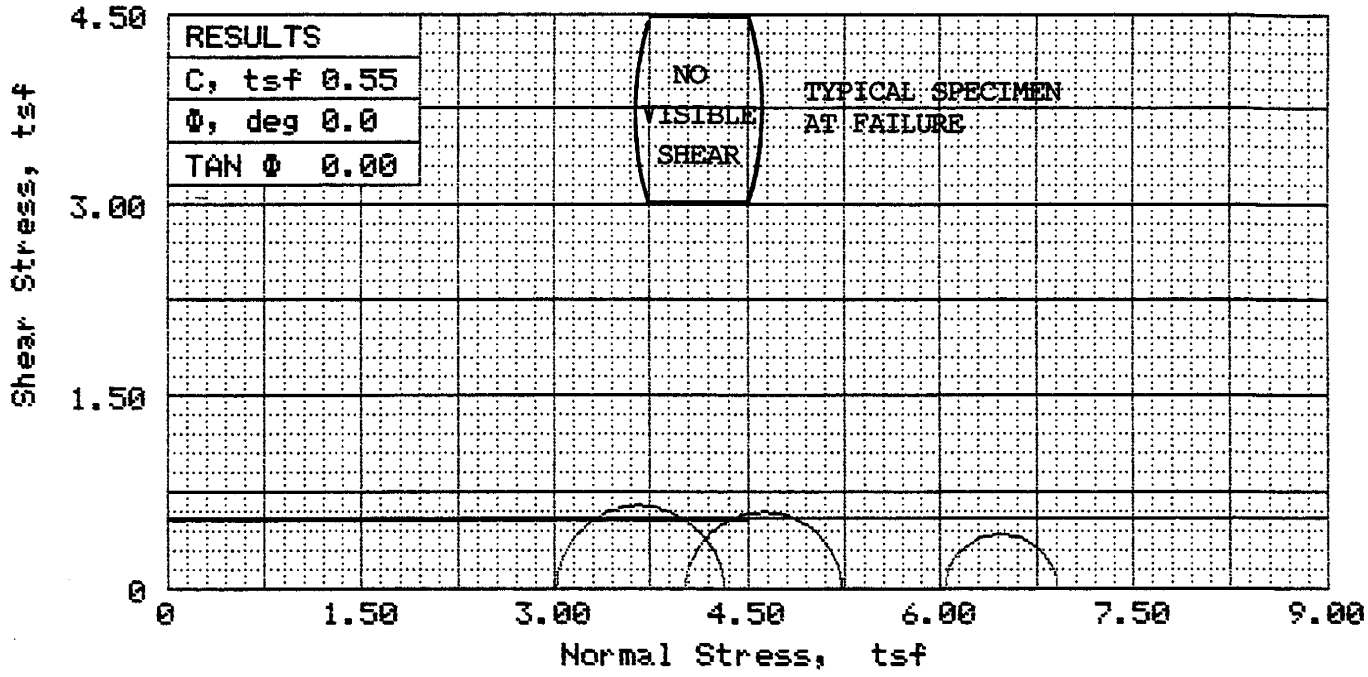
SUSPENDED SEDIMENT-TIME CURVE

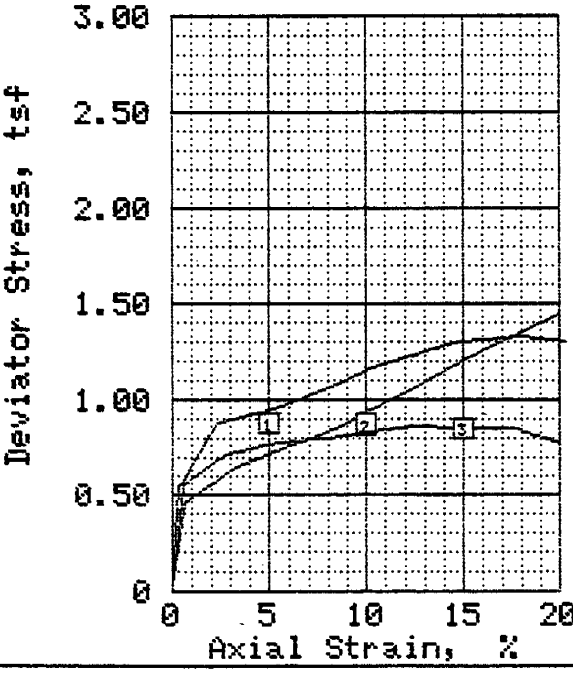


NOTES: 1. Test specimens (100 grams/ liter ,moist weight of specimen) suspended in sea water(salinity about 11 ppT) in 100 cm. long bottom withdrawal tubes.
2. Suspended sediment-time curves represent the contact surface between the sediment still in suspension and the "clear" water on top at the elapsed time indicated.
3. See grain-size data on enclosed gradation curve.
4. Percent Solids = 70.87

PROJECT	RIO PUERTO NEUVO	**REQ'N NO.**	RM-CW-96-0038
		W.O. NO.	7825
AREA		**DATE RECEIVED**	16 OCT. 1995
		DATE REPORTED	13-Nov-95
BORING NO.	CB-PNB-4U	**DEPTH**	59.0 - 60.2'
SAMPLE NO.	1	**LAB NO.**	73/7144

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	41.5	41.1	40.8
	DRY DENSITY, pcf	78.6	78.8	79.4
	SATURATION, %	95.9	96.6	97.0
	VOID RATIO	1.193	1.163	1.148
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	41.5	41.1	40.8
	DRY DENSITY, pcf	78.6	78.8	79.4
	SATURATION, %	95.9	96.6	97.0
	VOID RATIO	1.193	1.163	1.148
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		3.02	4.03	6.05
MAX. DEV. STRESS, tsf		1.30	1.20	0.86
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		20	20	17
RATE, %/min.		0.75	0.75	0.74
ULT. DEV. STRESS, tsf		1.30	1.20	0.85

DESCRIPTION REDDISH BROWN, FAT CLAY (CH), WITH A TRACE OF SAND SIZES.

LL= 86	PL= 35	PI= 51	Gs= 2.76	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Q

REMARKS

PROJECT RIO PUERTO NEUVO

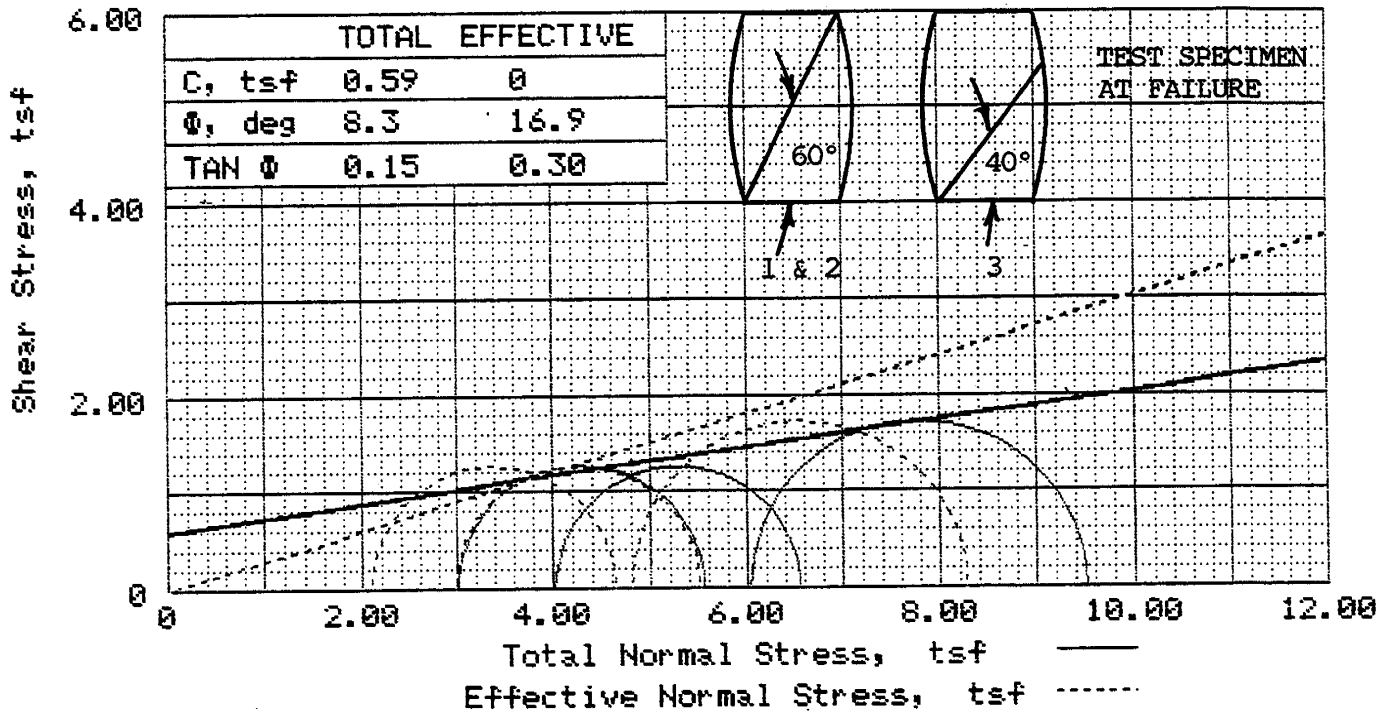
AREA

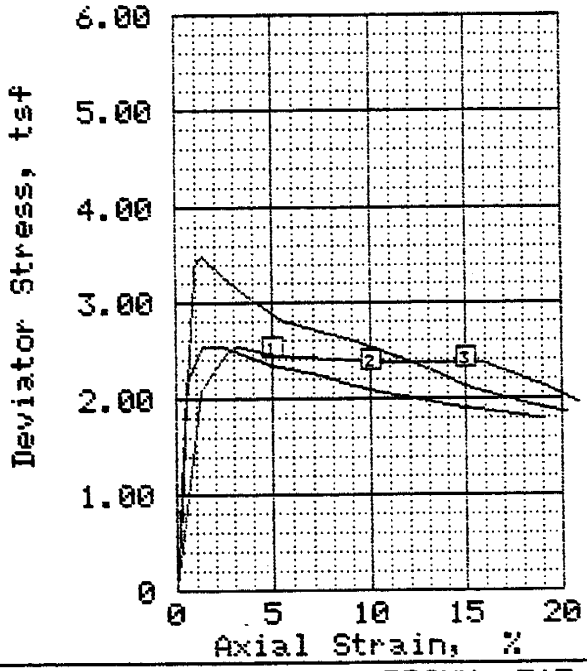
LAB NO. 73/7144

BORING NO. CB-PNB-4U
SAMPLE NO. 1
DEPTH/~~ELEV~~ 59.0 - 60.2'
LABORATORY CESAD-EN-FL DATE 6 NOV. 1995

TRIAXIAL COMPRESSION TEST

SOUTHATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	39.6	42.6	39.8
	DRY DENSITY, pcf	80.1	77.6	80.3
	SATURATION, %	95.0	96.4	95.9
	VOID RATIO	1.150	1.220	1.145
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	37.4	35.2	35.1
	DRY DENSITY, pcf	84.8	87.4	87.5
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.032	0.971	0.970
	DIAMETER, in	1.35	1.32	1.34
	HEIGHT, in	3.02	2.96	2.99
BACK PRESSURE, tsf		5.04	5.04	5.04
INIT. EFF. STR., tsf		3.02	4.03	6.05
MAX. DEV. STRESS, tsf		2.54	2.52	3.47
PORE PRESSURE, tsf		0.92	1.04	1.24
TIME TO FAILURE, min.		30	25	10
RATE, %/min.		0.08	0.13	0.13
ULT. DEV. STRESS, tsf		1.89	2.36	2.12

DESCRIPTION REDDISH BROWN, FAT CLAY (CH), WITH A TRACE OF SAND SIZES.

LL= 86	PL= 35	PI= 51	Gs= 2.76	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST R w/pore pressures

REMARKS 1. Insufficient Material for additional specimens.

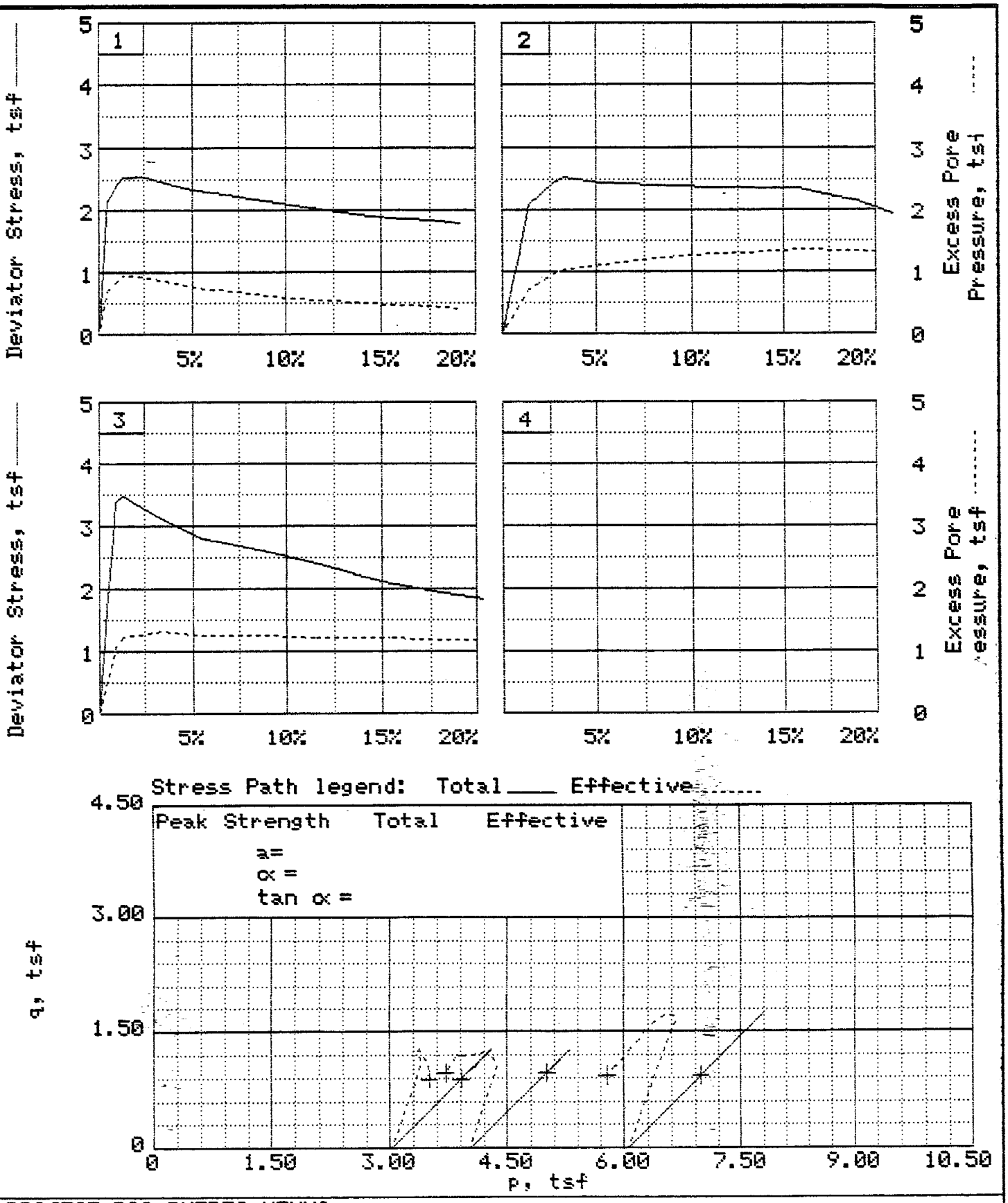
PROJECT RIO PUERTO NEUVO

AREA

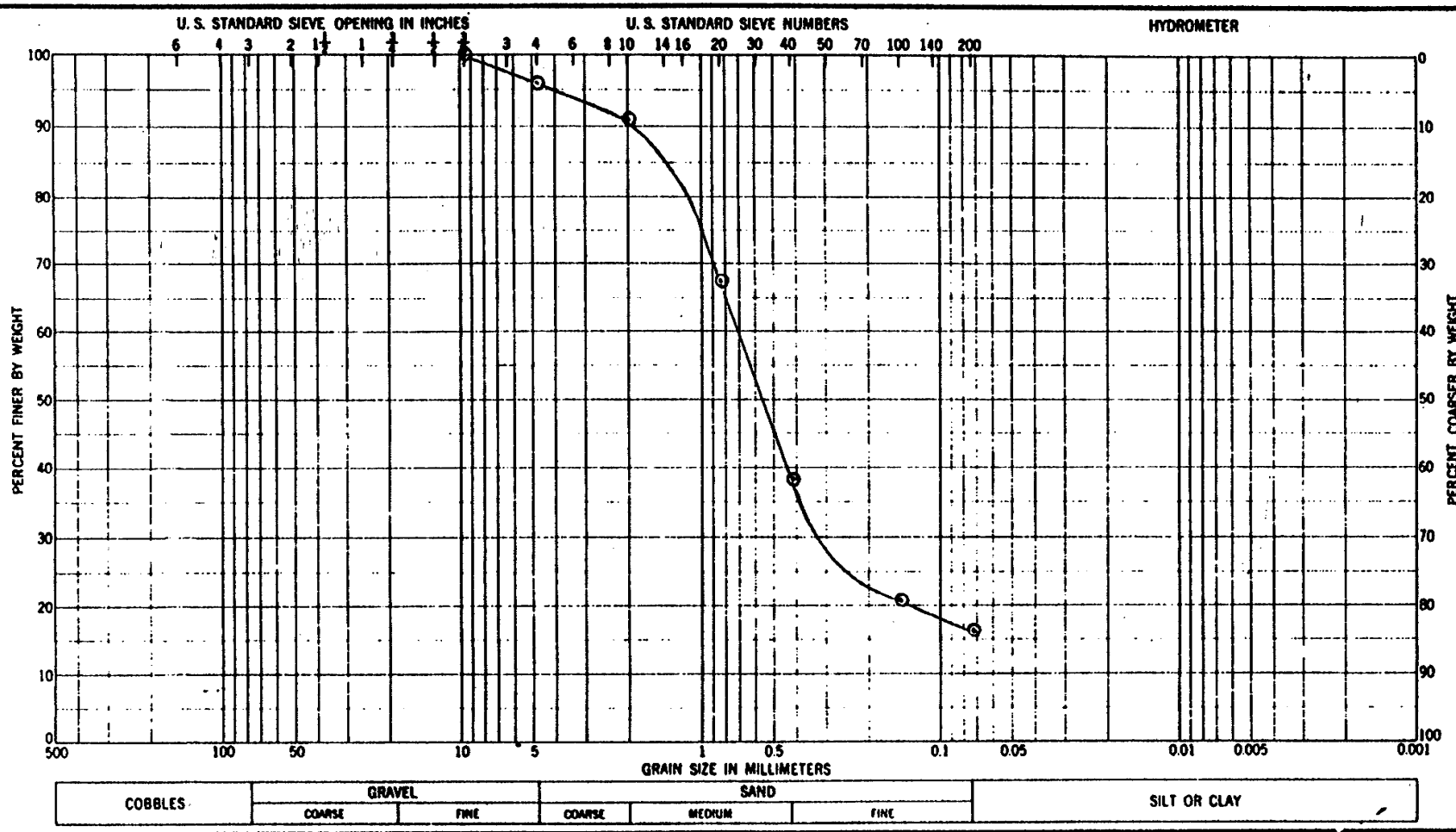
LAB NO. 73/7144

BORING NO. CB-PNB-4U
SAMPLE NO. 1
DEPTH/~~ELEV~~ 59.0 - 60.2'
LABORATORY CESAD-EN-FL DATE 8 NOV. 1995

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825



PROJECT RIO PUERTO NEUVO
BORING CB-PNB-4U SAMPLE 1 DEPTH/~~ELEV~~ 59.0 - 60.2'
TYPE OF TEST R w/pore pressures LAB NO. 73/7144
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 8 NOV. 1995

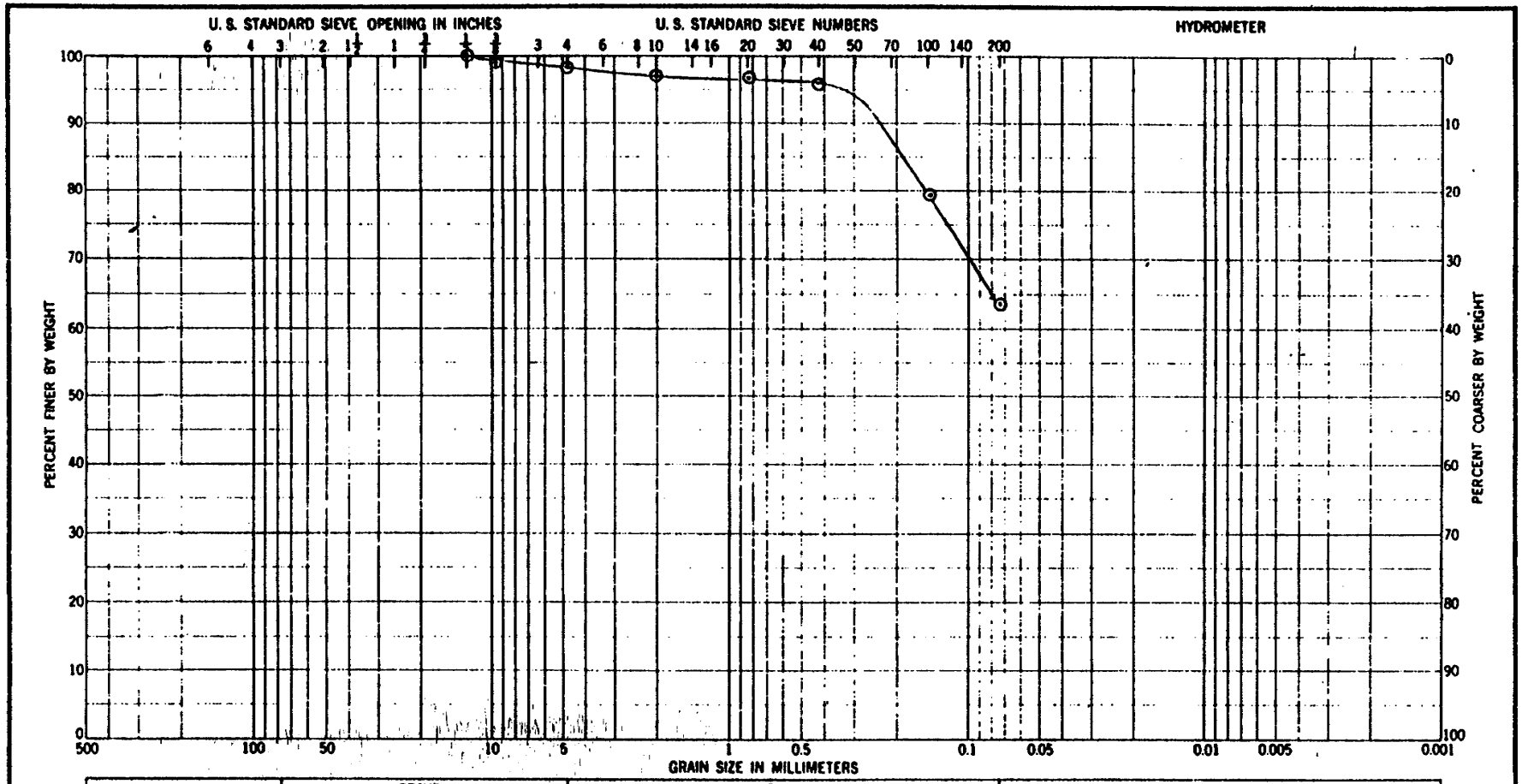


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
11	15 to 16.5'	SP	20			

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-5
Date: 05-10-89

ENG FORM 1 MAY 63 2087

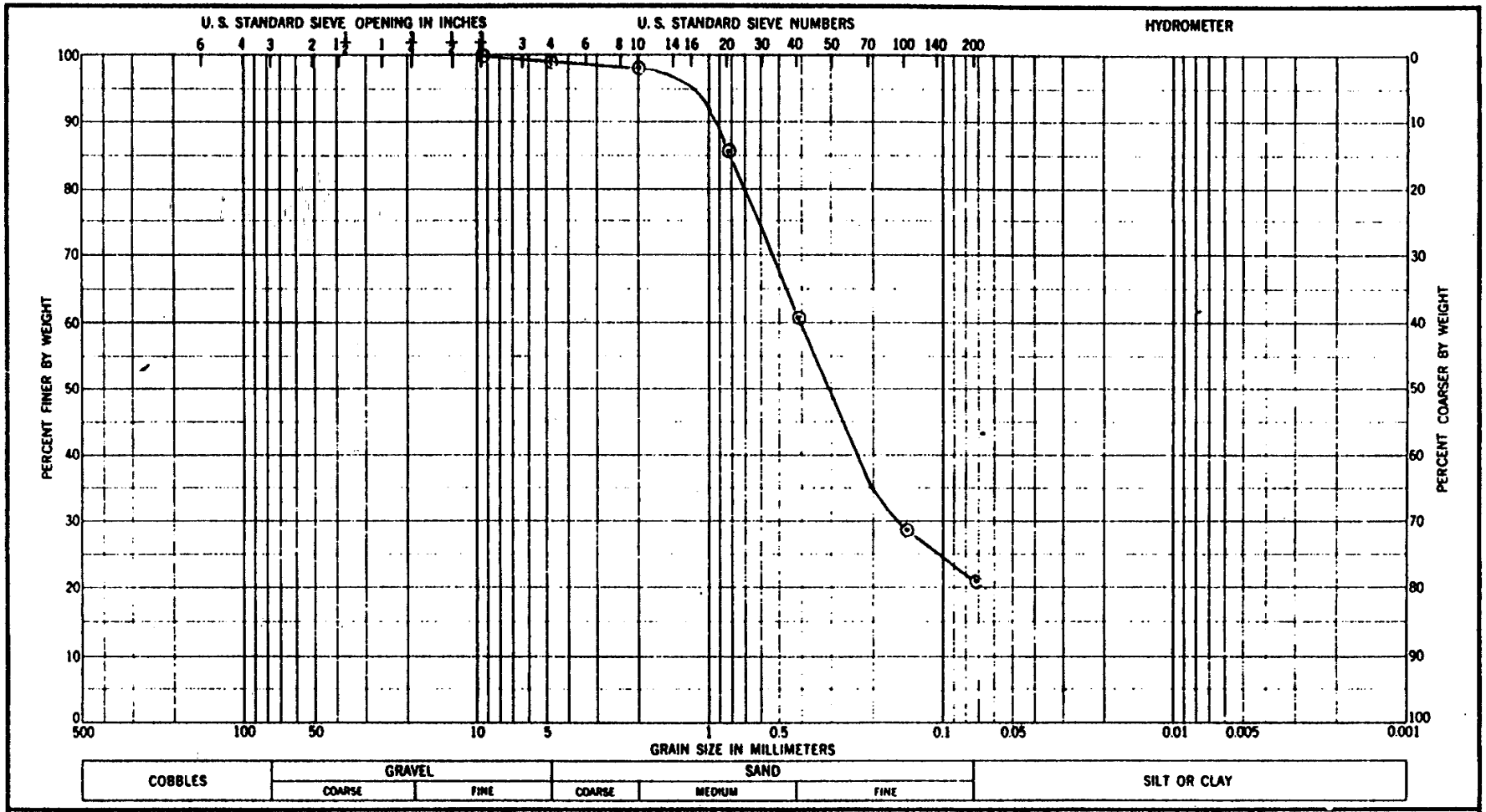


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
26	37.5 to 39'	CH	32	53	24	29

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-5
Date: 05-18-89

G FORM 1 MAY 69 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
29	42 to 43.5'	SW	17			

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1

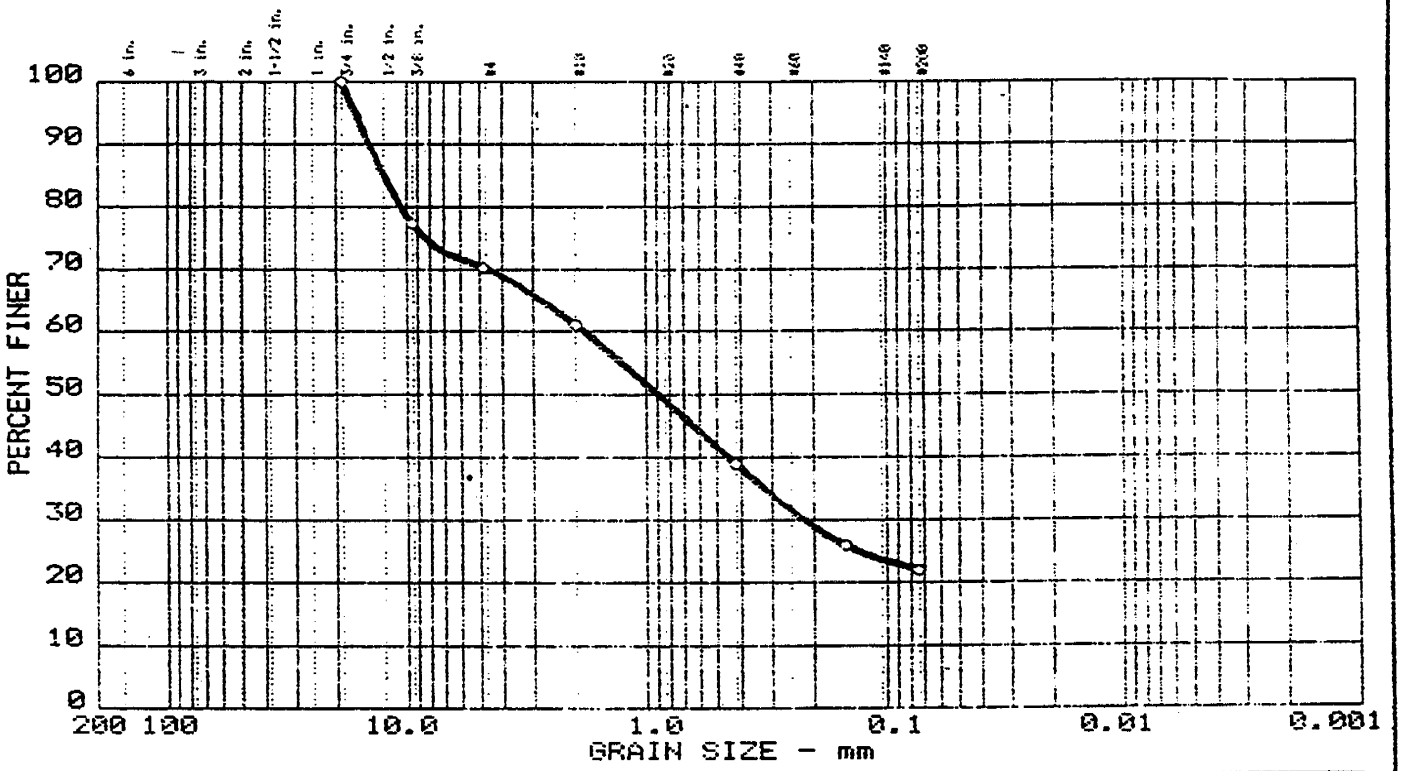
Area: San Juan, Puerto Rico

Boring No.: CB-PNB-5

Date: 05-10-89

ENG FORM 1 MAY 63 2087

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLA
○	0.0	29.7	48.3	22.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	39	16	12.59	1.82	0.88	0.219				

MATERIAL DESCRIPTION	USCS	AASHTO
○ CLAYEY SAND, BROWN	SC	A-2-6(0)

Project No.:
Project: RIO PUERTO NUEVO
○ Location: BOR. CB-PNB-5

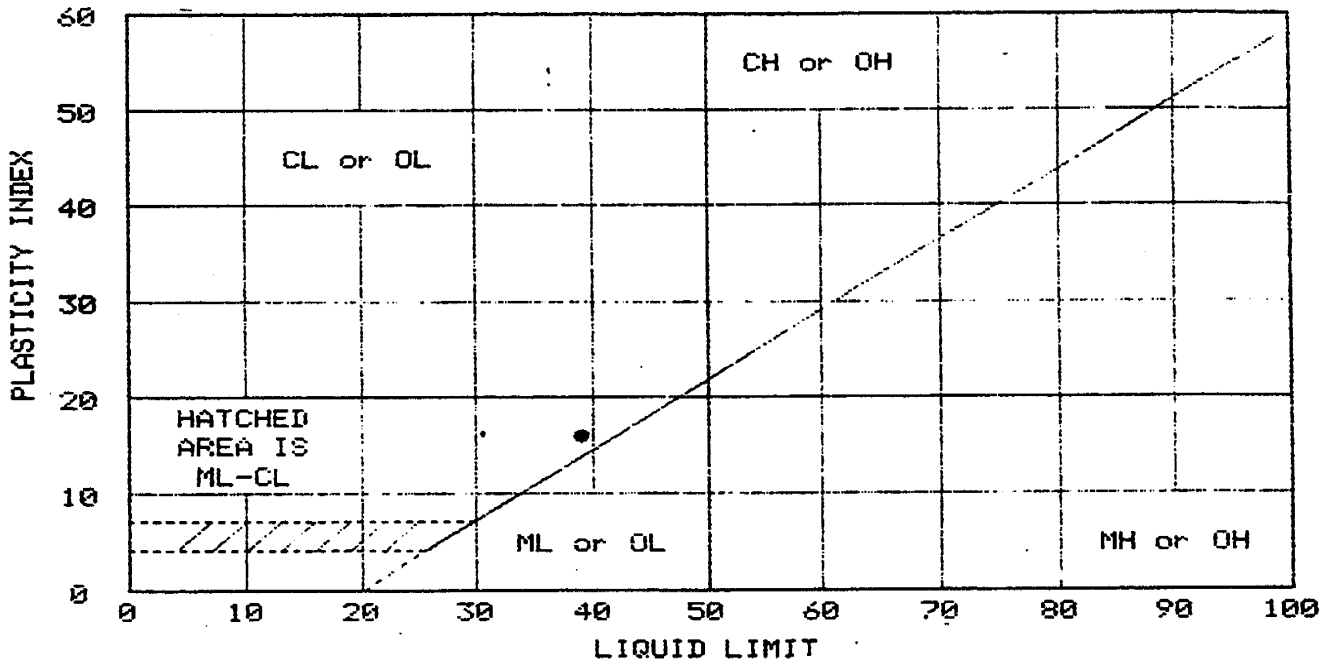
Date: 10-27-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
SAMPLE : 1
DEPTH: 59.0-60.5'
NAT. MOIST.: 21%

Figure No. ___

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAYEY SAND, BROWN	39	23	16	22.0	SC	A-2-6(0)

Project No.:
Project: RIO PUERTO NUEVO

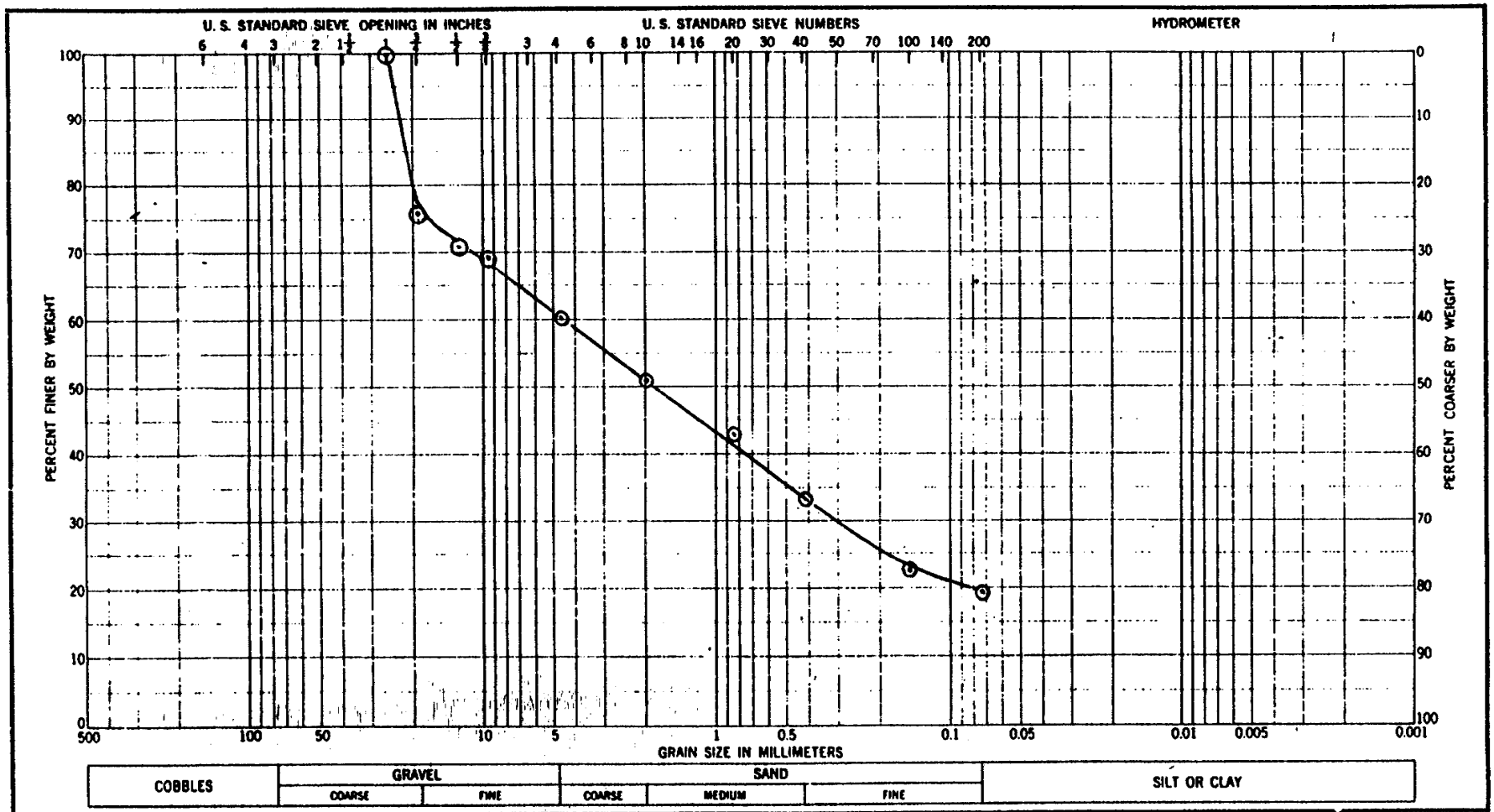
Client:
Location: SAN JUAN P.R.

Date: 10-27-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNB-5
SAMPLE: 1
DEPTH: 59.0-60.5'
NAT. MOIST.: 21%

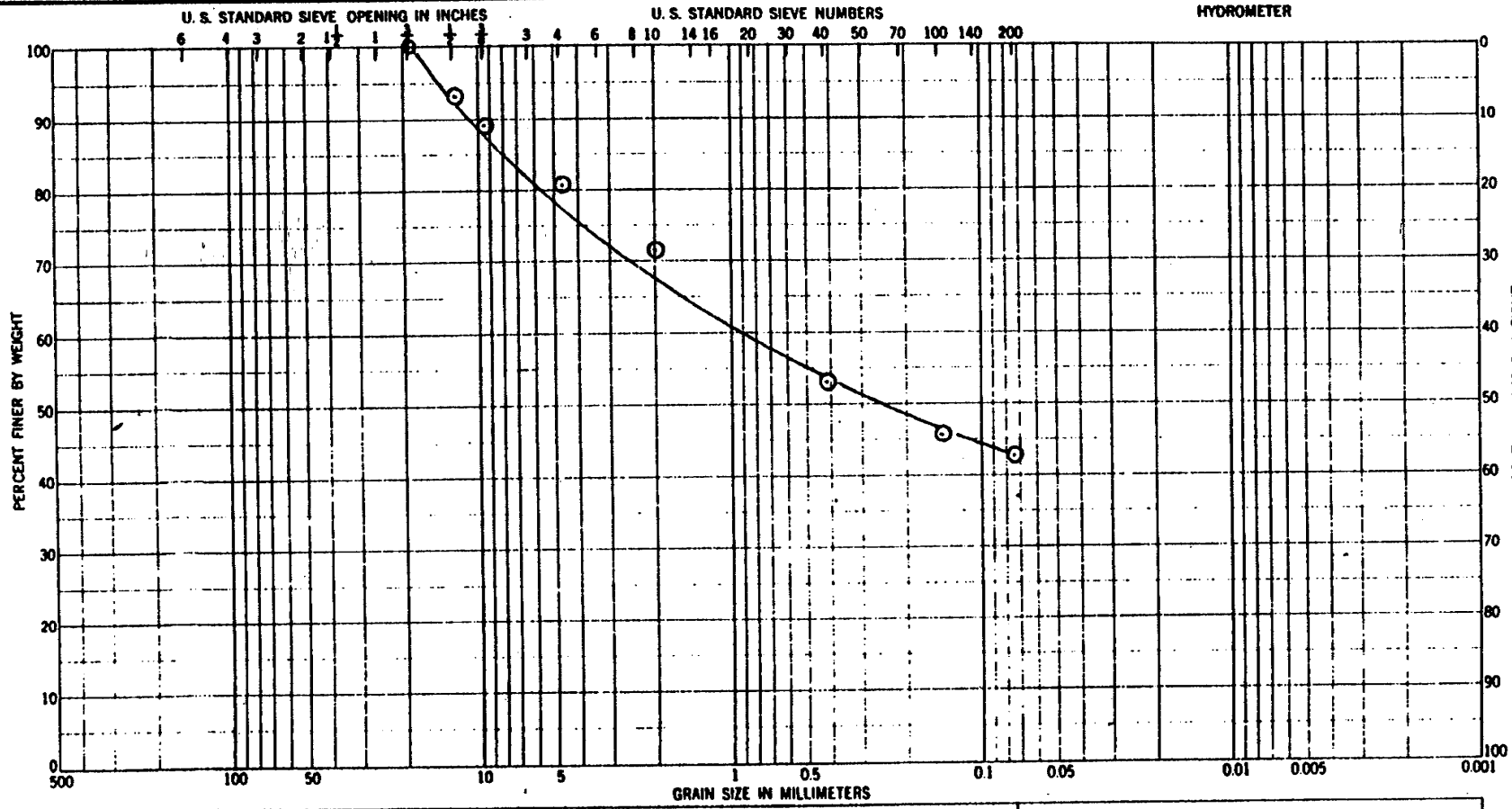
Fig. No._____



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
3	3 to 4.5'	SM	11			

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-6
Date: 05-16-89

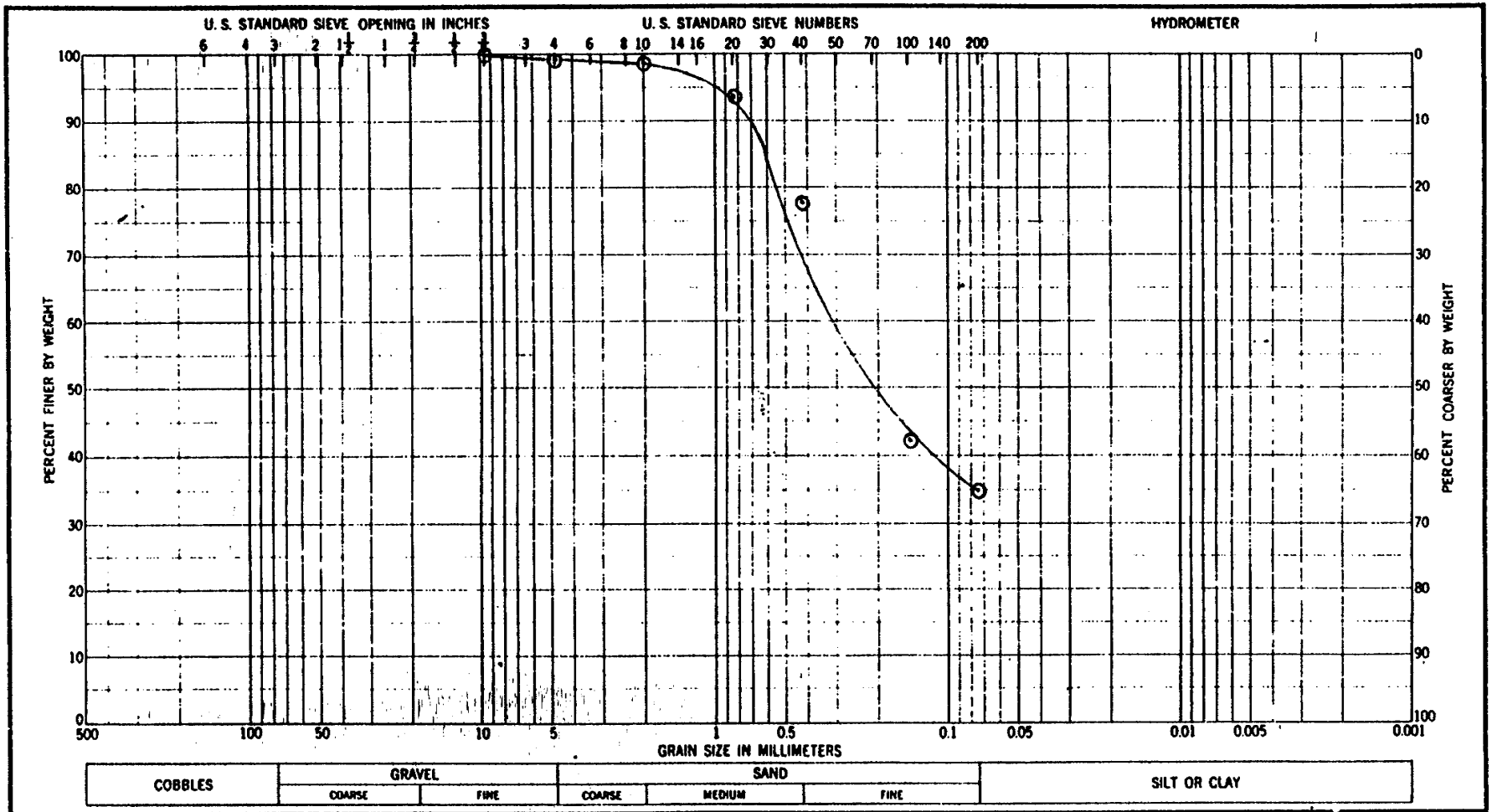


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
6	7.5 to 9'	SM	19			

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-6
Date: 05-11-89

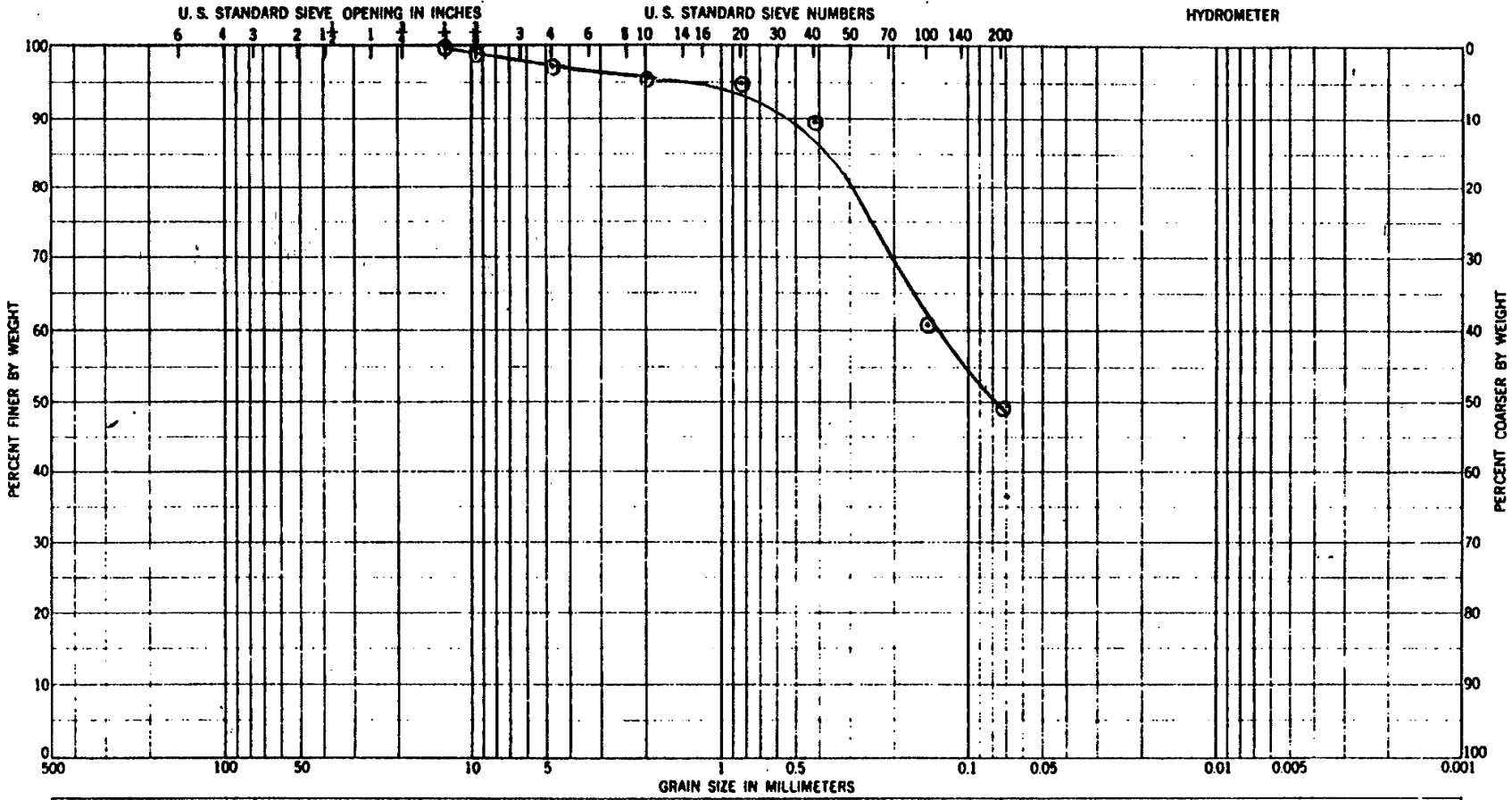
ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
32	46.5 to 48'	SC	32			

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-6
Date: 05-10-89



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
36	52.5 to 54'	CL	32	36	18	18

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1

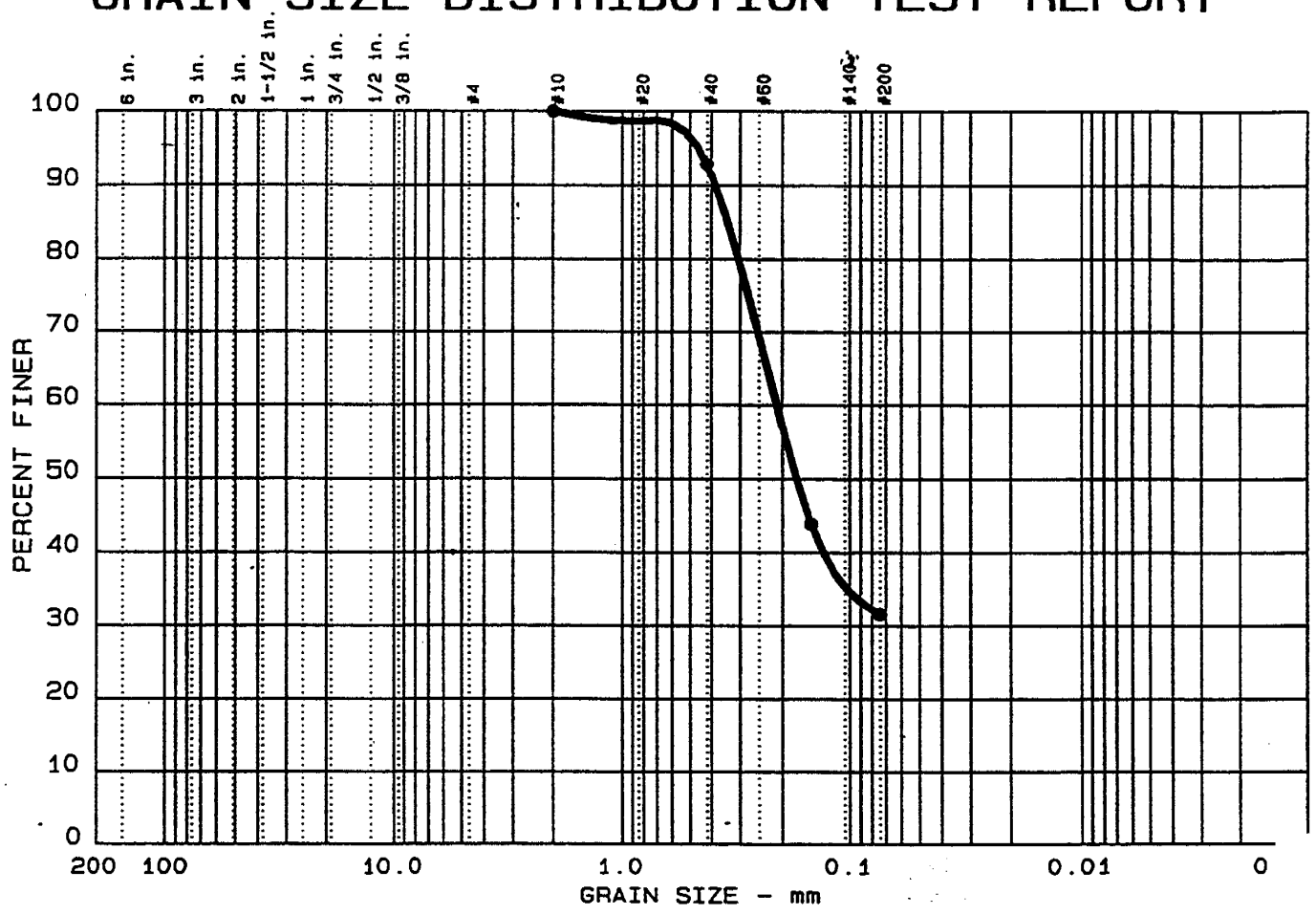
Area: San Juan, Puerto Rico

Boring No.: CB-PNB-6

Date: 05-17-89

ENG FORM 1 MAY 63 2087

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	68.4	31.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	35	13	0.34	0.21	0.17					

MATERIAL DESCRIPTION	USCS	AASHTO
● CLAYEY SAND, REDDISH BROWN	SC	A-2-6(1)

Project No.:

Project: USACE RIO PUERTO NUEVO PROJECT

● Location: BOR. CB-PNB-6D SAMPLE 31

Date: 10-27-95

Remarks:

NAT. MOIST.: 20%

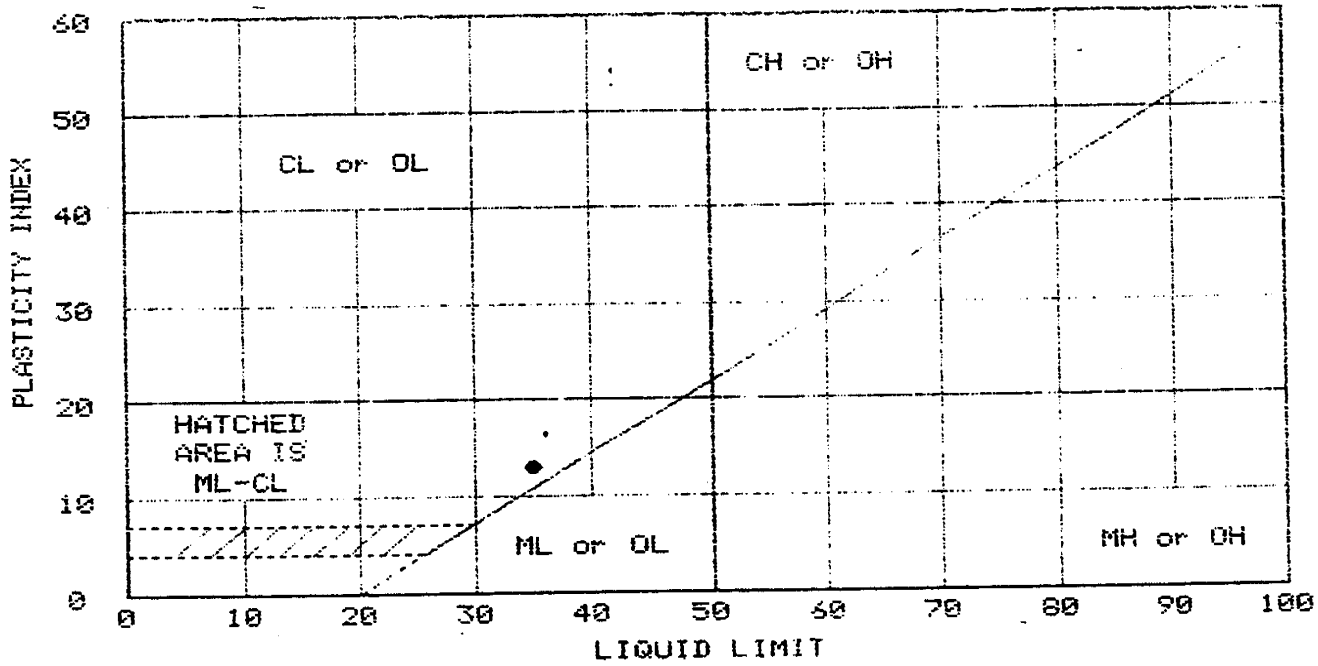
DEPTH: 64.0-65.5'

GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Figure No. _____

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● CLAYEY SAND, REDDISH BROWN	35	22	13	31.6	SC	A-2-6(1)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: **SAN JUAN P.R.**

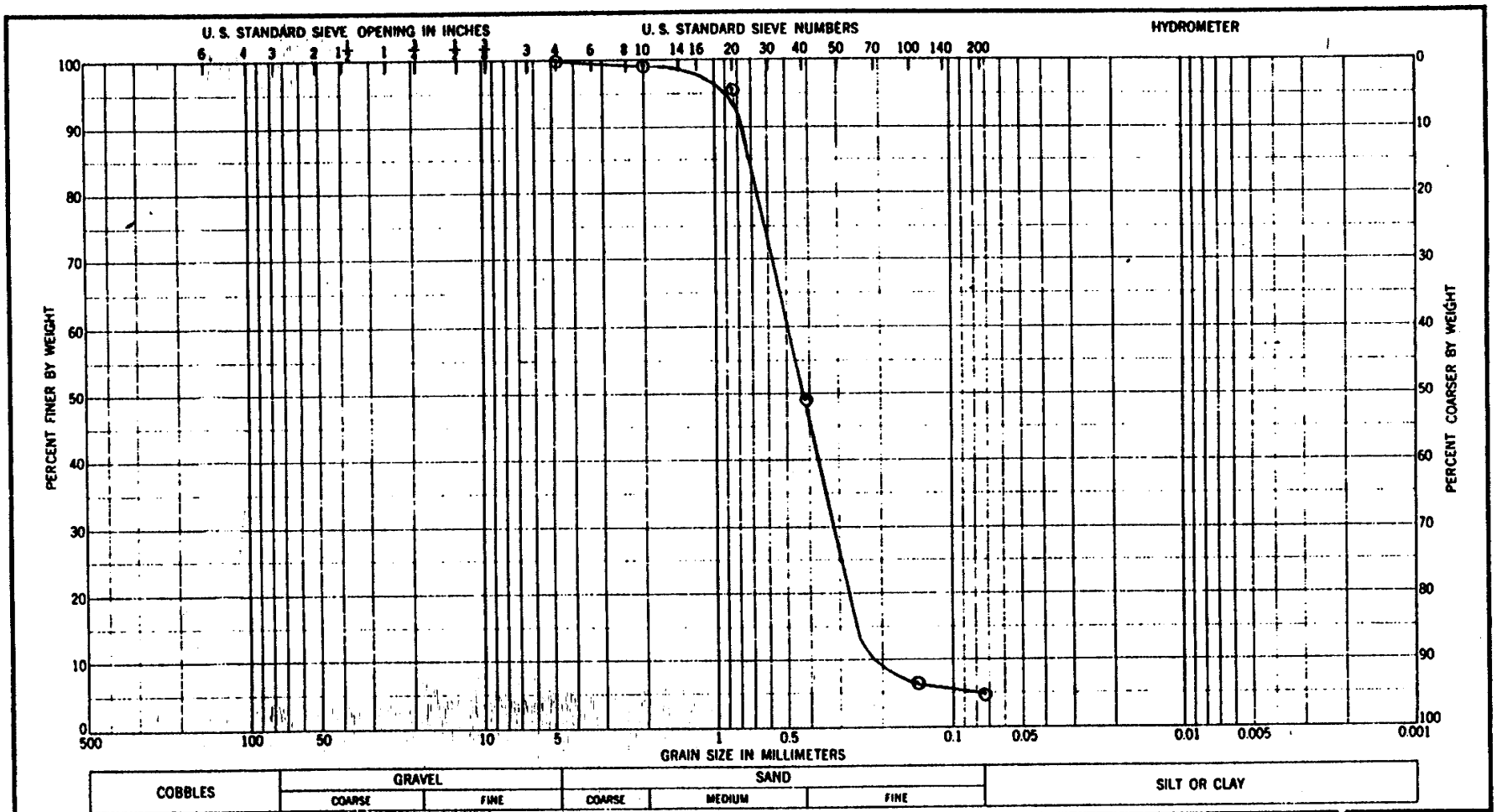
Date: 10-27-95

LIQUID AND PLASTIC LIMITS TEST REPORT

SUELOS INC.

Remarks:
BOR. CB-PNB-6D
SAMPLE: 31
DEPTH: 64.0-65.5'
NAT. MOIST.: 20%

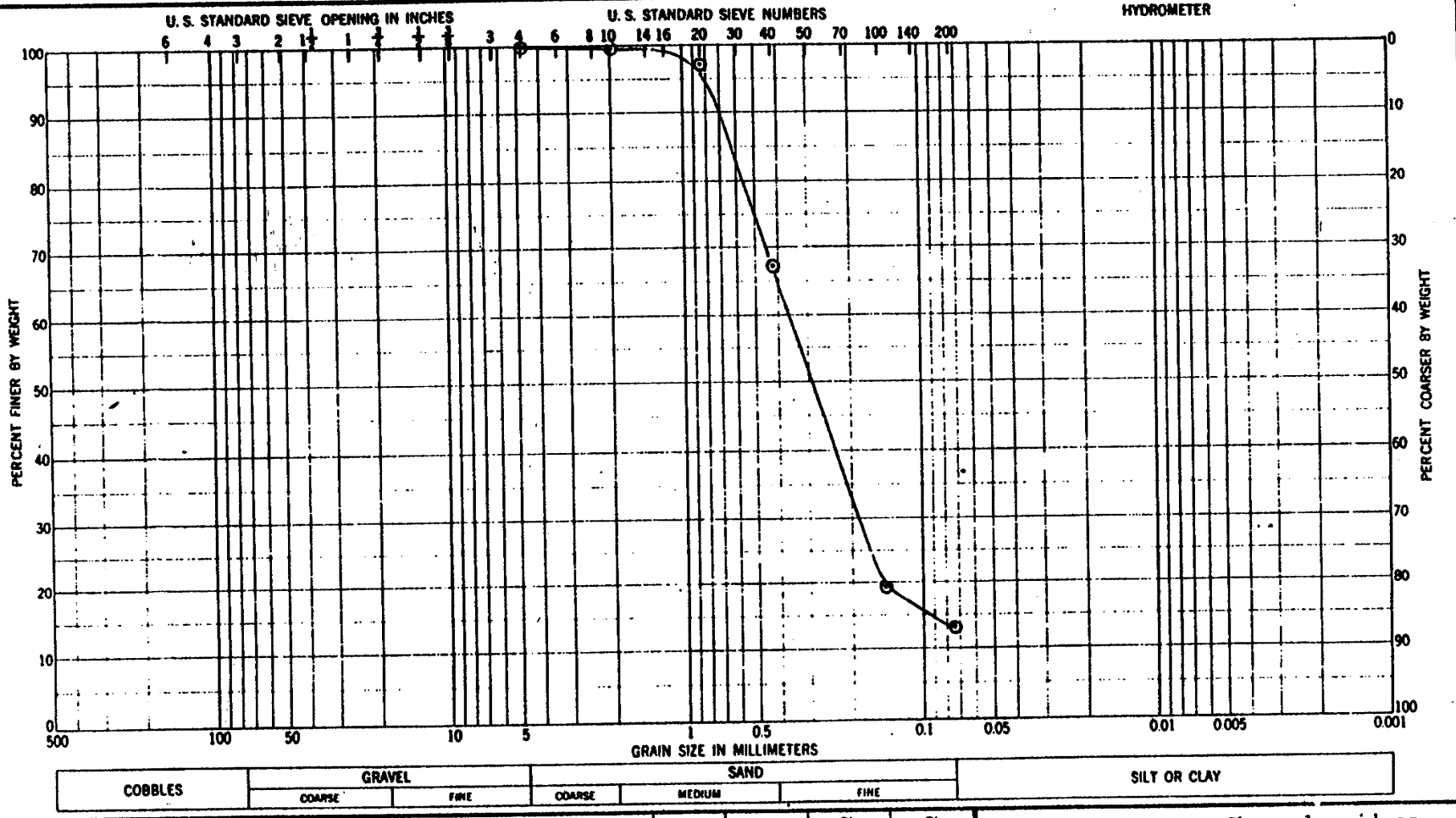
Fig. No. _____



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
10	13.5 to 15'	SP	32			

GRADATION CURVES

Project: Puerto Nuevo Channel Bridges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-7
Date: 05-11-89



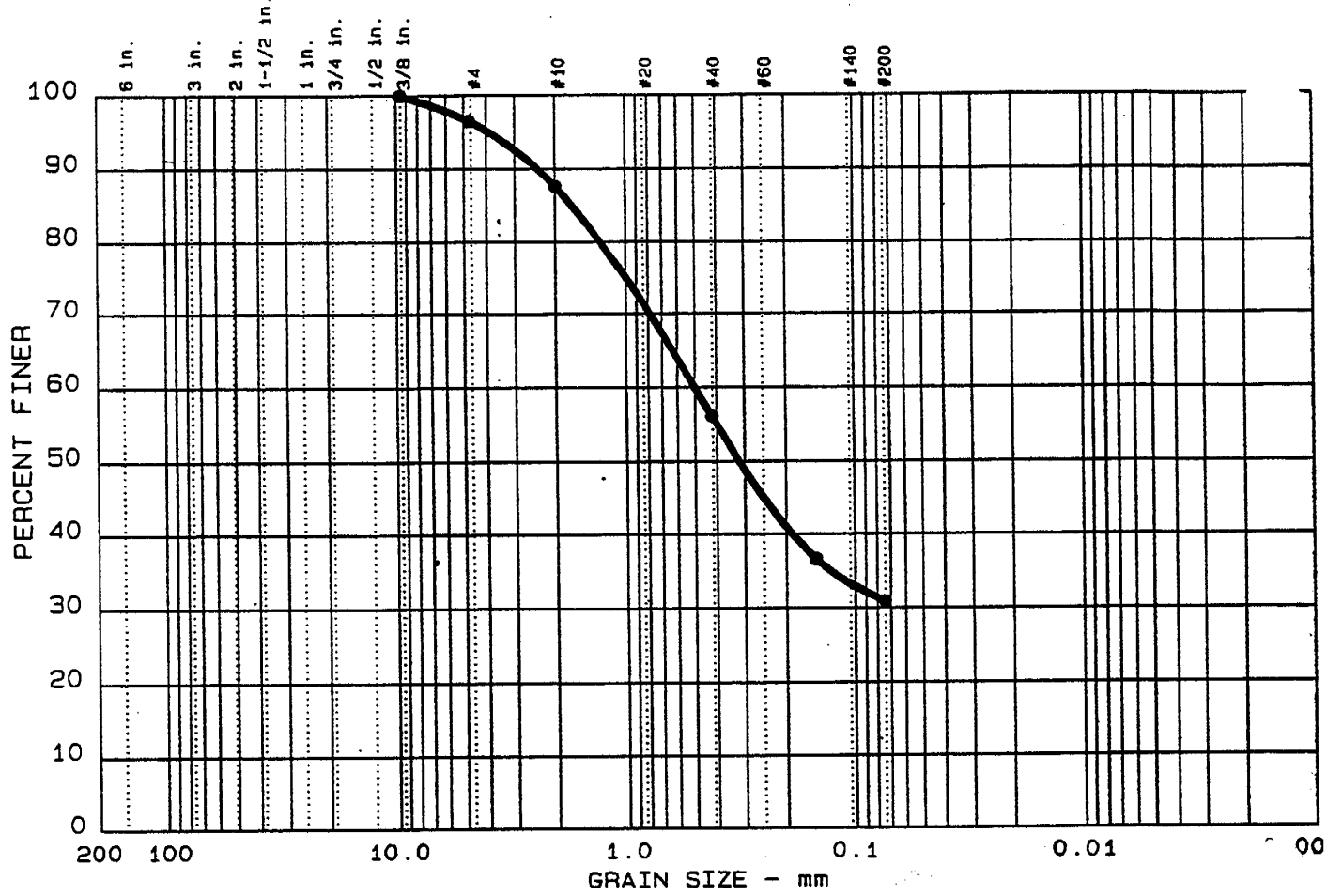
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
34	49.5 to 51'	SW	28			

GRADATION CURVES

Project: Puerto Nuevo Channel ... idges
Assignment No. 1
Area: San Juan, Puerto Rico
Boring No.: CB-PNB-7
Date: 05-10-89

ENG FORM 1 MAY 63 2087

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	3.5	65.6	30.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	34	16	1.68	0.50	0.32					

MATERIAL DESCRIPTION	USCS	AASHTO
● SAND, **SOME CLAY, TRACE GRAVEL, BROWN**	SC	A-2-6 (1)

Project No.:

Project: USACE RIO PUERTO NUEVO PROJECT

● Location: BOR. CB-PNB-7D, SAMPLE 3

Date: 10-27-95

Remarks:

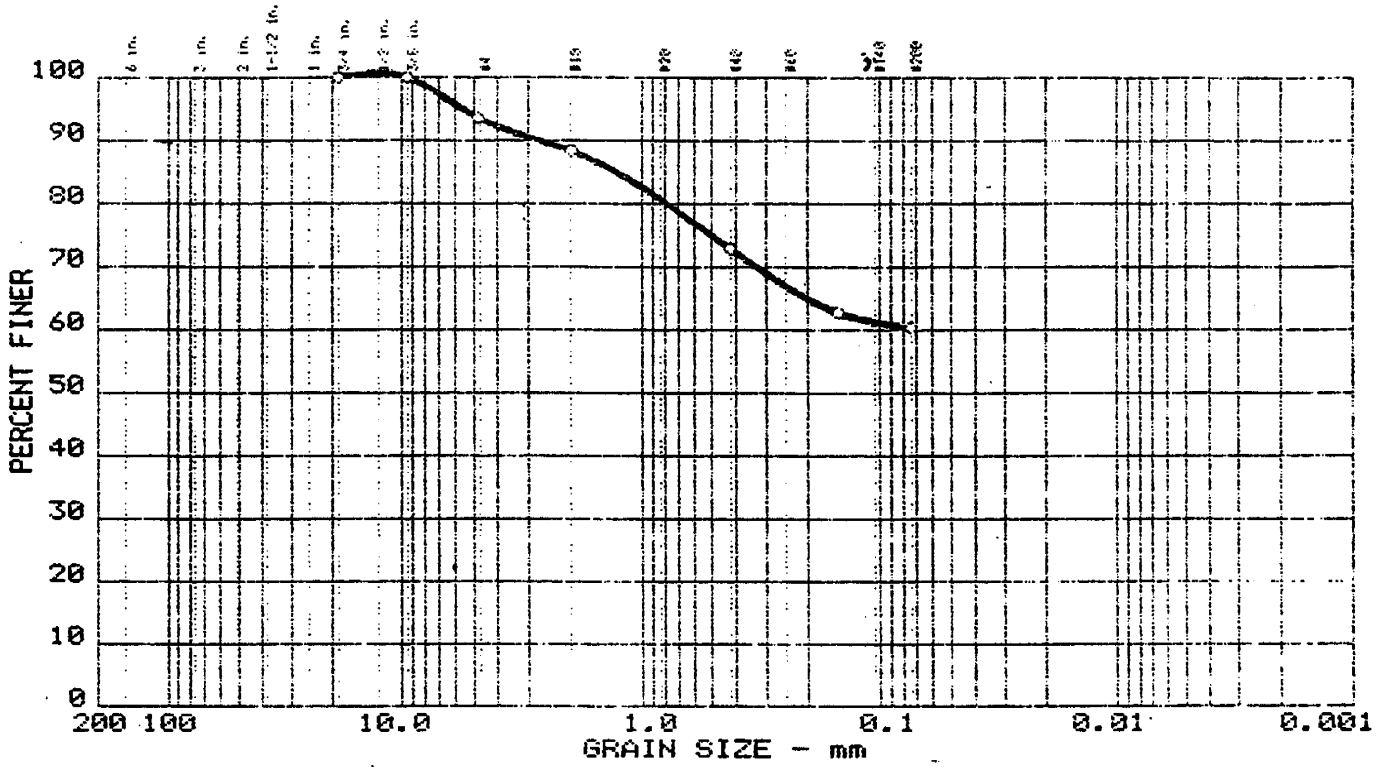
NAT. MOIST.: 21%

GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	6.4	33.2	60.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	68	41	1.26							

MATERIAL DESCRIPTION	USCS	AASHTO
○ CLAY, SOME SAND, TRACE GRAVEL, BROWN	CH	A-7(22)

Project No.:
Project: RIO PUERTO NUEVO
○ Location: BOR. CB-PNB-?D SAMPLE. 11

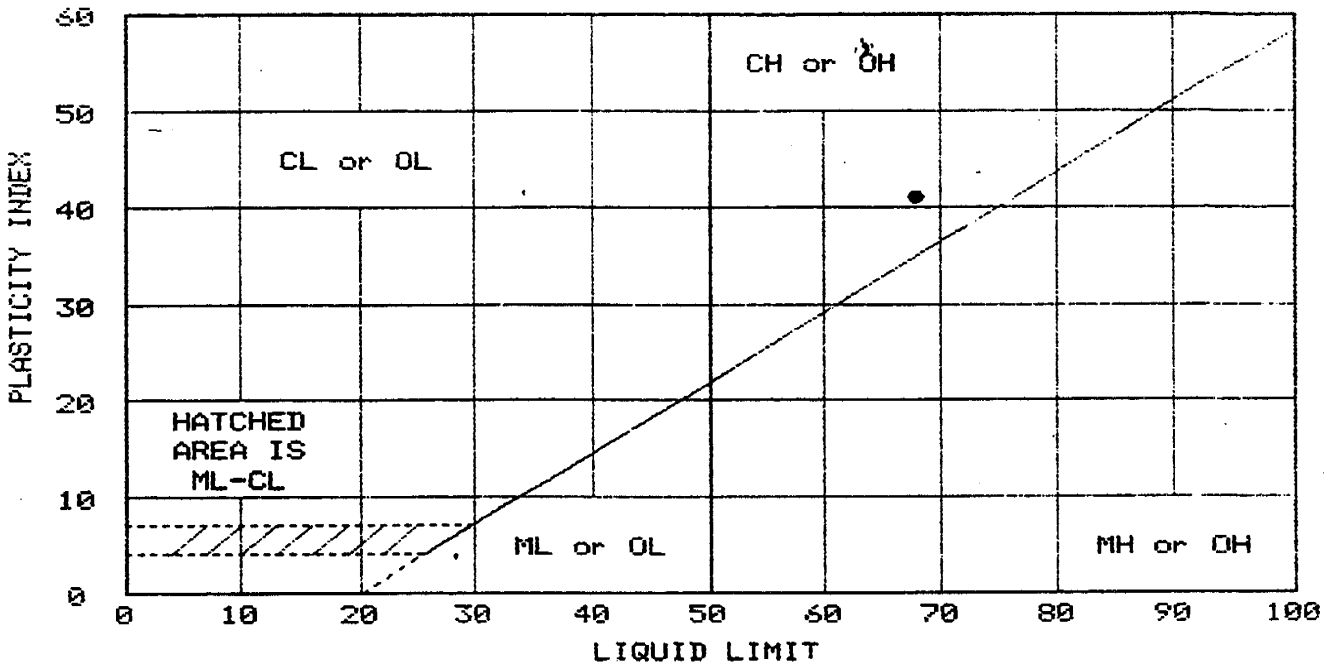
Date: 10-31-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
NAT. MOIST: 23%

Figure No.

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
• CLAY, SOME SAND, TRACE GRAVEL, BROWN	68	27	41	60.4	CH	A-7-6(22)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: SAN JUAN P.R.

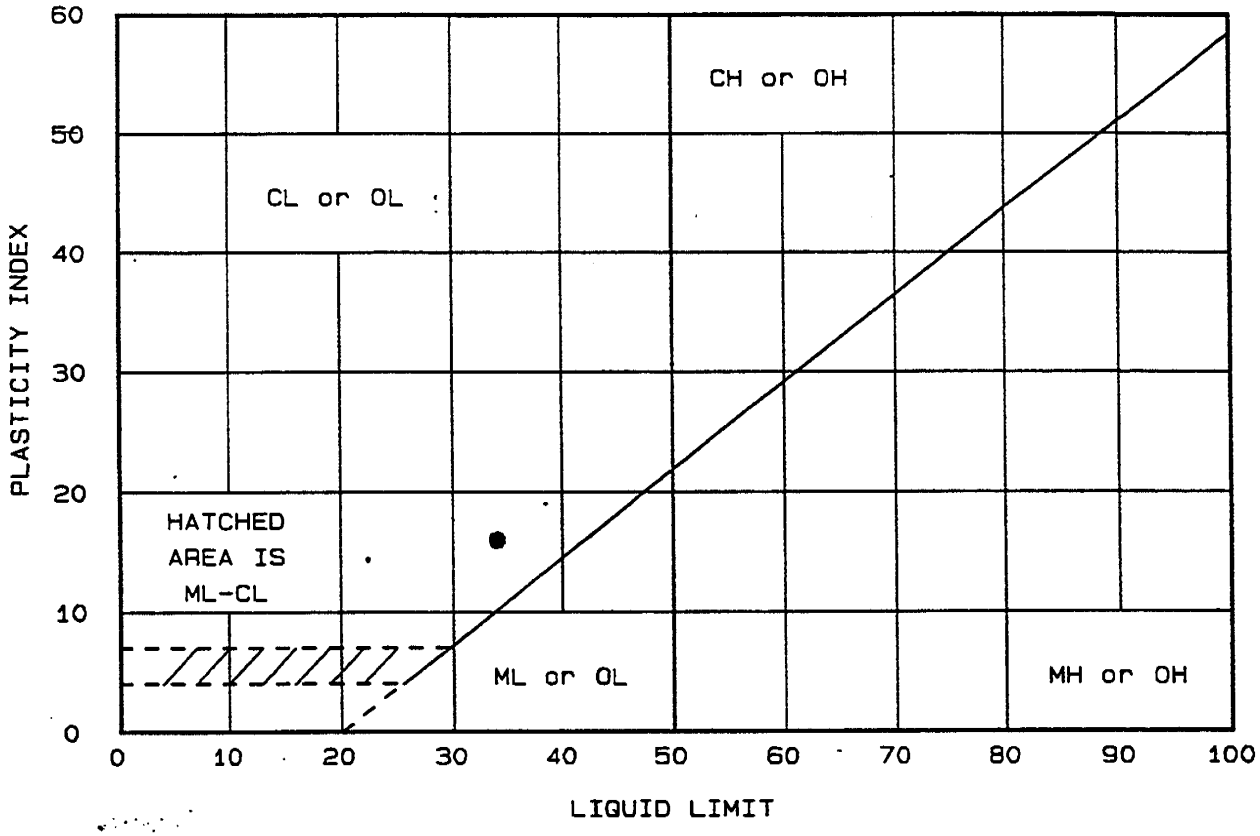
Date: 10-31-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNB-7D
SAMPLE: 11
NAT. MOIST.: 23%

Fig. No.____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-90
●	BOR. CB-PN-7D, SAMPLE 3 SAND, SOME CLAY, TRACE GRAVEL, BROWN	34	18	16	31	SC, Clayey sand

Project No.:
Project: USACE RIO PUERTO NUEVO PROJECT

Client: USACE
Location: SAN JUAN P.R.

Date: 10-27-95

Remarks:

NAT. MOIST.: 21%

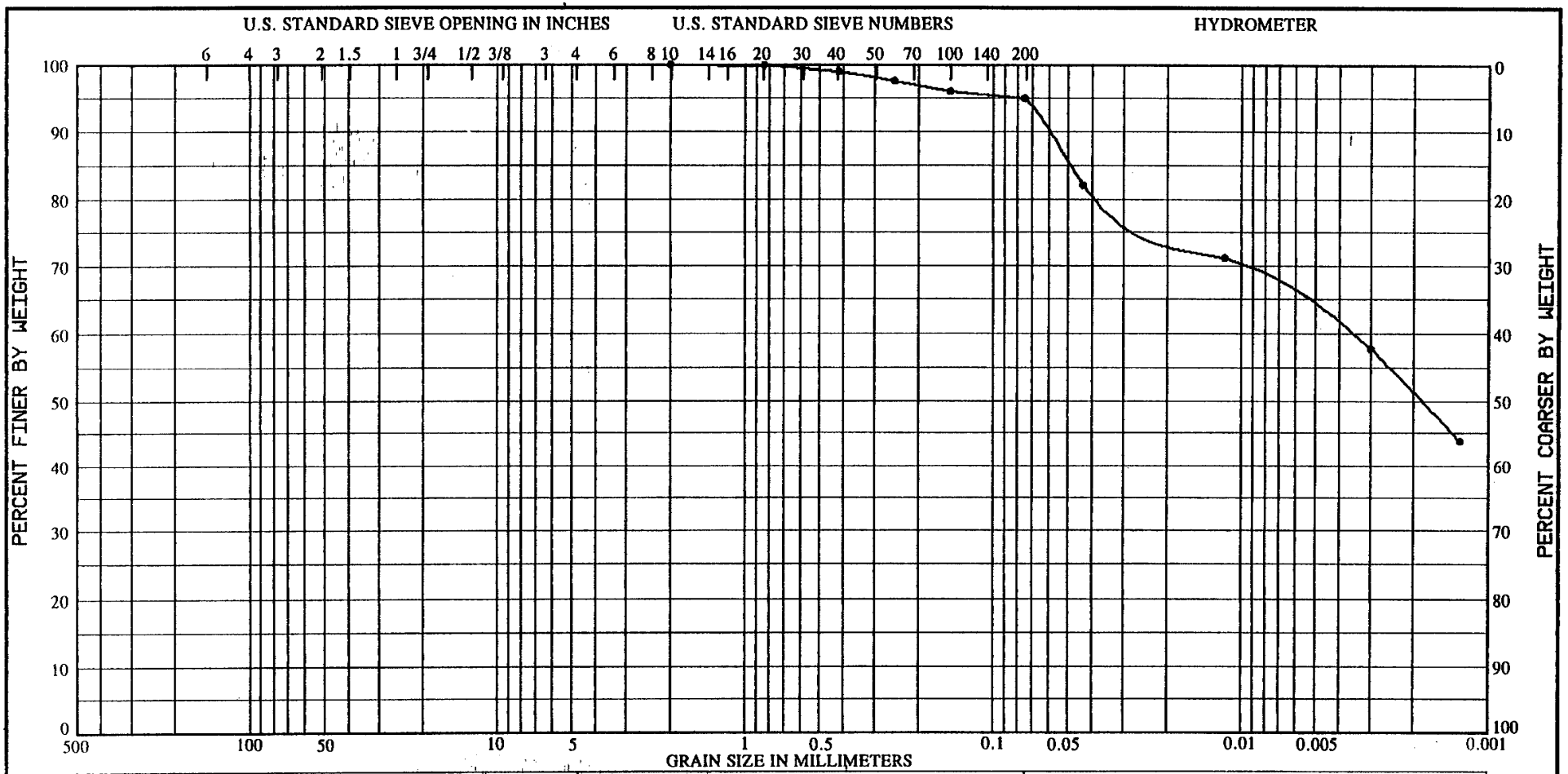
LIQUID AND PLASTIC LIMITS TEST REPORT

SUELOS INC.

Fig. No. ____

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
1	16.5-18.5	GRAY, FAT CLAY (CH), WITH A TRACE OF SAND SIZES.		63	29	34

Project RIO PUERTO NEUVO

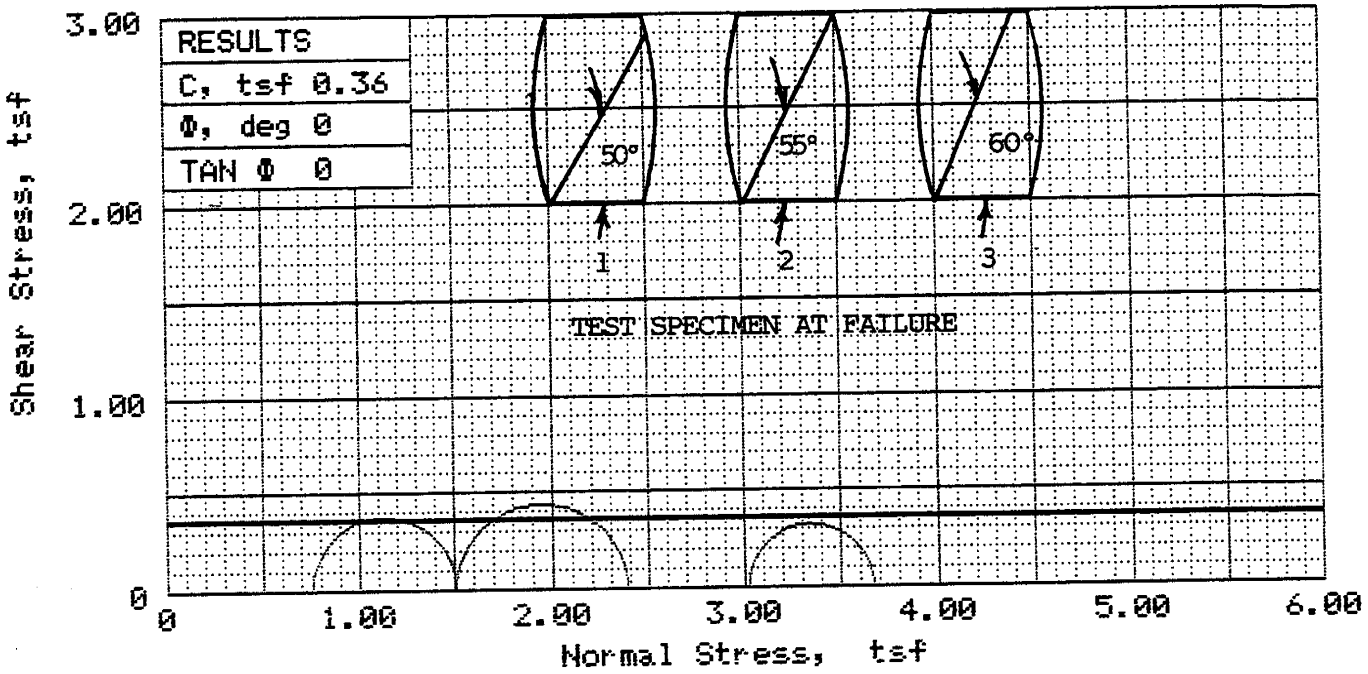
Lab No. 73/7145

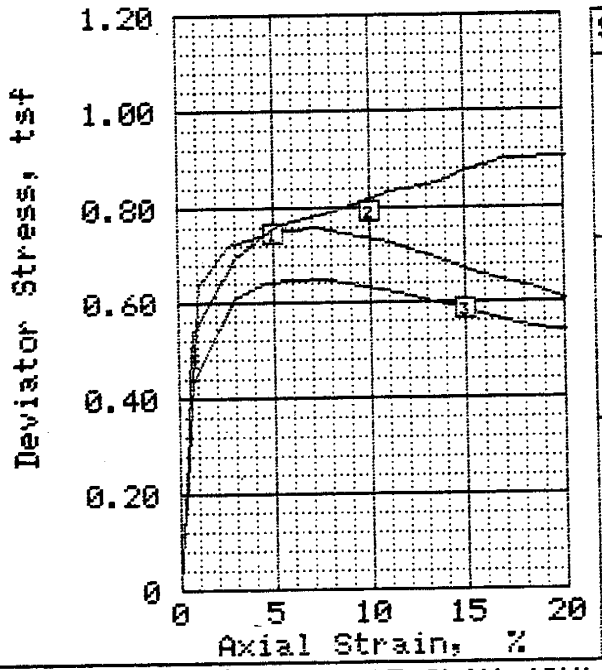
Boring No. CB-PNB-7U

Date 11/16/95

GRADATION CURVES

SOUTHATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	48.6	48.4	49.4
	DRY DENSITY, pcf	72.4	72.5	71.3
	SATURATION, %	97.8	97.8	97.0
	VOID RATIO	1.356	1.352	1.390
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	48.6	48.4	49.4
	DRY DENSITY, pcf	72.4	72.5	71.3
	SATURATION, %	97.8	97.8	97.0
	VOID RATIO	1.356	1.352	1.390
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		0.76	1.51	3.02
MAX. DEV. STRESS, tsf		0.76	0.87	0.65
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		10	20	10
RATE, %/min.		0.72	0.75	0.76
ULT. DEV. STRESS, tsf		0.67	0.87	0.58

DESCRIPTION GRAY, FAT CLAY (CH), WITH A TRACE OF SAND SIZES..

LL= 63	PL= 29	PI= 34	Gs= 2.71	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Q

REMARKS

PROJECT RIO PUERTO NUEVO

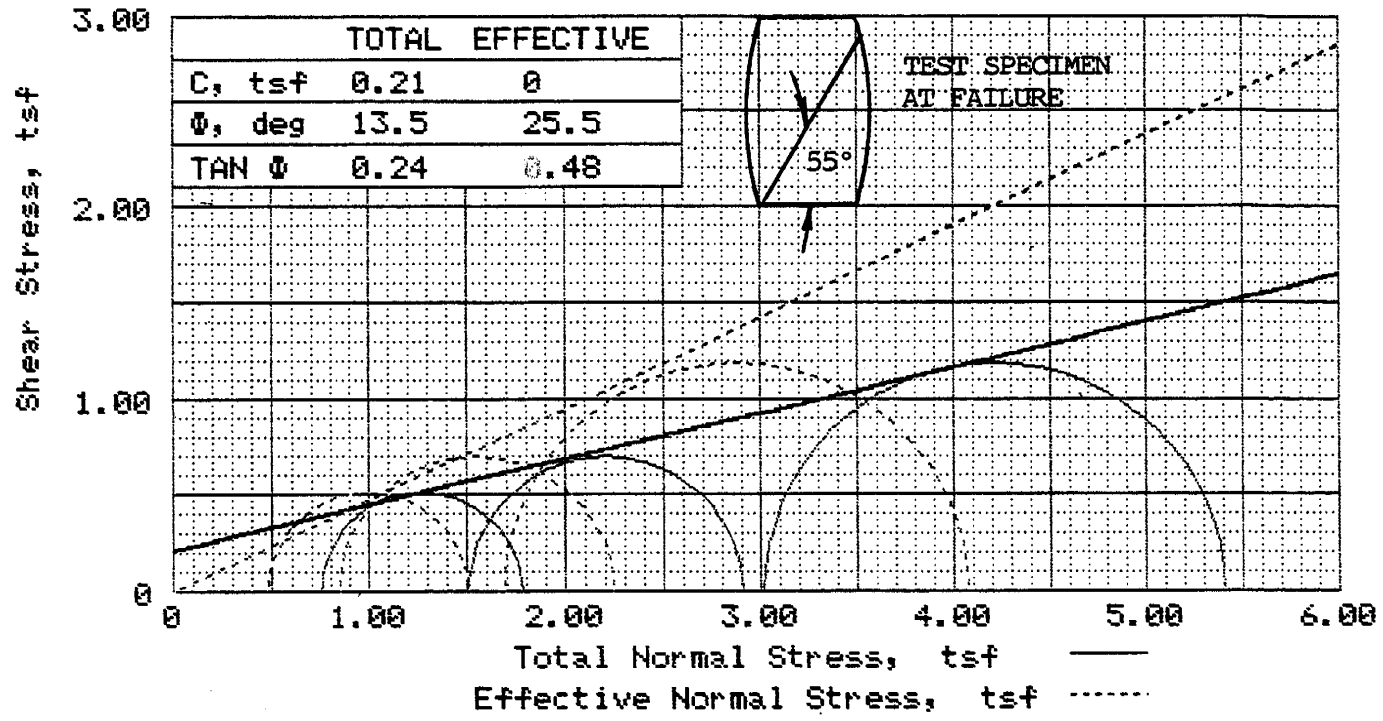
AREA

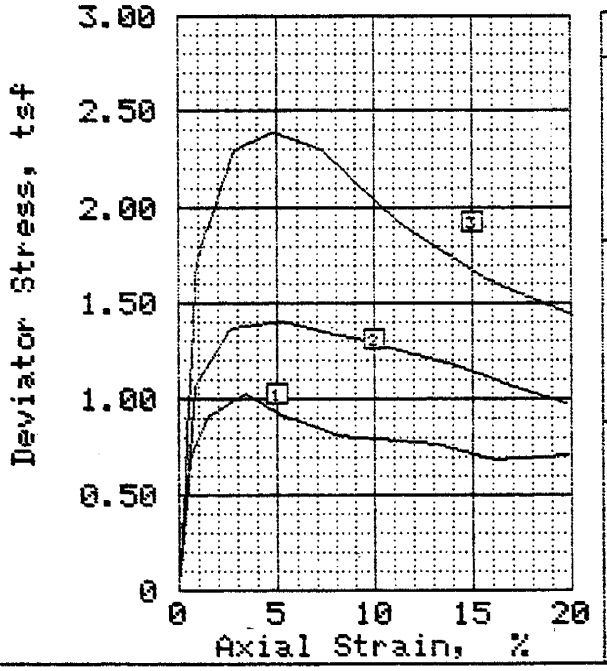
LAB NO. 73/7145

BORING NO. CB-PNB-7U
SAMPLE NO. 1
DEPTH~~/ELEV~~ 16.5 - 18.5'
LABORATORY CESAD-EN-FL DATE 6 NOV. 1995

TRIAXIAL COMPRESSION TEST

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	48.8	49.1	49.2
	DRY DENSITY, pcf	72.3	71.6	72.1
	SATURATION, %	98.7	97.8	99.2
	VOID RATIO	1.340	1.361	1.345
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	46.2	45.2	42.6
	DRY DENSITY, pcf	75.1	76.0	78.5
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.252	1.225	1.154
	DIAMETER, in	1.36	1.35	1.34
	HEIGHT, in	3.04	3.02	2.99
BACK PRESSURE, tsf		5.04	5.04	5.04
INIT. EFF. STR., tsf		0.76	1.51	3.02
MAX. DEV. STRESS, tsf		1.03	1.40	2.39
PORE PRESSURE, tsf		0.27	0.66	1.33
TIME TO FAILURE, min.		40	50	45
RATE, %/min.		0.09	0.11	0.11
ULT. DEV. STRESS, tsf		0.71	1.14	1.68

DESCRIPTION GRAY, FAT CLAY (CH), WITH A TRACE OF SAND SIZES.

LL= 63	PL= 29	PI= 34	Gs= 2.71	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST R w/pore pressures

REMARKS

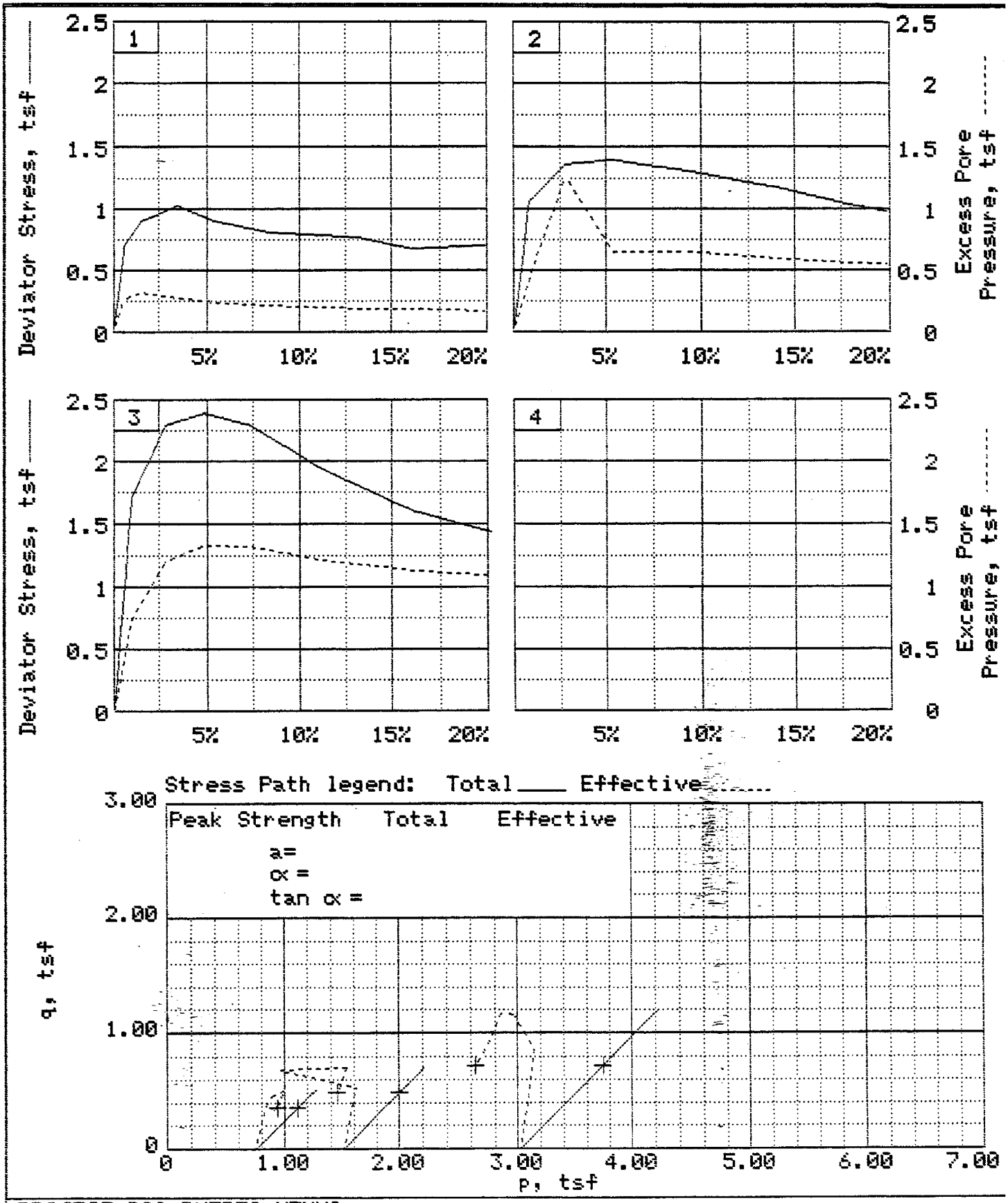
PROJECT RIO PUERTO NEUVO

AREA

LAB NO. 73/7145

BORING NO. CB-PNB-7U
SAMPLE NO. 1
DEPTH~~/ELEV~~ 16.5 - 18.5'
LABORATORY CESAD-EN-FL DATE 13 NOV. 1995

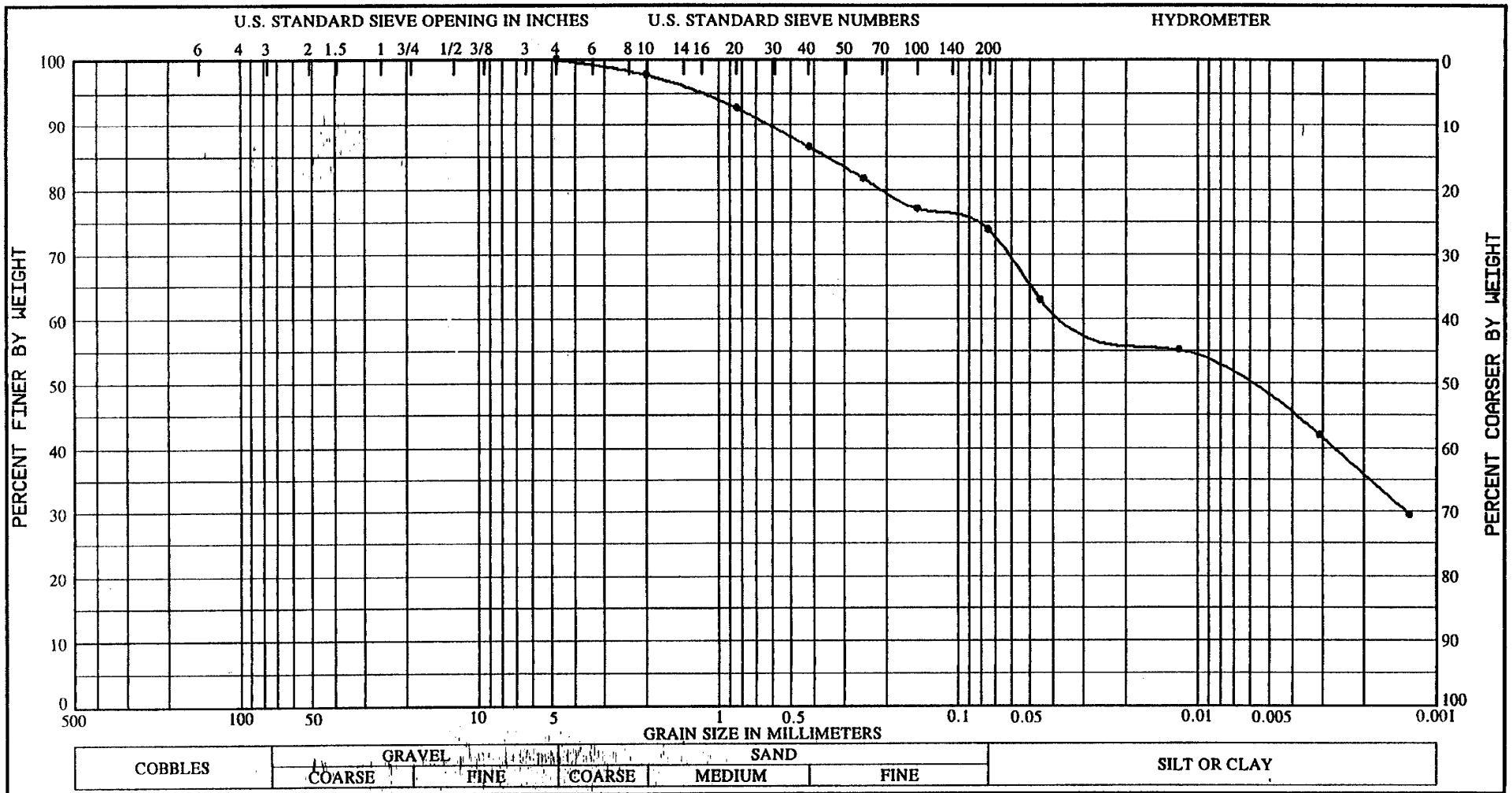
SOUTHATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825



PROJECT RIO PUERTO NEUVO
BORING CB-PNB-7U SAMPLE 1 DEPTH/~~ELEV~~ 16.5 - 18.5'
TYPE OF TEST R w/pore pressures LAB NO. 73/7145
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 13 NOV. 1995

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
2	34.5-36.5	TAN, LEAN CLAY (CL), WITH SOME SAND	34.2	49	24	25
		SIZES.				

Project RIO PUERTO NEUVO

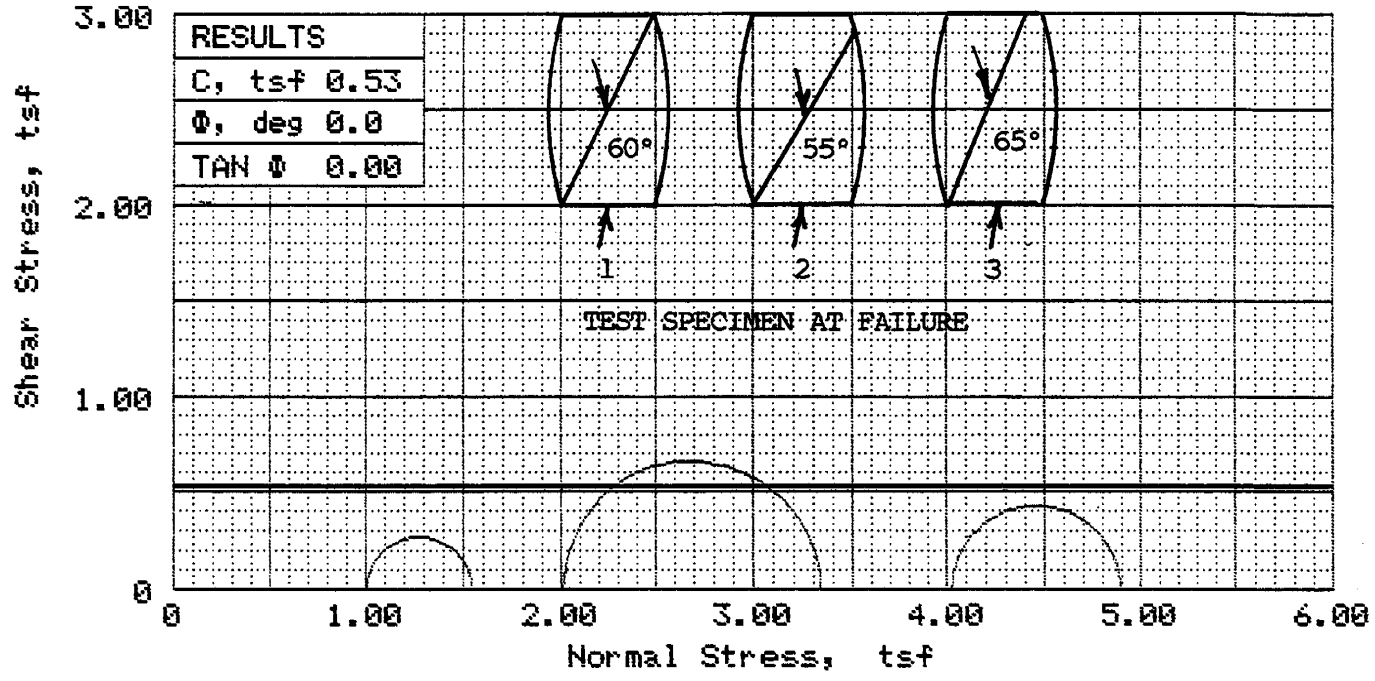
Lab No. 73/7146

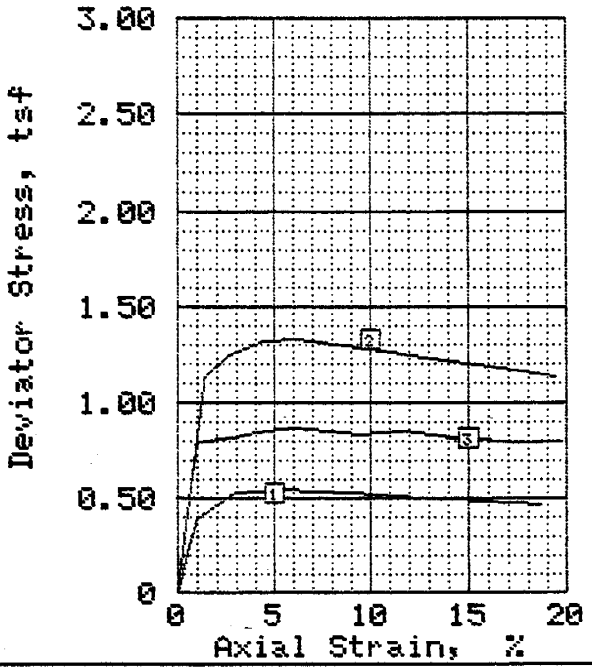
Boring No. CB-PNB-7U

Date 11/08/95

GRADATION CURVES

SOUTHATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	30.2	28.4	30.8
	DRY DENSITY, pcf	90.2	91.1	88.8
	SATURATION, %	93.0	89.2	92.0
	VOID RATIO	0.883	0.865	0.912
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	32.5	31.8	33.5
	DRY DENSITY, pcf	90.2	91.1	88.8
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.883	0.865	0.912
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		1.01	2.02	4.03
MAX. DEV. STRESS, tsf		0.54	1.32	0.86
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		11	10	9
RATE, %/min.		0.49	0.63	0.67
ULT. DEV. STRESS, tsf		0.49	1.20	0.82

DESCRIPTION TAN, LEAN CLAY (CL), WITH SOME SAND SIZES.

LL= 49	PL= 24	PI= 25	Gs= 2.72	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Sat Q

REMARKS

PROJECT RIO PUERTO NEUVO

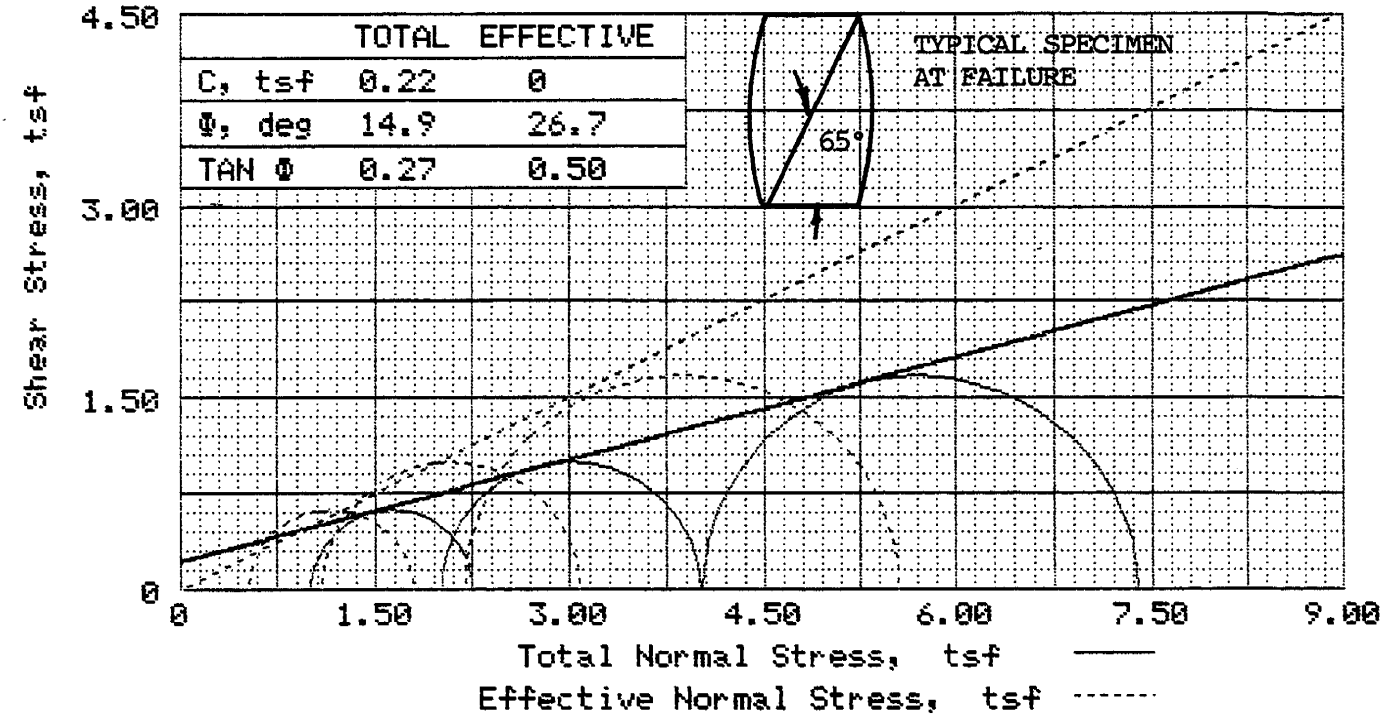
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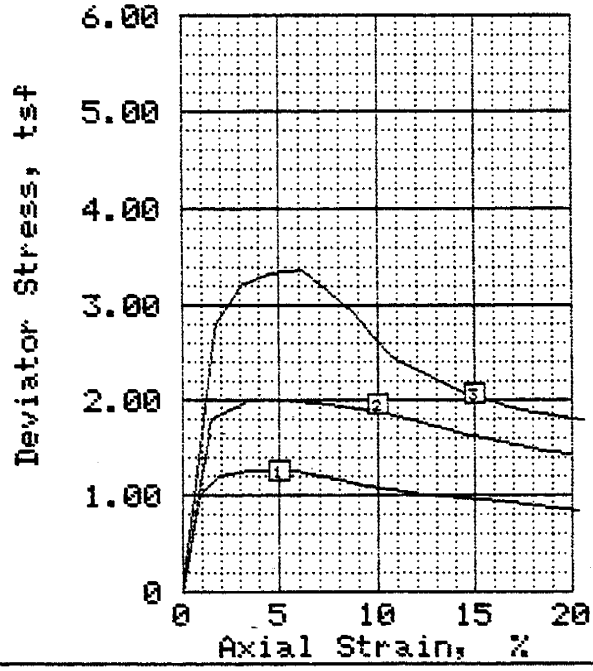
LAB NO. 73/7146

BORING NO. CB-PNB-7U
SAMPLE NO. 2
DEPTH/ELEV 34.5 - 36.5'
LABORATORY CESAD-EN-FL DATE 14 NOV. 1995

TRIAXIAL COMPRESSION TEST

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	33.6	34.7	34.2
	DRY DENSITY, pcf	85.8	84.6	85.5
	SATURATION, %	93.3	93.8	94.2
	VOID RATIO	0.978	1.006	0.986
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	32.6	33.0	28.4
	DRY DENSITY, pcf	90.0	89.5	95.7
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.887	0.898	0.774
	DIAMETER, in	1.36	1.35	1.33
	HEIGHT, in	3.03	3.02	2.97
BACK PRESSURE, tsf		5.04	5.04	5.04
INIT. EFF. STR., tsf		1.01	2.02	4.03
MAX. DEV. STRESS, tsf		1.25	2.00	3.36
PORE PRESSURE, tsf		0.47	0.93	1.83
TIME TO FAILURE, min.		30	25	50
RATE, %/min.		0.11	0.14	0.12
ULT. DEV. STRESS, tsf		0.95	1.61	2.04

DESCRIPTION TAN, LEAN CLAY (CL), WITH SOME SAND SIZES.

LL= 49	PL= 24	PI= 25	Gs= 2.72	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST R w/pore pressures

REMARKS

PROJECT RIO PUERTO NEUVO

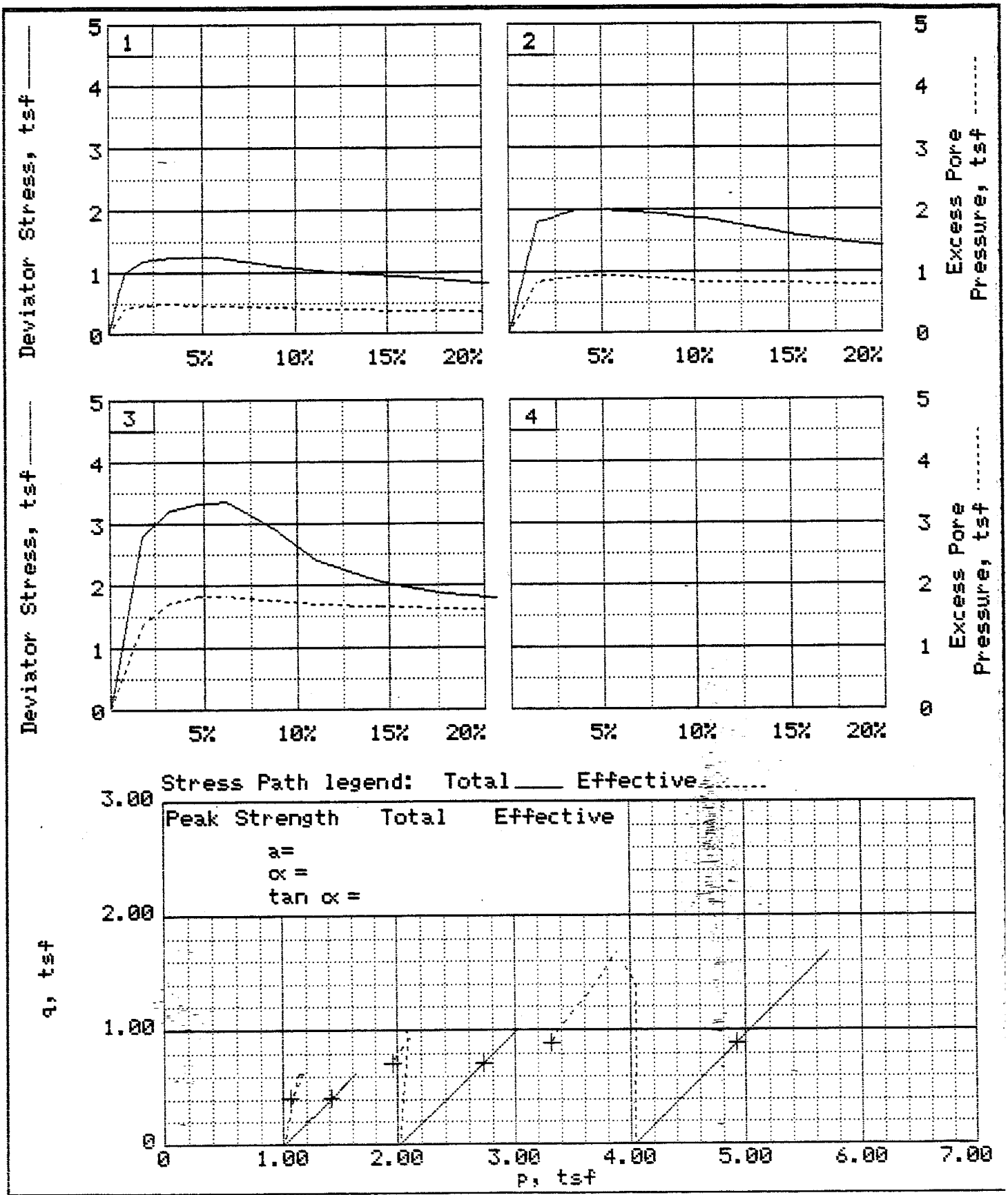
AREA

LAB NO. 73/7146

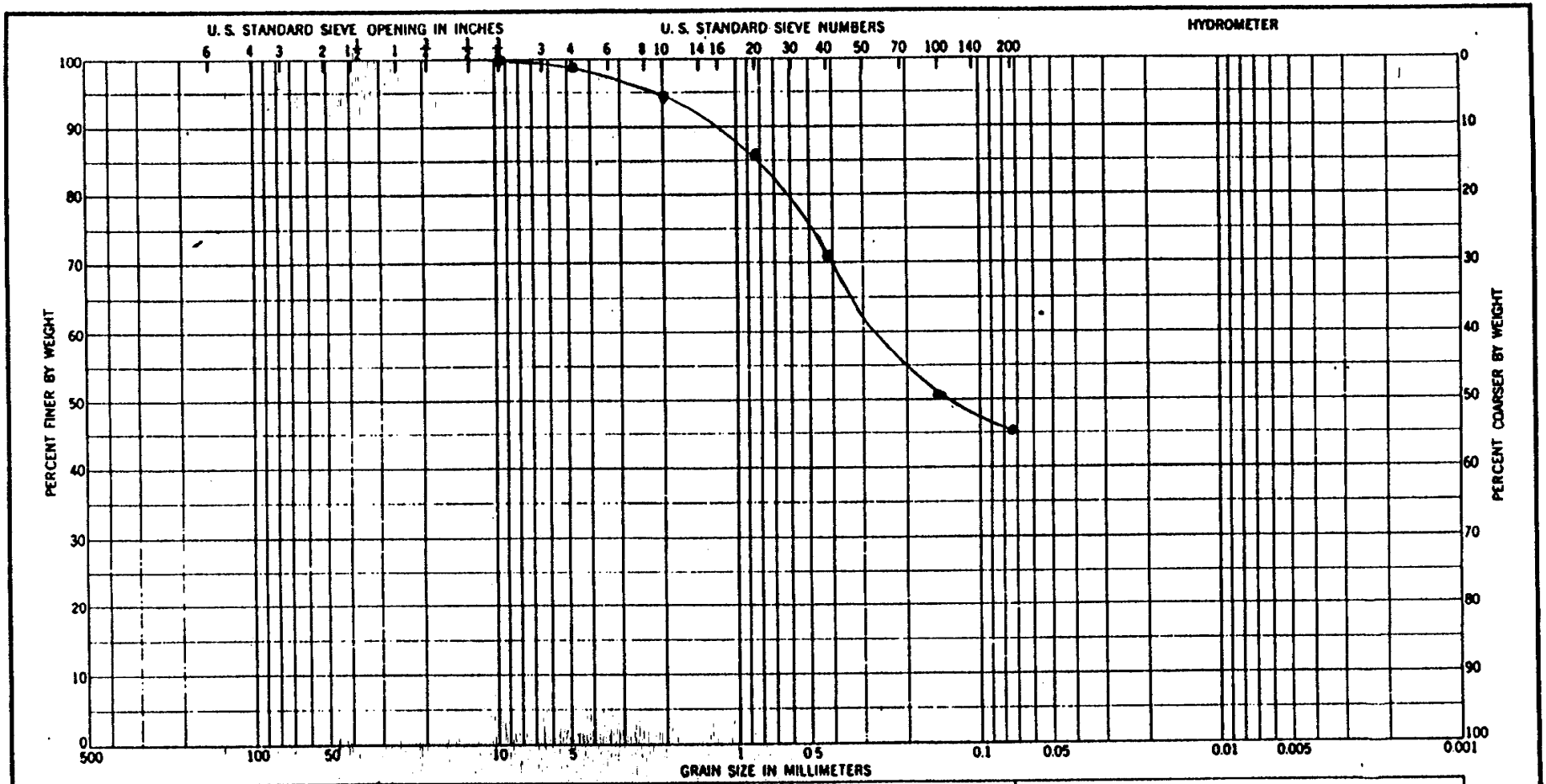
BORING NO. CB-PNB-7U
SAMPLE NO. 2
DEPTH/~~ELEV~~ 34.5 - 36.5'
LABORATORY CESAD-EN-FL DATE 8 NOV. 1995

 TRIAXIAL COMPRESSION TEST

SOUTHLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825



PROJECT RIO PUERTO NEUVO
BORING CB-PNB-7U SAMPLE 2 DEPTH/ELEV 34.5 - 36.5'
TYPE OF TEST R w/pore pressures LAB NO. 73/7146
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 8 NOV. 1995



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
18	25.5 to 27'	Clay, sandy, stiff olive gray.				

GRADATION CURVES

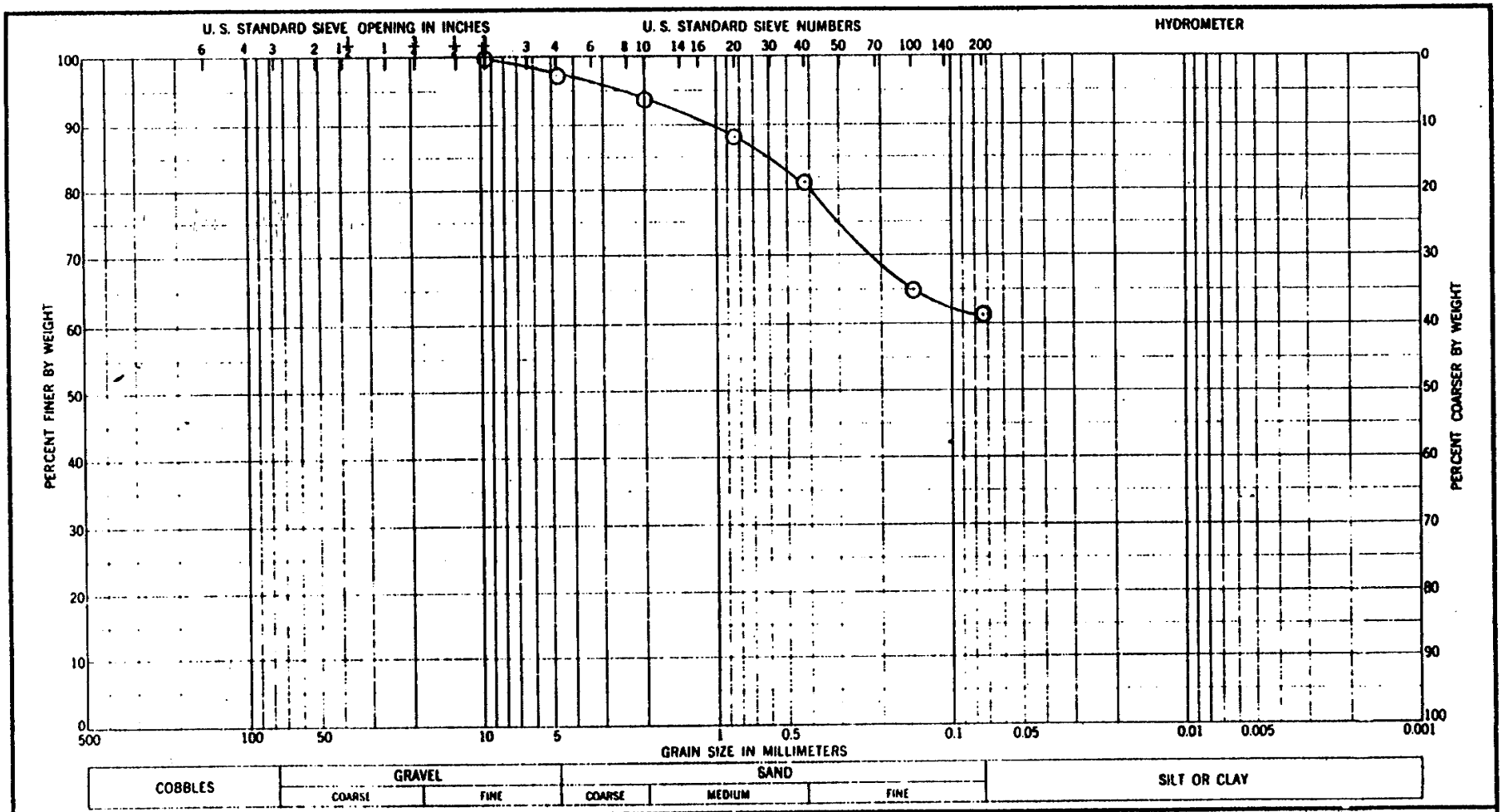
Project: Puerto Nuevo Channels Assignment #4

Area: San Juan, Puerto Rico

Boring No.: CB-PNM-43

Date: 6/1/90

ENG FORM MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
17	-15.73 to -17.23	CL	26	38	19	19

GRADATION CURVES

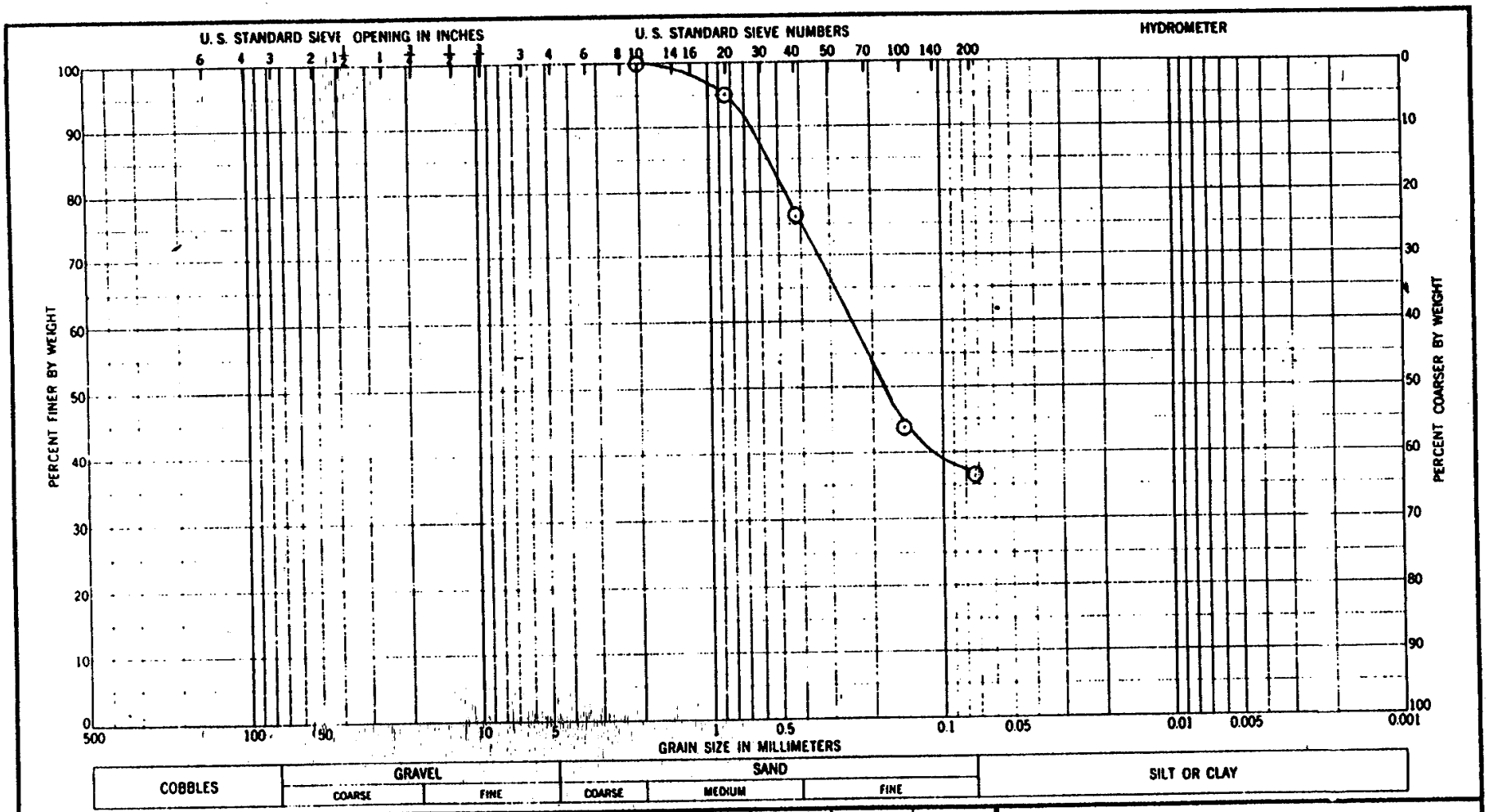
Project: Puerto Nuevo Channels
San Juan, Puerto Rico

Area:

Boring No.: CB-PNM-44

Date: 4-28-90

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
19	-18.73 to -20.23	SC				

GRADATION CURVES

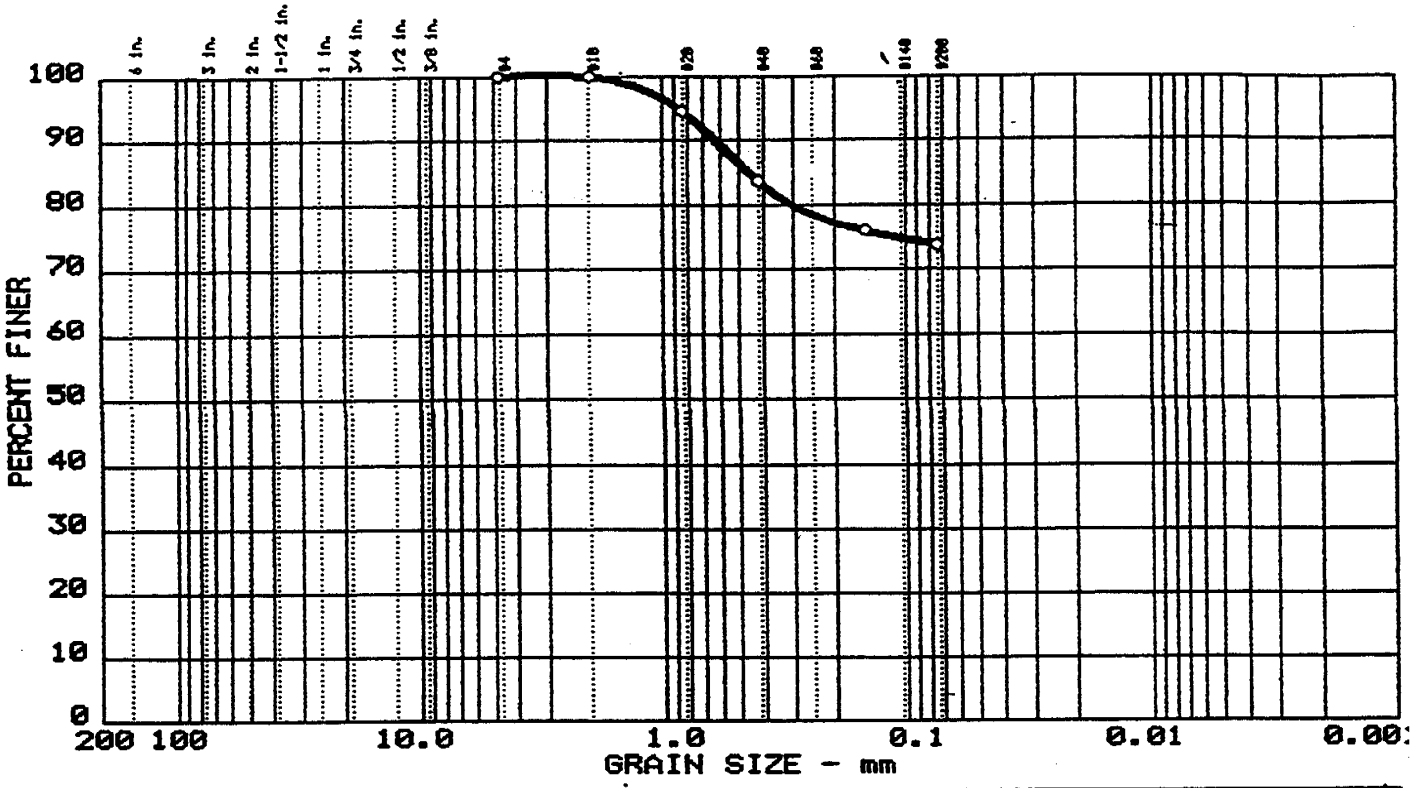
Project: Puerto Nuevo Channels
San Juan, Puerto Rico

Area:

Boring No.: CB-PNM-44

Date: 4-28-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	26.2	73.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	70	42	0.46							

MATERIAL DESCRIPTION	USCS	AASHTO
o CLAY, SILTY, SOME SAND, LIGHT BROWN	CH	A-7-6(33)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

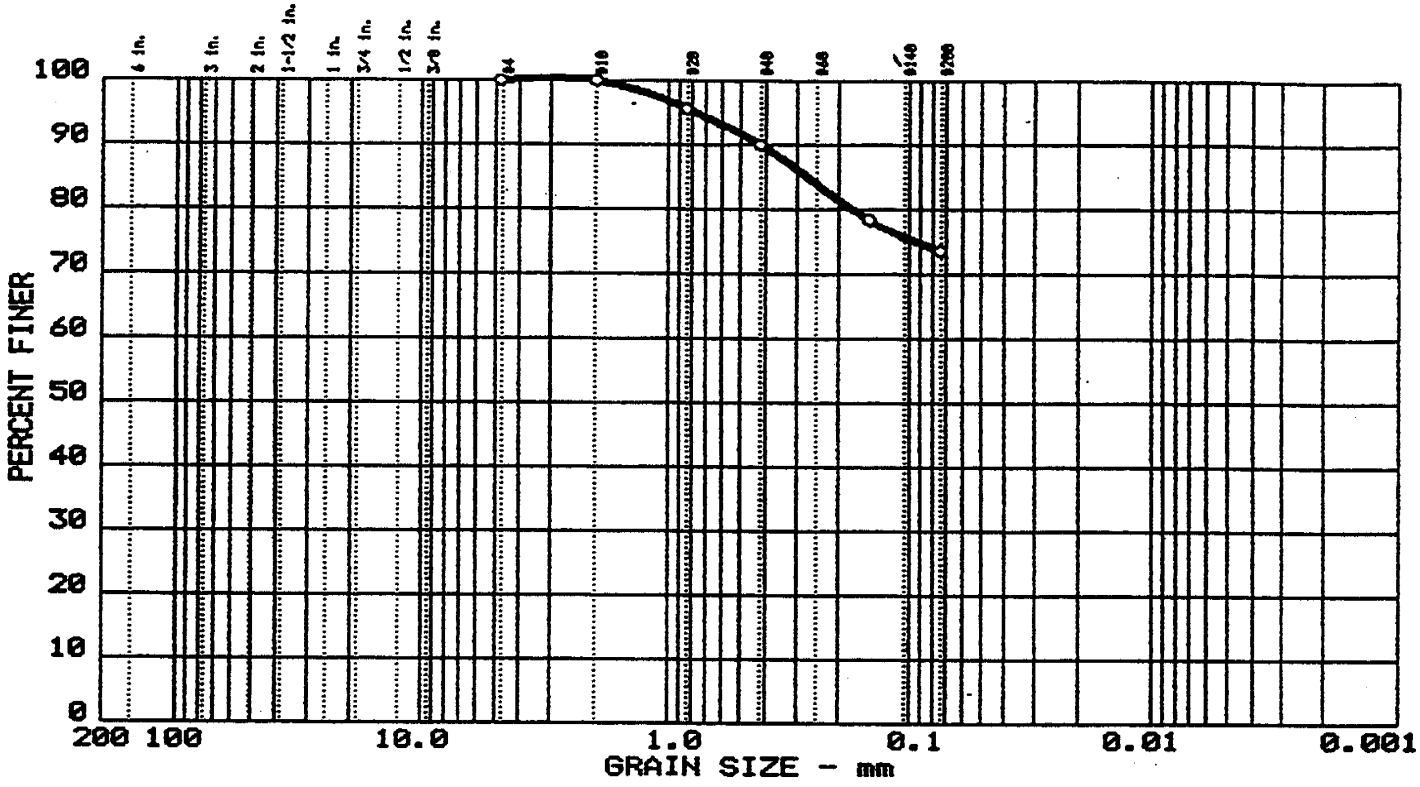
Date: 12-22-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNM-44D
SAMPLE. 23
NAT. MOIST. 41%

Figure No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	26.3	73.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_u
o	71	40	0.27							

MATERIAL DESCRIPTION	USCS	AASHTO
o CLAY, SOME SAND, LIGHT OLIVE	CH	A-7-5(31)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

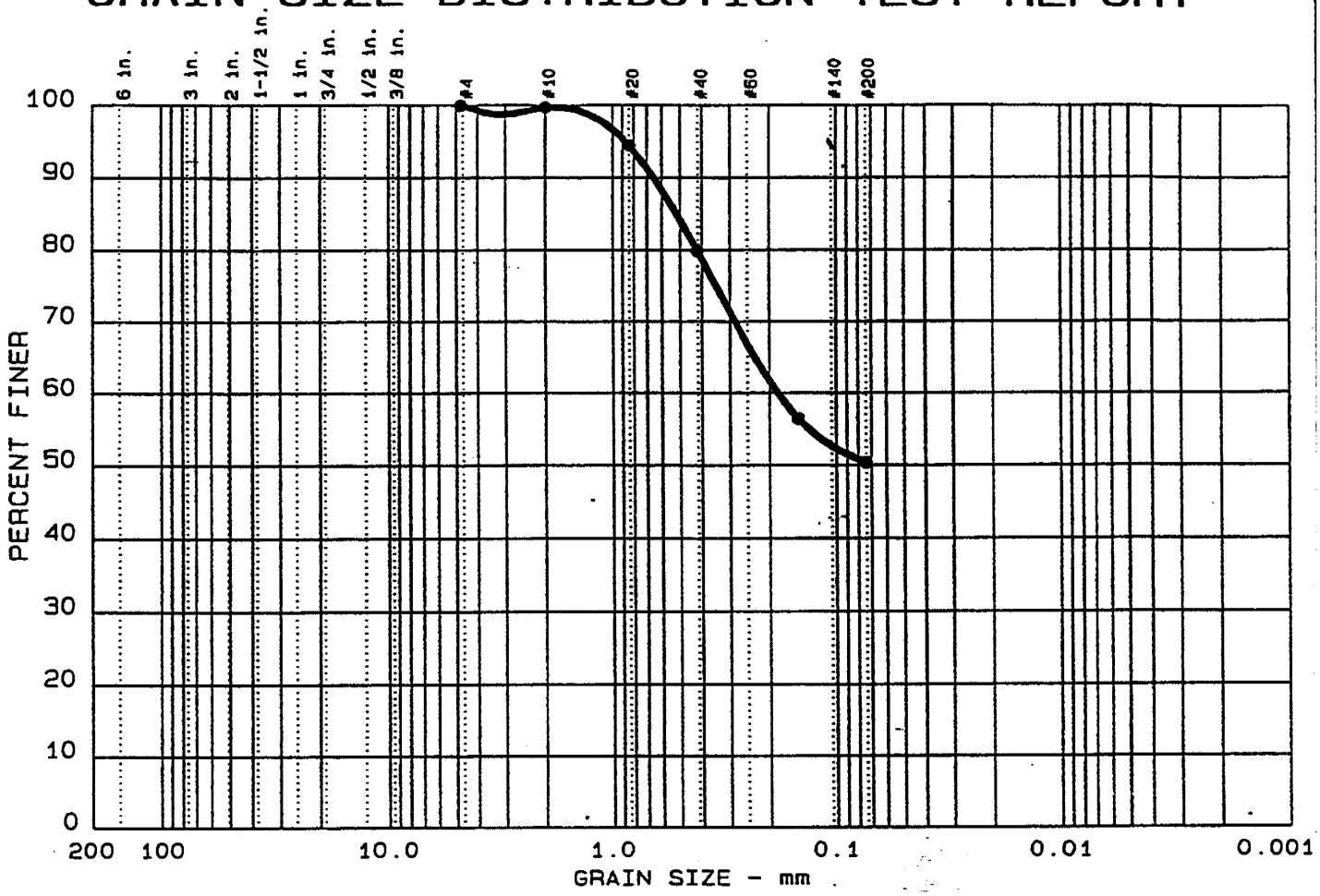
Date: 12-22-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNM-44D
SAMPLE. 26
NAT. MOIST. 45%

Figure No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	49.6	50.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.52	0.18						

MATERIAL DESCRIPTION	USCS	AASHTO
● **SILT, SANDY.** YELLOWISH BROWN		

Project No.:

Project: RIO PUERTO NUEVO

● Location: BOR. **CB-PNM-44D**

SAMPLE 28

Date: 1-2-96

GRAIN SIZE DISTRIBUTION TEST REPORT

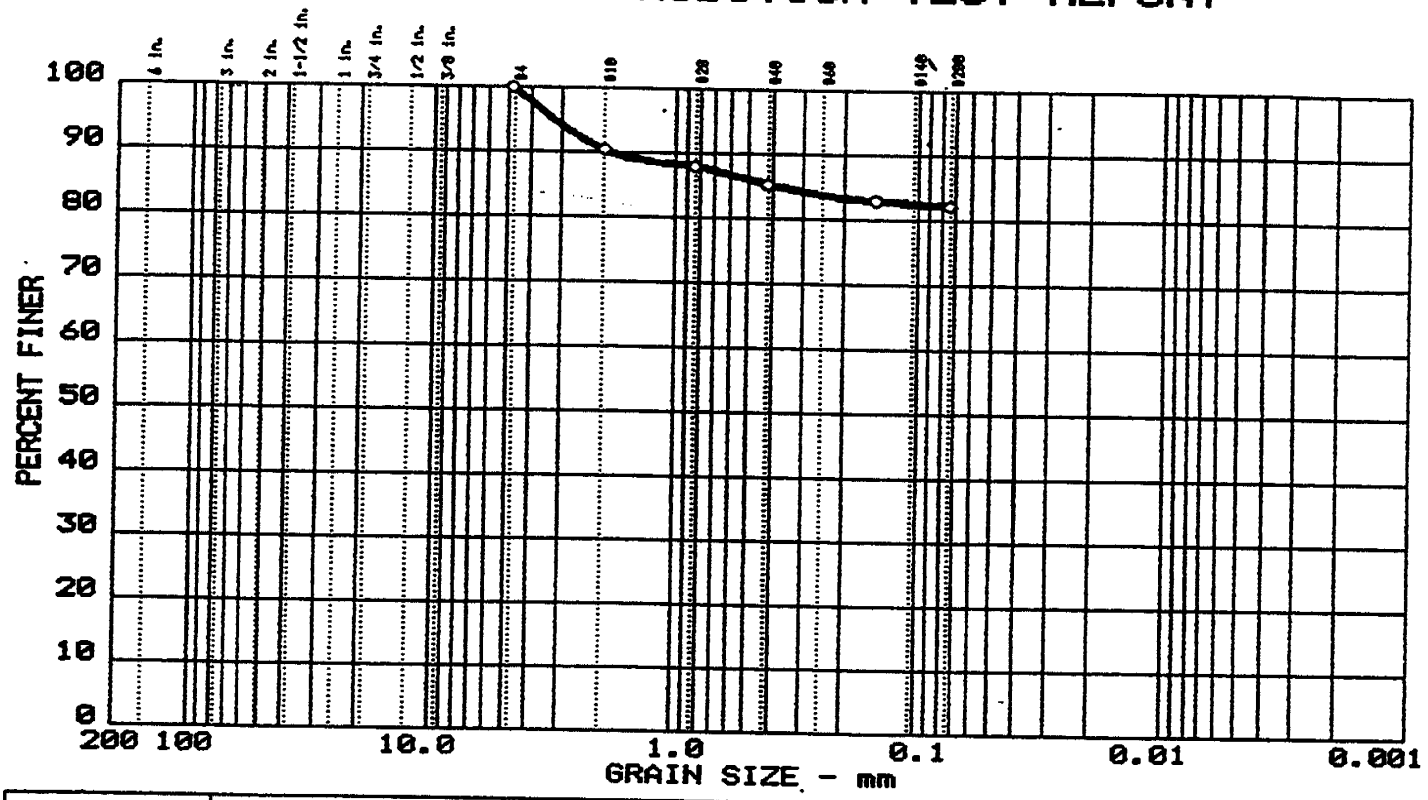
SUELOS INC.

Remarks:

MOIST. CONT.: 45%

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	17.8	82.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	60	28	0.37							

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT, LITTLE SAND, LIGHT OLIVE	MH	A-7-5(26)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

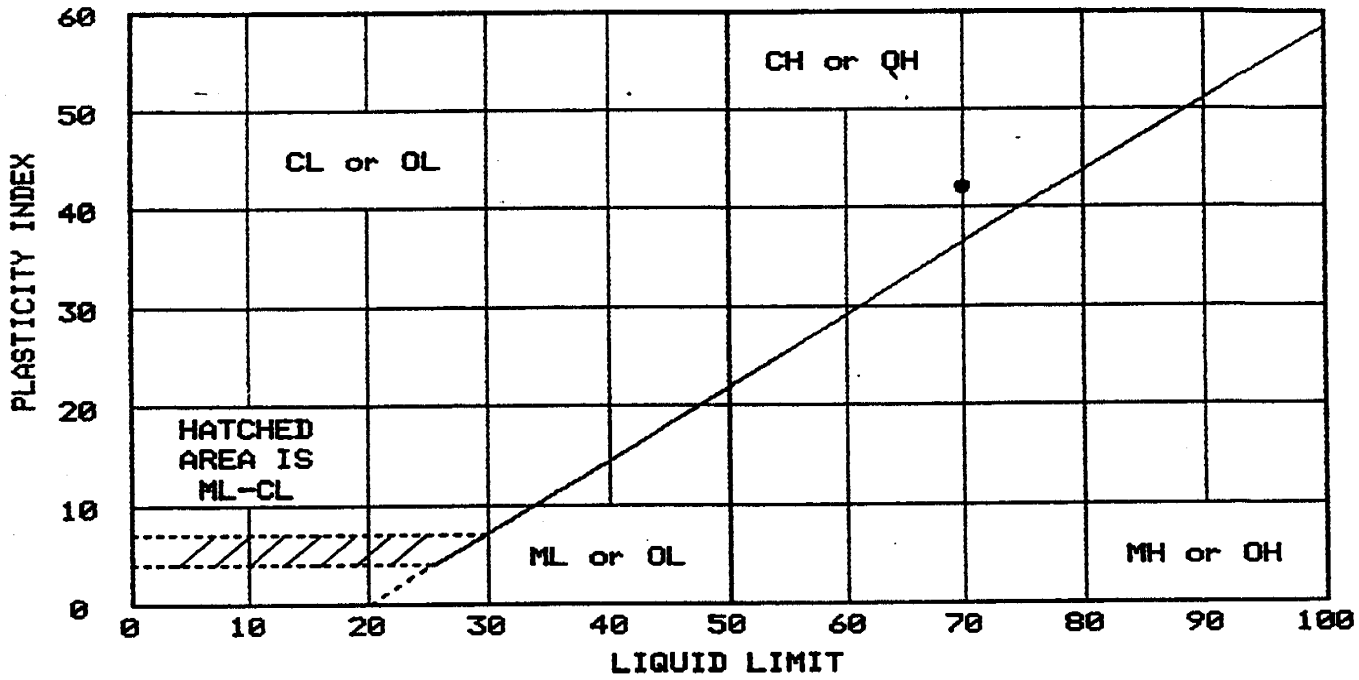
Date: 12-22-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNM-44D
SAMPLE. 33
NAT. MOIST. 32%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
• CLAY, SILTY, SOME SAND, LIGHT BROWN	70	28	42	73.9	CH	A-7-6(33)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

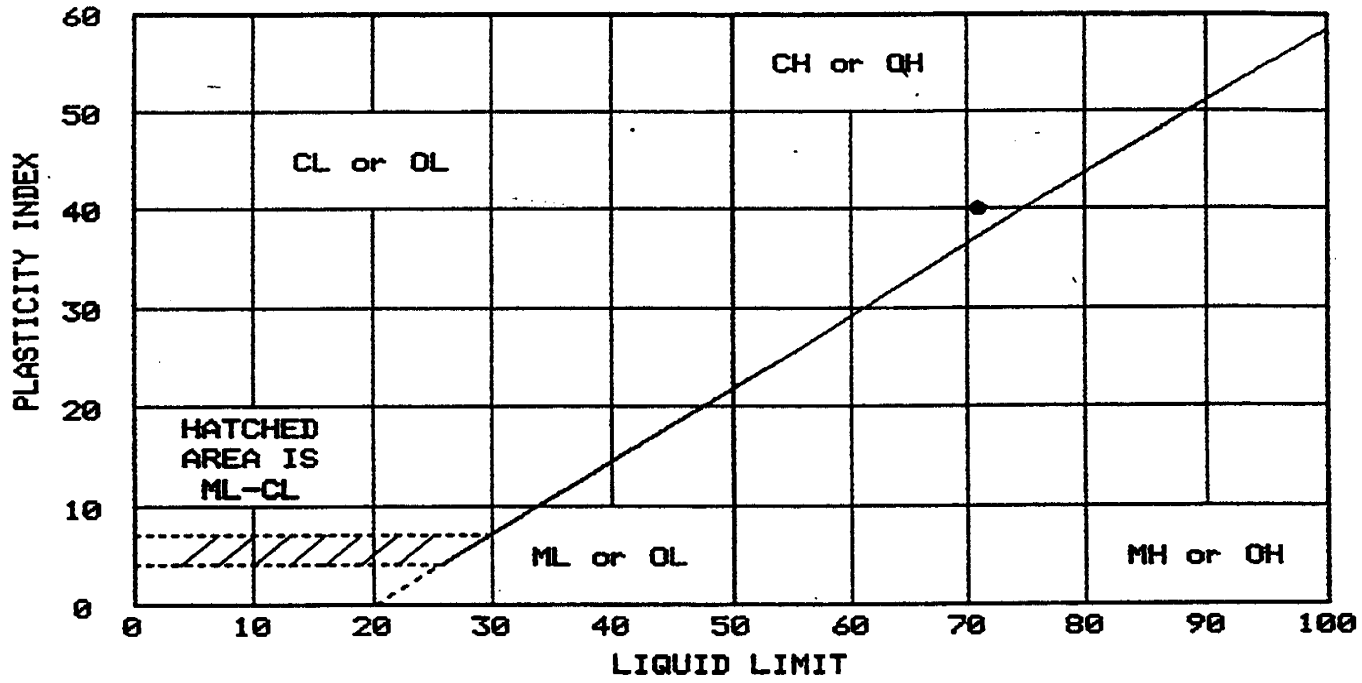
Date: 12-22-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNM-44D
SAMPLE. 23

Fig. No.____

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
• CLAY, SOME SAND, LIGHT OLIVE	71	31	40	73.7	CH	A-7-5(31)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

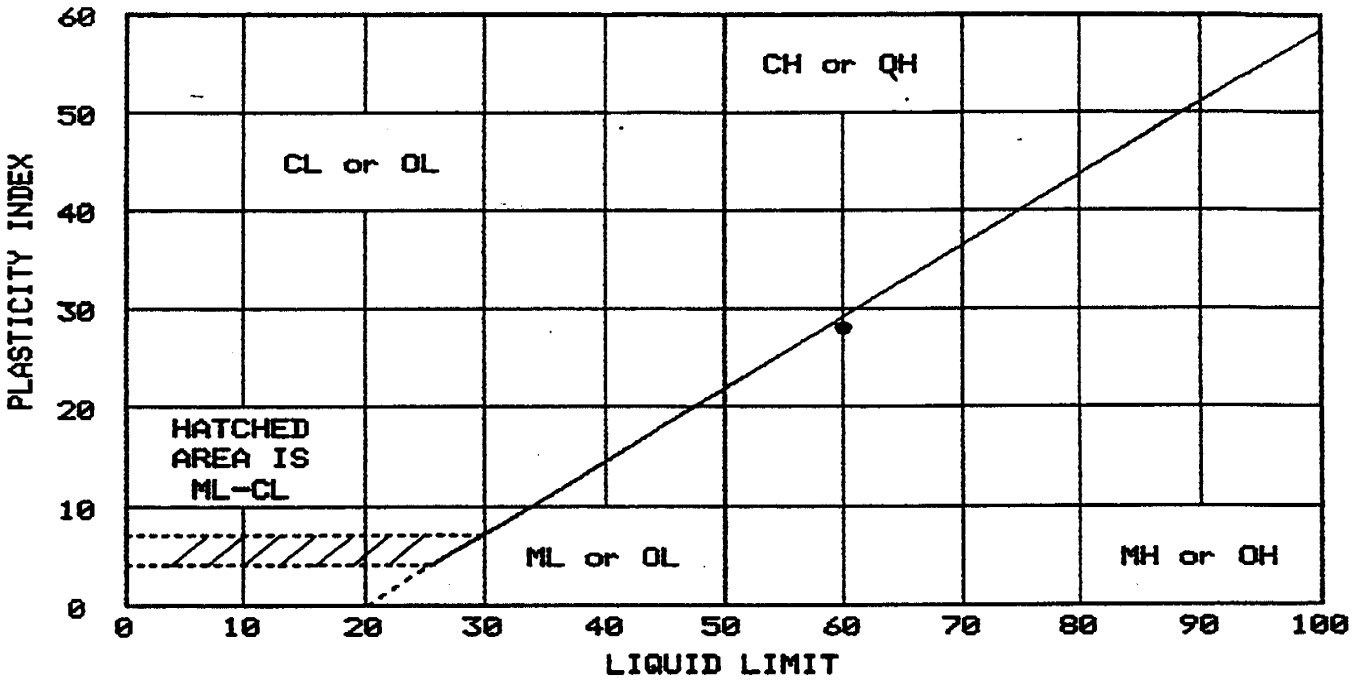
Date: 12-22-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNM-44D
SAMPLE. 26

Fig. No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SILT, LITTLE SAND, LIGHT OLIVE	60	32	28	82.3	MH	A-7-5(26)

Project No.:
Project: RIO PUERTO NUEVO

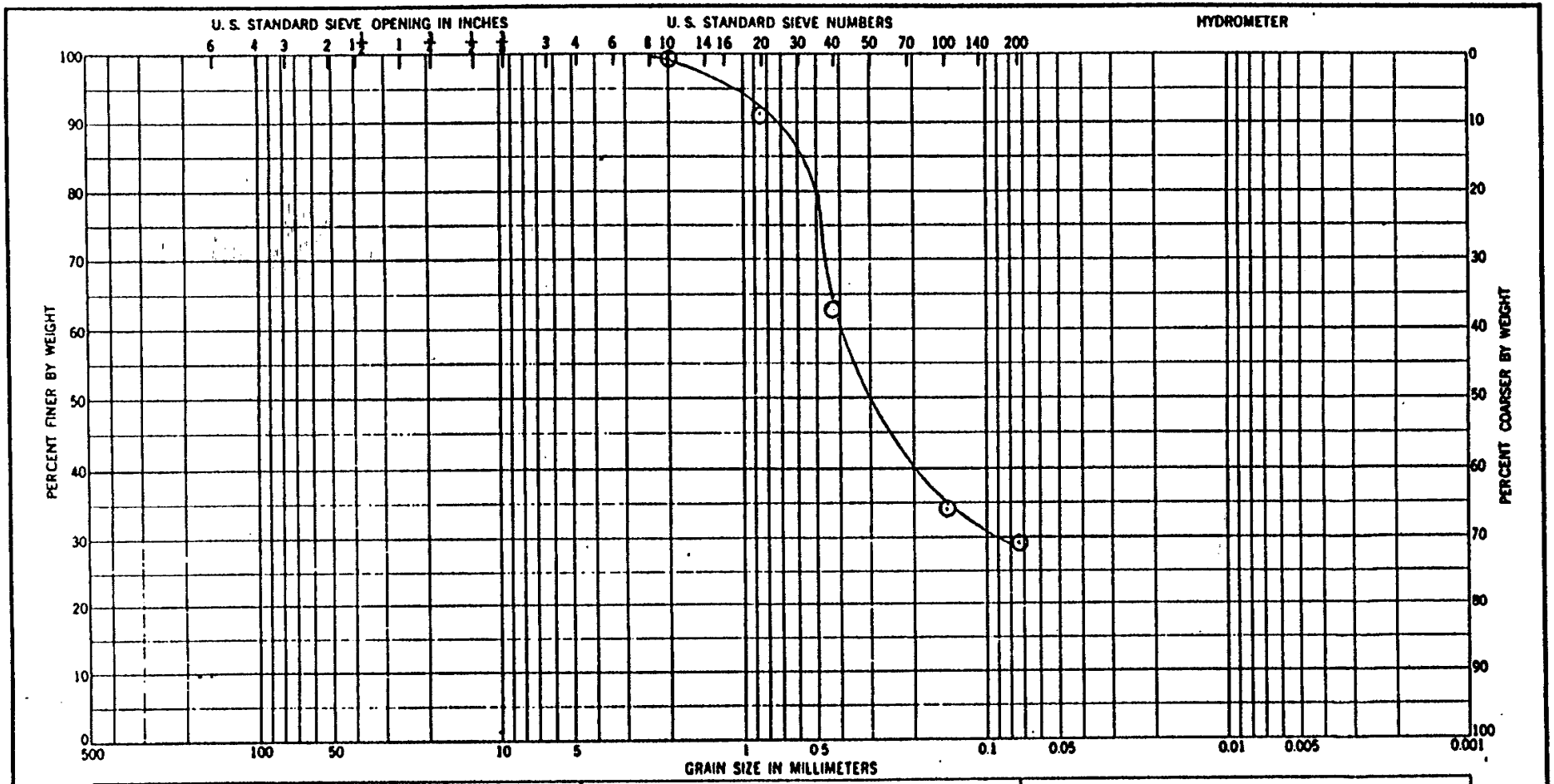
Client:
Location: HATO REY P.R.

Date: 12-22-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNM-44D
SAMPLE. 33

Fig. No._____



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
15	21 to 22.5'	Sand, silty, fine grain, some decayed wood, little clay, olive gray (SM)				

GRADATION CURVES

Project: Puerto Nuevo Channels
Assignment #4

Area: San Juan, Puerto Rico

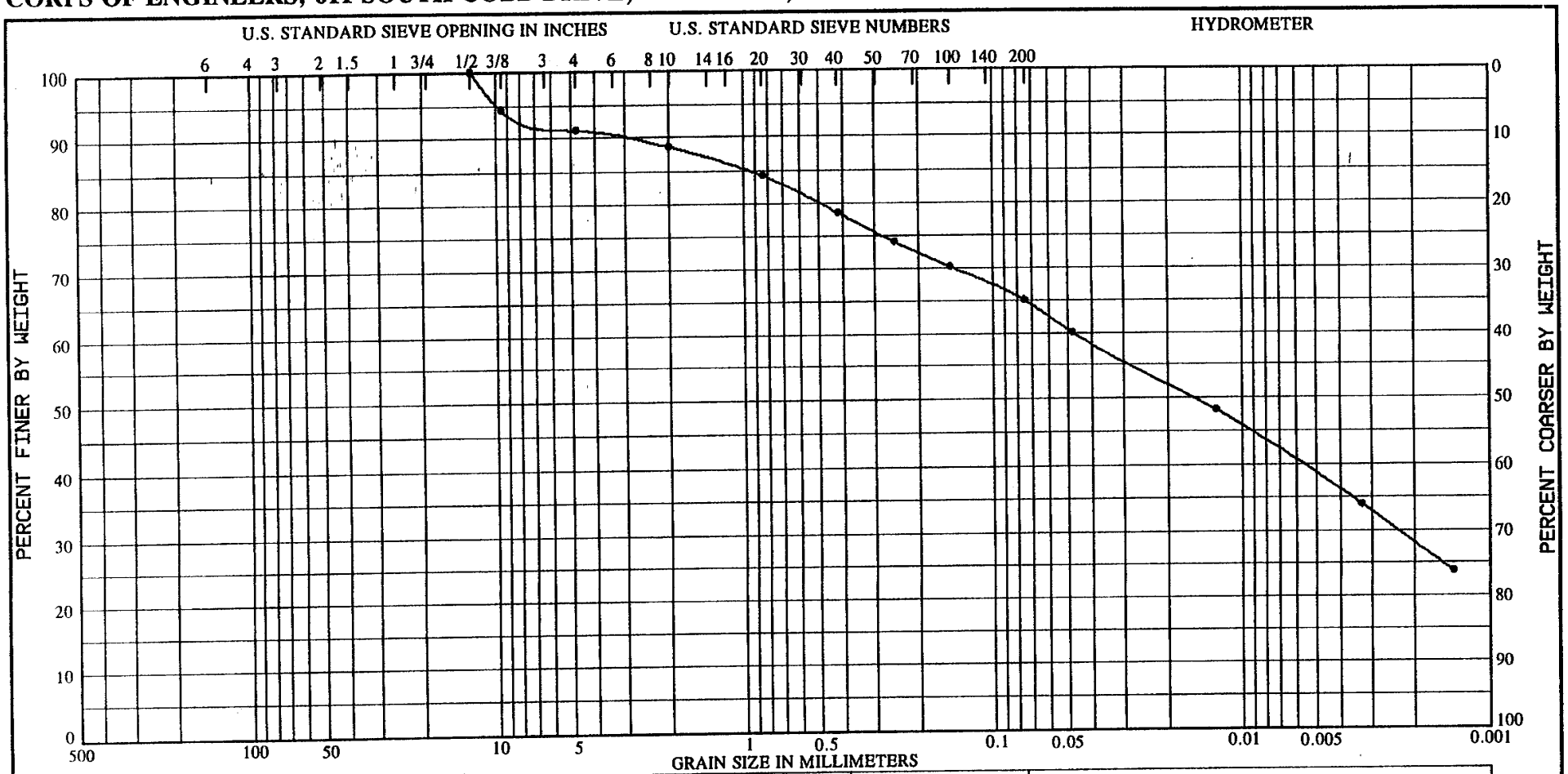
Boring No.: CB-PNM-45

Date: 06-27-90

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
1	22.5-24.5	GRAY & TAN, FAT CLAY (CH), WITH A TRACE OF GRAVEL SIZES AND SOME SAND SIZES.	46.9	84	21	63

Project RIO PUERTO NEUVO

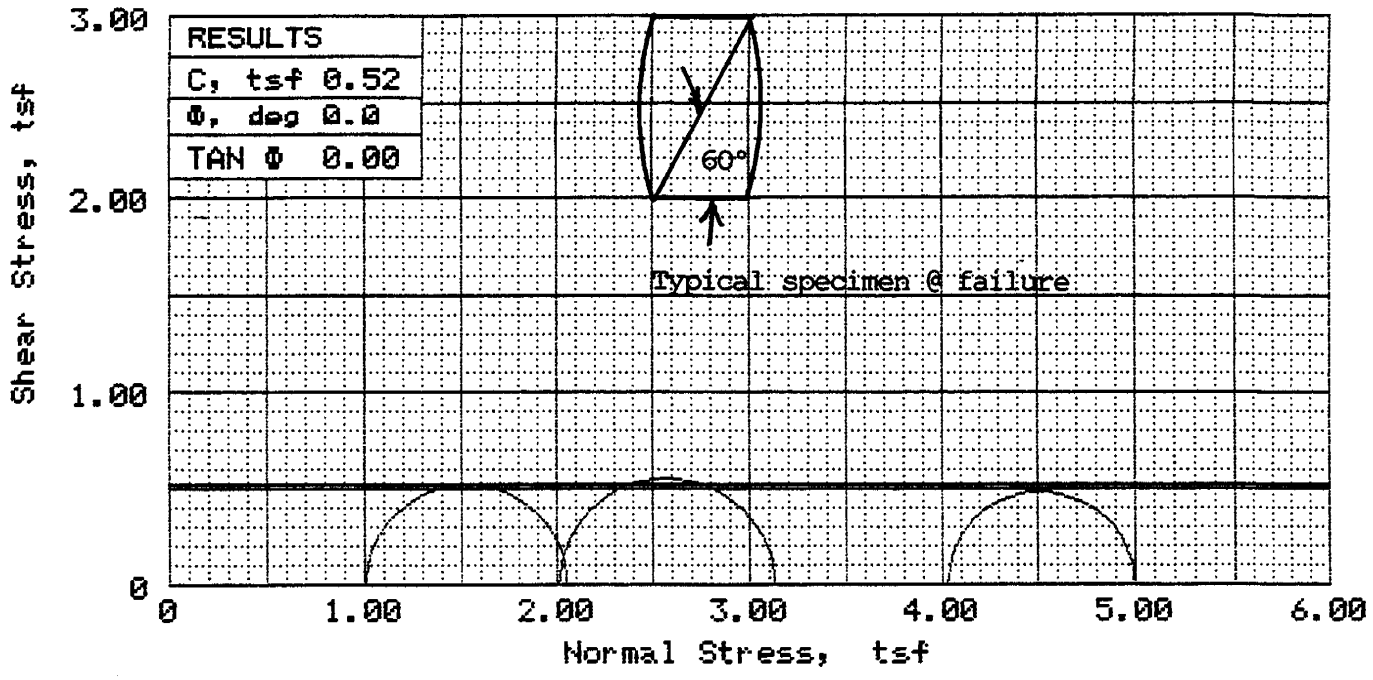
Lab No. 73/7147

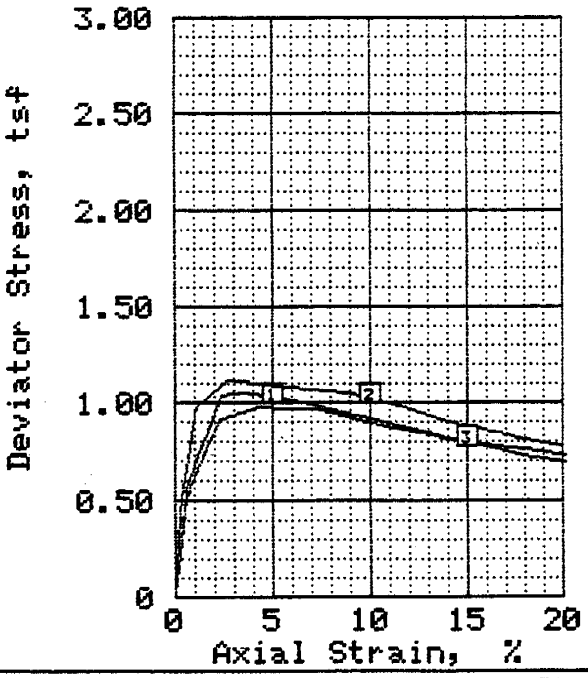
Boring No. CB-PNB-11U

Date 11/02/95

GRADATION CURVES

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	36.9	37.3	40.5
	DRY DENSITY, pcf	81.0	80.8	78.6
	SATURATION, %	90.4	90.9	93.7
	VOID RATIO	1.126	1.132	1.193
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	36.9	37.3	40.5
	DRY DENSITY, pcf	81.0	80.8	78.6
	SATURATION, %	90.4	90.9	93.7
	VOID RATIO	1.126	1.132	1.193
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		1.01	2.02	4.03
MAX. DEV. STRESS, tsf		1.05	1.12	0.97
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		5	4	6
RATE, %/min.		0.71	0.67	0.72
ULT. DEV. STRESS, tsf		0.79	0.87	0.80

DESCRIPTION GRAY & TAN, FAT CLAY (CH), WITH A TRACE OF GRAVEL SIZES AND SOME SAND SIZES.

LL= 84	PL= 21	PI= 63	Gs= 2.76	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Q

REMARKS

PROJECT RIO PUERTO NEUVO

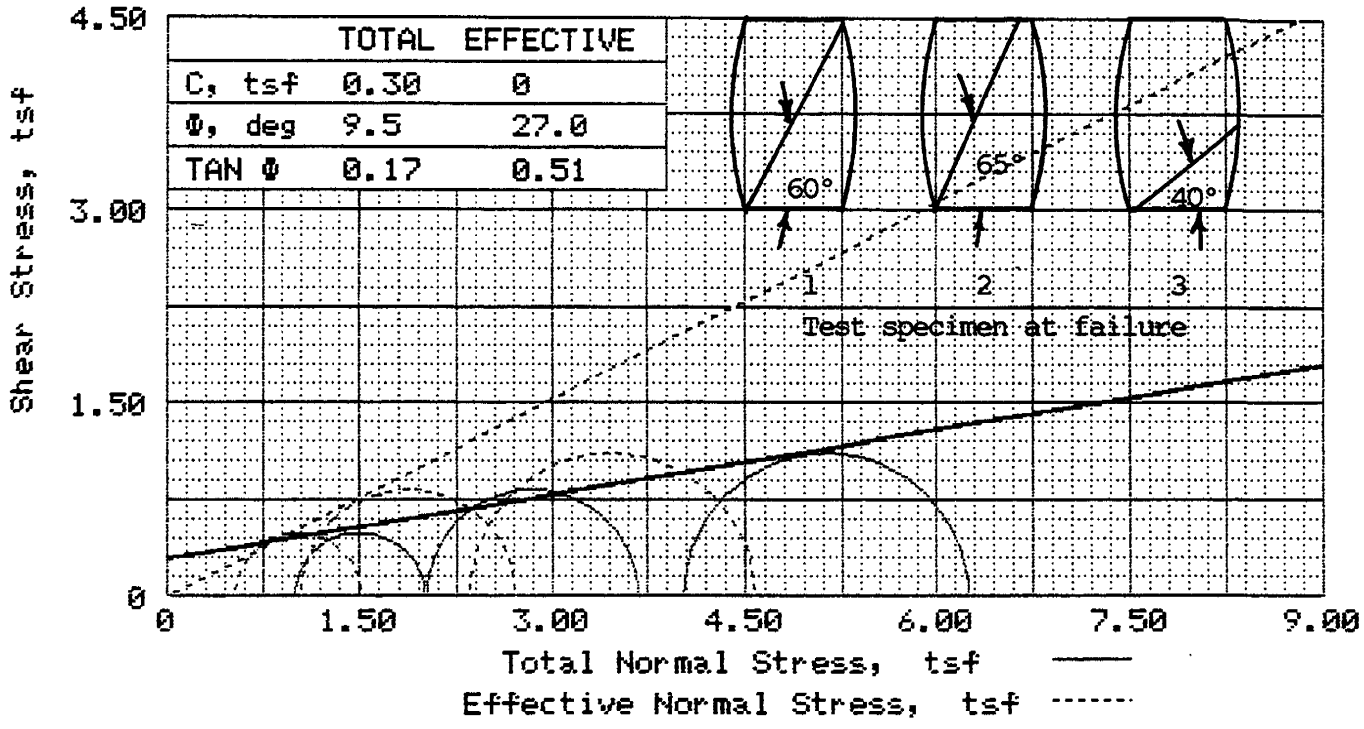
AREA

LAB NO. 73/7147

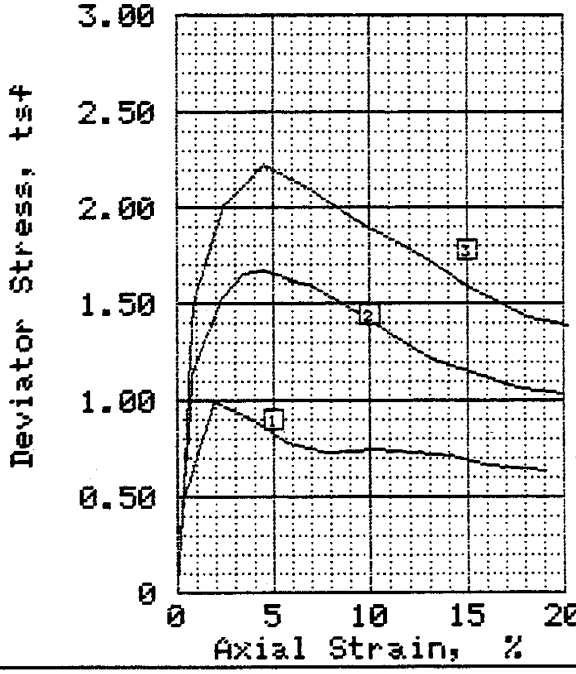
BORING NO. CB-PNB-11U
SAMPLE NO. 1
DEPTH/~~ELEV~~ 22.5 - 24.5
LABORATORY CESAD-EN-FL DATE 1 NOV. 1995

TRIAXIAL COMPRESSION TEST

SOIL ATLANTIC DIVISION LABORATORY, CORPS OF E ,NEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825



	TOTAL	EFFECTIVE
C, tsf	0.30	0
Φ, deg	9.5	27.0
TAN Φ	0.17	0.51



SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	41.8	42.5	49.5
	DRY DENSITY, pcf	77.8	76.4	70.4
	SATURATION, %	95.8	94.2	95.1
	VOID RATIO	1.192	1.231	1.422
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	38.5	37.3	38.7
	DRY DENSITY, pcf	83.1	84.4	82.9
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.052	1.019	1.056
	DIAMETER, in	1.35	1.33	1.30
	HEIGHT, in	3.01	2.98	2.92
BACK PRESSURE, tsf		5.04	5.04	5.04
INIT. EFF. STR., tsf		1.01	2.02	4.03
MAX. DEV. STRESS, tsf		0.99	1.66	2.22
PORE PRESSURE, tsf		0.48	0.96	1.68
TIME TO FAILURE, min.		25	45	45
RATE, %/min.		0.08	0.10	0.10
ULT. DEV. STRESS, tsf		0.69	1.15	1.59

DESCRIPTION GRAY & TAN, FAT CLAY (CH), WITH A TRACE OF GRAVEL SIZES AND SOME SAND SIZES.

LL= 84	PL= 21	PI= 63	Gs= 2.73	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST R w/pore pressures

REMARKS

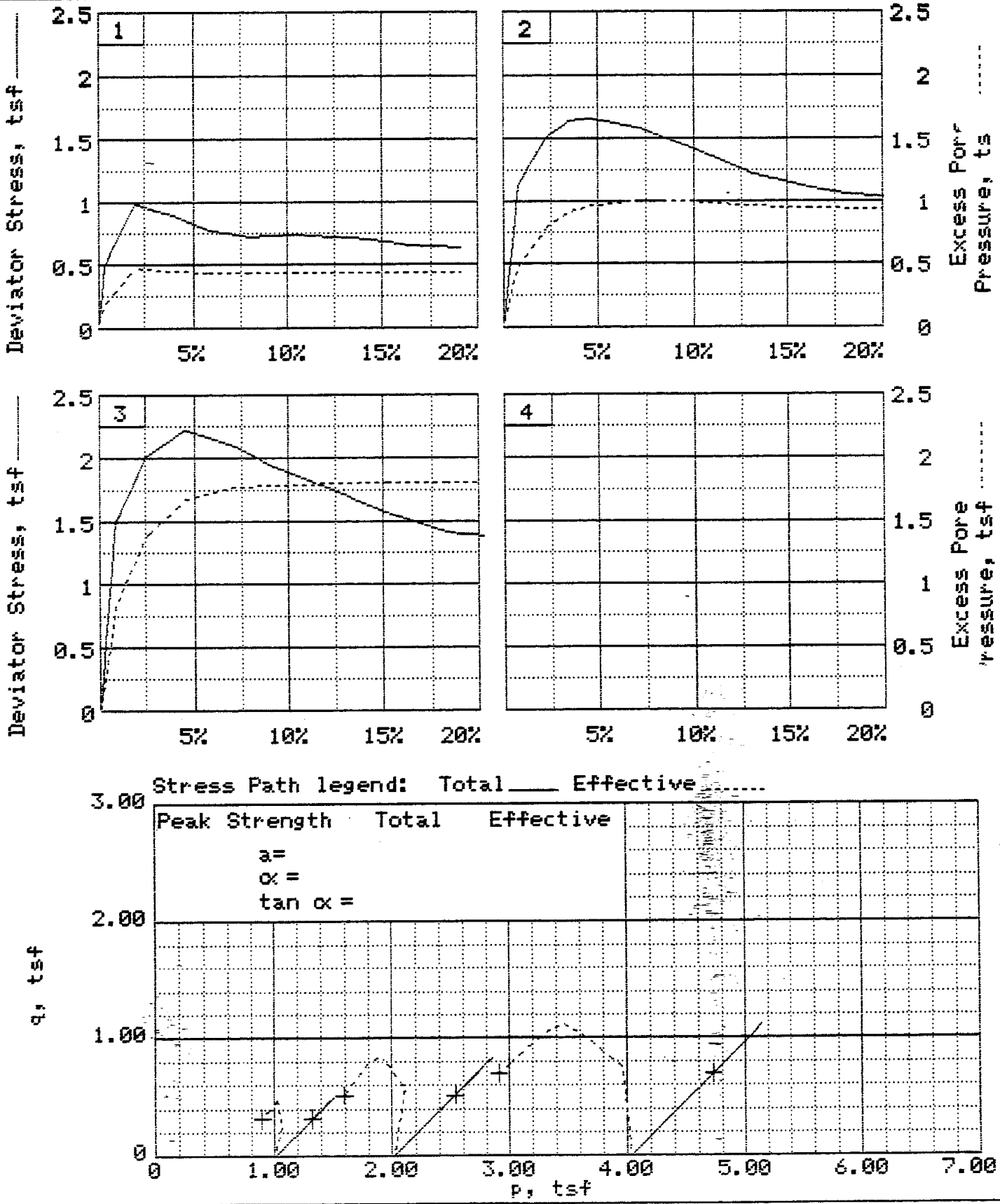
PROJECT RIO PUERTO NEUVO

AREA

LAB NO. 73/7147

BORING NO. CB-PNB-11U
SAMPLE NO. 1
DEPTH/ELEV 22.5 - 24.5'
LABORATORY CESAD-EN-FL DATE 28 OCT. 1995

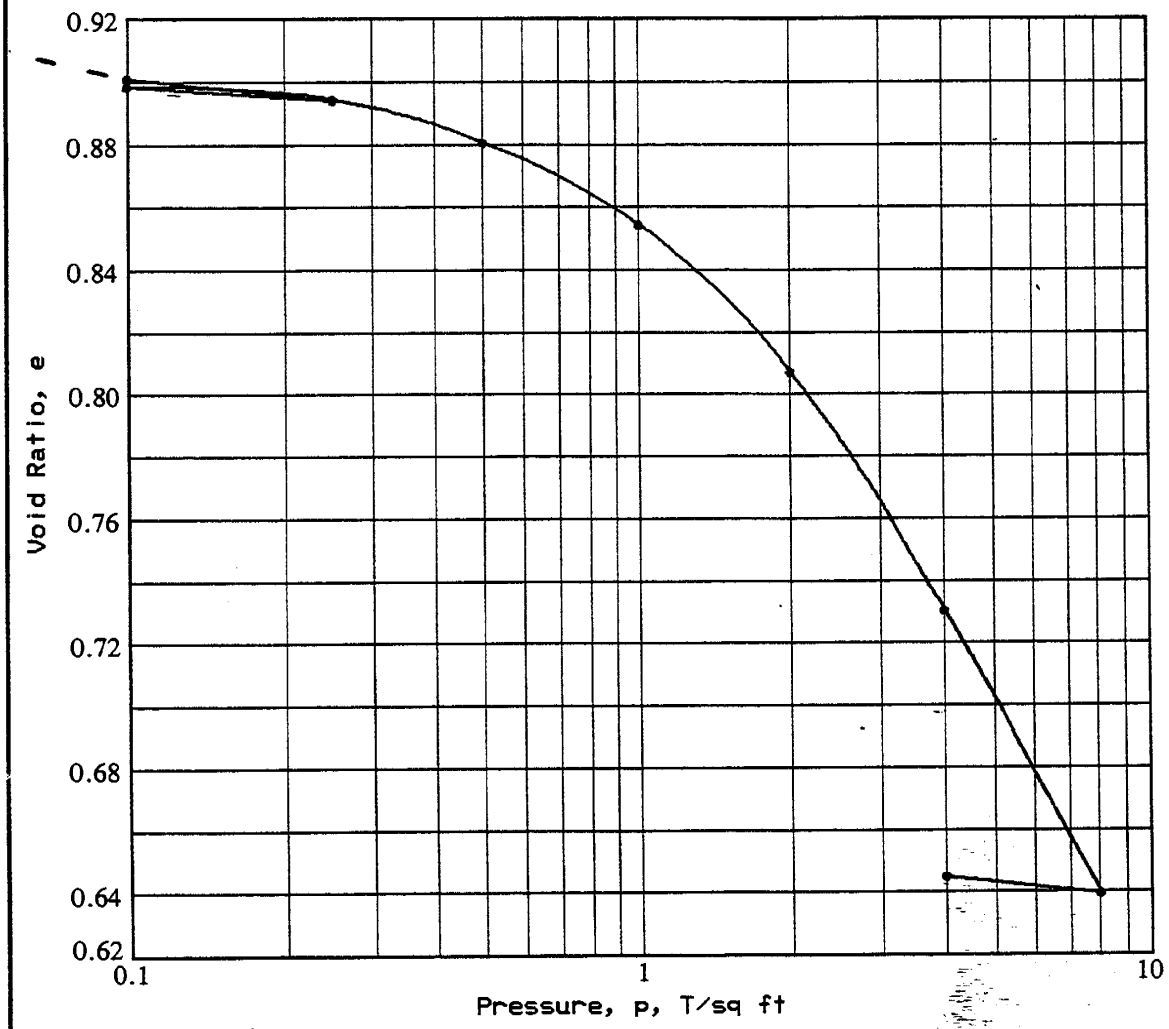
SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825



PROJECT RIO PUERTO NEUVO
BORING CB-PNB-11U SAMPLE 1 DEPTH/ELEV 22.5 - 24.5'
TYPE OF TEST R w/pore pressures LAB NO. 73/7147
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 28 OCT. 1995

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038



Type of Specimen UNDISTURBED			Before Test			After Test	
Diam. 3.980 in.	Height 1.250 in.	Water Content	w_o	33.0 %	w_f	23.4 %	
Overburden Pressure, p_o T/sq ft		Void Ratio	e_o	0.909	e_f	0.645	
Preconsol. Pressure, p_c T/sq ft		Saturation	S_o	100.0 %	S_f	100.0 %	
Compression Index, C_c		Dry Density	γ_d	90.2 lb/ft^3			

Classification GRAY & TAN, FAT CLAY (CH), WITH A TRACE OF GRAVEL AND SOME SAND.

LL	84	G_s	2.76
PL	21	D_{10}	< 0.002 MM

Project RIO PUERTO NEUVO

Remarks 1. SPECIMEN FLOODED THROUGHOUT TEST. 2. TIME CURVES FURNISHED FOR LOADS OF 0.50, 1.0, 2.0 AND 4.0 T/SF.

Lab No. 73/7147

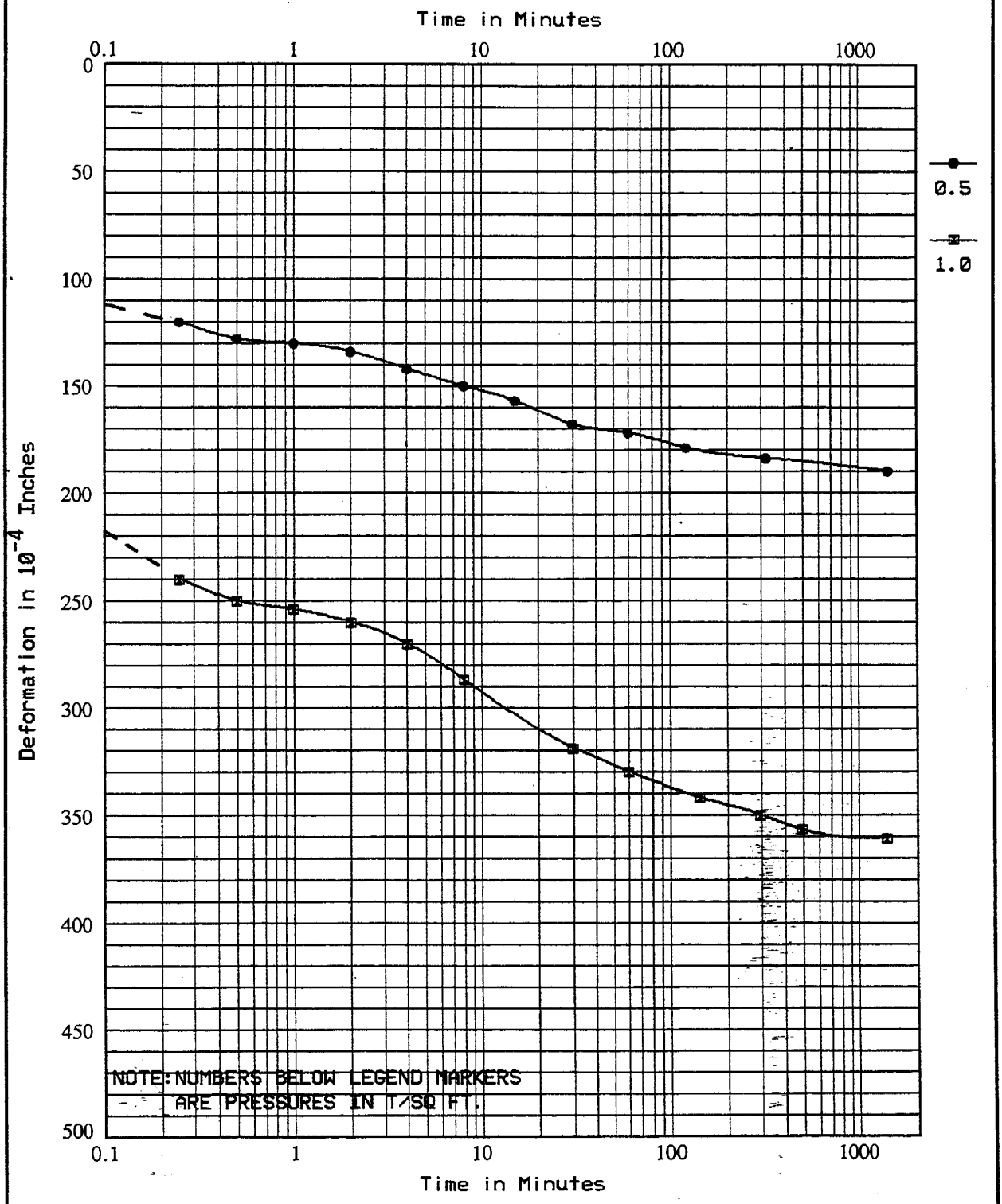
Boring No. CB-PNB-11U | Sample No. 1

Depth (ft) 22.5-24.5 | Date 03/21/96

CONSOLIDATION TEST REPORT

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038

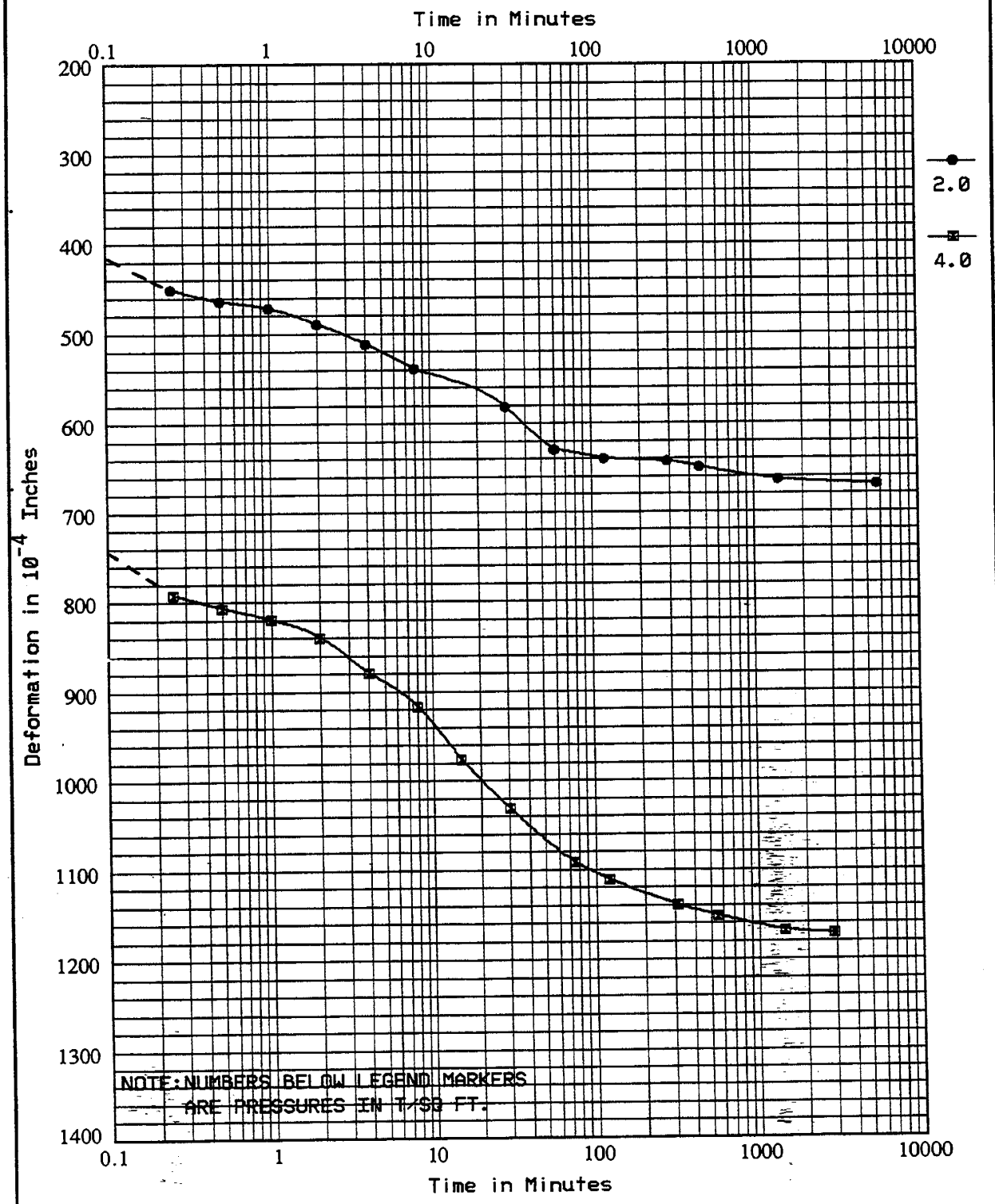


Project RIO PUERTO NEUVO			
Area			Lab No. 73/7147
Boring No. CB-PNB-11U	Sample No. 1	Depth (ft) 22.5-24.5	Date 03/19/96

CONSOLIDATION TEST - TIME CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

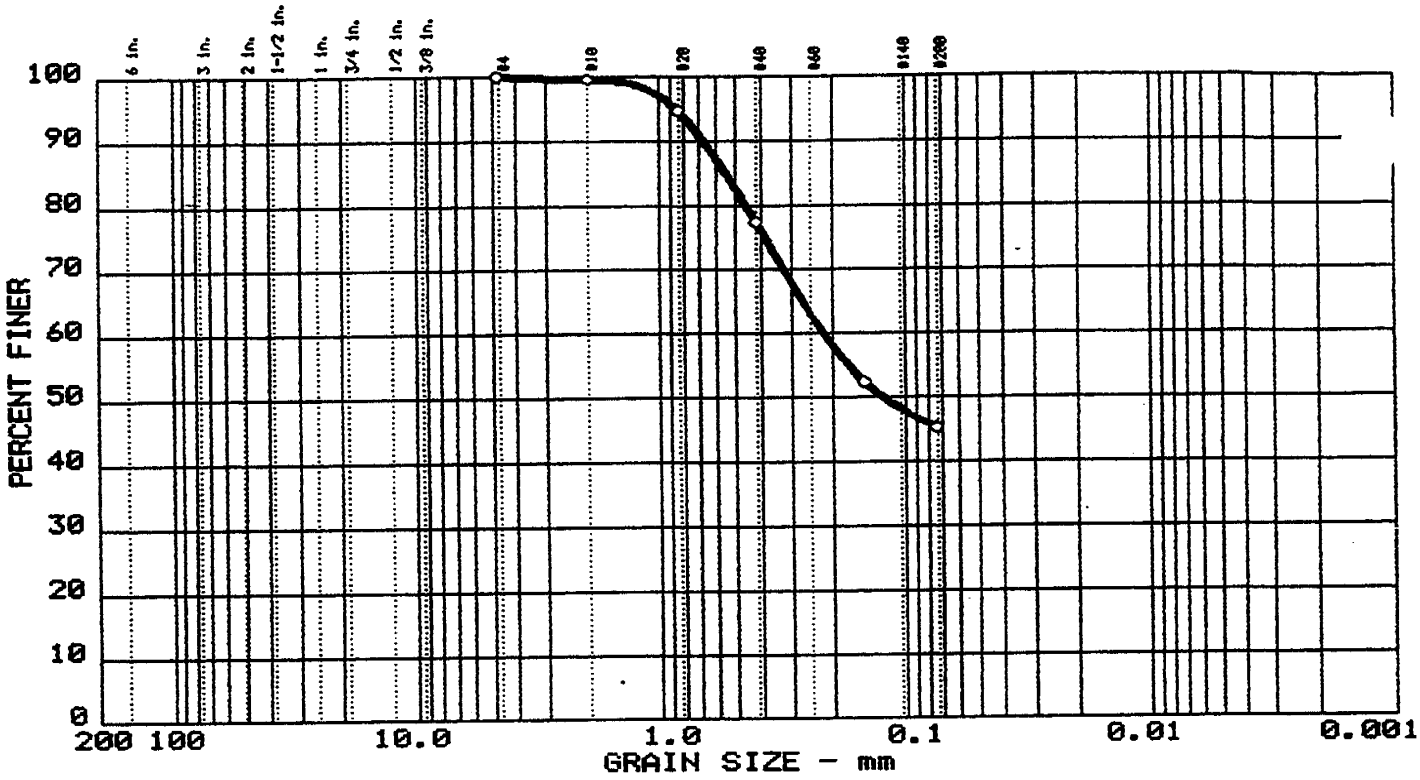
WORK ORDER: 7825
REQUSITION: RM-CW-96-0038



Project RIO PUERTO NEUVO			
Area			Lab No. 73/7147
Boring No. CB-PNB-11U	Sample No. 1	Depth (ft) 22.5-24.5	Date 03/19/96

CONSOLIDATION TEST - TIME CURVES

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	54.7	45.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	
o	41	15	0.55	0.22	0.12					

MATERIAL DESCRIPTION	USCS	AASHTO
o SAND,SILTY,FINE TO MEDIUM GRANED,PALE BROWNISH	SM	A-7-6(4)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

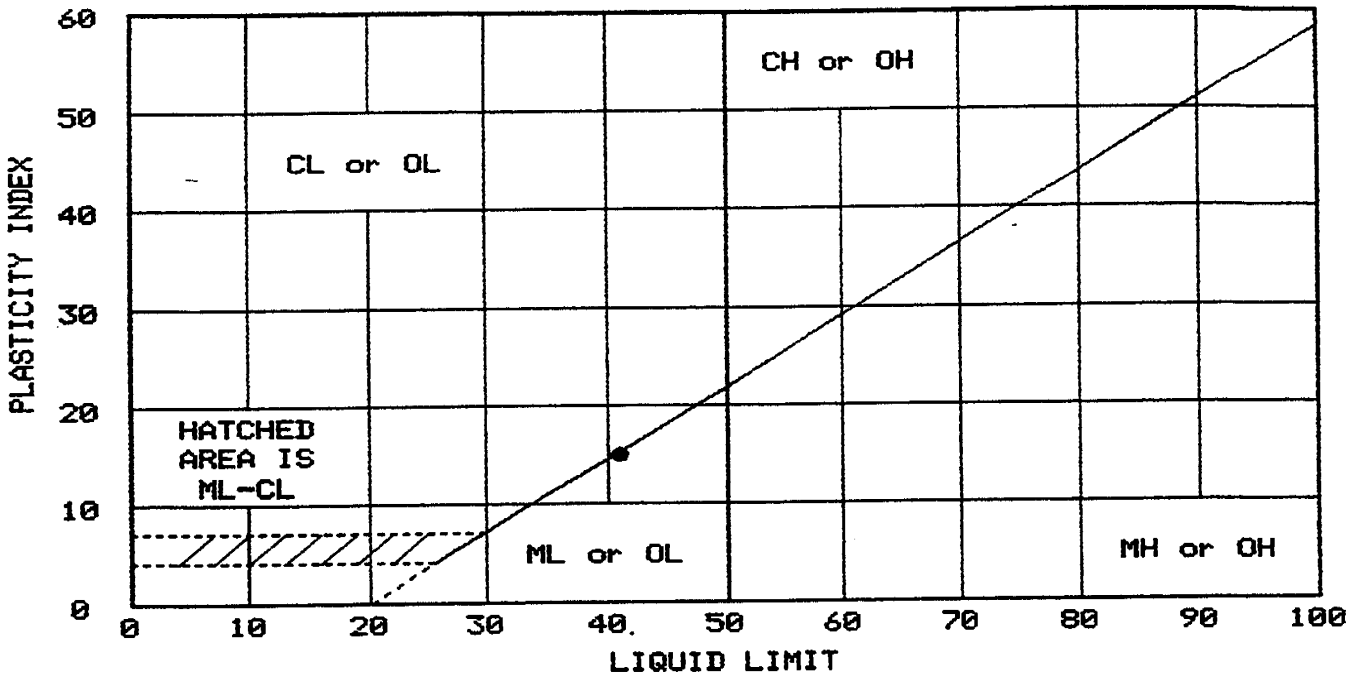
Date: 01-11-96

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNB-11D
SAMPLE. 32
NAT. MOIST. 22%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SAND,SILT,FINE TO MEDIUM GRAINED,PALE BROWNISH YELLOW	41	26	15	45.3	SM	A-7-6(4)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

Date: 01-11-96

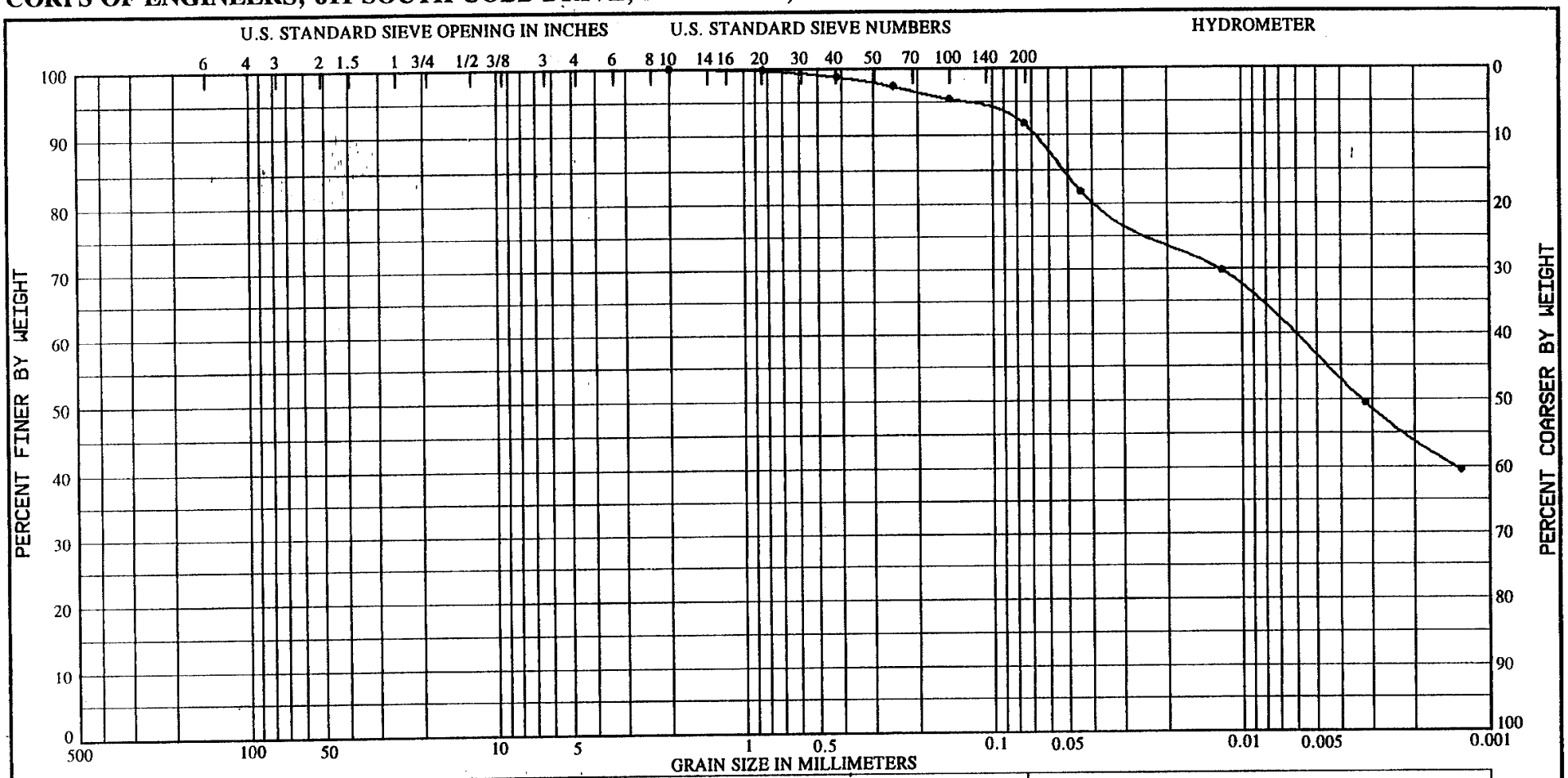
LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNB-11D
SAMPLE. 32

Fig. No.____

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION:RM-CW-96-0038



Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
1	11.0-13.0	TAN, FAT CLAY (CH), WITH A TRACE OF SAND	40.5	72	31	41
		SIZES.				

Project RIO PUERTO NEUVO

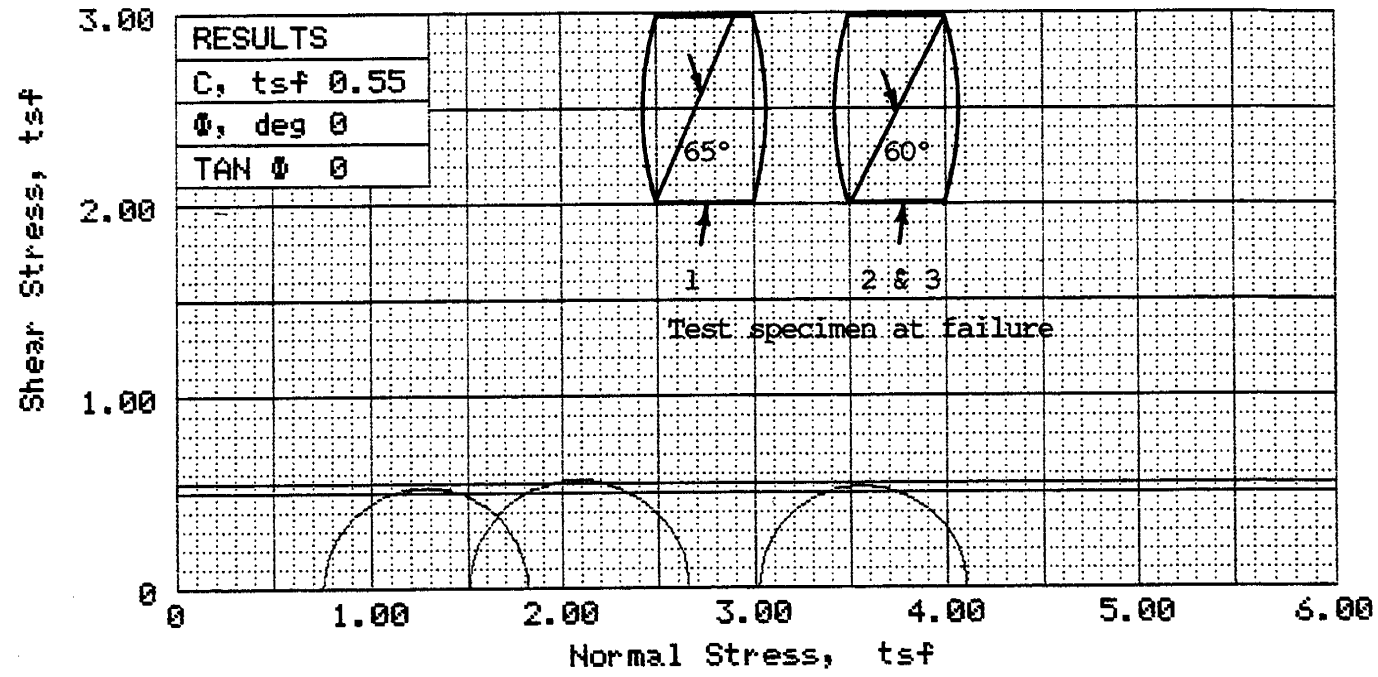
Lab No. 73/7148

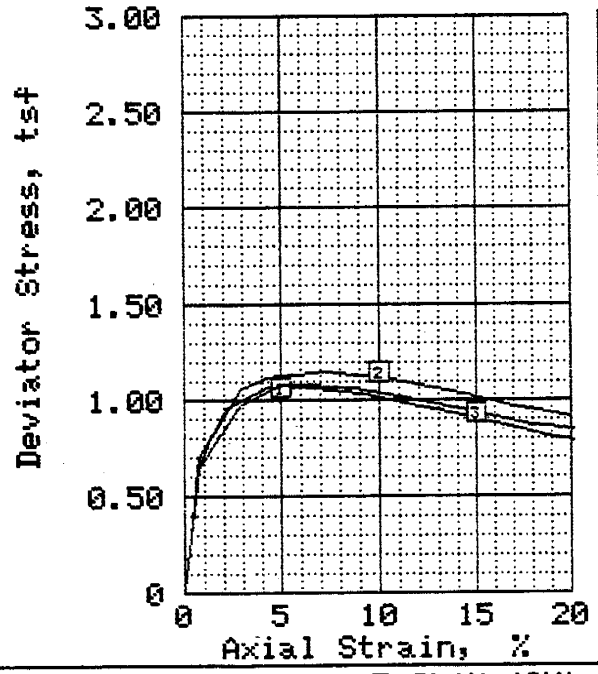
Boring No. CB-PNB-13A U

Date 11/02/95

GRADATION CURVES

SOU ATLANTIC DIVISION LABORATORY, CORPS OF E MEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	40.5	41.0	41.4
	DRY DENSITY, pcf	78.1	78.2	78.0
	SATURATION, %	93.4	94.9	95.3
	VOID RATIO	1.183	1.181	1.186
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	40.5	41.0	41.4
	DRY DENSITY, pcf	78.1	78.2	78.0
	SATURATION, %	93.4	94.9	95.3
	VOID RATIO	1.183	1.181	1.186
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		0.76	1.51	3.02
MAX. DEV. STRESS, tsf		1.07	1.15	1.07
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		6	10	7
RATE, %/min.		0.74	0.73	0.71
ULT. DEV. STRESS, tsf		0.90	1.01	0.94

DESCRIPTION TAN, FAT CLAY (CH), WITH A TRACE OF SAND-SIZES.

LL= 72	PL= 31	PI= 41	Gs= 2.73	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Q

REMARKS

PROJECT RIO PUERTO NEUVO

AREA

LAB NO. 73/7148

BORING NO. CB-PNB-13AU

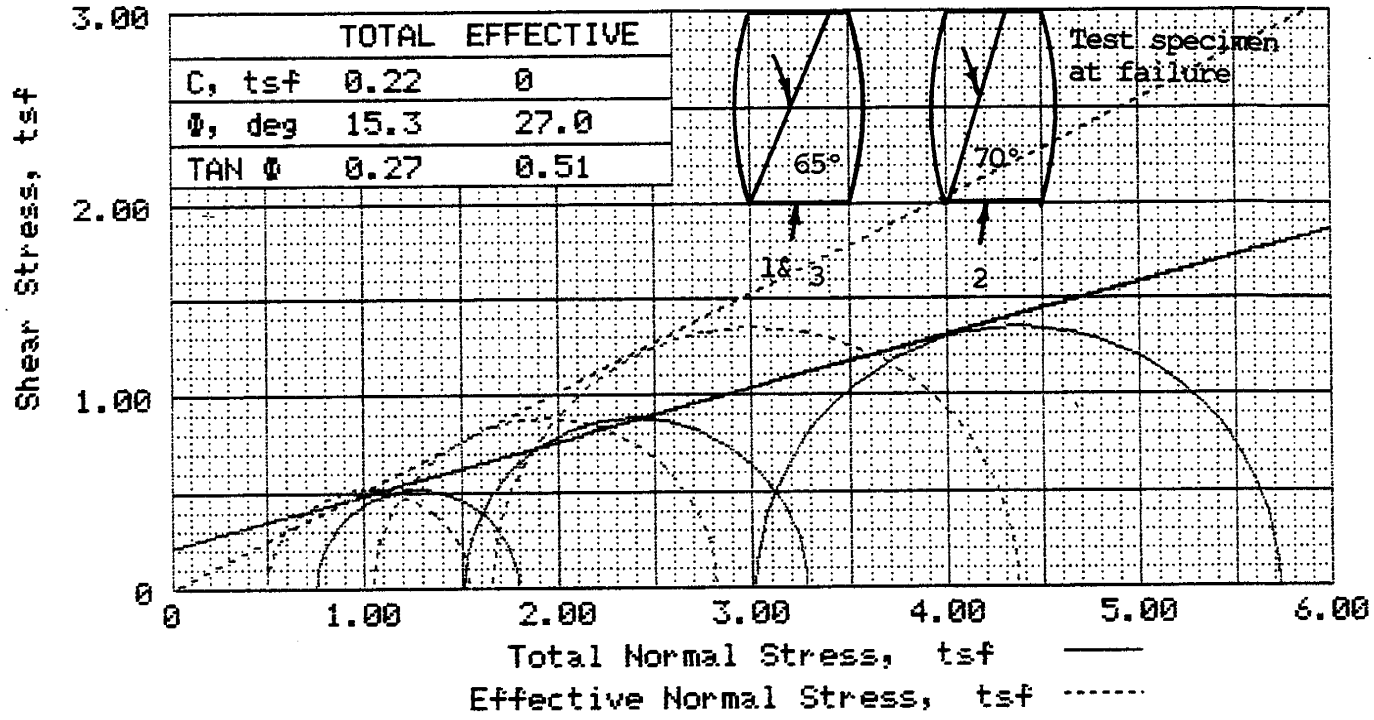
SAMPLE NO. 1

DEPTH/~~ELEV~~ 11.0 - 13.0'

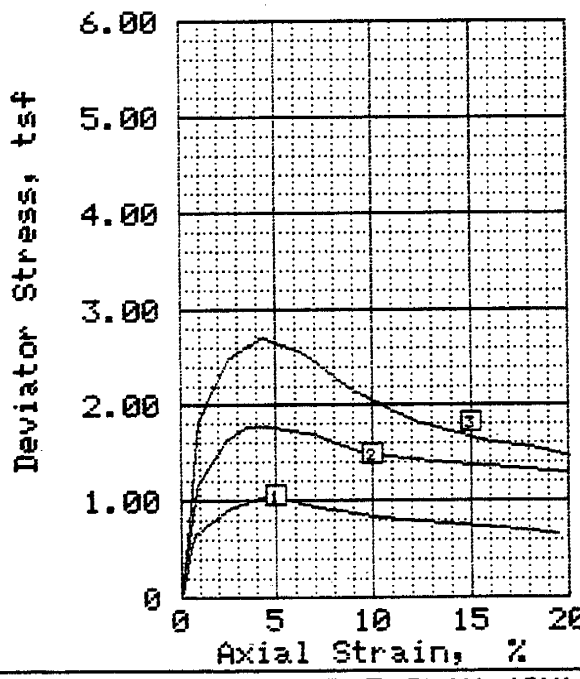
LABORATORY CESAD-EN-FL DATE 28 OCT. 1995

TRIAXIAL COMPRESSION TEST

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825



	TOTAL	EFFECTIVE
C, tsf	0.22	0
Φ, deg	15.3	27.0
TAN Φ	0.27	0.51



SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	42.3	41.1	43.3
	DRY DENSITY, pcf	77.1	78.2	76.3
	SATURATION, %	95.5	95.1	95.9
	VOID RATIO	1.211	1.181	1.235
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	42.6	39.3	39.0
	DRY DENSITY, pcf	78.8	82.2	82.6
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.164	1.073	1.064
	DIAMETER, in	1.37	1.35	1.34
	HEIGHT, in	3.06	3.03	3.00
BACK PRESSURE, tsf		5.04	5.04	5.04
INIT. EFF. STR., tsf		0.76	1.51	3.02
MAX. DEV. STRESS, tsf		1.04	1.77	2.70
PORE PRESSURE, tsf		0.25	0.46	1.36
TIME TO FAILURE, min.		60	45	45
RATE, %/min.		0.08	0.10	0.10
ULT. DEV. STRESS, tsf		0.74	1.36	1.65

DESCRIPTION TAN, FAT CLAY (CH), WITH A TRACE OF SAND-SIZES.

LL= 72	PL= 31	PI= 41	Gs= 2.73	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST R w/pore pressures

REMARKS

PROJECT RIO PUERTO NUEVO

AREA

LAB NO. 73/7148

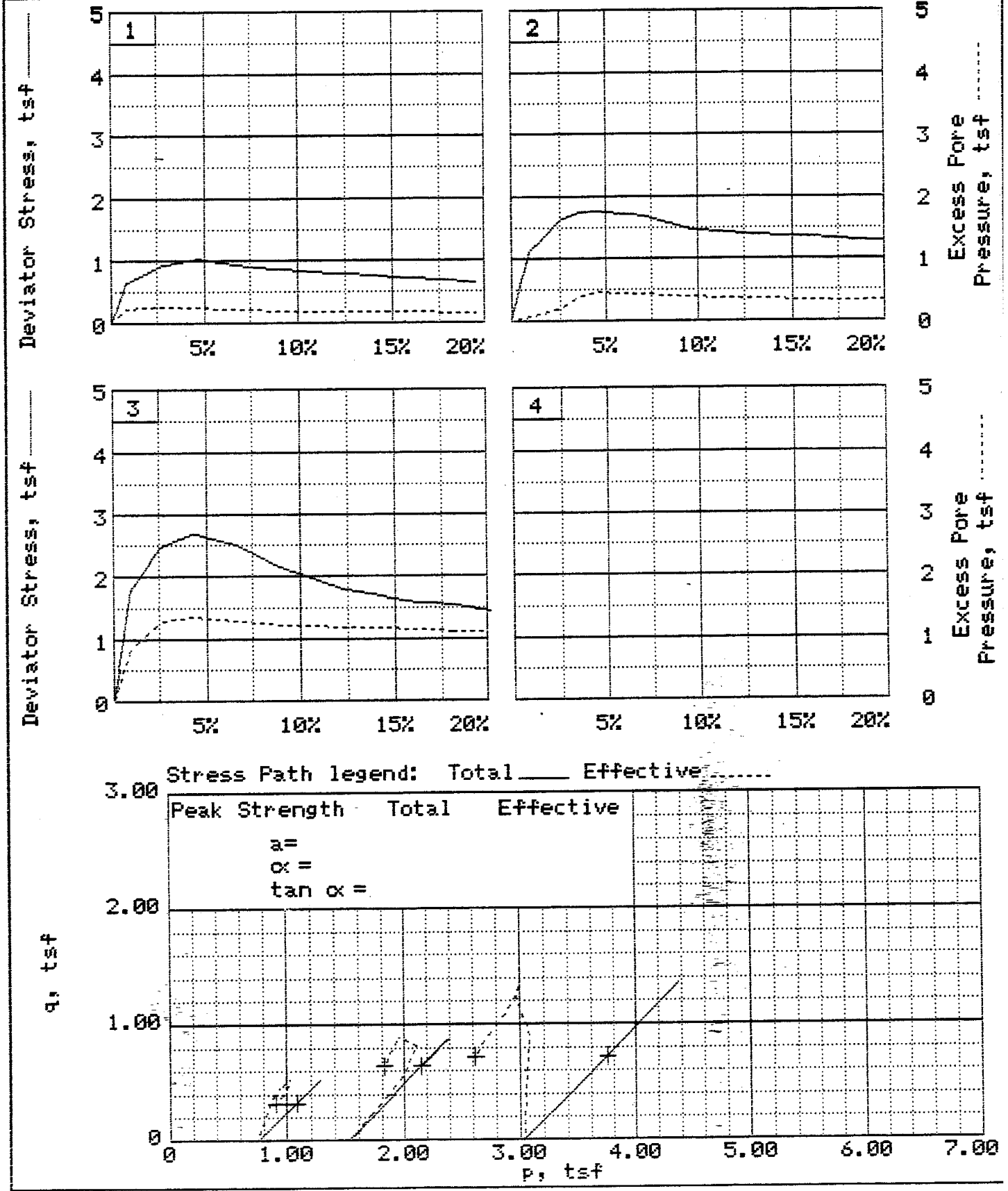
BORING NO. CB-PNB-13A/U

SAMPLE NO. 1

DEPTH/~~ELEV~~ 11.0 - 13.0'

LABORATORY CESAD-EN-FL DATE 3 NOV. 1995

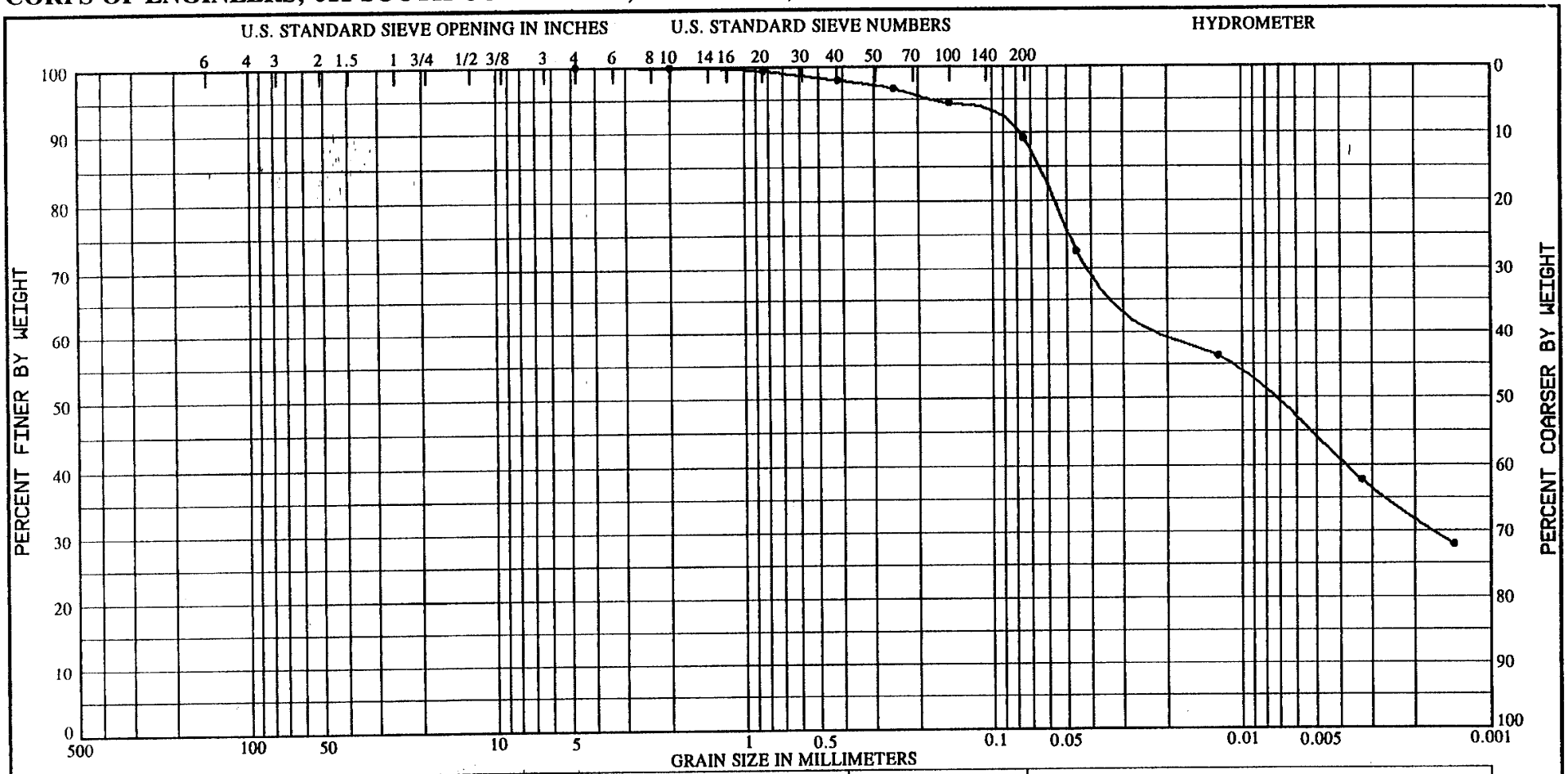
SOU... ATLANTIC DIVISION LABORATORY, CORPS OF E. ..NEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825



PROJECT RIO PUERTO NEUVO
BORING CB-PNB-13 SAMPLE 1 DEPTH/ELEV 11.0 - 13.0'
TYPE OF TEST R w/pore pressures LAB NO. 73/7148
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 3 NOV. 1995

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
2	16.5-18.5	GRAYISH TAN, SILTY FAT CLAY (CH), WITH A LITTLE SAND SIZES.	39.6	59	30	29

Project RIO PUERTO NEUVO

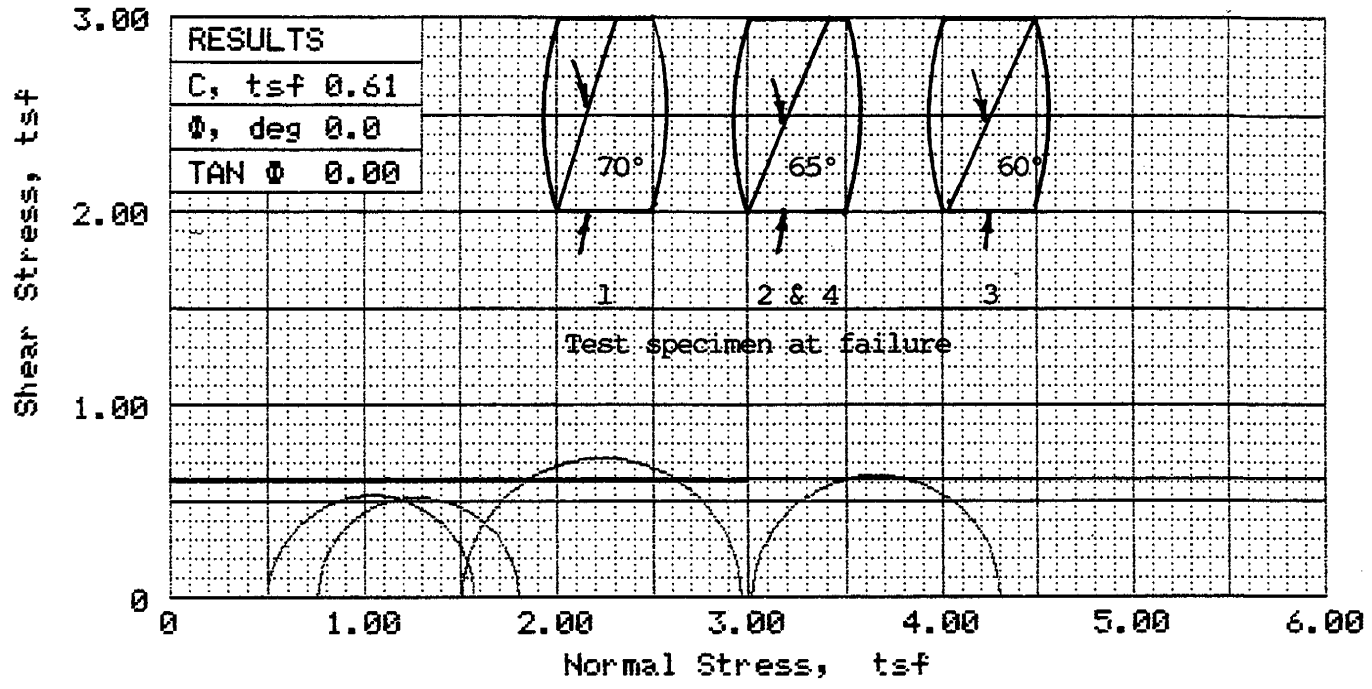
Lab No. 73/7149

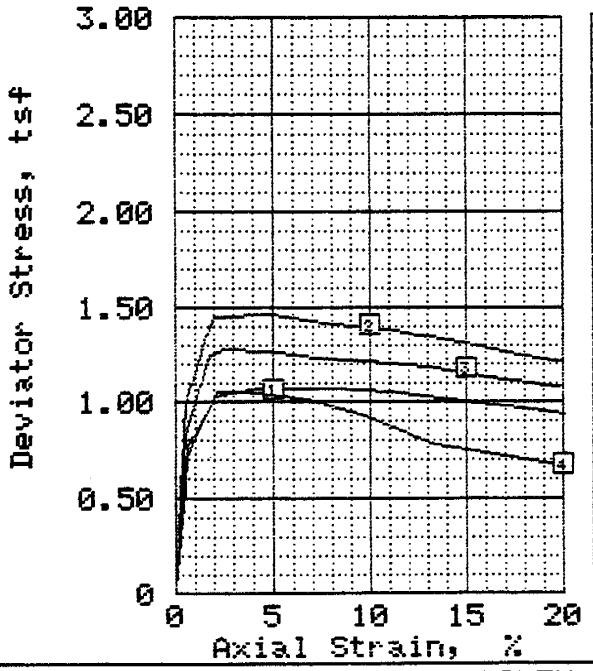
Boring No. CB-PNB-13U

Date 11/02/95

GRADATION CURVES

SOIL ATLANTIC DIVISION LABORATORY, CORPS OF L INEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3	4
INITIAL	WATER CONTENT, %	39.0	38.6	40.5	41.5
	DRY DENSITY, pcf	79.5	80.3	79.1	78.3
	SATURATION, %	93.2	93.8	95.8	96.2
	VOID RATIO	1.144	1.122	1.156	1.178
	DIAMETER, in	1.38	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	39.0	38.6	40.5	41.5
	DRY DENSITY, pcf	79.5	80.3	79.1	78.3
	SATURATION, %	93.2	93.8	95.8	96.2
	VOID RATIO	1.144	1.122	1.156	1.178
	DIAMETER, in	1.38	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00	0.00
INIT. EFF. STR., tsf		0.50	1.51	3.02	0.76
MAX. DEV. STRESS, tsf		1.07	1.46	1.28	1.05
PORE PRESSURE, tsf					
TIME TO FAILURE, min.		6	7	4	5
RATE, %/min.		0.71	0.71	0.63	0.71
ULT. DEV. STRESS, tsf		1.00	1.31	1.15	0.75

DESCRIPTION GRAYISH TAN, SILTY FAT CLAY (CH), WITH A LITTLE SAND SIZES.

LL= 59	PL= 30	PI= 29	Gs= 2.73	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Q

REMARKS

PROJECT RIO PUERTO NEUVO

AREA

LAB NO. 73/7149

BORING NO. CB-PNB-13 ~~A~~ U

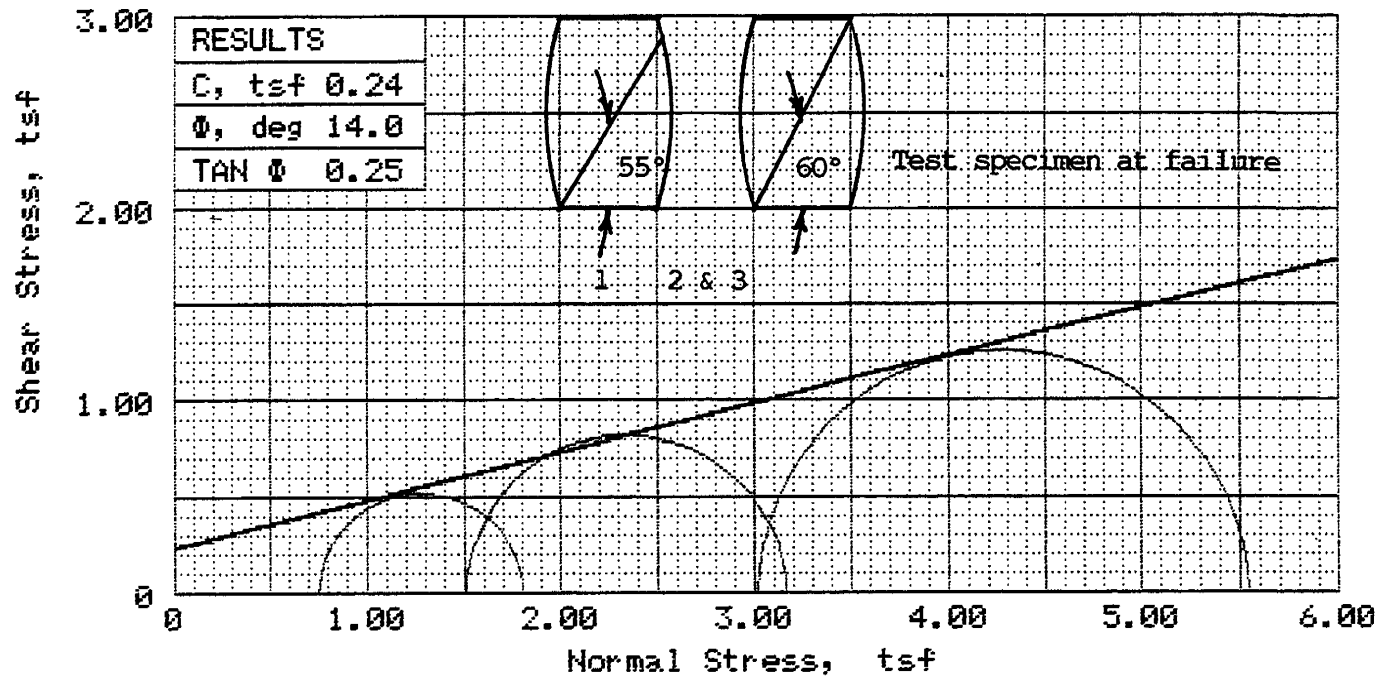
SAMPLE NO. 2

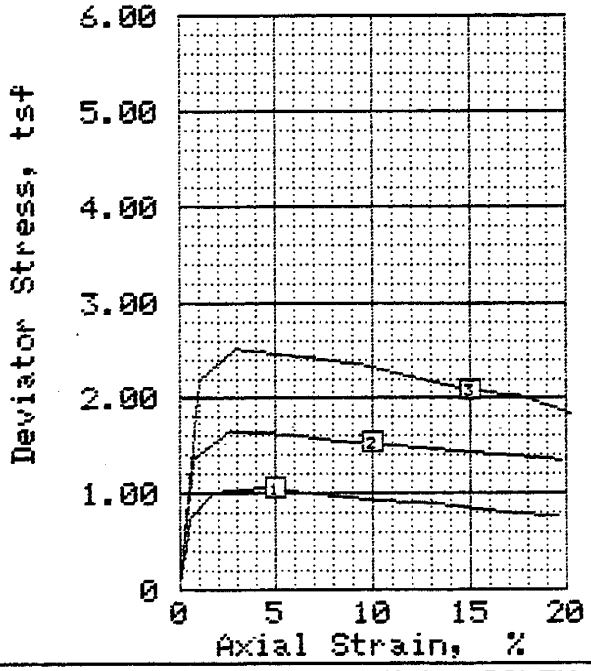
DEPTH/~~ELEV~~ 16.5 - 18.5'

LABORATORY CESAD-EN-FL DATE 28 OCT. 1995

TRIAXIAL COMPRESSION TEST

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	38.4	40.0	39.3
	DRY DENSITY, pcf	80.9	79.9	80.4
	SATURATION, %	94.6	96.3	95.8
	VOID RATIO	1.107	1.133	1.119
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	38.4	40.0	39.3
	DRY DENSITY, pcf	83.2	81.5	82.2
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.048	1.091	1.073
	DIAMETER, in	1.37	1.37	1.38
	HEIGHT, in	3.05	3.04	3.01
BACK PRESSURE, tsf		5.04	5.04	5.04
INIT. EFF. STR., tsf		0.76	1.51	3.02
MAX. DEV. STRESS, tsf		1.05	1.65	2.52
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		35	20	20
RATE, %/min.		0.12	0.13	0.15
ULT. DEV. STRESS, tsf		0.84	1.41	2.07

DESCRIPTION GRAYISH TAN, SILTY FAT CLAY (CH), WITH A LITTLE SAND SIZES.

LL= 59	PL= 30	PI= 29	Gs= 2.73	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST R

REMARKS

PROJECT RIO PUERTO NEUVO

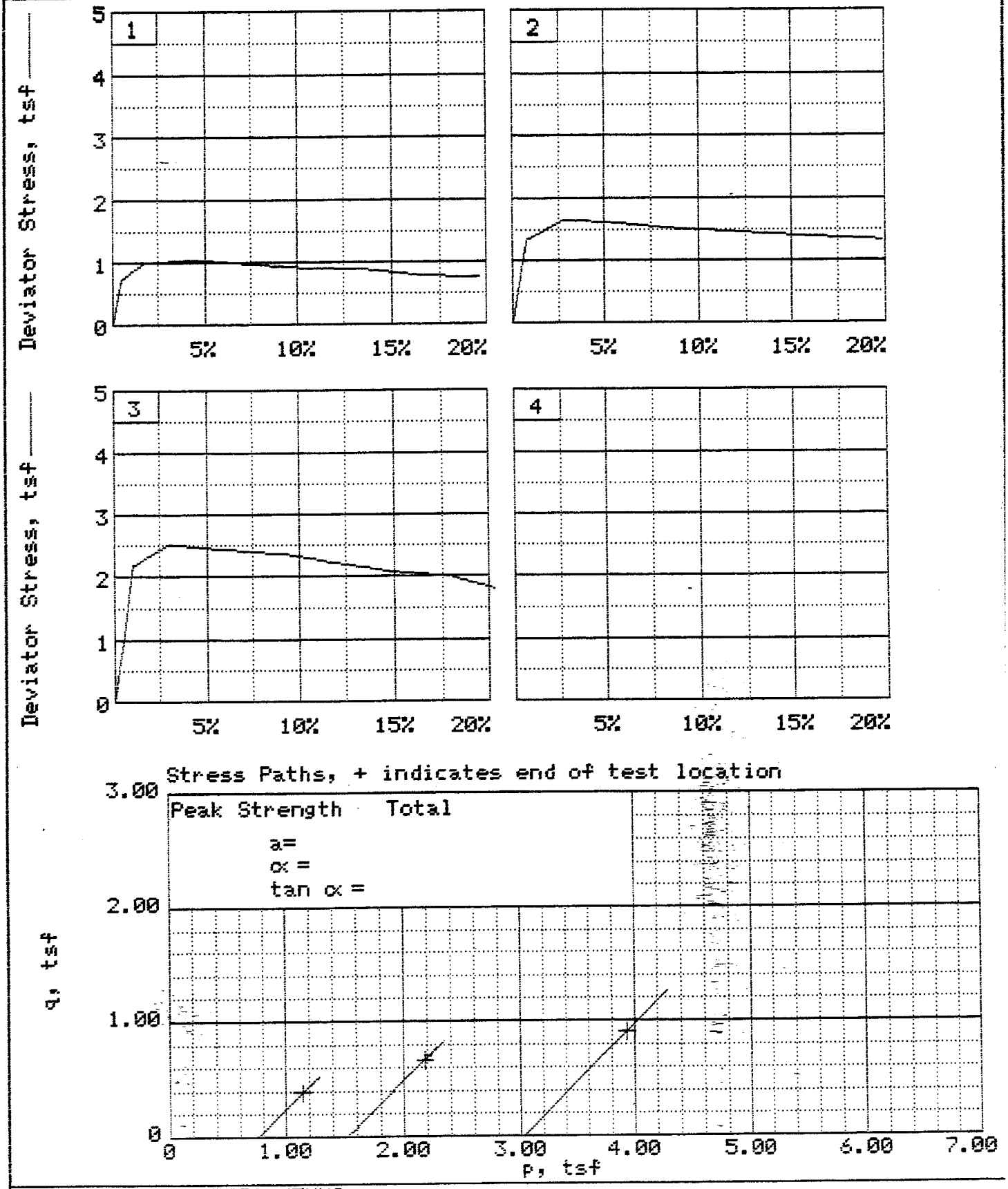
AREA

LAB NO. 73/7149

BORING NO. CB-PNB-13A U
SAMPLE NO. 2
DEPTH/~~ELEV~~ 16.5 - 18.5'
LABORATORY CESAD-EN-FL DATE 4 NOV. 1995

TRIAXIAL COMPRESSION TEST

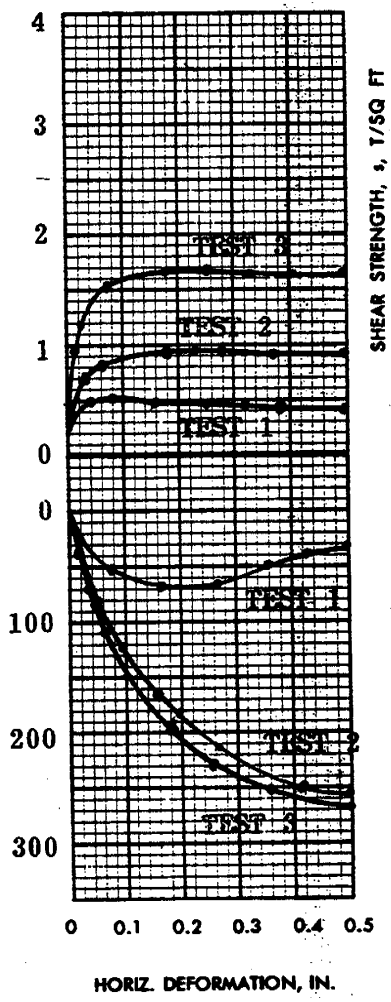
SOU ATLANTIC DIVISION LABORATORY, CORPS OF E NEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825

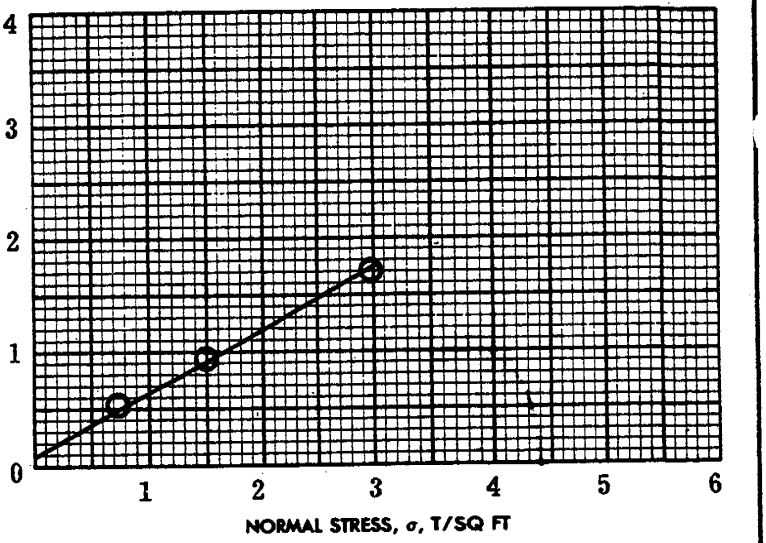


PROJECT RIO PUERTO NEUVO
BORING CB-PNB-13Ø/U SAMPLE 2 DEPTH/~~ELEV~~ 16.5 - 18.5'
TYPE OF TEST R LAB NO. 73/7149
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 4 NOV. 1995

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER NO. 7881
Req. No. RM-CW-96-0072





SHEAR STRENGTH PARAMETERS

$\phi' =$ 28.0

TAN $\phi' =$ 0.532

$c' =$ 0.10* T/SQ FT

*Apparent cohesion not recommended for design computation

☐ CONTROLLED STRESS
☒ CONTROLLED STRAIN

TEST NO.			1	2	3	
INITIAL	WATER CONTENT	w_o	40.8 %	40.1 %	42.2 %	%
	VOID RATIO	e_o	1.148	1.148	1.154	
	SATURATION	S_o	97.1 %	95.4 %	99.8 %	%
	DRY DENSITY, LB/CU FT	γ_d	79.3	79.3	79.1	
VOID RATIO AFTER CONSOLIDATION		e_c	0.746	0.715	0.639	
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	<1.0	<1.0	<1.0	
FINAL	WATER CONTENT	w_f	39.7 %	34.7 %	31.1 %	%
	VOID RATIO	e_f	1.084	.946	.850	
	SATURATION	S_f	100.0 %	100.0 %	100.0 %	%
NORMAL STRESS, T/SQ FT		σ	0.75	1.50	3.00	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.52	0.93	1.67	
ACTUAL TIME TO FAILURE, MIN		t_f	105	420	210	
RATE OF STRAIN, IN./MIN			0.001	0.001	0.001	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}	0.45	0.90	1.63	

TYPE OF SPECIMEN Undisturbed — 3.0 IN. SQUARE — 0.48 IN. THICK

CLASSIFICATION Grayish Tan, Silty Fat Clay (CH) with a little sand sizes.

LL	PL	PI		G_s
59	30	29	-	2.73

REMARKS

PROJECT Rio Puerto Neuvo

Lab No. 73/7149

AREA

BORING NO. CB-PNB-13~~A~~U — SAMPLE NO. 2

DEPTH ~~XX~~ 16.5-18.5' — DATE 26 Feb 96

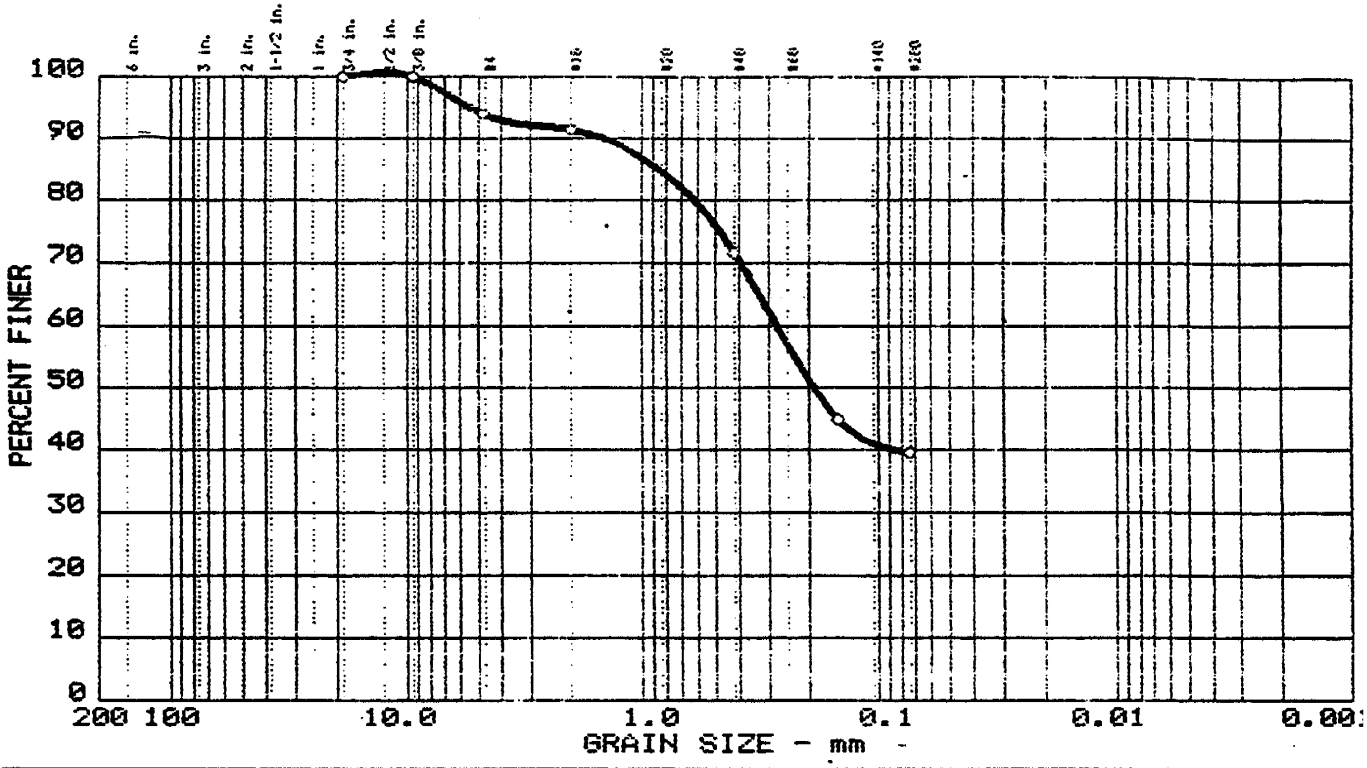
DIRECT SHEAR TEST REPORT

ENG FORM 2092 1 JUN 65 (EM 1110-2-1906) PREVIOUS EDITIONS ARE OBSOLETE

GPO : 1966 OP—214-945

PLATE IX-3

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	6.1	54.4	39.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	40	19	0.84	0.28	0.19					

	MATERIAL DESCRIPTION	USCS	AASHTO
o	CLAYEY SAND, TRACE GRAVEL, LIGHT GREEN	SC	A-6(3)

Project No.:
Project: RIO PUERTO NUEVO
o Location: BOR. CB-PNB-13DSAMPLE. 2

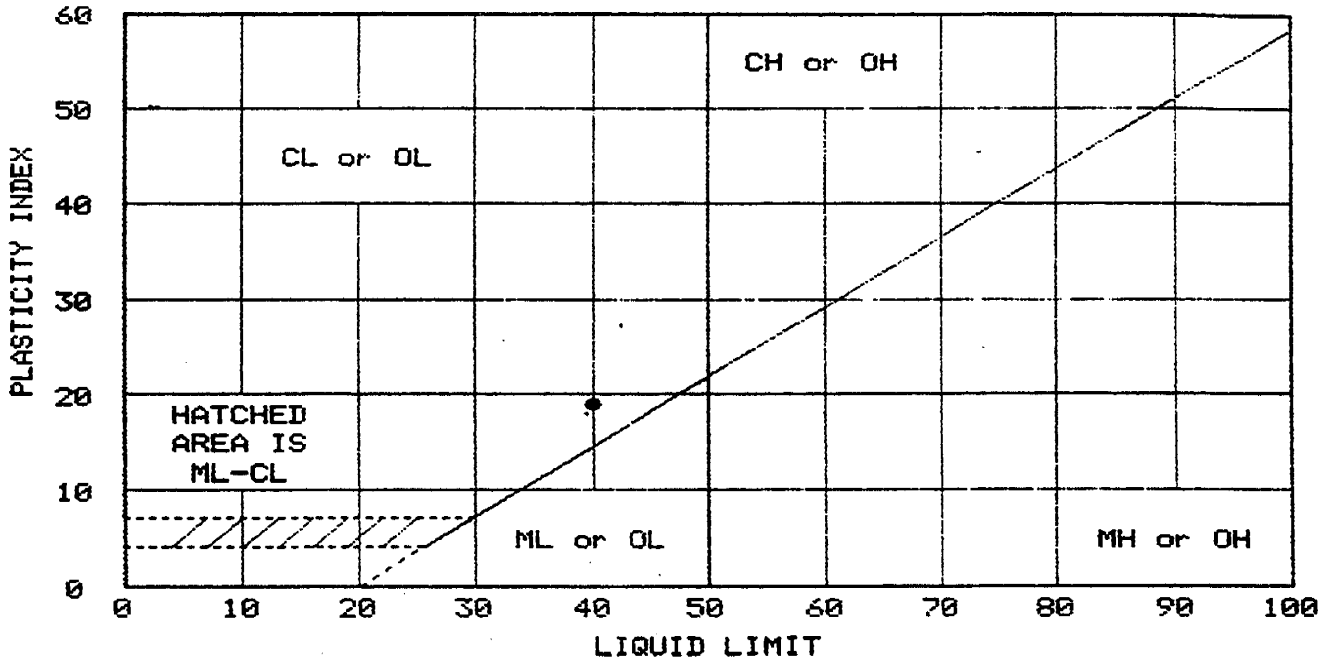
Date: 10-31-95

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
NAT. MOIST: 25%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAYEY SAND, TRACE GRAVEL, & LIGHT GREEN	40	21	19	39.5	SC	A-6(3)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: SAN JUAN P.R.

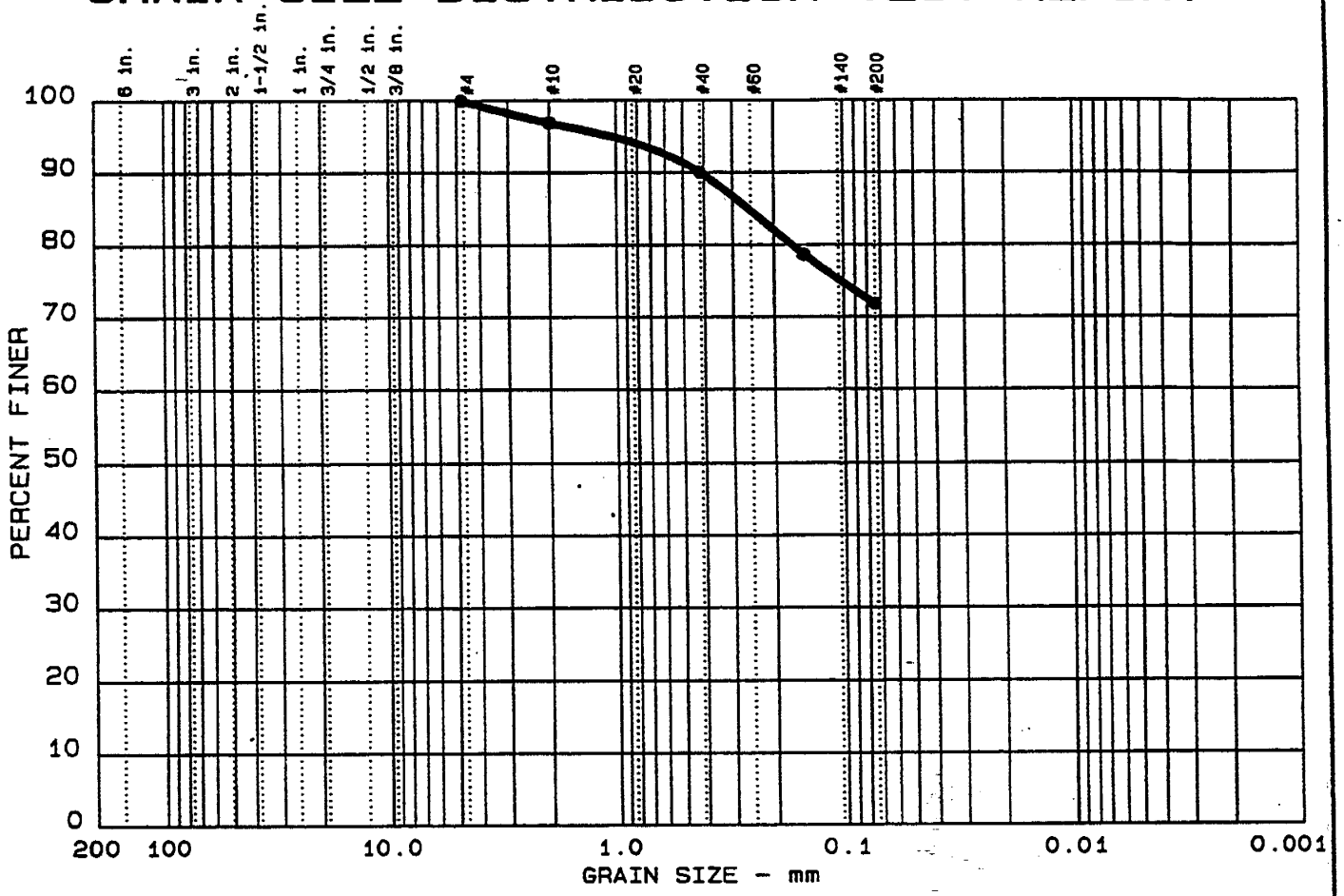
Date: 10-31-95

Remarks:
BOR. CB-PNB-13D
SAMPLE: 2
NAT. MOIST: 25%

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Fig. No.____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	28.2	71.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	52	24	0.26							

MATERIAL DESCRIPTION	USCS	AASHTO
● **CLAY, SOME SAND, OLIVE AND GRAY**	CH	A-7-6 (18)

Project No.:
Project: USACE RIO PUERTO NUEVO PROJECT
● Location: BOR. CB-PNB-61, SAMPLE 7

Date: 11-01-95

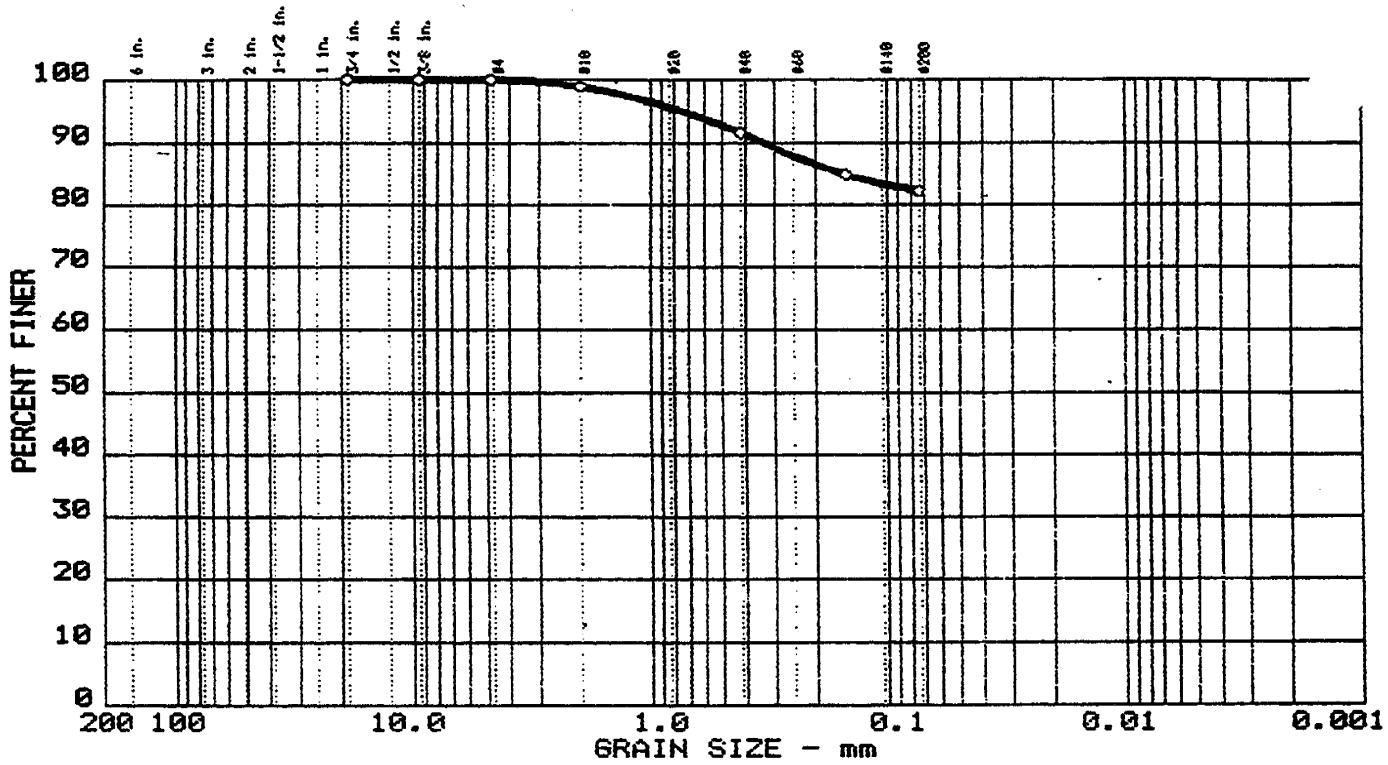
Remarks:
NAT. **MOIST.**: 24%

GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	17.7	82.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	102	72	0.15							

MATERIAL DESCRIPTION	USCS	AASHTO
o CLAY, LITTLE SAND, LIGHT GRAY	CH	A-7-5(66)

Project No.:
Project: RIO PUERTO NUEVO
o Location: BOR. CB-PNB-61 SAMPLE. 13

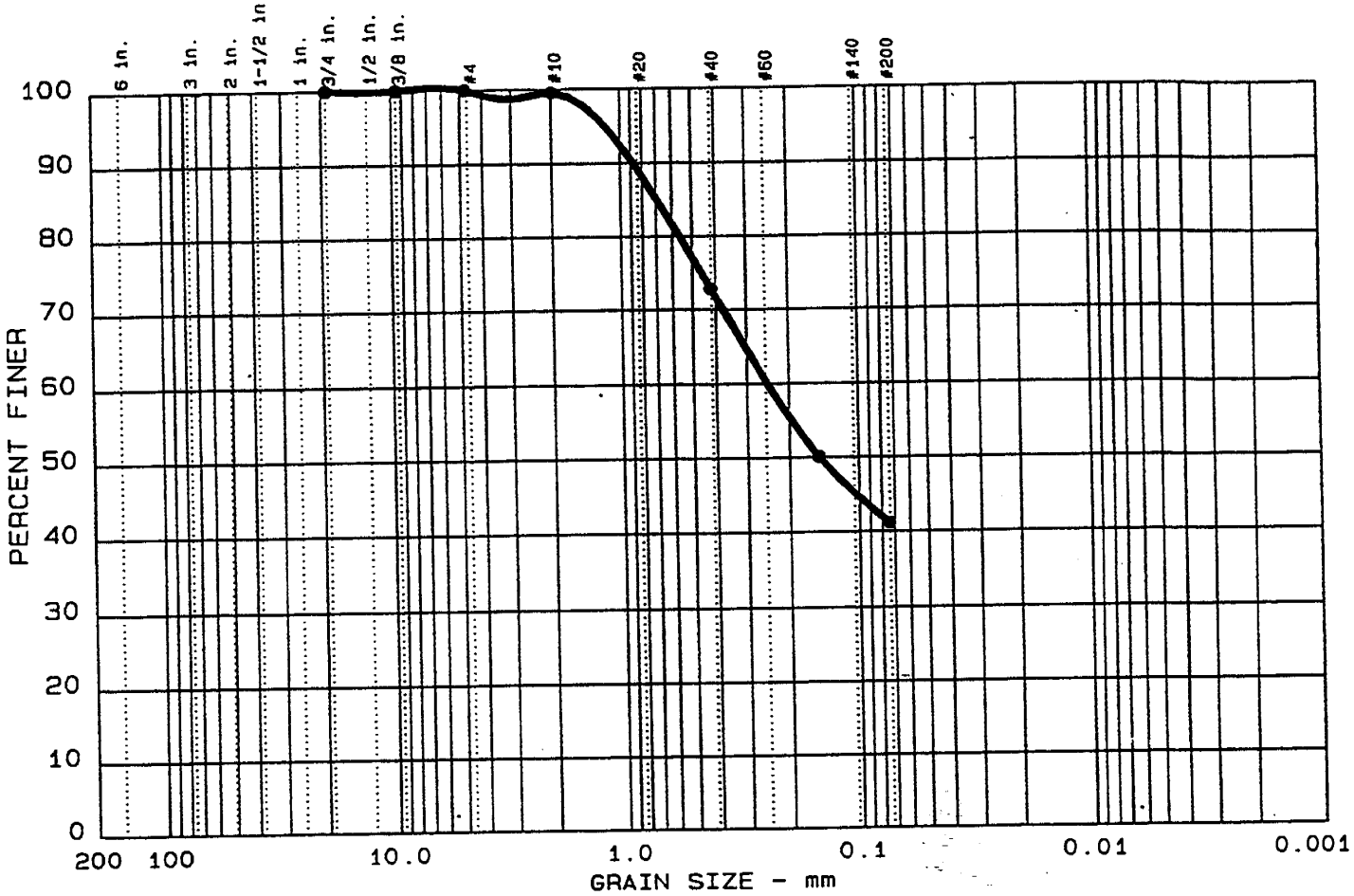
Date: 11-01-95

Remarks:
NAT. MOIST: 30%

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	58.9	41.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.69	0.25	0.15					

MATERIAL DESCRIPTION	USCS	AASHTO
● SILTY SAND, OLIVE AND GRAY	SM	

Project No.:

Project: USACE RIO PUERTO NUEVO PROJECT

● Location: BOR. CB-PNB-61, SAMPLE 18

Date: 10-27-95

Remarks:

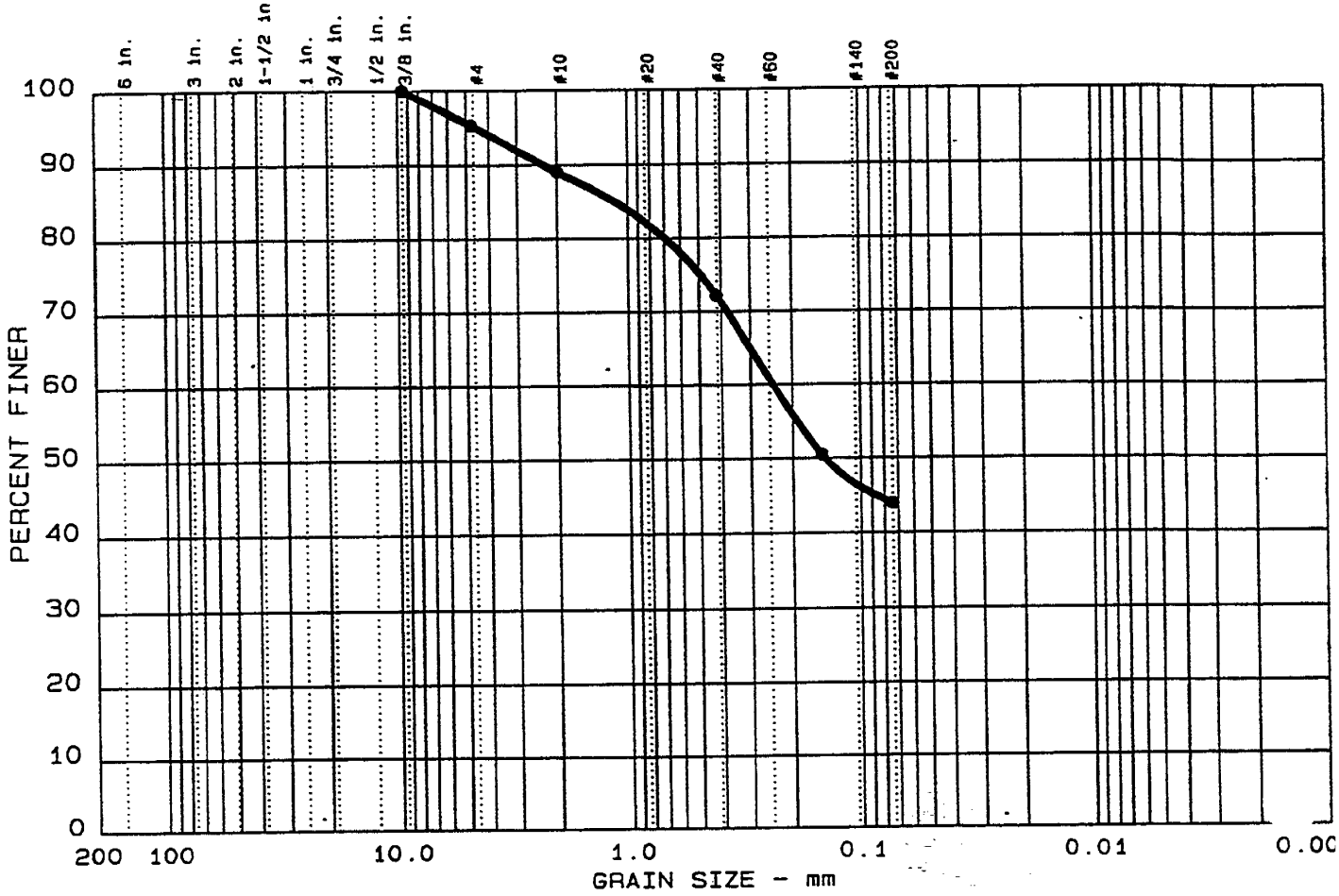
NAT. MOIST.: 19%

GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	4.6	51.4	44.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.12	0.24	0.14					

MATERIAL DESCRIPTION	USCS	AASHTO
● SILTY SAND, OLIVE AND GRAY	SM	

Project No.:

Project: USACE RIO PUERTO NUEVO PROJECT

● Location: BOR. CB-PNB-61, SAMPLE 41

Date: 10-30-95

Remarks:

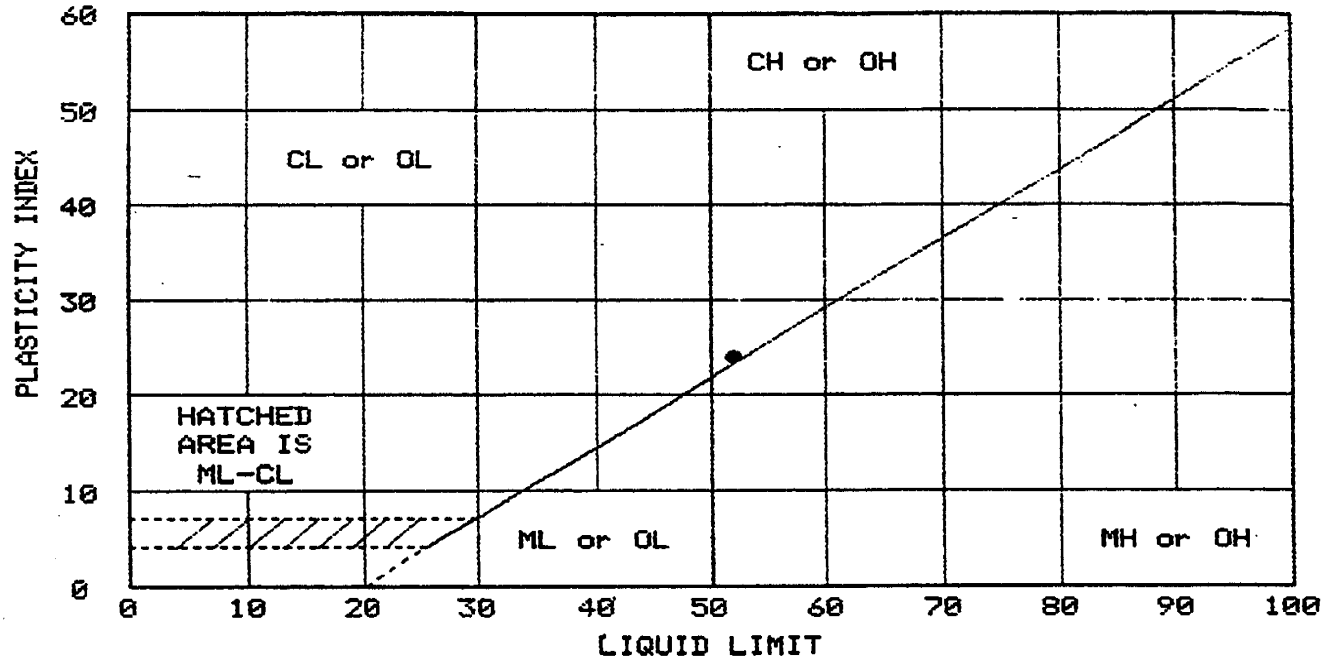
NAT. MOIST.: 16%

GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Figure No. _____

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● CLAY, SOME SAND, OLIVE AND GRAY	52	28	24	71.8	CH	A-7-6(18)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: SAN JUAN P.R.

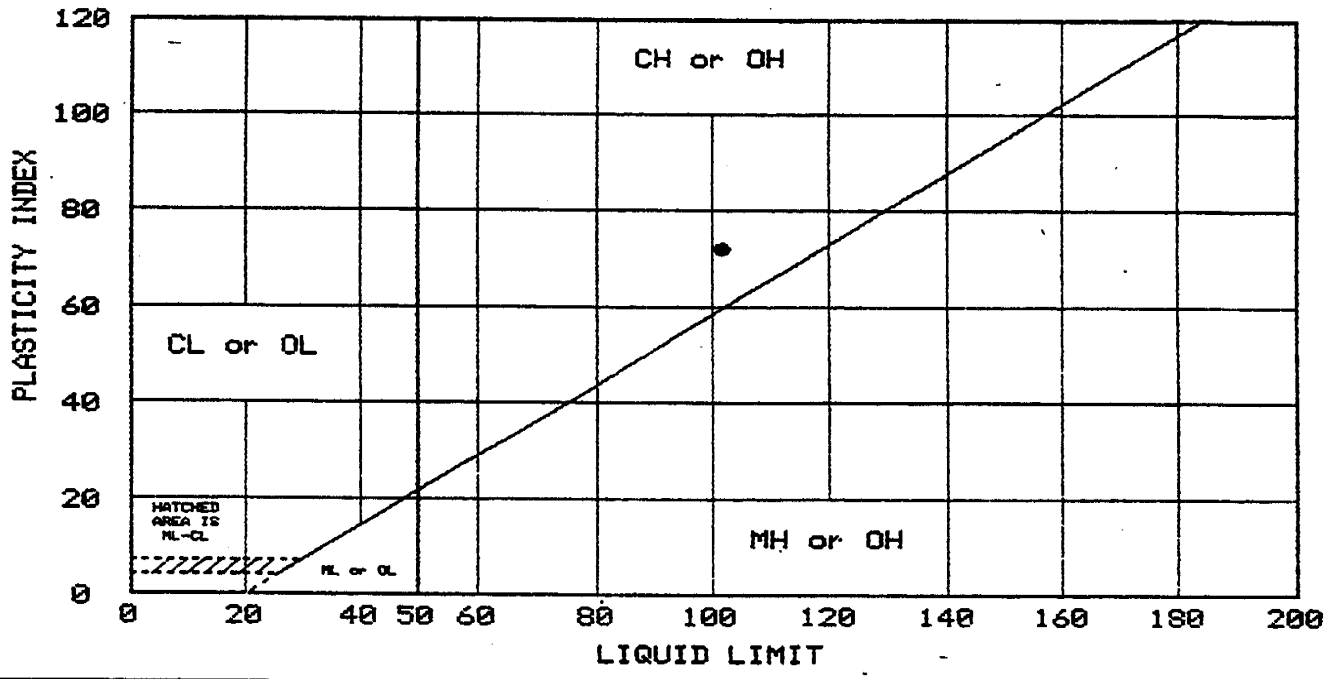
Date: 11-01-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNB-61
SAMPLE: 7
NAT. MOIST: 24%

Fig. No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● CLAY, LITTLE SAND, LIGHT GRAY	102	30	72	82.2	CH	A-7-5(66)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: SAN JUAN P.R.

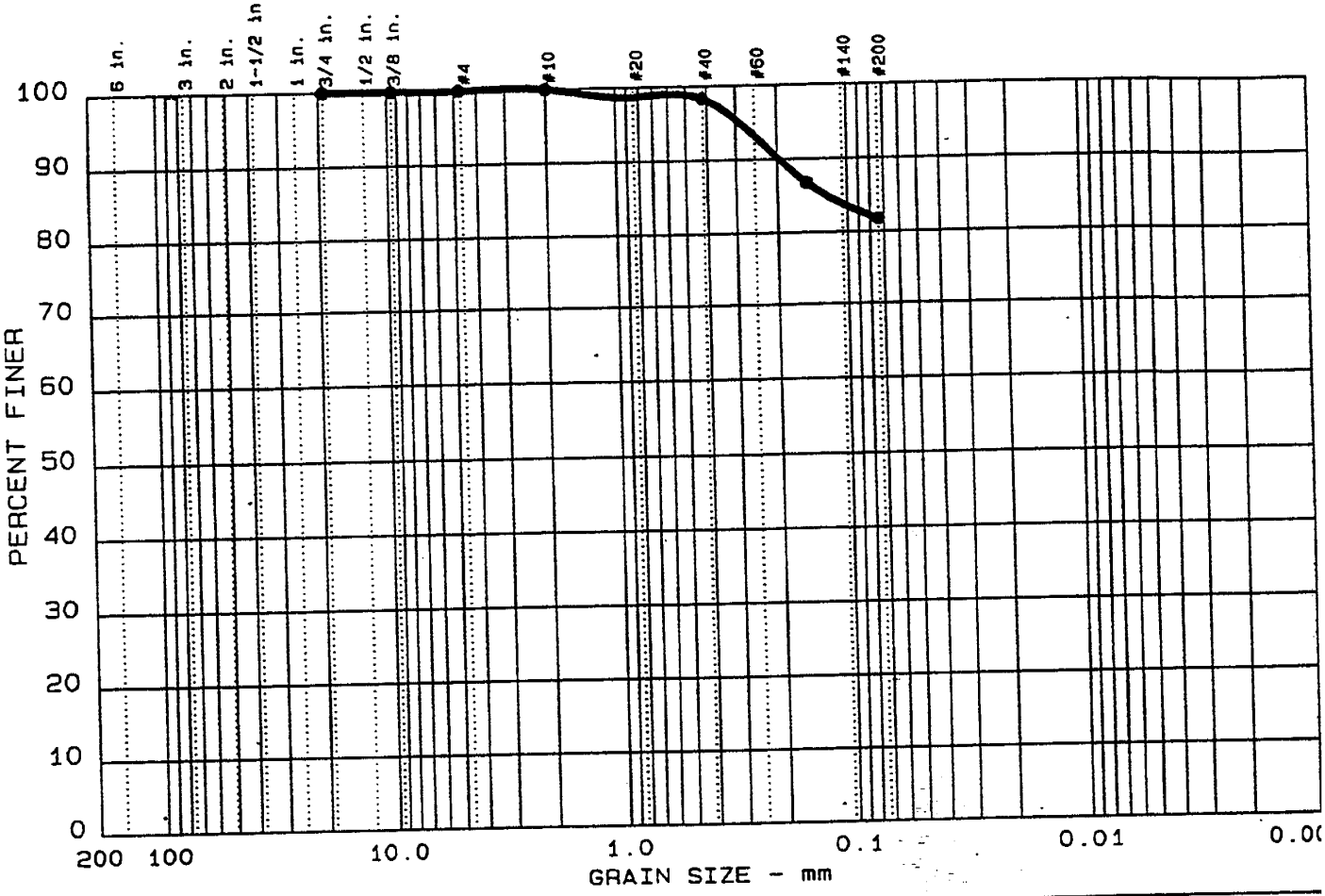
Date: 11-01-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNB-61
SAMPLE: 13
NAT. MOIST: 30%

Fig. No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	18.3	81.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.12							

MATERIAL DESCRIPTION	USCS	AASHTO
● SILT, **LITTLE SAND, GRAY AND OLIVE BROWN**	**ML**	

Project No.:

Project: USACE RIO PUERTO NUEVO PROJECT

● Location: BOR. C8-PNB-62, SAMPLE 13

Date: 1-27-95

Remarks:

DEPTH 18.0-19.5'

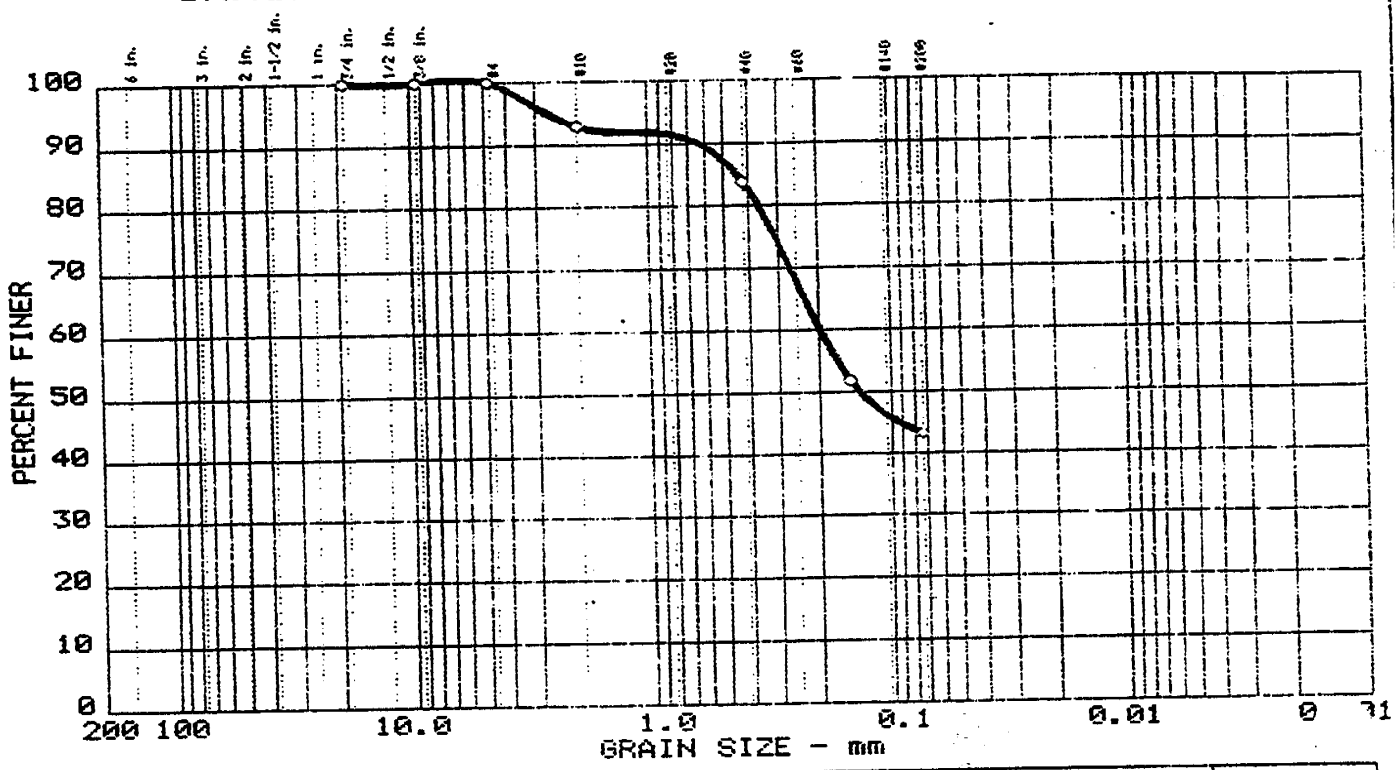
NAT. MOIST.: 24%

GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Figure No. ———

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	56.7	43.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	39	18	0.44	0.20	0.13					

	MATERIAL DESCRIPTION	USCS	AASHTO
○	CLAYEY SAND, OLIVE BROWN	SC	A-6(4)

Project No.:
Project: RIO PUERTO NUEVO
○ Location: BOR. CB-PNB-62

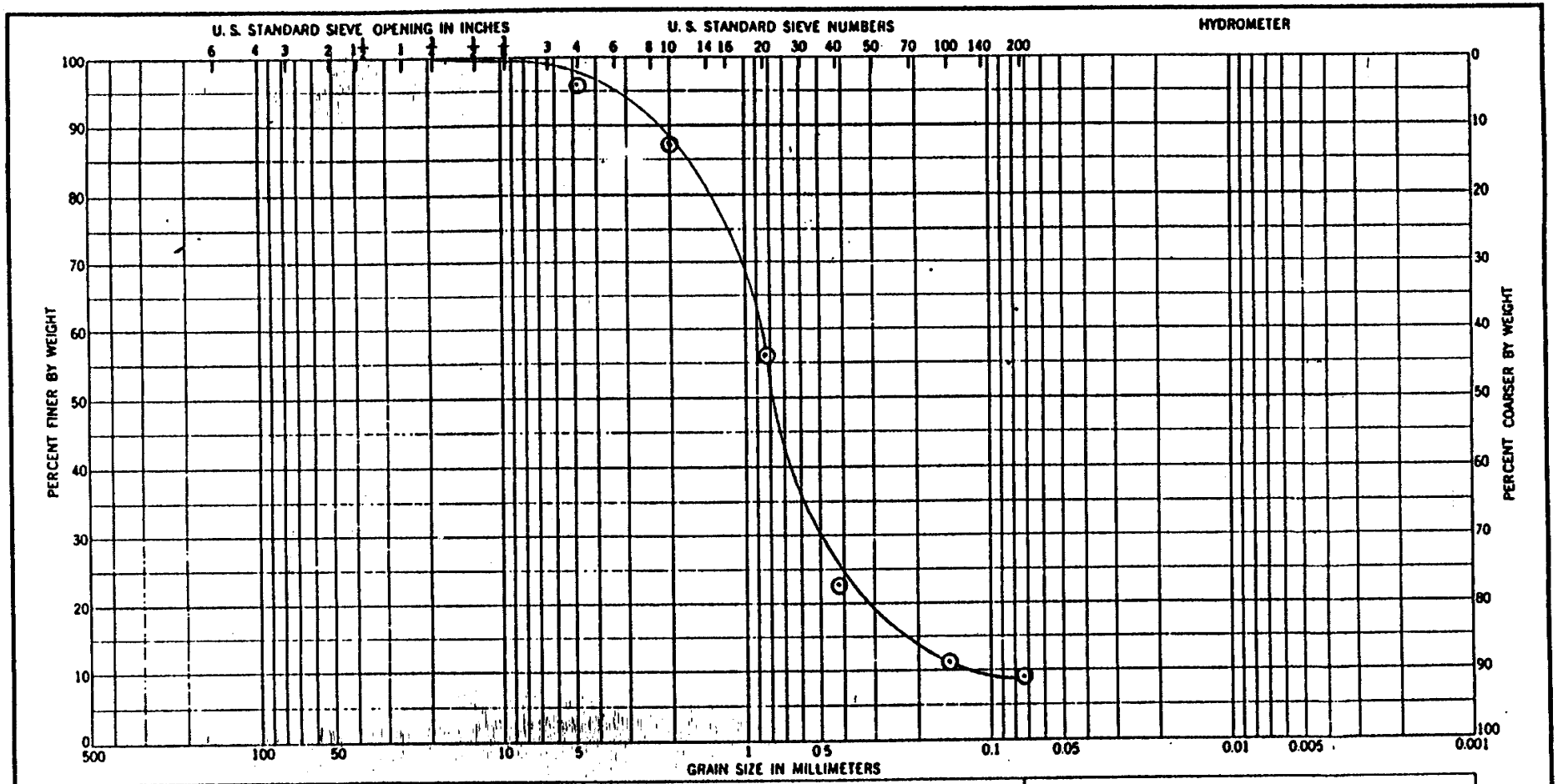
Date: 10-30-95

GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Remarks:
SAMPLE : 17
NAT. MOIST: 23%

Figure No._____



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
13	18 to 19.5'	Sand, medium to coarse grain, gray, silty, some fine gravel, sub-angular to sub-rounded, little clay (SM)				

GRADATION CURVES

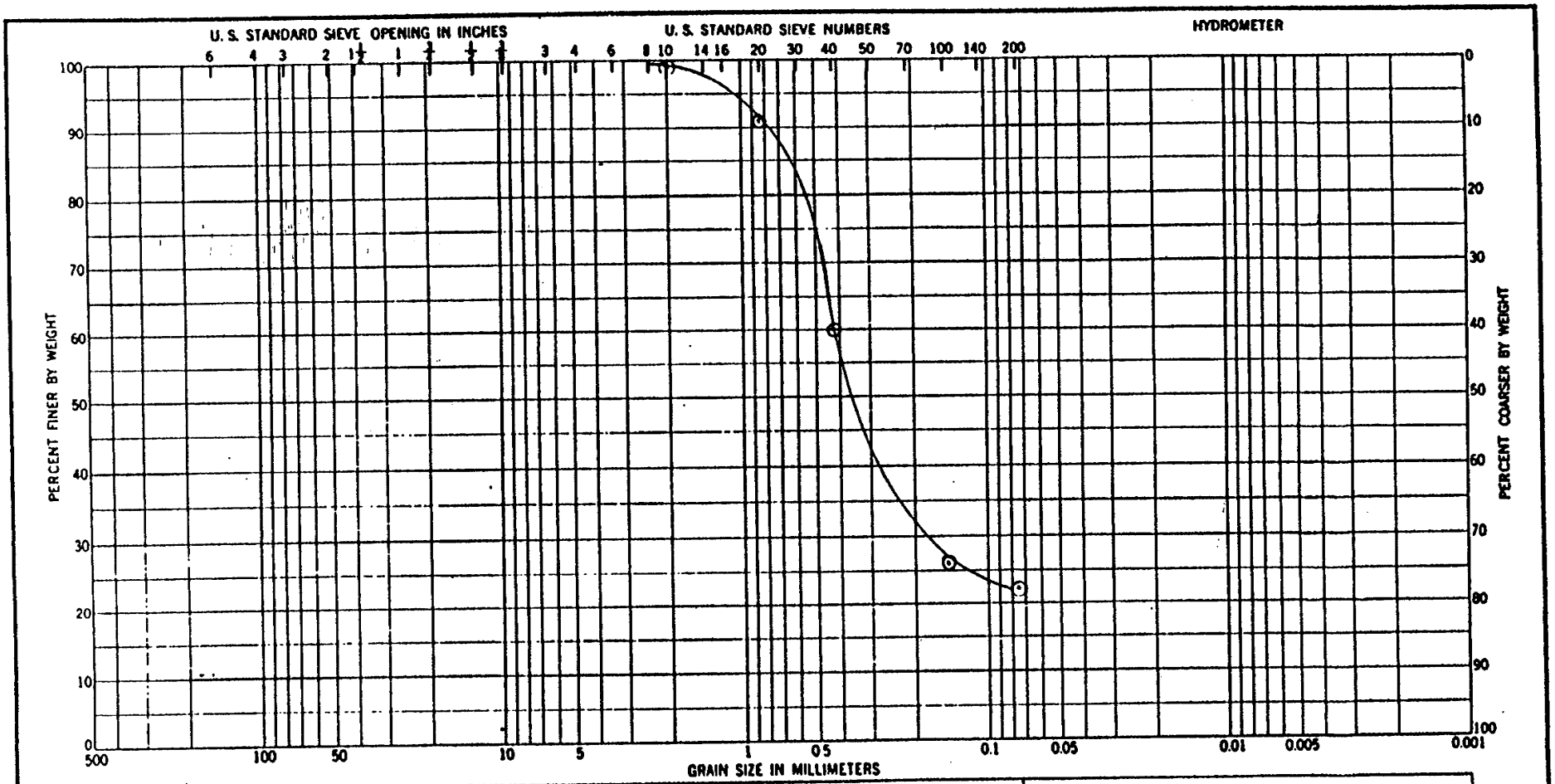
Project: Puerto Nuevo Channels
Assignment #4

Area: San Juan, Puerto Rico

Boring No.: CB-PNM-46

Date: 06-27-90

ENG. FORM 2087



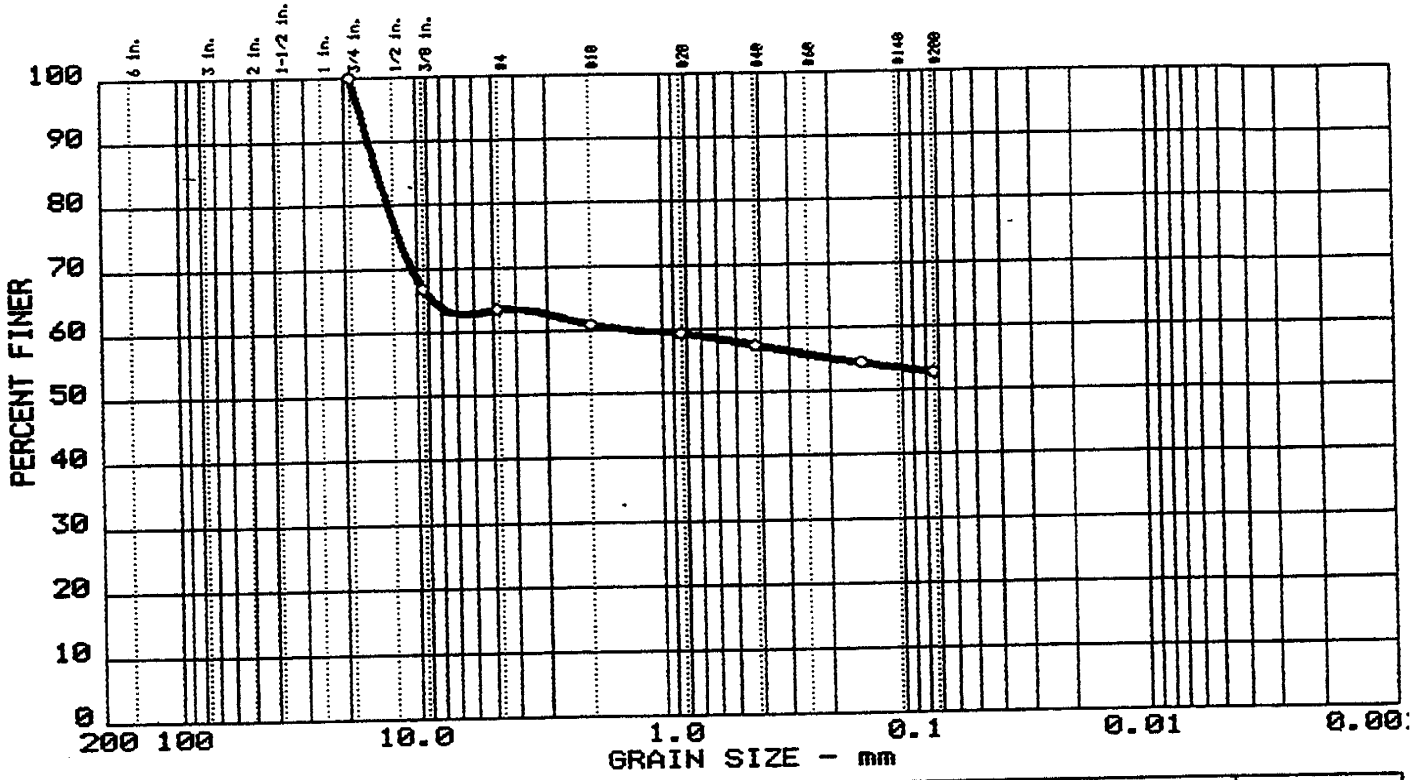
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
29	42 to 43.5'	Sand, silty, fine grained, pale olive and white, little clay, partly cemented (SM)				

GRADATION CURVES

Project: Puerto Nuevo Channels
Assignment #4
Area: San Juan, Puerto Rico
Boring No.: CB-PNM-46
Date: 06-27-90

ENG FORM 1 MAY 63 2087

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	36.5	10.8	52.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	46	18	14.67	1.25						

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT,GRAVELLY,LITTLE SAND,YELLOWISH BROWN	ML	A-7-6(7)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

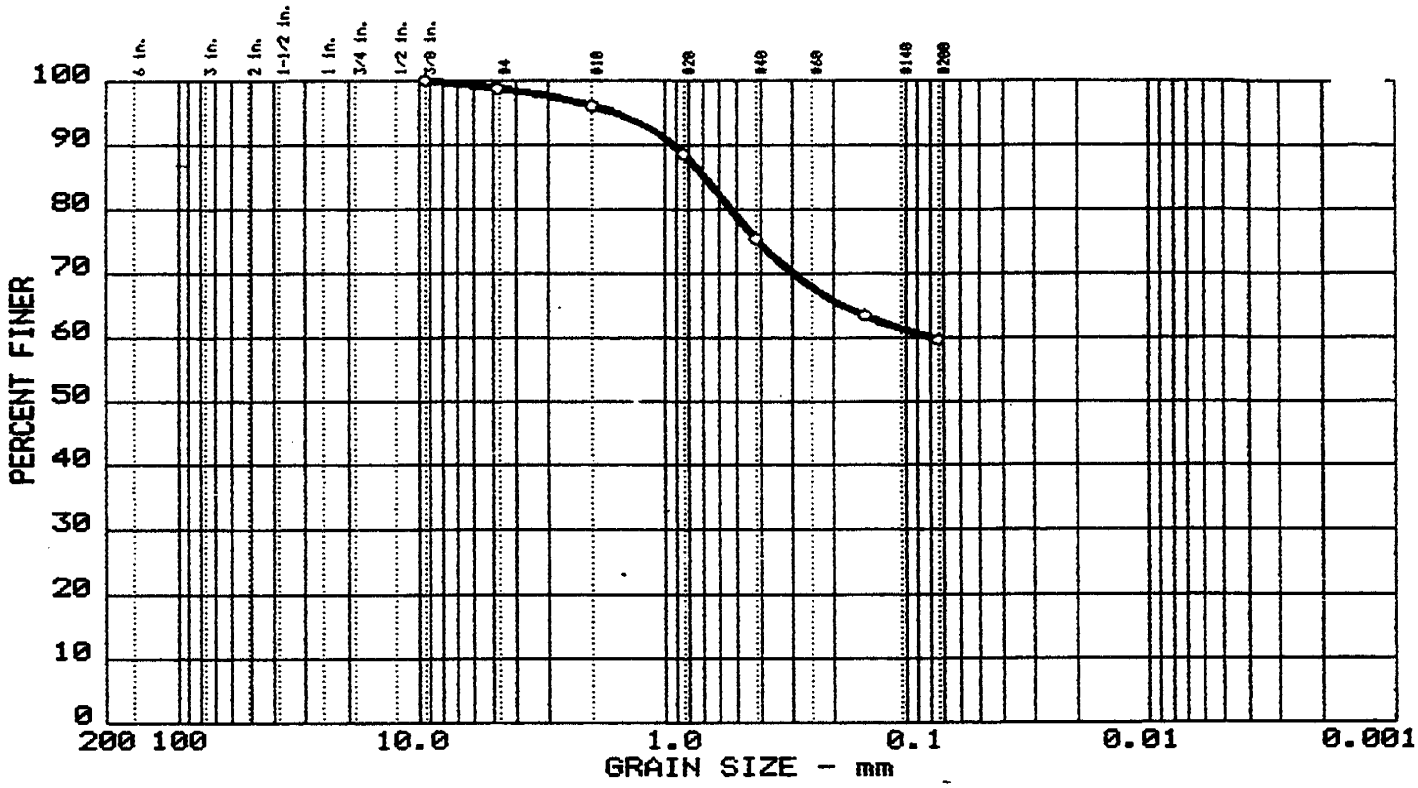
Date: 01-09-96

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNM-46
SAMPLE. 8
NAT. MOIST. 55%

Figure No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	1.2	39.1	59.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o			0.68	0.08						

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT,SANDY,TRACE CLAY,PALE YELLOW TO OLIVE	ML	A-4

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

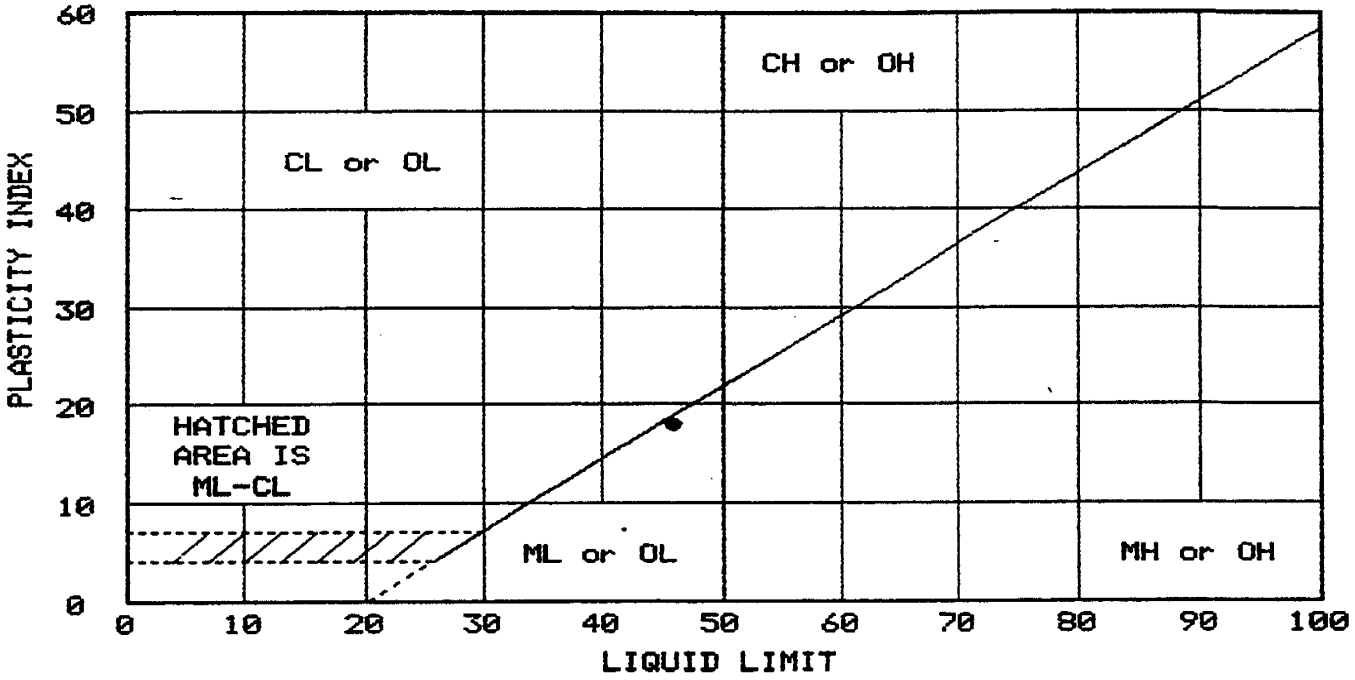
Date: 01-09-96

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNM-46D
SAMPLE. 2
NAT. MOIST. 24%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SILT,GRAVELLY,LITTLE SAND, YELLOWISH BROWN	46	28	18	52.8	ML	A-7-6(7)

Project No.:
Project: RIO PUERTO NUEVO

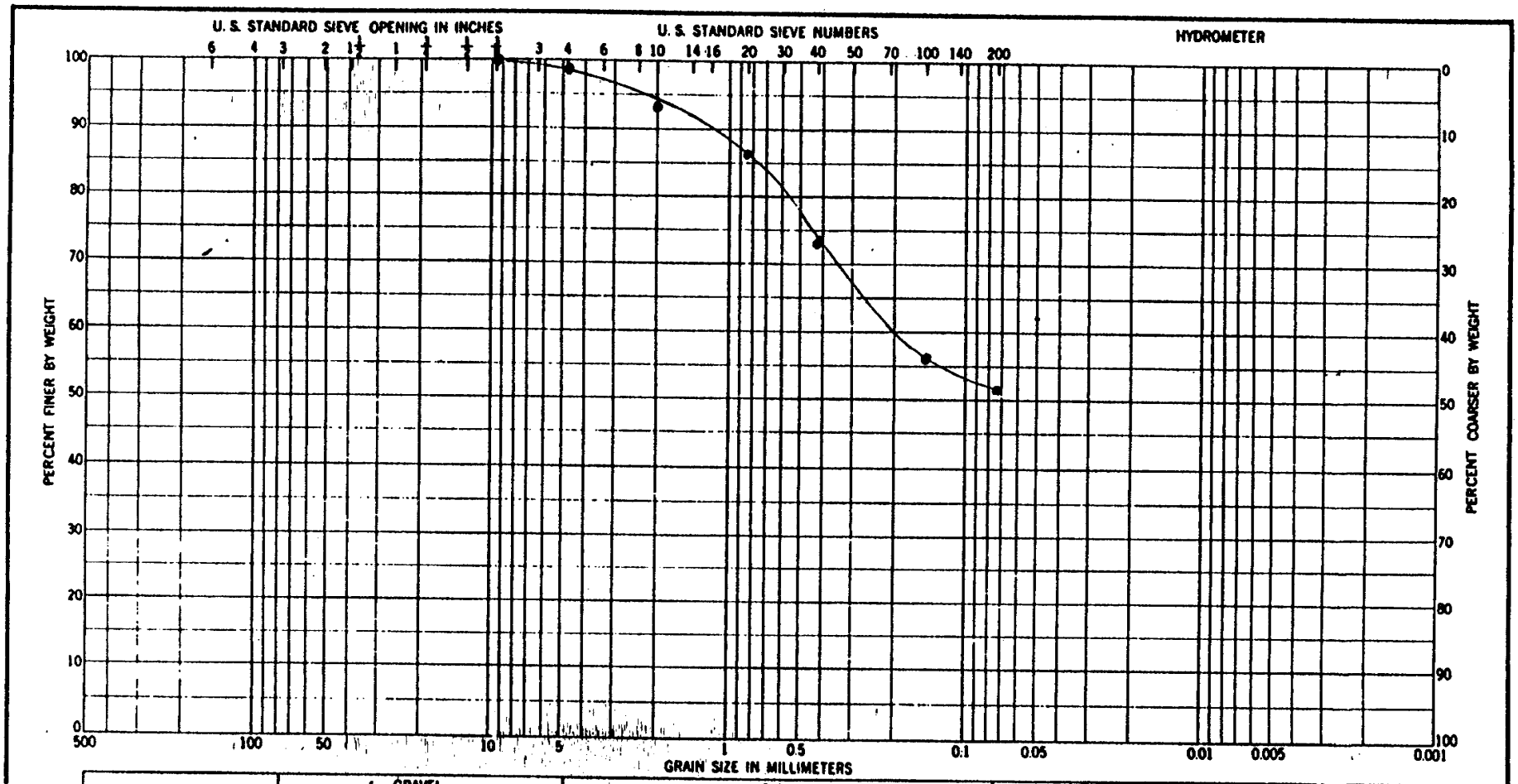
Client:
Location: HATO REY P.R.

Date: 01-09-96

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNM-46
SAMPLE. 8

Fig. No.____



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
27	39 to 40.5'	Clay, sandy, some silt, stiff, trace fine gravel, brown mottled gray. (CL)		40	16	24

GRADATION CURVES

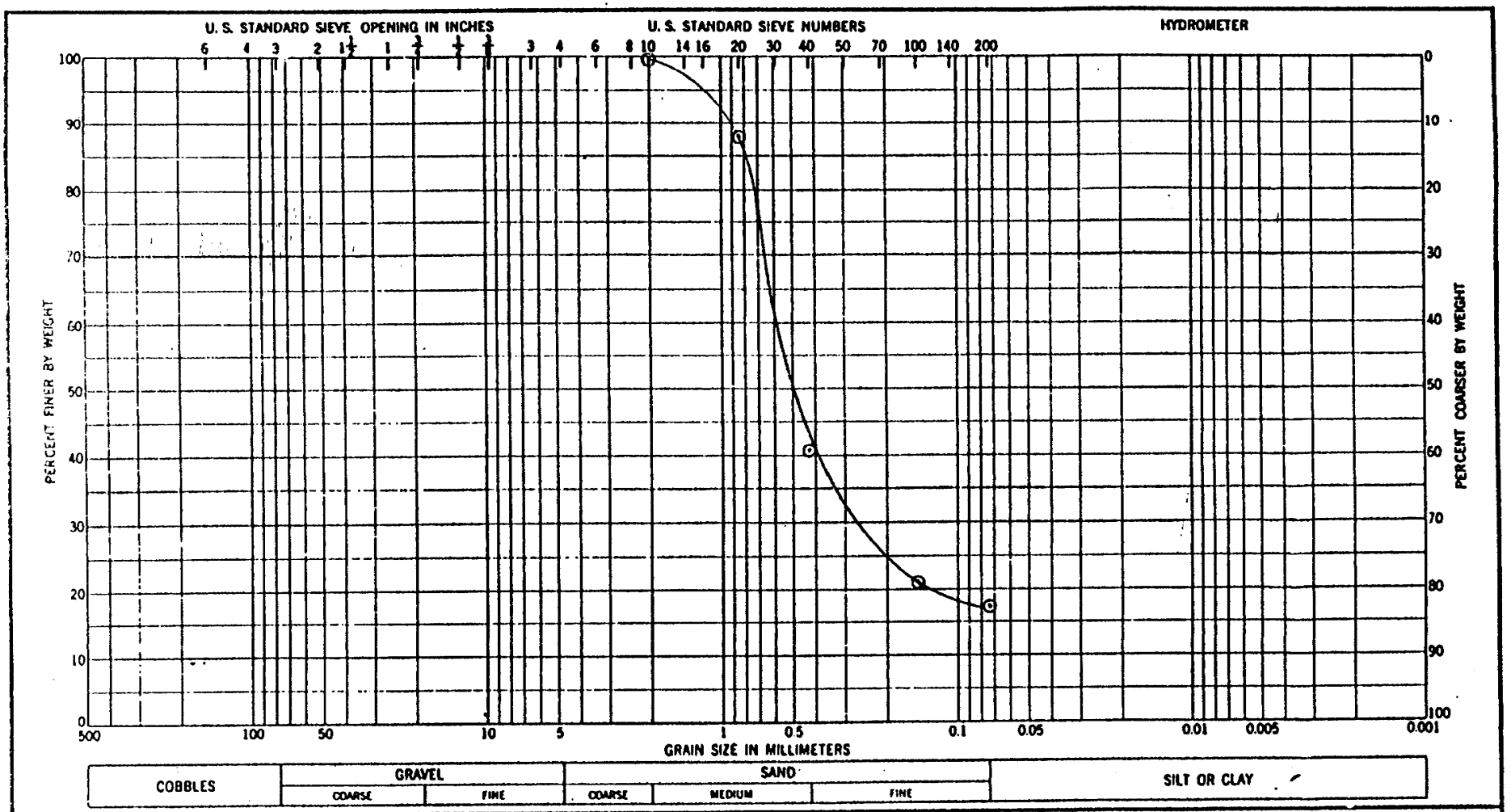
Project: Puerto Nuevo Channels Assignment #4

Area: San Juan, Puerto Rico

Boring No.: CB-PNM-47

Date: 6/1/90

ENG M 63 2087



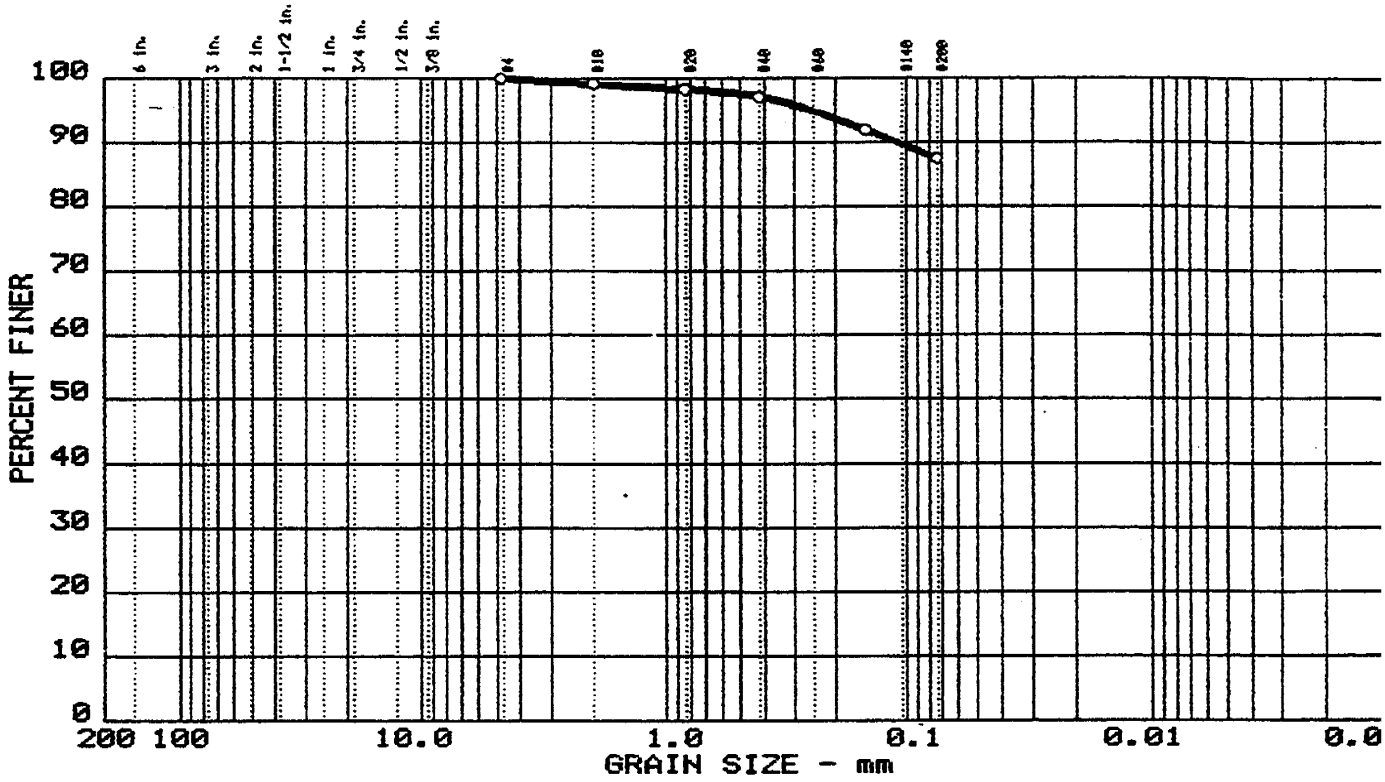
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
17	24 to 25.5'	Sand, fine grained, clayey, reddish brown and pale yellow, little silt (SC)				

GRADATION CURVES

Project	Puerto Nuevo Channels
	Assignment #4
Area	San Juan, Puerto Rico
Boring No.	CB-PNM-48
Date	06-27-90

ENG FORM 1 MAY 63 2087

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	12.5	87.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	55	23								

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT,LITTLE SAND,BROWN	MH	A-7-5(24)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

Date: 01-12-96

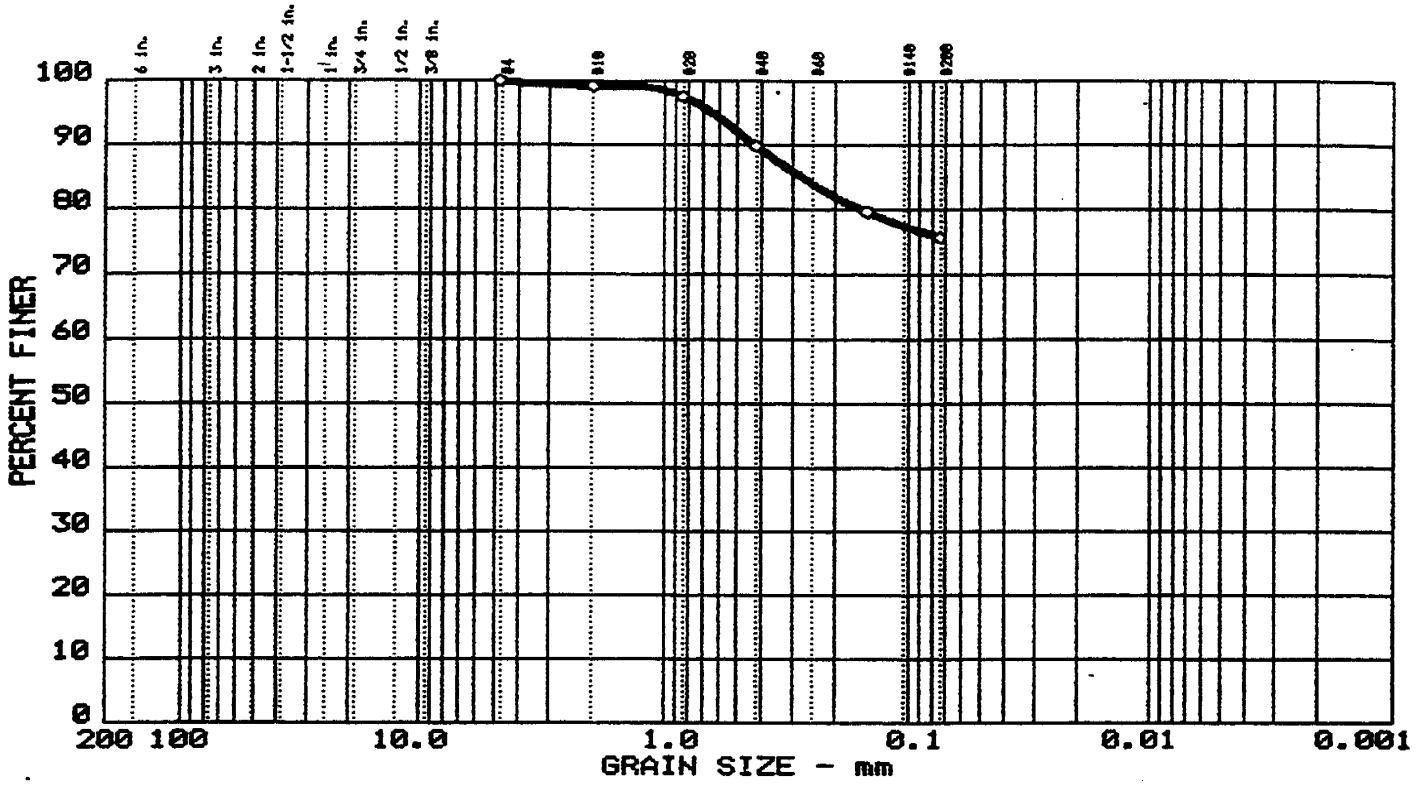
GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Remarks:
BOR. CB-PNM-55
SAMPLE. 1
NAT. MOIST. 49%

Figure No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	24.2	75.8	

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
56	28	0.28							

MATERIAL DESCRIPTION	USCS	AASHTO
CLAY,SOME SAND,LIGHT BROWN	CH	A-7-6(23)

Project No.:
Project: RIO PUERTO NUEVO
Location: HATO REY P.R.

Date: 12-22-95

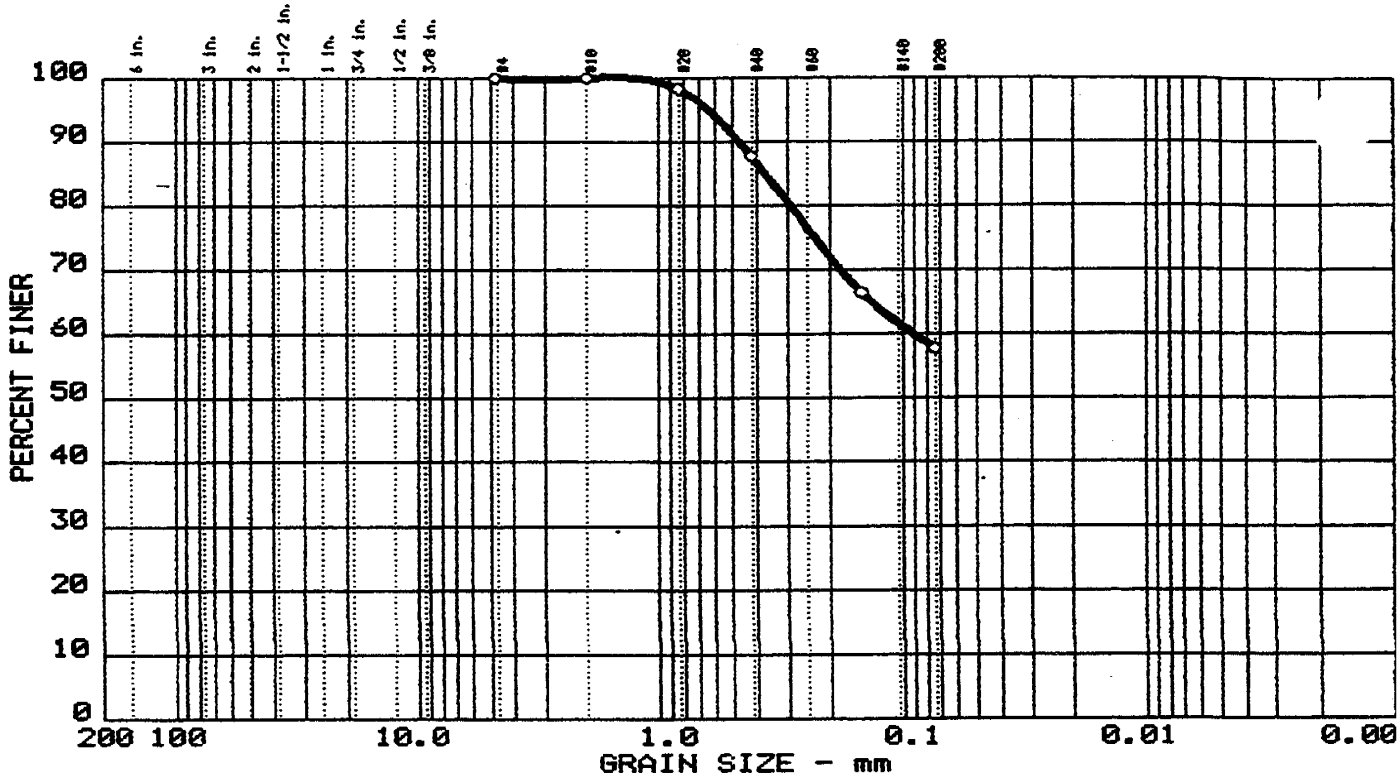
GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Remarks:
BOR. CB-PNM-55
SAMPLE. 3
NAT. MOIST. 34%

Figure No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	42.3	57.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	38	20	0.36	0.09						

MATERIAL DESCRIPTION	USCS	AASHTO
o CLAY,SANDY,LITTLE SILT,BROWNISH RED	CL	A-6(8)

Project No.:
Project: RIO PUERTO NUEVO
o Location: HATO REY P.R.

Date: 01-12-96

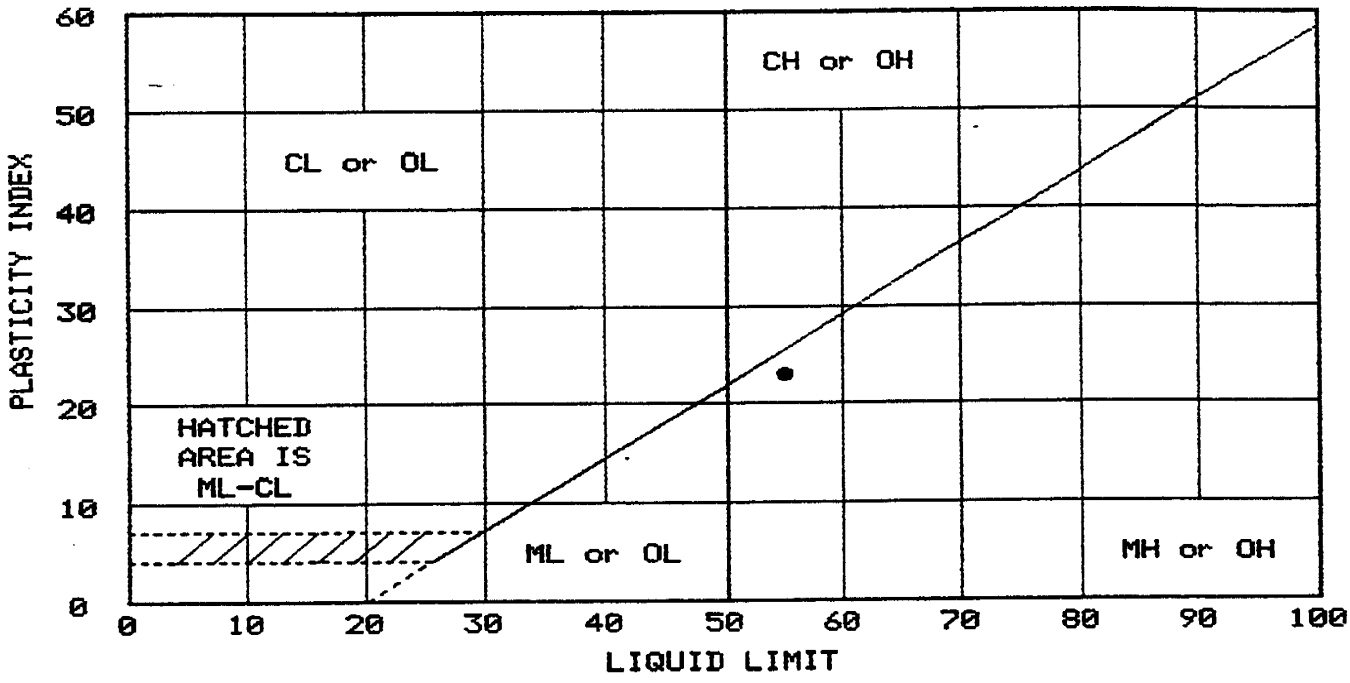
GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Remarks:
BOR. CB-PNM-55
SAMPLE. 18
NAT. MOIST. 19%

Figure No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SILT,LITTLE SAND,BROWN	55	32	23	87.5	MH	A-7-5(24

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

Date: 01-12-96

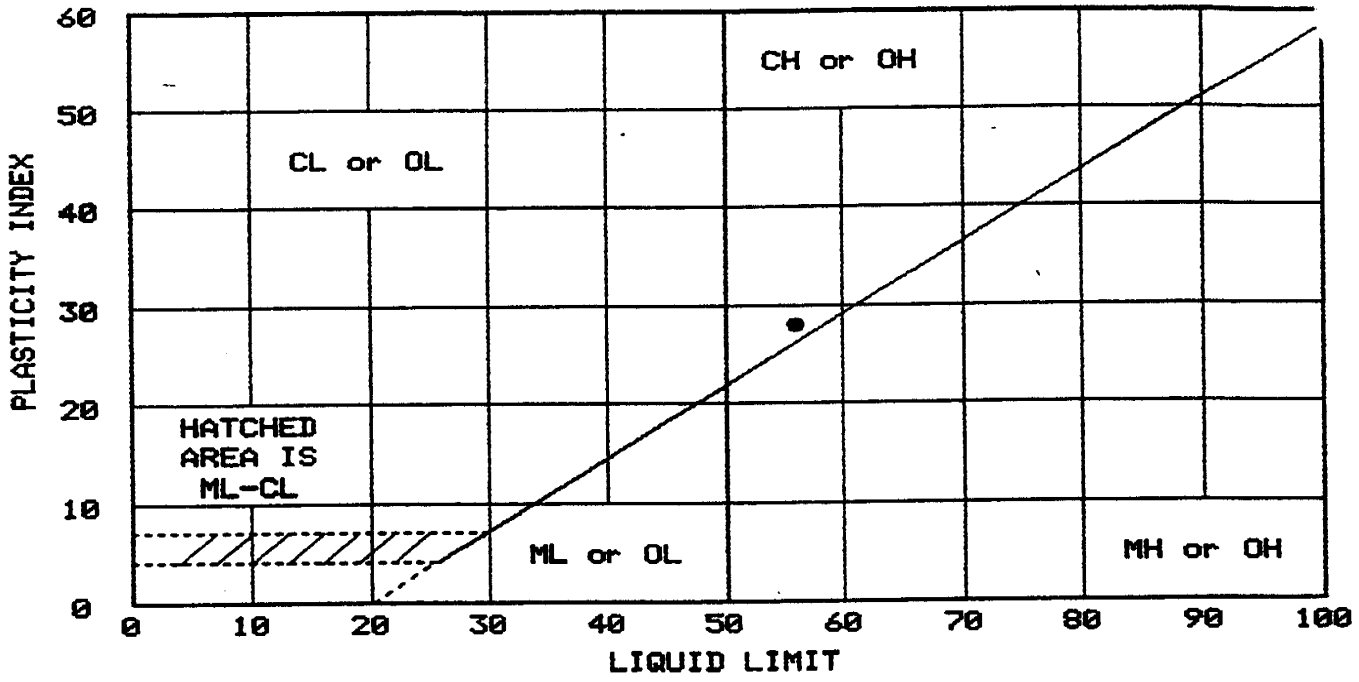
LIQUID AND PLASTIC LIMITS TEST REPORT

SUELOS INC.

Remarks:
BOR. CB-PNM-55
SAMPLE. 1
NAT. MOIST. 49%

Fig. No.____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAY,SANDY,LIGHT BROWN	56	28	28	75.7	CH	A-7-6(23)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

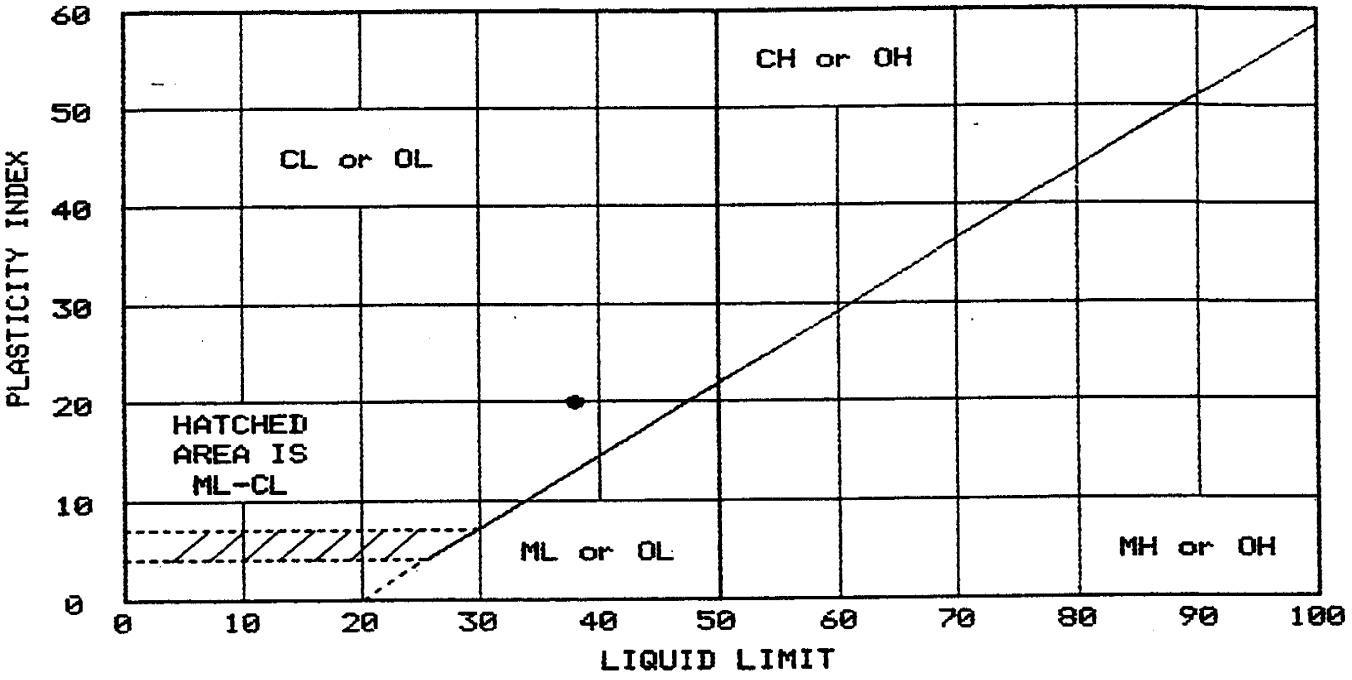
Date: 12-22-95

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-PNM-55
SAMPLE. 3

Fig. No.____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAY,SANDY,LITTLE SILT, BROWNISH RED	38	18	20	57.6	CL	A-6(8)

Project No.:
Project: RIO PUERTO NUEVO

Client:
Location: HATO REY P.R.

Date: 01-12-96

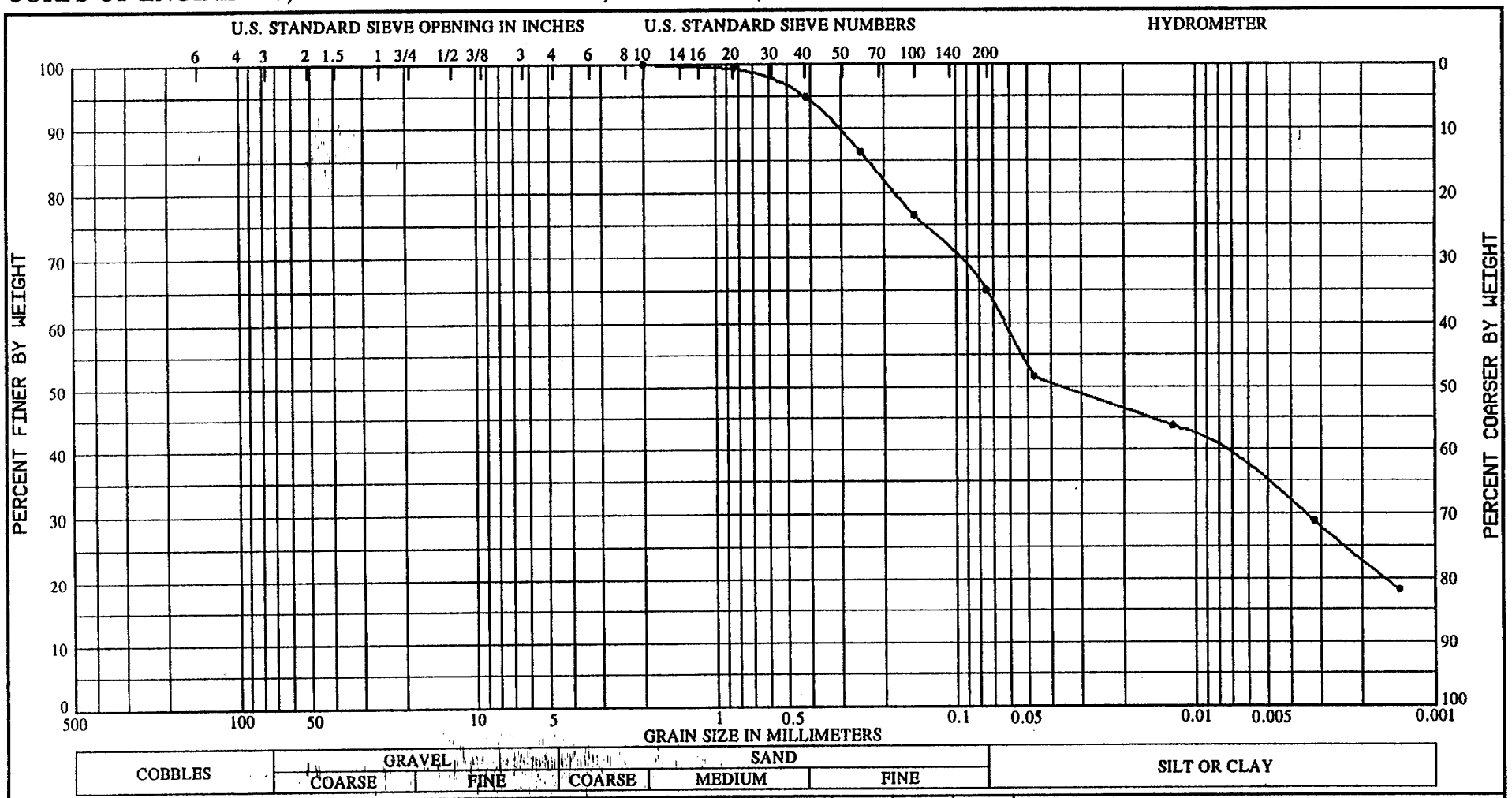
Remarks:
BOR. CB-PNM-55
SAMPLE. 18
NAT. MOIST. 19%

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Fig. No.____

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7825
REQUISITION: RM-CW-96-0038



Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
1	11.0-13.4	GRAY, SILTY FAT CLAY (CH), WITH SOME SAND SIZES AND A TRACE OF ORGANIC MATTER.	40.1	59	30	29

Project RIO PUERTO NEUVO

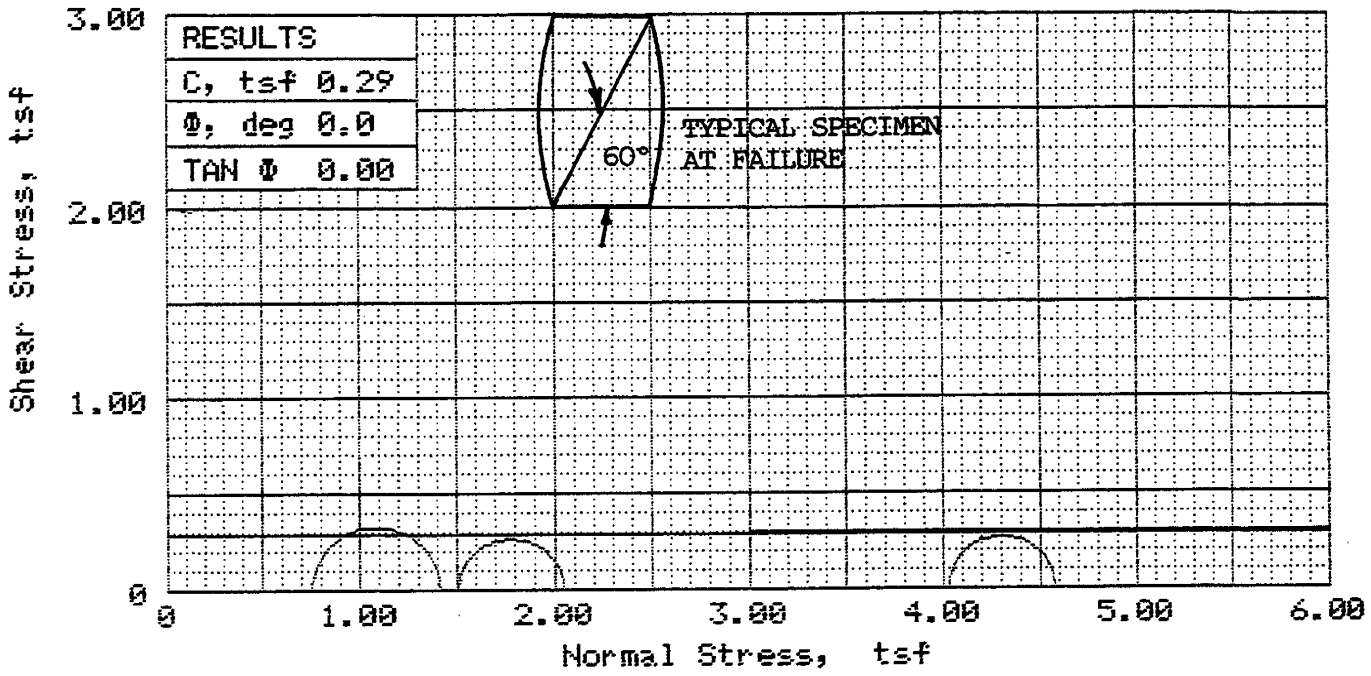
Lab No. 73/7154

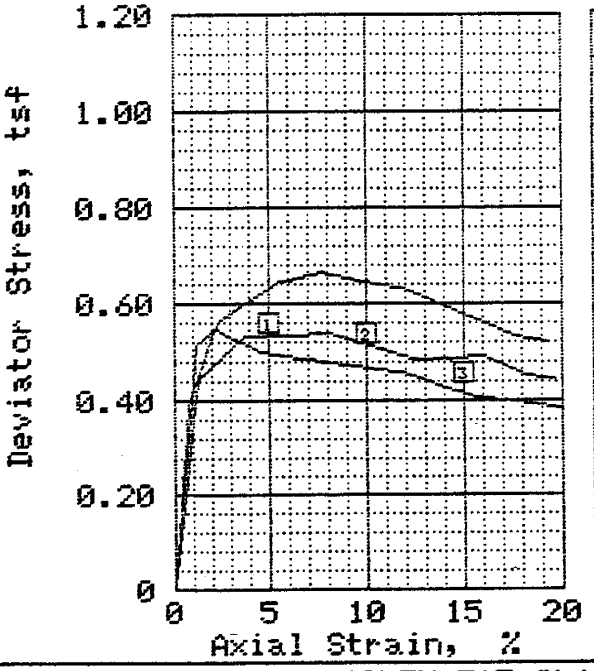
Boring No. CB-PNM-56

Date 11/07/95

GRADATION CURVES

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	35.1	36.0	36.7
	DRY DENSITY, pcf	83.8	82.3	81.2
	SATURATION, %	94.7	93.6	93.2
	VOID RATIO	0.989	1.026	1.052
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	35.9	36.8	37.7
	DRY DENSITY, pcf	83.8	82.3	81.2
	SATURATION, %	96.9	95.7	95.8
	VOID RATIO	0.989	1.026	1.052
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		0.76	1.51	4.03
MAX. DEV. STRESS, tsf		0.66	0.54	0.55
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		11	10	2
RATE, %/min.		0.70	0.82	1.12
ULT. DEV. STRESS, tsf		0.58	0.49	0.41

DESCRIPTION GRAY, SILTY FAT CLAY (CH), WITH SOME SAND SIZES AND A TRACE OF ORGANIC MATTER.

LL= 59	PL= 30	PI= 29	Gs= 2.67	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST Sat Q

REMARKS

PROJECT RIO PUERTO NUEVO

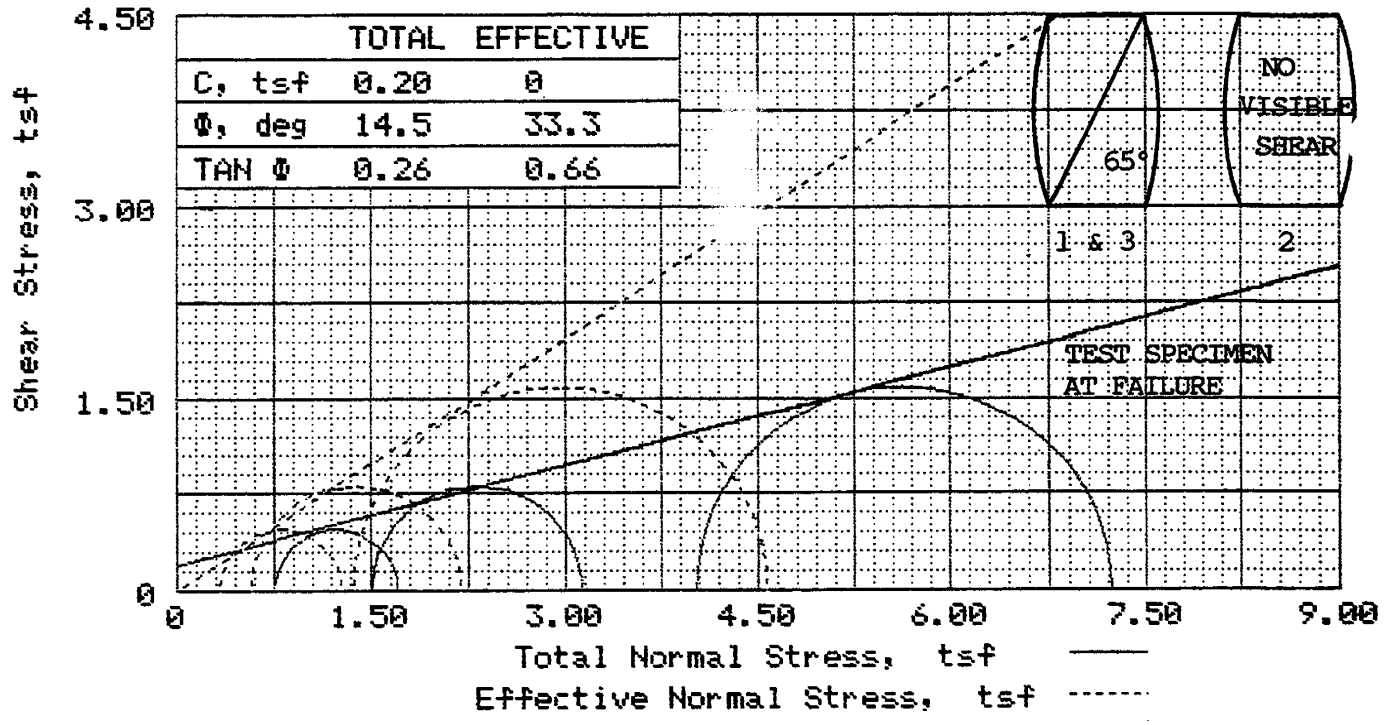
AREA

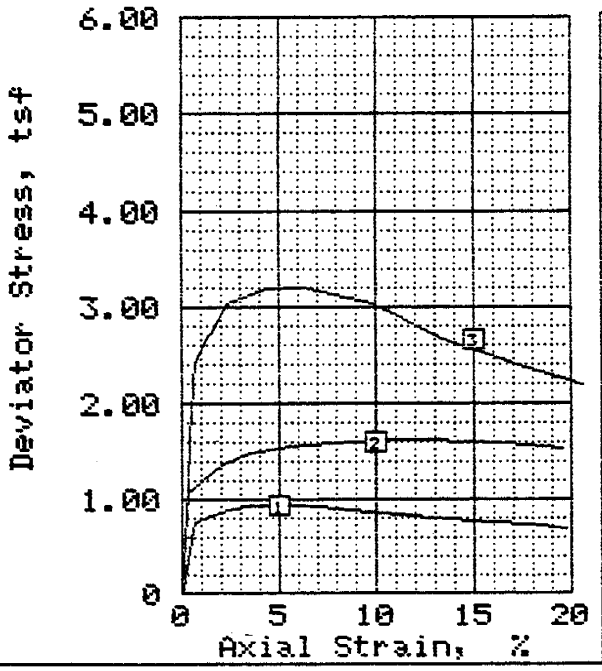
LAB NO. 73/7154

BORING NO. CB-PNM-56
SAMPLE NO. 1
DEPTH/~~ELEV~~ 11.0 - 13.4'
LABORATORY CESAD-EN-FL DATE 15 NOV. 1995

TRIAXIAL COMPRESSION TEST

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825





SPECIMEN NO.		1	2	3
INITIAL	WATER CONTENT, %	38.9	37.4	44.1
	DRY DENSITY, pcf	81.8	82.1	75.8
	SATURATION, %	100.0	96.8	98.2
	VOID RATIO	1.038	1.031	1.200
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	34.4	34.4	31.8
	DRY DENSITY, pcf	86.9	86.9	90.1
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.919	0.918	0.850
	DIAMETER, in	1.35	1.35	1.30
	HEIGHT, in	3.02	3.02	2.91
BACK PRESSURE, tsf		5.04	5.04	5.04
INIT. EFF. STR., tsf		0.76	1.51	4.03
MAX. DEV. STRESS, tsf		0.95	1.62	3.20
PORE PRESSURE, tsf		0.42	0.94	2.66
TIME TO FAILURE, min.		60	115	60
RATE, %/min.		0.09	0.11	0.11
ULT. DEV. STRESS, tsf		0.77	1.60	2.54

DESCRIPTION GRAY, SILTY FAT CLAY (CH), WITH SOME SAND SIZES AND A TRACE OF ORGANIC MATTER.

LL= 59	PL= 30	PI= 29	Gs= 2.67	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST R w/pore pressures

REMARKS

PROJECT RIO PUERTO NUEVO

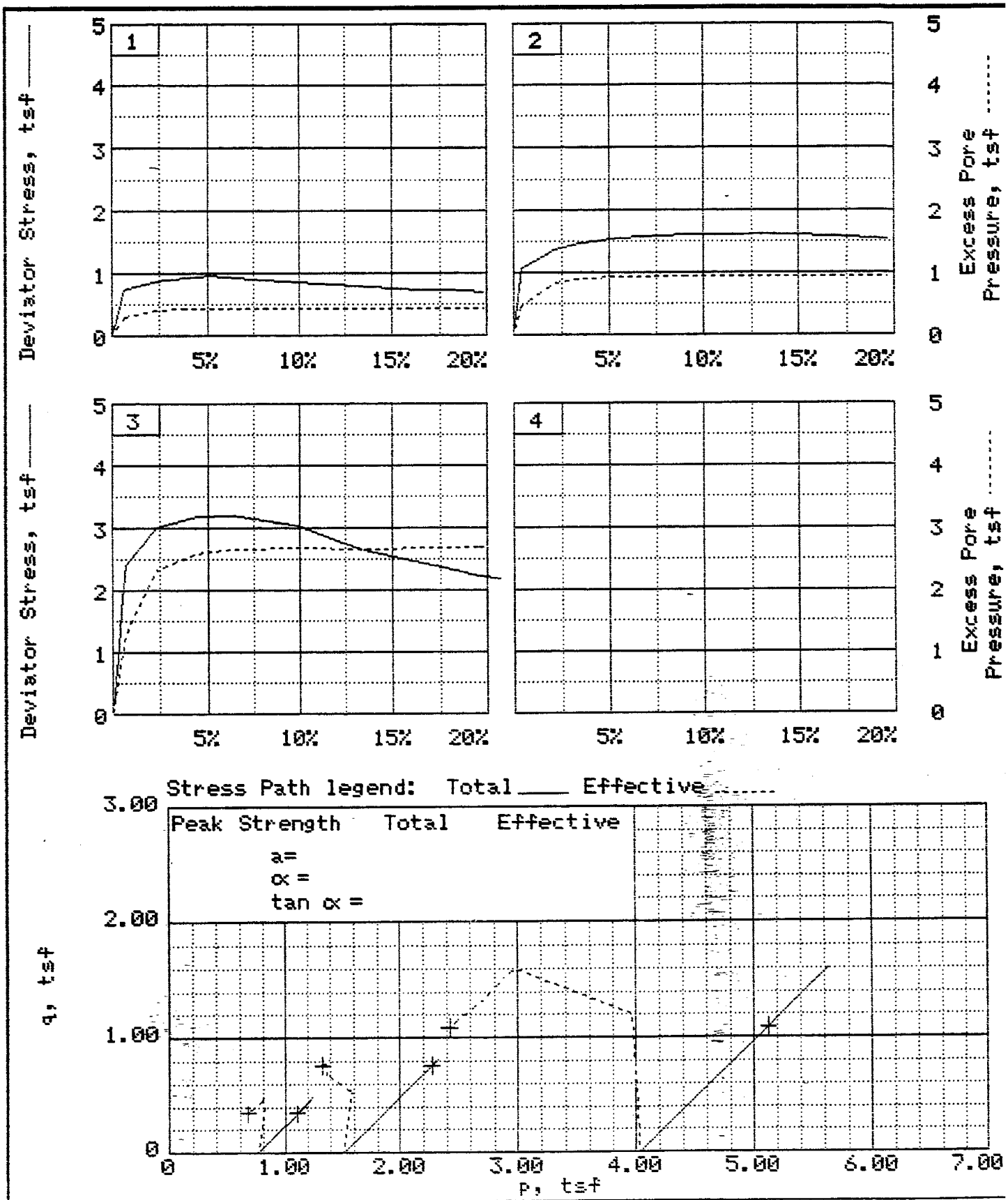
AREA

LAB NO. 73/7154

BORING NO. CB-PNM-56
SAMPLE NO. 1
DEPTH/~~ELEV~~ 11.0 - 13.4'
LABORATORY CESAD-EN-FL DATE 13 NOV. 19

 TRIAXIAL COMPRESSION TEST

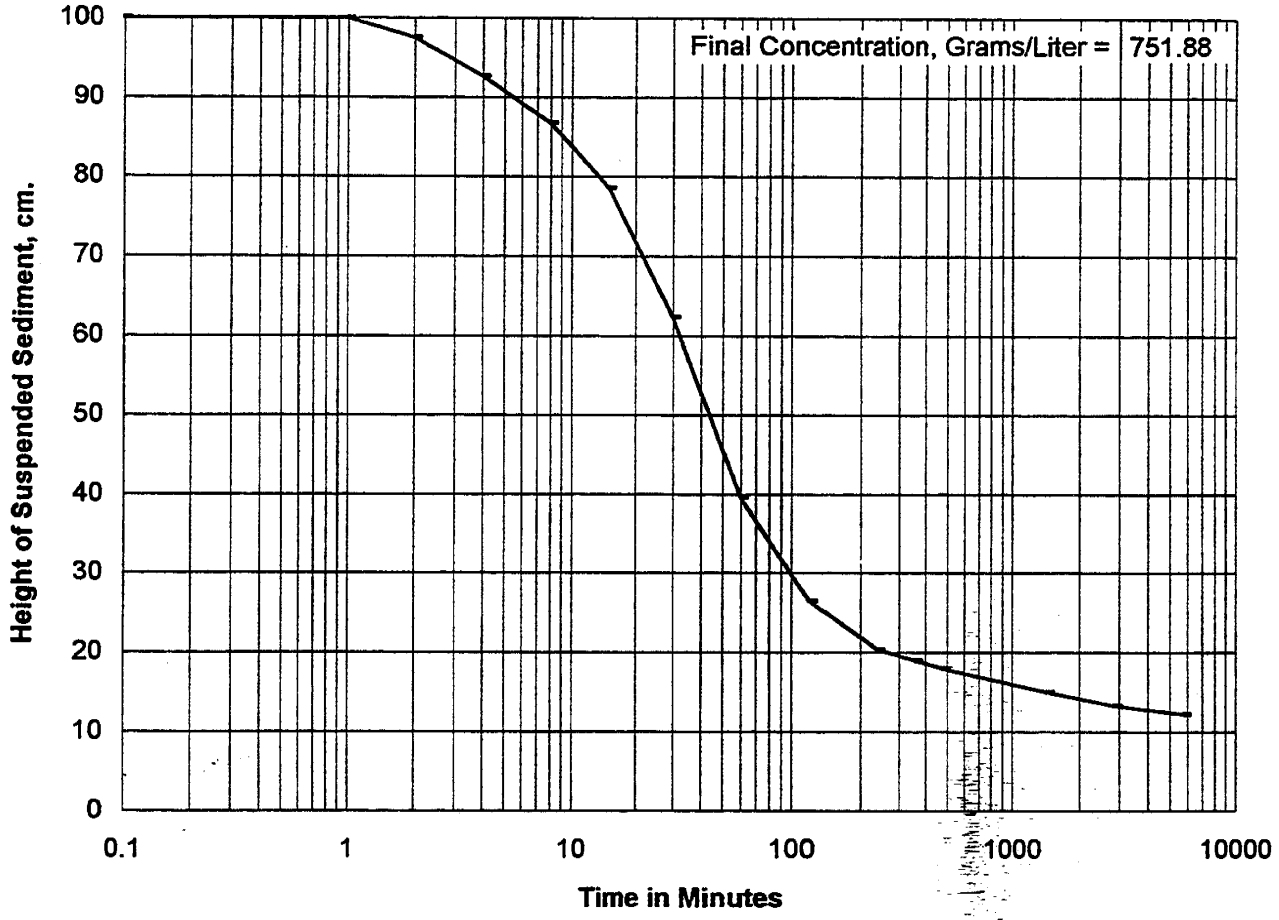
SOIL ATLANTIC DIVISION LABORATORY, CORPS OF E. ,NEERS - MARIETTA, GEORGIA
Requisition No. RM-CW-96-0038 Work Order No. 7825



PROJECT RIO PUERTO NEUVO
BORING CB-PNM-56 SAMPLE 1 DEPTH/~~ELEV~~ 11.0 - 13.4'
TYPE OF TEST R w/pore pressures LAB NO. 73/7154
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 13 NOV. 1995

U.S. ARMY CORPS OF ENGINEERS
SOUTH ATLANTIC DIVISION LABORATORY
MARIETTA, GEORGIA

SUSPENDED SEDIMENT-TIME CURVE



NOTES: 1. Test specimens (100 grams/ liter ,moist weight of specimen) suspended in sea water(salinity about 11 ppT) in 100 cm. long bottom withdrawal tubes.
2. Suspended sediment-time curves represent the contact surface between the sediment still in suspension and the "clear" water on top at the elapsed time indicated.
3. See grain-size data on enclosed gradation curve.
4. Percent Solids = 71.38

PROJECT	RIO PUERTO NEUVO	**REQ'N NO.**	RM-CW-96-0038
		W.O. NO.	7825
AREA		**DATE RECEIVED**	16 OCT. 1995
		DATE REPORTED	13-Nov-95
BORING NO.	CB-PNM-56	**DEPTH**	11.0 - 13.4'
SAMPLE NO.	1	**LAB NO.**	73/7154

LAW

February 8, 1996

Suelos, Inc.
Figueroa No. 611, Stop 18
Santurce, Puerto Rico

Attention: Mr. Carlos Rodríguez

Subject: Dilatometer Sounding Test Results
Puerto Nuevo Channel
San Juan, Puerto Rico
Law Engineering Project No. 20905-6-0003

Dear Mr. Rodríguez:

As authorized by your acceptance of our proposal for testing services, Law Environmental - Caribe (LAW) has completed the dilatometer testing program outlined by the U.S. Army Corps of Engineers, Jacksonville District. Five dilatometer soundings were performed adjacent to the Puerto Nuevo Channel at locations specified by you and shown on the Dilatometer Location Plan included in the Appendix. We understand that the objective of the soundings was to obtain soil modulus information for the purpose of deep foundation design. This report supersedes our draft version dated February 5, 1996.

Soil test borings had been previously drilled by others at the sounding locations, and that information was supplied to us prior to initiation of our work. The corresponding borings performed near the soundings areas are included in the Appendix. Several feet of fill material was initially encountered in the soil test borings near dilatometer locations DMT-2, -3, -4, and -6. Due to the heterogeneous composition of the fill, the dilatometer test was started below the fill at the elevation of the native soil. The following is a table summarizing the extent of each dilatometer sounding performed for this study.

Summary of Dilatometer Testing

Sounding	Soil Test Boring	Fill (Auger Depth)	Refusal	Comments
DMT-1	59D	none	52 ft	Tip refusal
DMT-2	7D	11 ft	43 ft	Friction refusal
DMT-3	4D	18 ft	49.5 ft	Tip refusal
DMT-4	11D	7 ft	30.5 ft	Tip refusal
DMT-6	62	4 ft	39.3 ft	Friction refusal

LAW ENVIRONMENTAL - CARIBE

A PUERTO RICO PARTNERSHIP
CASO BUILDING, SUITE 603
1225 PONCE DE LEON AVE.
SANTURCE, P.R. 00907
(809) 722-7740 · (809) 722-7796

B-1-1

The dilatometer blade was advanced using the downward stroke of a CME 750 mobile drilling rig supplied by Suelos, Inc. The blade progression was stopped at 1 foot intervals and the dilatometer test was performed in general accordance with ASTM procedures and the U.S. Department of Transportation Report FHWA-PA-87-024+84-24. The thrust was measured using a load cell placed at the top of the rods, above the ground surface. After testing, the raw data is reduced using a QBASIC computer program developed by Schmertman and Crapps, Inc. (1989)[1]. The reduced output data sheet for each sounding is are included in the Appendix.

The reduced data is also presented in graphical form illustrating the material index (I_D), the horizontal-stress index (K_D), and the dilatometer modulus (E_D). The definition of these terms is explained in detail in a technical paper presented by Campanella and Robertson (1990)[2]. Briefly, the material index represents the difference in the corrected "A" and "B" readings which defines the soil type. The horizontal stress index is based on the ratio of the corrected "A" reading, hydrostatic pore pressure, and the vertical effective stress. The dilatometer modulus is based on a proportional relationship between the difference of the corrected "A" and "B" readings. These three index parameters are used to interpret soil type, soil unit weight, coefficient of earth pressure at rest (K_o), overconsolidation ratio (OCR), constrained modulus (M), undrained shear strength (S_u), and friction angle (ϕ') through empirical correlations.

We sincerely appreciate the opportunity of working with you and the U.S. Army Corps of Engineers. We are available to consult further with you on this project or future projects.

Respectfully yours,

LAW ENVIRONMENTAL - CARIBE

Rebecca A. Russo
Geotechnical Consultant

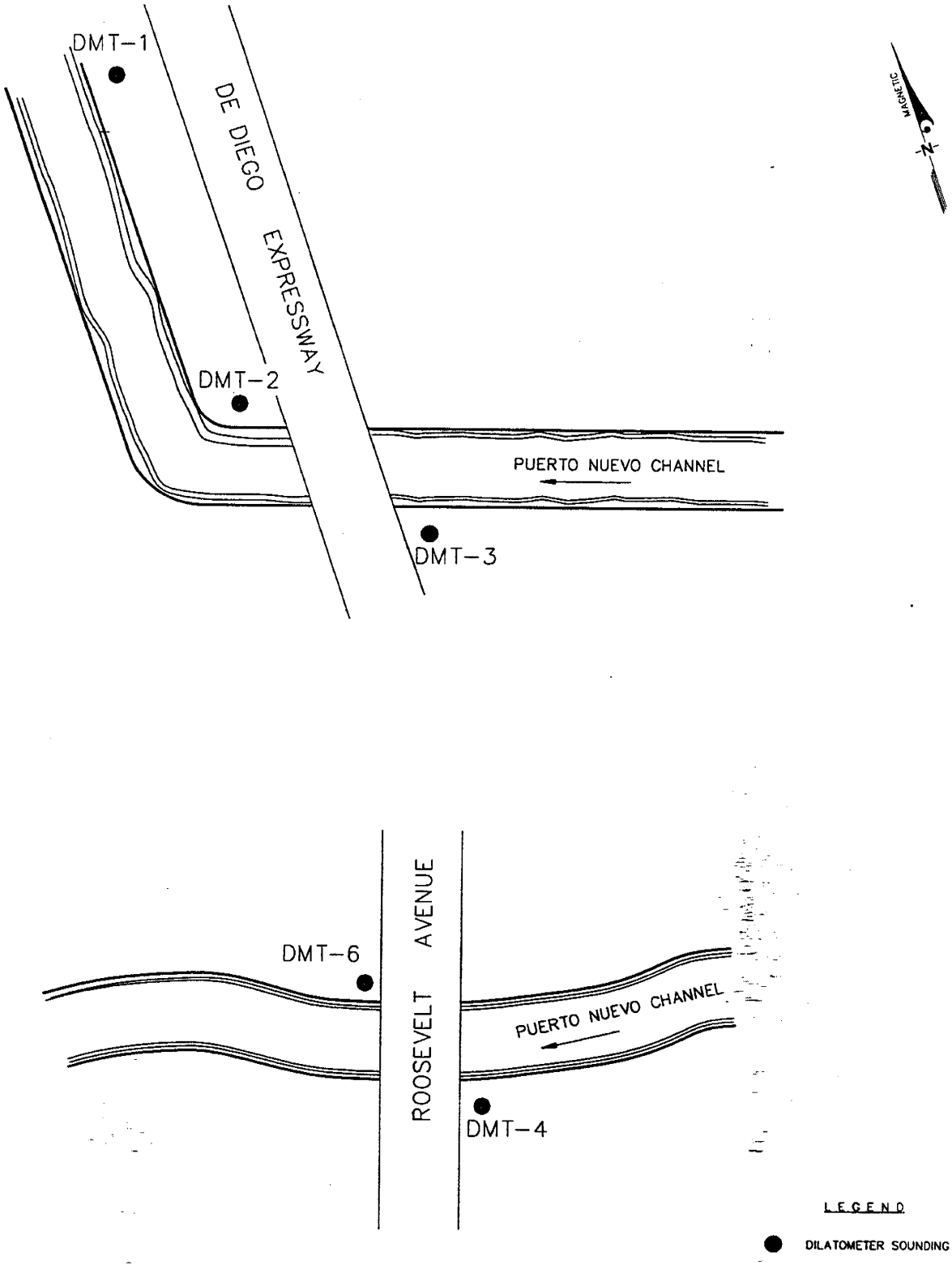
James W. Niehoff
Geotechnical Consultant

Wendell K. Rogers, P.E.
Partner, Principal Engineer

Schmertmann and Crapps, Inc. (1989) "Dilatometer Data Reduction Program." Based on the S&C Fortran Program "DILLY4". Written by Paul Bullock, November

Campanella, R.G. and Robertson, P.K. (1990). "Use and Interpretation of a Research Dilatometer." Canadian Geotechnical Journal, Volume 28, pg 113-126.

APPENDIX



DILATOMETER LOCATION PLAN

LAW
ENGINEERING AND ENVIRONMENTAL SERVICES

B-1-4

PUERTO NUEVO CHANNEL

JOB NO.	DATE:	SCALE:
20905-6-0003	FEB. 96	N.T.S.

CB-PNL-59 D (PN-DT1)

Hole No. CB-PNL-59

DRILLING LOG	DIVISION ATLANTIC DIVISION
1. PROJECT	PUERTO NUEVO CHANNEL, PUERTO NUEVO CHANNELS PROJECT, SAN JUAN, P.R.
2. LOCATION (Coordinates or Station)	X=623,084.90FT Y=216,375.86FT
3. DRILLING AGENCY	GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number)	CB-PNL-59
5. NAME OF DRILLER	SANTOS RODRIGUEZ
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	70.5'
8. DEPTH DRILLED INTO ROCK	-
9. TOTAL DEPTH OF HOLE	70.5'
10. DATE HOLE	STARTED 7/20/88 COMPLETED 7/20/88
11. ELEVATION GROUND WATER	1.14FT
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-450
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 47 UNDISTURBED -
14. TOTAL NUMBER CORE BOXES	2
15. ELEVATION TOP OF HOLE	4.56FT
16. TOTAL CORE RECOVERY FOR BORING	93.4 %
17. SIGNATURE OF INSPECTOR	ALBERTO R. BARRERA
18. DIRECTION OF BIT	SEE REMARKS
19. ELEVATIONS (Ft. MSL)	MSL
INSTALLATION	JACKSONVILLE DISTRICT CORPS OF ENGINEERS
SHEET	1 OF 4 SHEETS

ELEVATION FT	DEPTH FT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	SAMPLE NO.	BLOWS/6"	"N" VALUE	REMARKS
4.56	0		Clay, trace sand, trace roots, trace gravel, soft, yellowish brown. (CL)	33	1	2 2 2	4	
3.06	1.5		Clay, soft to medium yellowish brown to olive gray. (CH)	39	2	1 2 2	4	
				100	3	2 1 2	3	
			- medium stiff.	100	4	2 3 3	6	
				100	5	1 2 2	4	
				100	6	4 5 5	10	51.2
				100	7	1 1 2	3	
			- gray.	100	8	2 2 3	5	
				100	9	2 1 2	3	
				100	10	2 3 3	6	
				100	11	WH WH WH	WH	
				100	12	1 2 2	4	
			- trace organic matter.	100	13	1 1 2	3	
-15.44	20					1		

"N" VALUE - BLOWS IN LAST 12" OF PENETRATION OF 1-3/8" I.D. x 2' LONG SPLIT-SPOON SAMPLER FROM BLOWS OF 140 LBS. HAMMER DROPPING 30 INCHES.
WH - SAMPLER PENETRATED WITH WEIGHT OF HAMMER.
% - NATURAL WATER CONTENT (%)

PROJECT PUERTO NUEVO CHANNEL HOLE NO. CB-PNL-59

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT)

B-1-5

CB-PNL-59D

DRILLING LOG (Cont Sheet). ELEVATION TOP OF HOLE 4.56FT Hole No. CB-PNL-59

PROJECT PUERTO NUEVO CHANNEL, PUERTO NUEVO CHANNELS PROJECT, SAN JUAN, P.R. | INSTALLATION JACKSONVILLE DISTRICT CORPS OF ENGINEERS | Sheet 2 of 4 sheets

ELEVATION FT. a	DEPTH FT. b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV FRT e	SAMPLE NO f	BLOWS N	WATER g	REMARKS (Drilling rate, water loss, depth of weathering, etc.)
-15.44	20		As Above.	100	14	2 3 3	5	
				100	15	1 1 2	3	
				100	16	2 2 3	5	
			- olive stains.	39	17	2 2 3	5	
				94	18	2 1 2	3	
				56	19	2 3 3	6	
				67	20	2 2 3	5	
				100	21	1 2 3	5	
-26.94	31		Clay, trace fine sand, medium to stiff, olive gray to yellowish brown. (CH)	100	22	2 2 3	5	AS ABOVE.
				78	23	2 4 5	9	
				83	24	2 4 5	9	
				100	25	4 4 5	9	
				100	26	4 5 6	11	
				100	27	5 5 9	14	
				100	28	3 4 7	11	
-37.44	42		Clay, trace fine sand, very stiff, olive yellowish brown. (CH)	100	29	5 10 11	21	
-39.44	44					12		

ENG FORM 1836-A (ER 1110-1-1801) PUERTO NUEVO CHANNEL CB-PNL-59

6-1-6

CB-Prv-59D

DRILLING LOG (Cont Sheet), Elevation top of hole 4.56FT — Hole No. CB-PNL-59

Project: PUERTO NUEVO CHANNEL, PUERTO NUEVO CHANNELS PROJECT, SAN JUAN, P.R. — Installation: JACKSONVILLE DISTRICT CORPS OF ENGINEERS — Sheet 3 of 6 sheets

Elevation FT a	Depth FTb	Legend	Classification of Materials (Description) d	% Core Recovery e	Sample No f	Remarks (Drilling time, water loss, depth of weathering, etc.) Blows N	Wsg
-39.44	44		As Above, hard.	100	30	13 20 33	
-40.44	45		Clay, trace fine sand, yellowish brown, very stiff to hard. (CH)	100	31	3 6 9 15	
				100	32	7 9 15 24	
				100	33	7 8 10 18	
				100	34	7 10 14 24	
				100	35	5 9 12 21	
			- red stains.	100	36	17 18 18 36	
				100	37	4 8 11 19	
				100	38	8 16 17 33	
				100	39	6 8 9 17	
				100	40	7 8 10 18	
-55.44	60		Clay, very stiff, yellowish to reddish brown. (CH)	100	41	4 8 10 18	
				100	42	5 10 12 22	
				100	43	6 8 10 18	42.5
				100	44	6 9 14 23	
				100	45	7 10 10 20	
-63.44	68					6	

AS ABOVE.

ENG FORM 1836-A (EP 1110-1-1801) — PUERTO NUEVO CHANNEL — Hole No. CB-PNL-59

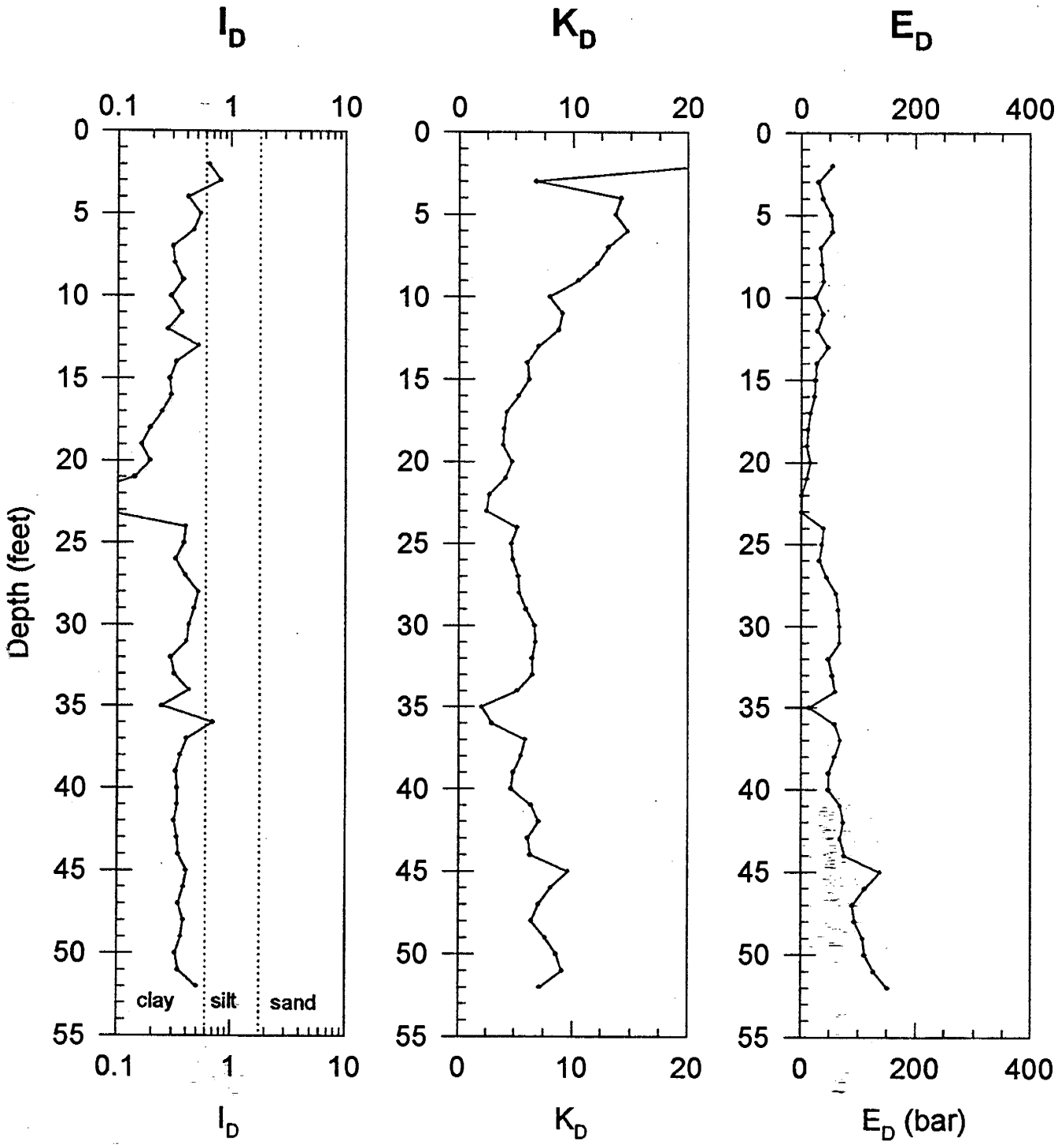
PB-1-7

DRILLING LOG (Cont Sheet) Elevation top of hole 4.56FT Hole No. CB-PNL-59

Project PUERTO NUEVO CHANNEL, PUERTO NUEVO CHANNELS PROJECT, SAN JUAN, P.R. Location JACKSONVILLE DISTRICT CORPS OF ENGINEERS Sheet 4 of 4 sheets

ELEVATION FT a	DEPTH FT b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERY e	SAMPLE NO f	BLOWS N	W g		REMARKS (Drilling time, water loss, depth of weathering, etc.)
-63.44	68		As Above; gray streaks.	100	46	8 14	22		AS ABOVE.
				100	47	6 10 12	22		
-65.94	70.5		END OF BORING NO. CB-PNL-59 AT 70'6" DEPTH; -65.94FT ELEVATION.						

CB-PNL-59D



1 BAR = 1.044 TSF

Law Environmental Caribe
Edificio Caso, Suite 603
Avenida Ponce de Leon 1225
Santurce, Puerto Rico 00907
Law Engineering and Environmental Services, Inc.

PUERTO NUEVO CHANNEL

Dilatometer Test Results for DMT-1

Law Engineering Job Number 20905-6-0003

B-1-9

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
LAW ENGINEERING - PUERTO RICO
JOB FILE: RIO PUERTO NUEVO PROJECT
LOCATION: LOCATION: B-59D
SNDG.BY : J NIEHOFF - LAW ENGINEERING - ATLANTA
ANAL.BY : RUSSO - LAW ENGINEERING

SNDG. NO. DMT-1
PAGE 1
FILE NO. : 20905-6-0003

SNDG.DATE: 1 FEBRUARY 96
ANAL.DATE: 1 FEBRUARY 96

ANALYSIS PARAMETERS: LO RANGE = 9.00 BARS ROD DIAM. = 6.03 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 1.10 M LO GAGE 0 = 0.15 BARS FR.RED.DIA. = 5.39 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 1.00 M HI GAGE 0 = 0.60 BARS LIN.ROD WT. = 6.80 KGF/M DELTA-A = 0.12 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.90 BARS M FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT KO FACTOR = 1.00

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
0.61	953.	2.55	5.05		0.12	0.90	0.15	9.00	0.60	0.00	2.45	4.00		0.000	1.70	0.110
0.91	635.	1.15	3.00		0.12	0.90	0.15	9.00	0.60	0.00	1.08	1.95		0.000	1.60	0.159
1.22	635.	2.75	4.80		0.12	0.90	0.15	9.00	0.60	0.00	2.67	3.75		0.022	1.70	0.187
1.52	590.	3.00	5.45		0.12	0.90	0.15	9.00	0.60	0.00	2.90	4.40		0.051	1.70	0.208
1.83	726.	3.55	6.05		0.12	0.90	0.15	9.00	0.60	0.00	3.45	5.00		0.081	1.70	0.229
2.13	817.	3.45	5.40		0.12	0.90	0.15	9.00	0.60	0.00	3.37	4.35		0.111	1.70	0.250
2.44	907.	3.50	5.50		0.12	0.90	0.15	9.00	0.60	0.00	3.42	4.45		0.141	1.70	0.271
2.74	1043.	3.30	5.40		0.12	0.90	0.15	9.00	0.60	0.00	3.22	4.35		0.171	1.70	0.292
3.05	1089.	2.75	4.45		0.12	0.90	0.15	9.00	0.60	0.00	2.69	3.40		0.201	1.60	0.311
3.35	1270.	3.30	5.35		0.12	0.90	0.15	9.00	0.60	0.00	3.22	4.30		0.231	1.70	0.331
3.66	1225.	3.40	5.20		0.12	0.90	0.15	9.00	0.60	0.00	3.33	4.15		0.261	1.70	0.352
3.96	1315.	3.00	5.30		0.12	0.90	0.15	9.00	0.60	0.00	2.91	4.25		0.290	1.70	0.372
4.27	1315.	2.75	4.50		0.12	0.90	0.15	9.00	0.60	0.00	2.68	3.45		0.321	1.60	0.392
4.57	1497.	2.95	4.65		0.12	0.90	0.15	9.00	0.60	0.00	2.89	3.60		0.350	1.60	0.410
4.87	1542.	2.70	4.35		0.12	0.90	0.15	9.00	0.60	0.00	2.64	3.30		0.380	1.60	0.428
5.18	1452.	2.35	3.80		0.12	0.90	0.15	9.00	0.60	0.00	2.30	2.75		0.410	1.60	0.446
5.49	1406.	2.35	3.70		0.12	0.90	0.15	9.00	0.60	0.00	2.30	2.65		0.441	1.60	0.464
5.79	1452.	2.40	3.70		0.12	0.90	0.15	9.00	0.60	0.00	2.36	2.65		0.470	1.50	0.480
6.10	1497.	2.90	4.35		0.12	0.90	0.15	9.00	0.60	0.00	2.85	3.30		0.500	1.60	0.497
6.40	1497.	2.70	4.00		0.12	0.90	0.15	9.00	0.60	0.00	2.66	2.95		0.530	1.50	0.513
6.71	1497.	2.00	3.05		0.12	0.90	0.15	9.00	0.60	0.00	1.97	2.00		0.560	1.50	0.528
7.01	1542.	1.95	3.00		0.12	0.90	0.15	9.00	0.60	0.00	1.92	1.95		0.590	1.50	0.543
7.32	1769.	3.60	5.70		0.12	0.90	0.15	9.00	0.60	0.00	3.52	4.65		0.620	1.70	0.561
7.62	1860.	3.45	5.45		0.12	0.90	0.15	9.00	0.60	0.00	3.37	4.40		0.650	1.70	0.582
7.92	1950.	3.65	5.55		0.12	0.90	0.15	9.00	0.60	0.00	3.58	4.50		0.679	1.70	0.603
8.23	1860.	4.10	6.35		0.12	0.90	0.15	9.00	0.60	0.00	4.01	5.30		0.710	1.70	0.624
8.53	2041.	4.30	7.00		0.12	0.90	0.15	9.00	0.60	0.00	4.19	5.95		0.739	1.70	0.644
8.84	2223.	4.85	7.65		0.12	0.90	0.15	9.00	0.60	0.00	4.73	6.60		0.769	1.80	0.667
9.14	2676.	5.55	8.40		0.12	0.90	0.15	9.00	0.60	0.00	5.43	7.35		0.799	1.80	0.691
9.45	2540.	5.80	8.65		0.12	0.90	0.15	9.00	0.60	0.00	5.68	7.60		0.829	1.80	0.715
9.75	2676.	5.75	8.10		0.12	0.90	0.15	9.00	0.60	0.00	5.65	7.05		0.859	1.80	0.739
10.06	2495.	5.95	8.45		0.12	0.90	0.15	9.00	0.60	0.00	5.85	7.40		0.889	1.80	0.763
10.36	2540.	5.10	7.75		0.12	0.90	0.15	9.00	0.60	0.00	4.99	6.70		0.919	1.70	0.785
10.67	2495.	2.65	4.05		0.12	0.90	0.15	9.00	0.60	0.00	2.60	3.00		0.949	1.60	0.805
10.97	2631.	3.50	6.10		0.12	0.90	0.15	9.00	0.60	0.00	3.39	5.05		0.978	1.70	0.824
11.28	2812.	6.10	9.00		0.12	0.90	0.15	9.00	0.60	0.00	5.98	7.95		1.009	1.80	0.847
11.58	2812.	5.95	8.55		0.12	0.90	0.15	9.00	0.60	0.00	5.84	7.50		1.038	1.80	0.870
11.89	2767.	5.50	7.85		0.12	0.90	0.15	9.00	0.60	0.00	5.40	6.80		1.069	1.70	0.893
12.19	3311.	5.45	7.80		0.12	0.90	0.15	9.00	0.60	0.00	5.35	6.75		1.098	1.70	0.914
12.50	3357.	7.25	10.60		0.12	0.90	0.15	9.00	0.60	0.00	7.13	9.10		1.129	1.80	0.937
12.80	3629.	8.10	11.60		0.12	0.90	0.15	9.00	0.60	0.00	7.97	10.10		1.158	1.80	0.960
13.11	3402.	7.35	10.70		0.12	0.90	0.15	9.00	0.60	0.00	7.23	9.20		1.188	1.80	0.985

B-1-10

13.41	3765.	7.75	11.30	0.12	0.90	0.15	9.00	0.60	0.00	7.62	9.80	1.218	1.80	1.008
13.72	4128.	11.80	16.60	0.12	0.90	0.15	9.00	0.60	0.00	11.13	15.10	1.248	1.90	1.034
14.02	4264.	10.50	14.60	0.12	0.90	0.15	9.00	0.60	0.00	9.87	13.10	1.278	1.90	1.060
14.33	4400.	9.60	13.10	0.12	0.90	0.15	9.00	0.60	0.00	9.00	11.60	1.308	1.80	1.086
14.63	4536.	9.10	12.70	0.12	0.90	0.15	9.00	0.60	0.00	8.49	11.20	1.338	1.80	1.110
14.94	4491.	10.70	14.70	0.12	0.90	0.15	9.00	0.60	0.00	10.07	13.20	1.368	1.90	1.136
15.24	4536.	12.00	16.10	0.12	0.90	0.15	9.00	0.60	0.00	11.37	14.60	1.397	1.90	1.162
15.55	4536.	12.90	17.40	0.12	0.90	0.15	9.00	0.60	0.00	12.25	15.90	1.428	1.90	1.190
15.85	4536.	10.90	16.10	0.12	0.90	0.15	9.00	0.60	0.00	10.21	14.60	1.457	1.90	1.216
0.00		0.00	0.00	0.12	0.90									

END OF SOUNDING

(INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. DMT-1
LAW ENGINEERING - PUERTO RICO PAGE 2
JOB FILE: RIO PUERTO NUEVO PROJECT FILE NO. : 20905-6-0003
LOCATION: LOCATION: B-59D
SNDG.BY : J NIEHOFF - LAW ENGINEERING - ATLANTA SNDG.DATE: 1 FEBRUARY 96
ANAL.BY : RUSSO - LAW ENGINEERING ANAL.DATE: 1 FEBRUARY 96

ANALYSIS PARAMETERS: LO RANGE = 9.00 BARS ROD DIAM. = 6.03 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 1.10 M LO GAGE 0 = 0.15 BARS FR.RED.DIA. = 5.39 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 1.00 M HI GAGE 0 = 0.60 BARS LIN.ROD WT. = 6.80 KGF/M DELTA-A = 0.12 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.90 BARS M FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT KO FACTOR = 1.00

Z (M)	KD	ID	UD	ED (BAR)	KO	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
0.61	22.24	0.64	0.00	54.	2.95	0.49	21.7	40.5	0.18	36.2	4.71	42.8	176.	CLAYEY SILT
0.91	6.80	0.81	0.00	30.	1.43	0.16	17.4	39.1	0.26	35.2	1.07	6.7	64.	CLAYEY SILT
1.22	14.14	0.41	0.00	38.	2.27	0.47	12.1	34.5	0.29	30.4	3.96	21.1	106.	SILTY CLAY
1.52	13.70	0.53	0.00	52.	2.23	0.51	10.4	32.9	0.32	28.8	4.18	20.1	146.	SILTY CLAY
1.83	14.69	0.46	0.00	54.	2.32	0.61	12.9	33.5	0.36	29.7	5.14	22.4	154.	SILTY CLAY
2.13	13.07	0.30	0.00	34.	2.17	0.57	16.0	34.5	0.39	30.9	4.67	18.7	93.	CLAY
2.44	12.10	0.31	0.00	36.	2.07	0.57	18.8	35.1	0.43	31.8	4.49	16.6	96.	CLAY
2.74	10.44	0.37	0.00	39.	1.89	0.51	23.9	36.4	0.46	33.3	3.84	13.2	100.	SILTY CLAY
3.05	7.98	0.29	0.00	25.	1.59	0.39	27.4	37.3	0.50	34.4	2.70	8.7	56.	CLAY
3.35	9.04	0.36	0.00	38.	1.73	0.48	31.4	37.5	0.53	34.7	3.48	10.5	90.	SILTY CLAY
3.66	8.73	0.27	0.00	28.	1.69	0.49	29.8	36.9	0.56	34.2	3.50	10.0	67.	CLAY
3.96	7.02	0.51	0.00	47.	1.47	0.39	34.5	37.8	0.60	35.2	2.64	7.1	100.	SILTY CLAY
4.27	6.02	0.32	0.00	27.	1.32	0.34	35.5	37.9	0.63	35.5	2.19	5.6	53.	CLAY
4.57	6.19	0.28	0.00	25.	1.35	0.37	40.8	38.4	0.66	36.1	2.39	5.8	50.	CLAY
4.87	5.28	0.29	0.00	23.	1.21	0.32	43.5	38.8	0.70	36.6	1.95	4.6	42.	CLAY
5.18	4.24	0.24	0.00	16.	1.03	0.25	42.1	38.8	0.72	36.6	1.44	3.2	25.	CLAY
5.49	4.01	0.19	0.00	12.	0.99	0.24	40.7	38.4	0.75	36.3	1.38	3.0	19.	CLAY
5.79	3.93	0.16	0.00	10.	0.97	0.25	42.2	38.5	0.78	36.4	1.38	2.9	16.	MUD
6.10	4.72	0.19	0.00	16.	1.11	0.32	42.0	37.9	0.80	35.9	1.90	3.8	27.	CLAY
6.40	4.14	0.14	0.00	10.	1.01	0.28	42.9	38.1	0.83	36.1	1.60	3.1	16.	MUD
6.71	2.67	0.02	0.00	1.	0.71	0.17	45.8	39.0	0.86	37.2	0.83	1.6	1.	MUD
7.01	2.45	0.02	0.00	1.	0.66	0.15	47.7	39.3	0.89	37.4	0.74	1.4	1.	MUD
7.32	5.16	0.39	0.00	39.	1.19	0.40	49.0	38.0	0.91	36.1	2.46	4.4	72.	SILTY CLAY
7.62	4.68	0.38	0.00	36.	1.11	0.37	52.7	38.3	0.94	36.6	2.19	3.8	61.	SILTY CLAY
7.92	4.81	0.32	0.00	32.	1.13	0.40	55.0	38.3	0.98	36.7	2.37	3.9	56.	CLAY
8.23	5.29	0.39	0.00	45.	1.21	0.46	50.7	37.5	1.00	35.8	2.84	4.6	83.	SILTY CLAY
8.53	5.35	0.51	0.00	61.	1.22	0.48	56.0	37.9	1.04	36.3	2.99	4.6	114.	SILTY CLAY
8.84	5.94	0.47	0.00	65.	1.31	0.57	60.0	37.9	1.08	36.3	3.64	5.5	127.	SILTY CLAY
9.14	6.70	0.42	0.00	67.	1.42	0.69	72.2	38.5	1.12	37.1	4.56	6.6	139.	SILTY CLAY
9.45	6.78	0.40	0.00	67.	1.43	0.72	67.1	37.9	1.15	36.5	4.80	6.7	140.	SILTY CLAY
9.75	6.49	0.29	0.00	48.	1.39	0.71	71.8	38.2	1.20	36.8	4.64	6.3	100.	CLAY
10.06	6.50	0.31	0.00	54.	1.39	0.73	65.5	37.4	1.23	36.1	4.79	6.3	111.	CLAY
10.36	5.18	0.42	0.00	59.	1.19	0.57	70.3	38.1	1.27	36.8	3.47	4.4	108.	SILTY CLAY
10.67	2.05	0.24	0.00	14.	0.56	0.18	78.6	40.2	1.32	39.0	0.84	1.0	12.	CLAY
10.97	2.93	0.69	0.00	58.	0.77	0.29	80.1	39.6	1.35	38.4	1.49	1.8	72.	CLAYEY SILT
11.28	5.87	0.40	0.00	68.	1.30	0.72	76.0	37.9	1.37	36.7	4.54	5.4	134.	SILTY CLAY
11.58	5.52	0.35	0.00	58.	1.24	0.68	76.7	37.9	1.40	36.8	4.24	4.9	109.	CLAY
11.89	4.85	0.32	0.00	48.	1.14	0.60	77.2	38.0	1.44	36.9	3.56	4.0	85.	CLAY
12.19	4.66	0.33	0.00	48.	1.10	0.58	95.3	39.2	1.49	38.2	3.42	3.7	83.	CLAY
12.50	6.40	0.33	0.00	68.	1.38	0.88	90.0	38.1	1.51	37.2	5.75	6.1	140.	CLAY
12.80	7.09	0.31	0.00	74.	1.48	1.03	95.8	38.2	1.55	37.2	6.92	7.2	159.	CLAY
13.11	6.13	0.33	0.00	68.	1.34	0.88	91.6	38.0	1.59	37.1	5.65	5.7	137.	CLAY

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13.41	6.35	0.34	0.00	76.	1.37	0.94	102.0	38.4	1.63	37.6	6.11	6.1	154.	CLAY
13.72	9.56	0.40	0.00	138.	1.79	1.61	100.6	37.5	1.66	36.6	11.87	11.5	338.	SILTY CLAY
14.02	8.10	0.38	0.00	112.	1.61	1.34	109.9	38.1	1.72	37.4	9.40	8.9	256.	SILTY CLAY
14.33	7.08	0.34	0.00	90.	1.47	1.16	117.8	38.6	1.76	37.9	7.80	7.2	194.	CLAY
14.63	6.45	0.38	0.00	94.	1.38	1.05	124.4	39.0	1.81	38.3	6.89	6.2	193.	SILTY CLAY
14.94	7.66	0.36	0.00	109.	1.55	1.34	117.1	38.2	1.84	37.6	9.23	8.1	242.	SILTY CLAY
15.24	8.58	0.32	0.00	112.	1.67	1.58	113.9	37.7	1.87	37.1	11.26	9.7	263.	CLAY
15.55	9.09	0.34	0.00	127.	1.73	1.74	110.9	37.3	1.91	36.7	12.63	10.6	305.	CLAY
15.85	7.20	0.50	0.00	152.	1.49	1.33	118.7	38.0	1.96	37.5	8.97	7.4	329.	SILTY CLAY
0.00									POOR DATA					

END OF SOUNDING

CB-PNB-7D (PW-DT2)

Hole No. CB-PNB-7

DRILLING LOG	Division SOUTH ATLANTIC	Installation JACKSONVILLE DISTRICT	Sheet 1 of 3 sheets
1. Project PUERTO NUEVO CHANNEL BRIDGES		11. Size and type of bit See remarks	
2. Location (Coordinates or Station) X= 621850.77 Y= 214783.12		12. Datum for elevation shown (MSL or MLW) MSL	
3. Drilling agency GEOCONSULT		13. Manufacturer's designation of drill CME - 55	
4. Hole No. (As shown on drawing title or letter) CB-PNB- 7		14. Total no. of overburden samples taken: Disturbed / Undisturbed	
5. Name of driller P. Robles		15. Total number core boxes 2	feet
6. Direction of hole ☒ Vertical ☐ Inclined ____ deg. from vert.		16. Elevation ground water -2.40	feet
7. Thickness of overburden		17. Date hole: Started 3-15-89 / Completed 3-16-89	
8. Depth drilled into rock		18. Elevation top of hole 9.60	
9. Total depth of hole 60 feet		19. Total core recovery for boring 83.0 %	
		20. Signature of inspector Kermit Schmidt, PE	

Elevation (ft)	Depth	Legend	Classification of materials (Description)	% Core Recov.	Box or Sample No.	Remarks (Drilling time, water loss, depth of weathering, etc., if significant)
+ 9.60	0.0					BIT OR BARREL B1s/6"
+ 8.10	1.5		TOP SOIL, organic, dark gray, with clay, medium, brown and gray organic, trace silt (CL)	67	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 3 3 4
			FILL material, mixture of rock fragments, gravel size, and clay, little silt, trace sand, brown and gray, from 1.5' to 11' (GC)	56	2	6 5 6
				78	3	3 3 6
				100	4	6 6 3
				67	5	3 3 2
				33	6	2 2 1
				56	7	1 1 1
- 1.40	11.0			44	8	3 1 1
- 3.90	13.5		CLAY, very soft, organic, very dark gray, little silt, trace sand (OH)	67	9	1 1 1
- 5.60	15.0		SAND, organic, fine to medium grained, trace clay, dark gray occ. shell fragments (SP)	72	10	N = 324 WH 1 1
- 6.90	16.5		CLAY, very soft, organic, very sandy, very dark gray, some silt, pebbles (OL)	44	11	WH WH 1
- 8.90	18.5		CLAY, very soft, organic, gray & very dark gray, little silt, trace sand, occ. fibrous matter and shell frags. (OH)	100	12	1 1 WH
-11.40	21.0		CLAY, stiff, possibly slightly organic, olive gray, little sand, trace silt, occ. pebbles, yellowish brown and olive mottled (CH)	100	13	1 2 4
				94	14	5 3 5 7

B-1-14

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.

Project PUERTO NUEVO CHANNEL BRIDGES Hole No. CB-PNB-7

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 9.60 feet | Hole No CB-PNB-7

PROJECT PUERTO NUEVO CHANNEL BRIDGES | LOCATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (Ft), a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., of significance) g
						BIT OR BARREL
						816/6"
-11.40	21.0		from 21' to 24' rust colored oxidized veins and nodules	100	15	1402 hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 3 4 6
				100	16	3 4 5
-14.40	24.0					
-15.90	25.5		from 24' to 25.5' sand, fine to medium grained	100	17	W = 35% PI= 35% LL= 54% PL= 19% 3 5 9
				100	18	4 6 9
				100	19	3 7 9
				100	20	4 5 8
				89	21	4 6 6
				100	22	3 5 7
-24.90	34.5			NR	23	3 6 6
-26.40	36.0		from 34.5' to 36' partly sandy	100	24	4 6 9
-27.90	37.5		from 36' to 37.5' sand, black mottled	72	25	4 5 7
			clay, stiff, silty, yellowish brown, some sand, occ. pebbles gray mottled	100	26	4 6 8
				83	27	4 6 10
-32.40	42.0			100	28	W = 26% PI=33% LL= 55% PL= 22% 5 6 10
			from 42' to 46.5' red to reddish brown	67	29	6 7 9
-35.40	45.0			89	30	6 6 9

ENG FORM 1836-A (EP 1110-1-1801) OBSOLETE OF 1 OCT 80

PROJECT PUERTO NUEVO CHANNEL BRIDGES CB-PNB-7

CB-PNB-7D

B-1-15

CB-PNB-7D

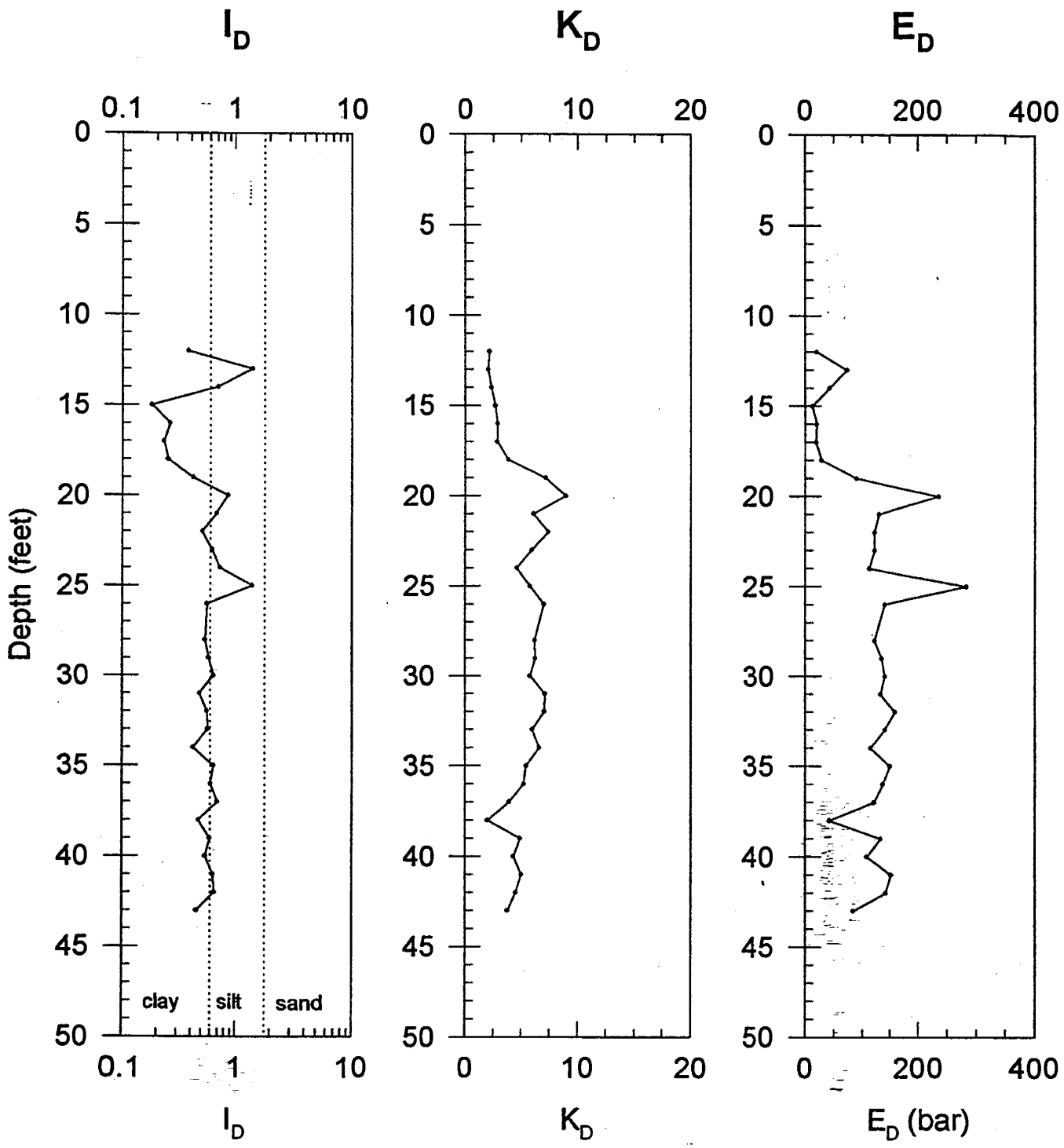
DRILLING LOG (Cont Sheet) Elevation top of hole 9.60 feet Hole No. CB-PNB-7

PROJECT PUERTO RICO CHANNEL BRIDGES | LOCATION JACKSONVILLE DISTRICT | SHEET 3 OF 3 SHEETS

ELEVATION (ft)	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% CORE RECOVERY	BOX OR SAMPLE NO	REMARKS	
						BIT OR BARREL	B1s/6"
-35.40	45.0'		from 45' to 46.5' very silty	100	31	140# hammer with 30" drop on 1 3/8" ID X 2" OD std. split spoon	4 4 6
-36.90	46.5'		from 46.5' to 48' some sand, fine grained, silty	100	32		5 7 12
-38.40	48.0'		SAND, fine to medium grained, clayey, trace silt, occ. pebbles (SW)	100	33		9 16 24
-39.90	49.5'		from 49.5' to 54' trace to little silt	89	34	W = 26%	2 3 11
				100	35		10 15 19
				94	36		9 15 20
-44.40	54.0'		from 54' to 57' very silty	78	37		11 17
				100	38		6 10 13
-47.40	57.0'		from 57' to 58.5' some clay, trace gravel angular	94	39		7 14 14
-48.90	58.5'		from 58.5' to 60' trace silt	78	40		14 21 20
-50.40	60.0'		END 60.0'				

6-1-16

ENG FORM 1836-A (ER 1110-1-8101) PUERTO NUEVO CHANNEL BRIDGES CB-PNB-7



1 BAR = 1.044 TSF

Law Environmental Caribe
Edificio Caso, Suite 603
Avenida Ponce de Leon 1225
Santurce, Puerto Rico 00907
Law Engineering and Environmental Services, Inc.

PUERTO NUEVO CHANNEL

Dilatometer Test Results for DMT-2

Law Engineering Job Number 20905-6-0003

B-1-17

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. DMT-2
LAW ENGINEERING - PUERTO RICO PAGE 1
JOB FILE: RIO PUERTO NUEVO PROJECT FILE NO. : 20905-6-0003
LOCATION: LOCATION: B-7D
SNDG.BY : J NIEHOFF - LAW ENGINEERING - ATLANTA SNDG.DATE: 1 FEBRUARY 96
ANAL.BY : RUSSO - LAW ENGINEERING ANAL.DATE: 1 FEBRUARY 96

ANALYSIS PARAMETERS: LO RANGE = 9.00 BARS ROD DIAM. = 6.03 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 3.00 M LO GAGE 0 = 0.15 BARS FR.RED.DIA. = 5.39 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 3.60 M HI GAGE 0 = 0.60 BARS LIN.ROD WT. = 6.80 KGF/M DELTA-A = 0.10 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.64 BARS M FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT KO FACTOR = 1.00

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
3.96	318.	1.65	2.95		0.10	0.64	0.15	9.00	0.60	0.00	1.57	2.16		0.035	1.60	0.720
4.27	408.	1.70	4.45		0.10	0.64	0.15	9.00	0.60	0.00	1.55	3.66		0.066	1.70	0.740
4.57	499.	1.95	3.85		0.10	0.64	0.15	9.00	0.60	0.00	1.84	3.06		0.095	1.60	0.759
4.87	91.	2.25	3.35		0.10	0.64	0.15	9.00	0.60	0.00	2.18	2.56		0.125	1.60	0.777
5.18	91.	2.50	3.80		0.10	0.64	0.15	9.00	0.60	0.00	2.42	3.01		0.155	1.60	0.795
5.49	181.	2.55	3.80		0.10	0.64	0.15	9.00	0.60	0.00	2.47	3.01		0.185	1.60	0.813
5.79	635.	3.50	5.00		0.10	0.64	0.15	9.00	0.60	0.00	3.41	4.21		0.215	1.70	0.832
6.10	907.	6.55	10.20		0.10	0.64	0.15	9.00	0.60	0.00	6.38	8.96		0.245	1.80	0.855
6.40	1542.	8.55	16.20		0.10	0.64	0.15	9.00	0.60	0.00	8.18	14.96		0.275	1.95	0.881
6.71	1996.	6.05	10.80		0.10	0.64	0.15	9.00	0.60	0.00	5.82	9.56		0.305	1.80	0.907
7.01	363.	7.45	12.00		0.10	0.64	0.15	9.00	0.60	0.00	7.23	10.76		0.335	1.80	0.931
7.32	1452.	6.25	10.80		0.10	0.64	0.15	9.00	0.60	0.00	6.03	9.56		0.365	1.80	0.955
7.62	2495.	5.10	8.95		0.10	0.64	0.15	9.00	0.60	0.00	4.89	8.16		0.395	1.80	0.979
7.92	2903.	6.65	15.60		0.10	0.64	0.15	9.00	0.60	0.00	6.21	14.36		0.424	1.95	1.005
8.23	1950.	7.95	13.00		0.10	0.64	0.15	9.00	0.60	0.00	7.71	11.76		0.454	1.90	1.033
8.53	1860.	7.25	11.80		0.10	0.64	0.15	9.00	0.60	0.00	7.03	10.56		0.484	1.80	1.058
8.84	2268.	7.50	12.40		0.10	0.64	0.15	9.00	0.60	0.00	7.26	11.16		0.514	1.80	1.082
9.14	2540.	7.15	12.20		0.10	0.64	0.15	9.00	0.60	0.00	6.91	10.96		0.544	1.80	1.106
9.45	2676.	8.85	13.70		0.10	0.64	0.15	9.00	0.60	0.00	8.62	12.46		0.574	1.90	1.132
9.75	2812.	9.50	14.60		0.10	0.64	0.15	9.00	0.60	0.00	8.78	13.36		0.604	1.90	1.158
10.06	2812.	7.95	13.00		0.10	0.64	0.15	9.00	0.60	0.00	7.71	11.76		0.634	1.90	1.185
10.36	3130.	8.85	13.20		0.10	0.64	0.15	9.00	0.60	0.00	8.64	11.96		0.663	1.90	1.212
10.67	3493.	7.70	13.00		0.10	0.64	0.15	9.00	0.60	0.00	7.44	11.76		0.694	1.95	1.240
10.97	3674.	7.55	12.50		0.10	0.64	0.15	9.00	0.60	0.00	7.31	11.26		0.723	1.80	1.266
11.28	3856.	6.00	10.50		0.10	0.64	0.15	9.00	0.60	0.00	5.78	9.26		0.754	1.80	1.290
11.58	3493.	3.50	5.40		0.10	0.64	0.15	9.00	0.60	0.00	3.39	4.61		0.783	1.70	1.312
11.89	3493.	7.55	12.40		0.10	0.64	0.15	9.00	0.60	0.00	7.32	11.16		0.814	1.80	1.335
12.19	3810.	6.85	11.00		0.10	0.64	0.15	9.00	0.60	0.00	6.65	9.76		0.843	1.80	1.359
12.50	4218.	8.05	13.40		0.10	0.64	0.15	9.00	0.60	0.00	7.79	12.16		0.873	1.95	1.385
12.80	4082.	7.50	12.60		0.10	0.64	0.15	9.00	0.60	0.00	7.25	11.36		0.903	1.80	1.411
13.11	3901.	6.50	10.00		0.10	0.64	0.15	9.00	0.60	0.00	6.33	8.76		0.933	1.80	1.435
0.00		0.00	0.00		0.10	0.64										

END OF SOUNDING (INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

B-1-18

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. DMT-2
LAW ENGINEERING - PUERTO RICO PAGE 2
JOB FILE: RIO PUERTO NUEVO PROJECT FILE NO. : 20905-6-0003
LOCATION: LOCATION: B-7D
SNDG.BY : J NIEHOFF - LAW ENGINEERING - ATLANTA SNDG.DATE: 1 FEBRUARY 96
ANAL.BY : RUSSO - LAW ENGINEERING ANAL.DATE: 1 FEBRUARY 96

ANALYSIS PARAMETERS: LO RANGE = 9.00 BARS ROD DIAM. = 6.03 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 3.00 M LO GAGE 0 = 0.15 BARS FR.RED.DIA. = 5.39 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 3.60 M HI GAGE 0 = 0.60 BARS LIN.ROD WT. = 6.80 KGF/M DELTA-A = 0.10 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.64 BARS M FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT KO FACTOR = 1.00

Z (M)	KD	ID	UD	ED (BAR)	KO	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
3.96	2.13	0.38	0.00	20.	0.58	0.17	8.0	24.5	1.02	22.3	0.80	1.1	19.	SILTY CLAY
4.27	2.01	1.42	0.00	73.	0.71	0.16	10.8	26.6	1.07	24.6	1.47	2.0	69.	SANDY SILT
4.57	2.30	0.70	0.00	42.	0.62	0.20	12.9	27.9	1.11	26.1	0.94	1.2	42.	CLAYEY SILT
4.87	2.65	0.18	0.00	13.	0.71	0.24	2.0	11.3	0.93	8.6	1.20	1.6	15.	CLAY
5.18	2.85	0.26	0.00	20.	0.75	0.27	2.0	10.8	0.94	8.1	1.38	1.7	25.	CLAY
5.49	2.82	0.23	0.00	19.	0.74	0.27	3.6	16.3	1.04	13.9	1.39	1.7	22.	CLAY
5.79	3.84	0.25	0.00	28.	0.96	0.41	13.6	27.0	1.21	25.3	2.30	2.8	42.	CLAY
6.10	7.17	0.42	0.00	90.	1.49	0.93	14.5	26.5	1.24	24.9	6.27	7.3	194.	SILTY CLAY
6.40	8.97	0.86	0.00	235.	1.72	1.27	27.4	30.5	1.33	29.1	9.16	10.4	563.	CLAYEY SILT
6.71	6.08	0.68	0.00	130.	1.33	0.80	48.0	34.6	1.42	33.4	5.14	5.7	258.	CLAYEY SILT
7.01	7.41	0.51	0.00	122.	1.52	1.05	3.5	14.2	1.16	12.1	7.18	7.7	268.	SILTY CLAY
7.32	5.93	0.62	0.00	122.	1.31	0.82	31.2	31.5	1.45	30.3	5.21	5.5	241.	CLAYEY SILT
7.62	4.60	0.73	0.00	113.	1.09	0.61	67.6	36.8	1.56	35.8	3.59	3.7	194.	CLAYEY SILT
7.92	5.76	1.41	0.00	283.	0.89	0.83	75.6	37.7	1.62	36.9	5.07	5.0	555.	SANDY SILT
8.23	7.02	0.56	0.00	141.	1.47	1.09	41.7	32.6	1.59	31.6	7.33	7.1	301.	SILTY CLAY
8.53	6.19	0.54	0.00	122.	1.35	0.96	41.2	32.6	1.63	31.6	6.16	5.8	246.	SILTY CLAY
8.84	6.24	0.58	0.00	135.	1.35	0.99	53.1	34.1	1.69	33.2	6.38	5.9	273.	SILTY CLAY
9.14	5.76	0.64	0.00	141.	1.28	0.91	63.0	35.2	1.74	34.4	5.75	5.2	272.	CLAYEY SILT
9.45	7.11	0.48	0.00	133.	1.48	1.21	61.7	34.5	1.77	33.8	8.18	7.2	287.	SILTY CLAY
9.75	7.06	0.56	0.00	159.	1.47	1.23	65.6	34.8	1.82	34.1	8.29	7.2	341.	SILTY CLAY
10.06	5.97	0.57	0.00	141.	1.31	1.02	69.4	35.3	1.87	34.6	6.52	5.5	277.	SILTY CLAY
10.36	6.58	0.42	0.00	115.	1.40	1.18	76.4	35.6	1.92	34.9	7.77	6.4	239.	SILTY CLAY
10.67	5.44	0.64	0.00	150.	1.23	0.95	92.4	36.9	1.98	36.4	5.91	4.8	281.	CLAYEY SILT
10.97	5.21	0.60	0.00	137.	1.19	0.92	98.9	37.3	2.03	36.8	5.63	4.4	251.	SILTY CLAY
11.28	3.90	0.69	0.00	121.	0.97	0.65	110.9	38.3	2.09	37.9	3.66	2.8	186.	CLAYEY SILT
11.58	1.99	0.47	0.00	42.	0.54	0.29	108.7	39.2	2.14	38.8	1.30	1.0	36.	SILTY CLAY
11.89	4.87	0.59	0.00	133.	1.14	0.89	93.8	36.7	2.13	36.3	5.35	4.0	235.	SILTY CLAY
12.19	4.28	0.54	0.00	108.	1.04	0.77	106.6	37.6	2.19	37.3	4.44	3.3	176.	SILTY CLAY
12.50	4.99	0.63	0.00	152.	1.16	0.96	115.8	37.7	2.23	37.4	5.78	4.2	271.	CLAYEY SILT
12.80	4.50	0.65	0.00	142.	1.08	0.86	113.6	37.7	2.27	37.4	5.00	3.5	240.	CLAYEY SILT
13.11	3.76	0.45	0.00	84.	0.94	0.70	111.4	37.8	2.31	37.5	3.85	2.7	126.	SILTY CLAY
0.00									POOR DATA					

END OF SOUNDING

CB-PNB-4D (PN-DT3)

Hole No. CB-PNB-4

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT PUERTO NUEVO CHANNEL BRIDGES		8. SIZE AND TYPE OF BIT See remarks	
2. LOCATION (Coordinates or Station) X= 621633.36 Y= 214268.93		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEOCONSULT		12. MANUFACTURER'S DESIGNATION OF DRILL CME - 55	
4. HOLE NO. (As shown on drawing title and file number) CB-PNB-4		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED	UNDISTURBED
5. NAME OF DRILLER P. Robles		14. TOTAL NUMBER CORE BOXES 2	feet
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER -5.92	feet
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED 3-17-89	COMPLETED 3-20-89
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE 24.08	
9. TOTAL DEPTH OF HOLE 60 feet		18. TOTAL CORE RECOVERY FOR BORING 81.0. %	
		19. SIGNATURE OF INSPECTOR Kermit Schmidt, PE	

ELEVATION (ft.) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling rate, water loss, depth of weathering, etc., if significant) g
+24.08	0.0					BIT OR BARREL Bls/6"
+21.08	3.0		FILL material, clay, very sandy, brown, medium to silt, trace pebbles, occ. thin roots. (CL)	100	1	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 2 2 2
				33	2	3 4 4
+15.08	9.0		FILL material, clay, rock fragments, brown, little sand, trace silt, occ. brownish yellow, mottled (GC)	89	3	2 4 4
				44	4	4 5 4
				100	5	4 3 2
				28	6	7 6 6
+13.58	10.5		1.5" piece of rock from 9' to 10.5', trace clay	6	7	5 5 6
				50	8	3 2 2
				100	9	2 4 9
				44	10	5 11 25
				39	11	11 6 5
+ 6.08	18.0		many rock fragments from 16.5' to 18'	33	12	6 5 2
+ 3.08	21.0		CLAY, possibly slightly organic, dark gray and occ. brown, little silt, trace sand, occ. pebbles. (OH)	100	13	2 3 3
				100	14	1 2 3

B-1-20

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE

PROJECT PUERTO NUEVO CHANNEL BRIDGES HOLE NO. CB-PNB-4

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 24.08 feet Hole No. CB-PNB-4

PROJECT PUERTO NUEVO CHANNEL BRIDGES INSTALLATION JACKSONVILLE DISTRICT SHEET 2 OF 3 SHEETS

ELEVATION (ft.) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. FEET e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL B1&6"
+ 3.08	21.0					
				100	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 1 3 3
- 1.58	22.6					
			CLAY, little sand, olive gray, trace silt, occ. pebbles, yellowish brown mottled, medium (CH)	100	16	WH 2 3
- 0.08	24.0					
			oxidized veins from 24' to 25.5'	100	17	1 3 6
- 1.42	25.5					
			light gray and brown, stiff, from 25.5' to 31.5'	100	18	W = 36% PI= 33% LL= 55% PL= 22% 2 5 6
				100	19	4 6 8
				100	20	6 6 9
				100	21	4 7 10
- 7.42	31.5					
			clay, stiff, olive gray, occ. brown mottled, trace silt, trace sand, occ. pebbles	100	22	4 6 7
- 8.92	33.0					
			little pebbles from 33' to 34.5'	100	23	4 6 9
-10.42	34.5					
			partially silty, some sand from 34.5' to 36'	100	24	4 6 7
-11.92	36.0					
			CLAY, sandy, stiff, little pebbles yellowish brown and gray, sand, fine to coarse, silty (CL)	100	25	4 6 10
				100	26	4 6 7
				100	27	4 6 6
-16.42	40.5					
				100	28	W = 28% PI= 17% LL= 44% PL= 27% 3 5 7
				67	29	3 4 5
				56	30	4 4 6
-20.92	45.0					

ENG FORM 1836-A (ER 1110-1-1801) prev. edition of this form is obsolete.

BORED PUERTO NUEVO CHANNEL BRIDGES HOLE NO. CB-PNB-4

CB-PNB-4D

B-1-21

CB-PNB-4D

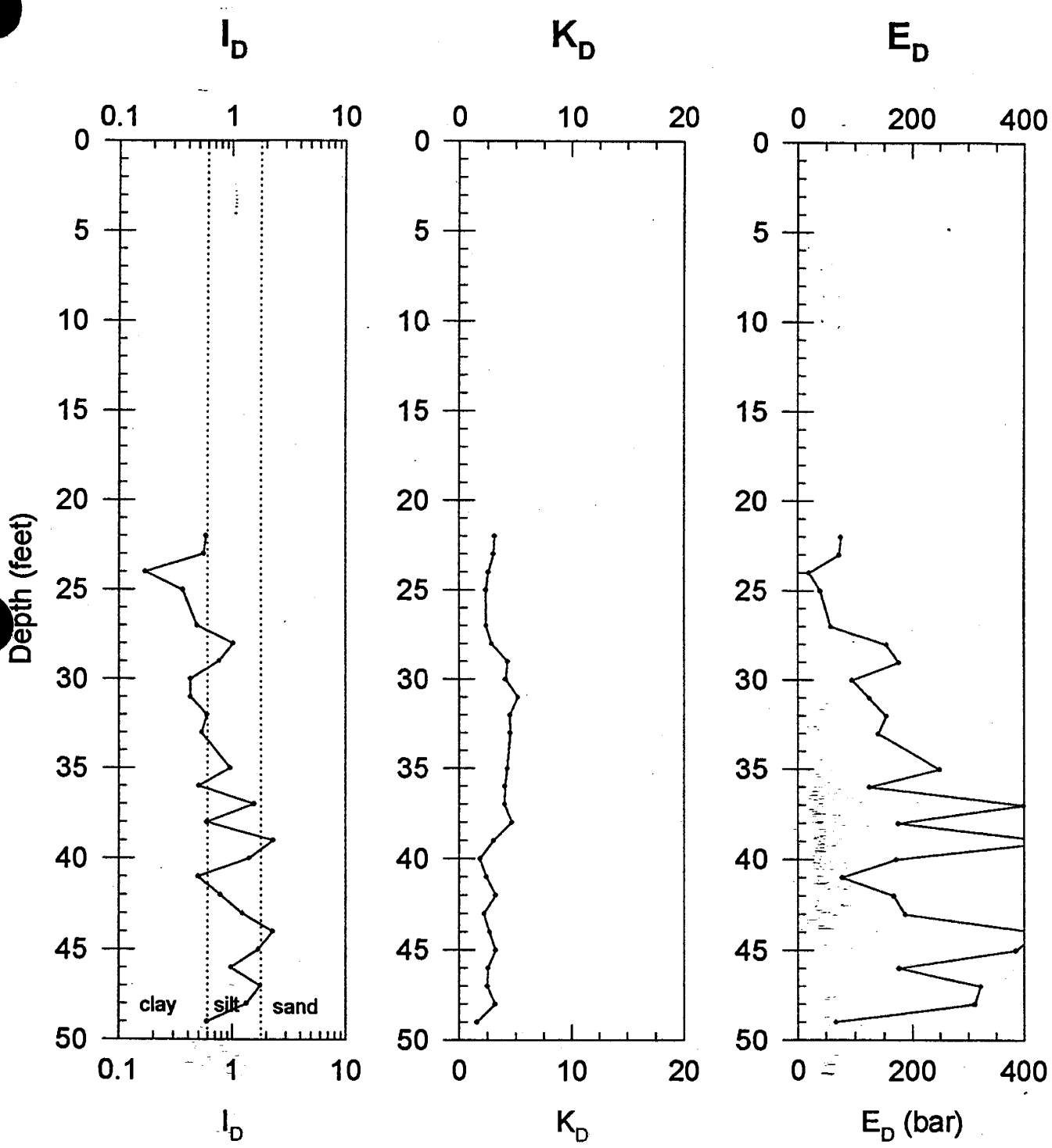
DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 24.08 feet Hole No. CB-PNB- 4

PROJECT PUERTO NUEVO CHANNEL BRIDGES INSTALLATION JACKSONVILLE DISTRICT SHEET 3 OF 3 SHEETS

ELEVATION (ft), a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Identification) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
						BIT OR BARREL B1s/6'
-20.98	45.0					
-22.42	46.5			NR	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 3 5 6
			SAND, fine to coarse, silty, yellowish brown, little sandstone, trace clay, from 46.5' to 49.5' (SM)	94	32	W = 21% 5 8 14
-25.42	49.5			89	33	7 7 9
			CLAY, very silty, some fine sand, yellowish brown, trace pebbles, occ. gray mottled, from 49.5' to 51.5' (CL)	56	34	W = 31% PI= 14% LL= 36% PL= 22% 6 9 10
-28.42	52.5			100	35	3 7 9
			CLAY, little silt, very stiff to hard, yellowish brown to red, trace sand dark gray mottled (CH)	100	36	8 10 13
				100	37	7 14 19
				100	38	8 14 19
				100	39	8 15 16
-34.42	58.5		little limestone, decomposed, from 58.5' to 60'	100	40	14 19 21
-35.92	60.0		END 60.0'			

6-1-22

ENG FORM 1836-A (EM 1110-1-1801) PUERTO NUEVO CHANNEL BRIDGES CB-PNB- 4



1 BAR = 1.044 TSF

Law Environmental Caribe
Edificio Caso, Suite 603
Avenida Ponce de Leon 1225
Santurce, Puerto Rico 00907
.aw Engineering and Environmental Services, Inc.

PUERTO NUEVO CHANNEL

Dilatometer Test Results for DMT-3

Law Engineering Job Number 20905-6-0003

B-1-23

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. DMT-3
LAW ENGINEERING - PUERTO RICO PAGE 1
JOB FILE: RIO PUERTO NUEVO PROJECT FILE NO. : 20905-6-0003
LOCATION: LOCATION: B-4D
SNDG.BY : J NIEHOFF - LAW ENGINEERING - ATLANTA SNDG.DATE: 30 JANUARY 96
ANAL.BY : RUSSO - LAW ENGINEERING ANAL.DATE: 31 JANUARY 96

ANALYSIS PARAMETERS: LO RANGE = 9.00 BARS ROD DIAM. = 6.03 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 7.30 M LO GAGE 0 = 0.15 BARS FR.RED.DIA. = 5.39 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 9.10 M HI GAGE 0 = 0.50 BARS LIN.ROD WT. = 6.80 KGF/M DELTA-A = 0.11 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.50 BARS M FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT KO FACTOR = 1.00

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
6.71	907.	3.90	6.60		0.11	0.50	0.15	9.00	0.50	0.00	3.76	5.95		0.000	1.80	1.210
7.01	1043.	3.95	6.55		0.11	0.50	0.15	9.00	0.50	0.00	3.81	5.90		0.000	1.80	1.263
7.32	1043.	3.45	4.60		0.11	0.50	0.15	9.00	0.50	0.00	3.38	3.95		0.000	1.70	1.316
7.62	998.	3.30	5.00		0.11	0.50	0.15	9.00	0.50	0.00	3.21	4.35		0.000	1.70	1.366
8.23	1270.	3.60	5.80		0.11	0.50	0.15	9.00	0.50	0.00	3.48	5.15		0.000	1.70	1.468
8.53	1452.	4.60	9.80		0.11	0.50	0.15	9.00	0.50	0.00	4.35	8.80		0.000	1.80	1.520
8.84	1769.	7.00	12.80		0.11	0.50	0.15	9.00	0.50	0.00	6.72	11.80		0.000	1.95	1.577
9.14	1950.	6.80	10.40		0.11	0.50	0.15	9.00	0.50	0.00	6.63	9.40		0.004	1.80	1.628
9.45	2177.	8.80	13.20		0.11	0.50	0.15	9.00	0.50	0.00	8.59	12.20		0.034	1.90	1.654
9.75	2223.	7.80	13.00		0.11	0.50	0.15	9.00	0.50	0.00	7.55	12.00		0.064	1.90	1.680
10.06	2540.	8.00	12.80		0.11	0.50	0.15	9.00	0.50	0.00	7.77	11.80		0.094	1.90	1.708
10.67	2903.	8.00	15.80		0.11	0.50	0.15	9.00	0.50	0.00	7.62	14.80		0.154	1.95	1.763
10.97	3221.	7.60	12.00		0.11	0.50	0.15	9.00	0.50	0.00	7.39	11.00		0.184	1.90	1.790
11.28	2994.	8.10	20.00		0.11	0.50	0.15	9.00	0.50	0.00	7.51	19.00		0.214	1.95	1.818
11.58	3221.	9.40	14.80		0.11	0.50	0.15	9.00	0.50	0.00	8.77	13.80		0.243	1.90	1.846
11.89	3221.	6.60	20.00		0.11	0.50	0.15	9.00	0.50	0.00	5.94	19.00		0.274	2.00	1.874
12.19	2676.	4.05	9.70		0.11	0.50	0.15	9.00	0.50	0.00	3.78	8.70		0.303	1.80	1.901
12.50	2631.	5.10	7.85		0.11	0.50	0.15	9.00	0.50	0.00	4.95	7.20		0.334	1.80	1.925
12.80	2994.	6.85	12.40		0.11	0.50	0.15	9.00	0.50	0.00	6.58	11.40		0.363	1.95	1.951
13.11	2903.	5.00	11.00		0.11	0.50	0.15	9.00	0.50	0.00	4.71	10.00		0.394	1.80	1.978
13.41	4128.	6.40	19.00		0.11	0.50	0.15	9.00	0.50	0.00	5.78	18.00		0.423	2.00	2.004
13.72	4128.	7.50	19.00		0.11	0.50	0.15	9.00	0.50	0.00	6.93	18.00		0.453	1.95	2.034
14.02	4128.	6.00	11.80		0.11	0.50	0.15	9.00	0.50	0.00	5.72	10.80		0.483	1.80	2.060
14.33	4037.	6.20	16.00		0.11	0.50	0.15	9.00	0.50	0.00	5.72	15.00		0.513	1.95	2.086
14.63	3719.	7.70	17.20		0.11	0.50	0.15	9.00	0.50	0.00	7.23	16.20		0.543	1.95	2.114
14.94	4173.	4.00	6.45		0.11	0.50	0.15	9.00	0.50	0.00	3.87	5.80		0.573	1.70	2.139
0.00		0.00	0.00		0.11	0.50										

END OF SOUNDING (INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

6-1-24

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. DMT-3
LAW ENGINEERING - PUERTO RICO PAGE 2
JOB FILE: RIO PUERTO NUEVO PROJECT FILE NO. : 20905-6-0003
LOCATION: LOCATION: B-4D
SNDG.BY : J NIEHOFF - LAW ENGINEERING - ATLANTA SNDG.DATE: 30 JANUARY 96
ANAL.BY : RUSSO - LAW ENGINEERING ANAL.DATE: 31 JANUARY 96

ANALYSIS PARAMETERS: LO RANGE = 9.00 BARS ROD DIAM. = 6.03 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 7.30 M LO GAGE 0 = 0.15 BARS FR.RED.DIA. = 5.39 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 9.10 M HI GAGE 0 = 0.50 BARS LIN.ROD WT. = 6.80 KGF/M DELTA-A = 0.11 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.50 BARS M FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT KO FACTOR = 1.00

Z (M)	KD	ID	UD	ED (BAR)	KO	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
6.71	3.10	0.58	0.00	76.	0.81	0.46	21.2	27.8	1.77	26.9	2.40	2.0	99.	SILTY CLAY
7.01	3.02	0.55	0.00	73.	0.79	0.46	25.2	28.9	1.87	28.1	2.40	1.9	92.	SILTY CLAY
7.32	2.57	0.17	0.00	20.	0.69	0.40	26.5	29.1	1.96	28.4	1.95	1.5	22.	CLAY
7.62	2.35	0.36	0.00	40.	0.63	0.37	25.8	28.7	2.02	28.1	1.75	1.3	40.	SILTY CLAY
8.23	2.37	0.48	0.00	58.	0.64	0.40	33.7	30.2	2.21	29.8	1.91	1.3	59.	SILTY CLAY
8.53	2.86	1.02	0.00	154.	0.75	0.52	36.9	30.4	2.29	30.0	2.66	1.7	193.	SILT
8.84	4.26	0.76	0.00	176.	1.03	0.89	40.0	30.2	2.37	29.9	5.13	3.3	288.	CLAYEY SILT
9.14	4.07	0.42	0.00	96.	1.00	0.87	45.9	31.0	2.47	30.8	4.93	3.0	152.	SILTY CLAY
9.45	5.17	0.42	0.00	125.	1.19	1.19	47.2	30.8	2.50	30.6	7.28	4.4	229.	SILTY CLAY
9.75	4.45	0.59	0.00	154.	1.07	1.01	51.8	31.5	2.56	31.4	5.86	3.5	258.	SILTY CLAY
10.06	4.49	0.53	0.00	140.	1.07	1.03	61.0	32.5	2.63	32.4	6.04	3.5	235.	SILTY CLAY
10.67	4.23	0.96	0.00	249.	1.03	0.99	73.0	33.6	2.74	33.6	5.68	3.2	409.	SILT
10.97	4.02	0.50	0.00	125.	0.99	0.94	84.0	34.5	2.80	34.5	5.33	3.0	196.	SILTY CLAY
11.28	4.01	1.57	0.00	399.	0.76	0.96	76.2	34.3	2.84	34.3	6.01	3.3	647.	SANDY SILT
11.58	4.62	0.59	0.00	175.	1.10	1.16	79.8	33.7	2.87	33.8	6.81	3.7	298.	SILTY CLAY
11.89	3.02	2.31	0.00	453.	0.61	0.69	89.4	35.5	2.96	35.6	3.98	2.1	637.	SILTY SAND
12.19	1.83	1.42	0.00	171.	0.48	0.37	79.8	35.0	2.99	35.1	2.30	1.2	145.	SANDY SILT
12.50	2.40	0.49	0.00	78.	0.65	0.53	74.4	34.0	3.00	34.1	2.56	1.3	81.	SILTY CLAY
12.80	3.19	0.78	0.00	167.	0.82	0.77	80.7	34.0	3.04	34.2	4.04	2.1	224.	CLAYEY SILT
13.11	2.18	1.23	0.00	184.	0.52	0.49	84.3	35.0	3.11	35.2	2.90	1.5	184.	SANDY SILT
13.41	2.67	2.28	0.00	424.	0.53	0.63	120.2	37.2	3.22	37.5	3.28	1.6	548.	SILTY SAND
13.72	3.19	1.71	0.00	384.	0.60	0.80	116.1	36.7	3.25	37.0	4.35	2.1	542.	SANDY SILT
14.02	2.54	0.97	0.00	176.	0.68	0.61	121.1	36.7	3.29	37.0	2.99	1.5	199.	SILT
14.33	2.49	1.78	0.00	322.	0.51	0.61	118.1	36.9	3.34	37.2	3.20	1.5	381.	SANDY SILT
14.63	3.16	1.34	0.00	311.	0.63	0.83	102.4	35.6	3.34	35.9	4.76	2.2	428.	SANDY SILT
14.94	1.54	0.59	0.00	67.	0.41	0.34	130.2	37.7	3.45	38.0	1.42	0.7	57.	SILTY CLAY
0.00									POOR DATA					

END OF SOUNDING

B-1-25

CB-PNB-11D (PN-DT 4)

Hole No. CB-PNE- 11

DRILLING LOG | DIVISION SOUTH ATLANTIC | INSTALLATION JACKSONVILLE DISTRICT | SHEET 1 OF 3 SHEETS

1. PROJECT: PUERTO NUEVO CHANNEL BRIDGES
2. LOCATION: X= 622878.55 Y= 212423.87
3. DRILLING AGENCY: GEOCONSULT
4. HOLE NO.: CB-PNB- 11
5. NAME OF DRILLER: H. González
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: -
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 60 feet
10. SIZE AND TYPE OF BIT: See remarks
11. DATUM FOR ELEVATION: NSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME - 45B
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED ____ UNDISTURBED ____
14. TOTAL NUMBER CORE BOXES: 2
15. ELEVATION GROUND WATER: -2.06 feet
16. DATE HOLE: STARTED 4-25-89 COMPLETED 4-25-89
17. ELEVATION TOP OF HOLE: 14.94
18. TOTAL CORE RECOVERY FOR BORING: 61.0
19. SIGNATURE OF INSPECTOR: Kermit Schmidt, PE

ELEVATION (ft)	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% CORE RECOV.	BOX OR SAMPLE NO.	REMARKS	
14.94	0.0					BIT OR BARREL	B1s/6"
13.44	1.5		FILL material, sand, some gravel size rock frags, ltc. clay silt, occ. roots (SM)	17	1	140# hammer with 30" drop on 1-3/8" ID X. 2" OD std. split spoon	17 12 3
			FILL material, clay, some sand, reddish brown and red, little silt, occ. pebbles (CH)	67	2		3 3 6
			very poor recovery	17	3		6 6 4
				100	4		3 4 5
7.44	7.5			100	5		2 3 6
			CLAY, stiff, dark olive gray, organic, little sand and silt, pebbles black mottled (OH)	100	6		3 4 6
				100	7		2 4 6
2.94	12.0			100	8		2 3 4
			CLAY, medium to stiff, some sand and silt, brown and gray, occ. reddish brown mottled (CH)	100	9		3 3 3
- 0.06	15.0			100	10		2 2 3
			partly sandy	100	11		2 3 3
- 1.56	16.5						2
			SAND, medium to coarse grained, clayey, gray, little silt, trace fine gravel (SC)	67	12		2 6 6
- 4.56	19.5		poor recovery	17	13		1 1 3
			CLAY, soft to medium, dark gray, some sand, little silt, organic (OH)	67	14		1 2 3
- 6.06	21.0						

B-1-26

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE

PROJECT PUERTO NUEVO CHANNEL BRIDGES HOLE NO. CB-PNB- 11

CB-PNB-11D

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 14.94 feet | Hole No. CB-PNB-11

PROJECT PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION JACKSONVILLE DISTRICT | SHEET 2 OF 3 SHEETS

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. (RQD) e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
						Bls/6"
- 6.06	21.0					
			CLAY, medium, slightly organic, dark olive gray, little sand and silt, occ. pebbles (CH)	67	15	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 1 / 1 / 2
- 7.56	22.5					
			some fibrous matter	67	16	1 / 1 / 2
- 9.06	24.0					
				NR	17	WH / WH / 1
-10.56	25.5					
			SILT, very stiff, sandy, some clay, brownish yellow, trace weathered rock frags. (ML)	68	18	4 / 10 / 11
-12.06	27.0					
			CLAY, stiff, silty, yellowish brown & olive gray, little sand, occ. pebbles, white mottled (CH)	67	19	2 / 4 / 4
-13.56	28.5					
			CLAY, very stiff, brownish yellow, weathered rock, frags some sand, gray mottled (CL)	67	20	10 / 16 / 17
-15.06	30.0					
			SAND, fine to medium grained, very silty, gray and yellow, some clay (SM)	NR	21	7 / 30 / 23
-16.56	31.5					
				67	22	17 / 23 / 22
				39	23	17 / 24 / 32
-19.56	34.5					
			SILT, very hard, sandy, olive gray and yellowish brown, some clay (ML)	39	24	46 / 50/3
				89	25	12 / 24 / 36
				78	26	17 / 31 / 50/4
-24.06	39.0					
			little weathered rock frags	44	27	12 / 50/2
				50	28	18 / 50/3
				100	29	15 / 22 / 32
-28.56	43.5					
				100	30	19 / 29 / 34
-30.06	45.0					

ENG FORM 1836-A (ER 1110-1-1801) | PROJECT PUERTO NUEVO CHANNEL BRIDGES | HOLE NO CB-PNB-11

6-1-27

CB-PNB-11D

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: 14.94 feet | Hole No. CB-PNB-11 | Sheet 3 of 3 sheets

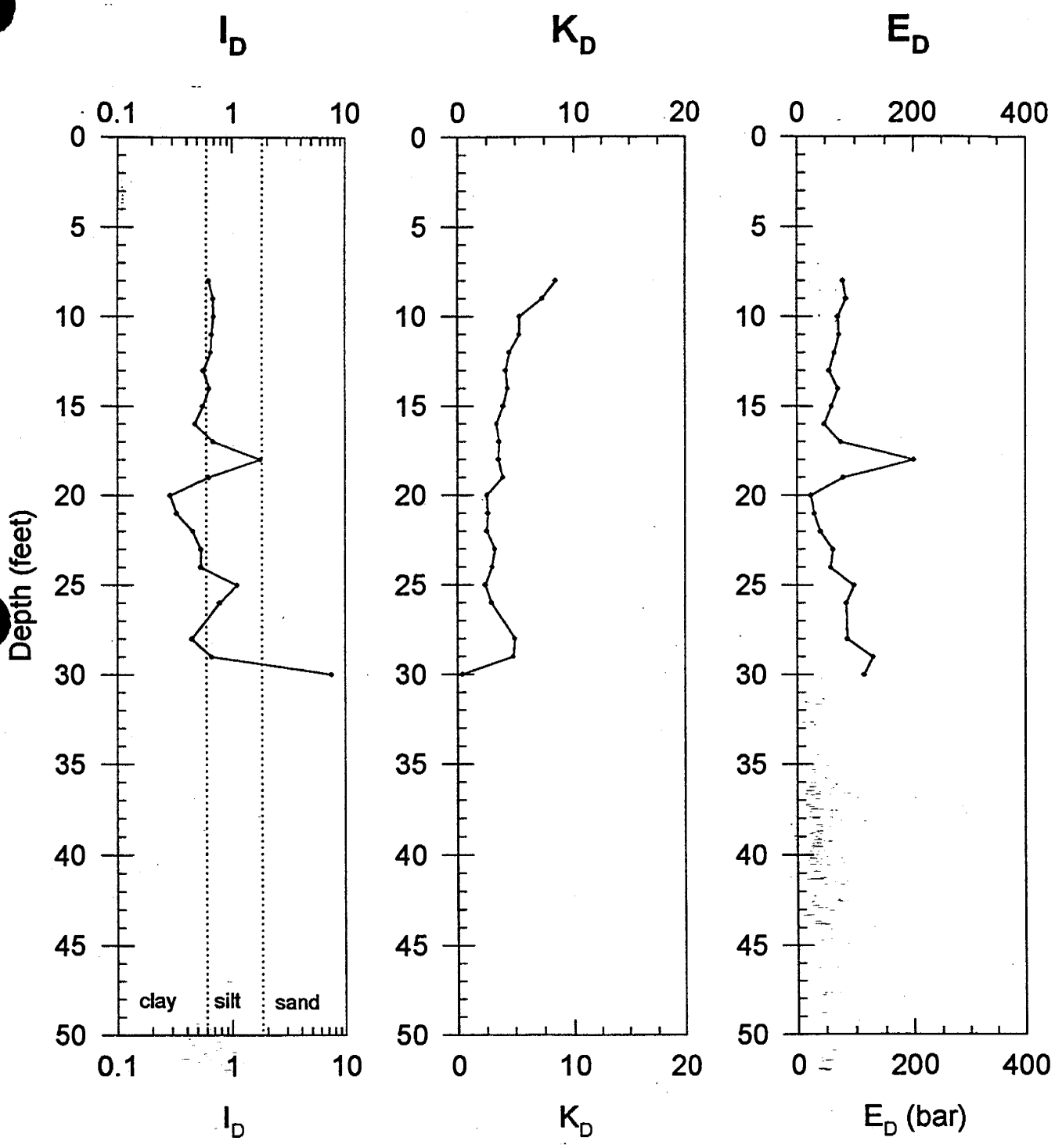
PROJECT: PUERTO NUEVO CHANNEL BRIDGES | INSTALLATION: JACKSONVILLE DISTRICT

ELEVATION (ft) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Identification) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc.; if significant) g
						BIT OR BARREL B1s/6"
-30.06	45.0			100	31	140# hammer with 30" drop on 1-3/8" ID X 2" OD std. split spoon 24 34
				67	32	29 48 50/3"
				NR	33	19 39 50/5"
-34.56	49.5					
-36.06	51.0		some weathered rock, partly clayey	56	34	38 50/4"
			CLAY, very hard, very sandy, white and very pale yellow, some silt (CL)	67	35	16 39 50/4"
				11	36	50/3"
				56	37	39 50/5"
-40.56	55.5					
			some weathered rock	11	38	50/3"
				11	39	50/2"
-43.56	58.5					
-45.06	60.0		SAND, fine grained, silty, some clay, olive brown and gray, trace pebbles (SM)	56	40	20 50/4"
			END 60.0'			

B-1-28

ENG FORM 1836-A (ER 1110-1-1801) OBSOLETE

PROJECT: PUERTO NUEVO CHANNEL BRIDGES HOLE NO: CB-PNB-11



1 BAR = 1.044 TSF

Law Environmental Caribe
Edificio Caso, Suite 603
Avenida Ponce de Leon 1225
Santurce, Puerto Rico 00907
Law Engineering and Environmental Services, Inc.

PUERTO NUEVO CHANNEL

Dilatometer Test Results for DMT-4

Law Engineering Job Number 20905-6-0003

B-1-29

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. DMT-4
LAW ENGINEERING - PUERTO RICO PAGE 1
JOB FILE: RIO PUERTO NUEVO PROJECT FILE NO. : 20905-6-0003
LOCATION: LOCATION: B-11D
SNDG.BY : J NIEHOFF - LAW ENGINEERING - ATLANTA SNDG.DATE: 30 JANUARY 96
ANAL.BY : RUSSO - LAW ENGINEERING ANAL.DATE: 31 JANUARY 96

ANALYSIS PARAMETERS: LO RANGE = 9.00 BARS ROD DIAM. = 6.03 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 4.60 M LO GAGE 0 = 0.14 BARS FR.RED.DIA. = 5.39 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 5.20 M HI GAGE 0 = 0.50 BARS LIN.ROD WT. = 6.80 KGF/M DELTA-A = 0.13 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.20 BARS M FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT KO FACTOR = 1.00

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
2.44	590.	3.85	6.40		0.13	0.20	0.14	9.00	0.50	0.00	3.73	6.06		0.000	1.80	0.440
2.74	817.	3.75	6.45		0.13	0.20	0.14	9.00	0.50	0.00	3.62	6.11		0.000	1.80	0.493
3.05	953.	3.05	5.35		0.13	0.20	0.14	9.00	0.50	0.00	2.94	5.01		0.000	1.70	0.546
3.35	907.	3.30	5.65		0.13	0.20	0.14	9.00	0.50	0.00	3.19	5.31		0.000	1.70	0.596
3.66	953.	3.00	5.15		0.13	0.20	0.14	9.00	0.50	0.00	2.90	4.81		0.000	1.70	0.648
3.96	907.	3.00	4.90		0.13	0.20	0.14	9.00	0.50	0.00	2.91	4.56		0.000	1.70	0.698
4.27	1315.	3.35	5.65		0.13	0.20	0.14	9.00	0.50	0.00	3.24	5.31		0.000	1.70	0.750
4.57	1542.	3.25	5.25		0.13	0.20	0.14	9.00	0.50	0.00	3.16	4.91		0.000	1.70	0.800
4.88	1542.	2.95	4.60		0.13	0.20	0.14	9.00	0.50	0.00	2.87	4.26		0.000	1.70	0.852
5.18	1542.	3.35	5.80		0.13	0.20	0.14	9.00	0.50	0.00	3.23	5.46		0.000	1.70	0.902
5.49	2495.	3.60	9.80		0.13	0.20	0.14	9.00	0.50	0.00	3.31	9.10		0.028	1.80	0.926
5.79	2313.	3.90	6.45		0.13	0.20	0.14	9.00	0.50	0.00	3.78	6.11		0.058	1.80	0.950
6.10	1950.	2.60	3.60		0.13	0.20	0.14	9.00	0.50	0.00	2.56	3.26		0.088	1.60	0.971
6.40	1678.	2.75	3.90		0.13	0.20	0.14	9.00	0.50	0.00	2.70	3.56		0.118	1.70	0.990
6.71	1452.	2.75	4.20		0.13	0.20	0.14	9.00	0.50	0.00	2.68	3.86		0.148	1.70	1.012
7.01	1542.	3.60	5.65		0.13	0.20	0.14	9.00	0.50	0.00	3.50	5.31		0.178	1.70	1.032
7.32	1724.	3.45	5.40		0.13	0.20	0.14	9.00	0.50	0.00	3.36	5.06		0.208	1.70	1.054
7.62	1814.	2.95	6.00		0.13	0.20	0.14	9.00	0.50	0.00	2.80	5.66		0.237	1.70	1.074
7.92	1860.	3.60	6.30		0.13	0.20	0.14	9.00	0.50	0.00	3.47	5.96		0.267	1.70	1.095
8.53	3039.	6.10	9.20		0.13	0.20	0.14	9.00	0.50	0.00	5.97	8.50		0.327	1.80	1.140
8.84	2767.	6.15	10.40		0.13	0.20	0.14	9.00	0.50	0.00	5.96	9.70		0.357	1.80	1.164
9.14	4309.	1.00	4.50		0.13	0.20	0.14	9.00	0.50	0.00	0.83	4.16		0.387	1.70	1.186

END OF SOUNDING (INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

B-1-30

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) — SNDG. NO. DMT-4
LAW ENGINEERING - PUERTO RICO — PAGE 2
JOB FILE: RIO PUERTO NUEVO PROJECT — FILE NO. : 20905-6-0003
LOCATION: LOCATION: B-11D
SNDG.BY : J NIEHOFF - LAW ENGINEERING - ATLANTA — SNDG.DATE: 30 JANUARY 96
ANAL.BY : RUSSO - LAW ENGINEERING — ANAL.DATE: 31 JANUARY 96

ANALYSIS PARAMETERS: LO RANGE = 9.00 BARS ROD DIAM. = 6.03 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 4.60 M LO GAGE 0 = 0.14 BARS FR.RED.DIA. = 5.39 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 5.20 M HI GAGE 0 = 0.50 BARS LIN.ROD WT. = 6.80 KGF/M DELTA-A = 0.13 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.20 BARS M FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT KO FACTOR = 1.00

Z (M)	KD	ID	UD	ED (BAR)	KO	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
2.44	8.47	0.63	0.00	81.	1.66	0.59	9.5	28.1	0.65	25.1	4.19	9.5	189.	CLAYEY SILT
2.74	7.35	0.69	0.00	86.	1.51	0.55	16.3	31.2	0.75	28.7	3.75	7.6	189.	CLAYEY SILT
3.05	5.39	0.70	0.00	72.	1.22	0.41	22.6	33.2	0.85	31.0	2.56	4.7	134.	CLAYEY SILT
3.35	5.35	0.67	0.00	74.	1.22	0.45	20.6	32.0	0.91	29.9	2.77	4.6	137.	CLAYEY SILT
3.66	4.47	0.66	0.00	66.	1.07	0.39	23.1	32.5	1.00	30.6	2.28	3.5	111.	CLAYEY SILT
3.96	4.17	0.57	0.00	57.	1.02	0.38	21.8	31.7	1.06	29.9	2.20	3.1	92.	SILTY CLAY
4.27	4.32	0.64	0.00	72.	1.04	0.43	33.6	34.1	1.17	32.6	2.50	3.3	118.	CLAYEY SILT
4.57	3.95	0.56	0.00	61.	0.98	0.41	41.3	35.2	1.26	33.8	2.31	2.9	94.	SILTY CLAY
4.88	3.38	0.48	0.00	48.	0.86	0.36	42.4	35.2	1.34	33.9	1.93	2.3	67.	SILTY CLAY
5.18	3.59	0.69	0.00	77.	0.91	0.41	41.3	34.5	1.41	33.3	2.24	2.5	112.	CLAYEY SILT
5.49	3.55	1.76	0.00	201.	0.59	0.42	71.7	38.7	1.51	37.7	2.05	2.2	304.	SANDY SILT
5.79	3.92	0.63	0.00	81.	0.97	0.48	64.5	36.9	1.52	35.9	2.71	2.9	125.	CLAYEY SILT
6.10	2.54	0.29	0.00	24.	0.68	0.29	57.5	36.7	1.55	35.8	1.41	1.5	27.	CLAY
6.40	2.61	0.33	0.00	30.	0.70	0.30	48.3	35.4	1.56	34.4	1.50	1.5	34.	CLAY
6.71	2.51	0.46	0.00	41.	0.67	0.30	41.2	34.3	1.58	33.3	1.44	1.4	44.	SILTY CLAY
7.01	3.22	0.54	0.00	63.	0.83	0.41	41.5	33.8	1.61	32.8	2.17	2.1	84.	SILTY CLAY
7.32	2.99	0.54	0.00	59.	0.78	0.38	48.0	34.8	1.65	33.9	1.97	1.9	75.	SILTY CLAY
7.62	2.39	1.11	0.00	99.	0.64	0.30	53.0	35.6	1.70	34.8	1.42	1.3	107.	SILT
7.92	2.93	0.78	0.00	86.	0.77	0.39	52.3	35.1	1.72	34.3	1.98	1.8	108.	CLAYEY SILT
8.53	4.95	0.45	0.00	88.	1.15	0.78	81.6	36.8	1.82	36.1	4.69	4.1	156.	SILTY CLAY
8.84	4.82	0.67	0.00	130.	1.13	0.77	73.1	36.1	1.85	35.4	4.58	3.9	228.	CLAYEY SILT
9.14	0.38	7.48	0.00	115.	0.02	0.03	145.2	43.6	2.00	43.2	0.00	0.0	98.	SAND

END OF SOUNDING

CB-PNB-62 (PN-DT6)

Hole No.CB-PNB-62

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 4

1. PROJECT: RIO PUERTO NUEVO PROJECT
2. LOCATION (Coordinates or Station): X=822,000 Y=212,825
3. DRILLING AGENCY: SUELOS INC
4. HOLE NO. (As shown on drawing title and file number): CB-PNB-62
5. NAME OF DRILLER: JOSE AYALA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 85.5 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 85.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: ACKER AD-II
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 58 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: 3.2 Ft.
16. DATE HOLE STARTED: 09/18/95 COMPLETED: 09/21/95
17. ELEVATION TOP OF HOLE: 14.1 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 89.8 %
19. SIGNATURE OF GEOLOGIST: LUIS MOLINA

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'
14.1	0					14.1	
			SILT, sandy, little clay, trace roots, brown. (ML)	77	1	SPLIT SPOON	3 3 4
			Some gravel size rock fragments at 1 feet.			12.6	
				100	2	"	5 5 6
			Trace gravel size brick fragments at 3 feet.			11.1	
				73	3	"	4 5 5
9.6	4.5					9.6	
			CLAY, silty, some decayed roots, brown mottled, gray and brown. (CL)	100	4	"	3 5 8
						8.1	
				100	5	"	10 10 12
						6.6	
				100	6	"	6 5 8
						5.1	
				100	7	"	4 4 8
						3.6	
			Some lamination at 11 feet.	100	8	"	8 8 11
2.1	12.0					2.1	
			SILT, clayey, few decayed roots, brown mottled, gray and brown. (MH)	100	9	"	3 4 4
						.6	
				100	10	"	4 5 7
			Trace coarse sand at 18 feet.			-.9	
				100	11	"	3 3 3
-2.4	16.6					-2.4	
			SAND, silty, little clayey, medium to coarse grained, some decayed roots, brown. (SW-SM)	100	12	"	4 4 7
						-3.9	
-4.9	19.0			100	13	"	WH 2 2
			SILT, olive mottled, gray and olive brown. (ML)			-5.4	
				100	14	"	1 3 4
						-8.9	
			Trace clayey sand.	100	15	"	3 4 8
-8.4	22.5					-8.4	
						(continued)	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: RIO PUERTO NUEVO PROJECT | HOLE NUMBER: CB-PNB-62

Hole No.CB-PNB-62

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE 14.11 Ft. | SHEET 2 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/.5'	
-8.4	22.5					-8.4		
			SAND, clayey, little silt, fine grained, some fine sub-rounded gravel, olive brown. (SW-SC)	100	16	-9.9	4 8 10	22.5
				100	17	-11.4	5 7 10	25
				100	18	-12.9	8 8 11	
				100	19	-14.4	7 9 11	27.5
			Coarse grained sand from 28 to 31 feet.	100	20	-15.9	6 5 7	30
-15.9	30.0							
			SAND, silty, coarse grained, highly quartzose, pale yellow. (SP-SM)	100	21	-17.4	4 6 9	
				100	22	-18.9	8 8 11	32.5
				100	23	-20.4	6 9 12	
-20.4	34.5							
			SILT, moderately consolidated, some oxidation, light yellowish brown. (ML)	100	24	-21.9	8 11 13	35
-21.9	38.0							
			SILT, clayey, light brown and gray. (MH)	100	25	-23.4	9 12 15	37.5
				100	26	-24.9	8 13 16	
-24.9	39.0							
			SILT, slightly laminated, yellowish brown. (ML)	88	27	-26.4	4 8 8	40
			Some fine sand at 41 feet.	83	28	-27.9	8 8 10	
-27.9	42.0							
			SAND, silty, fine to medium grained, Yellowish brown. (SP-SM)	100	29	-29.4	8 12 18	42.5
			Coarse grained quartz sand from 44 to 48 feet.	100	30	-30.9	12 25 40	45
				93	31	-32.4	24 35 55	
				100	32	-33.9	25 45 68	47.5
				100	33	-35.4	25 30 40	
-35.4	49.5							
			SILT, trace sand.	83	34		16	50
						(continued)		

ENG FORM 1838 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: RIO PUERTO NUEVO PROJECT | HOLE NUMBER: CB-PNB-62

CB-PNB-62

8-1-33

CB-PNB-62

Hole No.CB-PNB-62

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE 14.0 Ft. | SHEET 3 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/6"
-36.9	50.0						
-36.9	51.0		slightly consolidated, olive pale brown. (ML)	83	34	-36.9	21 43
			SAND, silty, medium grained, light gray. (SP-SM)	100	35	-38.4	19 25 33
-39.9	54.0		SILT, slightly consolidated, yellowish brown and gray. (ML)	100	36	-39.9	20 30 40
			SAND, silty, coarse grained, highly quartzose, light gray. (SP-SM)	88	37	-41.4	29 49 54
-42.9	57.0			100	38	-42.9	26 39 50
-44.4	58.5		SILT, sandy, slightly consolidated, olive gray and brown. (ML)	100	39	-44.4	22 35 64
			SAND silty, medium grained, highly quartzose, pale olive gray (SP-SM)	100	40	-45.9	23 48 60
				100	41	-48.9	76/4
				88	42	-50.4	80 81 40
			Coarse grained quartz sand with few microfossils from 63 to 65 feet.	53	43	-49.9	22 38 40
				100	44	-51.4	20 32 42
			Medium grained quartz sand and trace clayey material at 68 feet	88	45	-52.9	33 46 53
				100	46	-54.4	25 45 60
			Face fine gravel from 68 to 71 feet.	88	47	-55.9	50 80 78
				100	48	-57.4	26 30 53
				38	49	-58.0	43 50/3
				38	50	-60.4	40 50/3
-61.9	78.0			88	51	-61.9	40 80 85
			LIMESTONE, impure, granular, slightly fossiliferous, highly weathered,	55	52	-63.4	75/3
						(continued)	

EDIC FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE

PROJECT: RIO PUERTO NUEVO PROJECT | HOLE NUMBER: CB-PNB-62

B-1-34

Hole No.CB-PNB-62

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 14.11 Ft.

SHEET 4 OF 4

PROJECT: RIO PUERTO NUEVO PROJECT

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Split Spoon	BLOWS/6"
-63.4	77.5					-63.4	
			Sampled as SAND, silty, calcareous, and gravel size limestone fragments, light gray. (SM)	44	S5	"	47
							50/2
						-64.9	
			Unconsolidated limestone from 79 to 82 feet.	33	S4	"	80/8
						-65.9	
			Few microfossils at 80 feet.	33	S6	"	50/8
						-66.9	
				100	S8	"	28
							45
							70
-68.4	82.5					-68.4	
			SILT, trace fine sand, olive gray. (ML)	100	S7	"	30
							50
							57
						-69.9	
			Occasional gravel size rock fragments.	100	S8	"	35
							57
							60
-71.4	85.5					-71.4	
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0" SPLIT SPOON (1-3/8 I.D. X 2" O.D.)	
						Ground water at the time of drilling was 3.8 feet.	

LAB CLASSIFICATIONS

Elev. (Ft.)	Class.	Wn	LL	PL	PI
-5.4	ML	24%			
-11.4	SC	23%	39	21	18

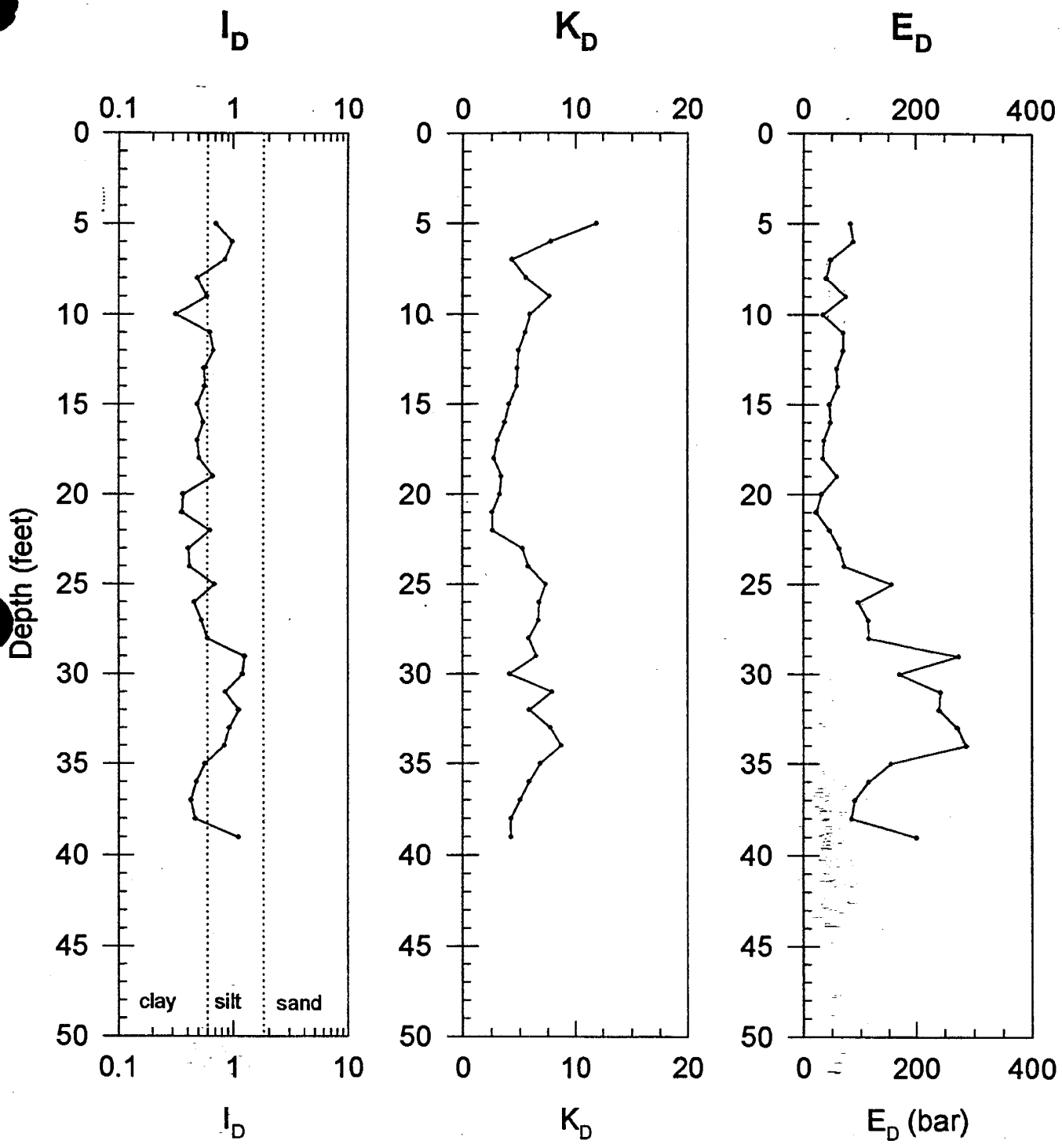
ENG FORM 1939 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: RIO PUERTO NUEVO PROJECT

HOLE NUMBER: CB-PNB-62

CB-PNB-62

B-1-35



1 BAR = 1.044 TSF

Law Environmental Caribe
Edificio Caso, Suite 603
Avenida Ponce de Leon 1225
Santurce, Puerto Rico 00907
Law Engineering and Environmental Services, Inc.

PUERTO NUEVO CHANNEL

Dilatometer Test Results for DMT-6

Law Engineering Job Number 20905-6-0003

B-1-31

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. DMT-6
LAW ENGINEERING - PUERTO RICO PAGE 1
JOB FILE: RIO PUERTO NUEVO PROJECT FILE NO. : 20905-6-0003
LOCATION: LOCATION: B-62
SNDG.BY : J NIEHOFF - LAW ENGINEERING - ATLANTA SNDG.DATE: 30 JANUARY 96
ANAL.BY : RUSSO - LAW ENGINEERING ANAL.DATE: 31 JANUARY 96

ANALYSIS PARAMETERS: LO RANGE = 9.00 BARS ROD DIAM. = 6.03 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 4.30 M LO GAGE 0 = 0.15 BARS FR.RED.DIA. = 5.39 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 3.40 M HI GAGE 0 = 0.60 BARS LIN.ROD WT. = 6.80 KGF/M DELTA-A = 0.10 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.63 BARS M FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT KO FACTOR = 1.00

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
1.52	681.	3.50	6.50		0.10	0.63	0.15	9.00	0.60	0.00	3.34	5.72		0.000	1.70	0.280
1.83	817.	2.75	5.90		0.10	0.63	0.15	9.00	0.60	0.00	2.58	5.12		0.000	1.70	0.332
2.13	681.	1.75	3.80		0.10	0.63	0.15	9.00	0.60	0.00	1.63	3.02		0.000	1.60	0.380
2.44	590.	2.50	4.35		0.10	0.63	0.15	9.00	0.60	0.00	2.39	3.57		0.000	1.70	0.430
2.74	771.	3.85	6.65		0.10	0.63	0.15	9.00	0.60	0.00	3.70	5.87		0.000	1.80	0.482
3.05	953.	3.25	4.95		0.10	0.63	0.15	9.00	0.60	0.00	3.15	4.17		0.000	1.70	0.535
3.35	1134.	3.35	6.00		0.10	0.63	0.15	9.00	0.60	0.00	3.20	5.22		0.000	1.70	0.585
3.66	1225.	3.15	5.80		0.10	0.63	0.15	9.00	0.60	0.00	3.00	5.02		0.026	1.70	0.612
3.96	1406.	3.20	5.55		0.10	0.63	0.15	9.00	0.60	0.00	3.07	4.77		0.055	1.70	0.632
4.27	1406.	3.30	5.70		0.10	0.63	0.15	9.00	0.60	0.00	3.17	4.92		0.085	1.70	0.653
4.57	1542.	2.95	4.95		0.10	0.63	0.15	9.00	0.60	0.00	2.84	4.17		0.115	1.70	0.674
4.88	1497.	2.80	4.85		0.10	0.63	0.15	9.00	0.60	0.00	2.68	4.07		0.145	1.70	0.695
5.18	1588.	2.45	4.20		0.10	0.63	0.15	9.00	0.60	0.00	2.35	3.42		0.175	1.70	0.716
5.49	1678.	2.30	4.00		0.10	0.63	0.15	9.00	0.60	0.00	2.20	3.22		0.205	1.60	0.736
5.79	1452.	2.90	5.25		0.10	0.63	0.15	9.00	0.60	0.00	2.77	4.47		0.235	1.70	0.755
6.10	1724.	2.85	4.45		0.10	0.63	0.15	9.00	0.60	0.00	2.76	3.67		0.265	1.70	0.776
6.40	1724.	2.40	3.75		0.10	0.63	0.15	9.00	0.60	0.00	2.32	2.97		0.294	1.60	0.795
6.71	1724.	2.55	4.55		0.10	0.63	0.15	9.00	0.60	0.00	2.44	3.77		0.325	1.70	0.815
7.01	1769.	4.85	7.30		0.10	0.63	0.15	9.00	0.60	0.00	4.71	6.52		0.354	1.80	0.837
7.32	2223.	5.45	8.15		0.10	0.63	0.15	9.00	0.60	0.00	5.30	7.37		0.385	1.80	0.861
7.62	2540.	7.15	12.60		0.10	0.63	0.15	9.00	0.60	0.00	6.89	11.37		0.414	1.95	0.887
7.92	2858.	6.75	10.60		0.10	0.63	0.15	9.00	0.60	0.00	6.57	9.37		0.444	1.80	0.913
8.23	2994.	6.90	11.20		0.10	0.63	0.15	9.00	0.60	0.00	6.69	9.97		0.474	1.80	0.937
8.53	2948.	6.25	10.60		0.10	0.63	0.15	9.00	0.60	0.00	6.04	9.37		0.503	1.80	0.961
8.84	3221.	7.30	16.00		0.10	0.63	0.15	9.00	0.60	0.00	6.87	14.77		0.534	1.95	0.987
9.14	3493.	4.95	10.80		0.10	0.63	0.15	9.00	0.60	0.00	4.67	9.57		0.563	1.80	1.013
9.45	3175.	9.60	17.00		0.10	0.63	0.15	9.00	0.60	0.00	8.77	15.77		0.594	1.95	1.040
9.75	4128.	7.20	15.00		0.10	0.63	0.15	9.00	0.60	0.00	6.82	13.77		0.623	1.95	1.068
10.06	3674.	10.00	18.20		0.10	0.63	0.15	9.00	0.60	0.00	9.13	16.97		0.654	1.95	1.097
10.36	3856.	11.40	20.00		0.10	0.63	0.15	9.00	0.60	0.00	10.51	18.77		0.683	1.95	1.125
10.67	3901.	8.80	14.20		0.10	0.63	0.15	9.00	0.60	0.00	8.54	12.97		0.713	1.90	1.153
10.97	3965.	7.80	12.10		0.10	0.63	0.15	9.00	0.60	0.00	7.59	10.87		0.743	1.80	1.178
11.28	2858.	6.95	10.60		0.10	0.63	0.15	9.00	0.60	0.00	6.78	9.37		0.773	1.80	1.202
11.58	3629.	6.10	9.60		0.10	0.63	0.15	9.00	0.60	0.00	5.93	8.37		0.803	1.80	1.226
11.89	3629.	6.40	13.10		0.10	0.63	0.15	9.00	0.60	0.00	6.07	11.87		0.833	1.80	1.250

END OF SOUNDING (INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

B-1-37

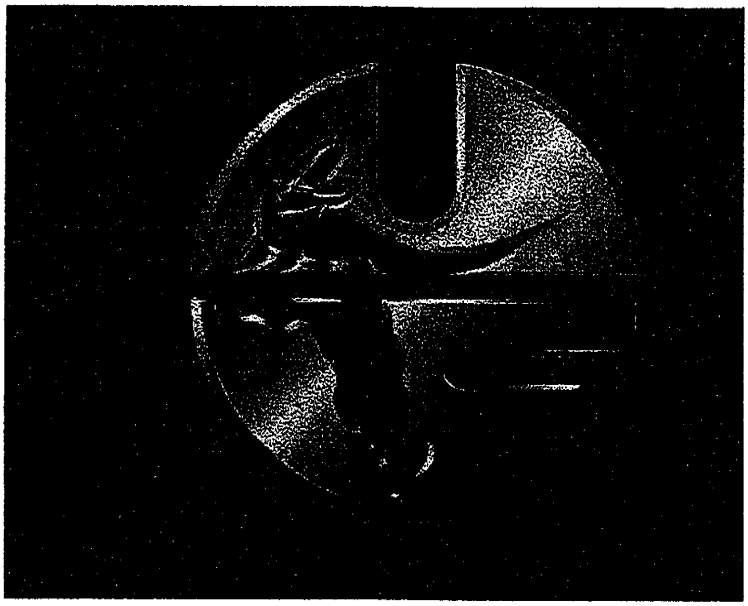
DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. DMT-6
LAW ENGINEERING - PUERTO RICO PAGE 2
JOB FILE: RIO PUERTO NUEVO PROJECT FILE NO. : 20905-6-0003
LOCATION: LOCATION: B-62
SNDG.BY : J NIEHOFF - LAW ENGINEERING - ATLANTA SNDG.DATE: 30 JANUARY 96
ANAL.BY : RUSSO - LAW ENGINEERING ANAL.DATE: 31 JANUARY 96

ANALYSIS PARAMETERS: LO RANGE = 9.00 BARS ROD DIAM. = 6.03 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
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UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT KO FACTOR = 1.00

Z (M)	KD	ID	UD	ED (BAR)	KO	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
1.52	11.92	0.71	0.00	83.	2.05	0.57	12.0	32.2	0.43	28.6	4.53	16.2	220.	CLAYEY SILT
1.83	7.77	0.99	0.00	88.	1.57	0.40	18.6	34.6	0.52	31.6	2.76	8.3	198.	SILT
2.13	4.30	0.85	0.00	48.	1.04	0.22	17.7	34.4	0.60	31.6	1.25	3.3	79.	CLAYEY SILT
2.44	5.56	0.49	0.00	41.	1.25	0.34	12.8	30.9	0.65	28.1	2.12	4.9	77.	SILTY CLAY
2.74	7.67	0.59	0.00	75.	1.55	0.57	14.7	30.6	0.73	28.0	3.92	8.1	168.	SILTY CLAY
3.05	5.89	0.32	0.00	35.	1.30	0.45	21.9	33.0	0.83	30.8	2.88	5.4	69.	CLAY
3.35	5.47	0.63	0.00	70.	1.24	0.45	27.5	34.0	0.91	32.0	2.82	4.8	132.	CLAYEY SILT
3.66	4.87	0.68	0.00	70.	1.14	0.41	31.2	34.8	0.96	32.9	2.45	4.0	124.	CLAYEY SILT
3.96	4.77	0.56	0.00	59.	1.12	0.41	36.9	35.7	1.00	33.9	2.45	3.9	103.	SILTY CLAY
4.27	4.72	0.57	0.00	61.	1.11	0.42	36.7	35.4	1.03	33.7	2.49	3.8	105.	SILTY CLAY
4.57	4.04	0.49	0.00	46.	0.99	0.36	42.4	36.4	1.07	34.8	2.02	3.0	73.	SILTY CLAY
4.88	3.65	0.55	0.00	48.	0.92	0.32	41.7	36.3	1.11	34.7	1.78	2.6	71.	SILTY CLAY
5.18	3.04	0.49	0.00	37.	0.79	0.27	46.1	37.0	1.15	35.5	1.37	1.9	48.	SILTY CLAY
5.49	2.71	0.51	0.00	35.	0.72	0.24	49.8	37.5	1.18	36.1	1.18	1.6	41.	SILTY CLAY
5.79	3.36	0.67	0.00	59.	0.86	0.32	40.5	35.7	1.20	34.2	1.69	2.2	82.	CLAYEY SILT
6.10	3.21	0.37	0.00	32.	0.83	0.31	49.6	36.9	1.24	35.5	1.62	2.1	42.	SILTY CLAY
6.40	2.55	0.32	0.00	23.	0.68	0.24	51.4	37.3	1.28	36.0	1.16	1.5	25.	CLAY
6.71	2.59	0.63	0.00	46.	0.69	0.25	51.1	37.1	1.31	35.8	1.22	1.5	52.	CLAYEY SILT
7.01	5.21	0.41	0.00	63.	1.20	0.61	44.6	34.9	1.32	33.6	3.73	4.5	115.	SILTY CLAY
7.32	5.71	0.42	0.00	72.	1.27	0.70	57.1	36.1	1.37	34.9	4.42	5.1	138.	SILTY CLAY
7.62	7.30	0.69	0.00	156.	1.50	0.98	61.8	36.0	1.41	34.8	6.68	7.5	339.	CLAYEY SILT
7.92	6.71	0.46	0.00	97.	1.42	0.91	73.2	37.0	1.46	35.9	6.03	6.6	203.	SILTY CLAY
8.23	6.64	0.53	0.00	114.	1.41	0.92	77.3	37.2	1.50	36.2	6.09	6.5	236.	SILTY CLAY
8.53	5.76	0.60	0.00	115.	1.28	0.79	78.4	37.4	1.54	36.4	5.01	5.2	224.	CLAYEY SILT
8.84	6.42	1.25	0.00	274.	0.95	0.93	83.6	38.3	1.60	37.4	5.85	5.9	566.	SANDY SILT
9.14	4.05	1.20	0.00	170.	0.99	0.54	101.8	39.2	1.65	38.4	3.05	3.0	274.	SILT
9.45	7.86	0.86	0.00	243.	1.58	1.27	76.4	36.2	1.65	35.3	8.79	8.5	549.	CLAYEY SILT
9.75	5.80	1.12	0.00	241.	1.29	0.89	114.4	38.9	1.74	38.2	5.62	5.3	473.	SILT
10.06	7.73	0.93	0.00	272.	1.56	1.31	91.3	37.0	1.76	36.2	9.03	8.2	610.	SILT
10.36	8.73	0.84	0.00	287.	1.69	1.56	92.4	36.7	1.80	35.9	11.21	10.0	678.	CLAYEY SILT
10.67	6.79	0.57	0.00	154.	1.43	1.17	101.3	37.5	1.85	36.9	7.76	6.7	323.	SILTY CLAY
10.97	5.82	0.48	0.00	114.	1.29	0.98	107.1	38.0	1.90	37.4	6.23	5.3	221.	SILTY CLAY
11.28	4.99	0.43	0.00	90.	1.16	0.83	74.8	36.0	1.91	35.3	5.01	4.2	161.	SILTY CLAY
11.58	4.19	0.47	0.00	85.	1.02	0.68	103.0	38.1	1.98	37.6	3.88	3.2	136.	SILTY CLAY
11.89	4.19	1.11	0.00	201.	1.02	0.69	102.7	37.9	2.02	37.4	3.97	3.2	329.	SILT

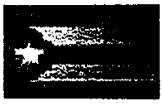
END OF SOUNDING

B-1-38



Pressuremeter and Dilatatometer Testing

At



Puerto Nuevo Flood Control Project
San Juan, Puerto Rico

For
United States Corp of Engineers
Jacksonville District

By
University of Florida
Kimberly Spoor
Jeremy B. Anderson
Ivan Guzman
Franck Townsend
GEO Cim

March 1998

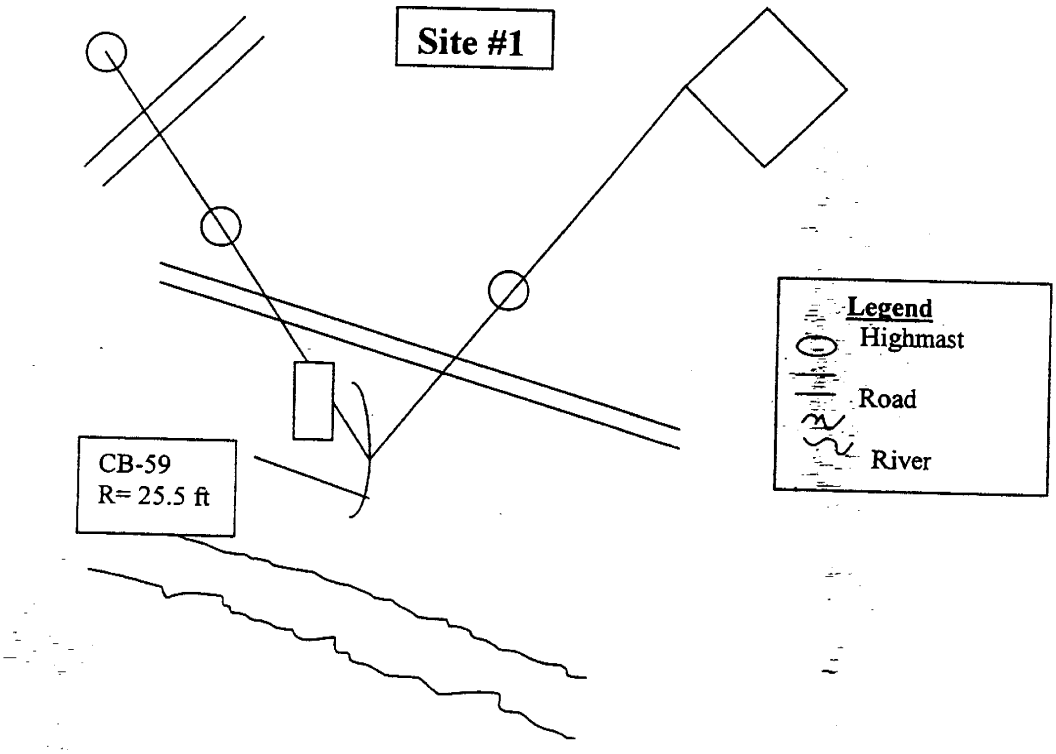
B-1-39

MEMORANDUM

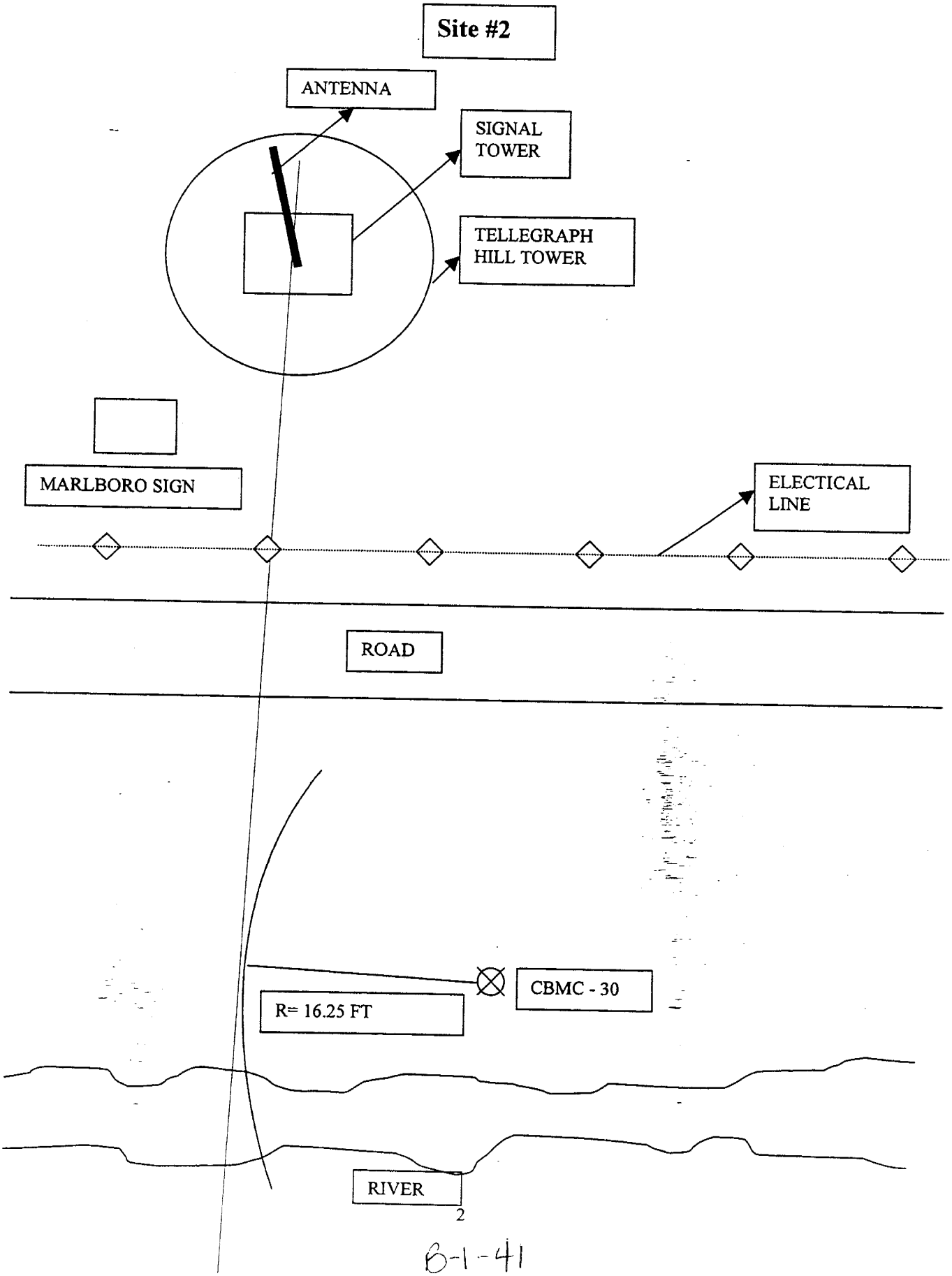
Trip Report for Insitu Testing – March 6-14, 1998 – Puerto Nuevo, San Juan Puerto Rico

1. 3-6-98 We left Gainesville, FL @ 11:00 and drove to Orlando, FL to catch American Airlines flight to San Juan. Excess baggage consists of 1-foot locker, 2 wooden chests, and 1 duffel bag. Team members are: F.C. Townsend, J.B. Anderson, and Ivan Guzman.

2. 3-7-98 We left the hotel for jobsite with Kim Spoor and Pauline Smith, CESAJ. After stopping at site #1, location of proposed load test (CB-59), we discussed how to locate borings. The problem is that CB-59 is located very close to the abutment pile cap for a ramp leading into the Plaza of the Americas. This ramp will severely restrict overhead clearances for driving piles and proposed sheet-pile cofferdam. Consequently, we went to site #2 (CB-30) to begin testing with the intention of Pauline discussing site #1 problems with Dr. Crapps.



B-1-40


Site #2
ANTENNA
SIGNAL TOWER
TELLEGRAPH HILL TOWER
MARLBORO SIGN
ELECTICAL LINE
ROAD
CBMC - 30
R= 16.25 FT
RIVER

B-1-41

At site #2 @ CBMC-30 we initiated PMT #1 @ 9:35. Testing is using a CME BK-66 drill truck with AW rods. GeoCim drill crew consists of: Antonio, "Rocky", and Alejandro.

PMT #1 Summary

Time	Depth, ft.	Max P @ V=110cc
9:35	5	4.75 x 100 kPa
10:05	10	3.9
10:30	15	3.25
	20	3.4
11:25	25	7.75
11:55	30	15.3
12:36	35	13.75

We were unable to penetrate to a depth of 40 ft., so we moved approximately 5 ft. towards the highway and reinitiated PMT 1-b. We were able to push to 39.8 ft. and then again encountered resistance. Upon testing we were unable to develop pressure until volume = 70cc, at which time the pressure "pegged" = 2500 kPa @ v = 78.7cc. Extraction of the drill rods revealed that the pressure-meter had snapped just below the quick-connect threads. Since it had rained most of the day, we returned to the hotel, wet, muddy, and without the pressure-meter.

3. 3-8-98 Sunday night was spent calibrating the old pressure-meter and reconnecting tubing.

4. 3-9-98 We left the hotel with Kim for test site # 1 CB-59, to meet with Pauline later. We augured 9 ft. through the highway fill to approximate soft ground level. Subsequent survey level placed the top of fill @ el. +8.81ft.

PMT #2 Summary

Time	Depth, ft.	Max P @ V=110cc
11:00	14	5.4 x 100 kPa
11:14	19	4.0
11:35	24	4.4
11:55	29	3.5
12:18	34	7.0
12:45	39	6.0
	44	10.3
Membrane broke @ 49 ft. change and recalibrate, augered to 49 ft.		
4:30	54	12.5
4:40	59	14.25
	64	10.1

Since proposed pile tip is at el. –66.5 ft, testing stopped.

B-1-42

5. 3-10-98 Met Kim @ site #1 to initiate DMT testing. Using 5" auger we augured 10 ft., but the weight of rod carried us to 18 ft. for the first test. We were able to penetrate to 45.75 ft. We attempted to augur to 50 ft., but upon reaching 45 ft., the "kelly" broke and we could auger no deeper.

6. 3-11-98 Met Kim @ site # 3, SW corner of bridge abutment @ CB-4. We augured using small trailer rig through 20 ft. of highway fill and began PMT #3.

PMT #3 Summary

Time	Depth, ft.	Max P @ V=110cc
8:45	25	3.8 x 100 kPa
9:10	30	8.3
9:30	35	10.8
Testing interrupted to auger to 40 ft		
2:30	45	8.25
2:45	50	15.25

DMT testing @ site #1 commenced after auguring to 50ft. at previous hole using trailer rig. We were able to penetrate to 60ft. (El. –51.2), but an 18" drop of the SPT hammer failed to move the DMT.

7. 3-12-98 Site #2 (scene of lost PMT). The small drill trailer augured to 40 ft., while simultaneously we performed DMT testing. However, we changed blades as the previous blade had an electrical short and "beeped" continuously. DMT testing was @ 2ft. intervals to a depth of 31.0 ft. We used 47 blows/4" of 18" SPT drop, but it was too stiff to penetrate. COE team with: Ed Middleton, Ed Cuevas, Scott Burch, Randy Bush, and others arrived to observe PMT test.

PMT #1 Continued Summary

Time	Depth, ft.	Max P @ V=110cc
11:00	45	9.25 x 100 kPa
	50	9.0
	52	11.0

Testing Summary

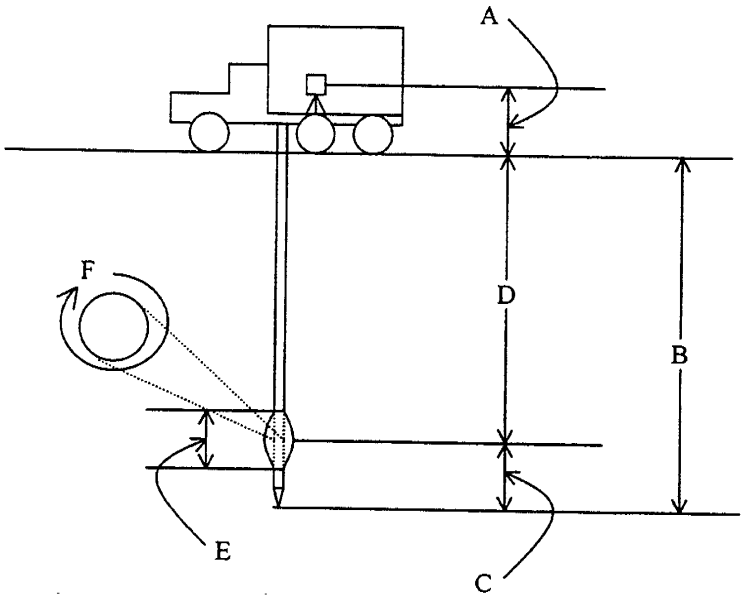
Site	Max. Depth, ft.	No. PMT	Depth, ft	DMT @ 2'
1	64	10	60	20
2	52	10	31.3	15
3	50	5	None	

B-1-43

Explanation for Reduction of Pressuremeter Data to P-y Curves

Required Input Data:

A) Distance from Pressuremeter Control Unit to ground surface (m or ft)
B) Distance from ground surface to tip or Pressuremeter probe (m or ft)
C) Length from center of probe to tip (mm or in)
D) Distance from ground surface to center of membrane (m or ft)
Note: Ground water table elevation does *not* affect pressure corrections, as total pressure is what is used.
E) Total length of pressuremeter membrane (mm or in)
F) Initial circumference of pressuremeter membrane (mm or in)
G) Diameter of pile to be installed in the field (mm or in)



Data Reduction from Robertson et al. 1995

Given **corrected** pressuremeter data:

Point	P (bar)	V (cm^3)
1	1.5	10
2	2	20
etc...		

It will be convenient to convert any quantity such as pressure or length to the units you wish the P-y curves to be expressed as now. In other words, convert the bars to psi or KN/mm^2 before doing any calculations.

B-1-44

Initial radius of probe:

$$R_P = \frac{\text{Initial Circumference of Probe}}{2\pi}$$

Initial Volume of Probe:

$$V_P = \pi * R_P^{\,2} * \text{Length of Membrane}$$

Determine P in units of Force/Length:

Robertson et al. (1985) suggested a method that uses the results of a pushed-in pressuremeter to evaluate P-y curves of a driven displacement pile. They multiplied the pressure component of the PMT curve by a α factor to obtain the correct P-y curve. This factor is applied to the pressure component of the PMT expansion curve. The critical depth is assumed to be four pile diameters as shown in the Figure below.
Robertson et al. reduced α near the surface assuming that the response is affected by the reduced vertical stress. To obtain the p-y curve, the pressuremeter curve is translated to the lift off pressure that is equivalent to the initial lateral stress around the pile. The stress is multiplied by the pile width and the strain component ($\Delta R/R$) is multiplied by the pile half width. For small strain conditions ($\Delta R/R$) is equal to ($\Delta V/2V$).

A reduction factor, α, is applied to the P for shallow depths.

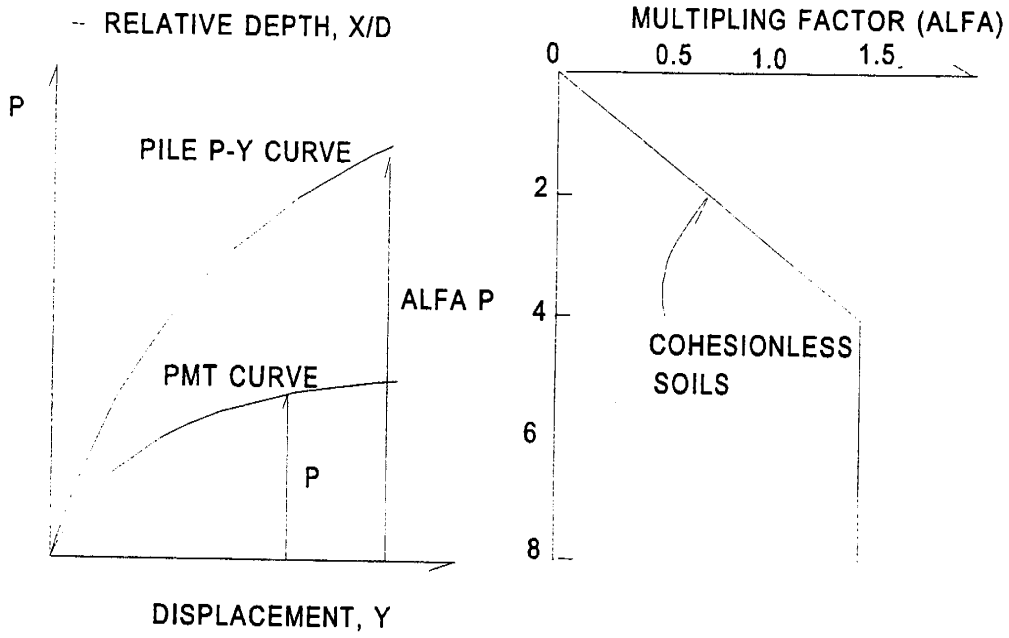
If $\dfrac{\text{Depth from Ground Surface to Center of Membrane}}{\text{Pile Diameter}} > 4$

Then $\alpha = 1.5$

Else $\alpha = \dfrac{1.5 * \text{Depth from Gound Surface to Center of Membrane}}{4 * \text{Pile Diameter}}$

Thus P = (Corrected Pressure from PMT) * (Pile Diameter) * (Reduction Factor)

B-1-45



Determine Y in units of Length

$$Y = \frac{(\text{Corrected Volume from PMT})}{2 * \text{Initial Volume}} * \frac{\text{Pile Diameter}}{2}$$

Example:

Given a fully corrected Pencel pressuremeter curve shown in Figure PMT-1 below, the procedure is as follows:

1. Extend unload point A back to P = 0.0 using sequential 2 reload points as a straight-line guide.

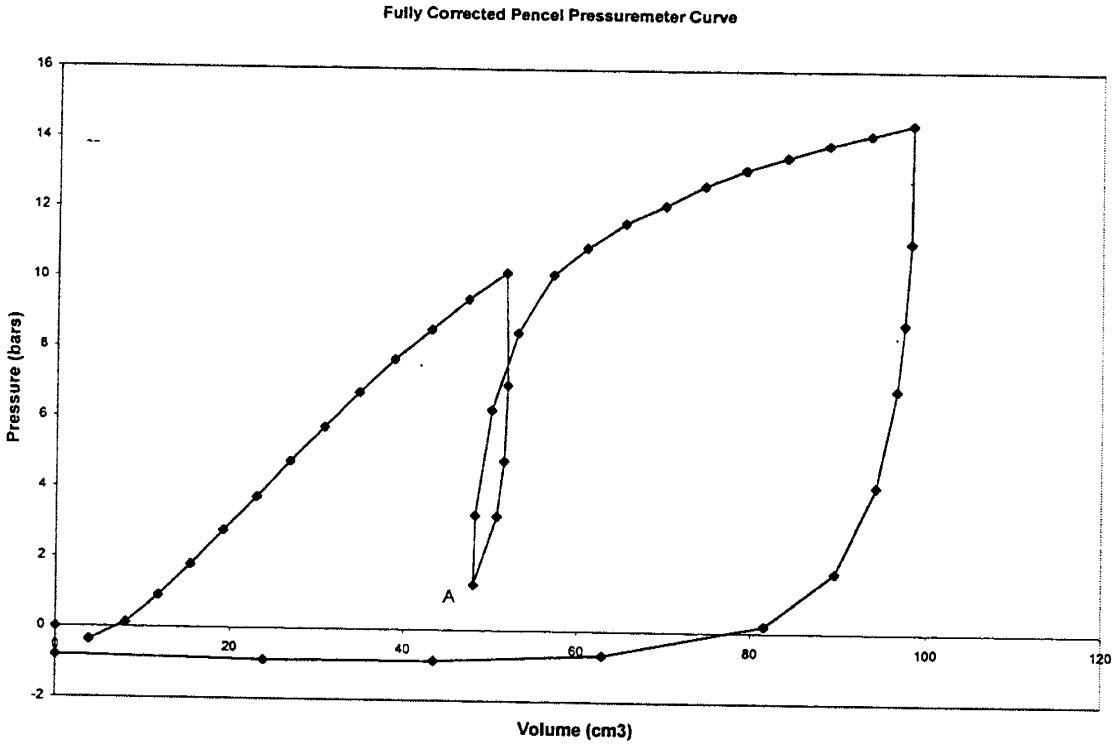


Figure PMT-1 Example Corrected Pressuremeter Curve

2. Readjust V= 0 where P=0; i.e., we have shifted the origin to where the unload curve would have been. This shift mitigates hole disturbance effects. Although Volume has been readjusted, we do not recalculate the radius, but use R_0.
3. Select 10 "good" points along the reload curve as the 10 points to represent the p-y curve. (Most programs only allow 10 points to describe a p-y curve)

Numerical Data Reduction – Table PMT-1 presents the corrected volume and pressures displayed graphically in Figure PMT-1.

Table PMT-1 Corrected PMT Curve

Corrected Volume (cm3)	Corrected Pressure (bar)	Corrected Volume (cm3)	Corrected Pressure (bar)
3.701502	-0.366814	57.1166	10.13389
7.858678	0.132824	60.98886	10.91235
11.6975	0.907633	65.42689	11.62772
15.46395	1.790605	70.02565	12.14286
19.18672	2.770453	74.59056	12.71856
23.00292	3.734302	79.24808	13.17312
26.83077	4.753389	83.97282	13.53595
30.75468	5.746156	88.70793	13.88664
34.73695	6.742996	93.48632	14.17409
38.81805	7.693162	98.24704	14.48797
43.02999	8.546121	98.11225	11.10934
47.25967	9.422803	97.43251	8.796159
51.6166	10.18168	96.57061	6.914684
51.83602	6.989696	94.28865	4.156596
51.45499	4.823153	89.59231	1.709011
50.67122	3.240336	81.56597	0.20509
48.01406	1.295446	62.94173	-0.67305
48.17122	3.263927	43.45992	-0.868451
50.02202	6.27636	23.85901	-0.889778
53.00432	8.479233	0	-0.8

The above table presents the 10 selected data points to use for the p-y curves. The "new zero" volume = 47.91, and consequently the values of V_0 are less this amount.

The Table below presents these 10 p-y points and corresponding p-y values.

Point No.	Volume (cm3)	Pressure (bar)	Initialized Volume (cm3)	Initialized Pressure (bar)
1	47.91064	0	0	0
2	48.01406	1.295446	0.103423	1.295446
3	48.17122	3.263927	0.260579	3.263927
4	50.02202	6.27636	2.111382	6.27636
5	53.00432	8.479233	5.09368	8.479233
6	57.1166	10.13389	9.205956	10.13389
7	65.42689	11.62772	17.51625	11.62772
8	74.59056	12.71856	26.67992	12.71856
9	83.97282	13.53595	36.06218	13.53595
10	98.24704	14.48797	50.3364	14.48797

First the P units are changed from bars to PSI (1 bar = 14.486 psi). Then P = (pressure)*(pile diameter) * (reduction factor α). For example #4;

$$P = \frac{(6.276bars * 14.486psi/bar)(30in)(\alpha = 1.5)}{(1000lbs/kip)} = 4.091kips/in$$

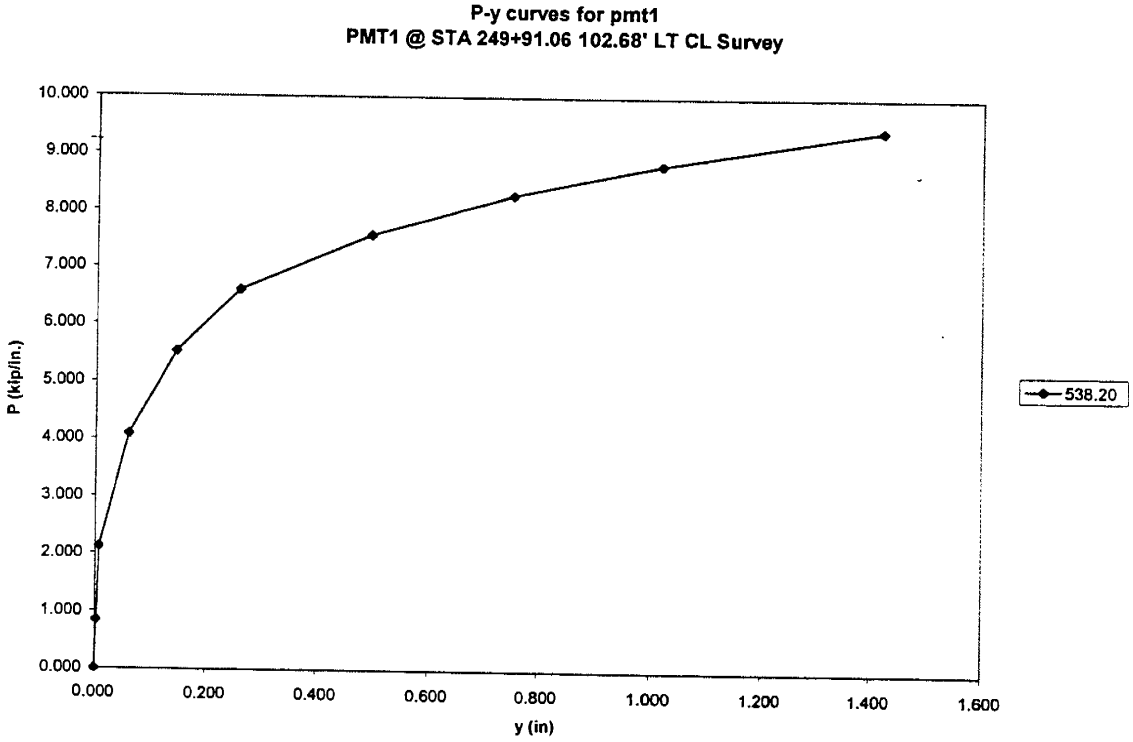
$$y = \frac{(2.111cc)(30in/2)}{(2 * 16.221in^3)(2.54^3)} = 0.06in.$$

Pressuremeter Site / Test #: 10

Ground Surface to Center of Membrane: 538.20 in

α: 1.5

Point No.	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	0.103	1.295	18.766	0.844	0.003
3	0.261	3.264	47.281	2.128	0.007
4	2.111	6.276	90.918	4.091	0.060
5	5.094	8.479	122.828	5.527	0.144
6	9.206	10.134	146.797	6.606	0.260
7	17.516	11.628	168.437	7.580	0.494
8	26.680	12.719	184.238	8.291	0.753
9	36.062	13.536	196.079	8.824	1.018
10	50.336	14.488	209.870	9.444	1.420



Reference:

Robertson, P. K., Campanella, R. G., Brown, P. T., Grof, I., and Hughes, J. M., "Design of Axially and Laterally Loaded Piles Using In Situ Tests : A Case History," Canadian Geotechnical Journal, Vol. 22, No. 4, pp.518-527, 1985.

B-1-50

Data Reduction of DMT for P-y Curves

Reference: Robertson, P.K., Davies, M.P., and Campanella, R.G. (1989) "Design of Laterally Loaded Driven Piles using the Flat Dilatometer" ASTM Geotechnical Testing Journal, Vol. 12, No. 1, March. pp 30-38.

For cohesive soils a cubic parabolic p-y curve is suggested:

$$\frac{P}{P_u} = 0.5\left(\frac{y}{y_c}\right)^{0.33}$$

where: $y_c = \frac{23.67 S_u D^{0.5}}{F_c E_D}$; with y_c in cm, D = Pile diameter, cm, and $F_c \approx 10$

The evaluation of the ultimate lateral resistance P_u is given as:

$$P_u = N_p S_u D$$

At considerable depths $N_p \approx 9$, but near the surface it reduces to a range of 2 – 4; accordingly,

$N_p = 3 + \frac{\sigma_{vo}}{S_u} + \left(J\frac{x}{D}\right) < 9.0$, and x = depth, σ_{vo} = effective stress at depth x, and

J = 0.5 (soft clay) to 0.25 (stiff clay)

The value of S_u can either be obtained from DMT values, or PMT estimates as

$S_{uPMT} = 0.67(P_{limit})^{0.75}$, with S_u and P_{limit} in kPa.

Example:

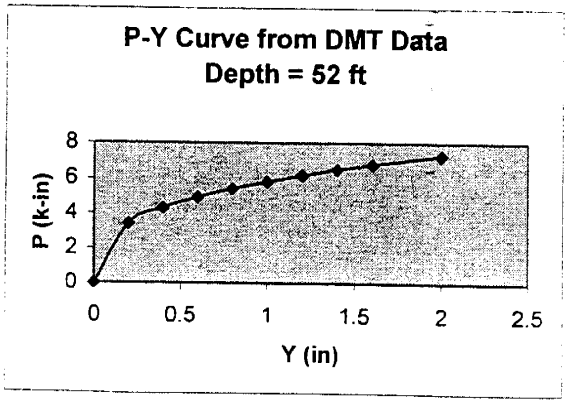
Given the DMT S_u value of 0.84 bars, and a Ed value of 136 bars at a depth of 52 ft the following table summarizes the calculation for a DMT P-y curve. For a 42 inch pile.

a. $$y_c = \frac{23.67 S_u D^{0.5}}{F_c E_D} = \frac{23.67 * 0.84 bars * (42" * 2.54)^{0.5}}{10 * 136 bars} * \frac{1}{2.54} = 0.059 in.$$

b. $$P_u = N_p S_u D = 9 * (0.84 bars * 100 kPa/bar) * 1.067 m * \frac{0.225 kips}{kN} * \frac{1 m}{39.6 in} = 4.58 kip/in$$

Depth (ft) = 52

Y (in)	P (k/in)
0	0
0.2	3.42
0.4	4.30
0.6	4.91
0.8	5.40
1	5.82
1.2	6.18
1.4	6.50
1.6	6.79
2	7.31



B-1-51

Data Reduction of DMT-PMY for P-y Curves

Ruesta (1997) suggested that the even the "rebound" p-y slope was too soft to be used as the initial p-y slope. Consequently, he suggested a DMT/PMT method that uses the initial slope related to the DMT E_d and the PMT limit pressure for the final pressures. The shape of the p-y curve is linear from zero to 1.1mm (DMT B reading) , which is the dilatometer modulus E_d multiplied by a modulus factor F_ϕ (between 2 and 3). The PMT limit pressure is multiplied by an α factor according to Robertson et al. An exponential equation describes the curve from y = 1.1mm thereafter.

Example: Given a 42-inch pile at a depth of 29 ft. and the data below, the p-y curve can be developed.

Dr. Townsend { Granular mat'l, PMT curve is too soft. (St. Lucie, Roosevelt Bridge)
{ Cohesive mat'l, PMT curve is usually a good method.

DMT/PMT P-Y CURVES Puerto Nuevo Puerto Rico CB-59 PMT 1 / DMT 1

PILE DIAMETER: 42 INCHES
Empirical F factor: 2.5
BETWEEN 2 AND 3

Depth Feet	DEPTH INCHES	DILATOMETER Ed (BAR)	INITIAL SLOPE	PRESSUREMETER CORRECTED PRESSURE (BAR)	(LBS/IN)	α DEPTH	ULTIMATE SOIL RESISTANCE Ph
19	228	23	833.75	2.40	1461.60	1.50	2192.40
24	288	34	1232.50	2.80	1705.20	1.50	2557.80
29	348	83.5	3026.88	1.90	1157.10	1.50	1735.65
34	408	67	2428.75	5.40	3288.60	1.50	4932.90
39	468	66.5	2410.63	4.40	2679.60	1.50	4019.40
44	528	107	3878.75	8.75	5328.75	1.50	7993.13
54	648	172	6235.00	10.80	6577.20	1.50	9865.80
59	708	125	4531.25	12.60	7673.40	1.50	11510.10

For example: consider depth of 29 feet.

α IS DEPTH FACTOR
ROBERTSON & CAMPANELLA

$$P = \frac{e^{a} - e^{-a}}{e^{a} + e^{-a}} * (Ph_i - Po_i) + Po_i$$

Where:

$$a = (y_i - y_0) * (Ed_i / Ph_i)$$

$$Po_i = Ed_i * \frac{14.5psi}{bar} * Diameter * F_\phi$$

$$y_0 = 1.1mm = 0.0433in$$

$$Ph_i = PL_i * \frac{14.5psi}{bar} * Diameter * \alpha$$

α See Pressuremeter Information

1. $P_0 @ y_0 = 1.1mm = (83.5bars * 14.5psi / bar)(2.5) = 3026.88 * \frac{1.1mm}{25.4} = 131.1lbs / in$

2. $P_h = 1.90 * (14.5psi / bar) * 42in = 1157lbs / in * 1.5 = 1735.6lbs / in$

(D) (α)

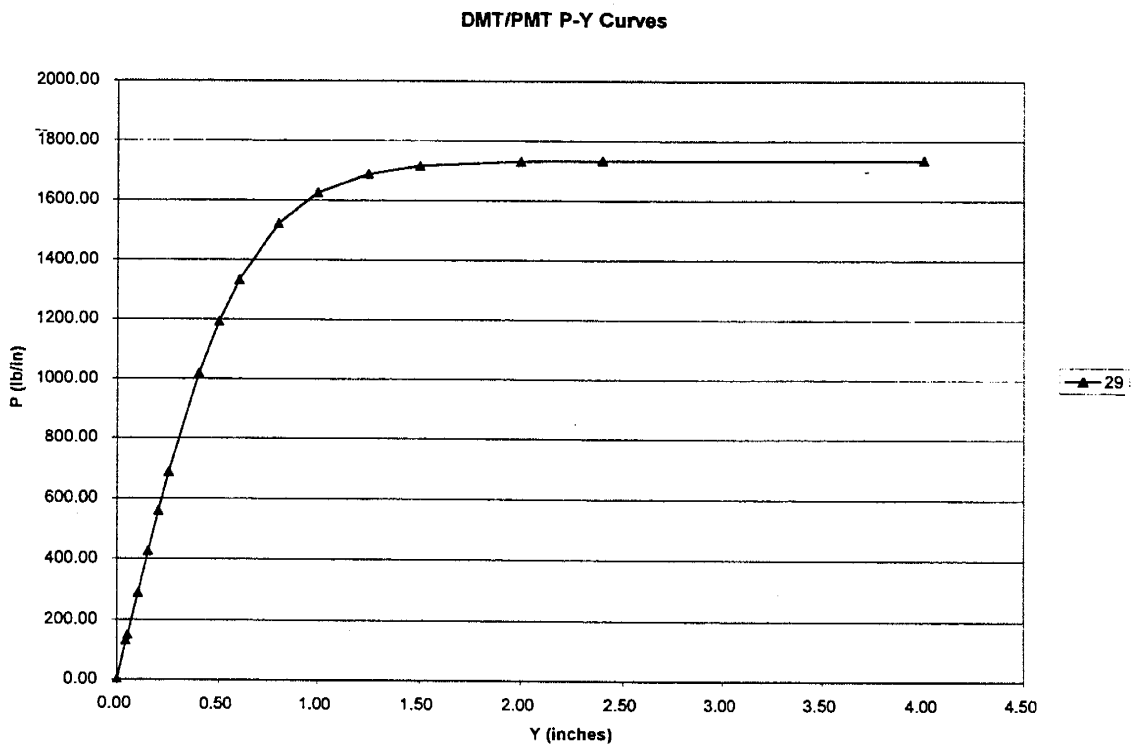
B-1-52

3. If y = 1.0in, then: $a = (1.0" - 0.0433")(3026.88/1735.65) = 1.6686$

And 4. $P = \left[\frac{e^{1.6686} - e^{-1.6686}}{e^{1.6686} + e^{-1.6686}}\right](1735.6 - 131.1) + 131.1 = 1625.5 lbs/in$

Y (in)	P (lb/in)
0.00	0.00
0.04	131.09
0.05	149.81
0.10	289.21
0.15	426.24
0.2	558.96
0.25	685.65
0.4	1017.70
0.5	1193.38
0.6	1333.02
0.8	1521.75
1	1625.48
1.25	1688.65
1.5	1715.83
2	1732.17
2.4	1734.79
4	1735.65

B-1-53



Site Description

The site locations are summarized in the following Site Details Table

Table-Site Details

Site No.	Y	X	El. (ft)	Core Boring
1	216376.12	623085.04	8.81	CB PNL 59
2	213427.99	617252.35	8.11	CM MC 30
3	214269.00	621634.01	24.4	CB PNB 4

Site #1 was located at the proposed load test across from the Plaza of the Americas. The PMT and DMT borings were made approximately 25.5 and 33.5 ft. respectively from CB-59. (See sketch page 1). The borings are very close to the abutment pile cap.

Site #2 was located in a grassy field between the road and Puerto Nuevo channel. The PMT and DMT borings were made approximately 17 and 20 ft. from CBMC 30. (See sketch page 2).

Site #3 was located at the SW overpass abutment of a highway bridge. The PMT boring was located about 6 ft. from CB PNB 4.

B-1-54

Data Reduction

DMT data reduction was accomplished using Dilly4, a program supplied with the DMT. The "raw" field data, and subsequently "reduced" data are contained in Appendix DMT.

The PMT data reduction was accomplished via spreadsheets, which incorporate both volume and pressure corrections, as well as PMT elevation. The volume and pressure correction data use Excel to generate appropriate equations to fit the data, from which the "corrected" PMT curves are developed. The "raw" and "corrected PMT data and corresponding PMT curves are presented in Appendix PMT.

Results

Inasmuch as the insitu soils are consolidated, and the PMT or DMT tests are performed relatively quickly or undrained; the strengths represent a C/U (R) condition. Tables S_u 1, S_u 2, and S_u 3 summarize undrained S_u estimated from SPT, PMT, or DMT correlations.

Table S_u 1 Summary of S_u – Site #1

Depth	El.	N CB-59	PMT P_l, (Bars)	S_u –N (tsf)	S_u –DMT (tsf)	S_u –PMT (tsf)
14	-5.2	6	3.8	.23		.58
19	-10.2	3	2.4	.11		.41
24	-15.2	5	2.8	.19		.46
29	-20.2	5	1.9	.19		.34
34	-25.2	9	5.4	.34		.75
39	-30.2	14	4.4	.54		.64
44	-35.2	33	8.75	1.26	.53	1.08
54	-45.2	19	10.8	.73	1.01	1.26
59	-50.2	18	12.6	.69	.97	1.42
64	-55.2	18	8.4	.69	1.16	1.05

Table S_u 2 summarizes S_u estimates for site #2.

Table S_u 2 Summary of S_u – Site #2

Depth	El.	CB-30	PMT P_l, (Bars)	S_u –N (tsf)	S_u –DMT (tsf)	S_u –PMT (tsf)
5	-3.1	10	2.5	.38		.42
10	-1.9	3	1.7	.11	.14	.32
15	-6.9	1	1.1	.04	.14	.23
20	-11.9	1	1.2	.04	.16	.24
25	-16.9	9	5.5	.34	.24	.76
30	-21.9	11	13.2	.42		1.47
35	-26.9	18	11.6	.69		1.33
45	-36.9	16	7.5	.61		.96
50	-41.9	9	7.3	.34		.94
52	-43.9	11	9.3	.42		1.13

B-1-55

Table S_u 3 summarizes S_u estimates for Site #3.

Table S_u 3 Summary of S_u – Site #1

Depth	El.	CB-4	PMT P_l, (Bars)	S_u –N (tsf)	S_u –DMT (tsf)	S_u –PMT (tsf)
25	-0.9	9	2.12	.34	N/A	.37
30	-5.9	17	6.57	.65		.87
35	-10.9	13	9.1	.50		1.11
45	-20.9	11	6.5	.42		.86
50	-25.9	19	13.4	.73		1.48

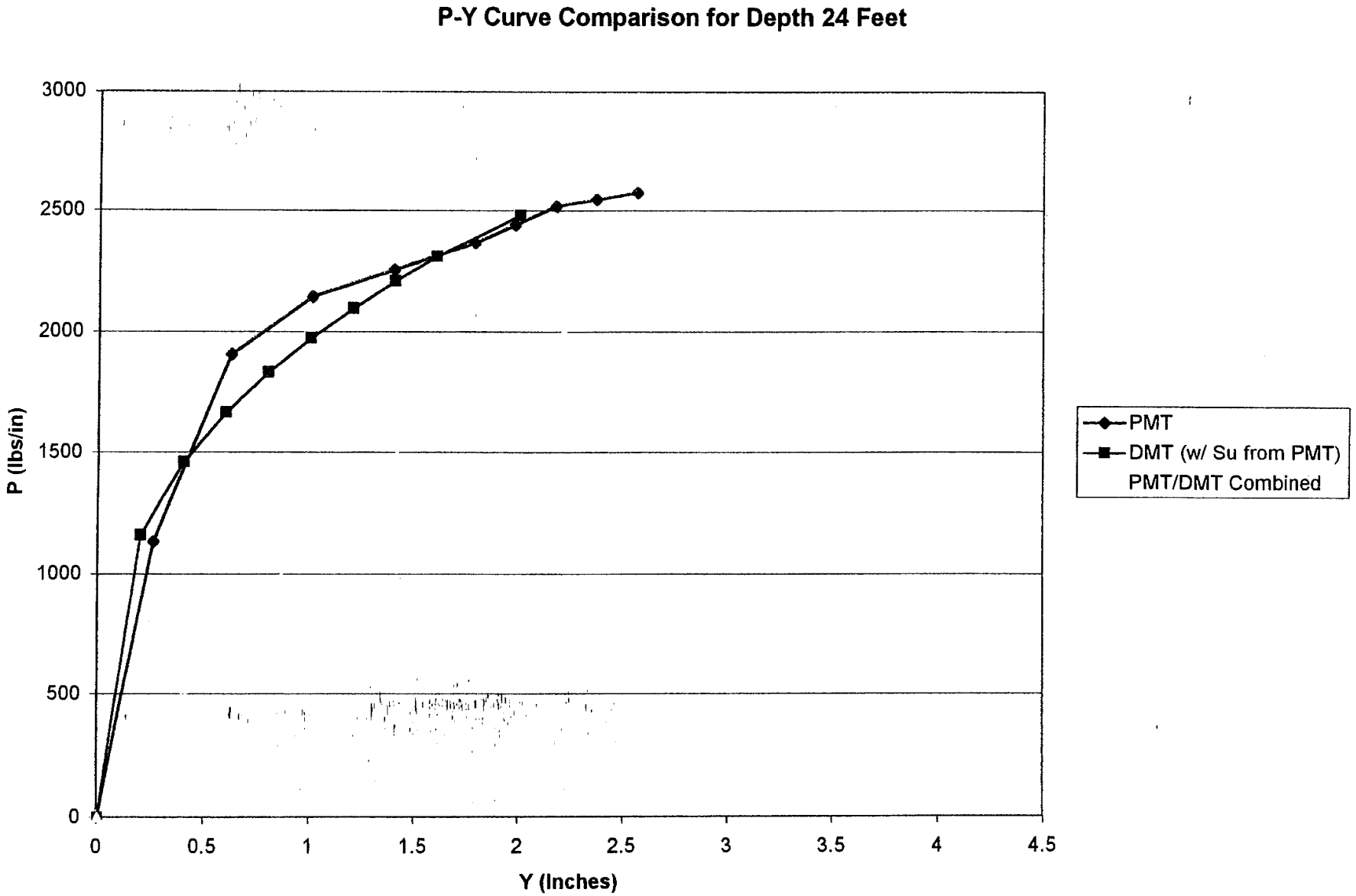
Summary of P-Y Results

The p-y results were developed using; (1) DMT, (2) PMT, and (3) DMT/PMT data. Example comparisons of these 3 techniques are presented in the Figures below from Site #1 at depths of 24 and 54 ft. As shown the PMT produces the ~~stiffest~~ softest curve and the stiffest DMT/PMT the ~~softest~~. All the p-y curves and corresponding data tables are presented/summarized in Appendix P-Y. Note: *These curves are for a 42" diameter pile @ specified depths, and cannot be used indiscriminately for other conditions.*

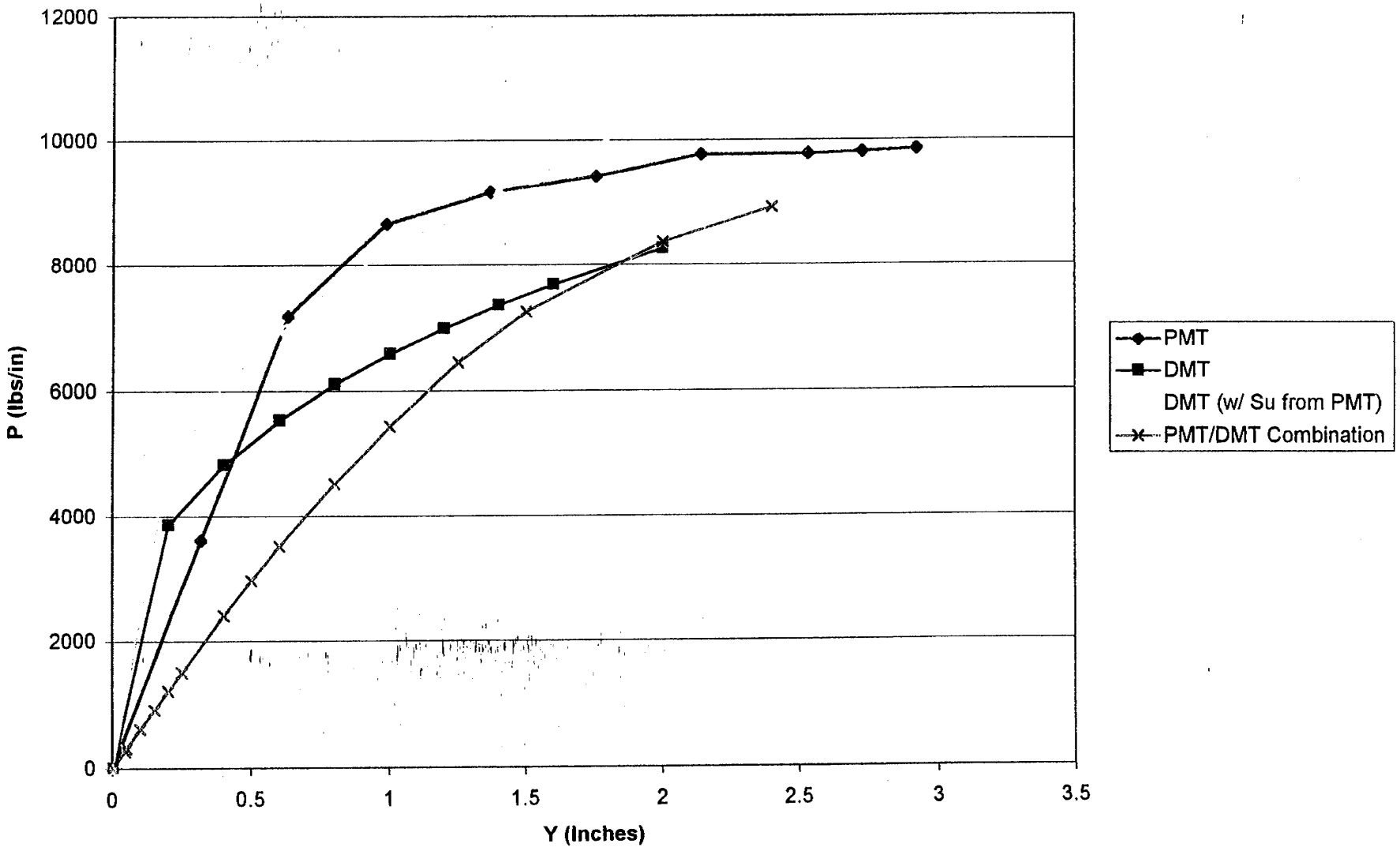
Conclusions

1. All 3 sites consist of approximately 35-40 ft of soft clay (S_u values from PMT ranging from 0.23 tsf to 1.48 tsf). Beneath this soft clay is a stiff layer of decomposed limestone.
2. P-y curves representing Consolidated-Undrained (R) conditions developed from DMT, PMT, and DMT/PMT relationships show the PMT is the stiffest curve. However, until a lateral load test is performed we are unable to recommend which curve is superior.

B-1-56


P-Y Curve Comparison for Depth 24 Feet
P (lbs/in)
3000
2500
2000
1500
1000
500
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Y (Inches)
PMT
DMT (w/ Su from PMT)
PMT/DMT Combined

G-1-57


Comaprison of P-Y Curves for Depth 54 Feet
P (lbs/in)
12000
10000
8000
6000
4000
2000
0
0
0.5
1
1.5
2
2.5
3
3.5
Y (Inches)
PMT
DMT
DMT (w/ Su from PMT)
PMT/DMT Combination

85-1-9

Dilatometer Appendix

6-1-59

Data Reduction and P-Y Curves
For Site #1, CB-59

Data Reduction for Dilatometer P-Y curves

Puerto Nuevo Puerto Rico CB-59 Site #1

Diameter of Pile (cm) 106.7 (42")

Unit Weight of Water (pcf) 62.4
Depth to GWT (ft) 8.81

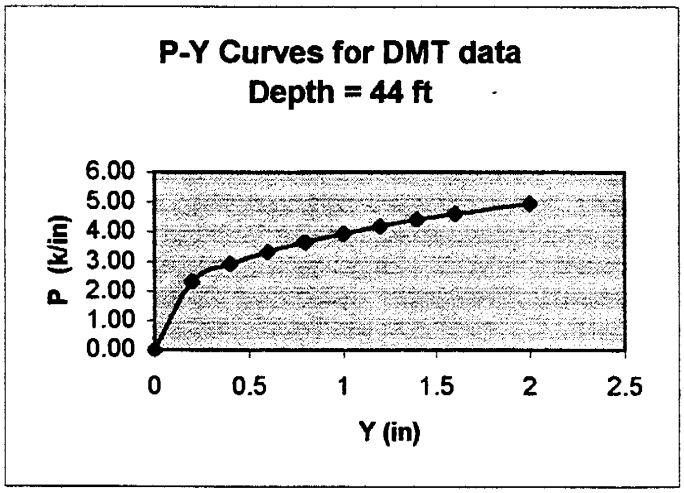
Depth mt	Depth Ft	Elevation	Unit Weight T/m^3	Unit Weight pcf	Ed bars	Su bar	Fc	Sigma V' bars	J	Np	Np Corrected	Pu k/in	Yc in
13.41	44	-35.2	1.8	102.0	107	0.53	10	1.10	0.5	11.36	9	2.89	0.048
15.85	52	-43.2	1.9	107.7	136	0.84	10	1.39	0.5	12.08	9	4.58	0.059
16.46	54	-45.2	1.9	107.7	172	1.01	10	1.43	0.5	12.13	9	5.51	0.071
17.07	56	-47.2	1.9	107.7	165	0.95	10	1.48	0.5	12.55	9	5.18	0.053
17.86	59	-49.8	1.9	107.7	136	0.97	10	1.53	0.5	12.95	9	5.29	0.057
18.29	60	-51.2	1.9	107.7	114	1.16	10	1.56	0.5	12.92	9	6.33	0.082

19-1-01

P-Y Curves from DMT Data

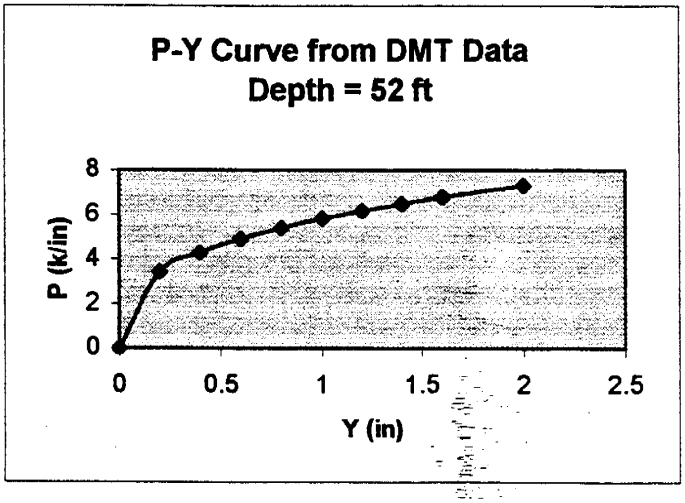
Depth (ft) = 44 Site #1

Y (in)	P (k/in)
0	0.00
0.2	2.32
0.4	2.92
0.6	3.33
0.8	3.67
1	3.95
1.2	4.19
1.4	4.41
1.6	4.61
2	4.96



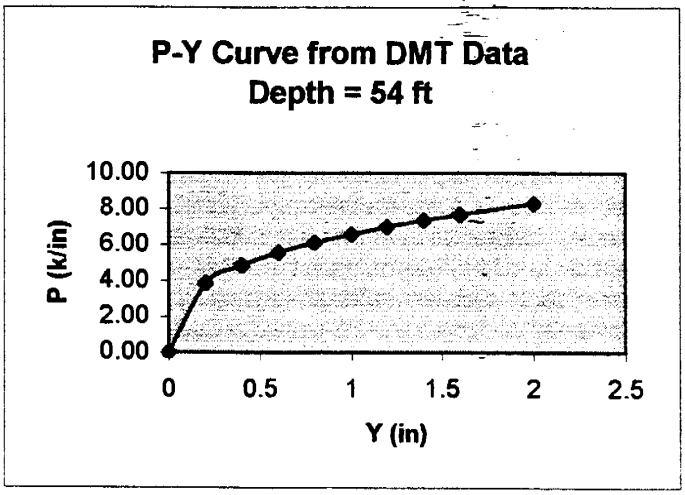
Depth (ft) = 52 Site #1

Y (in)	P (k/in)
0	0
0.2	3.42
0.4	4.30
0.6	4.91
0.8	5.40
1	5.82
1.2	6.18
1.4	6.50
1.6	6.79
2	7.31



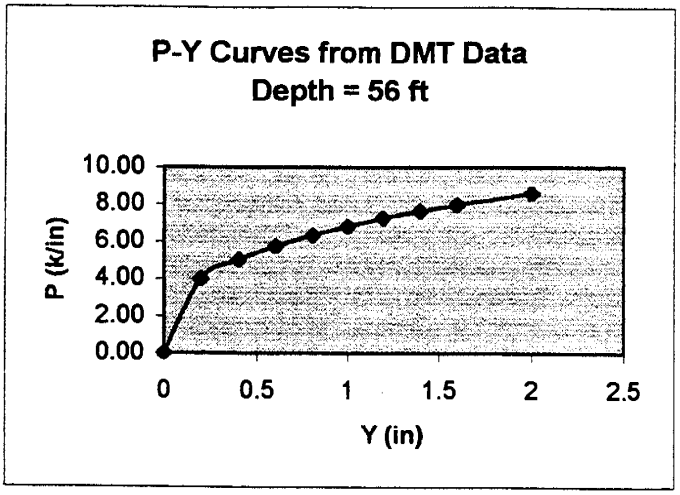
Depth (ft) = 54 Site #1

Y (in)	P (k/in)
0	0.00
0.2	3.87
0.4	4.86
0.6	5.56
0.8	6.11
1	6.58
1.2	6.99
1.4	7.35
1.6	7.69
2	8.27



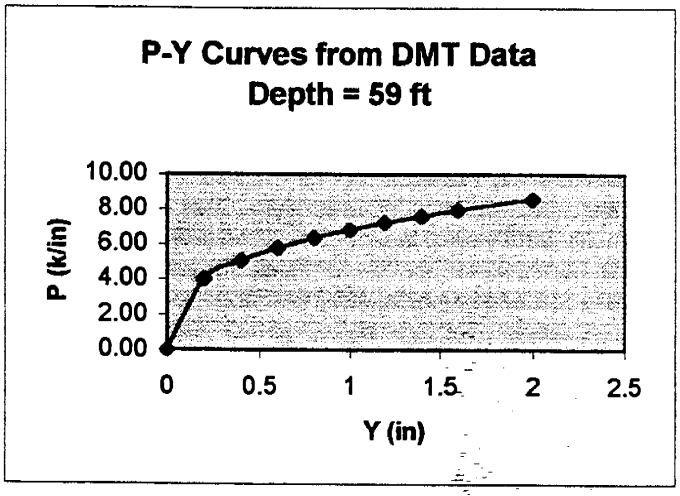
Depth (ft) = 56 Site #1

Y (in)	P (k/in)
0	0.00
0.2	4.01
0.4	5.04
0.6	5.77
0.8	6.34
1	6.83
1.2	7.25
1.4	7.63
1.6	7.97
2	8.58



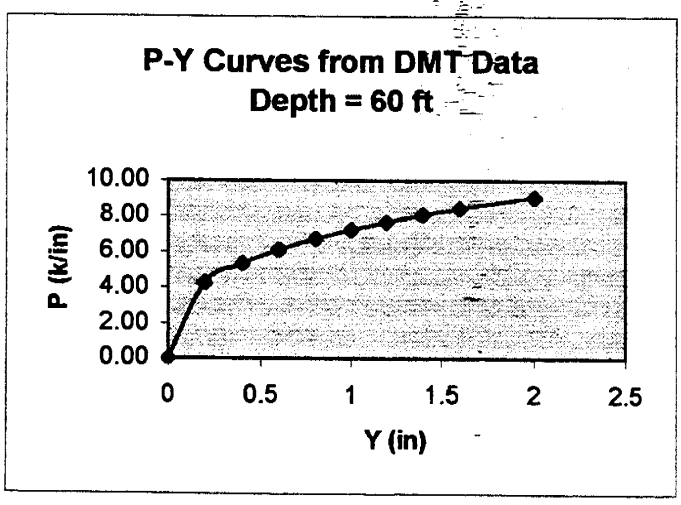
Depth (ft) = 59 Site #1

Y (in)	P (k/in)
0	0.00
0.2	4.01
0.4	5.05
0.6	5.77
0.8	6.34
1	6.83
1.2	7.25
1.4	7.63
1.6	7.97
2	8.58



Depth (ft) = 60 Site #1

Y (in)	P (k/in)
0	0.00
0.2	4.25
0.4	5.34
0.6	6.10
0.8	6.71
1	7.22
1.2	7.67
1.4	8.07
1.6	8.43
2	9.08



Data Reduction for Dilatometer and Pressuremeter P-Y Curves

Puerto Nuevo, Puerto Rico CB-59 Site #1

Diameter of Pile (cm) 106.7

Unit Weight of Water (pcf) 62.4
Depth to GWT (ft) 8.81

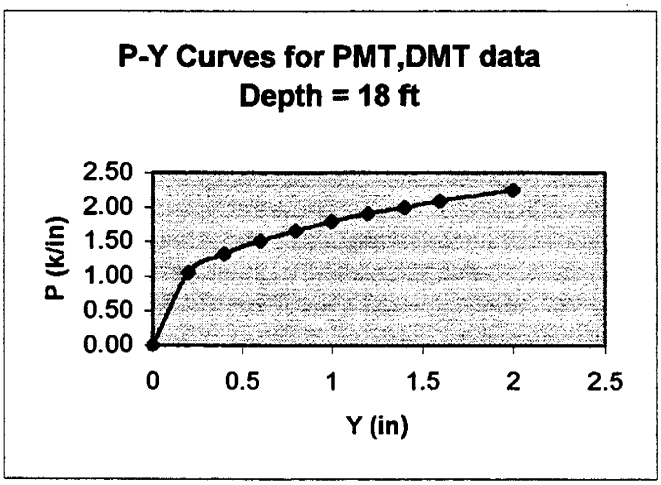
Depth mt	Depth Ft	Elevation	Unit Weight T/m^3	Unit Weight pcf	Ed bars	Preasure Limit (bars)	Su bar	Fc	Sigma V ' bars	J	Np	Np Corrected	Pu k/in	Yc in
5.48	18.0	-9.2	1.6	90.7	38	2.42	0.411	10	0.507	0.5	6.80	6.80	1.69	0.104
6.1	20.0	-11.2	1.5	85.0	8	2.5	0.421	10	0.480	0.5	7.00	7.00	1.79	0.507
6.71	22.0	-13.2	1.6	90.7	38	2.66	0.441	10	0.561	0.5	7.42	7.42	1.98	0.112
7.32	24.0	-15.2	1.6	90.7	34	2.82	0.461	10	0.589	0.5	7.71	7.71	2.15	0.131
7.92	26.0	-17.2	1.7	96.4	48	2.45	0.415	10	0.686	0.5	8.36	8.36	2.10	0.083
8.53	28.0	-19.2	1.7	96.4	78	2.1	0.370	10	0.718	0.5	8.94	8.94	2.00	0.046
9.14	30.0	-21.2	1.7	96.4	89	1.2	0.243	10	0.751	0.5	10.37	9.00	1.33	0.026
9.75	32.0	-23.2	1.7	96.4	70	2.6	0.434	10	0.783	0.5	9.37	9.00	2.37	0.060
10.36	34.0	-25.2	1.8	102.0	67	5.4	0.751	10	0.908	0.5	9.06	9.00	4.10	0.108
10.97	36.0	-27.2	1.7	96.4	99	5	0.708	10	0.848	0.5	9.34	9.00	3.87	0.069
11.58	38.0	-29.2	1.7	96.4	70	4.6	0.665	10	0.881	0.5	9.75	9.00	3.63	0.092
12.19	40.0	-31.2	1.7	96.4	63	5.3	0.740	10	0.913	0.5	9.95	9.00	4.04	0.113
12.8	42.0	-33.2	1.8	102.0	78	7	0.912	10	1.060	0.5	10.16	9.00	4.97	0.113
13.94	45.7	-36.9	1.9	107.7	140	9.2	1.119	10	1.255	0.5	10.65	9.00	6.11	0.077

B-1-69

P-Y Curves from PMT,DMT Data

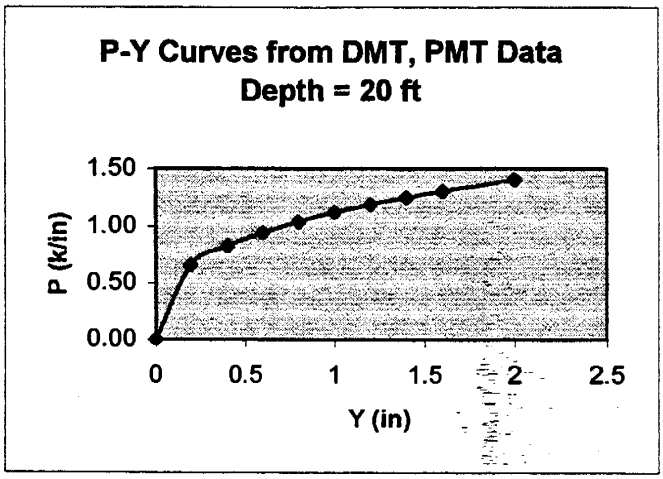
Depth (ft) = 18 Site #1

Y (in)	P (k/in)
0	0.00
0.2	1.05
0.4	1.32
0.6	1.51
0.8	1.66
1	1.79
1.2	1.90
1.4	2.00
1.6	2.09
2	2.25



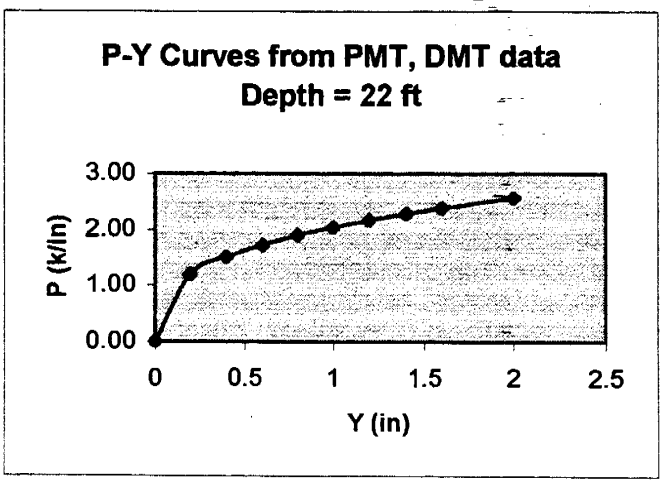
Depth (ft) = 20 Site #1

Y (in)	P (k/in)
0	0.00
0.2	0.66
0.4	0.83
0.6	0.94
0.8	1.04
1	1.12
1.2	1.19
1.4	1.25
1.6	1.31
2	1.41



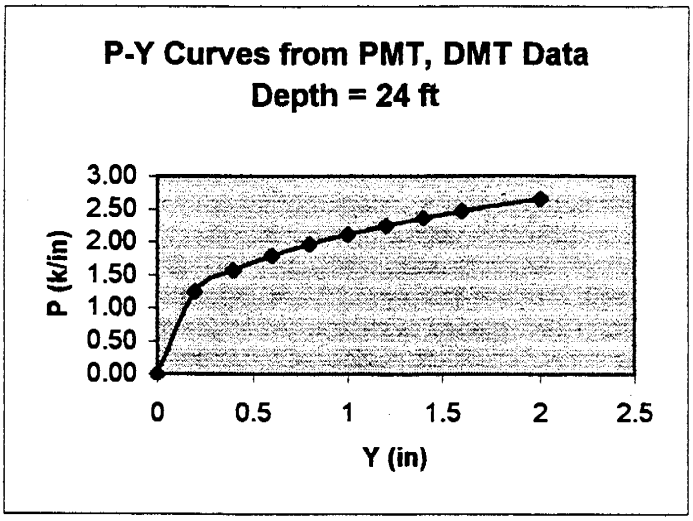
Depth (ft) = 22 Site #1

Y (in)	P (k/in)
0	0.00
0.2	1.20
0.4	1.51
0.6	1.73
0.8	1.90
1	2.04
1.2	2.17
1.4	2.28
1.6	2.39
2	2.57



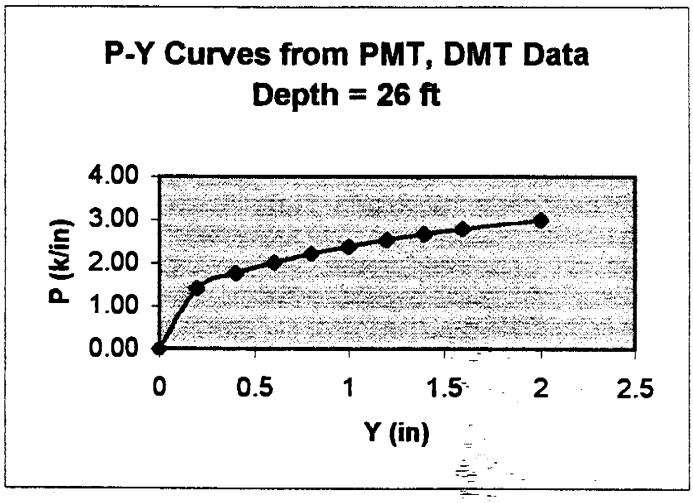
Depth (ft) = 24 Site #1

Y (in)	P (k/in)
0	0.00
0.2	1.24
0.4	1.56
0.6	1.78
0.8	1.96
1	2.11
1.2	2.24
1.4	2.36
1.6	2.46
2	2.65



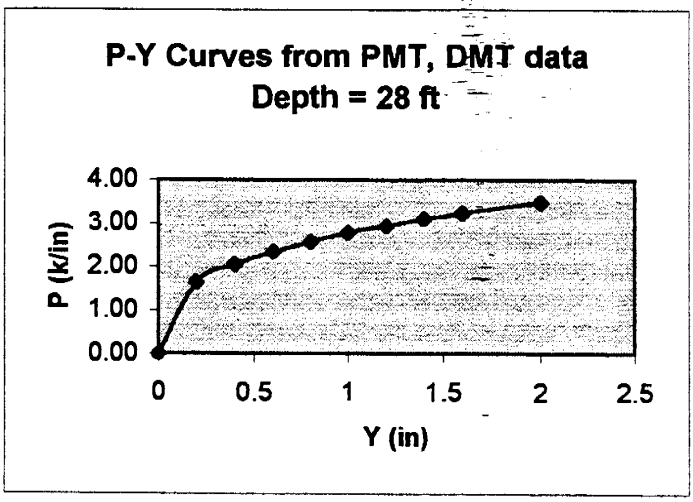
Depth (ft) = 26 Site #1

Y (in)	P (k/in)
0	0.00
0.2	1.40
0.4	1.77
0.6	2.02
0.8	2.22
1	2.39
1.2	2.54
1.4	2.67
1.6	2.79
2	3.00



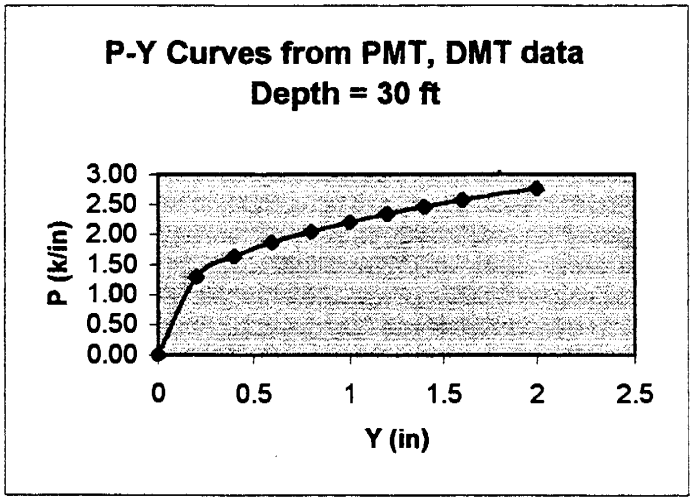
Depth (ft) = 28 Site #1

Y (in)	P (k/in)
0	0.00
0.2	1.63
0.4	2.05
0.6	2.34
0.8	2.58
1	2.77
1.2	2.95
1.4	3.10
1.6	3.24
2	3.49



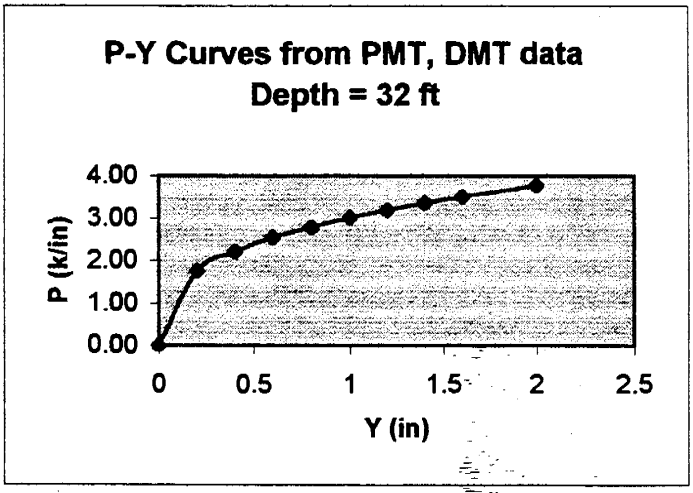
Depth (ft) = 30 Site #1

Y (in)	P (k/in)
0	0.00
0.2	1.29
0.4	1.63
0.6	1.86
0.8	2.05
1	2.20
1.2	2.34
1.4	2.46
1.6	2.57
2	2.77



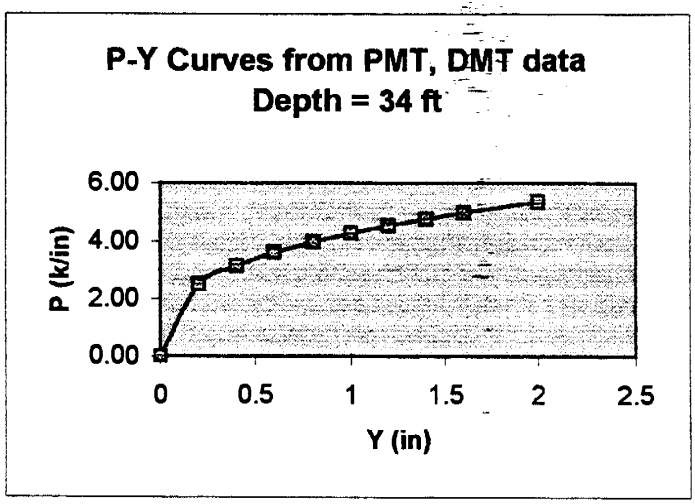
Depth (ft) = 32 Site #1

Y (in)	P (k/in)
0	0.00
0.2	1.76
0.4	2.22
0.6	2.54
0.8	2.79
1	3.00
1.2	3.19
1.4	3.35
1.6	3.50
2	3.77



Depth (ft) = 34 Site #1

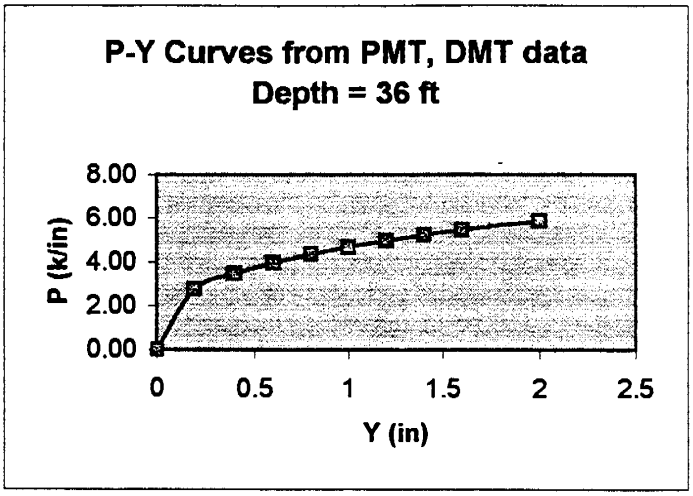
Y (in)	P (k/in)
0	0.00
0.2	2.51
0.4	3.16
0.6	3.61
0.8	3.97
1	4.27
1.2	4.53
1.4	4.77
1.6	4.99
2	5.37



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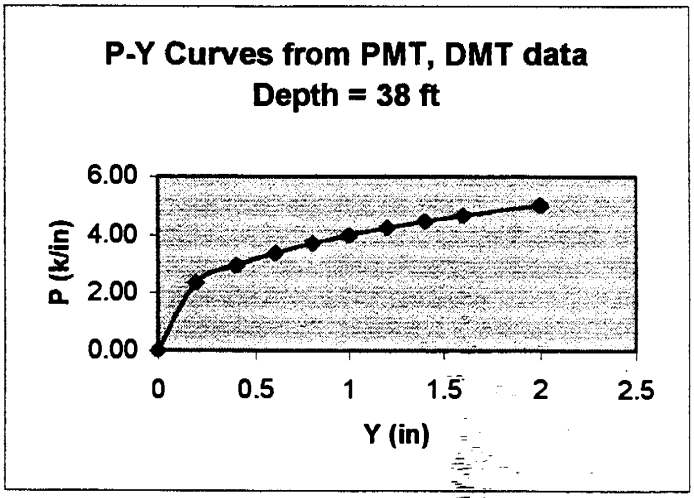
Depth (ft) = 36 Site #1

Y (in)	P (k/in)
0	0.00
0.2	2.75
0.4	3.45
0.6	3.95
0.8	4.34
1	4.67
1.2	4.96
1.4	5.22
1.6	5.46
2	5.87



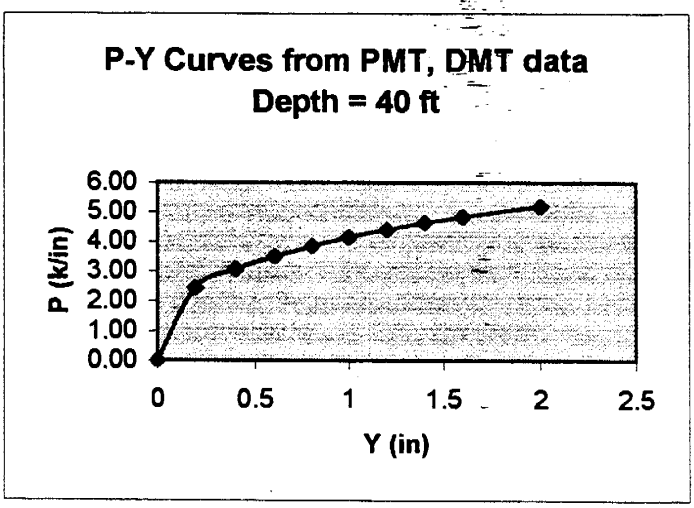
Depth (ft) = 38 Site #1

Y (in)	P (k/in)
0	0.00
0.2	2.35
0.4	2.95
0.6	3.38
0.8	3.71
1	4.00
1.2	4.24
1.4	4.47
1.6	4.67
2	5.02



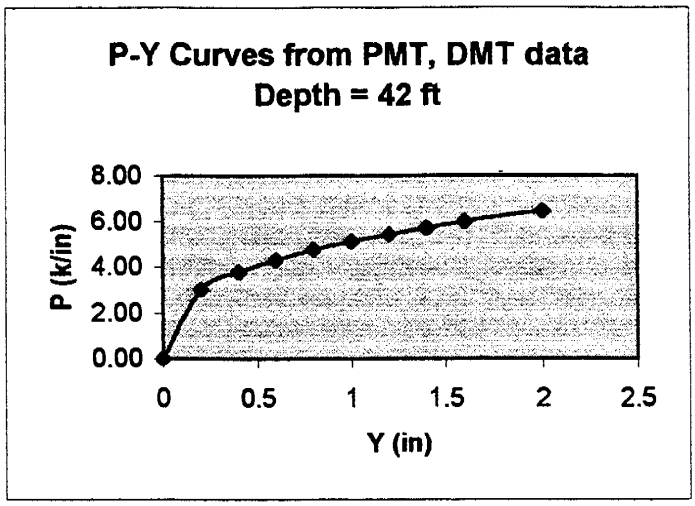
Depth (ft) = 40 Site #1

Y (in)	P (k/in)
0	0.00
0.2	2.44
0.4	3.06
0.6	3.50
0.8	3.85
1	4.15
1.2	4.40
1.4	4.63
1.6	4.84
2	5.21



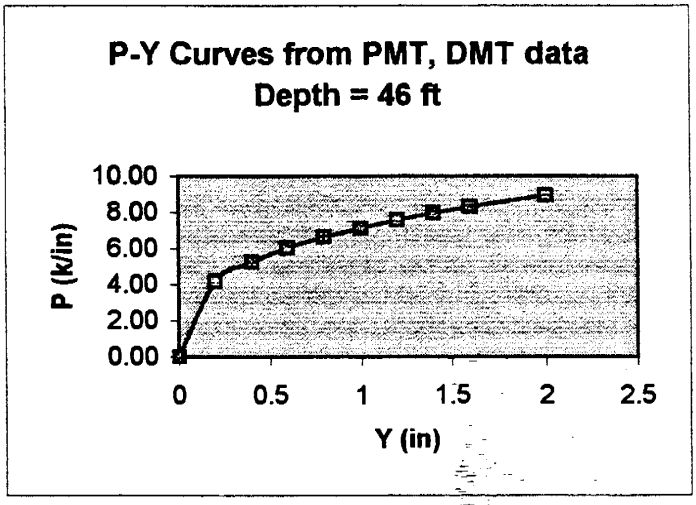
Depth (ft) = 42 Site #1

Y (in)	P (k/in)
0	0.00
0.2	3.01
0.4	3.78
0.6	4.32
0.8	4.75
1	5.12
1.2	5.43
1.4	5.72
1.6	5.97
2	6.43



Depth (ft) = 46 Site #1

Y (in)	P (k/in)
0	0.00
0.2	4.18
0.4	5.26
0.6	6.01
0.8	6.61
1	7.12
1.2	7.56
1.4	7.95
1.6	8.31
2	8.95



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Data Reduction and P-Y Curves
For Site #2, CBMC-30

B-1-70

Data Reduction for Dilatometer P-Y curves

Puerto Nuevo Puerto Rico CBMC-30 Site #2

Diameter of Pile (cm) 106.7

Unit Weight of Water (pcf) 62.4
Depth to GWT (ft) 8.11

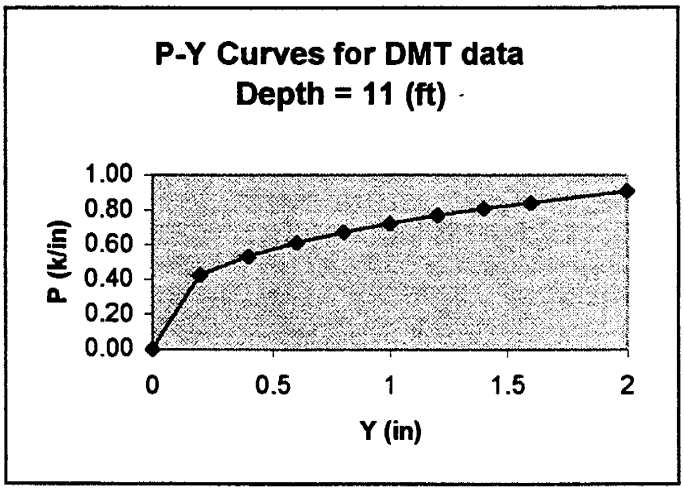
Depth mt	Depth Ft	Elevation	Unit Weight T/m^3	Unit Weight pcf	Ed bars	Su bar	Fc	Sigma V ' bars	J	Np	Np Corrected	Pu k-in	Yc in
3.35	11	-2.9	1.6	90.7	17	0.14	10	0.391	0.5	7.36	7.36	0.625	0.079
3.96	13	-4.9	1.6	90.7	25	0.14	10	0.418	0.5	7.84	7.84	0.666	0.054
4.57	15	-6.9	1.6	90.7	14	0.14	10	0.445	0.5	8.32	8.32	0.706	0.054
5.18	17	-8.9	1.6	90.7	14	0.14	10	0.473	0.5	8.80	8.80	0.747	0.096
5.79	19	-10.9	1.6	90.7	21	0.16	10	0.500	0.5	8.84	8.84	0.857	0.110
6.4	21	-12.9	1.6	90.7	21	0.17	10	0.527	0.5	9.10	9.00	0.928	0.078
7.01	23	-14.9	1.7	96.4	46	0.24	10	0.616	0.5	8.85	8.85	1.288	0.110

17-1-9

P-Y Curves from DMT Data

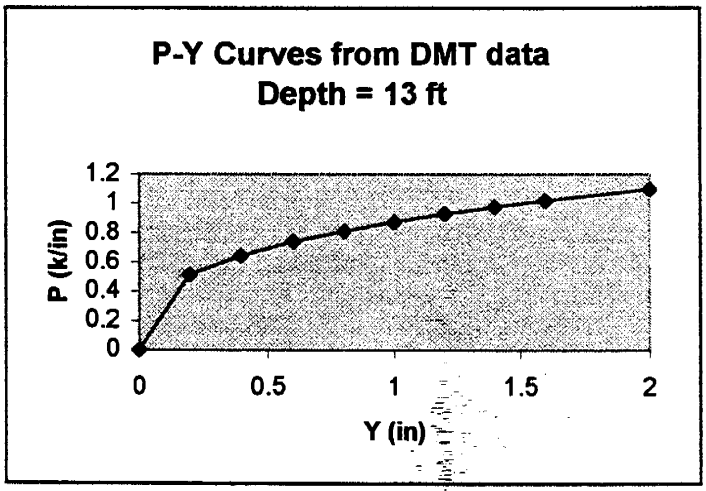
Depth (ft) = 11 **Site #2**

Y (in)	P (k/in)
0	0.00
0.2	0.42
0.4	0.53
0.6	0.61
0.8	0.67
1	0.72
1.2	0.77
1.4	0.81
1.6	0.84
2	0.91



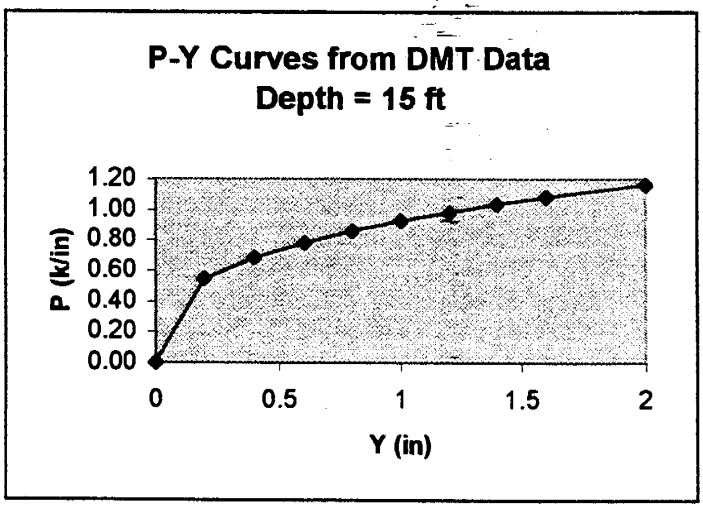
Depth (ft) = 13 **Site #2**

Y (in)	P (k/in)
0	0
0.2	0.51
0.4	0.64
0.6	0.74
0.8	0.81
1	0.87
1.2	0.93
1.4	0.98
1.6	1.02
2	1.10



Depth (ft) = 15 **Site #2**

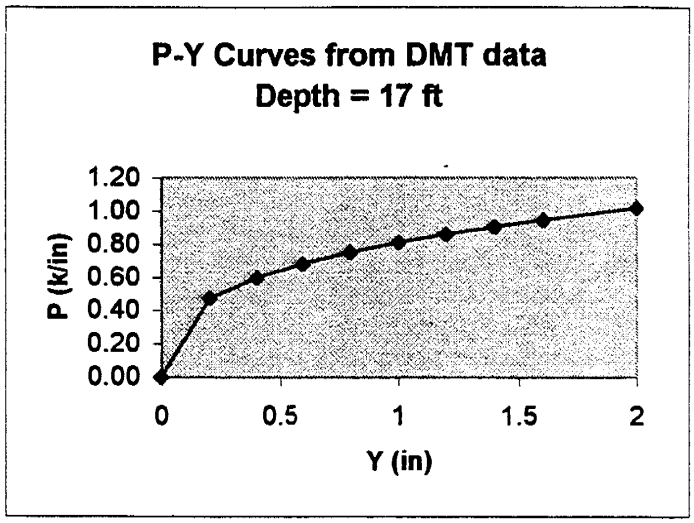
Y (in)	P (k/in)
0	0.00
0.2	0.54
0.4	0.68
0.6	0.78
0.8	0.86
1	0.93
1.2	0.98
1.4	1.03
1.6	1.08
2	1.16



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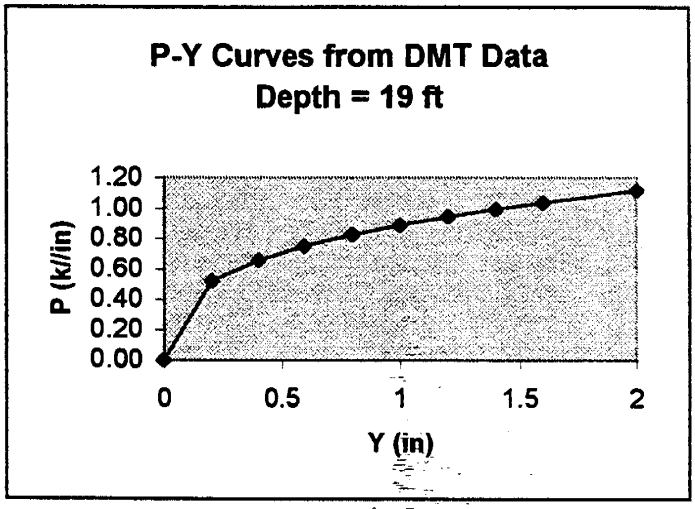
Depth (ft) = 17 **Site #2**

Y (in)	P (k/in)
0	0.00
0.2	0.48
0.4	0.60
0.6	0.68
0.8	0.75
1	0.81
1.2	0.86
1.4	0.90
1.6	0.94
2	1.02



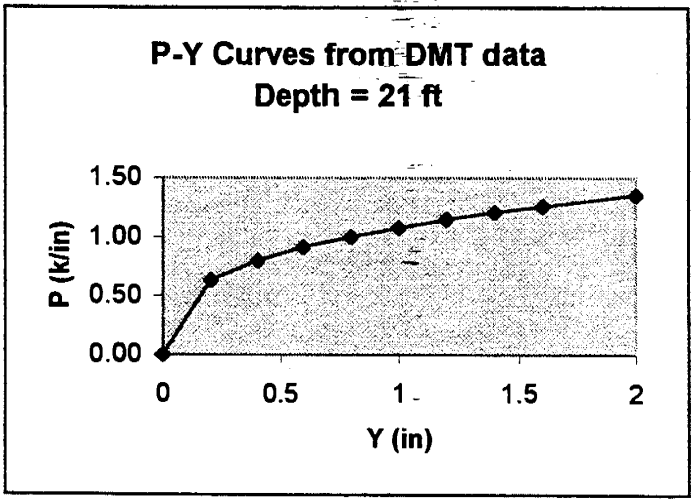
Depth (ft) = 19 **Site #2**

Y (in)	P (k/in)
0	0.00
0.2	0.52
0.4	0.66
0.6	0.75
0.8	0.82
1	0.89
1.2	0.94
1.4	0.99
1.6	1.04
2	1.12



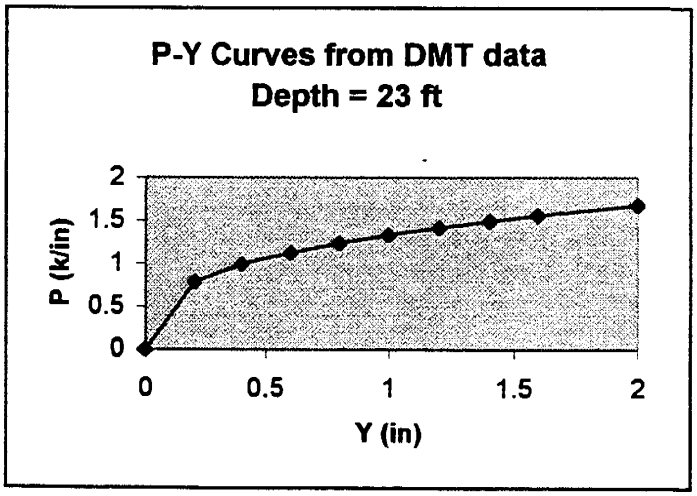
Depth (ft) = 21 **Site #2**

Y (in)	P (k/in)
0	0.00
0.2	0.63
0.4	0.80
0.6	0.91
0.8	1.00
1	1.08
1.2	1.14
1.4	1.20
1.6	1.26
2	1.35



Depth (ft) = 23 Site #2

Y (in)	P (k/in)
0	0
0.2	0.784453
0.4	0.986068
0.6	1.127241
0.8	1.2395
1	1.334218
1.2	1.416957
1.4	1.490902
1.6	1.558068
2	1.67713



Data Reduction for Dilatometer and Pressuremeter P-Y curves

Puerto Nuevo Puerto Rico CBMC-30 Site #2

Diameter of Pile (cm) 106.7

Unit Weight of Water (pcf) 62.4
Depth to GWT (ft) 8.81

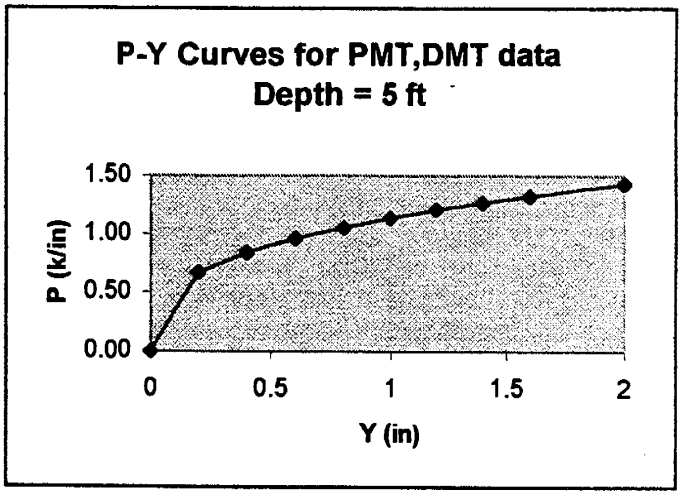
Depth mt	Depth Ft		Unit Weight T/m^3	Unit Weight pcf	Ed bars	Preasure Limit (bars)	Su bar	Fc	Sigma V ' bars	J	Np	Np Corrected	Pu k-in	Yc in
1.52	5.0	3.8	1.6	90.7	32	2.5	0.421	10	0.331	0.5	4.50	4.50	1.15	0.127
2.13	7.0	1.8	1.6	90.7	28	2.2	0.383	10	0.358	0.5	4.93	4.93	1.14	0.132
2.74	9.0	-0.2	1.7	96.4	50	1.9	0.343	10	0.409	0.5	5.48	5.48	1.14	0.066
7.62	25.0	-16.2	1.8	102.0	207	5.5	0.761	10	0.738	0.5	7.54	7.54	3.48	0.035
8.22	27.0	-18.2	1.95	110.5	280	8.9	1.092	10	0.885	0.5	7.66	7.66	5.07	0.038
8.84	29.0	-20.2	1.95	110.5	236	11.7	1.340	10	0.932	0.5	7.84	7.84	6.37	0.055
9.45	31.0	-22.2	1.95	110.5	250	12.9	1.442	10	0.978	0.5	8.11	8.11	7.09	0.056
9.54	31.3	-22.5	1.95	110.5	356	12.8	1.434	10	0.984	0.5	8.16	8.16	7.09	0.039

SL-1-9

P-Y Curves from PMT,DMT Data

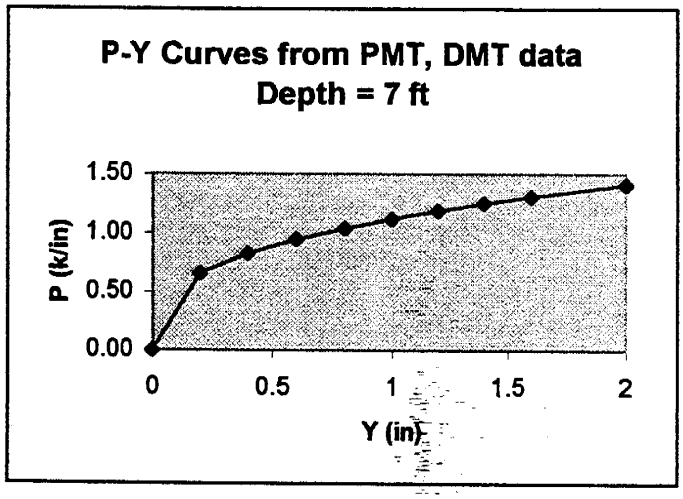
Depth (ft) = 5 **Site #2**

Y (in)	P (k/in)
0	0.00
0.2	0.67
0.4	0.84
0.6	0.96
0.8	1.05
1	1.14
1.2	1.21
1.4	1.27
1.6	1.33
2	1.43



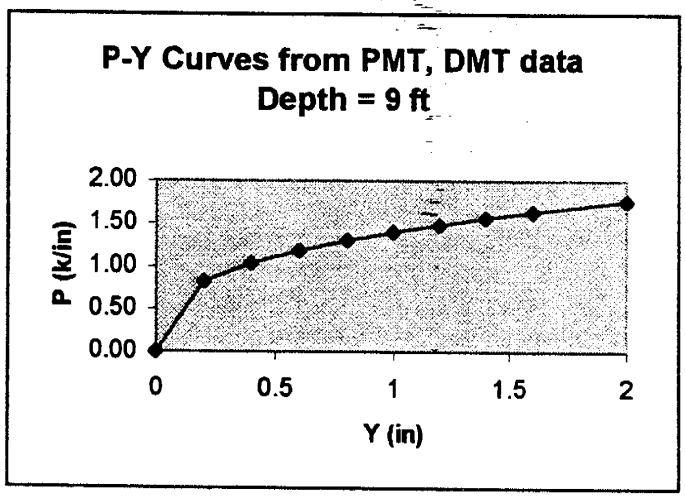
Depth (ft) = 7 **Site #2**

Y (in)	P (k/in)
0	0.00
0.2	0.66
0.4	0.83
0.6	0.94
0.8	1.04
1	1.12
1.2	1.19
1.4	1.25
1.6	1.31
2	1.40



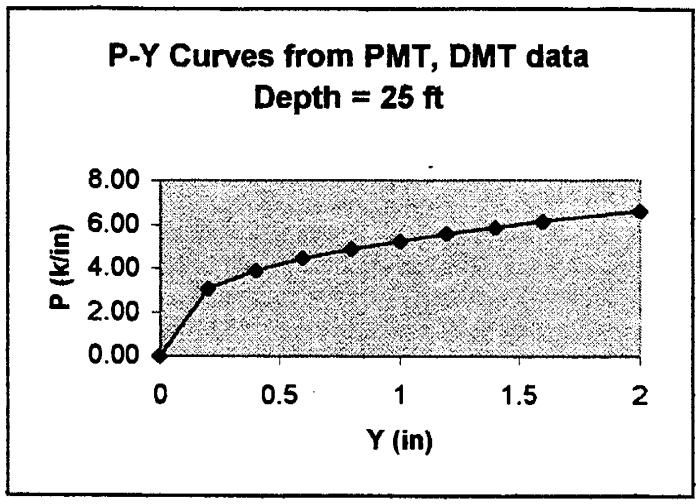
Depth (ft) = 9 **Site #2**

Y (in)	P (k/in)
0	0.00
0.2	0.82
0.4	1.03
0.6	1.18
0.8	1.30
1	1.40
1.2	1.48
1.4	1.56
1.6	1.63
2	1.75



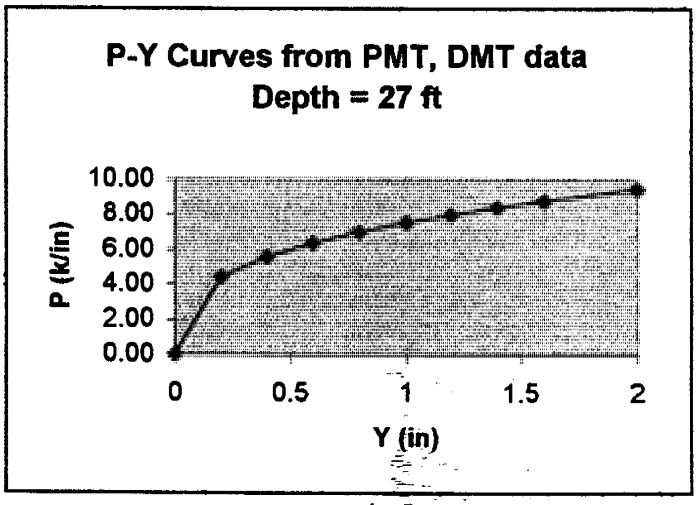
Depth (ft) = 25 **Site #2**

Y (in)	P (k/in)
0	0.00
0.2	3.08
0.4	3.87
0.6	4.43
0.8	4.87
1	5.24
1.2	5.56
1.4	5.85
1.6	6.12
2	6.59



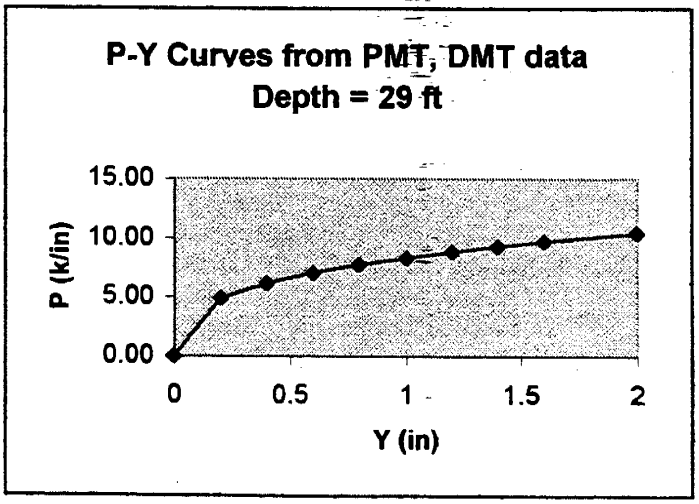
Depth (ft) = 27 **Site #2**

Y (in)	P (k/in)
0	0.00
0.2	4.40
0.4	5.54
0.6	6.33
0.8	6.96
1	7.49
1.2	7.96
1.4	8.37
1.6	8.75
2	9.42



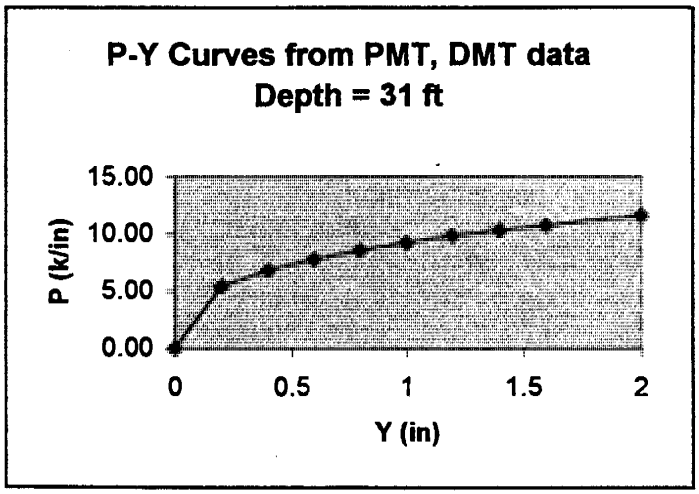
Depth (ft) = 29 **Site #2**

Y (in)	P (k/in)
0	0.00
0.2	4.89
0.4	6.14
0.6	7.02
0.8	7.72
1	8.31
1.2	8.82
1.4	9.28
1.6	9.70
2	10.44



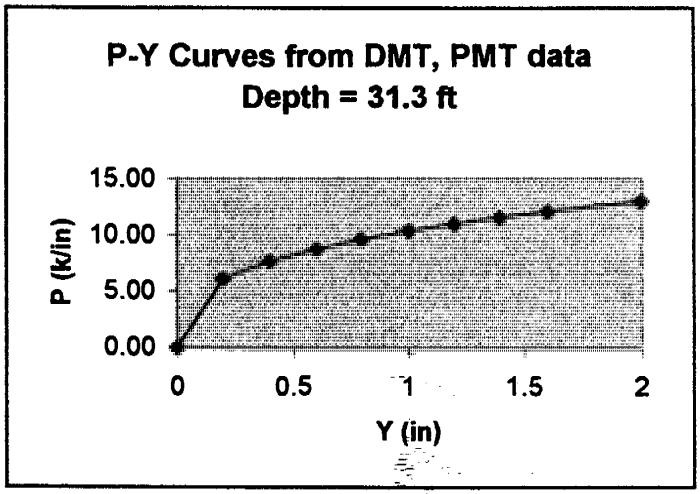
Depth (ft) = 31 Site #2

Y (in)	P (k/in)
0	0.00
0.2	5.41
0.4	6.80
0.6	7.77
0.8	8.55
1	9.20
1.2	9.77
1.4	10.28
1.6	10.74
2	11.56



Depth (ft) = 31.3 Site #2

Y (in)	P (k/in)
0	0.00
0.2	6.09
0.4	7.66
0.6	8.75
0.8	9.63
1	10.36
1.2	11.00
1.4	11.58
1.6	12.10
2	13.03



B-1-78

P-Y Curves from Presuremeter Tests

B-1-79

A Quick Note About the Use of These P-Y Curves:

These curves have been developed with two initial assumptions.

1. The first assumption is that the ground surface elevation after pile installation is the same as the ground surface when the pressuremeter tests were performed. If you wish to change the elevation of the ground surface for design, you must adjust the depth of each PMT test. See the main text of the report for more information.

Pressuremeter Site / Test #: 1 Change this Number

Ground Surface to Center of Membrane: 168.00 in α:
Elevation of Center of Membrane -62.28 in 1.5 Elevation (ft) -5.19

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	7.903	2.357	34.150	2.151	0.312	2151.44
3	17.090	3.253	47.126	2.969	0.675	2968.91
4	26.852	3.459	50.106	3.157	1.061	3156.70
5	36.774	3.475	50.336	3.171	1.453	3171.16
6	46.425	3.848	55.748	3.512	1.834	3512.13
7	51.406	3.834	55.537	3.499	2.031	3498.81
8	56.386	3.819	55.325	3.485	2.227	3485.50
9	61.348	3.827	55.432	3.492	2.423	3492.21
10	66.310	3.834	55.539	3.499	2.619	3498.93

2. The second assumption is the pile diameter. The default value is 42". This can be easily adjusted by changing the pile diameter at the top of the PY-Curve sheet.

PMT1 Test Date 3/9/98 CB-59
Diameter of Pile 42 in Change this Number

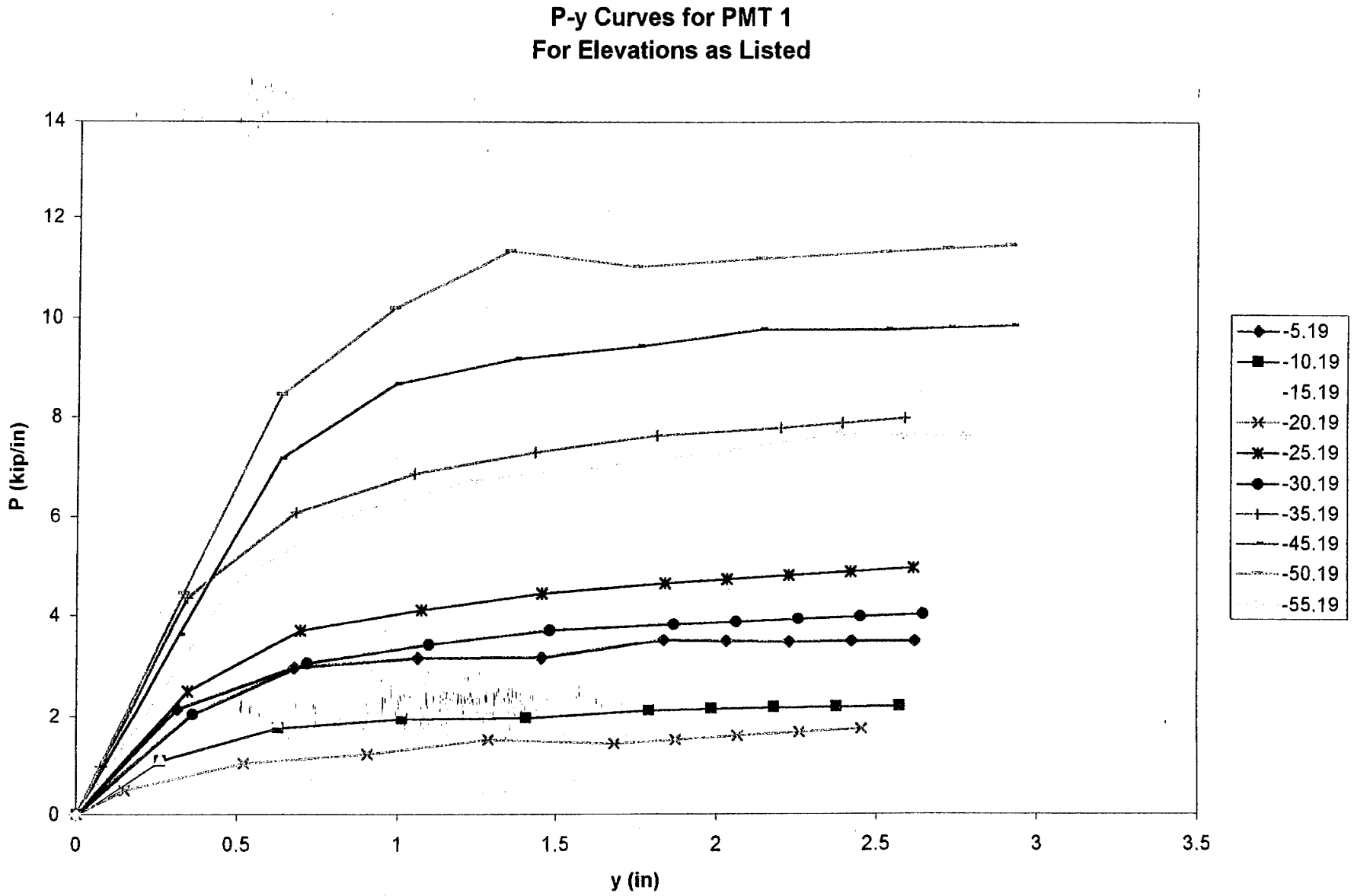
Length from Cone Tip to Center of Membrane 14.055 in
Length of Pressuremeter Probe 9.76 in
Initial Circumference of Pressuremeter Probe 4.57 in
Initial Volume of Probe 16.2208031 in3
Surface Elevation: 105.72 in

B-1-80

P-Y Curves

PMT 1
(CB-59)

B-1-81


P-y Curves for PMT 1
For Elevations as Listed
P (kip/in)
y (in)
0
2
4
6
8
10
12
14
0
0.5
1
1.5
2
2.5
3
3.5
-5.19
-10.19
-15.19
-20.19
-25.19
-30.19
-35.19
-45.19
-50.19
-55.19

C8-1-9

RAW PMT DATA

PMT1 Test Date 3/9/98 CB-59

Diameter of Pile	42 in	<- You should change this number based on the actual pile geometry
Length from Cone Tip to Center of Membrane	14.055 in	
Length of Pressuremeter Probe	9.76 in	
Initial Circumference of Pressuremeter Probe	4.57 in	
Initial Volume of Probe	16.2208031 in3	
Surface Elevation:	105.72 in	

Pressuremeter Site / Test #: 1

Ground Surface to Center of Membrane: 168.00 in α:
Elevation of Center of Membrane -62.28 in 1.5 Elevation (ft) -5.19

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	7.903	2.357	34.150	2.151	0.312	2151.44
3	17.090	3.253	47.126	2.969	0.675	2968.91
4	26.852	3.459	50.106	3.157	1.061	3156.70
5	36.774	3.475	50.336	3.171	1.453	3171.16
6	46.425	3.848	55.748	3.512	1.834	3512.13
7	51.406	3.834	55.537	3.499	2.031	3498.81
8	56.386	3.819	55.325	3.485	2.227	3485.50
9	61.348	3.827	55.432	3.492	2.423	3492.21
10	66.310	3.834	55.539	3.499	2.619	3498.93

Pressuremeter Site / Test #: 2

Ground Surface to Center of Membrane: 228.00 in α:
Elevation of Center of Membrane -122.28 in 1.5 Elevation (ft) -10.19

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	6.600	1.194	17.295	1.090	0.261	1089.57
3	15.867	1.941	28.116	1.771	0.627	1771.30
4	25.615	2.149	31.123	1.961	1.012	1960.76
5	35.532	2.165	31.368	1.976	1.404	1976.16
6	45.325	2.338	33.870	2.134	1.790	2133.84
7	50.263	2.374	34.385	2.166	1.985	2166.24
8	55.201	2.409	34.899	2.199	2.181	2198.65
9	60.160	2.416	34.997	2.205	2.376	2204.83
10	65.120	2.423	35.096	2.211	2.572	2211.02

Pressuremeter Site / Test #: 3

Ground Surface to Center of Membrane: 288.00 in α:
Elevation of Center of Membrane -182.28 in 1.5 Elevation (ft) -15.19

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	6.609	1.243	18.004	1.134	0.261	1134.24
3	15.788	2.091	30.289	1.908	0.624	1908.20
4	25.494	2.349	34.026	2.144	1.007	2143.62
5	35.328	2.466	35.728	2.251	1.396	2250.86
6	45.163	2.589	37.501	2.363	1.784	2362.58
7	50.061	2.675	38.745	2.441	1.978	2440.94
8	54.959	2.761	39.989	2.519	2.171	2519.29
9	59.898	2.793	40.453	2.549	2.366	2548.54
10	64.838	2.825	40.917	2.578	2.561	2577.78

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Pressuremeter Site / Test #: 4

Ground Surface to Center of Membrane: 348.00 in α:
Elevation of Center of Membrane -242.28 in 1.5 Elevation (ft) -20.19

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	3.770	0.534	7.732	0.487	0.149	487.09
3	13.141	1.131	16.387	1.032	0.519	1032.41
4	22.877	1.340	19.415	1.223	0.904	1223.14
5	32.529	1.660	24.046	1.515	1.285	1514.91
6	42.529	1.581	22.906	1.443	1.680	1443.06
7	47.422	1.667	24.147	1.521	1.873	1521.26
8	52.315	1.753	25.388	1.599	2.067	1599.47
9	57.209	1.835	26.576	1.674	2.260	1674.27
10	62.103	1.917	27.763	1.749	2.453	1749.08

Pressuremeter Site / Test #: 5

Ground Surface to Center of Membrane: 408.00 in α:
Elevation of Center of Membrane -302.28 in 1.5 Elevation (ft) -25.19

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	8.724	2.755	39.915	2.515	0.345	2514.62
3	17.584	4.055	58.739	3.701	0.695	3700.53
4	27.155	4.512	65.362	4.118	1.073	4117.83
5	36.811	4.880	70.689	4.453	1.454	4453.39
6	46.586	5.102	73.911	4.656	1.840	4656.42
7	51.493	5.188	75.158	4.735	2.034	4734.98
8	56.400	5.275	76.405	4.814	2.228	4813.55
9	61.308	5.358	77.610	4.889	2.422	4889.42
10	66.216	5.441	78.814	4.965	2.616	4965.30

Pressuremeter Site / Test #: 6

Ground Surface to Center of Membrane: 468.00 in α:
Elevation of Center of Membrane -362.28 in 1.5 Elevation (ft) -30.19

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	9.153	2.249	32.574	2.052	0.362	2052.16
3	18.146	3.348	48.496	3.055	0.717	3055.22
4	27.741	3.756	54.406	3.428	1.096	3427.58
5	37.423	4.074	59.014	3.718	1.478	3717.88
6	47.266	4.196	60.783	3.829	1.867	3829.34
7	52.188	4.257	61.664	3.885	2.062	3884.86
8	57.110	4.318	62.546	3.940	2.256	3940.38
9	62.033	4.375	63.380	3.993	2.450	3992.97
10	66.956	4.433	64.215	4.046	2.645	4045.56

B-1-84

Pressuremeter Site / Test #: 7

Ground Surface to Center of Membrane: 528.00 in α:
Elevation of Center of Membrane -422.28 in 1.5 Elevation (ft) -35.19

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	1.948	1.064	15.418	0.971	0.077	971.35
3	8.736	4.773	69.135	4.355	0.345	4355.49
4	17.242	6.673	96.668	6.090	0.681	6090.07
5	26.577	7.530	109.080	6.872	1.050	6872.04
6	36.205	7.996	115.831	7.297	1.430	7297.38
7	45.907	8.369	121.225	7.637	1.813	7637.16
8	55.744	8.541	123.723	7.795	2.202	7794.57
9	60.648	8.650	125.303	7.894	2.396	7894.08
10	65.551	8.759	126.882	7.994	2.589	7993.59

Pressuremeter Site / Test #: 8

Ground Surface to Center of Membrane: 648.00 in α:
Elevation of Center of Membrane -542.28 in 1.5 Elevation (ft) -45.19

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	8.059	3.968	57.486	3.622	0.318	3621.62
3	15.963	7.861	113.866	7.174	0.631	7173.57
4	24.989	9.511	137.780	8.680	0.987	8680.12
5	34.625	10.074	145.936	9.194	1.368	9193.98
6	44.428	10.345	149.861	9.441	1.755	9441.26
7	54.175	10.715	155.219	9.779	2.140	9778.83
8	64.119	10.721	155.297	9.784	2.533	9783.72
9	69.063	10.761	155.888	9.821	2.728	9820.95
10	74.007	10.802	156.479	9.858	2.923	9858.17

Pressuremeter Site / Test #: 9

Ground Surface to Center of Membrane: 708.00 in α:
Elevation of Center of Membrane -602.28 in 1.5 Elevation (ft) -50.19

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	8.410	4.874	70.606	4.448	0.332	4448.16
3	15.994	9.269	134.271	8.459	0.632	8459.05
4	24.871	11.170	161.803	10.194	0.982	10193.58
5	34.116	12.435	180.128	11.348	1.348	11348.09
6	44.255	12.103	175.315	11.045	1.748	11044.83
7	54.116	12.272	177.770	11.200	2.138	11199.53
8	63.977	12.430	180.054	11.343	2.527	11343.42
9	68.907	12.497	181.029	11.405	2.722	11404.80
10	73.838	12.564	182.003	11.466	2.917	11466.18

B-1-85

Pressuremeter Site / Test #: 10

Ground Surface to Center of Membrane: 768.00 in α:
Elevation of Center of Membrane -662.28 in 1.5 Elevation (ft) -55.19

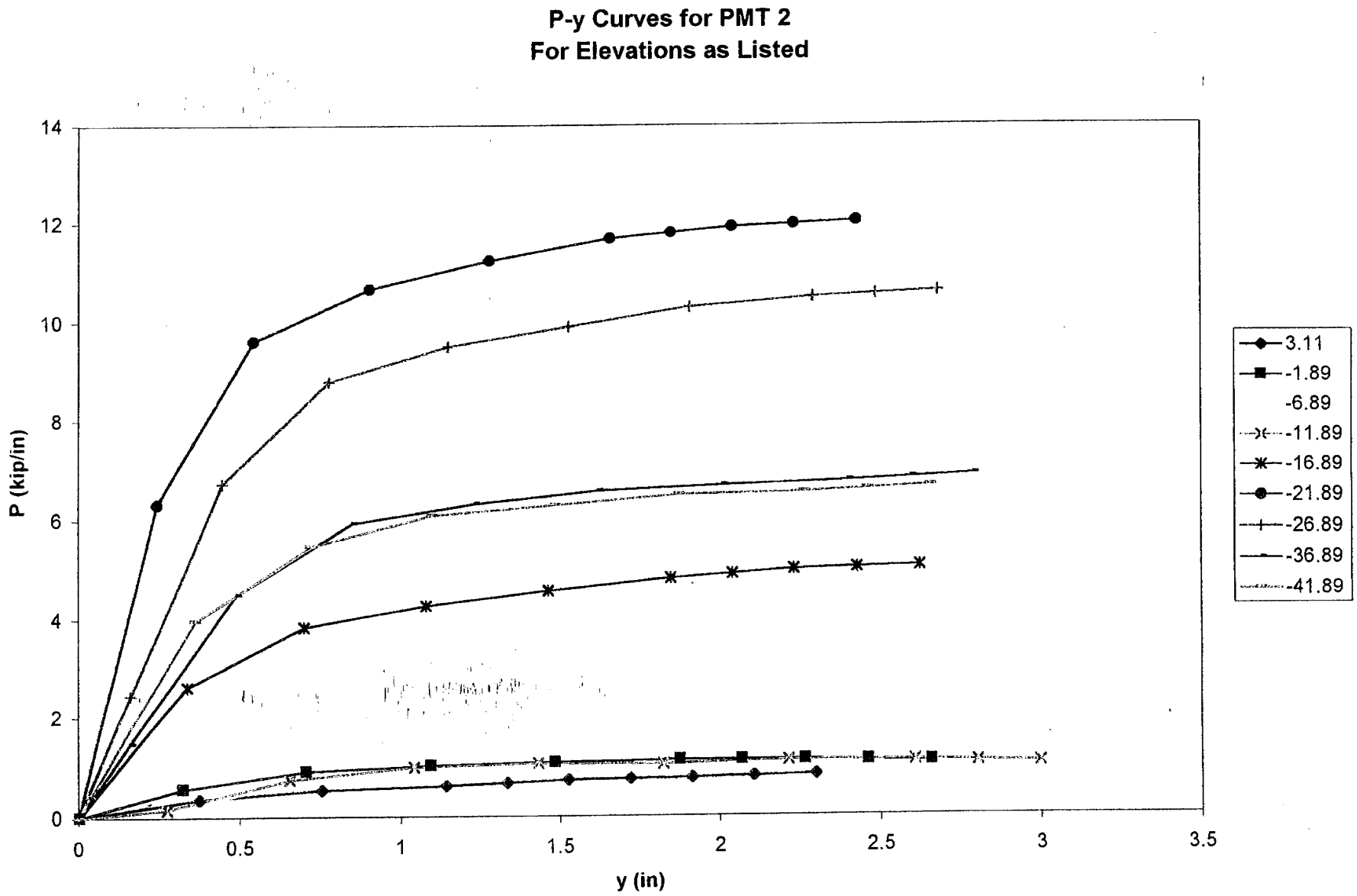
	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN	P lbs/in
1	0.000	0.000	0.000	0.000	0.000	0.00
2	3.998	1.651	23.911	1.506	0.158	1506.41
3	12.332	5.091	73.748	4.646	0.487	4646.13
4	21.470	6.645	96.252	6.064	0.848	6063.88
5	31.038	7.361	106.625	6.717	1.226	6717.36
6	40.820	7.682	111.284	7.011	1.612	7010.90
7	50.600	8.001	115.894	7.301	1.999	7301.35
8	60.323	8.405	121.753	7.670	2.383	7670.46
9	65.295	8.393	121.581	7.660	2.579	7659.61
10	70.267	8.381	121.409	7.649	2.776	7648.77

8-1-86

P-Y Curves

PMT 2
(CBMC-30)

B-1-87


P-y Curves for PMT 2
For Elevations as Listed
P (kip/in)
y (in)
0
0.5
1
1.5
2
2.5
3
3.5
0
2
4
6
8
10
12
14
3.11
-1.89
-6.89
-11.89
-16.89
-21.89
-26.89
-36.89
-41.89

88-1-9

RAW PMT DATA

PMT 2 Test Dates 3/7 & 3/12/98 CBMC-30

Diameter of Pile	42 in	<- You should change this number based on the actual pile geometry
Length from Cone Tip to Center of Membrane	14.055 in	
Length of Pressuremeter Probe	9.76 in	
Initial Circumference of Pressuremeter Probe	4.57 in	
Initial Volume of Probe	16.2208031 in3	
Surface Elevation:	97.32 in	

Pressuremeter Site / Test #: 1

Ground Surface to Center of Membrane: 60.00 in
Elevation of Center of Membrane 37.32 in
α: 0.53571429
Elevation (ft) 3.11

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	9.401	1.078	15.611	0.351	0.371
3	19.056	1.611	23.342	0.525	0.753
4	28.865	1.844	26.715	0.601	1.140
5	33.726	2.030	29.406	0.662	1.332
6	38.586	2.216	32.097	0.722	1.524
7	43.501	2.288	33.140	0.746	1.718
8	48.416	2.360	34.184	0.769	1.912
9	53.315	2.437	35.307	0.794	2.106
10	58.213	2.515	36.430	0.820	2.300

Pressuremeter Site / Test #: 2

Ground Surface to Center of Membrane: 120.00 in
Elevation of Center of Membrane -22.68 in
α: 1.07142857
Elevation (ft) -1.89

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	8.145	0.859	12.447	0.560	0.322
3	17.811	1.379	19.971	0.899	0.704
4	27.652	1.560	22.600	1.017	1.092
5	37.545	1.642	23.783	1.070	1.483
6	47.436	1.711	24.779	1.115	1.874
7	52.395	1.706	24.716	1.112	2.070
8	57.354	1.702	24.653	1.109	2.266
9	62.313	1.677	24.292	1.093	2.461
10	67.271	1.652	23.931	1.077	2.657

Pressuremeter Site / Test #: 3

Ground Surface to Center of Membrane: 180.00 in
Elevation of Center of Membrane -82.68 in
α: 1.5
Elevation (ft) -6.89

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	6.933	0.164	2.377	0.150	0.274
3	16.598	0.707	10.242	0.645	0.656
4	26.398	0.975	14.125	0.890	1.043
5	36.296	1.056	15.299	0.964	1.434
6	46.244	1.037	15.021	0.946	1.827
7	56.141	1.105	16.003	1.008	2.218
8	66.062	1.095	15.856	0.999	2.610
9	71.035	1.043	15.114	0.952	2.806
10	76.009	0.992	14.372	0.905	3.002

B-1-89

Pressuremeter Site / Test #: 4

Ground Surface to Center of Membrane: 240.00 in
Elevation of Center of Membrane -142.68 in

α: 1.5 Elevation (ft) -11.89

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	6.875	0.163	2.359	0.149	0.272
3	16.495	0.807	11.685	0.736	0.652
4	26.296	1.075	15.570	0.981	1.039
5	36.194	1.156	16.743	1.055	1.430
6	46.143	1.137	16.465	1.037	1.823
7	56.039	1.204	17.446	1.099	2.214
8	65.961	1.194	17.298	1.090	2.606
9	70.921	1.168	16.922	1.066	2.801
10	75.881	1.142	16.545	1.042	2.997

Pressuremeter Site / Test #: 5

Ground Surface to Center of Membrane: 300.00 in
Elevation of Center of Membrane -202.68 in

α: 1.5 Elevation (ft) -16.89

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	8.490	2.871	41.594	2.620	0.335
3	17.660	4.195	60.773	3.829	0.698
4	27.302	4.678	67.764	4.269	1.078
5	37.028	5.012	72.610	4.574	1.463
6	46.781	5.286	76.577	4.824	1.848
7	51.671	5.386	78.023	4.915	2.041
8	56.562	5.486	79.469	5.007	2.234
9	61.483	5.516	79.911	5.034	2.429
10	66.405	5.547	80.353	5.062	2.623

Pressuremeter Site / Test #: 6

Ground Surface to Center of Membrane: 360.00 in
Elevation of Center of Membrane -262.68 in

α: 1.5 Elevation (ft) -21.89

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	6.138	6.907	100.048	6.303	0.242
3	13.676	10.547	152.783	9.625	0.540
4	22.843	11.681	169.203	10.660	0.902
5	32.345	12.318	178.437	11.242	1.278
6	41.949	12.800	185.424	11.682	1.657
7	46.818	12.932	187.334	11.802	1.849
8	51.687	13.064	189.243	11.922	2.042
9	56.589	13.130	190.199	11.983	2.235
10	61.491	13.196	191.156	12.043	2.429

B-1-90

Pressuremeter Site / Test #: 7

Ground Surface to Center of Membrane: 420.00 in
Elevation of Center of Membrane -322.68 in

α: 1.5 Elevation (ft) -26.89

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	4.097	2.682	38.844	2.447	0.162
3	11.245	7.360	106.610	6.716	0.444
4	19.674	9.638	139.609	8.795	0.777
5	29.075	10.419	150.933	9.509	1.148
6	38.708	10.855	157.250	9.907	1.529
7	48.341	11.286	163.489	10.300	1.910
8	58.108	11.497	166.538	10.492	2.295
9	63.008	11.560	167.463	10.550	2.489
10	67.909	11.624	168.388	10.608	2.683

Pressuremeter Site / Test #: 8

Ground Surface to Center of Membrane: 540.00 in
Elevation of Center of Membrane -442.68 in

α: 1.5 Elevation (ft) -36.89

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	4.007	1.604	23.235	1.464	0.158
3	12.349	4.944	71.612	4.512	0.488
4	21.477	6.497	94.110	5.929	0.848
5	31.206	6.911	100.114	6.307	1.233
6	41.014	7.183	104.046	6.555	1.620
7	50.904	7.300	105.745	6.662	2.011
8	60.794	7.402	107.229	6.755	2.401
9	65.725	7.466	108.147	6.813	2.596
10	70.656	7.529	109.064	6.871	2.791

Pressuremeter Site / Test #: 9

Ground Surface to Center of Membrane: 600.00 in
Elevation of Center of Membrane -502.68 in

α: 1.5 Elevation (ft) -41.89

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	0.937	0.446	6.460	0.407	0.037
3	9.116	4.339	62.855	3.960	0.360
4	18.210	5.993	86.819	5.470	0.719
5	27.808	6.659	96.467	6.077	1.098
6	37.645	6.881	99.671	6.279	1.487
7	47.481	7.098	102.823	6.478	1.876
8	57.399	7.150	103.573	6.525	2.267
9	62.330	7.213	104.485	6.583	2.462
10	67.262	7.276	105.397	6.640	2.657

B-1-91

Pressuremeter Site / Test #: 10

Ground Surface to Center of Membrane: 624.00 in α:
Elevation of Center of Membrane -526.68 in 1.5 Elevation (ft) -43.89

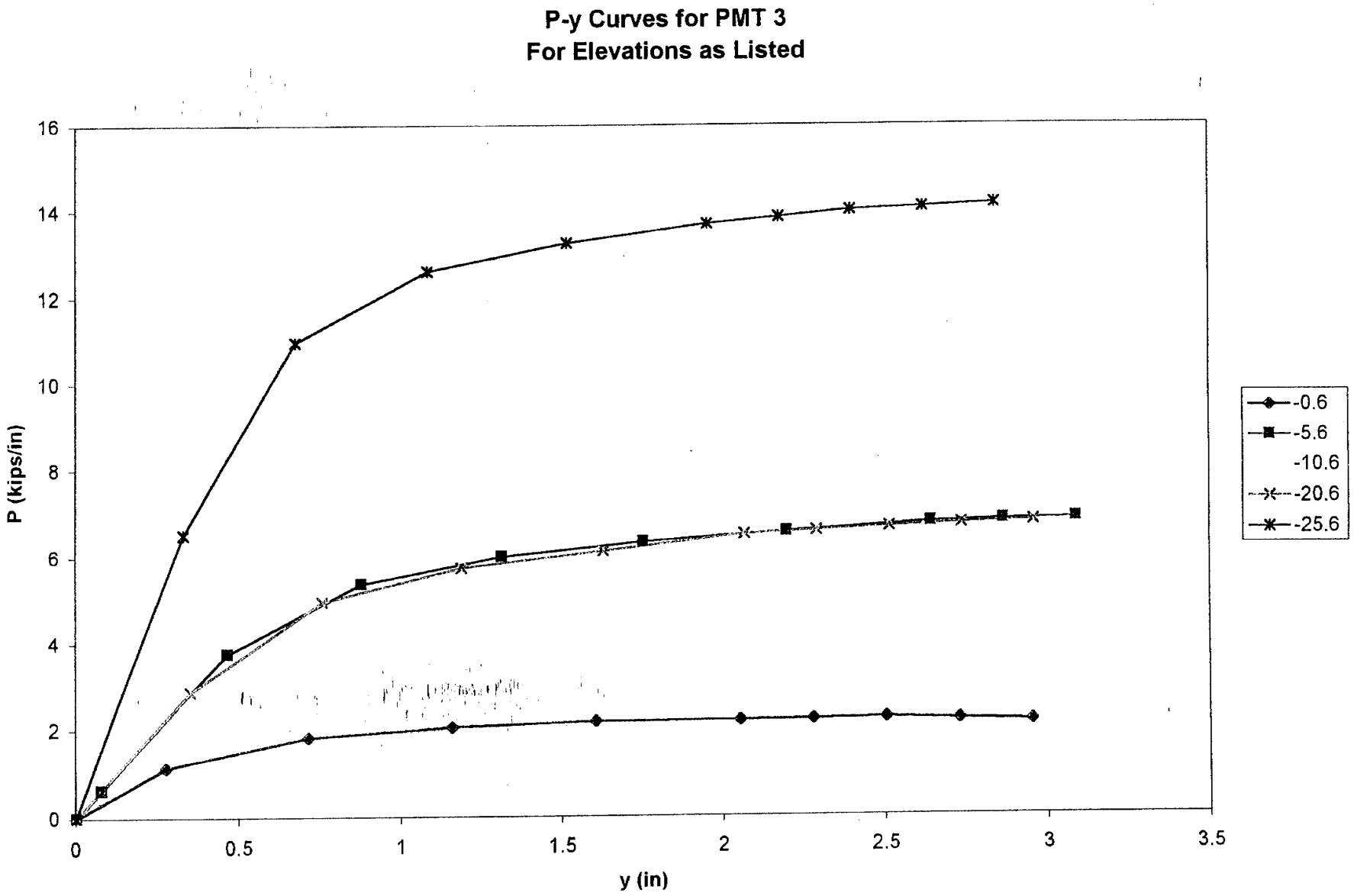
	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	1.993	1.200	17.384	1.095	0.079
3	9.714	5.848	84.711	5.337	0.384
4	18.579	7.853	113.753	7.166	0.734
5	28.191	8.467	122.655	7.727	1.114
6	37.940	8.839	128.039	8.066	1.499
7	47.745	9.108	131.933	8.312	1.886
8	57.661	9.162	132.715	8.361	2.278
9	62.590	9.226	133.652	8.420	2.472
10	67.520	9.291	134.589	8.479	2.667

6-1-92

P-Y Curves

PMT 3
(CB-PNB-4)

B-1-93


P-y Curves for PMT 3
For Elevations as Listed
P (kips/in)
y (in)
0
2
4
6
8
10
12
14
16
0
0.5
1
1.5
2
2.5
3
3.5
-0.6
-5.6
-10.6
-20.6
-25.6

tb-1-94

RAW PMT DATA

PMT 3 Test Date 3/11/98 Third Site CB-PNB-4

Diameter of Pile	48 in	<- You should change this number based on the actual pile geometry
Length from Cone Tip to Center of Membrane	14.055 in	
Length of Pressuremeter Probe	9.76 in	
Initial Circumference of Pressuremeter Probe	4.57 in	
Initial Volume of Probe	16.2208031 in3	
Surface Elevation:	292.8 in	

Pressuremeter Site / Test #: 1

Ground Surface to Center of Membrane: 300.00 in α:
Elevation of Center of Membrane -7.20 in 1.5 Elevation (ft) -0.6

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	6.111	1.076	15.581	1.122	0.276
3	15.770	1.727	25.020	1.801	0.712
4	25.629	1.943	28.148	2.027	1.157
5	35.534	2.064	29.898	2.153	1.604
6	45.487	2.078	30.105	2.168	2.053
7	50.451	2.102	30.444	2.192	2.278
8	55.415	2.125	30.783	2.216	2.502
9	60.403	2.083	30.181	2.173	2.727
10	65.390	2.042	29.578	2.130	2.952

Pressuremeter Site / Test #: 2

Ground Surface to Center of Membrane: 360.00 in α:
Elevation of Center of Membrane -67.20 in 1.5 Elevation (ft) -5.6

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	1.721	0.601	8.702	0.627	0.078
3	10.281	3.588	51.981	3.743	0.464
4	19.431	5.142	74.491	5.363	0.877
5	29.058	5.758	83.412	6.006	1.312
6	38.842	6.080	88.072	6.341	1.754
7	48.679	6.297	91.223	6.568	2.198
8	58.515	6.500	94.156	6.779	2.642
9	63.460	6.538	94.703	6.819	2.865
10	68.405	6.575	95.250	6.858	3.088

Pressuremeter Site / Test #: 3

Ground Surface to Center of Membrane: 420.00 in α:
Elevation of Center of Membrane -127.20 in 1.5 Elevation (ft) -10.6

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	3.060	1.556	22.538	1.623	0.138
3	11.012	5.600	81.117	5.840	0.497
4	19.898	7.554	109.426	7.879	0.898
5	29.453	8.269	119.781	8.624	1.330
6	39.230	8.590	124.437	8.959	1.771
7	49.005	8.909	129.060	9.292	2.212
8	58.865	9.064	131.305	9.454	2.657
9	63.823	9.079	131.518	9.469	2.881
10	68.781	9.094	131.731	9.485	3.105

B-1-95

Pressuremeter Site / Test #: 4

Ground Surface to Center of Membrane: 540.00 in α:
Elevation of Center of Membrane -247.20 in 1.5 Elevation (ft) -20.6

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	7.772	2.731	39.564	2.849	0.351
3	16.732	4.738	68.638	4.942	0.755
4	26.288	5.505	79.749	5.742	1.187
5	36.049	5.877	85.136	6.130	1.627
6	45.807	6.245	90.465	6.513	2.068
7	50.739	6.321	91.564	6.593	2.291
8	55.671	6.397	92.662	6.672	2.513
9	60.603	6.459	93.567	6.737	2.736
10	65.535	6.522	94.472	6.802	2.959

Pressuremeter Site / Test #: 5

Ground Surface to Center of Membrane: 600.00 in α:
Elevation of Center of Membrane -307.20 in 1.5 Elevation (ft) -25.6

	Volume Corrected (CC)	Pressure Corrected (bar)	Pressure Corrected (PSI)	P KIPS/IN	Y IN
1	0.000	0.000	0.000	0.000	0.000
2	7.313	6.251	90.554	6.520	0.330
3	14.906	10.518	152.362	10.970	0.673
4	23.982	12.085	175.058	12.604	1.083
5	33.593	12.707	184.066	13.253	1.517
6	43.318	13.128	190.164	13.692	1.956
7	48.209	13.282	192.407	13.853	2.176
8	53.100	13.437	194.649	14.015	2.397
9	58.032	13.506	195.639	14.086	2.620
10	62.964	13.574	196.628	14.157	2.843

B-1-96

PMT 1
(CB-59)

Raw Data, Corrections, and Fully Corrected Pressuremeter Curves

B-1-97

PMT #1 Test Date 3/9/98 Before Membrane Blowout CB-59

Calibrate

Insert Field Record Sheet

Pressure Correction

# Points	18
V	**P**
(cm3)	**(bar)**
0	0
5	0.25
10	0.4
15	0.5
20	0.6
25	0.7
30	0.75
35	0.8
40	0.9
45	1
50	1.1
55	1.15
60	1.2
70	1.25
80	1.35
90	1.45
100	1.5
110	1.6

Volume Correction

# Points	26
V	**P**
(cm3)	**(bar)**
0	0
6	1
9	2
11.1	3
12.5	4
13.7	5
14.7	6
15.5	7
16.2	8
17	9
17.6	10
18.1	11
18.7	12
19.2	13
19.6	14
20.1	15
20.5	16
20.9	17
21.3	18
21.7	19
22.1	20
22.5	21
22.9	22
23.2	23
23.6	24
24	25

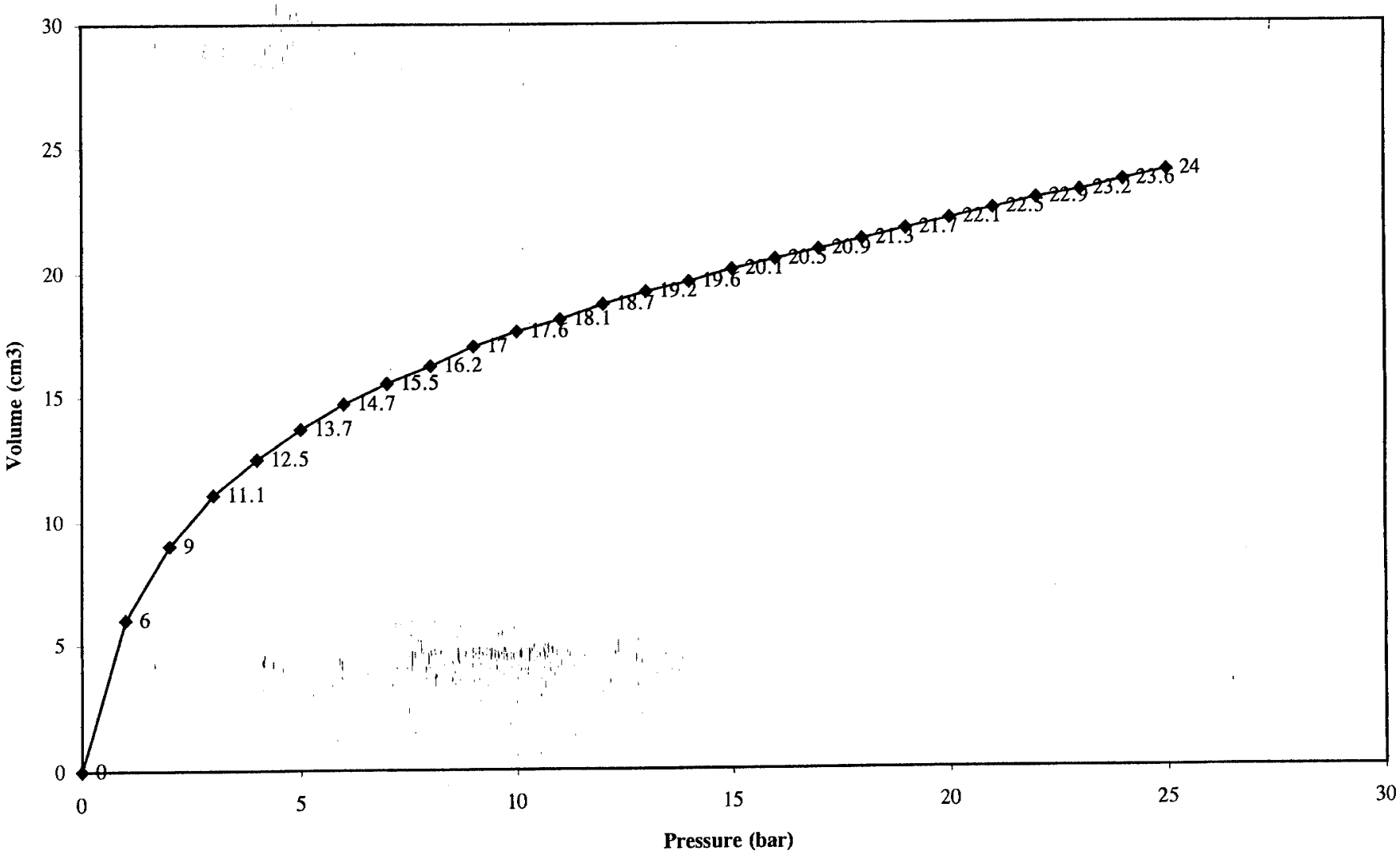
Volume Correction for Unit and Tubing

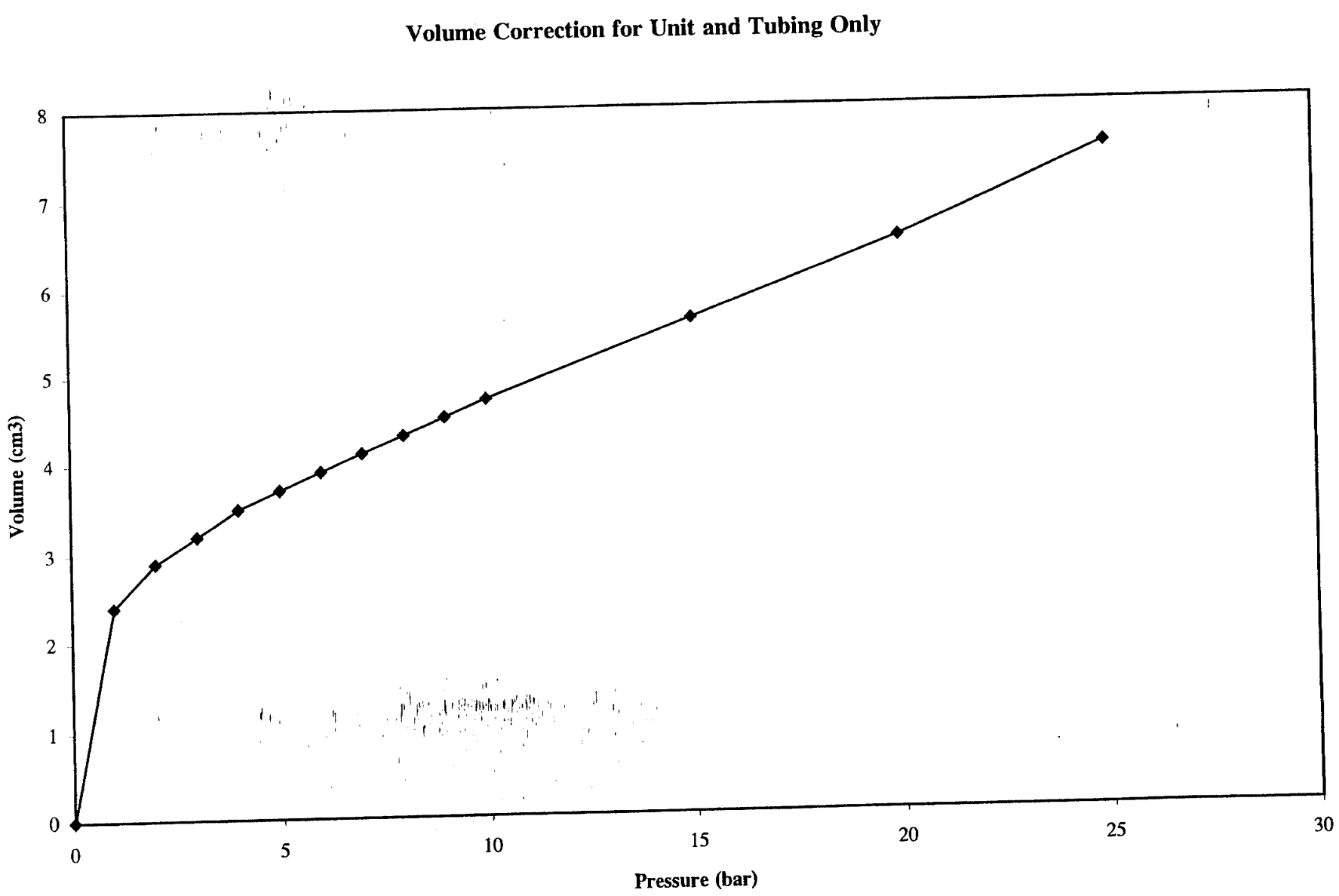
# Points	14
V	**P**
(cm3)	**(bar)**
0	0
2.4	1
2.9	2
3.2	3
3.5	4
3.7	5
3.9	6
4.1	7
4.3	8
4.5	9
4.7	10
5.6	15
6.5	20
7.5	25

B-1-98

bb-1-9

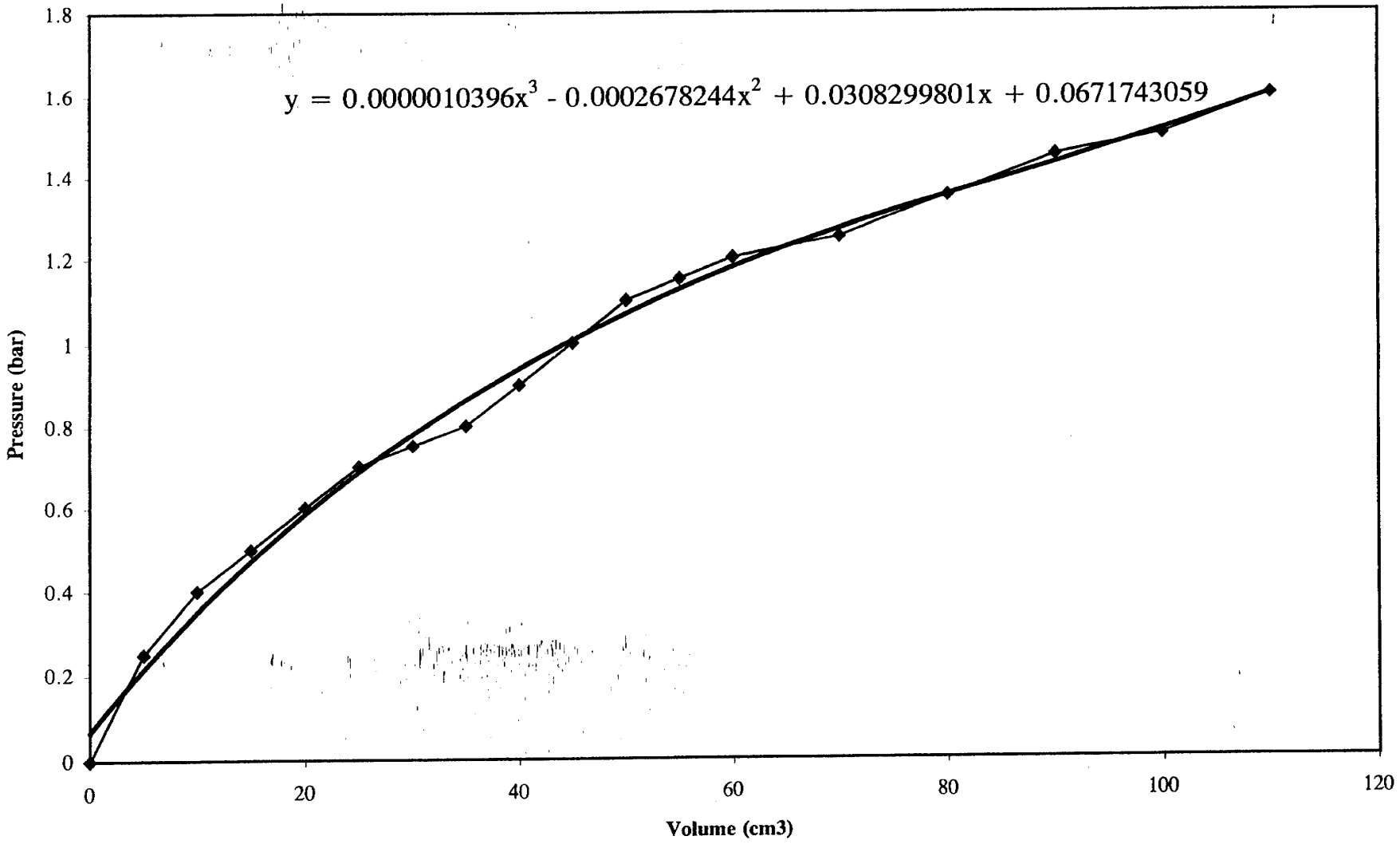
Volume Calibration

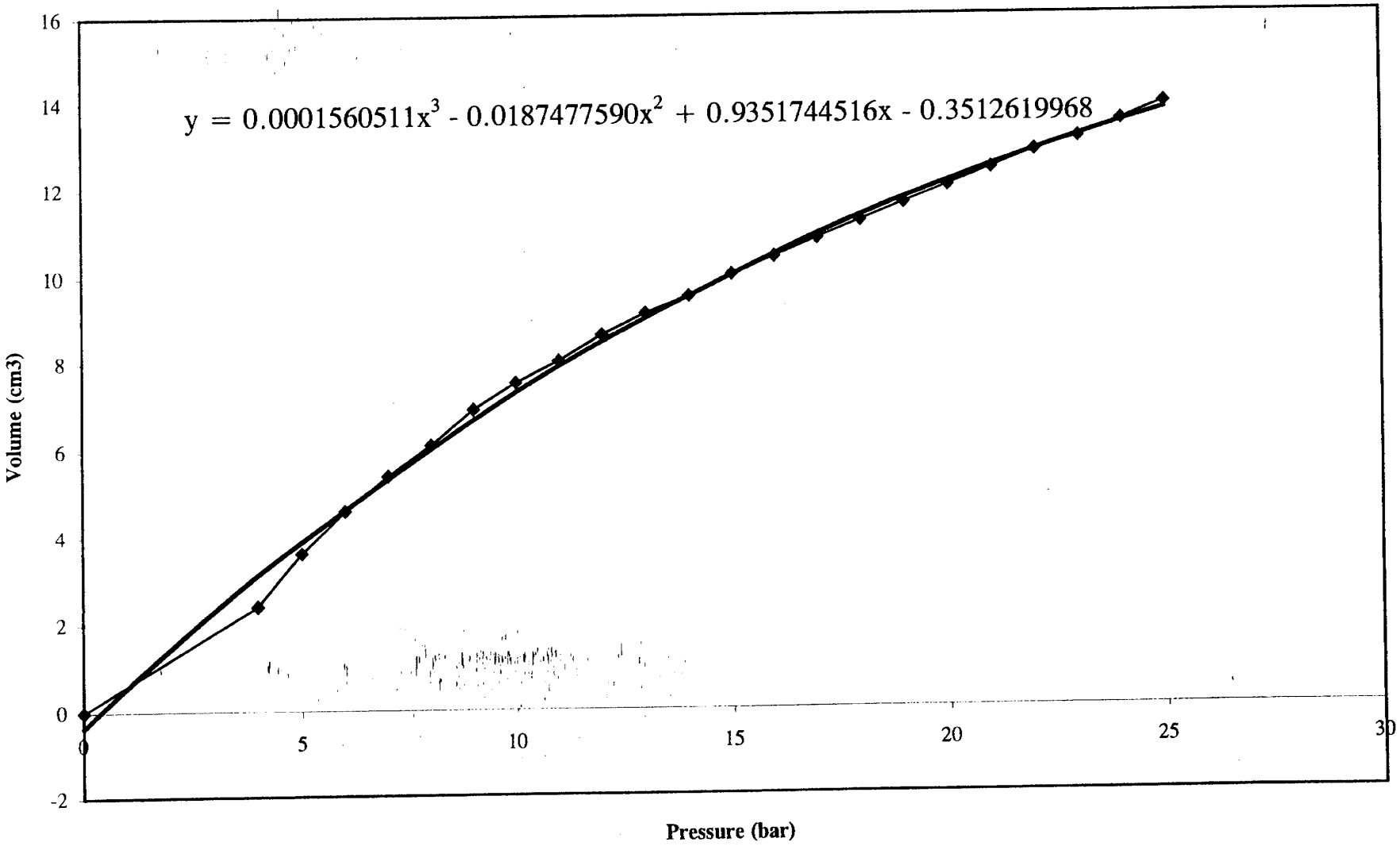



Volume Correction for Unit and Tubing Only
Volume (cm3)
0
1
2
3
4
5
6
7
8
0
5
10
15
20
25
30
Pressure (bar)

021-1-9

Pressure Correction




Final Volume
y = 0.0001560511x³ - 0.0187477590x² + 0.9351744516x - 0.3512619968
Volume (cm3)
Pressure (bar)
16
14
12
10
8
6
4
2
0
-2
0
5
10
15
20
25
30

B-1-102

Raw Data to Corrected Curve Sheet **PMT #1** Test Date 3/9/98 Before Membrane CB-59

Height of Control Unit
h= 1 m

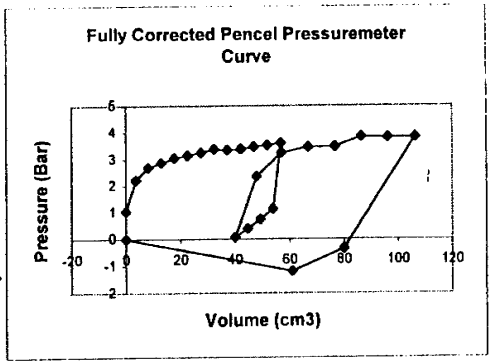
Depth of Probe
d= 4.2682927 m

Hydrostatic
u= 0.5162927 bar

Volume Coefficients	
P^3	1.56E-04
P^2	-0.018747759
P	+0.9351744516
C	-0.3512619968

Pressure Coefficients	
V^3	1.04E-06
V^2	-0.0002678244
V	+0.0308299801
C	+0.0671743059

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	1.1	0.5162927	0.5837073	1.88E-01	-0.18824958	0.0613611	1.0386389	-0.18825	1.038639
5	2.4	0.5162927	1.8837073	1.34E+00	3.65514766	0.176335	2.223665	3.655148	2.223665
10	3	0.5162927	2.4837073	1.86E+00	8.14182265	0.3009937	2.6990063	8.141823	2.699006
15	3.3	0.5162927	2.7837073	2.11E+00	12.8899207	0.4222977	2.8777023	12.88992	2.877702
20	3.6	0.5162927	3.0837073	2.36E+00	17.6411588	0.5334086	3.0665914	17.64116	3.066591
25	3.8	0.5162927	3.2837073	2.52E+00	22.4770495	0.6366371	3.1633629	22.47705	3.163363
30	4	0.5162927	3.4837073	2.69E+00	27.3143171	0.7306433	3.2693567	27.31432	3.269357
35	4.2	0.5162927	3.6837073	2.85E+00	32.152954	0.8161255	3.3838745	32.15295	3.383875
40	4.25	0.5162927	3.7337073	2.89E+00	37.1128263	0.8956129	3.3543871	37.11283	3.354387
45	4.35	0.5162927	3.8337073	2.97E+00	42.0328258	0.9670671	3.3829329	42.03283	3.382933
50	4.5	0.5162927	3.9837073	3.09E+00	46.9134605	1.0314072	3.4685928	46.91346	3.468593
55	4.625	0.5162927	4.1087073	3.19E+00	51.8145699	1.0901929	3.5348071	51.81457	3.534807
60	4.75	0.5162927	4.2337073	3.28E+00	56.716205	1.1438808	3.6061192	56.7162	3.606119
55	2.25	0.5162927	1.7337073	1.21E+00	53.7854809	1.1123527	1.1376473	53.78548	1.137647
50	1.8	0.5162927	1.2837073	8.19E-01	49.1813361	1.0592901	0.7407099	49.18134	0.74071
45	1.4	0.5162927	0.8837073	4.61E-01	44.5393746	1.0008782	0.3991218	44.53937	0.399122
40	1	0.5162927	0.4837073	9.67E-02	39.9032801	0.9369953	0.0630047	39.90328	0.063005
50	3.4	0.5162927	2.8837073	2.19E+00	47.8066525	1.0425339	2.3574661	47.80665	2.357466
60	4.4	0.5162927	3.8837073	3.01E+00	56.9929527	1.1467748	3.2532252	56.99295	3.253225
70	4.7	0.5162927	4.1837073	3.24E+00	66.755488	1.2410025	3.4589975	66.75549	3.458997
80	4.8	0.5162927	4.2837073	3.32E+00	76.6770059	1.3251521	3.4748479	76.67701	3.474848
90	5.25	0.5162927	4.7337073	3.67E+00	86.3279666	1.4015355	3.8484645	86.32797	3.848465
100	5.3	0.5162927	4.7837073	3.71E+00	96.2895993	1.4807173	3.8192827	96.2896	3.819283
110	5.4	0.5162927	4.8837073	3.79E+00	106.213112	1.5659984	3.8340016	106.2131	3.834002
80	1	0.5162927	0.4837073	9.67E-02	79.9032801	1.3510038	-0.351004	79.90328	-0.351
60	0	0.5162927	-0.516293	-8.39E-01	60.8391046	1.1856255	-1.185626	60.8391	-1.18563
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po	
1	39.90328	0	0	0	0
2	47.80665	2.357466	7.903372	2.357466	
3	56.99295	3.253225	17.08967	3.253225	
4	66.75549	3.458997	26.85221	3.458997	
5	76.67701	3.474848	36.77373	3.474848	
6	86.32797	3.848465	46.42469	3.848465	
7	91.30878	3.833874	51.4055	3.833874	
8	96.2896	3.819283	56.38632	3.819283	
9	101.2514	3.826642	61.34808	3.826642	
10	106.2131	3.834002	66.30983	3.834002	

X
39.90328
39.68626
47.80665

m
b

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.90328	cm3
V2	47.80665	cm3
P1	0.063005	bar
P2	2.357466	bar
Vm	43.85497	cm3
V	7.903372	cm3
P	229.4461	kPa
E	18213.57	kPa

B-1-103

Raw Data to Corrected Curve Sheet **PMT #1** Test Date 3/9/98 Before Membrane CB-59

Height of Control Unit
h= 1 m

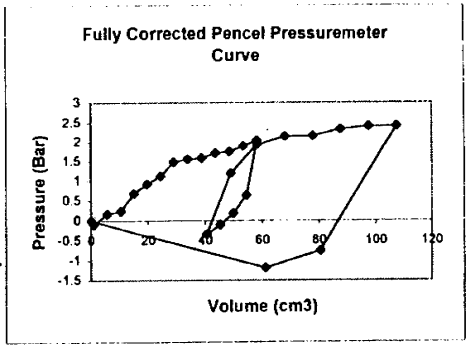
Depth of Probe
d= 5.7926829 m

Hydrostatic
u= 0.6656829 bar

Volume Coefficients	
P^3	1.56E-04
P^2	-0.018747759
P	+0.9351744516
C	-0.3512619968

Pressure Coefficients	
V^3	1.04E-06
V^2	-0.0002678244
V	+0.0308299801
C	+0.0671743059

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	0	0.6656829	-0.665683	-9.82E-01	0.982145461	0.0971965	-0.097196	0.982145	-0.0972
5	0.4	0.6656829	-0.265683	-6.01E-01	5.601048165	0.2316351	0.1683649	5.601048	0.168365
10	0.6	0.6656829	-0.065683	-4.13E-01	10.41276792	0.3603344	0.2396656	10.41277	0.239666
15	1.15	0.6656829	0.4843171	9.73E-02	14.90272085	0.4705843	0.6794157	14.90272	0.679416
20	1.5	0.6656829	0.8343171	4.16E-01	19.58398939	0.5760374	0.9239626	19.58399	0.923963
25	1.8	0.6656829	1.1343171	6.86E-01	24.31437217	0.6733948	1.1266052	24.31437	1.126605
30	2.25	0.6656829	1.5843171	1.08E+00	28.91608658	0.7598533	1.4901467	28.91609	1.490147
35	2.4	0.6656829	1.7343171	1.22E+00	33.78494948	0.8431527	1.5568473	33.78495	1.556847
40	2.5	0.6656829	1.8343171	1.30E+00	38.69797334	0.9194025	1.5805975	38.69797	1.580597
45	2.7	0.6656829	2.0343171	1.47E+00	43.52509345	0.9873971	1.7126029	43.52509	1.712603
50	2.8	0.6656829	2.1343171	1.56E+00	48.43918784	1.0502987	1.7497013	48.43919	1.749701
55	3	0.6656829	2.3343171	1.73E+00	53.26844059	1.1066166	1.8933834	53.26844	1.893383
60	3.2	0.6656829	2.5343171	1.90E+00	58.09910574	1.1582057	2.0417943	58.09911	2.041794
55	1.75	0.6656829	1.0843171	6.41E-01	54.35907998	1.1188537	0.6313463	54.35908	0.631346
50	1.25	0.6656829	0.5843171	1.89E-01	49.81119345	1.066822	0.183178	49.81119	0.183178
45	0.9	0.6656829	0.2343171	-1.33E-01	45.13316198	1.0086469	-0.108647	45.13316	-0.10865
40	0.6	0.6656829	-0.065683	-4.13E-01	40.41276792	0.944306	-0.344306	40.41277	-0.34431
50	2.25	0.6656829	1.5843171	1.08E+00	48.91608658	1.0560911	1.1939089	48.91609	1.193909
60	3.1	0.6656829	2.4343171	1.82E+00	58.18359708	1.15907	1.94093	58.1836	1.94093
70	3.4	0.6656829	2.7343171	2.07E+00	67.93117579	1.2514686	2.1485314	67.93118	2.148531
80	3.5	0.6656829	2.8343171	2.15E+00	77.84773531	1.334591	2.165409	77.84774	2.165409
90	3.75	0.6656829	3.0843171	2.36E+00	87.6406564	1.4118205	2.3381795	87.64066	2.33818
100	3.9	0.6656829	3.2343171	2.48E+00	97.51744822	1.4907987	2.4092013	97.51745	2.409201
110	4	0.6656829	3.3343171	2.56E+00	107.4357405	1.5772466	2.4227534	107.4357	2.422753
80	0.6	0.6656829	-0.065683	-4.13E-01	80.41276792	1.3550454	-0.755045	80.41277	-0.75505
60	0	0.6656829	-0.665683	-9.82E-01	60.98214546	1.1870237	-1.187024	60.98215	-1.18702
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po
1	42.31611	0	0	0
2	48.91609	1.193909	6.59998	1.193909
3	58.1836	1.94093	15.86749	1.94093
4	67.93118	2.148531	25.61507	2.148531
5	77.84774	2.165409	35.53163	2.165409
6	87.64066	2.33818	45.32455	2.33818
7	92.57905	2.37369	50.26295	2.37369
8	97.51745	2.409201	55.20134	2.409201
9	102.4766	2.415977	60.16049	2.415977
10	107.4357	2.422753	65.11963	2.422753

X	Y
40.41277	-0.34431
42.31611	0
48.91609	1.193909
m	5.528043
b	42.31611

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	40.41277	cm3
V2	48.91609	cm3
P1	-0.34431	bar
P2	1.193909	bar
Vm	44.66443	cm3
V	8.503319	cm3
P	153.8215	kPa
E	11387.89	kPa

6-1-98

Raw Data to Corrected Curve Sheet **PMT #1** Test Date 3/9/98 Before Membrane CB-59

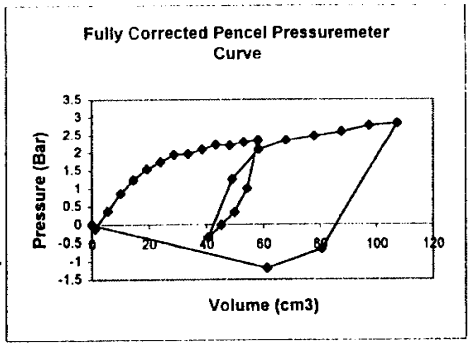
Height of Control Unit
h= 1 m
Depth of Probe
d= 7.3170732 m
Hydrostatic
u= 0.8150732 bar

Volume Coefficients	
P^3	1.56E-04
P^2	-0.018747759
P	+0.9351744516
C	-0.3512619968

Pressure Coefficients	
V^3	1.04E-06
V^2	-0.0002678244
V	+0.0308299801
C	+0.0671743059

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction	
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)
0	0	0.8150732	-0.815073	-1.13E+00	1.126037069	0.1015519	-0.101552
5	0.6	0.8150732	-0.215073	-5.53E-01	5.553261689	0.2302999	0.3697001
10	1.2	0.8150732	0.3849268	5.94E-03	9.994057191	0.349578	0.850422
15	1.7	0.8150732	0.8849268	4.62E-01	14.53827418	0.4619758	1.2380242
20	2.1	0.8150732	1.2849268	8.20E-01	19.18025344	0.5673088	1.5326912
25	2.4	0.8150732	1.5849268	1.08E+00	23.91555187	0.6655274	1.7344726
30	2.7	0.8150732	1.8849268	1.35E+00	28.65409134	0.7551386	1.9448614
35	2.8	0.8150732	1.9849268	1.43E+00	33.56765369	0.8396047	1.9603953
40	3	0.8150732	2.1849268	1.60E+00	38.39584656	0.9149261	2.0850739
45	3.2	0.8150732	2.3849268	1.77E+00	43.22545743	0.9833629	2.2166371
50	3.25	0.8150732	2.4349268	1.82E+00	48.18308083	1.0471662	2.2028338
55	3.4	0.8150732	2.5849268	1.94E+00	53.05647879	1.1042493	2.2957507
60	3.5	0.8150732	2.6849268	2.03E+00	57.97251607	1.1569084	2.3430916
55	2.1	0.8150732	1.2849268	8.20E-01	54.18025344	1.1186963	0.9833037
50	1.4	0.8150732	0.5849268	1.89E-01	49.81063649	1.0668154	0.3331846
45	1	0.8150732	0.1849268	-1.79E-01	45.1789633	1.0092424	-0.009242
40	0.6	0.8150732	-0.215073	-5.53E-01	40.55326169	0.946309	-0.346309
50	2.3	0.8150732	1.4849268	9.97E-01	49.00342436	1.0571462	1.2428538
60	3.25	0.8150732	2.4349268	1.82E+00	58.18308083	1.1590647	2.0909353
70	3.6	0.8150732	2.7849268	2.11E+00	67.88890317	1.2510951	2.3489049
80	3.8	0.8150732	2.9849268	2.28E+00	77.72272306	1.3335865	2.4664135
90	4	0.8150732	3.1849268	2.44E+00	87.55793098	1.4111719	2.5888281
100	4.25	0.8150732	3.4349268	2.65E+00	97.35388139	1.4894496	2.7605504
110	4.4	0.8150732	3.5849268	2.77E+00	107.2324809	1.575363	2.824637
80	0.7	0.8150732	-0.115073	-4.59E-01	80.45912398	1.3554127	-0.655413
60	0	0.8150732	-0.815073	-1.13E+00	61.12603707	1.1884269	-1.188427
0	0	0	0	0.00E+00	0	0	0

Corrected Volume	Corrected Pressure
(cm3)	(bar)
1.126037	-0.10155
5.553262	0.3697
9.994057	0.850422
14.53827	1.238024
19.18025	1.532691
23.91555	1.734473
28.65409	1.944861
33.56765	1.960395
38.39585	2.085074
43.22546	2.216637
48.18308	2.202834
53.05648	2.295751
57.97252	2.343092
54.18025	0.983304
49.81064	0.333185
45.17896	-0.00924
40.55326	-0.34631
49.00342	1.242854
58.18308	2.090935
87.8889	2.348905
77.72272	2.466413
87.55793	2.588828
97.35388	2.76055
107.2325	2.824637
80.45912	-0.65541
61.12604	-1.18843
0	0



10 P-y points

	V	P	Vo	Po
1	42.39471	0	0	0
2	49.00342	1.242854	8.608711	1.242854
3	58.18308	2.090935	15.78837	2.090935
4	67.8889	2.348905	25.49419	2.348905
5	77.72272	2.466413	35.32801	2.466413
6	87.55793	2.588828	45.16322	2.588828
7	92.45591	2.674689	50.06119	2.674689
8	97.35388	2.76055	54.95917	2.76055
9	102.2932	2.792594	59.89847	2.792594
10	107.2325	2.824637	64.83777	2.824637

X	Y
40.55326	-0.34631
42.39471	0
49.00342	1.242854
m	5.317368
b	42.39471

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	40.55326	cm3
V2	49.00342	cm3
P1	-0.34631	bar
P2	1.242854	bar
Vm	44.77834	cm3
V	8.450163	cm3
P	158.9163	kPa
E	11844.78	kPa

8-1-98

Raw Data to Corrected Curve Sheet **PMT #1** Test Date 3/9/98 Before Membrane CB-59

Height of Control Unit
h= 1 m

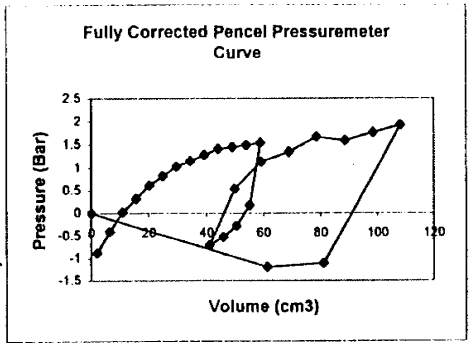
Depth of Probe
d= 8.8414634 m

Hydrostatic
u= 0.9644634 bar

Volume Coefficients	
P^3	1.56E-04
P^2	-0.018747759
P	+0.9351744516
C	-0.3512619968

Pressure Coefficients	
V^3	1.04E-06
V^2	-0.0002678244
V	+0.0308299801
C	+0.0671743059

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	-0.75	0.9644634	-1.714463	-2.01E+00	2.010477673	0.1280832	-0.878083	2.010478	-0.87808
5	-0.15	0.9644634	-1.114463	-1.42E+00	6.416980969	0.254256	-0.404256	6.416981	-0.40426
10	0.4	0.9644634	-0.564463	-8.85E-01	10.88513522	0.3723701	0.0276299	10.88514	0.02763
15	0.8	0.9644634	-0.164463	-5.06E-01	15.50557177	0.4846952	0.3153048	15.50557	0.315305
20	1.2	0.9644634	0.2355366	-1.32E-01	20.13203224	0.5877782	0.6122218	20.13203	0.612222
25	1.5	0.9644634	0.5355366	1.44E-01	24.85579474	0.6839775	0.8160225	24.85579	0.816022
30	1.8	0.9644634	0.8355366	4.17E-01	29.58288671	0.7717429	1.0282571	29.58289	1.028257
35	2	0.9644634	1.0355366	5.97E-01	34.40278525	0.8531574	1.1468426	34.40279	1.146843
40	2.2	0.9644634	1.2355366	7.76E-01	39.22414482	0.9271345	1.2728655	39.22414	1.272865
45	2.4	0.9644634	1.4355366	9.53E-01	44.04695794	0.9943669	1.4056331	44.04696	1.405633
50	2.5	0.9644634	1.5355366	1.04E+00	48.95890724	1.0566086	1.4433914	48.95891	1.443391
55	2.6	0.9644634	1.6355366	1.13E+00	53.87121712	1.1132987	1.4867013	53.87122	1.486701
60	2.7	0.9644634	1.7355366	1.22E+00	58.78388664	1.1651754	1.5348246	58.78389	1.534825
55	1.3	0.9644634	0.3355366	-3.98E-02	55.03958157	1.1260453	0.1739547	55.03958	0.173955
50	0.8	0.9644634	-0.164463	-5.06E-01	50.50557177	1.0750221	-0.275022	50.50557	-0.27502
45	0.5	0.9644634	-0.464463	-7.90E-01	45.78967634	1.017132	-0.517132	45.78968	-0.51713
40	0.25	0.9644634	-0.714463	-1.03E+00	41.02903678	0.9530506	-0.703051	41.02904	-0.70305
50	1.6	0.9644634	0.6355366	2.36E-01	49.76445671	1.0662662	0.5337338	49.76448	0.533734
60	2.3	0.9644634	1.3355366	8.65E-01	59.13537016	1.1687218	1.1312782	59.13537	1.131278
70	2.6	0.9644634	1.6355366	1.13E+00	68.87121712	1.2597252	1.3402748	68.87122	1.340275
80	3	0.9644634	2.0355366	1.48E+00	78.52404368	1.3400118	1.6599882	78.52404	1.659988
90	3	0.9644634	2.0355366	1.48E+00	88.52404368	1.4187517	1.5812483	88.52404	1.581248
100	3.25	0.9644634	2.2855366	1.69E+00	98.30995574	1.497383	1.752637	98.30996	1.752637
110	3.5	0.9644634	2.5355366	1.90E+00	108.0980775	1.5834234	1.9165766	108.0981	1.916577
80	0.25	0.9644634	-0.714463	-1.03E+00	81.02903678	1.3599224	-1.109922	81.02904	-1.10992
60	0	0.9644634	-0.964463	-1.27E+00	61.27078251	1.1898352	-1.189835	61.27078	-1.18984
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po
1	45.99469	0	0	0
2	49.76446	0.533734	3.769767	0.533734
3	59.13537	1.131278	13.14068	1.131278
4	68.87122	1.340275	22.87653	1.340275
5	78.52404	1.659988	32.52935	1.659988
6	88.52404	1.581248	42.52935	1.581248
7	93.417	1.666943	47.42231	1.666943
8	98.30996	1.752637	52.31527	1.752637
9	103.204	1.834607	57.20933	1.834607
10	108.0981	1.916577	62.10339	1.916577

X	Y
41.02904	-0.70305
45.99469	0
49.76446	0.533734
m	7.06301
b	45.99469

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	41.02904	cm3
V2	49.76446	cm3
P1	-0.70305	bar
P2	0.533734	bar
Vm	45.39675	cm3
V	8.73542	cm3
P	123.6784	kPa
E	8940.599	kPa

CB-1-09

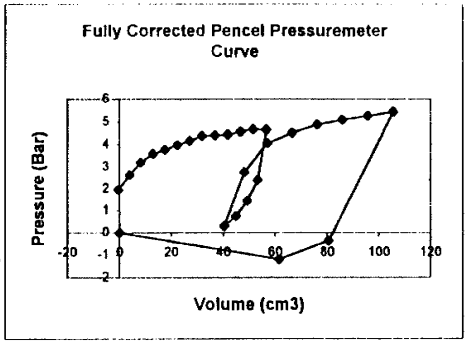
Raw Data to Corrected Curve Sheet **PMT #1** Test Date 3/9/98 Before Membrane CB-59

Height of Control Unit
h= 1 m
Depth of Probe
d= 10.365854 m
Hydrostatic
u= 1.1138537 bar

Volume Coefficients	
P^3	1.56E-04
P^2	-0.018747759
P	+0.9351744516
C	-0.3512619968

Pressure Coefficients	
V^3	1.04E-06
V^2	-0.0002678244
V	+0.0308299801
C	+0.0671743059

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	2	1.1138537	0.8861463	4.63E-01	-0.46282623	0.0528479	1.9471521	-0.46283	1.947152
5	2.8	1.1138537	1.6861463	1.17E+00	3.826974485	0.1812956	2.6187044	3.826974	2.618704
10	3.5	1.1138537	2.3861483	1.78E+00	8.224422802	0.3031955	3.1968045	8.224423	3.196805
15	4	1.1138537	2.8861463	2.20E+00	12.80462587	0.4202112	3.5797888	12.80463	3.579789
20	4.3	1.1138537	3.1861463	2.44E+00	17.55693039	0.5315245	3.7684755	17.55693	3.768475
25	4.6	1.1138537	3.4861463	2.69E+00	22.31234102	0.6332774	3.9667226	22.31234	3.966723
30	4.9	1.1138537	3.7861463	2.93E+00	27.07083247	0.7281217	4.1738783	27.07083	4.173878
35	5.2	1.1138537	4.0861483	3.17E+00	31.83237947	0.8107125	4.3892875	31.83238	4.389288
40	5.3	1.1138537	4.1861483	3.25E+00	36.75356978	0.8901159	4.4098841	36.75357	4.409884
45	5.4	1.1138537	4.2861463	3.32E+00	41.67509585	0.9621038	4.4378962	41.6751	4.437896
50	5.6	1.1138537	4.4861463	3.48E+00	46.51915152	1.0264338	4.5735662	46.51915	4.573566
55	5.75	1.1138537	4.6381483	3.60E+00	51.40306768	1.0854636	4.6845364	51.40307	4.664536
60	5.8	1.1138537	4.6861463	3.84E+00	58.36453899	1.1401832	4.6598168	56.36454	4.659817
55	3.5	1.1138537	2.3861463	1.78E+00	53.2244228	1.1061257	2.3938743	53.22442	2.393874
50	2.5	1.1138537	1.3681463	9.09E-01	49.09057971	1.0581973	1.4418027	49.09058	1.441803
45	1.75	1.1138537	0.6361463	2.36E-01	44.7639009	1.0038264	0.7461736	44.7639	0.746174
40	1.25	1.1138537	0.1361463	-2.24E-01	40.22428853	0.9418101	0.3083899	40.22429	0.30839
50	3.8	1.1138537	2.6861463	2.03E+00	47.9714943	1.0445665	2.7554335	47.97149	2.755433
60	5.2	1.1138537	4.0861463	3.17E+00	56.83237947	1.1450974	4.0549028	56.83238	4.054903
70	5.75	1.1138537	4.6361463	3.60E+00	66.40306768	1.2378336	4.5121664	68.40307	4.512166
80	6.2	1.1138537	5.0861463	3.94E+00	76.05927939	1.3201406	4.8798594	76.05928	4.879859
90	6.5	1.1138537	5.3881463	4.17E+00	85.83377497	1.3976655	5.1023345	85.83377	5.102335
100	6.75	1.1138537	5.6361463	4.35E+00	95.6480868	1.4754898	5.2745102	95.64809	5.27451
110	7	1.1138537	5.8861463	4.54E+00	105.4644123	1.5592047	5.4407953	105.4644	5.440795
80	1	1.1138537	-0.113854	-4.58E-01	80.45797628	1.3554036	-0.355404	80.45798	-0.3554
60	0	1.1138537	-1.113854	-1.42E+00	61.41638491	1.1912487	-1.191249	61.41638	-1.19125
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po	
1	39.24794	0	0	0	0
2	47.97149	2.755433	8.723551	2.755433	
3	56.83238	4.054903	17.58444	4.054903	
4	66.40307	4.512166	27.15512	4.512166	
5	76.05928	4.879859	36.81134	4.879859	
6	85.83377	5.102335	48.58583	5.102335	
7	90.74093	5.188422	51.49299	5.188422	
8	95.64809	5.27451	56.40014	5.27451	
9	100.5562	5.357653	61.30831	5.357653	
10	105.4644	5.440795	66.21647	5.440795	

X	Y
40.22429	0.30839
39.24794	0
47.97149	2.755433
m	3.165945
b	39.24794

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	40.22429	cm3
V2	47.97149	cm3
P1	0.30839	bar
P2	2.755433	bar
Vm	44.09789	cm3
V	7.747206	cm3
P	244.7044	kPa
E	19836.74	kPa

6-1-9

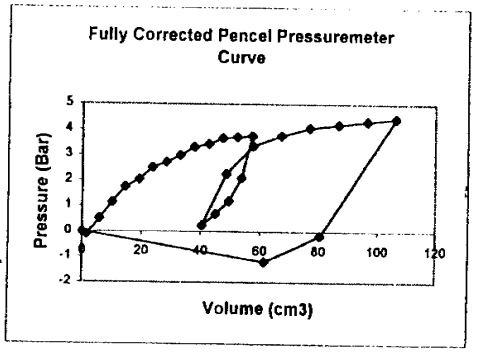
Raw Data to Corrected Curve Sheet **PMT #1** Test Date 3/9/98 Before Membrane CB-59

Height of Control Unit
h= 1 m
Depth of Probe
d= 11.890244 m
Hydrostatic
u= 1.2632439 bar

Volume Coefficients	
P^3	1.56E-04
P^2	-0.018747759
P	+0.9351744516
C	-0.3512619968

Pressure Coefficients	
V^3	1.04E-06
V^2	-0.0002678244
V	+0.0308299801
C	+0.0671743059

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	0	1.2632439	-1.263244	-1.56E+00	1.562847394	0.1147067	-0.114707	1.562847	-0.11471
5	0.75	1.2632439	-0.513244	-8.36E-01	5.836194201	0.2381883	0.5118117	5.836194	0.511812
10	1.5	1.2632439	0.2367561	-1.31E-01	10.13090255	0.3531026	1.1468974	10.1309	1.146897
15	2.2	1.2632439	0.9367561	5.08E-01	14.49155473	0.460868	1.739132	14.49155	1.739132
20	2.6	1.2632439	1.3367561	8.66E-01	19.13428978	0.5663108	2.0336892	19.13429	2.033689
25	3.15	1.2632439	1.8867561	1.35E+00	23.65250695	0.6603048	2.4896952	23.65251	2.489695
30	3.45	1.2632439	2.1867561	1.61E+00	28.39428171	0.750439	2.699561	28.39428	2.699561
35	3.8	1.2632439	2.5367561	1.90E+00	33.09704936	0.8318676	2.9681324	33.09705	2.968132
40	4.2	1.2632439	2.9367561	2.24E+00	37.76262097	0.9054559	3.2945441	37.76262	3.294544
45	4.4	1.2632439	3.1367561	2.40E+00	42.59749526	0.9748304	3.4251696	42.5975	3.42517
50	4.7	1.2632439	3.4367561	2.65E+00	47.35239625	1.0368991	3.6631009	47.3524	3.663101
55	4.8	1.2632439	3.5367561	2.73E+00	52.27138339	1.0954008	3.7045992	52.27138	3.704599
60	4.9	1.2632439	3.6367561	2.81E+00	57.19071236	1.1488344	3.7511656	57.19071	3.751166
55	3.2	1.2632439	1.9367561	1.39E+00	53.60924679	1.1104036	2.0895964	53.60925	2.089596
50	2.25	1.2632439	0.9867561	5.53E-01	49.44657743	1.0624728	1.1875272	49.44658	1.187527
45	1.7	1.2632439	0.4367561	5.36E-02	44.9463821	1.0062129	0.6937871	44.94638	0.693787
40	1.2	1.2632439	-0.063244	-4.10E-01	40.41048111	0.9442733	0.2557267	40.41048	0.255727
50	3.3	1.2632439	2.0367561	1.48E+00	46.52299396	1.0513204	2.2486796	48.52299	2.24868
60	4.5	1.2632439	3.2367561	2.48E+00	57.51545125	1.1522012	3.3477988	57.51545	3.347799
70	5	1.2632439	3.7367561	2.89E+00	67.11038224	1.2441788	3.7558212	67.11038	3.755821
80	5.4	1.2632439	4.1367561	3.21E+00	76.79245206	1.3260862	4.0739138	76.79245	4.073914
90	5.6	1.2632439	4.3367561	3.36E+00	86.63550805	1.4039441	4.1960559	86.63551	4.196056
100	5.8	1.2632439	4.5367561	3.52E+00	96.47990144	1.4822731	4.3177269	96.4799	4.317727
110	6	1.2632439	4.7367561	3.67E+00	106.3256247	1.5670254	4.4329746	106.3256	4.432975
80	1.2	1.2632439	-0.063244	-4.10E-01	80.41048111	1.3550273	-0.155027	80.41048	-0.15503
60	0	1.2632439	-1.263244	-1.56E+00	61.56284739	1.1926872	-1.192667	61.56285	-1.19267
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po	
1	39.36952	0	0	0	
2	48.52299	2.24868	9.153474	2.24868	
3	57.51545	3.347799	18.14593	3.347799	
4	67.11038	3.755821	27.74086	3.755821	
5	76.79245	4.073914	37.42293	4.073914	
6	86.63551	4.196056	47.26599	4.196056	
7	91.5577	4.256891	52.18618	4.256891	
8	96.4799	4.317727	57.11038	4.317727	
9	101.4028	4.375351	62.03324	4.375351	
10	106.3256	4.432975	66.9561	4.432975	

X	Y
40.41048	0.255727
39.36952	0
48.52299	2.24868
m	4.070599
b	39.36952

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	40.41048	cm3
V2	48.52299	cm3
P1	0.255727	bar
P2	2.24868	bar
Vm	44.46674	cm3
V	8.112513	cm3
P	199.2953	kPa
E	15452.31	kPa

CB-1-98

Raw Data to Corrected Curve Sheet **PMT #1** Test Date 3/9/98 Before Membrane CB-59

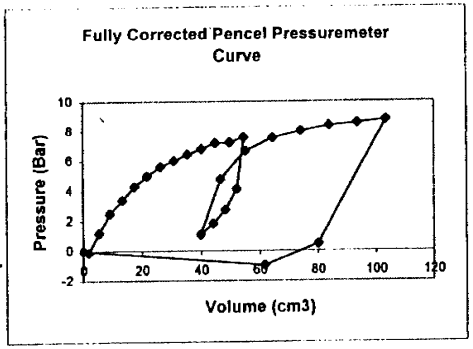
Height of Control Unit
h= 1 m
Depth of Probe
d= 13.414634 m
Hydrostatic
u= 1.4126341 bar

Volume Coefficients	
P^3	1.56E-04
P^2	-0.018747759
P	+0.9351744516
C	-0.3512619968

Pressure Coefficients	
V^3	1.04E-06
V^2	-0.0002678244
V	+0.0308299801
C	+0.0671743059

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction	
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)
0	0	1.4126341	-1.412634	-1.71E+00	1.710173076	0.1191208	-0.119121
5	1.4	1.4126341	-0.012634	-3.63E-01	5.363080121	0.224975	1.175025
10	2.8	1.4126341	1.3873659	9.10E-01	9.089501567	0.3260568	2.4739432
15	3.8	1.4126341	2.3873659	1.78E+00	13.22338823	0.4304236	3.3695764
20	4.8	1.4126341	3.3873659	2.61E+00	17.39253511	0.5278385	4.2721615
25	5.6	1.4126341	4.1873659	3.25E+00	21.75281076	0.6217792	4.9782208
30	6.3	1.4126341	4.8873659	3.79E+00	26.21032014	0.7099667	5.5900333
35	6.8	1.4126341	5.3873659	4.17E+00	30.83286426	0.793612	6.006388
40	7.3	1.4126341	5.8873659	4.54E+00	35.46352121	0.8700489	6.4299511
45	7.75	1.4126341	6.3373659	4.86E+00	40.13795219	0.9403718	6.8096282
50	8.2	1.4126341	6.7873659	5.18E+00	44.81877443	1.0045449	7.1954551
55	8.3	1.4126341	6.8873659	5.25E+00	49.74870541	1.0660788	7.2339212
60	8.7	1.4126341	7.2873659	5.53E+00	54.47152464	1.1198813	7.5801187
55	5.2	1.4126341	3.7873659	2.93E+00	52.06985698	1.0931067	4.1068913
50	3.75	1.4126341	2.3373659	1.73E+00	48.26584868	1.0481802	2.7018198
45	2.8	1.4126341	1.3873659	9.10E-01	44.08950157	0.994932	1.805068
40	2	1.4126341	0.5873659	1.92E-01	39.80840879	0.9356258	1.0643742
50	5.8	1.4126341	4.3873659	3.40E+00	46.59600589	1.0274061	4.7725939
60	7.8	1.4126341	6.3673659	4.90E+00	55.10217394	1.1267207	6.6732793
70	8.75	1.4126341	7.3373659	5.56E+00	64.43722333	1.2198725	7.5301275
80	9.3	1.4126341	7.8873659	5.94E+00	74.06493644	1.3037942	7.9962058
90	9.75	1.4126341	8.3373659	6.23E+00	83.76711997	1.3814722	8.3685278
100	10	1.4126341	8.5873659	6.40E+00	93.60426964	1.4589947	8.5410053
110	10.3	1.4126341	8.8873659	6.59E+00	103.411278	1.5409181	8.7590819
80	1.8	1.4126341	0.3673659	8.19E-03	79.99181142	1.3517067	0.4482933
60	0.2	1.4126341	-1.212634	-1.51E+00	61.51313297	1.1921861	-0.992186
0	0	0	0	0.00E+00	0	0	0

Corrected Volume	Corrected Pressure
(cm3)	(bar)
1.710173	-0.11912
5.36308	1.175025
9.089502	2.473943
13.22339	3.369576
17.39254	4.272162
21.75261	4.978221
26.21032	5.590033
30.83286	6.006388
35.46352	6.429951
40.13795	6.809628
44.81877	7.195455
49.74871	7.233921
54.47152	7.580119
52.06986	4.106891
48.26585	2.70182
44.0895	1.805068
39.80841	1.064374
46.59601	4.772594
55.10217	6.673279
64.43722	7.530128
74.06494	7.996206
83.76712	8.368528
93.60427	8.541005
103.4113	8.759082
79.99181	0.448293
61.51313	-0.99219
0	0



10 P-y points

	V	P	Vo	Po
1	37.86016	0	0	0
2	39.80841	1.064374	1.948251	1.064374
3	46.59601	4.772594	8.735848	4.772594
4	55.10217	6.673279	17.24202	6.673279
5	64.43722	7.530128	26.57707	7.530128
6	74.06494	7.996206	36.20478	7.996206
7	83.76712	8.368528	45.90696	8.368528
8	93.60427	8.541005	55.74411	8.541005
9	98.50777	8.650044	60.64762	8.650044
10	103.4113	8.759082	65.55112	8.759082

X	Y
39.80841	1.064374
37.86016	0
46.59601	4.772594
m	1.830419
b	37.88016

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.80841	cm3
V2	46.59601	cm3
P1	1.064374	bar
P2	4.772594	bar
Vm	43.20221	cm3
V	6.787597	cm3
P	370.622	kPa
E	34160.03	kPa

B-1-09

Raw Data to Corrected Curve Sheet **PMT #1** Test Date 3/9/98 Before Membrane CB-59

Height of Control Unit
h= 1 m

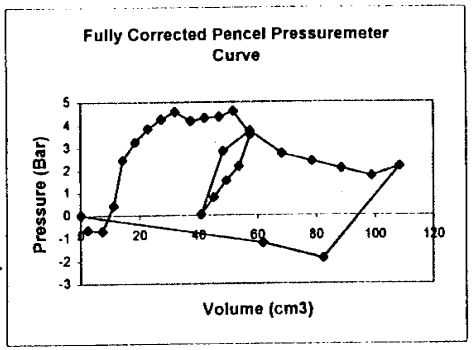
Depth of Probe
d= 14.939024 m

Hydrostatic
u= 1.5620244 bar

Volume Coefficients	
P^3	1.56E-04
P^2	-0.018747759
P	+0.9351744516
C	-0.3512619968

Pressure Coefficients	
V^3	1.04E-06
V^2	-0.0002678244
V	+0.0308299801
C	+0.0671743059

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	-0.5	1.5620244	-2.062024	-2.36E+00	2.360697153	0.1384757	-0.638476	2.360697	-0.63848
5	-0.4	1.5620244	-1.962024	-2.26E+00	7.25944596	0.2772664	-0.677266	7.259446	-0.67727
10	0.8	1.5620244	-0.762024	-1.07E+00	11.07484326	0.3771744	0.4228256	11.07484	0.422826
15	2.9	1.5620244	1.3379756	8.67E-01	14.13320945	0.4523385	2.4476615	14.13321	2.447662
20	3.8	1.5620244	2.2379756	1.65E+00	18.35051401	0.5491568	3.2508432	18.35051	3.250843
25	4.5	1.5620244	2.9379756	2.24E+00	22.7616099	0.6424165	3.8575835	22.76161	3.857584
30	5	1.5620244	3.4379756	2.65E+00	27.35140623	0.7313302	4.2686698	27.35141	4.26867
35	5.4	1.5620244	3.8379756	2.97E+00	32.02941869	0.8140436	4.5859564	32.02942	4.585956
40	5.1	1.5620244	3.5379756	2.73E+00	37.27039754	0.8980115	4.2019885	37.2704	4.201988
45	5.3	1.5620244	3.7379756	2.89E+00	42.1094047	0.968125	4.331875	42.1094	4.331875
50	5.4	1.5620244	3.8379756	2.97E+00	47.02941869	1.0328626	4.3871374	47.02942	4.387137
55	5.7	1.5620244	4.1379756	3.21E+00	51.79149101	1.0899286	4.6100714	51.79149	4.610071
60	4.75	1.5620244	3.1879756	2.44E+00	57.55542961	1.1526144	3.5973856	57.55543	3.597386
55	3.3	1.5620244	1.7379756	1.22E+00	53.78176111	1.1123116	2.1878884	53.78176	2.187688
50	2.6	1.5820244	1.0379756	5.99E-01	49.40059792	1.0619222	1.5380778	49.4006	1.538078
45	1.8	1.5620244	0.2379756	-1.30E-01	45.12977291	1.0086028	0.7913972	45.12977	0.791397
40	1	1.5620244	-0.562024	-8.83E-01	40.88280243	0.9509852	0.0490148	40.8828	0.049015
50	3.9	1.5620244	2.3379756	1.73E+00	48.28533034	1.0481739	2.8518261	48.26533	2.851826
60	4.9	1.5620244	3.3379756	2.57E+00	57.43275769	1.1513456	3.7486544	57.43276	3.748654
70	4	1.5620244	2.4379758	1.82E+00	68.18049974	1.2536679	2.7463321	68.1805	2.746332
80	3.75	1.5620244	2.1879756	1.61E+00	78.39323854	1.338965	2.411035	78.39324	2.411035
90	3.5	1.5620244	1.9379756	1.39E+00	88.60819278	1.4194126	2.0805874	88.60819	2.080587
100	3.25	1.5620244	1.6879756	1.17E+00	98.82537708	1.5016582	1.7483418	98.82538	1.748342
110	3.75	1.5620244	2.1879756	1.61E+00	108.3932385	1.5861955	2.1638045	108.3932	2.163805
80	-0.5	1.5620244	-2.062024	-2.38E+00	82.36069715	1.3704235	-1.870423	82.3607	-1.87042
60		1.5620244	-1.562024	-1.88E+00	61.85836508	1.1955195	-1.195519	61.85837	-1.19552
0		0	0	0.00E+00	0	0	0	0	0



6-11-10

PMT 1
(CB-59)

Raw Data, Corrections, and Fully Corrected Pressuremeter Curves

(New Calibration After Loss of Membrane)

PMT #1 Test Date 3/9/98 after Membrane Blowout CB-59

Calibrate

Insert Field Record Sheet

Pressure Correction

# Points	18
V	**P**
(cm3)	**(bar)**
0	0
5	0.25
10	0.35
15	0.55
20	0.7
25	0.8
30	0.9
35	0.95
40	1
45	1.1
50	1.2
55	1.25
60	1.3
70	1.35
80	1.45
90	1.5
100	1.7
110	1.75

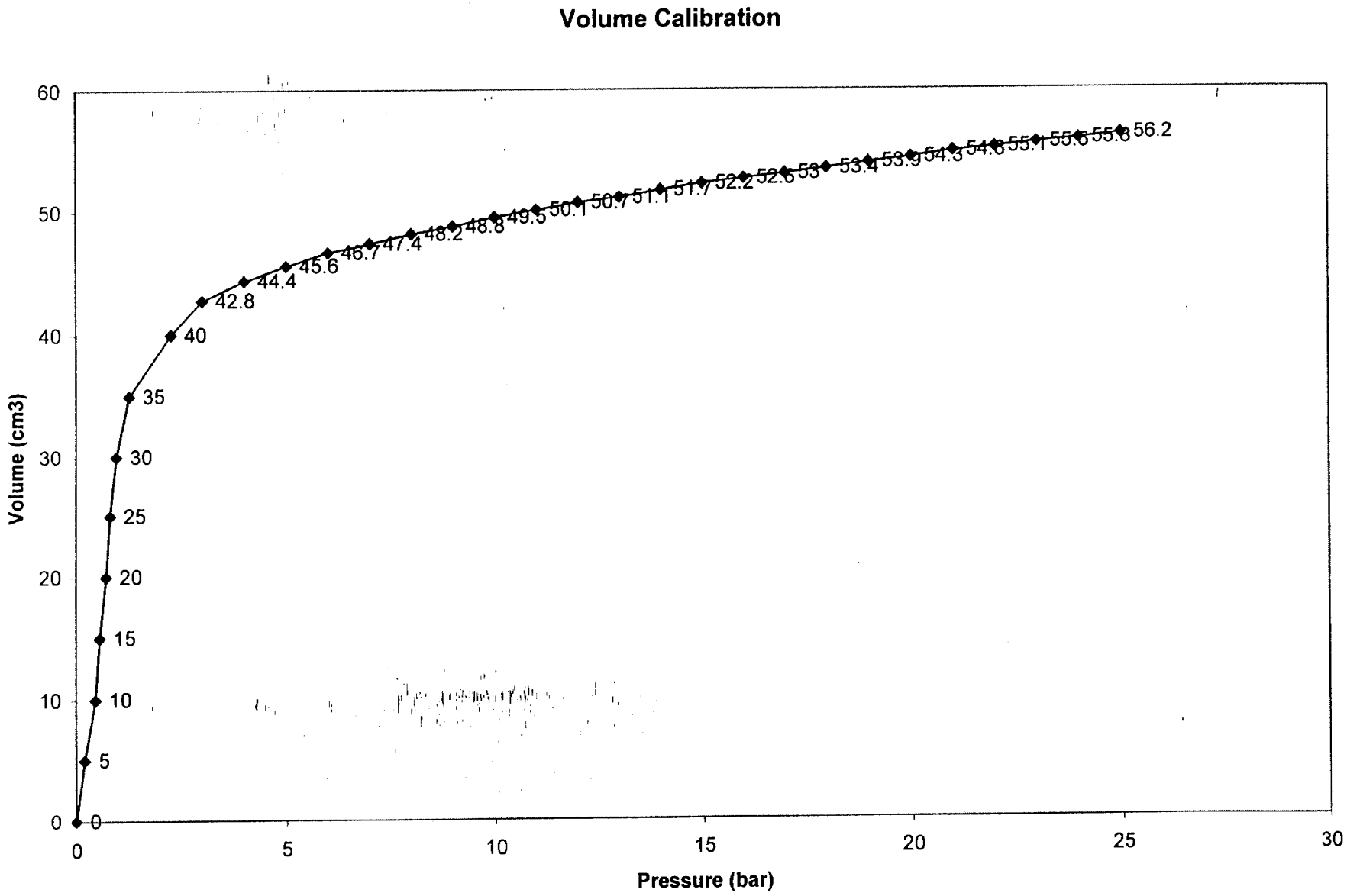
Volume Correction

# Points	32
V	**P**
(cm3)	**(bar)**
0	0
5	0.2
10	0.45
15	0.55
20	0.7
25	0.8
30	0.95
35	1.25
40	2.25
42.8	3
44.4	4
45.6	5
46.7	6
47.4	7
48.2	8
48.8	9
49.5	10
50.1	11
50.7	12
51.1	13
51.7	14
52.2	15
52.6	16
53	17
53.4	18
53.9	19
54.3	20
54.8	21
55.1	22
55.5	23
55.8	24
56.2	25

Volume Correction for Unit and Tubing

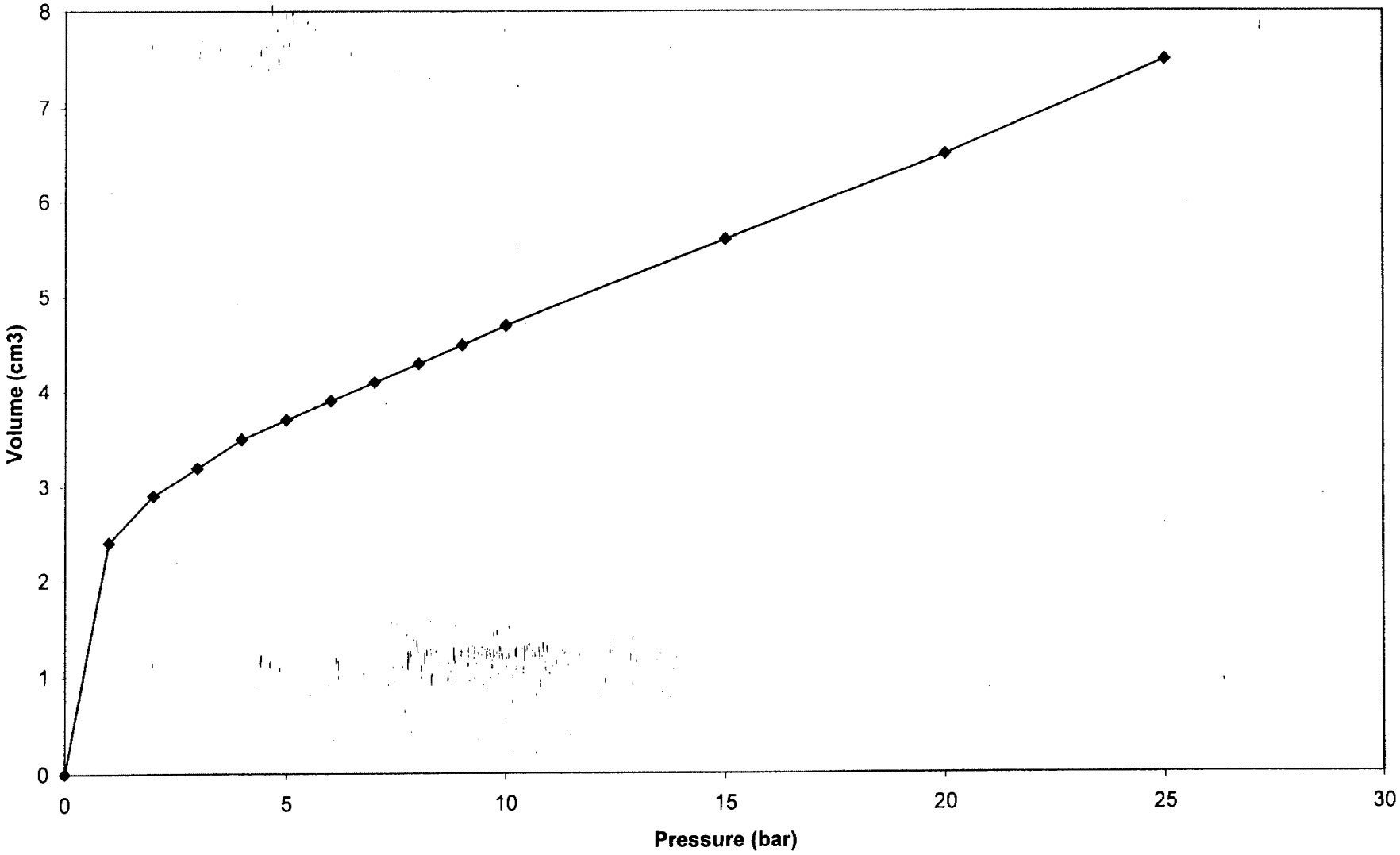
# Points	14
V	**P**
(cm3)	**(bar)**
0	0
2.4	1
2.9	2
3.2	3
3.5	4
3.7	5
3.9	6
4.1	7
4.3	8
4.5	9
4.7	10
5.6	15
6.5	20
7.5	25

B-1-112

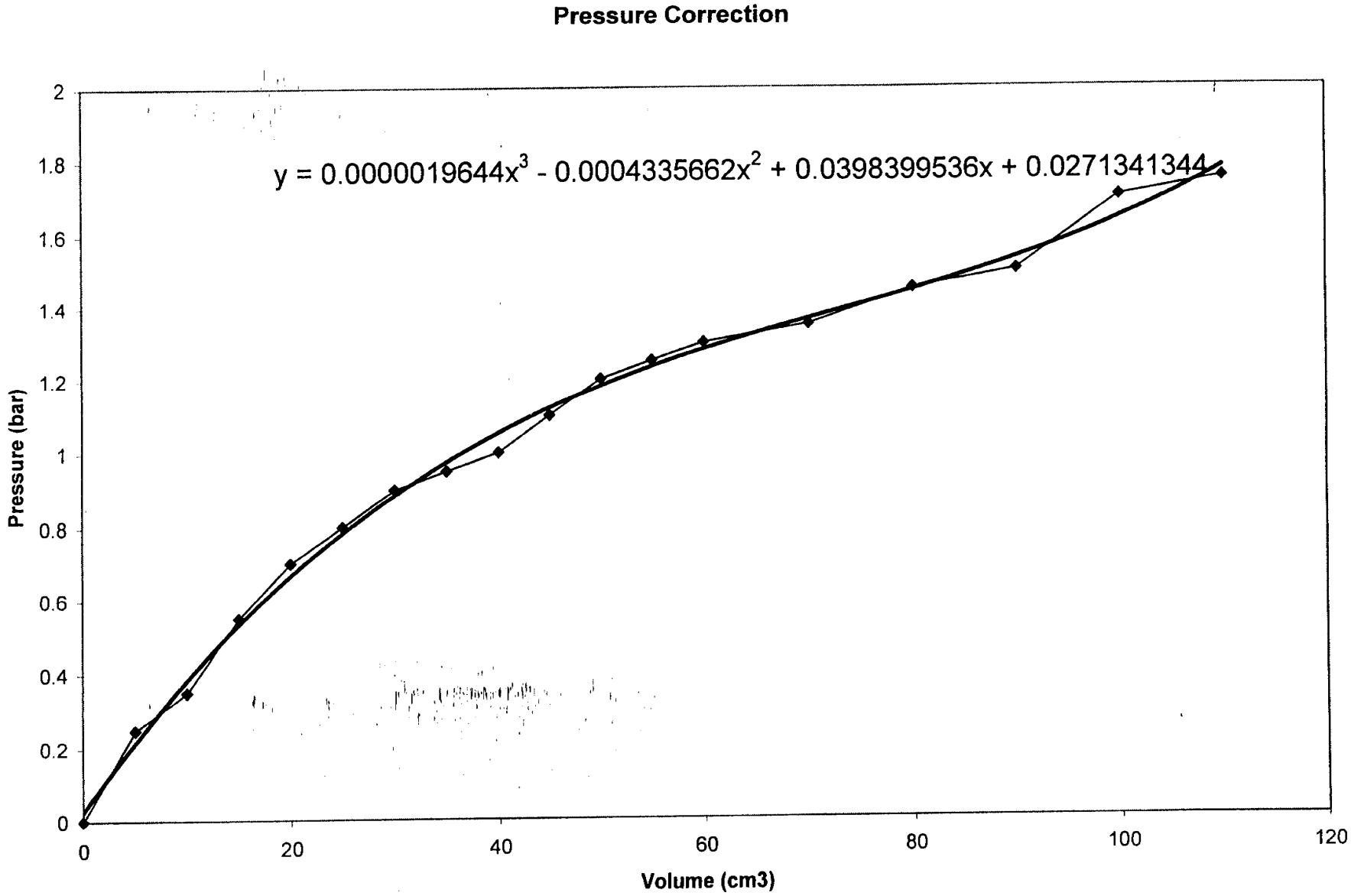

Volume Calibration
Volume (cm3)
Pressure (bar)
0
5
10
15
20
25
30
35
40
42.8
44.4
45.6
46.7
47.4
48.2
48.8
49.5
50.1
50.7
51.1
51.7
52.2
52.6
53
53.4
53.9
54.3
54.6
55.1
55.5
55.8
56.2

B-1-113

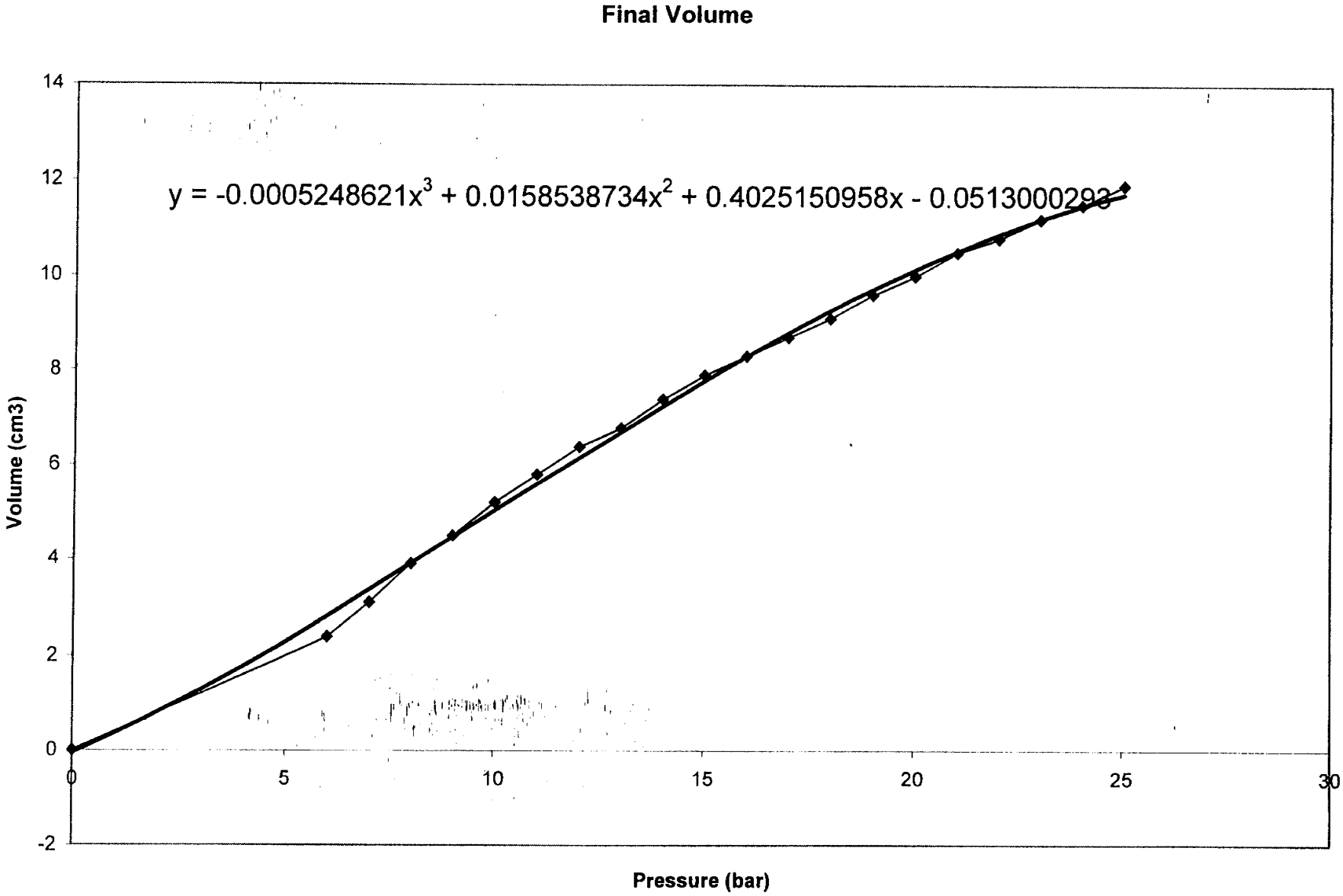
Volume Correction for Unit and Tubing Only



h11-1-8


Pressure Correction
y = 0.0000019644x3 - 0.0004335662x2 + 0.0398399536x + 0.0271341344
Pressure (bar)
Volume (cm3)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
20
40
60
80
100
120

S11-1-9


Final Volume
y = -0.0005248621x3 + 0.0158538734x2 + 0.4025150958x - 0.0513000293
Volume (cm3)
Pressure (bar)
14
12
10
8
6
4
2
0
-2
0
5
10
15
20
25
30

B-1-11

Raw Data to Corrected Curve Sheet PMT #1 Test Date 3/9/98 after Membrane Blowout CB-59

Height of Control Unit
h= 1 m

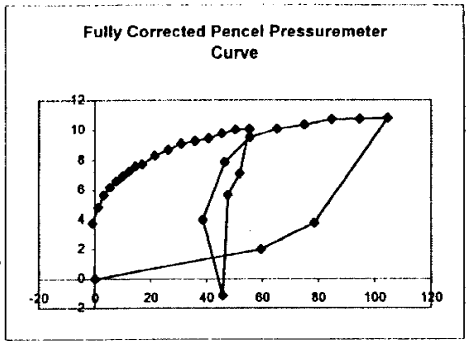
Depth of Probe
d= 16.463415 m

Hydrostatic
u= 1.7114146 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-06
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	3.75	1.7114146	2.0385854	8.31E-01	-0.83070072	-0.0062613	3.7562613	-0.8307	3.756261
2.5	4.9	1.7114146	3.1885854	1.38E+00	1.12367403	0.0713566	4.8286434	1.123674	4.828643
5	5.8	1.7114146	4.0885854	1.82E+00	3.176433674	0.1493715	5.6506285	3.176434	5.650629
7.5	8.4	1.7114146	4.6885854	2.13E+00	5.369657285	0.2288641	6.1711359	5.369657	6.171136
10	6.9	1.7114146	5.1885854	2.39E+00	7.609322217	0.3060504	6.5939496	7.609322	6.59395
12.5	7.3	1.7114146	5.5885854	2.60E+00	9.898269028	0.3809068	6.9190932	9.898269	6.919093
15	7.7	1.7114146	5.9885854	2.82E+00	12.16495851	0.4517632	7.2482388	12.18496	7.248237
17.5	8.1	1.7114146	6.3885854	3.03E+00	14.4695922	0.5187776	7.5812222	14.46959	7.581222
20	8.3	1.7114146	6.5885854	3.14E+00	16.86120111	0.5850373	7.7149627	16.8612	7.714963
25	9	1.7114146	7.2885854	3.52E+00	21.4785455	0.7022868	8.2977132	21.47855	8.297713
30	9.5	1.7114146	7.7885854	3.80E+00	26.20253066	0.8067065	8.6912935	26.20253	8.691294
35	10	1.7114146	8.2885854	4.08E+00	30.92472078	0.9026337	9.0973663	30.92472	9.097366
40	10.25	1.7114146	8.5385854	4.21E+00	35.78526571	0.9876197	9.2623803	35.78527	9.26238
45	10.5	1.7114148	8.7885854	4.35E+00	40.64550951	1.06208	9.43792	40.64551	9.43792
50	10.9	1.7114148	9.1885854	4.58E+00	45.42139602	1.1263106	9.7738894	45.4214	9.773889
55	11.2	1.7114146	9.4885854	4.75E+00	50.2530089	1.1835953	10.016405	50.25301	10.0164
60	11.3	1.7114146	9.5885854	4.80E+00	55.19683913	1.23558	10.06442	55.19684	10.06442
55	8.3	1.7114146	6.5885854	3.14E+00	51.86120111	1.2011737	7.0988263	51.8612	7.098826
50	6.8	1.7114146	5.0885854	2.34E+00	47.66170919	1.1537547	5.6462453	47.66171	5.646245
45		1.7114146	-1.711415	-6.91E-01	45.69110427	1.1297001	-1.1297	45.6911	-1.1297
40	5	1.7114146	3.2885854	1.43E+00	38.57480532	1.0315557	3.9684443	38.57461	3.968444
50	9	1.7114146	7.2885854	3.52E+00	46.4785455	1.1394602	7.8605398	46.47855	7.86054
60	10.75	1.7114146	9.0385854	4.49E+00	55.50550137	1.2388353	9.5113647	55.5055	9.511365
70	11.4	1.7114146	9.6885854	4.86E+00	65.14065424	1.3255643	10.074436	65.14065	10.07444
80	11.75	1.7114146	10.036585	5.06E+00	74.94393356	1.4046061	10.345394	74.94393	10.34539
90	12.2	1.7114146	10.488585	5.31E+00	84.69100865	1.484716	10.715284	84.69101	10.71528
100	12.3	1.7114146	10.588585	5.37E+00	94.63482983	1.5793504	10.72065	94.63483	10.72065
110	12.5	1.7114146	10.788585	5.48E+00	104.5225235	1.6977707	10.802229	104.5225	10.80223
80	5.2	1.7114146	3.4885854	1.52E+00	78.47643051	1.4326888	3.7671112	78.47643	3.767111
60	3.25	1.7114146	1.5385854	6.04E-01	59.39637785	1.2755248	1.9744754	59.39638	1.974475
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po
1	30.51602	0	0	0
2	38.57481	3.968444	8.058783	3.968444
3	46.47855	7.86054	15.96252	7.86054
4	55.5055	9.511365	24.98948	9.511365
5	65.14065	10.07444	34.62463	10.07444
6	74.94393	10.34539	44.42791	10.34539
7	84.69101	10.71528	54.17499	10.71528
8	94.63483	10.72065	64.11881	10.72065
9	99.57868	10.76144	69.06265	10.76144
10	104.5225	10.80223	74.0065	10.80223

X	Y
38.57481	3.968444
30.51602	0
46.47855	7.86054
m	2.030716
b	30.51602

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	38.57481	cm3
V2	46.47855	cm3
P1	3.968444	bar
P2	7.86054	bar
Vm	42.52668	cm3
V	7.90374	cm3
P	389.2096	kPa
E	30720.25	kPa

B-117

Raw Data to Corrected Curve Sheet **PMT #1** Test Date 3/9/98 after Membrane Blowout CB-59

Height of Control Unit
h= 1 m

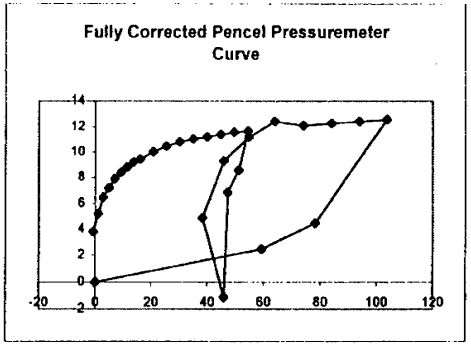
Depth of Probe
d= 17.987805 m

Hydrostatic
u= 1.8608049 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-06
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)		(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	3.8	1.8608049	1.9391951	7.85E-01	-0.78504597	-0.0044102	3.8044102	-0.78505	3.80441
2.5	5.3	1.8608049	3.4391951	1.50E+00	1.000802335	0.0665738	5.2334262	1.000802	5.233426
5	6.6	1.8608049	4.7391951	2.16E+00	2.843492391	0.1369583	6.4630417	2.843492	6.463042
7.5	7.4	1.8608049	5.5391951	2.58E+00	4.924455189	0.2130447	7.1869553	4.924455	7.186955
10	8.2	1.8608049	6.3391951	3.00E+00	6.996289113	0.2853165	7.9146835	6.996289	7.914684
12.5	8.75	1.8608049	6.8891951	3.30E+00	9.197467352	0.3584124	8.3915876	9.197467	8.391588
15	9.25	1.8608049	7.3891951	3.58E+00	11.42316915	0.4285853	8.8214147	11.42317	8.821415
17.5	9.7	1.8608049	7.8391951	3.83E+00	13.67448595	0.4958748	9.2041252	13.67449	9.204125
20	10	1.8608049	8.1391951	3.99E+00	16.0078896	0.5618434	9.4381566	16.00789	9.438157
25	10.7	1.8608049	8.8391951	4.38E+00	20.61718514	0.681442	10.018558	20.61719	10.01856
30	11.25	1.8608049	9.3891951	4.69E+00	25.30881808	0.7895667	10.460433	25.30882	10.46043
35	11.7	1.8608049	9.8391951	4.94E+00	30.05601273	0.8862327	10.813767	30.05601	10.81377
40	12	1.8608049	10.139195	5.11E+00	34.88737685	0.9727528	11.027247	34.88738	11.02725
45	12.25	1.8608049	10.389195	5.25E+00	39.74685863	1.0490435	11.200957	39.74686	11.20096
50	12.5	1.8608049	10.639195	5.39E+00	44.6064035	1.1159208	11.384079	44.6064	11.38408
55	12.75	1.8608049	10.889195	5.53E+00	49.46606069	1.1747378	11.575262	49.46606	11.57526
60	12.9	1.8608049	11.039195	5.62E+00	54.38192937	1.2274136	11.672586	54.38193	11.67259
55	9.75	1.8608049	7.8891951	3.85E+00	51.14676148	1.1934491	8.5565509	51.14676	8.556551
50	8	1.8608049	6.1391951	2.90E+00	47.10409829	1.1470723	6.8529277	47.1041	6.852928
45		1.8608049	-1.860805	-7.42E-01	45.74202475	1.1303374	-1.130337	45.74202	-1.13034
40	5.9	1.8608049	4.0391951	1.80E+00	38.20139387	1.0258661	4.8741339	38.20139	4.874134
50	10.4	1.8608049	8.5391951	4.22E+00	45.78492519	1.1308736	9.2691264	45.78493	9.269126
60	12.4	1.8608049	10.539195	5.34E+00	54.66257483	1.2302427	11.169757	54.66257	11.16976
70	13.75	1.8608049	11.889195	6.09E+00	63.90679661	1.3151666	12.434831	63.9068	12.43483
80	13.5	1.8608049	11.639195	5.95E+00	74.04619814	1.3974712	12.102529	74.0462	12.10253
90	13.75	1.8608049	11.889195	6.09E+00	83.90679661	1.4779554	12.272045	83.9068	12.27204
100	14	1.8608049	12.139195	6.23E+00	93.76775342	1.5702887	12.429711	93.76775	12.42971
110	14.25	1.8608049	12.389195	6.37E+00	103.6291178	1.6857752	12.564225	103.6291	12.56422
80	5.9	1.8608049	4.0391951	1.80E+00	78.20139387	1.4306676	4.4693324	78.20139	4.469332
60	3.75	1.8608049	1.8891951	7.62E-01	59.23782604	1.2740756	2.4759244	59.23783	2.475924
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po
1	29.79111	0	0	0
2	38.20139	4.874134	8.410287	4.874134
3	45.78493	9.269126	15.99382	9.269126
4	54.68257	11.16976	24.87147	11.16976
5	63.9068	12.43483	34.11569	12.43483
6	74.0462	12.10253	44.25509	12.10253
7	83.9068	12.27204	54.11569	12.27204
8	93.76775	12.42971	63.97665	12.42971
9	98.69844	12.49697	68.90733	12.49697
10	103.6291	12.56422	73.83801	12.56422

X	Y
38.20139	4.874134
29.79111	0
45.78493	9.269126
m	1.725494
b	29.79111

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	38.20139	cm3
V2	45.78493	cm3
P1	4.874134	bar
P2	9.269126	bar
Vm	41.99316	cm3
V	7.583531	cm3
P	439.4992	kPa
E	36072.1	kPa

311-1-9

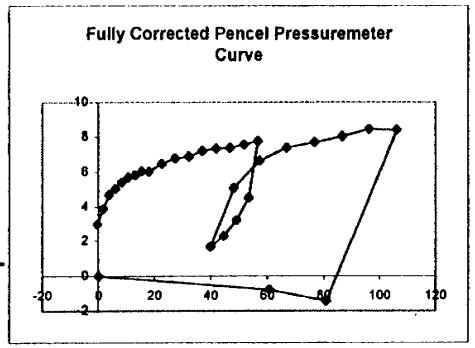
Raw Data to Corrected Curve Sheet **PMT #1** Test Date 3/9/98 after Membrane Blowout CB-59

Height of Control Unit
h= 1 m
Depth of Probe
d= 19.512195 m
Hydrostatic
u= 2.0101951 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-08
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	3	2.0101951	0.9898049	3.62E-01	-0.36213468	0.0126498	2.9873502	-0.36213	2.98735
2.5	4	2.0101951	1.9898049	8.08E-01	1.691737927	0.0933015	3.9066985	1.691738	3.906698
5	4.9	2.0101951	2.8898049	1.23E+00	3.768381015	0.1712144	4.7287856	3.768381	4.728786
7.5	5.3	2.0101951	3.2898049	1.43E+00	6.074208037	0.2535737	5.0464263	6.074208	5.046426
10	5.75	2.0101951	3.7398049	1.65E+00	8.351690751	0.3307679	5.4192321	8.351691	5.419232
12.5	6.1	2.0101951	4.0898049	1.82E+00	10.67581679	0.4054335	5.6945665	10.67582	5.694566
15	6.3	2.0101951	4.2898049	1.93E+00	13.07427317	0.4782904	5.8217096	13.07427	5.82171
17.5	6.6	2.0101951	4.5898049	2.08E+00	15.42060073	0.5455936	6.0544064	15.4206	6.054406
20	6.65	2.0101951	4.6398049	2.11E+00	17.89483539	0.6124815	6.0375185	17.89484	6.037518
25	7.2	2.0101951	5.1898049	2.39E+00	22.6088824	0.7289461	6.4710539	22.60868	6.471054
30	7.6	2.0101951	5.5898049	2.60E+00	27.39762202	0.8336053	6.7663947	27.39762	6.766395
35	7.8	2.0101951	5.7898049	2.71E+00	32.29123298	0.9276686	6.8723314	32.29123	6.872331
40	8.2	2.0101951	6.1898049	2.92E+00	37.07686309	1.008378	7.191622	37.07686	7.191622
45	8.4	2.0101951	6.3898049	3.03E+00	41.96893268	1.0807105	7.3192895	41.96893	7.31929
50	8.5	2.0101951	6.4898049	3.09E+00	46.91479209	1.1447817	7.3552183	46.91479	7.355218
55	8.75	2.0101951	6.7398049	3.22E+00	51.77895449	1.2002911	7.5497089	51.77895	7.549709
60	9	2.0101951	6.9898049	3.36E+00	56.6424617	1.2497172	7.7502828	58.64246	7.750283
55	5.75	2.0101951	3.7398049	1.65E+00	53.35169075	1.2168735	4.5331265	53.35169	4.533128
50	4.4	2.0101951	2.3898049	9.94E-01	49.00598699	1.169478	3.230522	49.00599	3.230522
45	3.4	2.0101951	1.3898049	5.37E-01	44.4626689	1.1140651	2.2859349	44.48267	2.285935
40	2.7	2.0101951	0.6898049	2.34E-01	39.76827167	1.0493285	1.6506715	39.78627	1.650672
50	6.25	2.0101951	4.2398049	1.90E+00	48.0997283	1.1589372	5.0910628	48.09973	5.091063
60	7.9	2.0101951	5.8898049	2.76E+00	57.23783474	1.2554163	6.6445837	57.23783	6.644584
70	8.7	2.0101951	6.6898049	3.19E+00	66.806178	1.339361	7.360639	68.80618	7.380639
80	9.1	2.0101951	7.0898049	3.41E+00	76.58789215	1.4177101	7.6822899	78.58769	7.68229
90	9.5	2.0101951	7.4898049	3.63E+00	86.3877074	1.4994481	8.0005519	88.38771	8.000552
100	10	2.0101951	7.9898049	3.91E+00	96.09092283	1.5949918	8.4050082	96.09092	8.405008
110	10.1	2.0101951	8.0898049	3.96E+00	106.0353569	1.7187514	8.3812486	106.0354	8.381249
60		2.0101951	-2.010195	-7.92E-01	80.7921068	1.4517884	-1.451788	80.79211	-1.45179
60	0.5	2.0101951	-1.510195	-6.21E-01	60.62121083	1.286581	-0.786581	60.62121	-0.78658
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po
1	35.76795	0	0	0
2	39.76627	1.650672	3.998324	1.650672
3	48.09973	5.091063	12.33178	5.091063
4	57.23783	6.644584	21.46989	6.644584
5	66.80818	7.360639	31.03823	7.360639
6	78.58769	7.68229	40.81974	7.68229
7	88.36771	8.000552	50.59978	8.000552
8	96.09092	8.405008	60.32298	8.405008
9	101.0631	8.393128	65.29519	8.393128
10	106.0354	8.381249	70.28741	8.381249

X	Y
39.76627	1.650672
35.76795	0
48.09973	5.091063
m	2.422241
b	35.76795

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.76627	cm3
V2	48.09973	cm3
P1	1.650672	bar
P2	5.091063	bar
Vm	43.933	cm3
V	8.333457	cm3
P	344.0391	kPa
E	25909.14	kPa

6-11-98

PMT 2
(CBMC-30)

Raw Data, Corrections, and Fully Corrected Pressuremeter Curves

B-1-120

PMT #2 Test Date 3/7/98 First Test Probe Lost CBMC-30

Calibrate

Insert Field Record Sheet

Pressure Correction

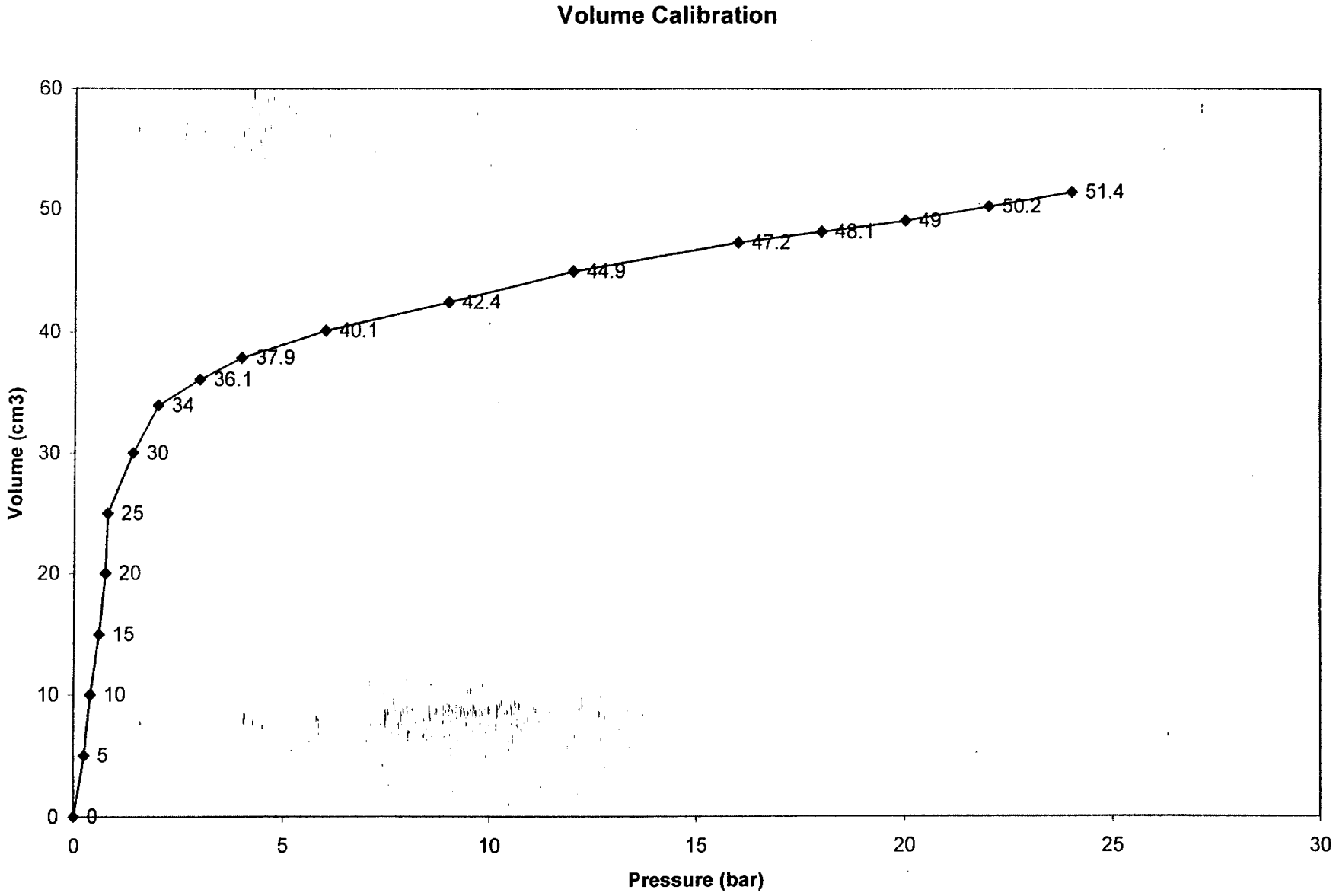
# Points	12
V	**P**
(cm3)	**(bar)**
0	0
10	0.5
20	0.8
30	1
40	1.25
50	1.45
60	1.5
70	1.6
80	1.75
90	2
100	2.1
110	2.25

Volume Correction

# Points	18
V	**P**
(cm3)	**(bar)**
0	0
5	0.25
10	0.4
15	0.6
20	0.75
25	0.8
30	1.4
34	2
36.1	3
37.9	4
40.1	6
42.4	9
44.9	12
47.2	16
48.1	18
49	20
50.2	22
51.4	24

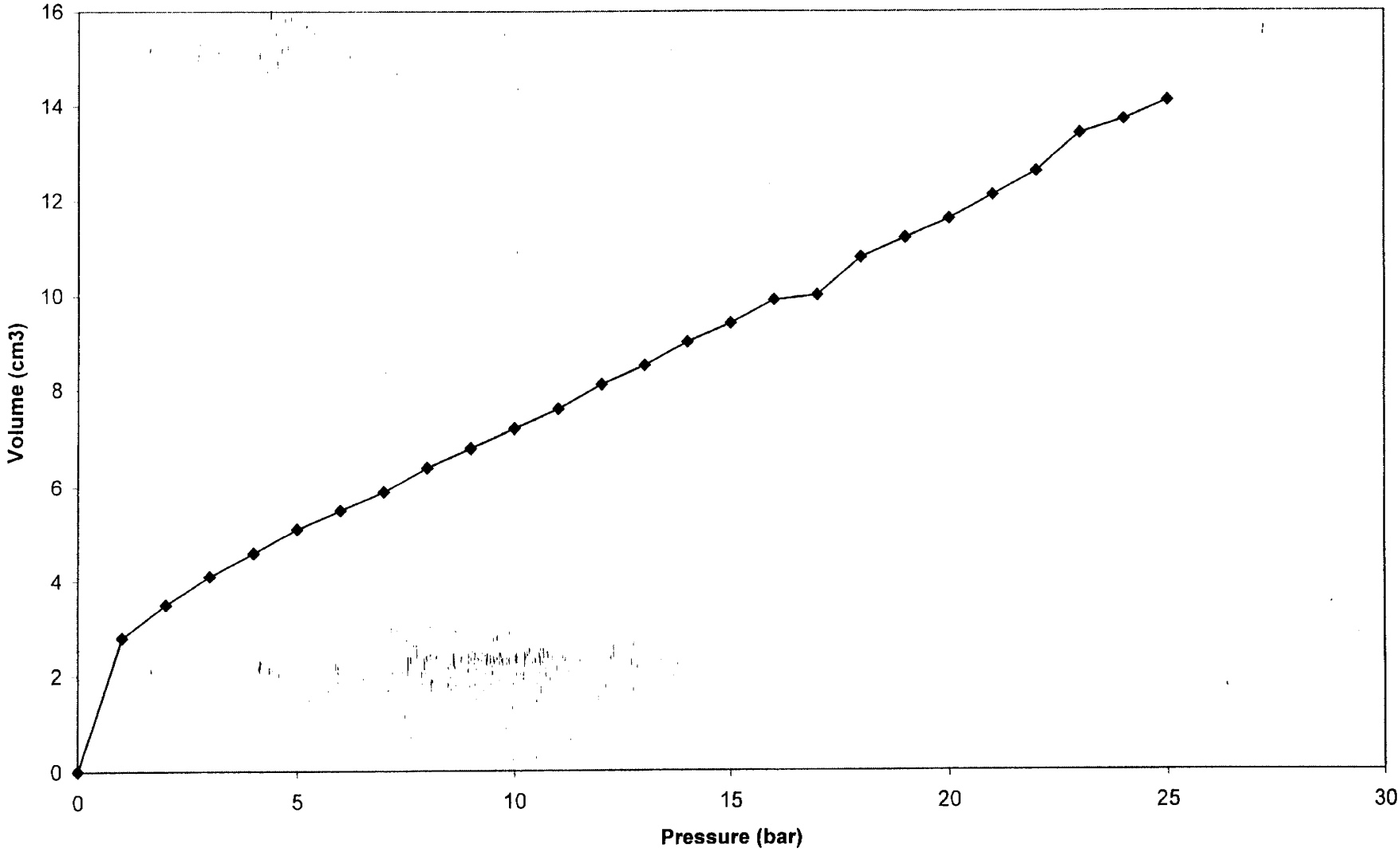
Volume Correction for Unit and Tubing

# Points	26
V	**P**
(cm3)	**(bar)**
0	0
2.8	1
3.5	2
4.1	3
4.6	4
5.1	5
5.5	6
5.9	7
6.4	8
6.8	9
7.2	10
7.6	11
8.1	12
8.5	13
9	14
9.4	15
9.9	16
10	17
10.8	18
11.2	19
11.6	20
12.1	21
12.6	22
13.4	23
13.7	24
14.1	25

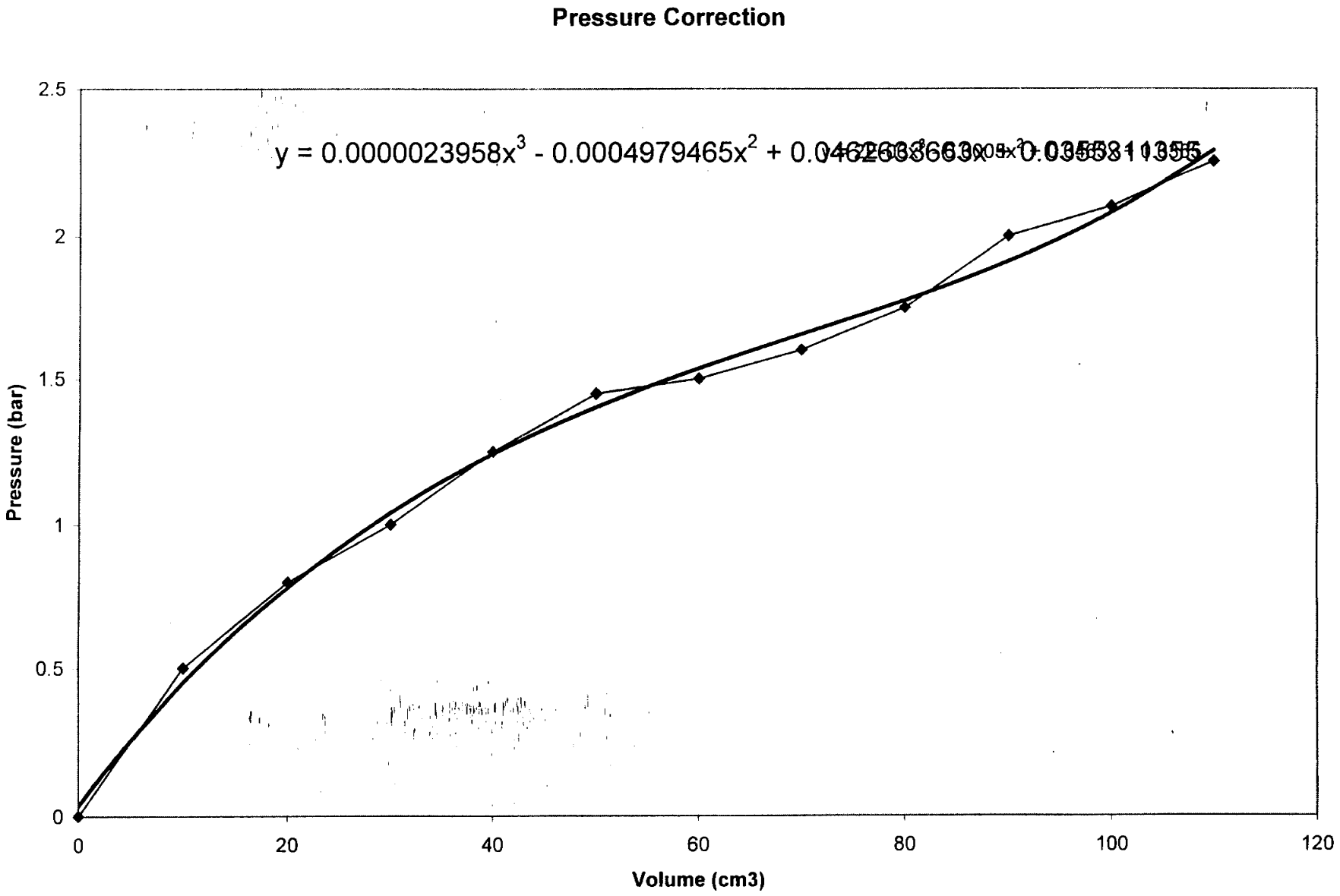

Volume Calibration
Volume (cm3)
Pressure (bar)
0
10
20
30
40
50
60
0
5
10
15
20
25
30
0
5
10
15
20
25
30
34
36.1
37.9
40.1
42.4
44.9
47.2
48.1
49
50.2
51.4

8-1-23

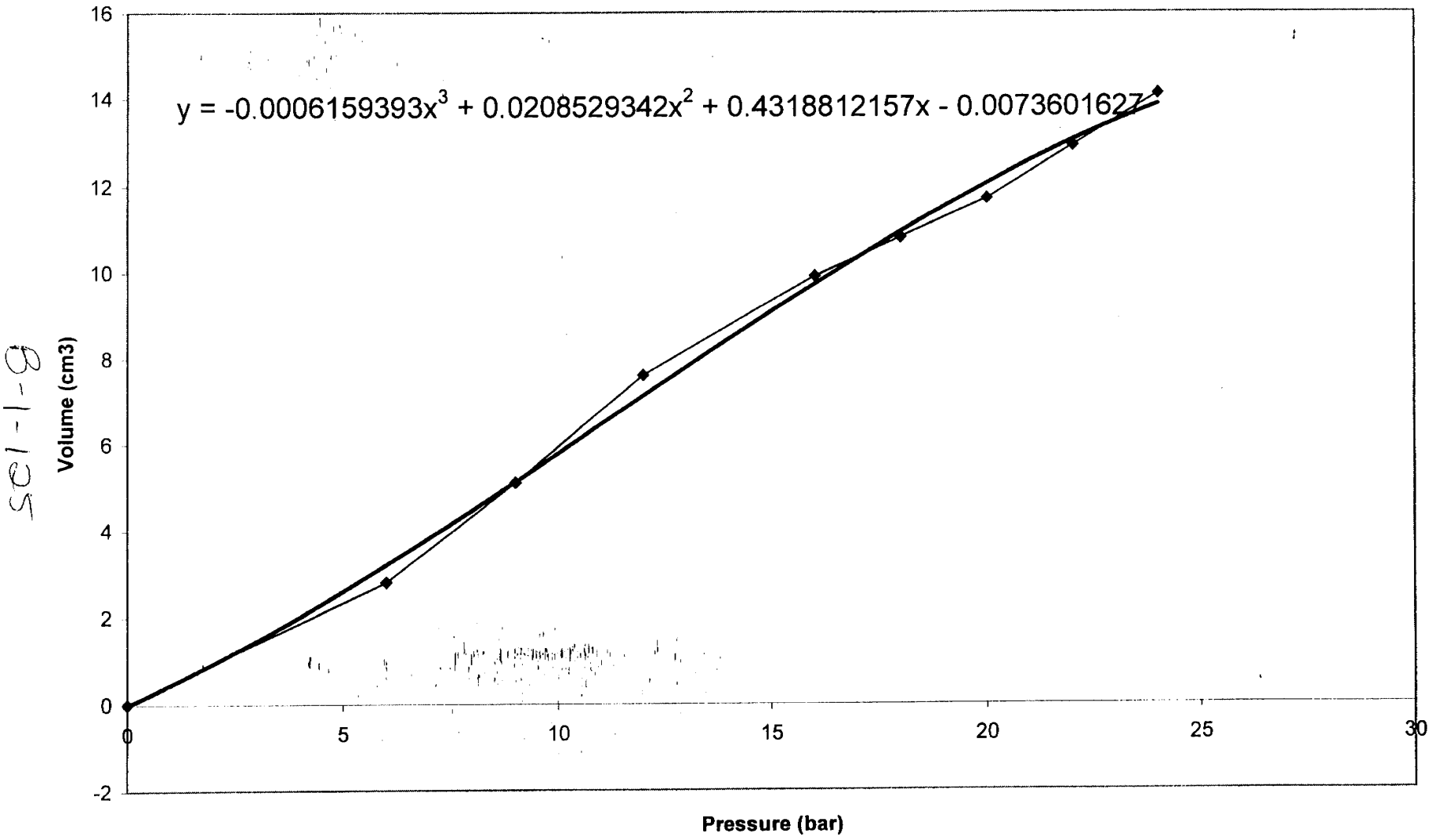
Volume Correction for Unit and Tubing Only



3821-1-3


Pressure Correction
y = 0.0000023958x3 - 0.0004979465x2 + 0.0462683663x + 0.0355831355
Pressure (bar)
Volume (cm3)
0
0.5
1
1.5
2
2.5
0
20
40
60
80
100
120

h21-1-8


Final Volume
y = -0.0006159393x^3 + 0.0208529342x^2 + 0.4318812157x - 0.0073601627
Volume (cm3)
Pressure (bar)
16
14
12
10
8
6
4
2
0
-2
0
5
10
15
20
25
30

SC1-1-8

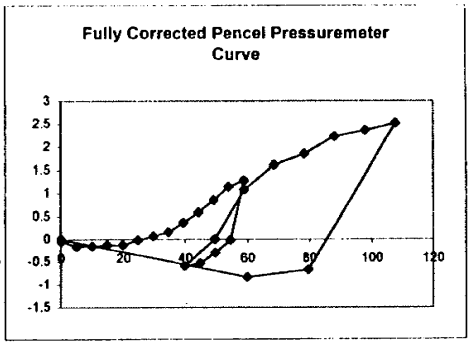
Raw Data to Corrected Curve Sheet **PMT #2** Test Date 3/7/98 First Test Probe Lost CBMC-30

Height of Control Unit
h= 1 m
Depth of Probe
d= 1.5243902 m
Hydrostatic
u= 0.2473902 bar

Volume Coefficients	
P^3	-6.16E-04
P^2	+0.0208529342
P	+0.4318812157
C	-0.0073601627

Pressure Coefficients	
V^3	2.40E-06
V^2	-0.0004979465
V	+0.0462633663
C	+0.0355311355

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	0	0.2473902	-0.24739	-1.13E-01	0.112917796	0.0407487	-0.040749	0.112918	-0.04075
5	0.1	0.2473902	-0.14739	-7.06E-02	5.070560282	0.2576222	-0.157622	5.07056	-0.15762
10	0.3	0.2473902	0.0526098	1.54E-02	9.98458137	0.450195	-0.150195	9.984581	-0.1502
15	0.5	0.2473902	0.2526098	1.03E-01	14.89694202	0.6221304	-0.12213	14.89694	-0.12213
20	0.65	0.2473902	0.4026098	1.70E-01	19.83014062	0.7758127	-0.125813	19.83014	-0.12581
25	0.9	0.2473902	0.6526098	2.83E-01	24.71880021	0.9109845	-0.010984	24.7168	-0.01098
30	1.1	0.2473902	0.8526098	3.76E-01	29.62435688	1.0313415	0.0686585	29.62436	0.068659
35	1.3	0.2473902	1.0526098	4.70E-01	34.53037135	1.1379378	0.1620622	34.53037	0.162062
40	1.6	0.2473902	1.3526098	6.13E-01	39.38656611	1.2316055	0.3683945	39.38657	0.368394
45	1.9	0.2473902	1.6526098	7.61E-01	44.23945723	1.3150855	0.5849145	44.23946	0.584914
50	2.25	0.2473902	2.0026098	9.36E-01	49.06378789	1.3896685	0.8603315	49.06379	0.860332
55	2.6	0.2473902	2.3526098	1.12E+00	53.8839162	1.4574311	1.1425689	53.88392	1.142569
60	2.8	0.2473902	2.5526098	1.22E+00	58.77930657	1.5209972	1.2790028	58.77931	1.279003
55	1.45	0.2473902	1.2026098	5.41E-01	54.45888792	1.4651394	-0.015139	54.45889	-0.01514
50	1.1	0.2473902	0.8526098	3.76E-01	49.62435688	1.3978653	-0.297865	49.62436	-0.29787
45	0.8	0.2473902	0.5526098	2.38E-01	44.76243431	1.3235467	-0.523547	44.76243	-0.52355
40	0.65	0.2473902	0.4026098	1.70E-01	39.83014062	1.2396314	-0.569631	39.83014	-0.58963
50	1.4	0.2473902	1.1526098	5.17E-01	49.4828095	1.395804	0.004196	49.48281	0.004196
60	2.6	0.2473902	2.3526098	1.12E+00	58.8839162	1.52231	1.07769	58.88392	1.07769
70	3.25	0.2473902	3.0026098	1.46E+00	68.53926013	1.6386003	1.6113997	68.53926	1.6114
80	3.6	0.2473902	3.3526098	1.65E+00	78.3482548	1.7557942	1.8442058	78.34825	1.844206
90	4.1	0.2473902	3.8526098	1.93E+00	88.06919968	1.8842694	2.2157306	88.0692	2.215731
100	4.4	0.2473902	4.1526098	2.10E+00	97.89844088	2.0401758	2.3596242	97.89844	2.359824
110	4.75	0.2473902	4.5026098	2.30E+00	107.6962309	2.2351232	2.5146768	107.6962	2.514877
80	1.1	0.2473902	0.8526098	3.76E-01	79.62435888	1.7716734	-0.671673	79.62436	-0.67167
60	0.7	0.2473902	0.4526098	1.92E-01	59.80767178	1.5338342	-0.833834	59.80767	-0.83383
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po
1	49.48281	0	0	0
2	58.88392	1.07769	9.401107	1.07769
3	66.53926	1.6114	19.05645	1.8114
4	78.34825	1.844206	28.86545	1.844206
5	83.20873	2.029968	33.72592	2.029968
6	88.0692	2.215731	38.58639	2.215731
7	92.98382	2.287777	43.50101	2.287777
8	97.89844	2.359824	48.41563	2.359824
9	102.7973	2.437351	53.31453	2.437351
10	107.6962	2.514877	58.21342	2.514877

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	49.48281	cm3
V2	58.88392	cm3
P1	0.004196	bar
P2	1.07769	bar
Vm	54.18336	cm3
V	9.401107	cm3
P	107.3494	kPa
E	7477.578	kPa

B-1-96

Raw Data to Corrected Curve Sheet **PMT #2** Test Date 3/7/98 First Test Probe Lost CBMC-30

Height of Control Unit
h= 1 m

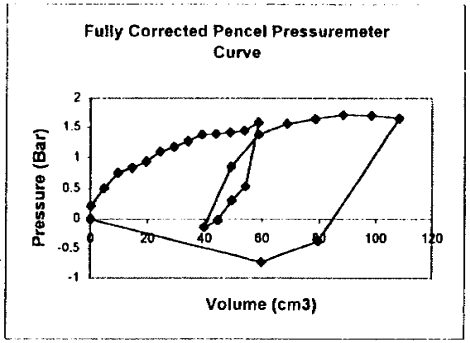
Depth of Probe
d= 3.0487805 m

Hydrostatic
u= 0.3967805 bar

Volume Coefficients	
P^3	-6.16E-04
P^2	+0.0208529342
P	+0.4318812157
C	-0.0073601627

Pressure Coefficients	
V^3	2.40E-06
V^2	-0.0004979465
V	+0.0462633663
C	+0.0355311355

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	0.25	0.3967805	-0.14678	-7.03E-02	0.070300684	0.038781	0.211219	0.070301	0.211219
5	0.75	0.3967805	0.3532195	1.48E-01	4.852236738	0.2485619	0.5014381	4.852237	0.501436
10	1.2	0.3967805	0.8032195	3.53E-01	9.647330415	0.4376559	0.7623441	9.64733	0.762344
15	1.45	0.3967805	1.0532195	4.70E-01	14.53008248	0.609963	0.840037	14.53008	0.840037
20	1.7	0.3967805	1.3032195	5.90E-01	19.4104712	0.7634364	0.9365636	19.41047	0.936564
25	2	0.3967805	1.6032195	7.36E-01	24.26389935	0.8991255	1.1008745	24.2639	1.100875
30	2.2	0.3967805	1.8032195	8.36E-01	29.16438958	1.0206703	1.1793297	29.16439	1.17933
35	2.4	0.3967805	2.0032195	9.37E-01	34.06347814	1.1283377	1.2716623	34.06348	1.271662
40	2.6	0.3967805	2.2032195	1.04E+00	38.96119458	1.2238296	1.3761704	38.96119	1.37617
45	2.7	0.3967805	2.3032195	1.09E+00	43.9095475	1.3096975	1.3903025	43.90955	1.390303
50	2.8	0.3967805	2.4032195	1.14E+00	48.85756848	1.3866302	1.4133698	48.85757	1.41337
55	2.9	0.3967805	2.5032195	1.19E+00	53.80526122	1.456371	1.443629	53.80526	1.443629
60	3.1	0.3967805	2.7032195	1.30E+00	58.69967674	1.5199967	1.5800033	58.69968	1.580003
55	2	0.3967605	1.6032195	7.36E-01	54.26389935	1.4625333	0.5374667	54.2639	0.537467
50	1.7	0.3967805	1.3032195	5.90E-01	49.4104712	1.3947484	0.3052516	49.41047	0.305252
45	1.3	0.3967805	0.9032195	3.99E-01	44.60071854	1.3209407	-0.020941	44.60072	-0.02094
40	1.1	0.3967805	0.7032195	3.06E-01	39.69355492	1.237169	-0.137169	39.69355	-0.13717
50	2.25	0.3967805	1.8532195	8.61E-01	49.13929197	1.3907778	0.8592222	49.13929	0.859222
60	2.9	0.3967805	2.5032195	1.19E+00	58.80526122	1.5213231	1.3786769	58.80526	1.378677
70	3.2	0.3967805	2.8032195	1.35E+00	68.64640692	1.6398613	1.5601387	68.64641	1.560139
80	3.4	0.3967805	3.0032195	1.46E+00	78.53893059	1.7581527	1.6418473	78.53893	1.641847
90	3.6	0.3967805	3.2032195	1.57E+00	88.43022997	1.8894508	1.7105492	88.43023	1.710549
100	3.75	0.3967805	3.3532195	1.65E+00	98.34791886	2.0481517	1.7018483	98.34792	1.701848
110	3.9	0.3967805	3.5032195	1.74E+00	108.2649482	2.2479364	1.6520636	108.2649	1.652064
80	1.4	0.3967805	1.0032195	4.46E-01	79.55372298	1.7707884	-0.370788	79.55372	-0.37079
60	0.8	0.3967805	0.4032195	1.70E-01	59.82986721	1.5341096	-0.73411	59.82987	-0.73411
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po
1	40.99391	0	0	0
2	49.13929	0.859222	8.145382	0.859222
3	58.80526	1.378677	17.81135	1.378677
4	68.64641	1.560139	27.6525	1.560139
5	78.53893	1.641847	37.54502	1.641847
6	88.43023	1.710549	47.43632	1.710549
7	93.38907	1.706199	52.39516	1.706199
8	98.34792	1.701848	57.35401	1.701848
9	103.3064	1.676956	62.31252	1.676956
10	108.2649	1.652064	67.27104	1.652064

X	Y
39.69355	-0.13717
40.99391	0
49.13929	0.859222
m	9.479948
b	40.99391

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.69355	cm3
V2	49.13929	cm3
P1	-0.13717	bar
P2	0.859222	bar
Vm	44.41642	cm3
V	9.445737	cm3
P	99.63912	kPa
E	6633.661	kPa

LE1-1-9

Raw Data to Corrected Curve Sheet **PMT #2** Test Date 3/7/98 First Test Probe Lost CBMC-30

Height of Control Unit
h= 1 m

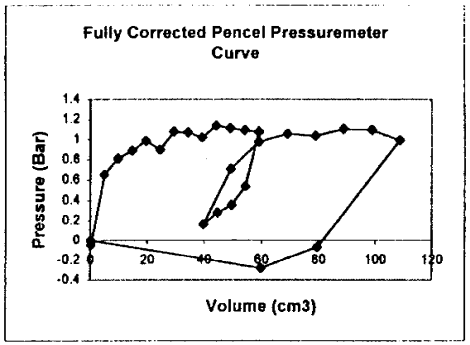
Depth of Probe
d= 4.5731707 m

Hydrostatic
u= 0.5461707 bar

Volume Coefficients	
P^3	-6.16E-04
P^2	+0.0208529342
P	+0.4318812157
C	-0.0073601627

Pressure Coefficients	
V^3	2.40E-06
V^2	-0.0004979465
V	+0.0462633663
C	+0.0355311355

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	0	0.5461707	-0.546171	-2.37E-01	0.236920209	0.0464639	-0.046464	0.23692	-0.04646
5	0.9	0.5461707	0.3538293	1.48E-01	4.851964547	0.2485506	0.6514494	4.851965	0.651449
10	1.25	0.5461707	0.7038293	3.07E-01	9.69327424	0.4393698	0.8106302	9.693274	0.81063
15	1.5	0.5461707	0.9538293	4.23E-01	14.57698192	0.6115244	0.8884756	14.57698	0.888476
20	1.75	0.5461707	1.2038293	5.42E-01	19.45830331	0.7648533	0.9851467	19.4583	0.985147
25	1.8	0.5461707	1.2538293	5.66E-01	24.43428631	0.9036025	0.8963975	24.43429	0.896398
30	2.1	0.5461707	1.5538293	7.12E-01	29.28825419	1.0235559	1.0764441	29.28825	1.076444
35	2.2	0.5461707	1.6538293	7.61E-01	34.23885262	1.1319566	1.0680434	34.23885	1.068043
40	2.25	0.5461707	1.7038293	7.86E-01	39.21401813	1.2284607	1.0215393	39.21402	1.021539
45	2.45	0.5461707	1.9038293	8.86E-01	44.11379955	1.3130379	1.1369621	44.1138	1.136962
50	2.5	0.5461707	1.9538293	9.11E-01	49.08852707	1.3900321	1.1099679	49.08853	1.109968
55	2.55	0.5461707	2.0038293	9.37E-01	54.06316837	1.4598419	1.0901581	54.06317	1.090158
60	2.6	0.5461707	2.0538293	9.62E-01	59.03772391	1.5242374	1.0757628	59.03772	1.075763
55	2	0.5461707	1.4538293	6.63E-01	54.33729613	1.4635152	0.5364848	54.3373	0.536485
50	1.75	0.5461707	1.2038293	5.42E-01	49.45830331	1.3954466	0.3545534	49.4583	0.354553
45	1.6	0.5461707	1.0538293	4.70E-01	44.5297936	1.3197948	0.2802052	44.52979	0.280205
40	1.4	0.5461707	0.8538293	3.76E-01	39.62378844	1.2359081	0.1640919	39.62379	0.164092
50	2.1	0.5461707	1.5538293	7.12E-01	49.28825419	1.3929615	0.7070385	49.28825	0.707038
60	2.5	0.5461707	1.9538293	9.11E-01	59.08852707	1.5248732	0.9751268	59.08853	0.975127
70	2.7	0.5461707	2.1538293	1.01E+00	68.98657961	1.6438641	1.0561359	68.98658	1.056136
80	2.8	0.5461707	2.2538293	1.06E+00	78.93509784	1.7630684	1.0369316	78.9351	1.036932
90	3	0.5461707	2.4538293	1.17E+00	88.8311367	1.8952466	1.1047534	88.83114	1.104753
100	3.15	0.5461707	2.6038293	1.25E+00	98.7523075	2.0553995	1.0946005	98.75231	1.0946
110	3.25	0.5461707	2.7038293	1.30E+00	108.6993529	2.2578456	0.9921544	108.6994	0.992154
80	1.7	0.5461707	1.1538293	5.18E-01	79.48222716	1.7698933	-0.069893	79.48223	-0.06989
60	1.25	0.5461707	0.7038293	3.07E-01	59.69327424	1.5324135	-0.282414	59.69327	-0.28241
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po
1	32.6906	0	0	0
2	39.62379	0.164092	6.933189	0.164092
3	49.28825	0.707038	16.59765	0.707038
4	59.08853	0.975127	26.39793	0.975127
5	68.98658	1.056136	36.29598	1.056136
6	78.9351	1.036932	48.2445	1.036932
7	88.83114	1.104753	56.14054	1.104753
8	98.75231	1.0946	66.06171	1.0946
9	103.7258	1.043377	71.03523	1.043377
10	108.6994	0.992154	76.00875	0.992154

X	Y
44.52979	0.280205
32.6906	0
39.62379	0.164092
m	42.25188
b	32.6906

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.62379	cm3
V2	49.28825	cm3
P1	0.164092	bar
P2	0.707038	bar
Vm	44.45602	cm3
V	9.664466	cm3
P	54.29466	kPa
E	3533.551	kPa

8-21-98

Raw Data to Corrected Curve Sheet PMT #2 Test Date 3/7/98 First Test Probe Lost CBMC-30

Height of Control Unit
h= 1 m

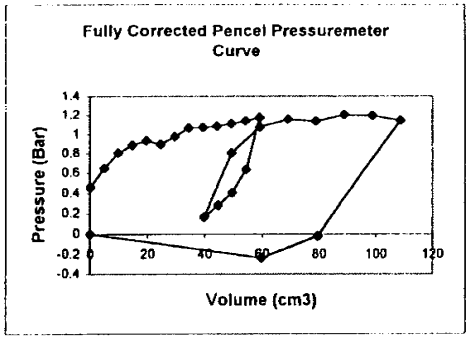
Depth of Probe
d= 6.097561 m

Hydrostatic
u= 0.695561 bar

Volume Coefficients	
P^3	-6.16E-04
P^2	+0.0208529342
P	+0.4318812157
C	-0.0073601627

Pressure Coefficients	
V^3	2.40E-06
V^2	-0.0004979465
V	+0.0462633663
C	+0.0355311355

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	0.5	0.695561	-0.195561	-9.10E-02	0.091017168	0.0397378	0.4602622	0.091017	0.460262
5	0.9	0.695561	0.204439	8.18E-02	4.918200496	0.251304	0.648696	4.9182	0.648696
10	1.25	0.695561	0.554439	2.38E-01	9.761603094	0.4419155	0.8080845	9.761603	0.808085
15	1.5	0.695561	0.804439	3.53E-01	14.6467643	0.6138444	0.8861556	14.64676	0.886156
20	1.7	0.695561	1.004439	4.47E-01	19.55314752	0.7676581	0.9323419	19.55315	0.932342
25	1.8	0.695561	1.104439	4.94E-01	24.50576737	0.9054751	0.8945249	24.50577	0.894525
30	2	0.695561	1.304439	5.90E-01	29.40988204	1.0263808	0.9736192	29.40988	0.973619
35	2.2	0.695561	1.504439	6.87E-01	34.3125213	1.1334721	1.0665279	34.31252	1.066528
40	2.3	0.695561	1.604439	7.37E-01	39.26329689	1.2293602	1.0706398	39.2633	1.07064
45	2.4	0.695561	1.704439	7.86E-01	44.21371472	1.3146665	1.0853335	44.21371	1.085333
50	2.5	0.695561	1.804439	8.36E-01	49.16377849	1.3911372	1.1088628	49.16378	1.108863
55	2.6	0.695561	1.904439	8.87E-01	54.11349187	1.4605175	1.1394825	54.11349	1.139482
60	2.7	0.695561	2.004439	9.37E-01	59.06285858	1.524552	1.175448	59.06286	1.175448
55	2.1	0.695561	1.404439	6.39E-01	54.38138425	1.4638372	0.6361628	54.36138	0.636163
50	1.8	0.695561	1.104439	4.94E-01	49.50576737	1.3961387	0.4038613	49.50577	0.403861
45	1.6	0.695561	0.904439	4.00E-01	44.60014773	1.3209315	0.2790685	44.60015	0.279069
40	1.4	0.695561	0.704439	3.07E-01	39.69299355	1.2371588	0.1628412	39.69299	0.162841
50	2.2	0.695561	1.504439	6.87E-01	49.3125213	1.3933166	0.8066834	49.31252	0.806683
60	2.6	0.695561	1.904439	8.87E-01	59.11349187	1.5251855	1.0748145	59.11349	1.074814
70	2.8	0.695561	2.104439	9.88E-01	69.01188231	1.6441618	1.1558382	69.01188	1.155838
80	2.9	0.695561	2.204439	1.04E+00	78.96056675	1.7633852	1.1366148	78.96057	1.136615
90	3.1	0.695561	2.404439	1.14E+00	88.85693256	1.895621	1.204379	88.85693	1.204379
100	3.25	0.695561	2.554439	1.22E+00	98.77834378	2.0558686	1.1941314	98.77834	1.194131
110	3.4	0.695561	2.704439	1.30E+00	108.699029	2.2578382	1.1421618	108.699	1.142162
80	1.75	0.695561	1.054439	4.70E-01	79.5295047	1.7704851	-0.020485	79.5295	-0.02049
60	1.3	0.695561	0.604439	2.61E-01	59.73883177	1.5329795	-0.23298	59.73883	-0.23298
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po
1	32.81779	0	0	0
2	39.69299	0.162841	6.875204	0.162841
3	49.31252	0.806683	16.49473	0.806683
4	59.11349	1.074814	26.2957	1.074814
5	69.01188	1.155838	36.19409	1.155838
6	78.96057	1.136615	46.14278	1.136615
7	88.85693	1.204379	56.03914	1.204379
8	98.77834	1.194131	65.96055	1.194131
9	103.7387	1.168147	70.9209	1.168147
10	108.699	1.142162	75.88124	1.142162

X	Y
44.60015	0.279069
32.81779	0
39.69299	0.162841
m	42.2203
b	32.81779

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.69299	cm3
V2	49.31252	cm3
P1	0.162841	bar
P2	0.806683	bar
Vm	44.50276	cm3
V	9.619528	cm3
P	64.38422	kPa
E	4210.595	kPa

bc1-1-9

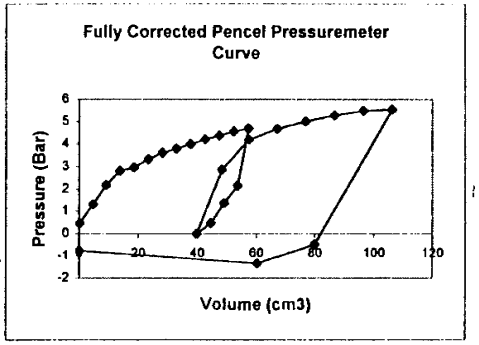
Raw Data to Corrected Curve Sheet **PMT #2** Test Date 3/7/98 First Test Probe Lost CBMC-30

Height of Control Unit
h= 1 m
Depth of Probe
d= 7.6219512 m
Hydrostatic
u= 0.8449512 bar

Volume Coefficients	
P^3	-6.16E-04
P^2	+0.0208529342
P	+0.4318812157
C	-0.0073601627

Pressure Coefficients	
V^3	2.40E-06
V^2	-0.0004979465
V	+0.0462633663
C	+0.0355311355

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	0.5	0.8449512	-0.344951	-1.54E-01	0.153831514	0.0426361	0.4573639	0.153832	0.457364
5	1.55	0.8449512	0.7050488	3.07E-01	4.692712846	0.2419139	1.3080861	4.692713	1.308086
10	2.6	0.8449512	1.7550488	8.12E-01	9.188486136	0.4204393	2.1795607	9.188486	2.179561
15	3.4	0.8449512	2.5550488	1.22E+00	13.77802282	0.584688	2.815312	13.77802	2.815312
20	3.7	0.8449512	2.8550488	1.38E+00	18.61867399	0.7397411	2.9602589	18.61867	2.960259
25	4.2	0.8449512	3.3550488	1.65E+00	23.34691097	0.8747067	3.3252933	23.34691	3.325293
30	4.6	0.8449512	3.7550488	1.88E+00	28.12420314	0.9960859	3.6039141	28.1242	3.603914
35	4.9	0.8449512	4.0550488	2.05E+00	32.95423734	1.1050844	3.7949156	32.95424	3.794916
40	5.2	0.8449512	4.3550488	2.22E+00	37.78186674	1.2018554	3.9981446	37.78187	3.998145
45	5.5	0.8449512	4.6550488	2.39E+00	42.60719114	1.2880349	4.2119651	42.60719	4.211965
50	5.75	0.8449512	4.9050488	2.54E+00	47.45993936	1.3657034	4.3842966	47.45994	4.384297
55	6	0.8449512	5.1550488	2.69E+00	52.31121391	1.435965	4.564035	52.31121	4.564035
60	6.2	0.8449512	5.3550488	2.81E+00	57.19121132	1.500854	4.699146	57.19121	4.699146
55	3.6	0.8449512	2.7550488	1.33E+00	53.67210674	1.4545732	2.1454268	53.67211	2.145427
50	2.75	0.8449512	1.9050488	8.87E-01	49.11318418	1.3903944	1.3596056	49.11318	1.359606
45	1.8	0.8449512	0.9550488	4.24E-01	44.57640875	1.3205481	0.4794519	44.57641	0.479452
40	1.25	0.8449512	0.4050488	1.71E-01	39.82904691	1.2396117	0.0103883	39.82905	0.010388
50	4.25	0.8449512	3.4050488	1.68E+00	48.31932407	1.3786411	2.8713589	48.31932	2.871359
60	5.7	0.8449512	4.8550488	2.51E+00	57.48950945	1.5046692	4.1953308	57.48951	4.195331
70	6.3	0.8449512	5.4550488	2.87E+00	67.13087945	1.6220073	4.6779927	67.13088	4.677993
80	6.75	0.8449512	5.9050488	3.14E+00	76.85677305	1.737502	5.012498	76.85677	5.012498
90	7.15	0.8449512	6.3050488	3.39E+00	86.60973234	1.8636753	5.2863247	86.60973	5.286325
100	7.5	0.8449512	6.6550488	3.61E+00	96.39114801	2.0140285	5.4859715	96.39115	5.485971
110	7.75	0.8449512	6.9050488	3.77E+00	106.2337238	2.2029865	5.5470135	106.2337	5.547013
80	1.3	0.8449512	0.4550488	1.93E-01	79.80657318	1.7739598	-0.47396	79.80657	-0.47396
60	0.2	0.8449512	-0.644951	-2.77E-01	60.27706321	1.5396447	-1.339645	60.27706	-1.33964
0	-0.75	0	-0.75	0.00E+00	0	0	-0.75	0	-0.75



10 P-y points

	V	P	Vo	Po
1	39.82905	0	0	0
2	48.31932	2.871359	8.490277	2.871359
3	57.48951	4.195331	17.66046	4.195331
4	67.13088	4.677993	27.30183	4.677993
5	76.85677	5.012498	37.02773	5.012498
6	86.60973	5.286325	46.78069	5.286325
7	91.50044	5.386148	51.67139	5.386148
8	96.39115	5.485971	56.5621	5.485971
9	101.3124	5.516492	61.48339	5.516492
10	106.2337	5.547013	66.40468	5.547013

X	Y
44.57641	0.479452
39.72391	0
39.82905	0.010388
m	10.12094
b	39.72391

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.82905	cm3
V2	48.31932	cm3
P1	0.010388	bar
P2	2.871359	bar
Vm	44.07419	cm3
V	8.490277	cm3
P	286.0971	kPa
E	21160.29	kPa

8-1-30

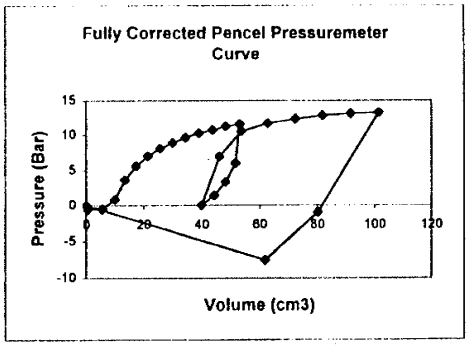
Raw Data to Corrected Curve Sheet **PMT #2** Test Date 3/7/98 First Test Probe Lost CBMC-30

Height of Control Unit
h= 1 m
Depth of Probe
d= 9.1463415 m
Hydrostatic
u= 0.9943415 bar

Volume Coefficients	
P^3	-6.16E-04
P^2	+0.0208529342
P	+0.4318812157
C	-0.0073601627

Pressure Coefficients	
V^3	2.40E-06
V^2	-0.0004979465
V	+0.0462633663
C	+0.0355311355

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	-0.5	0.9943415	-1.494341	-6.04E-01	0.604117034	0.0832984	-0.563298	0.604117	-0.5633
5	-0.25	0.9943415	-1.244341	-5.11E-01	5.511292739	0.2757784	-0.525778	5.511293	-0.52578
10	1.3	0.9943415	0.3056585	1.27E-01	9.873421342	0.4460728	0.8539272	9.873421	0.853927
15	4.2	0.9943415	3.2056585	1.57E+00	13.42889692	0.5728017	3.6271983	13.4289	3.627198
20	6.25	0.9943415	5.2556585	2.75E+00	17.25095817	0.6977314	5.5522686	17.25098	5.552269
25	7.75	0.9943415	6.7556585	3.67E+00	21.3279197	0.8189697	6.9310303	21.32792	6.93103
30	9	0.9943415	8.0056585	4.47E+00	25.52942079	0.9319341	8.0680659	25.52942	8.068066
35	9.9	0.9943415	8.9056585	5.06E+00	29.94235845	1.0386485	8.8613515	29.94236	8.861351
40	10.75	0.9943415	9.7556585	5.62E+00	34.38132449	1.1348851	9.6151149	34.38132	9.615115
45	11.5	0.9943415	10.505659	6.12E+00	38.8828291	1.2223885	10.277811	38.88283	10.27761
50	12	0.9943415	11.005659	6.45E+00	43.54950236	1.3037719	10.696228	43.5495	10.69623
55	12.6	0.9943415	11.605659	6.85E+00	48.14921005	1.3760981	11.223902	48.14921	11.2239
60	13	0.9943415	12.005859	7.12E+00	52.88253811	1.4438299	11.55617	52.88254	11.55617
55	7.4	0.9943415	8.4056585	3.45E+00	51.5471228	1.4253215	5.9746785	51.54712	5.974678
50	4.7	0.9943415	3.7056585	1.85E+00	48.15194787	1.3761391	3.3238609	48.15195	3.323861
45	2.75	0.9943415	1.7556585	8.12E-01	44.18818163	1.3142507	1.4357493	44.18818	1.435749
40	1.3	0.9943415	0.3056585	1.27E-01	39.87342134	1.24041	0.05959	39.87342	0.05959
50	8.25	0.9943415	7.2556585	3.99E+00	46.01125457	1.343365	6.906635	46.01125	6.908635
60	12	0.9943415	11.005659	6.45E+00	53.54950236	1.4529144	10.547086	53.5495	10.54709
70	13.25	0.9943415	12.255659	7.28E+00	62.71606623	1.5694114	11.680589	62.71607	11.68059
80	14	0.9943415	13.005659	7.78E+00	72.21823254	1.6819466	12.318053	72.21823	12.31805
90	14.6	0.9943415	13.605659	8.18E+00	81.82246586	1.79961	12.80039	81.82247	12.80039
100	15	0.9943415	14.005659	8.44E+00	91.56028727	1.935949	13.064051	91.56029	13.06405
110	15.3	0.9943415	14.305659	8.64E+00	101.3646961	2.1039325	13.196067	101.3647	13.19607
80	0.8	0.9943415	-0.194341	-9.05E-02	80.09050048	1.7775326	-0.977533	80.0905	-0.97753
60	-6	0.9943415	-6.994341	-1.80E+00	61.79718712	1.5582741	-7.558274	61.79719	-7.55827
0	0	0	0	0.00E+00	0	0	0	0	0



10 P-y points

	V	P	Vo	Po
1	39.87342	0	0	0
2	46.01125	6.906635	6.137833	6.906635
3	53.5495	10.54709	13.67608	10.54709
4	62.71607	11.68059	22.84264	11.68059
5	72.21823	12.31805	32.34481	12.31805
6	81.82247	12.80039	41.94904	12.80039
7	86.69138	12.93222	46.81796	12.93222
8	91.56029	13.06405	51.68687	13.06405
9	96.46249	13.13006	56.58907	13.13006
10	101.3647	13.19607	61.49127	13.19607

X	Y
44.18818	1.435749
39.68658	0
39.87342	0.05959
m	3.135364
b	39.68658

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.87342	cm3
V2	46.01125	cm3
P1	0.05959	bar
P2	6.906635	bar
Vm	42.94234	cm3
V	6.137833	cm3
P	684.7045	kPa
E	69715.77	kPa

B-1-31

Raw Data to Corrected Curve Sheet **PMT #2** Test Date 3/7/98 First Test Probe Lost CBMC-30

Height of Control Unit
h= 1 m

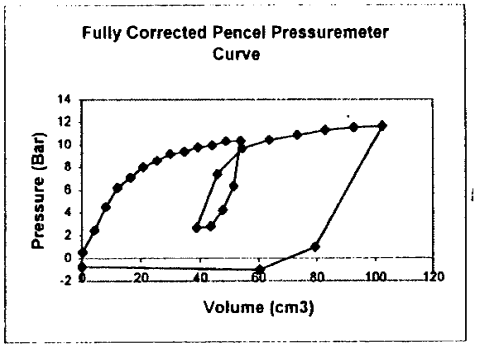
Depth of Probe
d= 10.670732 m

Hydrostatic
u= 1.1437317 bar

Volume Coefficients	
P^3	-6.16E-04
P^2	+0.0208529342
P	+0.4318812157
C	-0.0073601627

Pressure Coefficients	
V^3	2.40E-06
V^2	-0.0004979465
V	+0.0462633663
C	+0.0355311355

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	0.6	1.1437317	-0.543732	-2.36E-01	0.235923612	0.0464181	0.5535819	0.235924	0.553582
5	2.7	1.1437317	1.5562683	7.13E-01	4.28705354	0.2249018	2.4750982	4.287054	2.475098
10	4.9	1.1437317	3.7562683	1.88E+00	8.123517225	0.3797765	4.5202235	8.123517	4.520224
15	6.7	1.1437317	5.5562683	2.93E+00	12.06959241	0.5255851	6.1744149	12.06959	6.174415
20	7.75	1.1437317	6.6062683	3.58E+00	16.42174205	0.671583	7.078417	16.42174	7.076417
25	8.8	1.1437317	7.6562683	4.25E+00	20.7548278	0.8026419	7.9973581	20.75483	7.997358
30	9.5	1.1437317	8.3562683	4.70E+00	25.30173993	0.9261066	8.5738934	25.30174	8.573893
35	10.2	1.1437317	9.0562683	5.16E+00	29.84334822	1.0363796	9.1636204	29.84335	9.16362
40	10.5	1.1437317	9.3562683	5.35E+00	34.64558514	1.14029	9.35971	34.64559	9.35971
45	11	1.1437317	9.8562683	5.69E+00	39.31460358	1.2302955	9.7697045	39.3146	9.769704
50	11.25	1.1437317	10.106268	5.85E+00	44.14858886	1.3136054	9.9363946	44.14859	9.936395
55	11.7	1.1437317	10.556268	6.15E+00	48.84911498	1.3865054	10.313495	48.84911	10.31349
60	11.8	1.1437317	10.656268	6.22E+00	53.78247929	1.4560637	10.343936	53.78248	10.34394
55	7.75	1.1437317	6.6062683	3.58E+00	51.42174205	1.423561	6.326439	51.42174	6.326439
50	5.6	1.1437317	4.4562683	2.28E+00	47.72318416	1.3696907	4.2303093	47.72318	4.230309
45	4.1	1.1437317	2.9562683	1.44E+00	43.56427237	1.3040159	2.7959841	43.56427	2.795984
40	3.9	1.1437317	2.7562683	1.33E+00	38.67145702	1.2184881	2.6815119	38.67146	2.681512
50	8.7	1.1437317	7.5562683	4.18E+00	45.81904776	1.3403494	7.3596506	45.81905	7.359651
60	11.1	1.1437317	9.9562683	5.75E+00	54.24823406	1.4623236	9.6376764	54.24823	9.637676
70	12	1.1437317	10.856268	6.35E+00	63.64914189	1.5806392	10.419361	63.64914	10.41936
80	12.55	1.1437317	11.406268	6.72E+00	73.28222604	1.6945577	10.855442	73.28223	10.85544
90	13.1	1.1437317	11.956268	7.08E+00	82.91544558	1.8138159	11.286184	82.91545	11.28618
100	13.45	1.1437317	12.306268	7.32E+00	92.68239165	1.9533594	11.496641	92.68239	11.49664
110	13.75	1.1437317	12.606268	7.52E+00	102.4829931	2.1256554	11.624345	102.483	11.62434
80	2.75	1.1437317	1.6062683	7.38E-01	79.2623931	1.767146	0.982854	79.26239	0.982854
60	0.5	1.1437317	-0.643732	-2.77E-01	60.27657023	1.5396386	-1.039639	60.27657	-1.03964
0	-0.75	0	-0.75	0.00E+00	0	0	-0.75	0	-0.75



10 P-y points

	V	P	Vo	Po
1	34.57445	0	0	0
2	38.67146	2.681512	4.097003	2.681512
3	45.81905	7.359651	11.24459	7.359651
4	54.24823	9.637676	19.67378	9.637878
5	63.64914	10.41936	29.07469	10.41936
6	73.28223	10.85544	38.70777	10.85544
7	82.91545	11.28618	48.34099	11.28618
8	92.68239	11.49664	58.10794	11.49664
9	97.58269	11.56049	63.00824	11.56049
10	102.483	11.62434	67.90854	11.62434

X	Y
38.67146	2.681512
34.57445	0
45.81905	7.359651
m	1.527871
b	34.57445

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	38.67146	cm3
V2	45.61905	cm3
P1	2.681512	bar
P2	7.359651	bar
Vm	42.24525	cm3
V	7.147591	cm3
P	467.8139	kPa
E	40781.75	kPa

8-1-13 & 8-1-13

Raw Data to Corrected Curve Sheet **PMT #2** Test Date 3/7/98 First Test Probe Lost CBMC-30

Height of Control Unit
h= 1 m

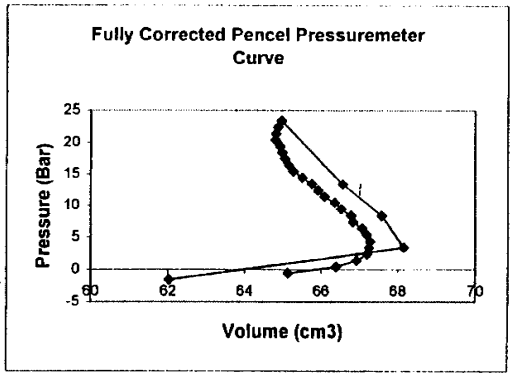
Depth of Probe
d= 12.195122 m

Hydrostatic
u= 1.293122 bar

Volume Coefficients	
P^3	-6.16E-04
P^2	+0.0208529342
P	+0.4318812157
C	-0.0073601627

Pressure Coefficients	
V^3	2.40E-06
V^2	-0.0004979465
V	+0.0462633663
C	+0.0355311355

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
65	1	1.293122	-0.293122	-1.32E-01	65.13214682	1.5983442	-0.598344	65.13215	-0.59834
66.7	2	1.293122	0.706878	3.08E-01	66.39187065	1.6132786	0.3867214	66.39187	0.386721
67.7	3	1.293122	1.706878	7.87E-01	66.91250096	1.61943	1.38057	66.9125	1.38057
68.5	4	1.293122	2.706878	1.30E+00	67.19773342	1.622796	2.377204	67.19773	2.377204
69.1	5	1.293122	3.706878	1.85E+00	67.25126363	1.6234274	3.3765726	67.25126	3.376573
69.7	6	1.293122	4.706878	2.42E+00	67.27678725	1.6237285	4.3762715	67.27679	4.376272
70.2	7	1.293122	5.706878	3.02E+00	67.17799991	1.6225632	5.3774368	67.178	5.377437
70.7	8	1.293122	6.706878	3.64E+00	67.05859725	1.6211544	6.3788456	67.0586	6.378846
71.1	9	1.293122	7.706878	4.28E+00	66.82227489	1.6183647	7.3816353	66.82227	7.381635
71.7	10	1.293122	8.706878	4.93E+00	66.77272848	1.6177795	8.3822205	66.77273	8.38222
72.1	11	1.293122	9.706878	5.59E+00	66.51365365	1.6147184	9.3852816	66.51365	9.385282
72.6	12	1.293122	10.706878	6.25E+00	66.34874604	1.6127686	10.387231	66.34875	10.38723
73	13	1.293122	11.706878	6.92E+00	66.08170129	1.6096087	11.390391	66.0817	11.39039
73.5	14	1.293122	12.706878	7.58E+00	65.91621502	1.6076489	12.392351	65.91622	12.39235
74	15	1.293122	13.706878	8.24E+00	65.75598288	1.60575	13.39425	65.75598	13.39425
74.4	16	1.293122	14.706878	8.90E+00	65.50470049	1.6027695	14.397231	65.5047	14.39723
74.8	17	1.293122	15.706878	9.53E+00	65.26606351	1.5999358	15.400064	65.26606	15.40006
75.3	18	1.293122	16.706878	1.02E+01	65.14376756	1.5984823	16.401518	65.14377	16.40152
75.8	19	1.293122	17.706878	1.08E+01	65.04150827	1.5972663	17.402734	65.04151	17.40273
76.3	20	1.293122	18.706878	1.13E+01	64.96298129	1.5963321	18.403668	64.96298	18.40367
76.8	21	1.293122	19.706878	1.19E+01	64.91186225	1.595724	19.404276	64.91188	19.40428
77.2	22	1.293122	20.706878	1.24E+01	64.79190678	1.5942955	20.405704	64.79191	20.4057
77.7	23	1.293122	21.706878	1.29E+01	64.80675053	1.5944723	21.405528	64.80675	21.40553
78.2	24	1.293122	22.706878	1.33E+01	84.86010912	1.5951077	22.404892	64.86011	22.40489
78.7	25	1.293122	23.706878	1.37E+01	64.9556782	1.5962452	23.403755	64.95568	23.40375
74.8	15	1.293122	13.706878	8.24E+00	66.55598288	1.6152188	13.364781	66.55598	13.38478
72.5	10	1.293122	8.706878	4.93E+00	67.57272848	1.6272177	8.3727823	67.57273	8.372782
70	5	1.293122	3.706878	1.85E+00	68.15126363	1.6340329	3.3659671	68.15126	3.365967
61.5	0	1.293122	-1.293122	-5.30E-01	62.02963386	1.5610996	-1.5611	62.02963	-1.5611



Probe Lost Here If

B-1-33

PMT 2
(CBMC-30)

Raw Data, Corrections, and Fully Corrected Pressuremeter Curves

(New Calibration After Loss of Probe)

B-1-134

PMT #2 Test Date 3/12/98 Revisit Site from 3/7/98 CBMC-30

Calibrate

Insert Field Record Sheet

Pressure Correction

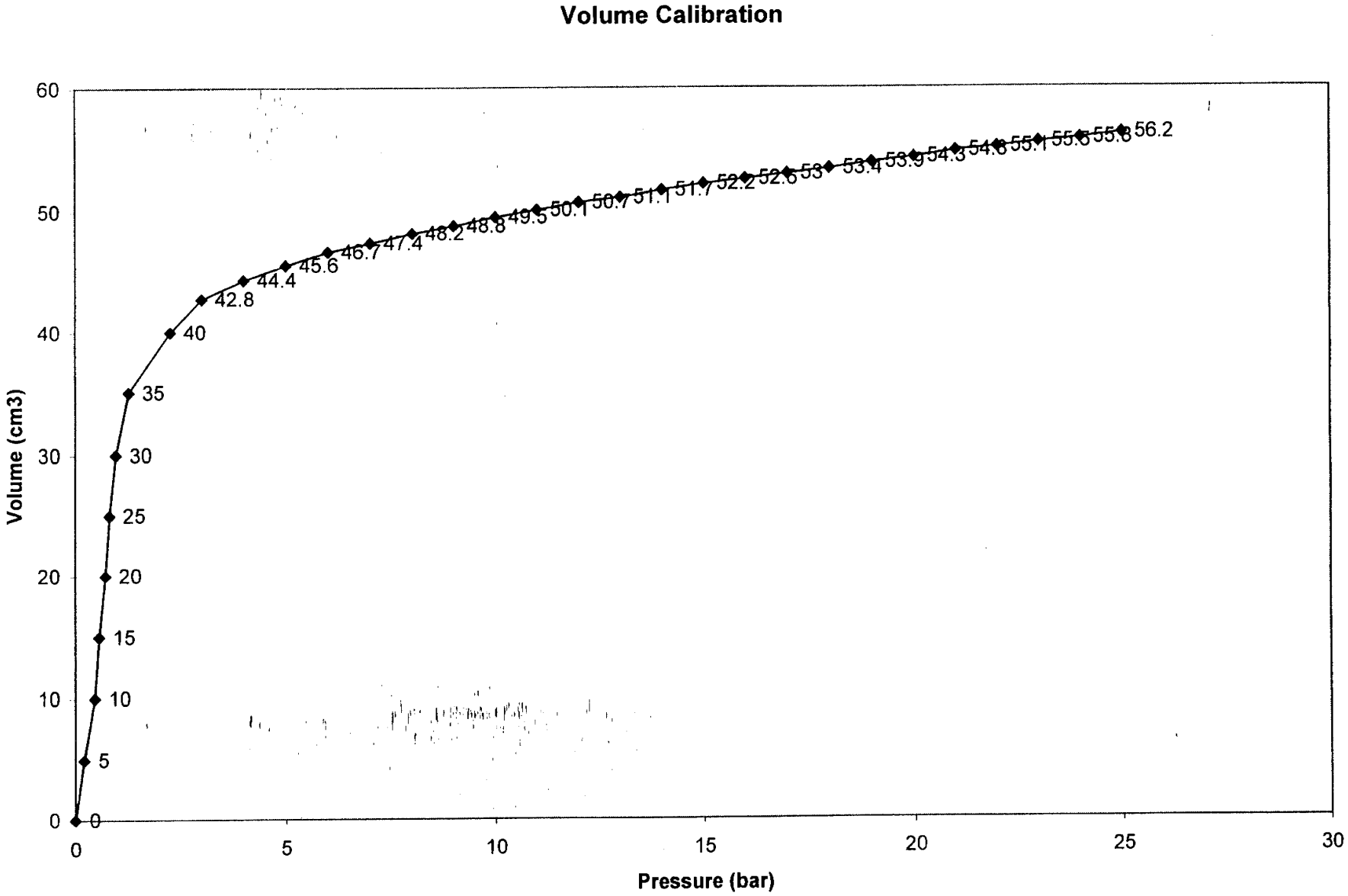
# Points	18
V	**P**
(cm3)	**(bar)**
0	0
5	0.25
10	0.35
15	0.55
20	0.7
25	0.8
30	0.9
35	0.95
40	1
45	1.1
50	1.2
55	1.25
60	1.3
70	1.35
80	1.45
90	1.5
100	1.7
110	1.75

Volume Correction

# Points	32
V	**P**
(cm3)	**(bar)**
0	0
5	0.2
10	0.45
15	0.55
20	0.7
25	0.8
30	0.95
35	1.25
40	2.25
42.8	3
44.4	4
45.6	5
46.7	6
47.4	7
48.2	8
48.8	9
49.5	10
50.1	11
50.7	12
51.1	13
51.7	14
52.2	15
52.6	16
53	17
53.4	18
53.9	19
54.3	20
54.8	21
55.1	22
55.5	23
55.8	24
56.2	25

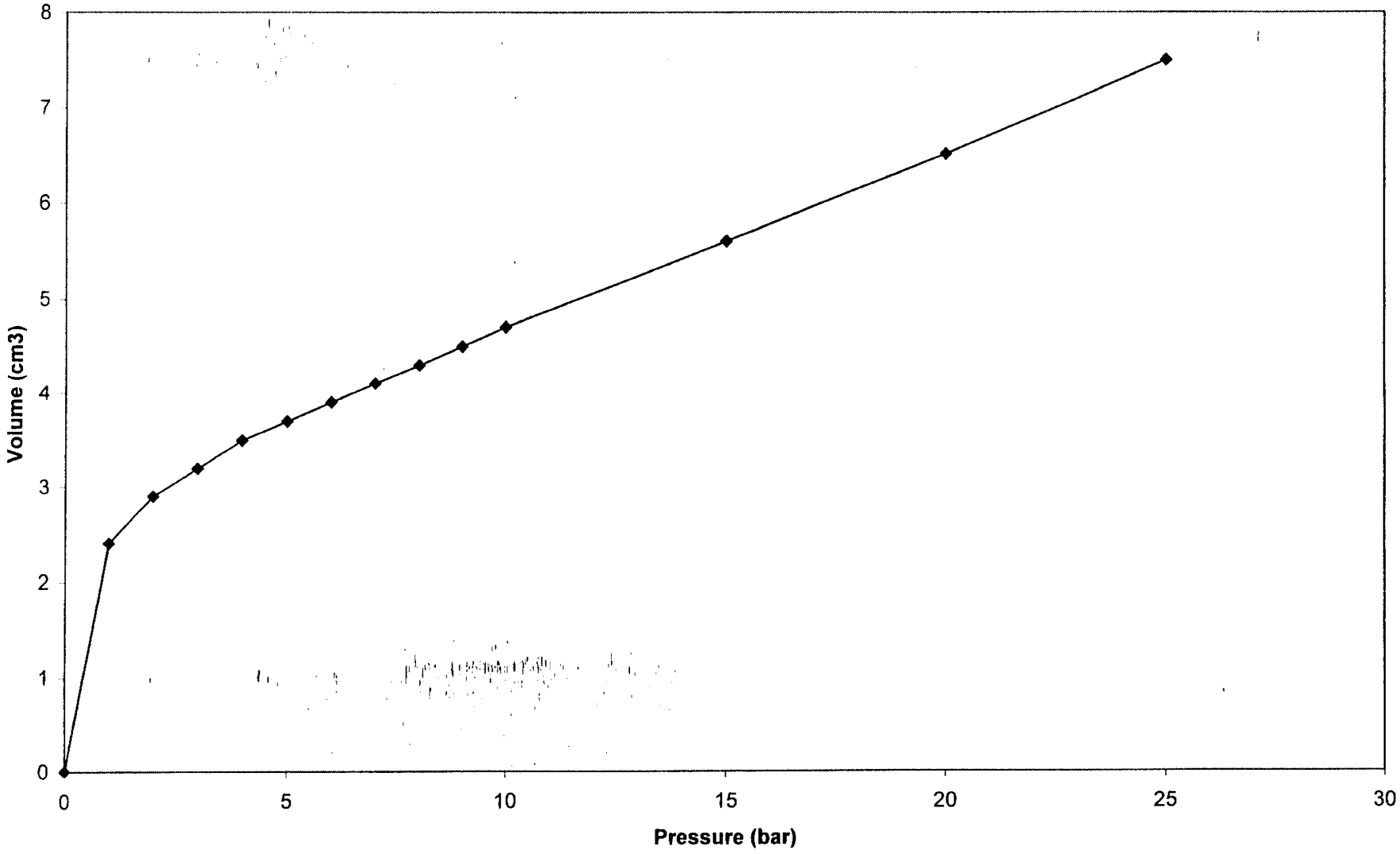
Volume Correction for Unit and Tubing

# Points	14
V	**P**
(cm3)	**(bar)**
0	0
2.4	1
2.9	2
3.2	3
3.5	4
3.7	5
3.9	6
4.1	7
4.3	8
4.5	9
4.7	10
5.6	15
6.5	20
7.5	25

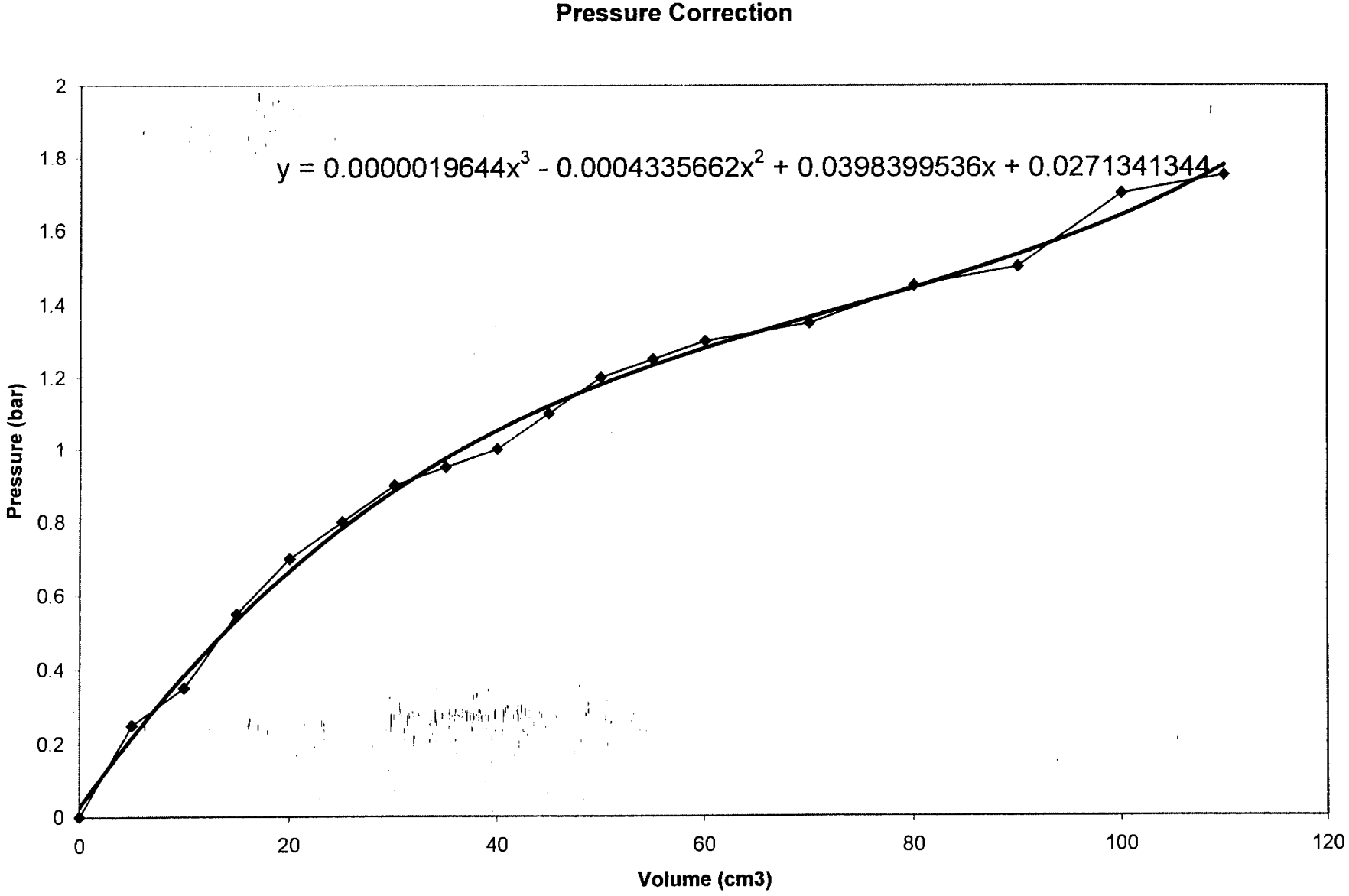

Volume Calibration
Volume (cm3)
Pressure (bar)
0
5
10
15
20
25
30
35
40
42.8
44.4
45.6
46.7
47.4
48.2
48.8
49.5
50.1
50.7
51.1
51.7
52.2
52.6
53
53.4
53.9
54.3
54.8
55.1
55.6
55.8
56.2

B-1-136

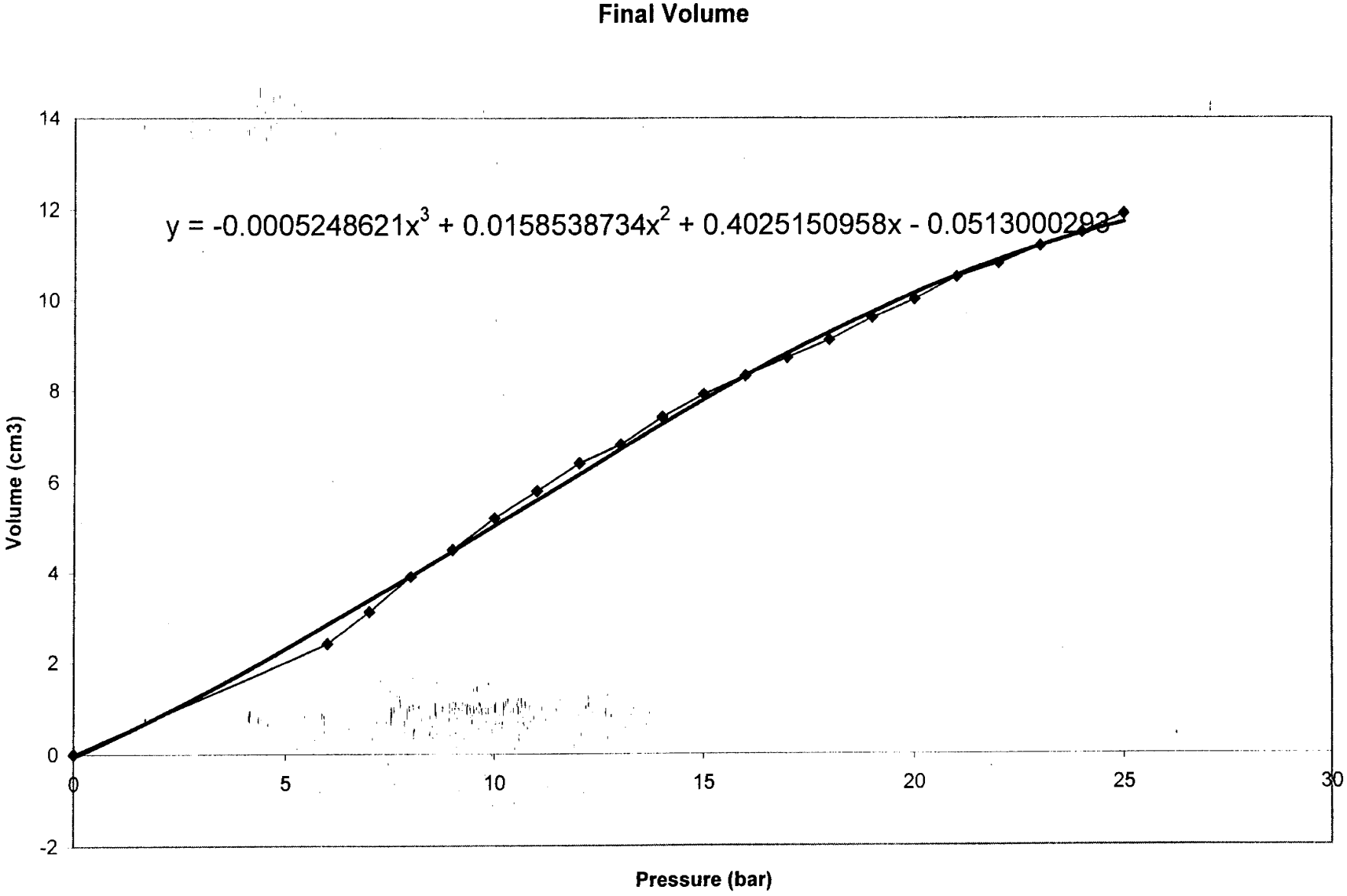
Volume Correction for Unit and Tubing Only



B-1-137


Pressure Correction
y = 0.0000019644x3 - 0.0004335662x2 + 0.0398399536x + 0.0271341344
Pressure (bar)
Volume (cm3)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
20
40
60
80
100
120

B-1-38


Final Volume
y = -0.0005248621x3 + 0.0158538734x2 + 0.4025150958x - 0.0513000293
Volume (cm3)
Pressure (bar)
14
12
10
8
6
4
2
0
-2
0
5
10
15
20
25
30

b21-1-9

Raw Data to Corrected Curve Sheet **PMT #2** Test Date 3/12/98 Revisit Site from 3/7/98 CBMC-30

Height of Control Unit
h= 1 m

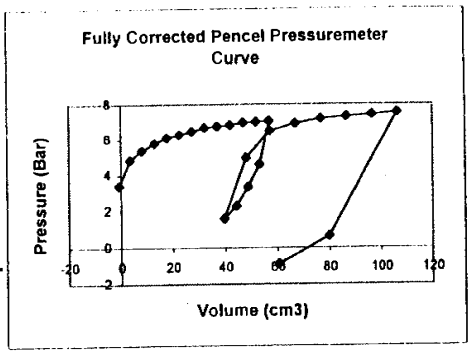
Depth of Probe
d= 13.719512 m

Hydrostatic
u= 1.4425122 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-06
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	3.4	1.4425122	1.9574878	7.93E-01	-0.79342978	-0.00475	3.40475	-0.79343	3.40475
5	5	1.4425122	3.5574878	1.56E+00	3.44234595	0.1592195	4.8407805	3.442346	4.84078
10	5.7	1.4425122	4.2574878	1.91E+00	8.090731102	0.3221277	5.3778723	8.090731	5.377872
15	6.25	1.4425122	4.8074878	2.19E+00	12.80811748	0.4704108	5.7795892	12.80812	5.779589
20	6.7	1.4425122	5.2574878	2.43E+00	17.5731367	0.6040158	6.0959842	17.57314	6.095984
25	7	1.4425122	5.5574878	2.59E+00	22.41476065	0.7244266	6.2755734	22.41476	6.275573
30	7.3	1.4425122	5.8574878	2.74E+00	27.25510603	0.8306773	6.4693227	27.25511	6.469323
35	7.6	1.4425122	6.1574878	2.91E+00	32.09425788	0.9241167	6.6758833	32.09426	6.675883
40	7.75	1.4425122	6.3074878	2.99E+00	37.01341279	1.0073752	6.7426248	37.01341	6.742625
45	7.9	1.4425122	6.4574878	3.07E+00	41.93230122	1.0802037	6.8197963	41.9323	6.819796
50	8.1	1.4425122	6.6574878	3.18E+00	46.82375626	1.1436762	6.9563238	46.82376	6.956324
55	8.2	1.4425122	6.7574878	3.23E+00	51.76932107	1.2001876	6.9998124	51.76932	6.999812
60	8.3	1.4425122	6.8574878	3.29E+00	56.71478162	1.2504132	7.0495868	56.71478	7.049587
55	5.8	1.4425122	4.3574878	1.96E+00	53.03974321	1.2136328	4.5863672	53.03974	4.586367
50	4.5	1.4425122	3.0574878	1.31E+00	48.68741101	1.1658001	3.3341999	48.68741	3.3342
45	3.4	1.4425122	1.9574878	7.93E-01	44.20657022	1.1107411	2.2892589	44.20657	2.289259
40	2.65	1.4425122	1.2074878	4.57E-01	39.54307663	1.0460428	1.6039572	39.54308	1.603957
50	6.1	1.4425122	4.6574878	2.11E+00	47.88571301	1.1584123	4.9435877	47.88571	4.943588
60	7.75	1.4425122	6.3074878	2.99E+00	57.01341279	1.2532762	6.4967238	57.01341	6.496724
70	8.25	1.4425122	6.8074878	3.26E+00	66.74206418	1.3388344	6.9111656	66.74206	6.911166
80	8.6	1.4425122	7.1574878	3.45E+00	76.5505691	1.4174133	7.1825867	76.55057	7.182587
90	8.8	1.4425122	7.3574878	3.56E+00	86.44063046	1.5000981	7.2999019	86.44063	7.299902
100	9	1.4425122	7.5574878	3.67E+00	96.33035031	1.5976166	7.4023834	96.33035	7.402383
110	9.25	1.4425122	7.8074878	3.81E+00	106.1920583	1.720974	7.529026	106.1921	7.529026
80	2.1	1.4425122	0.6574878	2.20E-01	79.77994697	1.44348	0.65652	79.77995	0.65652
60	0.4	1.4425122	-1.042512	-4.53E-01	60.45310175	1.2850776	-0.885078	60.4531	-0.88508



10 P-y points

	V	P	Vo	Po
1	35.53628	0	0	0
2	39.54308	1.603957	4.0068	1.603957
3	47.88571	4.943588	12.34944	4.943588
4	57.01341	6.496724	21.47714	6.496724
5	66.74206	6.911166	31.20579	6.911166
6	76.55057	7.182587	41.01429	7.182587
7	66.44063	7.299902	50.90435	7.299902
8	96.33035	7.402383	60.79407	7.402383
9	101.2612	7.465705	65.72493	7.465705
10	106.1921	7.529026	70.85578	7.529026

X	Y
39.54308	1.603957
35.53628	0
47.88571	4.943588
m	2.498072
b	35.53628

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.54308	cm3
V2	47.88571	cm3
P1	1.603957	bar
P2	4.943588	bar
Vm	43.71439	cm3
V	8.342636	cm3
P	333.9631	kPa
E	25099.37	kPa

B-1-140

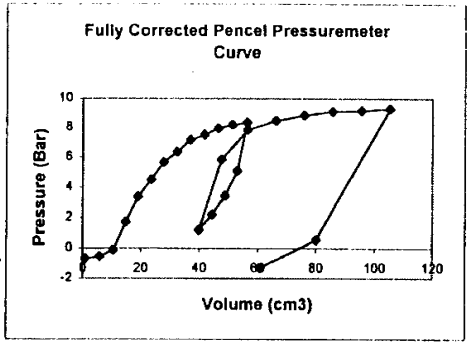
Raw Data to Corrected Curve Sheet **PMT #2** Test Date 3/12/98 Revisit Site from 3/7/98 CBMC-30

Height of Control Unit
h= 1 m
Depth of Probe
d= 15.853659 m
Hydrostatic
u= 1.6516585 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-06
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	-0.6	1.6516585	-2.251659	-8.71E-01	0.871256241	0.0615171	-0.661517	0.871256	-0.66152
5	-0.3	1.6516585	-1.951659	-7.73E-01	5.772583382	0.2430439	-0.543044	5.772583	-0.54304
10	0.3	1.6516585	-1.351659	-5.65E-01	10.56510215	0.4019687	-0.101969	10.5651	-0.10197
15	2.25	1.6516585	0.5983415	1.95E-01	14.80489511	0.5283038	1.7216962	14.8049	1.721696
20	4	1.6516585	2.3483415	9.75E-01	19.02542485	0.6416976	3.3583024	19.02542	3.358302
25	5.25	1.6516585	3.5983415	1.58E+00	23.42209048	0.7476582	4.5023418	23.42209	4.502342
30	6.5	1.6516585	4.8483415	2.21E+00	27.7869187	0.8415471	5.6584529	27.78692	5.658453
35	7.3	1.6516585	5.6483415	2.63E+00	32.36654103	0.9290216	6.3709784	32.36654	6.370978
40	8.2	1.6516585	6.5483415	3.12E+00	36.88304755	1.0053095	7.1946905	36.88305	7.194691
45	8.8	1.6516585	6.9483415	3.33E+00	41.66514277	1.0764926	7.5235074	41.66514	7.523507
50	9.1	1.6516585	7.4483415	3.61E+00	46.3905745	1.1383798	7.9616202	46.39057	7.96162
55	9.4	1.6516585	7.7483415	3.78E+00	51.22481816	1.1942995	8.2057005	51.22482	8.2057
60	9.6	1.6516585	7.9483415	3.89E+00	56.11394333	1.2445989	8.3554011	56.11394	8.355401
55	6.3	1.6516585	4.6483415	2.11E+00	52.89043215	1.2120733	5.0879267	52.89043	5.087927
50	4.6	1.6516585	2.9483415	1.26E+00	48.74018658	1.1664114	3.4335886	48.74019	3.433589
45	3.3	1.6516585	1.6483415	6.53E-01	44.34709291	1.1125678	2.1874322	44.34709	2.187432
40	2.25	1.6516585	0.5983415	1.95E-01	39.80489511	1.049895	1.200105	39.8049	1.200105
50	7	1.6516585	5.3483415	2.47E+00	47.52531327	1.152129	5.847871	47.52531	5.847871
60	9.1	1.6516585	7.4483415	3.61E+00	56.3905745	1.247285	7.852715	56.39057	7.852715
70	9.8	1.6516585	8.1483415	4.00E+00	66.00280142	1.332737	8.467263	66.0028	8.467263
80	10.25	1.6516585	8.5983415	4.25E+00	75.75188611	1.4110383	8.8389617	75.75189	8.838962
90	10.6	1.6516585	8.9483415	4.44E+00	85.55606685	1.4922672	9.1077328	85.55807	9.107733
100	10.75	1.6516585	9.0983415	4.53E+00	95.47200414	1.5882767	9.1617233	95.472	9.161723
110	11	1.6516585	9.3483415	4.67E+00	105.3317521	1.708887	9.291113	105.3318	9.291113
80	2	1.6516585	0.3483415	9.08E-02	79.90918578	1.4445365	0.5554635	79.90919	0.555464
60	0	1.6516585	-1.651659	-6.71E-01	60.67050368	1.2870211	-1.287021	60.6705	-1.28702



10 P-y points

	V	P	Vo	Po
1	37.8114	0	0	0
2	39.8049	1.200105	1.993498	1.200105
3	47.52531	5.847871	9.713916	5.847871
4	56.39057	7.852715	18.57918	7.852715
5	66.0028	8.467263	28.1914	8.467263
6	75.75189	8.838962	37.94049	8.838962
7	85.55607	9.107733	47.74467	9.107733
8	95.472	9.161723	57.66061	9.161723
9	100.4019	9.226418	62.59048	9.226418
10	105.3318	9.291113	67.52035	9.291113

X	Y
39.8049	1.200105
37.8114	0
47.52531	5.847871
m	1.661103
b	37.8114

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.8049	cm3
V2	47.52531	cm3
P1	1.200105	bar
P2	5.847871	bar
Vm	43.6651	cm3
V	7.720418	cm3
P	464.7766	kPa
E	37738.13	kPa

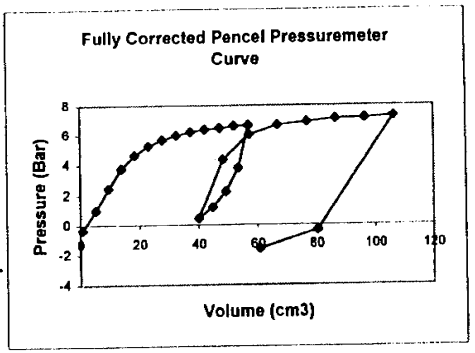
Raw Data to Corrected Curve Sheet **PMT #2** Test Date 3/12/98 Revisit Site from 3/7/98 CBMC-30

Height of Control Unit
h= 1 m
Depth of Probe
d= 15.243902 m
Hydrostatic
u= 1.5919024 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-06
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	-0.3	1.5919024	-1.891902	-7.53E-01	0.752519437	0.0568698	-0.35687	0.752519	-0.35687
5	1.2	1.5919024	-0.391902	-2.07E-01	5.206580128	0.223088	0.976912	5.20658	0.976912
10	2.8	1.5919024	1.2080976	4.57E-01	9.542609246	0.3695435	2.4304565	9.542809	2.430456
15	4.25	1.5919024	2.6580976	1.12E+00	13.87921767	0.5018145	3.7481855	13.87922	3.748185
20	5.25	1.5919024	3.6580976	1.61E+00	18.39240189	0.6254417	4.6245583	18.3924	4.624558
25	6	1.5919024	4.4080976	1.99E+00	23.01386962	0.7383165	5.2616835	23.01387	5.261683
30	6.5	1.5919024	4.9080976	2.24E+00	27.75586217	0.8409166	5.6590834	27.75586	5.659083
35	6.9	1.5919024	5.3080976	2.45E+00	32.54651208	0.9322437	5.9677563	32.54651	5.967756
40	7.2	1.5919024	5.6080976	2.61E+00	37.38791437	1.013269	6.186731	37.38791	6.186731
45	7.45	1.5919024	5.8580976	2.75E+00	42.25478028	1.0846479	6.3653521	42.25478	6.365352
50	7.6	1.5919024	6.0080976	2.83E+00	47.17449889	1.1479213	6.4520787	47.1745	6.452079
55	7.8	1.5919024	6.2080976	2.93E+00	52.06701133	1.2033745	6.5966255	52.06701	6.596626
60	7.9	1.5919024	6.3080976	2.99E+00	57.01308361	1.2532731	6.6467269	57.01308	6.646727
55	5	1.5919024	3.4080976	1.48E+00	53.51612145	1.2185724	3.7814276	53.51612	3.781428
50	3.4	1.5919024	1.8080976	7.25E-01	49.27478621	1.1725583	2.2274417	49.27479	2.227442
45	2.3	1.5919024	0.7080976	2.41E-01	44.75851725	1.117877	1.182123	44.75852	1.182123
40	1.5	1.5919024	-0.091902	-8.82E-02	40.08815784	1.0540321	0.4459679	40.08816	0.445968
50	5.5	1.5919024	3.9080976	1.73E+00	48.2674206	1.1609059	4.3390941	48.26742	4.339094
60	7.25	1.5919024	5.6580976	2.64E+00	57.36135622	1.2565901	5.9934099	57.36136	5.99341
70	8	1.5919024	6.4080976	3.04E+00	66.95903746	1.3406154	6.6593846	66.95904	6.659385
80	8.3	1.5919024	6.7080976	3.20E+00	76.79621997	1.4193782	6.8806218	76.79622	6.880622
90	8.6	1.5919024	7.0080976	3.37E+00	86.63245003	1.5018116	7.0981884	86.63245	7.098188
100	8.75	1.5919024	7.1580976	3.45E+00	98.55023446	1.6000407	7.1499593	96.55023	7.149959
110	9	1.5919024	7.4080976	3.59E+00	106.4127555	1.7241202	7.2758798	106.4128	7.27588
80	1.1	1.5919024	-0.491902	-2.45E-01	80.24539958	1.4472907	-0.347291	80.2454	-0.34729
60	-0.3	1.5919024	-1.891902	-7.53E-01	60.75251944	1.2877524	-1.587752	60.75252	-1.58775



10 P-y points

	V	P	Vo	Po
1	39.1512	0	0	0
2	40.08816	0.445968	0.936956	0.445968
3	48.26742	4.339094	9.116219	4.339094
4	57.36136	5.99341	18.21015	5.99341
5	66.95904	6.659385	27.80784	6.659385
6	76.79622	6.880622	37.64502	6.880622
7	86.63245	7.098188	47.48125	7.098188
8	96.55023	7.149959	57.39903	7.149959
9	101.4815	7.21292	62.33029	7.21292
10	106.4128	7.27588	67.26155	7.27588

X	Y
40.08816	0.445968
39.1512	0
48.26742	4.339094
m	2.10095
b	39.1512

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	40.08816	cm3
V2	48.26742	cm3
P1	0.445968	bar
P2	4.339094	bar
Vm	44.17779	cm3
V	8.179263	cm3
P	389.3126	kPa
E	29902.33	kPa

Page 1 of 2

PMT 3
(CB-PNB-4)

Raw Data, Corrections, and Fully Corrected Pressuremeter Curves

6-1-143

PMT #3 Test Date 3/11/98 Third Site CB-PNB-4

Calibrate

Insert Field Record Sheet

Pressure Correction

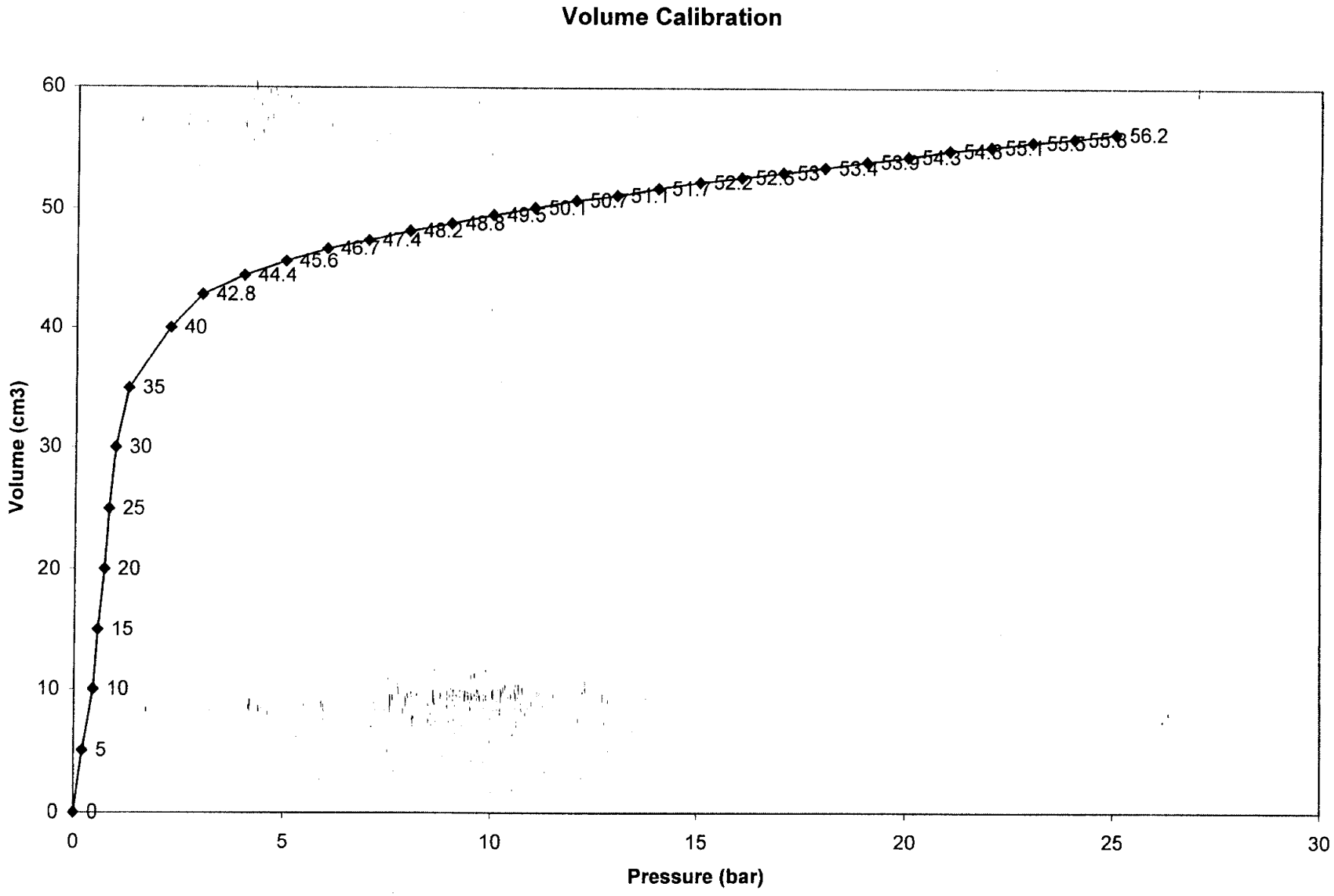
# Points	18
V	**P**
(cm3)	**(bar)**
0	0
5	0.25
10	0.35
15	0.55
20	0.7
25	0.8
30	0.9
35	0.95
40	1
45	1.1
50	1.2
55	1.25
60	1.3
70	1.35
80	1.45
90	1.5
100	1.7
110	1.75

Volume Correction

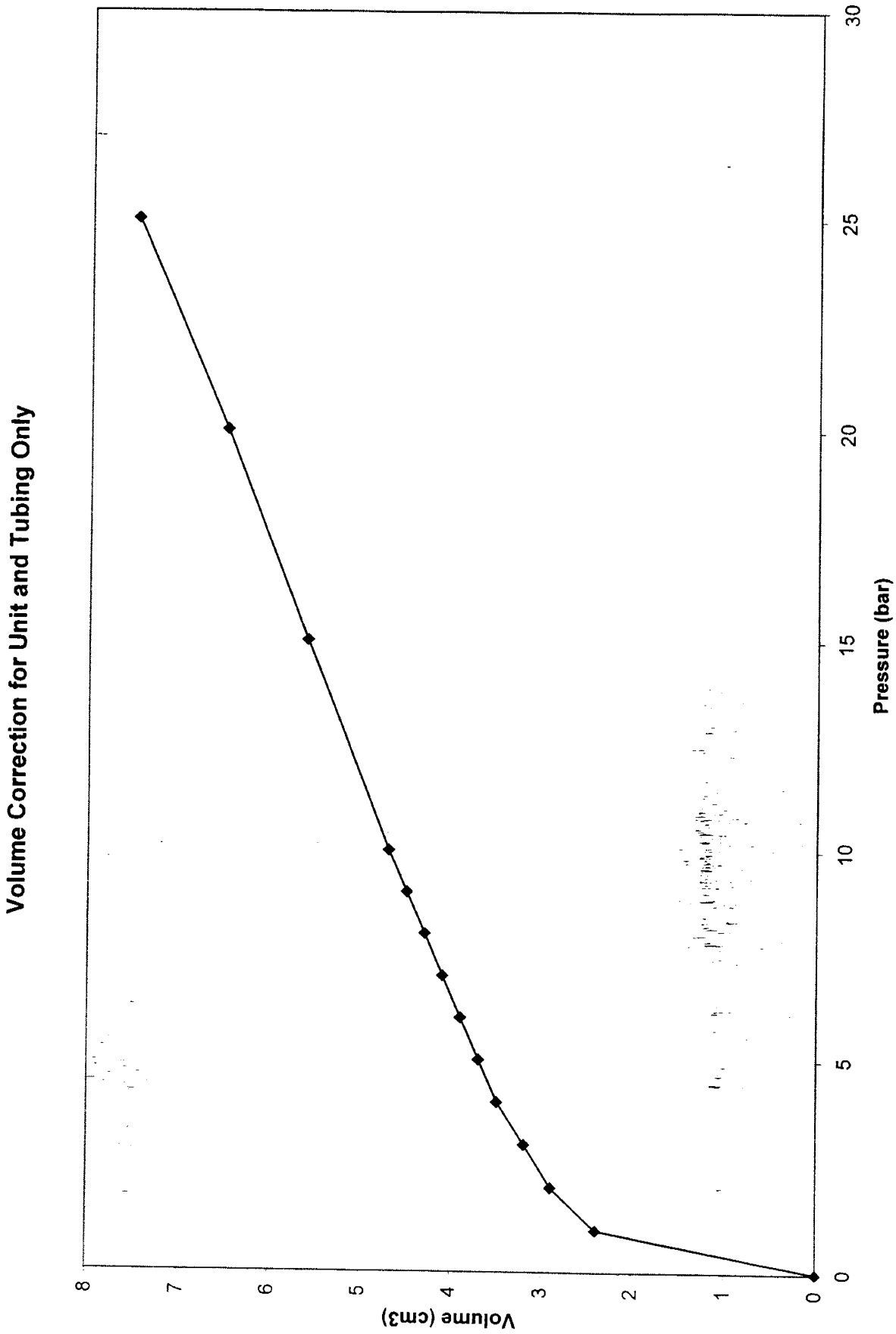
# Points	32
V	**P**
(cm3)	**(bar)**
0	0
5	0.2
10	0.45
15	0.55
20	0.7
25	0.8
30	0.95
35	1.25
40	2.25
42.8	3
44.4	4
45.6	5
46.7	6
47.4	7
48.2	8
48.8	9
49.5	10
50.1	11
50.7	12
51.1	13
51.7	14
52.2	15
52.6	16
53	17
53.4	18
53.9	19
54.3	20
54.8	21
55.1	22
55.5	23
55.8	24
56.2	25

Volume Correction for Unit and Tubing

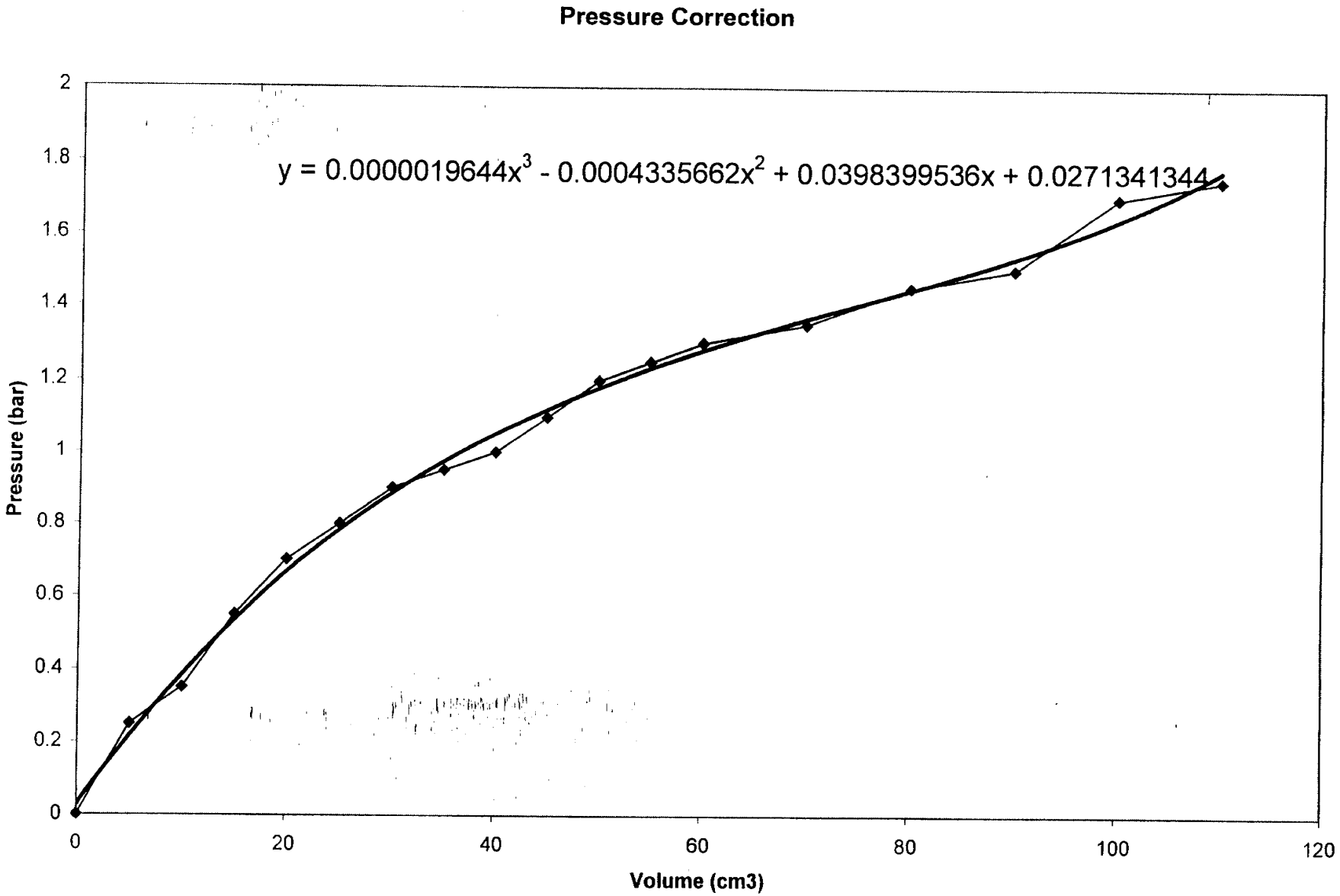
# Points	14
V	**P**
(cm3)	**(bar)**
0	0
2.4	1
2.9	2
3.2	3
3.5	4
3.7	5
3.9	6
4.1	7
4.3	8
4.5	9
4.7	10
5.6	15
6.5	20
7.5	25


Volume Calibration
Volume (cm3)
Pressure (bar)
0
10
20
30
40
50
60
0
5
10
15
20
25
30
0
5
10
15
20
25
30
35
40
42.8
44.4
45.6
46.7
47.4
48.2
48.8
49.5
50.1
50.7
51.1
51.7
52.2
52.6
53
53.4
53.9
54.3
54.8
55.1
55.5
55.8
56.2

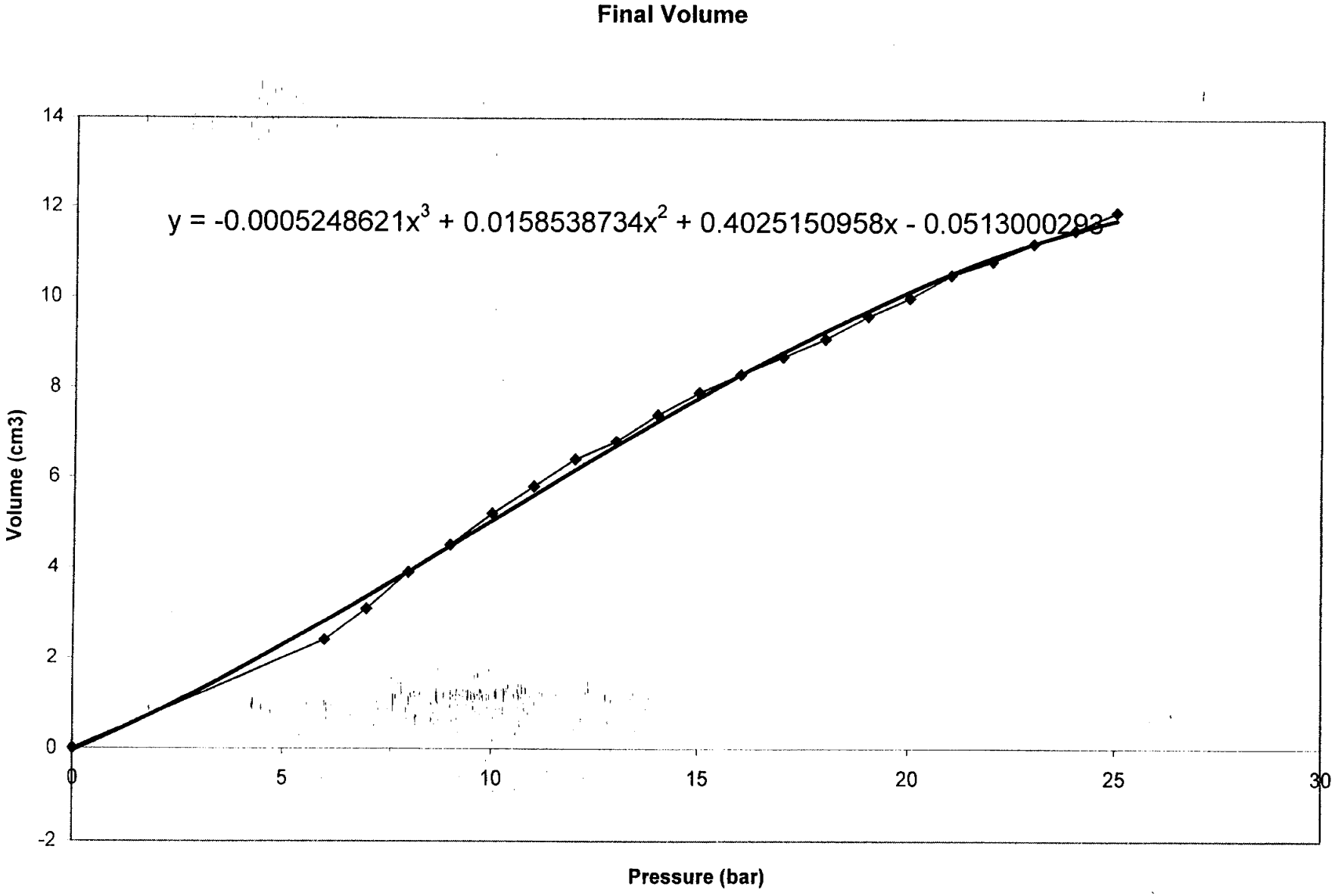
SH-1-9


Volume Correction for Unit and Tubing Only
Volume (cm3)
Pressure (bar)
0
1
2
3
4
5
6
7
8
0
5
10
15
20
25
30

B-1-146


Pressure Correction
y = 0.0000019644x3 - 0.0004335662x2 + 0.0398399536x + 0.0271341344
Pressure (bar)
Volume (cm3)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
20
40
60
80
100
120

LHI-1-9


Final Volume
y = -0.0005248621x3 + 0.0158538734x2 + 0.4025150958x - 0.0513000293
Volume (cm3)
Pressure (bar)
14
12
10
8
6
4
2
0
-2
0
5
10
15
20
25
30

3h1-1-9

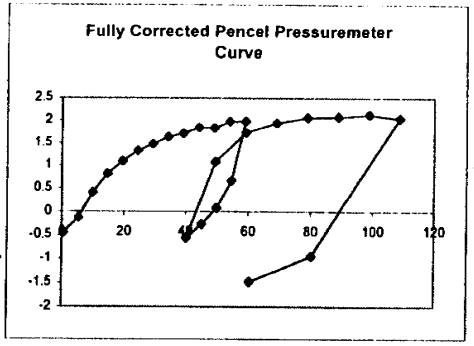
Raw Data to Corrected Curve Sheet **PMT #3** Test Date 3/11/98 Third Site CB-PNB-4

Height of Control Unit
h= 0.6097561 m
Depth of Probe
d= 7.6219512 m
Hydrostatic
u= 0.8067073 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-06
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	-0.4	0.8067073	-1.206707	-5.13E-01	0.513010186	0.0474586	-0.447459	0.51301	-0.44746
5	0.1	0.8067073	-0.706707	-3.28E-01	5.327657157	0.2273785	-0.127378	5.327657	-0.12738
10	0.8	0.8067073	-0.006707	-5.40E-02	10.05399911	0.3858553	0.4141447	10.054	0.414145
15	1.35	0.8067073	0.5432927	1.72E-01	14.82802115	0.5289579	0.8210421	14.82802	0.821042
20	1.75	0.8067073	0.9432927	3.42E-01	19.65794423	0.6576833	1.0923167	19.65794	1.092317
25	2.1	0.8067073	1.2932927	4.95E-01	24.50534828	0.771972	1.328028	24.50535	1.328028
30	2.35	0.8067073	1.5432927	6.06E-01	29.39427068	0.8734798	1.4765202	29.39427	1.47652
35	2.6	0.8067073	1.7932927	7.18E-01	34.28151511	0.962514	1.637486	34.28152	1.637486
40	2.75	0.8067073	1.9432927	7.87E-01	39.2130768	1.0411482	1.7088518	39.21308	1.708852
45	2.95	0.8067073	2.1432927	8.79E-01	44.12093198	1.1096245	1.8403755	44.12093	1.840376
50	3	0.8067073	2.1932927	9.02E-01	49.09773881	1.1705317	1.8294683	49.09774	1.829468
55	3.2	0.8067073	2.3932927	9.96E-01	54.00435002	1.2235792	1.9764208	54.00435	1.976421
60	3.25	0.8067073	2.4432927	1.02E+00	58.98085077	1.2717179	1.9782821	58.98085	1.978282
55	1.9	0.8067073	1.0932927	4.07E-01	54.59296915	1.2295426	0.6704574	54.59297	0.670457
50	1.25	0.8067073	0.4432927	1.30E-01	49.86979833	1.1793038	0.0706964	49.8698	0.070698
45	0.85	0.8067073	0.0432927	-3.38E-02	45.0338444	1.1213979	-0.271398	45.03384	-0.2714
40	0.5	0.8067073	-0.306707	-1.73E-01	40.17324785	1.0552686	-0.555269	40.17325	-0.55527
50	2.25	0.8067073	1.4432927	5.61E-01	49.43890584	1.1744288	1.0755712	49.43891	1.075571
60	3	0.8067073	2.1932927	9.02E-01	59.09773881	1.2727917	1.7272083	59.09774	1.727208
70	3.3	0.8067073	2.4932927	1.04E+00	68.95729149	1.3568608	1.9431392	68.95729	1.943139
80	3.5	0.8067073	2.6932927	1.14E+00	78.8624819	1.436014	2.063986	78.86246	2.063986
90	3.6	0.8067073	2.7932927	1.19E+00	88.81489713	1.5217247	2.0782753	88.8147	2.078275
100	3.75	0.8067073	2.9432927	1.26E+00	98.74282139	1.6249475	2.1250525	98.74262	2.125053
110	3.8	0.8067073	2.9932927	1.28E+00	108.7184834	1.7581422	2.0418578	108.7185	2.041858
80	0.5	0.8067073	-0.306707	-1.73E-01	80.17324785	1.4466989	-0.946699	80.17325	-0.9467
60	-0.2	0.8067073	-1.006707	-4.40E-01	60.43991217	1.2849594	-1.484959	60.43991	-1.48496



10 P-y points

	V	P	Vo	Po
1	43.32802	0	0	0
2	49.43891	1.075571	6.110885	1.075571
3	59.09774	1.727208	15.76972	1.727208
4	68.95729	1.943139	25.62927	1.943139
5	78.86246	2.063986	35.53444	2.063986
6	88.8147	2.078275	45.48668	2.078275
7	93.77866	2.101664	50.45064	2.101664
8	98.74262	2.125053	55.4146	2.125053
9	103.7306	2.083455	60.40253	2.083455
10	108.7185	2.041858	85.39046	2.041858

X	Y
40.17325	-0.55527
43.32802	0
49.43891	1.075571
m	5.681525
b	43.32802

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	40.17325	cm3
V2	49.43891	cm3
P1	-0.55527	bar
P2	1.075571	bar
Vm	44.80608	cm3
V	9.265658	cm3
P	163.084	kPa
E	11086.88	kPa

6-1-14

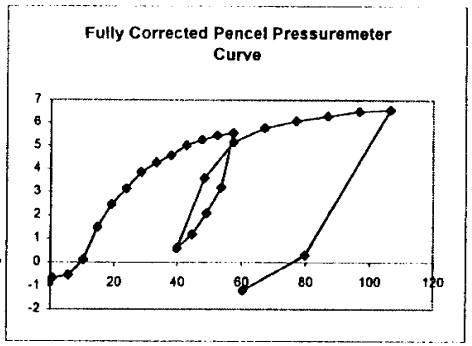
Raw Data to Corrected Curve Sheet **PMT #3** Test Date 3/11/98 Third Site CB-PNB-4

Height of Control Unit
h= 0.6097561 m
Depth of Probe
d= 9.1463415 m
Hydrostatic
u= 0.9560976 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-06
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	-0.6	0.9560976	-1.556098	-6.37E-01	0.637285913	0.052348	-0.652348	0.637286	-0.65235
5	-0.3	0.9560976	-1.256098	-5.31E-01	5.530844121	0.2345522	-0.534552	5.530844	-0.53455
10	0.5	0.9560976	-0.456098	-2.32E-01	10.23153838	0.3914746	0.1085254	10.23154	0.108525
15	2	0.9560976	1.0439024	3.86E-01	14.61443413	0.5229023	1.4770977	14.61443	1.477098
20	3.1	0.9560976	2.1439024	8.79E-01	19.12064952	0.6441206	2.4558794	19.12065	2.455879
25	3.9	0.9560976	2.9439024	1.26E+00	23.74232736	0.7549175	3.1450825	23.74233	3.145083
30	4.7	0.9560976	3.7439024	1.65E+00	28.3496456	0.8528827	3.8471173	28.34965	3.847117
35	5.2	0.9560976	4.2439024	1.90E+00	33.09764394	0.942014	4.257986	33.09764	4.257986
40	5.6	0.9560976	4.6439024	2.11E+00	37.89272199	1.021119	4.578881	37.89272	4.578881
45	6.1	0.9560976	5.1439024	2.37E+00	42.63274943	1.0898079	5.0101921	42.63275	5.010192
50	6.4	0.9560976	5.4439024	2.53E+00	47.47487965	1.1515264	5.2484736	47.47488	5.248474
55	6.65	0.9560976	5.6939024	2.66E+00	52.34231662	1.2063017	5.4436983	52.34232	5.443698
60	6.8	0.9560976	5.8439024	2.74E+00	57.26236236	1.2556496	5.5443504	57.26236	5.54435
55	4.4	0.9560976	3.4439024	1.50E+00	53.49848168	1.2183904	3.1816096	53.49848	3.18161
50	3.25	0.9560976	2.2939024	9.49E-01	49.05088211	1.1699939	2.0800061	49.05088	2.080006
45	2.3	0.9560976	1.3439024	5.17E-01	44.48299968	1.114328	1.185672	44.483	1.185672
40	1.65	0.9560976	0.6939024	2.35E-01	39.76453554	1.049303	0.600697	39.76454	0.600697
50	4.75	0.9560976	3.7939024	1.68E+00	48.32466301	1.1615761	3.5884239	48.32466	3.588424
60	6.4	0.9560976	5.4439024	2.53E+00	57.47487965	1.2576663	5.1423337	57.47488	5.142334
70	7.1	0.9560976	6.1439024	2.90E+00	67.10156642	1.3417833	5.7582167	67.10157	5.758217
80	7.5	0.9560976	6.5439024	3.11E+00	76.88545619	1.4200926	6.0799074	76.88546	6.079907
90	7.8	0.9560976	6.8439024	3.28E+00	86.72219701	1.5026153	6.2973847	86.7222	6.297385
100	8.1	0.9560976	7.1439024	3.44E+00	96.55802387	1.6001268	6.4998732	96.55802	6.499873
110	8.3	0.9560976	7.3439024	3.55E+00	106.4481093	1.724626	6.575374	106.4481	6.575374
80	1.75	0.9560976	0.7939024	2.78E-01	79.72201255	1.4430069	0.3069931	79.72201	0.306993
60	0.1	0.9560976	-0.856098	-3.84E-01	60.38394355	1.2844578	-1.184458	60.38394	-1.18446



10 P-y points

	V	P	Vo	Po
1	38.04348	0	0	0
2	39.76454	0.600697	1.721055	0.600697
3	48.32466	3.588424	10.28118	3.588424
4	57.47488	5.142334	19.4314	5.142334
5	67.10157	5.758217	29.05809	5.758217
6	76.88546	6.079907	38.84198	6.079907
7	86.7222	6.297385	48.67872	6.297385
8	96.55802	6.499873	58.51454	6.499873
9	101.5031	6.537624	63.45959	8.537624
10	106.4481	6.575374	68.40463	6.575374

X	Y
39.76454	0.600697
38.04348	0
48.32466	3.588424
m	2.865097
b	38.04348

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.76454	cm3
V2	48.32466	cm3
P1	0.600697	bar
P2	3.588424	bar
Vm	44.0446	cm3
V	8.560127	cm3
P	298.7727	kPa
E	21914.74	kPa

9-15-98

Raw Data to Corrected Curve Sheet **PMT #3** Test Date 3/11/98 Third Site CB-PNB-4

Height of Control Unit
h= 0.6097561 m

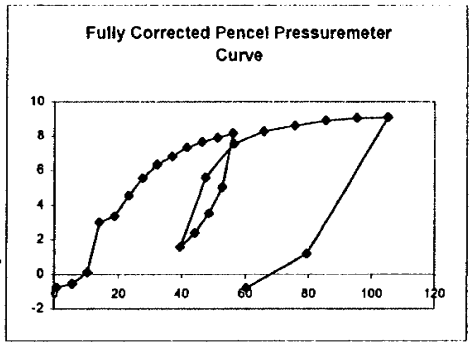
Depth of Probe
d= 10.670732 m

Hydrostatic
u= 1.1054878 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-06
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)		(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	-0.7	1.1054878	-1.805488	-7.23E-01	0.72326681	0.055723	-0.755723	0.723267	-0.75572
5	-0.3	1.1054878	-1.405488	-5.84E-01	5.584255186	0.2364324	-0.536432	5.584255	-0.53643
10	0.5	1.1054878	-0.605488	-2.89E-01	10.28908923	0.3932911	0.1067089	10.28909	0.106709
15	3.5	1.1054878	2.3945122	9.96E-01	14.00377758	0.5054138	2.9945862	14.00378	2.994586
20	4	1.1054878	2.8945122	1.23E+00	18.76611657	0.6350699	3.3649301	18.76612	3.36493
25	5.3	1.1054878	4.1945122	1.88E+00	23.12274733	0.7408178	4.5591822	23.12275	4.559162
30	6.4	1.1054878	5.2945122	2.45E+00	27.55366282	0.8367985	5.5632015	27.55366	5.563202
35	7.25	1.1054878	6.1445122	2.90E+00	32.10123843	0.9242429	6.3257571	32.10124	6.325757
40	7.8	1.1054878	6.6945122	3.20E+00	36.80361432	1.0040471	6.7959529	36.80361	6.795953
45	8.4	1.1054878	7.2945122	3.52E+00	41.47528575	1.0738389	7.3261611	41.47529	7.326161
50	8.8	1.1054878	7.6945122	3.75E+00	46.25461084	1.136705	7.663295	46.25461	7.663295
55	9.1	1.1054878	7.9945122	3.91E+00	51.08830861	1.1928112	7.9071888	51.08831	7.907189
60	9.4	1.1054878	8.2945122	4.08E+00	55.92141853	1.2427203	8.1572797	55.92142	8.15728
55	6.25	1.1054878	5.1445122	2.37E+00	52.63242994	1.2093658	5.0406342	52.63243	5.040634
50	4.7	1.1054878	3.5945122	1.58E+00	48.4239905	1.1627366	3.5372634	48.42399	3.537263
45	3.5	1.1054878	2.3945122	9.96E-01	44.00377758	1.1060928	2.3919072	44.00378	2.391907
40	2.6	1.1054878	1.4945122	5.84E-01	39.41607768	1.0441643	1.5558357	39.41608	1.555838
50	6.75	1.1054878	5.6445122	2.63E+00	47.36857571	1.1502537	5.5997463	47.36858	5.599746
60	8.8	1.1054878	7.6945122	3.75E+00	56.25461084	1.2459867	7.5540333	56.25461	7.554033
70	9.6	1.1054878	8.4945122	4.19E+00	65.80987389	1.331138	8.268862	65.80987	8.268862
80	10	1.1054878	8.8945122	4.41E+00	75.58621494	1.4097182	8.5902818	75.58621	8.590282
90	10.4	1.1054878	9.2945122	4.64E+00	85.36196441	1.4905639	8.9094381	85.36196	8.909436
100	10.65	1.1054878	9.5445122	4.78E+00	95.22159697	1.5855881	9.0644119	95.2216	9.064412
110	10.8	1.1054878	9.6945122	4.86E+00	105.1373238	1.706194	9.093806	105.1373	9.093806
80	2.6	1.1054878	1.4945122	5.84E-01	79.41607766	1.4405122	1.1594878	79.41608	1.159488
60	0.5	1.1054878	-0.605488	-2.89E-01	60.28908923	1.2836066	-0.783607	60.28909	-0.78361



10 P-y points

	V	P	Vo	Po
1	36.35647	0	0	0
2	39.41608	1.555836	3.059608	1.555836
3	47.36858	5.599746	11.01211	5.599746
4	56.25461	7.554033	19.89814	7.554033
5	65.80987	8.268862	29.4534	8.268862
6	75.58621	8.590282	39.22975	8.590262
7	85.36196	8.909436	49.00549	8.909436
8	95.2216	9.064412	58.86513	9.064412
9	100.1795	9.079109	63.82299	9.079109
10	105.1373	9.093806	68.78085	9.093806

X	Y
39.41608	1.555836
36.35647	0
47.36858	5.599746
m	1.966537
b	36.35647

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	39.41608	cm3
V2	47.36858	cm3
P1	1.555836	bar
P2	5.599746	bar
Vm	43.39233	cm3
V	7.952498	cm3
P	404.3911	kPa
E	31839.92	kPa

9-15-1

Raw Data to Corrected Curve Sheet **PMT #3** Test Date 3/11/98 Third Site CB-PNB-4

Height of Control Unit
h= 0.304878 m

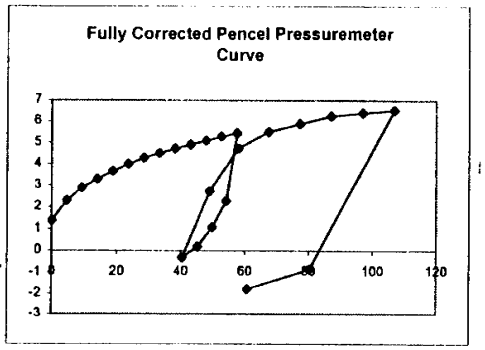
Depth of Probe
d= 13.719512 m

Hydrostatic
u= 1.3743902 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-06
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	1.4	1.3743902	0.0256098	-4.10E-02	0.040981327	0.0287661	1.3712339	0.040981	1.371234
5	2.5	1.3743902	1.1256098	4.21E-01	4.578886825	0.2006551	2.2993449	4.578887	2.299345
10	3.25	1.3743902	1.8756098	7.56E-01	9.244029419	0.3599184	2.8900816	9.244029	2.890082
15	3.8	1.3743902	2.4256098	1.01E+00	13.98916836	0.5049922	3.2950078	13.98917	3.295008
20	4.3	1.3743902	2.9256098	1.25E+00	18.75114458	0.6346859	3.6653141	18.75114	3.665314
25	4.75	1.3743902	3.3756098	1.47E+00	23.53210376	0.7501588	3.9998412	23.5321	3.999841
30	5.15	1.3743902	3.7756098	1.87E+00	28.33380873	0.852566	4.297434	28.33381	4.297434
35	5.45	1.3743902	4.0756098	1.82E+00	33.18299558	0.9435141	4.5064859	33.183	4.506486
40	5.75	1.3743902	4.3756098	1.97E+00	38.03048387	1.0232426	4.7267574	38.03048	4.726757
45	6	1.3743902	4.6256098	2.10E+00	42.9021546	1.0934541	4.9065459	42.90215	4.906546
50	6.25	1.3743902	4.8756098	2.23E+00	47.77275402	1.155074	5.094926	47.77275	5.094926
55	6.5	1.3743902	5.1256098	2.36E+00	52.64233135	1.20947	5.29053	52.64233	5.29053
60	6.7	1.3743902	5.3256098	2.46E+00	57.53729036	1.2582569	5.4417431	57.53729	5.441743
55	3.5	1.3743902	2.1256098	8.71E-01	54.12911953	1.2248499	2.2751501	54.12912	2.27515
50	2.25	1.3743902	0.8756098	3.13E-01	49.68705119	1.1772425	1.0727575	49.68705	1.072757
45	1.3	1.3743902	-0.07439	-8.12E-02	45.08115528	1.1220003	0.1779997	45.08116	0.178
40	0.75	1.3743902	-0.62439	-2.96E-01	40.29631792	1.0570521	-0.307052	40.29632	-0.30705
50	3.9	1.3743902	2.5256098	1.06E+00	48.94203239	1.168742	2.731258	48.94203	2.731258
60	6	1.3743902	4.6256098	2.10E+00	57.9021546	1.261695	4.738305	57.90215	4.738305
70	6.85	1.3743902	5.4756098	2.54E+00	67.45811616	1.3446983	5.5053017	67.45812	5.505302
80	7.3	1.3743902	5.9256098	2.78E+00	77.21868342	1.422763	5.877237	77.21868	5.877237
90	7.75	1.3743902	6.3756098	3.02E+00	86.97660866	1.5049002	6.2450998	86.97661	6.2451
100	8	1.3743902	6.6256098	3.16E+00	96.8410867	1.6032674	6.3967326	96.84109	6.396733
110	8.25	1.3743902	6.8756098	3.30E+00	106.7048871	1.7283139	6.5216861	108.7049	6.521686
80	0.6	1.3743902	-0.77439	-3.53E-01	80.3532528	1.448176	-0.848176	80.35325	-0.84818
60	-0.5	1.3743902	-1.87439	-7.47E-01	60.74661396	1.2876997	-1.7877	60.74661	-1.7877



10 P-y points

	V	P	Vo	Po
1	41.17006	0	0	0
2	48.94203	2.731258	7.771977	2.731258
3	57.90215	4.738305	16.7321	4.738305
4	67.45812	5.505302	26.28806	5.505302
5	77.21868	5.877237	36.04883	5.877237
6	86.97661	6.2451	45.80655	6.2451
7	91.90885	6.320916	50.73879	6.320916
8	96.84109	6.396733	55.67103	6.396733
9	101.773	6.459209	60.60293	6.459209
10	106.7049	6.521686	65.53483	6.521686

X	Y
40.29632	-0.30705
41.17006	0
48.94203	2.731258
m	2.845567
b	41.17006

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	40.29632	cm3
V2	48.94203	cm3
P1	-0.30705	bar
P2	2.731258	bar
Vm	44.61918	cm3
V	8.645714	cm3
P	303.831	kPa
E	22118.86	kPa

CB-PNB-4

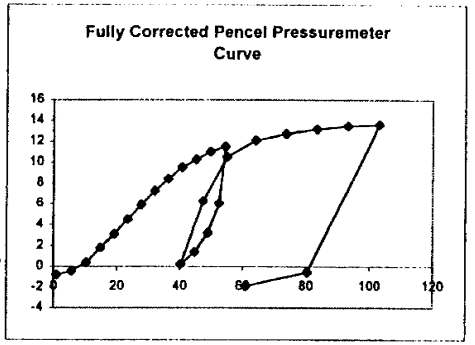
Raw Data to Corrected Curve Sheet **PMT #3** Test Date 3/11/98 Third Site CB-PNB-4

Height of Control Unit
h= 0.304878 m
Depth of Probe
d= 15.243902 m
Hydrostatic
u= 1.5237805 bar

Volume Coefficients	
P^3	-5.25E-04
P^2	+0.0158538734
P	+0.4025150958
C	-0.0513000293

Pressure Coefficients	
V^3	1.96E-06
V^2	-0.0004335662
V	+0.0398399536
C	+0.0271341344

Raw Data		Hydrostatic Correction		Volume Correction		Pressure Correction		Corrected Volume	Corrected Pressure
V	P	Pcorrection	Pcorrected	Vcorrection	Vcorrected	Pcorrection	Pcorrected		
(cm3)	(bar)	(bar)	(bar)	(cm3)	(cm3)	(bar)	(bar)	(cm3)	(bar)
0	-0.75	1.5237805	-2.27378	-8.78E-01	0.878395162	0.0617962	-0.811798	0.878395	-0.8118
5	-0.2	1.5237805	-1.72378	-6.95E-01	5.695350811	0.240336	-0.440336	5.695351	-0.44034
10	0.75	1.5237805	-0.77378	-3.53E-01	10.3530229	0.3953061	0.3546939	10.35302	0.354694
15	2.3	1.5237805	0.7762195	2.70E-01	14.7295532	0.5261701	1.7738299	14.72955	1.77383
20	3.75	1.5237805	2.2262195	9.18E-01	19.08243137	0.6431488	3.1068512	19.08243	3.106851
25	5.25	1.5237805	3.7262195	1.64E+00	23.35846901	0.7462088	4.5037912	23.35847	4.503791
30	6.75	1.5237805	5.2262195	2.41E+00	27.58956686	0.6375313	5.9124687	27.58957	5.912469
35	8.15	1.5237805	6.6262195	3.16E+00	31.84075531	0.9195176	7.2304824	31.84076	7.230482
40	9.4	1.5237805	7.8762195	3.85E+00	36.15395798	0.99362	8.40638	36.15396	8.40638
45	10.6	1.5237805	9.0762195	4.52E+00	40.48440626	1.0597662	9.5402338	40.48441	9.540234
50	11.4	1.5237805	9.8762195	4.96E+00	45.03520239	1.1214152	10.278585	45.0352	10.27858
55	12.2	1.5237805	10.67622	5.41E+00	49.5856108	1.1760944	11.023906	49.58561	11.02391
60	12.75	1.5237805	11.22622	5.72E+00	54.27712955	1.2263526	11.523647	54.27713	11.52365
55	7.25	1.5237805	5.7262195	2.67E+00	52.32511654	1.2061193	6.0438807	52.32512	6.043881
50	4.4	1.5237805	2.8762195	1.23E+00	48.77491342	1.1668132	3.2331868	48.77491	3.233187
45	2.5	1.5237805	0.9762195	3.56E-01	44.64373643	1.1164017	1.3835983	44.64374	1.383598
40	1.25	1.5237805	-0.27378	-1.60E-01	40.1603017	1.0550607	0.1949193	40.1603	0.194919
50	7.4	1.5237805	5.8762195	2.75E+00	47.24509688	1.1487711	6.2512289	47.2451	6.251229
60	11.75	1.5237805	10.22622	5.16E+00	54.83845872	1.2320067	10.517993	54.83846	10.51799
70	13.4	1.5237805	11.67622	6.09E+00	63.9140235	1.31523	12.08477	63.91402	12.08477
80	14.1	1.5237805	12.57622	6.47E+00	73.52570073	1.3933371	12.706663	73.5257	12.70666
90	14.6	1.5237805	13.07622	6.75E+00	83.25063342	1.4723566	13.127643	83.25063	13.12764
100	15	1.5237805	13.47622	6.97E+00	93.03226555	1.5627428	13.437257	93.03227	13.43726
110	15.25	1.5237605	13.72622	7.10E+00	102.8966448	1.6761519	13.573848	102.8966	13.57385
80	0.9	1.5237805	-0.62378	-2.96E-01	80.29608493	1.4477066	-0.547707	80.29608	-0.54771
60	-0.6	1.5237805	-2.12378	-8.30E-01	60.82961798	1.2884389	-1.888439	60.82962	-1.88844



10 P-y points

	V	P	Vo	Po
1	39.93228	0	0	0
2	47.2451	6.251229	7.312816	6.251229
3	54.83846	10.51799	14.90618	10.51799
4	63.91402	12.08477	23.98174	12.08477
5	73.5257	12.70666	33.59342	12.70666
6	83.25063	13.12764	43.31835	13.12764
7	88.14145	13.28245	48.20917	13.28245
8	93.03227	13.43726	53.09998	13.43726
9	97.96446	13.50555	58.03217	13.50555
10	102.6966	13.57385	62.96436	13.57385

X	Y
40.1603	0.194919
39.93228	0
47.2451	6.251229
m	1.169821
b	39.93228

Reload Modulus
E=2(1+u)(Vo+Vm)P/V

u	0.33	
Vo	192	cm3
V1	40.1603	cm3
V2	47.2451	cm3
P1	0.194919	bar
P2	6.251229	bar
Vm	43.7027	cm3
V	7.084795	cm3
P	605.631	kPa
E	53595.33	kPa

G-1-53

APPENDIX DMT/PMT

DMT/PMT p-y CURVES

A Quick Note About the Use of These P-Y Curves:

These curves have been developed with two initial assumptions.

1. The first assumption is that the ground surface elevation after pile installation is the same as the ground surface when the pressuremeter and dilatometer tests were performed. If you wish to change the elevation of the ground surface for design, you must adjust the depth of each PMT/DMT test. See the main text of the report for more information.

Input Soil Information

PILE DIAMETER: 42 INCHES α IS DEPTH FACTOR
Empirical F factor: 2.5 ROBERTSON & CAMPANELLA
BETWEEN 2 AND 3

Change this Number

Depth Feet	DEPTH INCHES	DILATOMETER Ed (BAR)	INITIAL SLOPE	PRESSUREMETER CORRECTED PRESSURE (BAR)	(LBS/IN)	α	ULTIMATE SOIL RESISTANCE Ph
19	228	23	833.75	2.40	1461.60	1.50	2192.40
24	288	34	1232.50	2.80	1705.20	1.50	2557.80
29	348	83.5	3026.88	1.90	1157.10	1.50	1735.65
34	408	67	2428.75	5.40	3288.60	1.50	4932.90
39	468	66.5	2410.63	4.40	2679.60	1.50	4019.40
44	528	107	3878.75	8.75	5328.75	1.50	7993.13
54	648	172	6235.00	10.80	6577.20	1.50	9865.80
59	708	125	4531.25	12.60	7673.40	1.50	11510.10

2. The second assumption is the pile diameter. The default value is 42". This can be easily adjusted by changing the pile diameter at the top of the PY Curve sheet.

Change this Number

Input Soil Information

PILE DIAMETER: 42 INCHES α IS DEPTH FACTOR
Empirical F factor: 2.5 ROBERTSON & CAMPANELLA
BETWEEN 2 AND 3

Depth Feet	DEPTH INCHES	DILATOMETER Ed (BAR)	INITIAL SLOPE	PRESSUREMETER CORRECTED PRESSURE (BAR)	(LBS/IN)	α	ULTIMATE SOIL RESISTANCE Ph
19	228	23	833.75	2.40	1461.60	1.50	2192.40
24	288	34	1232.50	2.80	1705.20	1.50	2557.80
29	348	83.5	3026.88	1.90	1157.10	1.50	1735.65
34	408	67	2428.75	5.40	3288.60	1.50	4932.90
39	468	66.5	2410.63	4.40	2679.60	1.50	4019.40
44	528	107	3878.75	8.75	5328.75	1.50	7993.13
54	648	172	6235.00	10.80	6577.20	1.50	9865.80
59	708	125	4531.25	12.60	7673.40	1.50	11510.10

B-1-155

DMT/PMT P-Y Curves CB-59

Input Soil Information

PILE DIAMETER: 42 INCHES
Empirical F factor: 2.5
BETWEEN 2 AND 3

α IS DEPTH FACTOR
ROBERTSON & CAMPANELLA

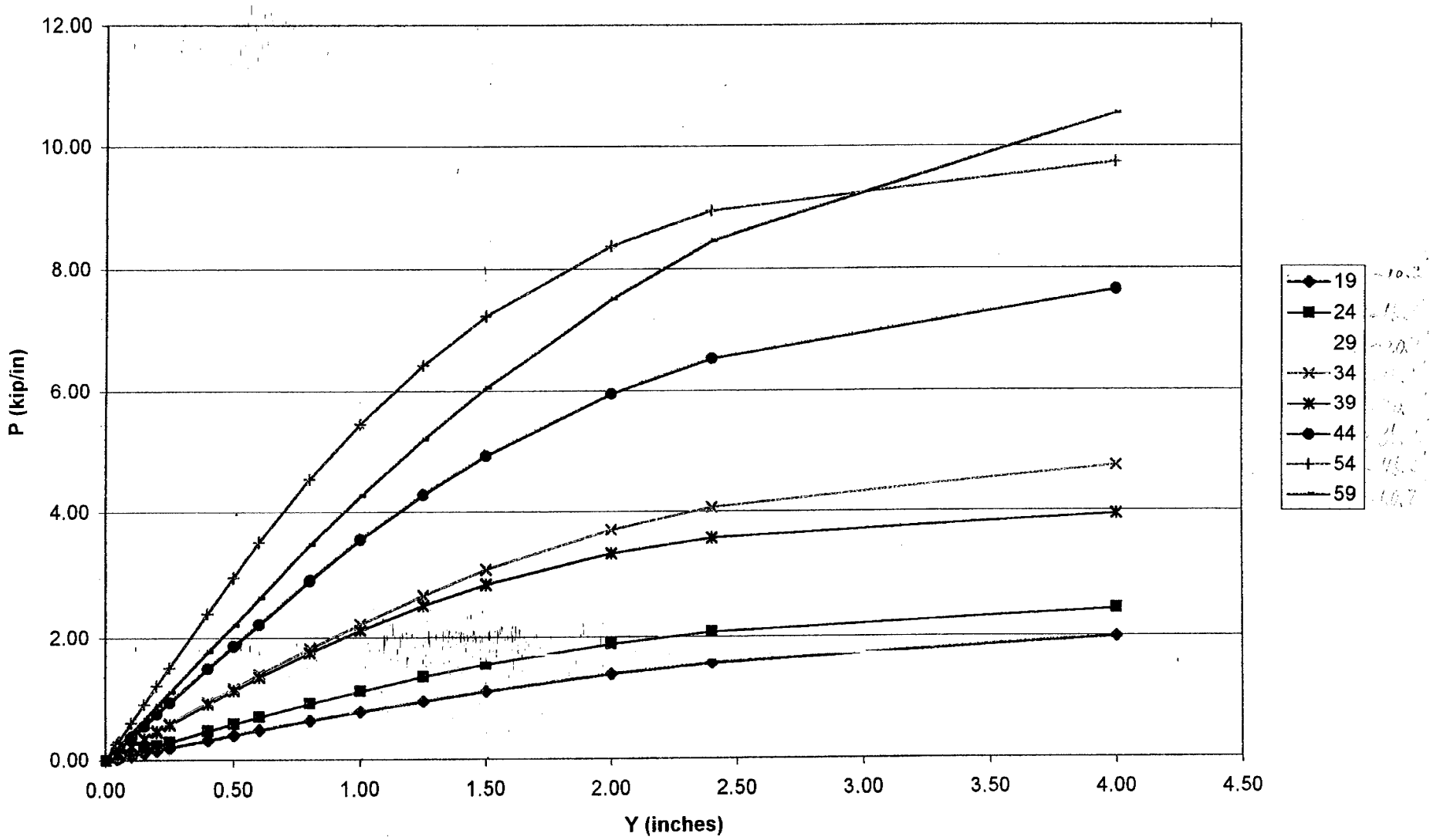
Depth Feet	DEPTH INCHES	DILATOMETER Ed (BAR)	INITIAL SLOPE	PRESSUREMETER CORRECTED PRESSURE (BAR)	(LBS/IN)	α	ULTIMATE SOIL RESISTANCE Ph
19	228	23	833.75	2.40	1461.60	1.50	2192.40
24	288	34	1232.50	2.80	1705.20	1.50	2557.80
29	348	83.5	3026.88	1.90	1157.10	1.50	1735.65
34	408	67	2428.75	5.40	3288.60	1.50	4932.90
39	468	66.5	2410.63	4.40	2679.60	1.50	4019.40
44	528	107	3878.75	8.75	5328.75	1.50	7993.13
54	648	172	6235.00	10.80	6577.20	1.50	9865.80
59	708	125	4531.25	12.60	7673.40	1.50	11510.10

95-1-9

Construction of P-Y Curves CB-59

Y (in)	P 228 (k/in)	P 288 (k/in)	P 348 (k/in)	P 408 (k/in)	P 468 (k/in)	P 528 (k/in)	P 648 (k/in)	P 708 (k/in)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.04	0.04	0.05	0.13	0.11	0.10	0.17	0.27	0.20
0.05	0.04	0.06	0.15	0.12	0.12	0.19	0.31	0.23
0.10	0.08	0.12	0.29	0.24	0.24	0.38	0.61	0.45
0.15	0.12	0.18	0.43	0.36	0.35	0.57	0.92	0.67
0.20	0.16	0.24	0.56	0.48	0.47	0.76	1.22	0.89
0.25	0.21	0.30	0.69	0.59	0.59	0.95	1.52	1.11
0.40	0.33	0.48	1.02	0.94	0.93	1.51	2.40	1.77
0.50	0.41	0.60	1.19	1.17	1.15	1.87	2.97	2.21
0.60	0.49	0.71	1.33	1.40	1.37	2.23	3.51	2.64
0.80	0.64	0.93	1.52	1.82	1.77	2.92	4.54	3.47
1.00	0.79	1.13	1.63	2.22	2.13	3.56	5.45	4.27
1.25	0.96	1.37	1.69	2.68	2.53	4.29	6.44	5.20
1.50	1.12	1.57	1.72	3.08	2.86	4.93	7.24	6.06
2.00	1.40	1.90	1.73	3.71	3.34	5.96	8.37	7.52
2.40	1.58	2.09	1.73	4.07	3.58	6.55	8.94	8.45
4.00	1.99	2.45	1.74	4.74	3.95	7.66	9.74	10.55

LS1-1-9


DMT/PMT P-Y Curves CB-59
P (kip/in)
Y (inches)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
19
24
29
34
39
44
54
59

DMT/PMT P-Y Curves CBMC-30

Input Soil Information

PILE DIAMETER: 42 INCHES
Empirical F factor: 2.5
BETWEEN 2 AND 3

α IS DEPTH FACTOR
ROBERTSON & CAMPANELLA

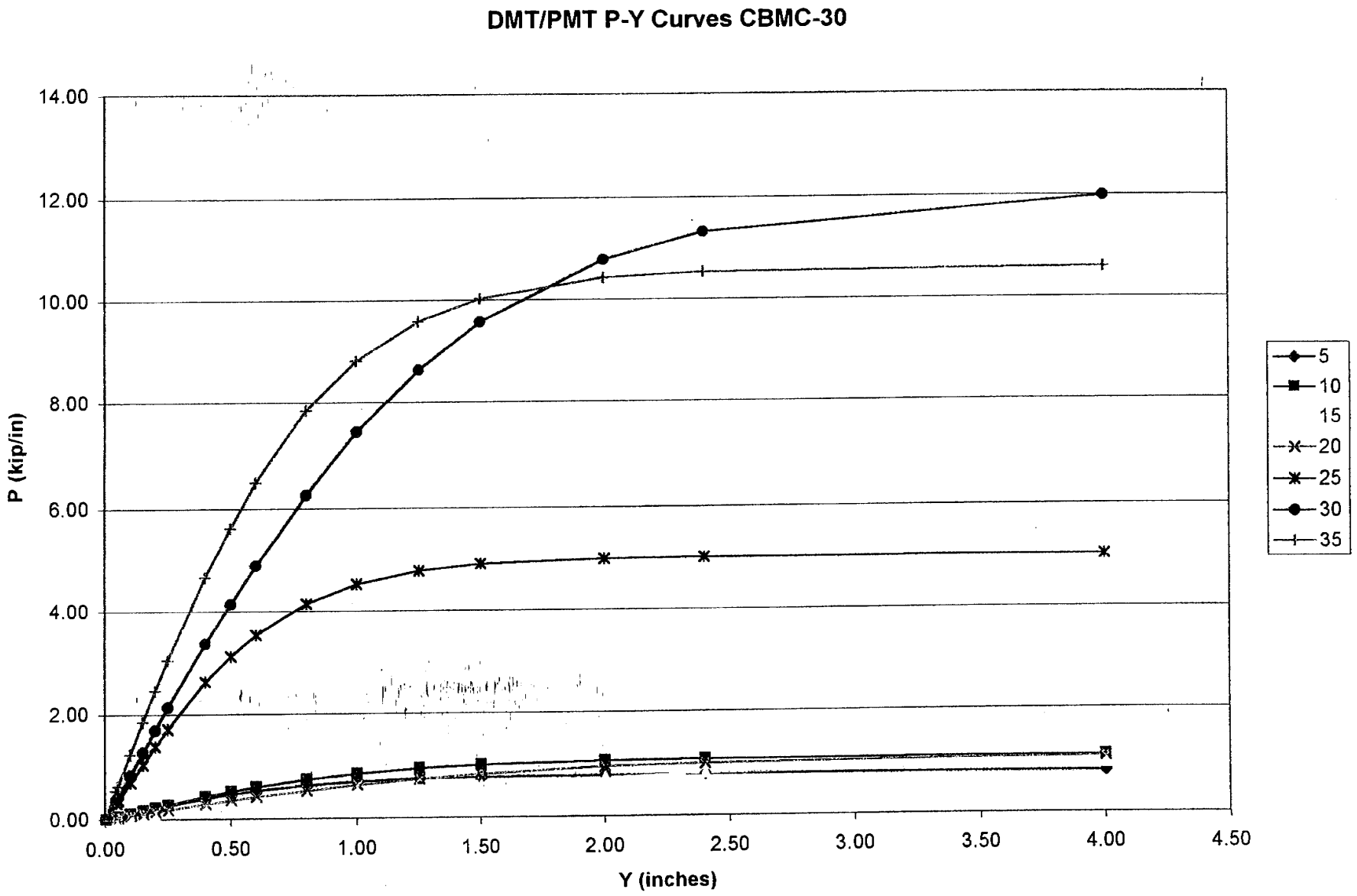
Depth Feet	DEPTH INCHES	DILATOMETER Ed (BAR)	INITIAL SLOPE	PRESSUREMETER RRECTED PRESSURE (BAR)	(LBS/IN)	α	ULTIMATE SOIL RESISTANCE Ph
5	60	32	1160.00	2.5	1522.50	0.54	815.63
10	120	33.5	1214.38	1.7	1035.30	1.07	1109.25
15	180	14	507.50	1.1	669.90	1.50	1004.85
20	240	21	761.25	1.2	730.80	1.50	1096.20
25	300	207	7503.75	5.5	3349.50	1.50	5024.25
30	360	243	8808.75	13.2	8038.80	1.50	12058.20
35	420	356	12905.00	11.6	7064.40	1.50	10596.60

B-1-154

Construction of P-Y Curves CB-MC 30

Y (in)	P 60 (k/in)	P 120 (k/in)	P 180 (k/in)	P 240 (k/in)	P 300 (k/in)	P 360 (k/in)	P 420 (k/in)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.04	0.05	0.05	0.02	0.03	0.32	0.38	0.56
0.05	0.06	0.06	0.03	0.04	0.37	0.44	0.64
0.10	0.11	0.12	0.05	0.07	0.72	0.86	1.25
0.15	0.17	0.18	0.07	0.11	1.07	1.29	1.86
0.20	0.22	0.23	0.10	0.15	1.41	1.71	2.45
0.25	0.27	0.29	0.12	0.18	1.73	2.13	3.03
0.40	0.41	0.45	0.20	0.29	2.62	3.36	4.66
0.50	0.49	0.54	0.24	0.36	3.11	4.14	5.63
0.60	0.55	0.63	0.29	0.42	3.53	4.88	6.48
0.80	0.66	0.77	0.38	0.55	4.14	6.25	7.85
1.00	0.72	0.88	0.46	0.65	4.51	7.43	8.82
1.25	0.77	0.97	0.56	0.76	4.78	8.64	9.59
1.50	0.79	1.03	0.64	0.85	4.90	9.57	10.03
2.00	0.81	1.08	0.77	0.96	5.00	10.79	10.43
2.40	0.81	1.10	0.84	1.02	5.02	11.33	10.53
4.00	0.82	1.11	0.97	1.09	5.02	11.99	10.60

B-1-160


DMT/PMT P-Y Curves CBMC-30
P (kip/in)
Y (inches)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5
10
15
20
25
30
35

191-1-9

APPENDIX B-2

MARGARITA RETAINING WALL
ROTATIONAL STABILITY ANALYSIS
UTEXAS3 RESULTS

```
HEADING
   Puerto Nuevo Sheet Pile Wall/South Side Margarita
   Sta. 50+00
   Q Case
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   10.50
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   -24.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -184.00   -15.00
   -64.00   0.00
   -24.00   5.00
   140.00   5.00

  4  4  CH
   -184.00   -15.00
   140.00   -15.00

  5  5  CH
   -184.00   -28.00
   140.00   -28.00

  6  6  LS
   -184.00   -46.00
   140.00   -46.00


MATERIAL PROPERTIES
  1  SC-H
     115.00 Fill
     Conventional Shear
      600.00   0.00
      No pore pressure
  2  CL
     100.00
     Conventional Shear
      550.00   0.00
      No pore pressure
  3  CH
     95.00
     Conventional Shear
      320.00   0.00
      No pore pressure
  4  CH
     115.00
     Conventional Shear
      1200.00   0.00
      No pore pressure
  5  CH
     115.00
     Conventional Shear
      850.00   0.00
      No pore pressure
  6  LS
     135.00
     Conventional Shear
```

```
     4000.00   0.00
     No pore pressure

PIEZOMETRIC LINE DATA
  1  62.5  GW
    -184.00  0.00
    -64.00  0.00
    0.00  5.00
    140.00  5.00


SURFACE PRESSURE
  -184.00  -15.00   937.50   0.000000
  -64.00  0.00   0.00   0.000000
  13.00  11.20   0.00   0.000000
  13.10  11.20   250.00   0.000000
  140.00  11.20   250.00   0.000000

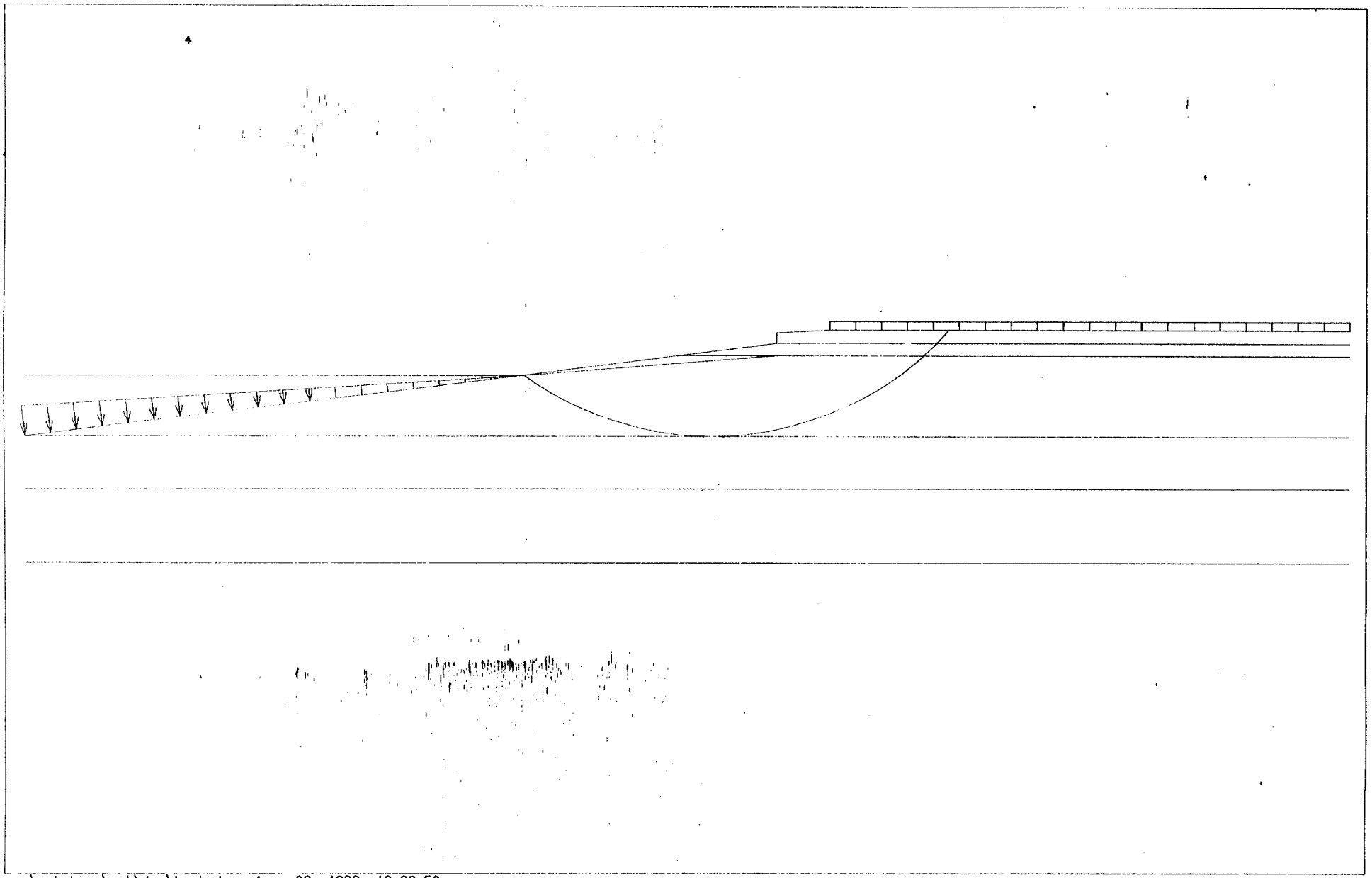
ANALYSIS/COMPUTATION
  Circular      Search
  0.00   40.00   1.00000   -46.00
  TANGENT
  -15.00

PLOT Output activated
COMPUTE Results


1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date:  6:18:1997   Time: 13: 0:53   Input file: marg50q.in
             Puerto Nuevo Sheet Pile Wall/South Side Margarita
             Sta. 50+00
             Q Case

          TABLE NO. 21
          *****  1-STAGE FINAL CRITICAL CIRCLE INFORMATION  *****
          X Coordinate of Center - - - - - - -   -16.000
          Y Coordinate of Center - - - - - - -    63.000
          Radius - - - - - - - - - - - - - - -    78.000
          Factor of Safety - - - - - - - - - -     1.865
          Side Force Inclination - - - - - - -      3.71

          Number of circles tried  - - - - - -   93
          No. of circles F calc. for - - - - -   90
```



..\ustation\out\dgn\test.dgn Apr. 02, 1999 12:28:50

```
HEADING
   Puerto Nuevo Sheet Pile Wall/South Side Margarita
   Sta. 50+00
   S Case
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   10.50
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   -24.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -184.00   -15.00
   -64.00   0.00
   -24.00   5.00
   140.00   5.00

  4  4  CH
   -184.00   -15.00
   140.00   -15.00

  5  5  CH
   -184.00   -28.00
   140.00   -28.00

  6  6  LS
   -184.00   -46.00
   140.00   -46.00


MATERIAL PROPERTIES
  1  SC-H
     115.00 Fill
     Conventional Shear
      0.00   26.00
      No pore pressure
  2  CL
     100.00
     Conventional Shear
      0.00   24.00
      No pore pressure
  3  CH
     95.00
     Conventional Shear
      0.00   20.00
      Piezometric Line
      1 GW
  4  CH
     115.00
     Conventional Shear
      0.00   27.00
      Piezometric Line
      1 gw
  5  CH
     115.00
     Conventional Shear
      0.00   24.00
      Piezometric Line
      1 gw
```

```
  6  LS
    135.00
    Conventional Shear
     0.00  38.00
     Piezometric Line
     1 gw

PIEZOMETRIC LINE DATA
  1  62.5  GW
    -184.00  0.00
    -64.00  0.00
    0.00  5.00
    140.00  5.00


SURFACE PRESSURE
  -184.00  -15.00   937.50   0.000000
  -64.00  0.00   0.00   0.000000
  13.00  11.20   0.00   0.000000
  13.10  11.20   250.00   0.000000
  140.00  11.20   250.00   0.000000

ANALYSIS/COMPUTATION
  Circular
  -30.00    70.00   95.00

PLOT Output activated
COMPUTE Results


Factor of Safety - - - - - - - - -     2.128
          Side Force Inclination - - - - -      5.83
          Number of Iterations - - - - - -     4
1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date:  6:18:1997   Time: 11: 2:34   Input file: marg50s1.in
             Puerto Nuevo Sheet Pile Wall/South Side Margarita
             Sta. 50+00
             S Case
```

```
HEADING
   Puerto Nuevo Sheet Pile Wall/South Side Margarita
   Sta. 50+00
   80% R strength for Seismic condition
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   10.50
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   -24.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -184.00   -15.00
   -64.00   0.00
   -24.00   5.00
   140.00   5.00

  4  4  CH
   -184.00   -15.00
   140.00   -15.00

  5  5  CH
   -184.00   -28.00
   140.00   -28.00

  6  6  LS
   -184.00   -46.00
   140.00   -46.00

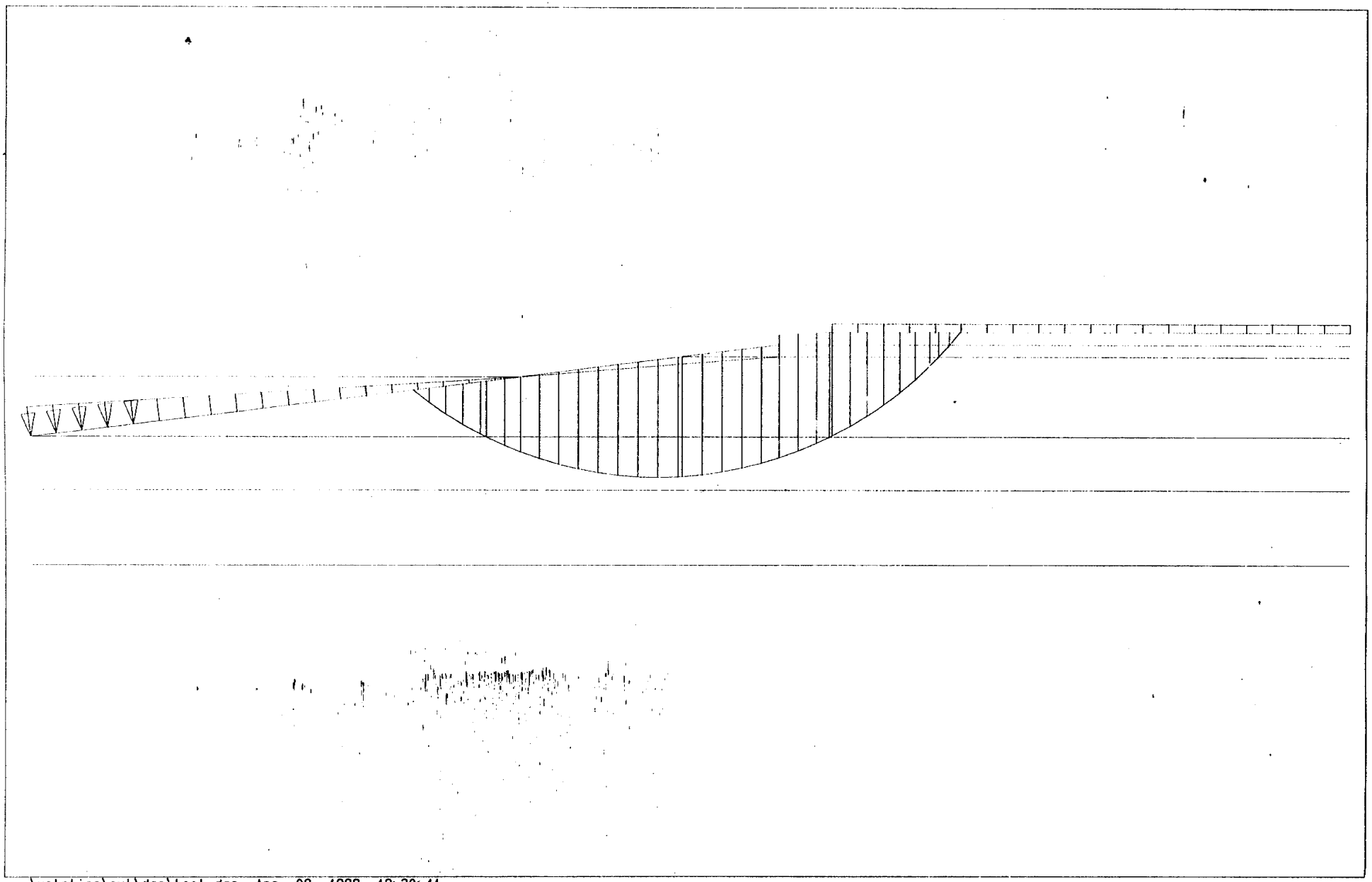

MATERIAL PROPERTIES
  1  SC-H
     115.00 Fill
     Conventional Shear
      0.00   26.00
      No pore pressure
  2  CL
     100.00
     Conventional Shear
      0.00   24.00
      No pore pressure
  3  CH
     95.00
     Conventional Shear
      0.00   20.00
      Piezometric Line
      1 GW
  4  CH
     115.00
     Conventional Shear
      0.00   27.00
      Piezometric Line
      1 gw
  5  CH
     115.00
     Conventional Shear
      0.00   24.00
      Piezometric Line
      1 gw
```

```
SURFACE PRESSURE
  -184.00  -15.00   937.50   0.000000
  -64.00   0.00     0.00     0.000000
  13.00    11.20    0.00     0.000000
  13.10    11.20    250.00   0.000000
  140.00   11.20    250.00   0.000000

ANALYSIS/COMPUTATION
  Circular
  -30.00     70.00   95.00
  TWO-STAGE COMPUTATIONS To Be Performed
   SEISMIC COEFFICIENT
    0.15

PLOT Output activated
COMPUTE Results


Factor of Safety - - - - - - - - -     1.076
          Side Force Inclination - - - - -      12.70
          Number of Iterations - - - - - -      5
1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date:  6:18:1997   Time: 10:27:30   Input file: marg50r2.in
             Puerto Nuevo Sheet Pile Wall/South Side Margarita
             Sta. 50+00
             80% R strength for Seismic condition
```



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```
HEADING
   Puerto Nuevo Sheet Pile Wall/South Side Margarita
   Sta. 51+00
   Q Case
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   10.50
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   0.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -151.00   -14.93
   -31.60   0.00
   0.00   3.95
   0.00   5.00
   140.00   5.00

  4  4  CH
   -151.00   -14.93
   140.00   -14.93

  5  5  CH
   -151.00   -28.00
   140.00   -28.00

  6  6  LS
   -151.00   -46.00
   140.00   -46.00


MATERIAL PROPERTIES
  1  SC-H
    115.00 Fill
    Conventional Shear
     600.00   0.00
     No pore pressure
  2  CL
    100.00
    Conventional Shear
     550.00   0.00
     No pore pressure
  3  CH
    95.00
    Conventional Shear
     320.00   0.00
     No pore pressure
  4  CH
    115.00
    Conventional Shear
     1200.00   0.00
     No pore pressure
  5  CH
    115.00
    Conventional Shear
     850.00   0.00
     No pore pressure
  6  LS
    135.00
```

```
   Conventional Shear
    4000.00  0.00
    No pore pressure

PIEZOMETRIC LINE DATA
  1  62.5  GW
    -151.00  0.00
    -31.60  0.00
    0.00  3.00
    140.00  5.00

SURFACE PRESSURE
  -151.00  -14.93   931.63   0.000000
  -31.60  0.00   0.00   0.000000
  0.00  3.95   0.00   0.000000
  13.00  11.20   0.00   0.000000
  13.10  11.20   250.00   0.000000
  140.00  11.20   250.00   0.000000

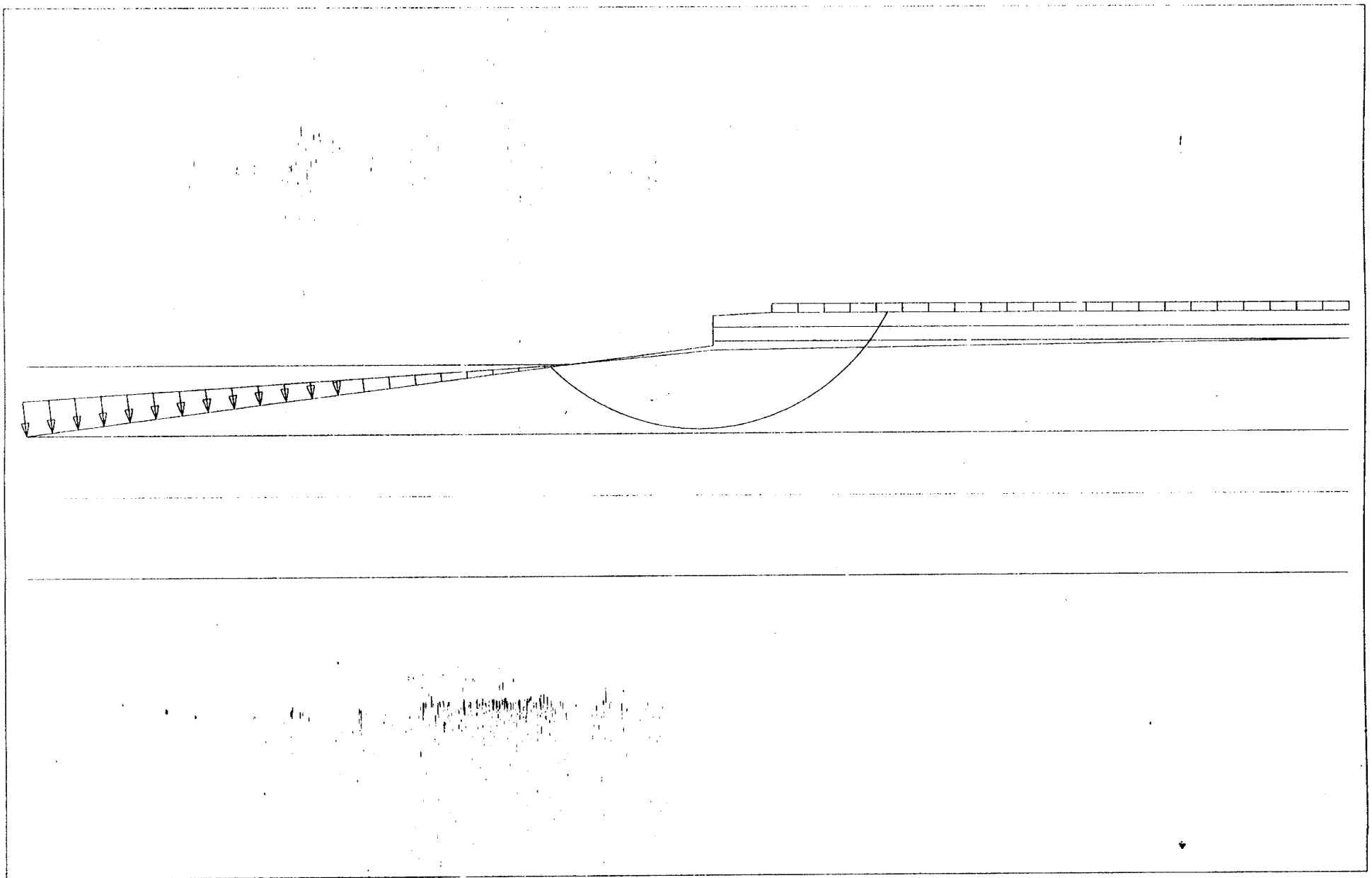
ANALYSIS/COMPUTATION
  Circular      Search
  0.00   40.00   1.00000   -46.00
  TANGENT
  -28.00

PLOT Output activated
COMPUTE Results


         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date:  6:18:1997   Time: 14:38:44   Input file: marg51q.in
             Puerto Nuevo Sheet Pile Wall/South Side Margarita
             Sta. 51+00
             Q Case

          TABLE NO. 21
          *****  1-STAGE FINAL CRITICAL CIRCLE INFORMATION  *****
          X Coordinate of Center - - - - - - -    -3.000
          Y Coordinate of Center - - - - - - -    33.000
          Radius - - - - - - - - - - - - - - -    47.000
          Factor of Safety - - - - - - - - - -     1.454
          Side Force Inclination - - - - - - -      3.18

          Number of circles tried  - - - - - -  180
          No. of circles F calc. for - - - - -  169
```



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```
HEADING
   Puerto Nuevo Sheet Pile Wall/South Side Margarita
   Sta. 51+00
   S Case
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   10.50
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   0.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -151.00   -14.93
   -31.60   0.00
   0.00   3.95
   0.00   5.00
   140.00   5.00

  4  4  CH
   -151.00   -14.93
   140.00   -14.93

  5  5  CH
   -151.00   -28.00
   140.00   -28.00

  6  6  LS
   -151.00   -46.00
   140.00   -46.00


MATERIAL PROPERTIES
  1  SC-H
    115.00 Fill
    Conventional Shear
     0.00   26.00
     No pore pressure
  2  CL
    100.00
    Conventional Shear
     0.00   24.00
     No pore pressure
  3  CH
    95.00
    Conventional Shear
     0.00   20.00
     Piezometric Line
     1 GW
  4  CH
    115.00
    Conventional Shear
     0.00   27.00
     Piezometric Line
     1 gw
  5  CH
    115.00
    Conventional Shear
     0.00   24.00
     Piezometric Line
```

```
    1 gw
  6 LS
    135.00
    Conventional Shear
     0.00  38.00
     Piezometric Line
     1 gw

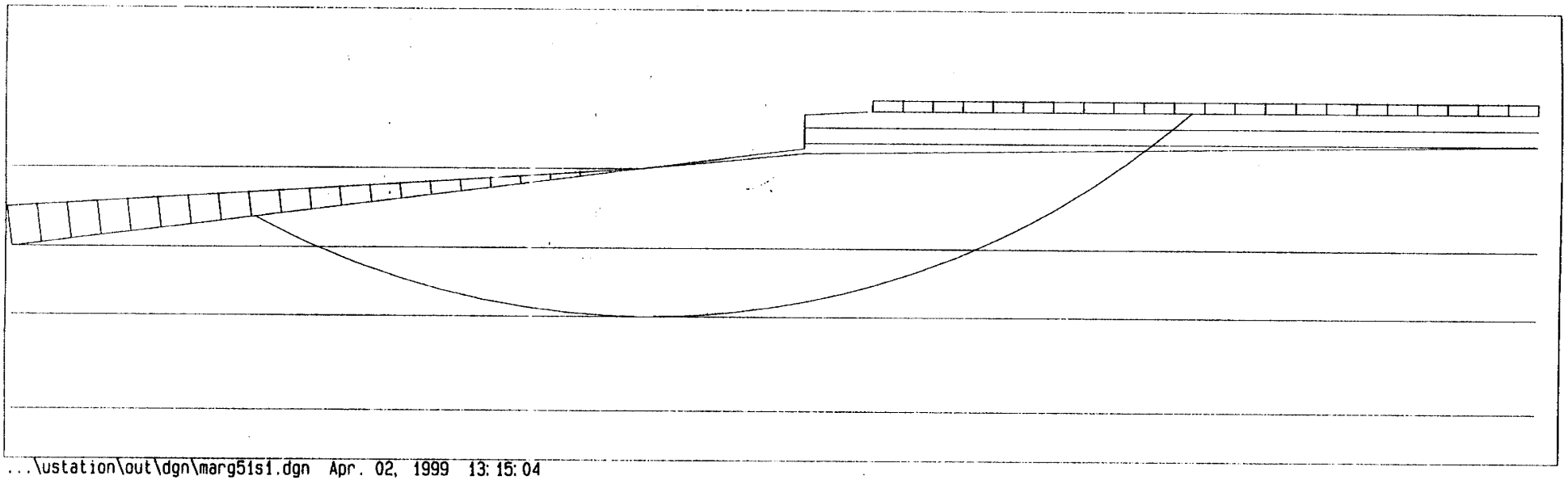
PIEZOMETRIC LINE DATA
  1  62.5  GW
    -151.00  0.00
    -31.60  0.00
    0.00  3.00
    140.00  5.00


SURFACE PRESSURE
  -151.00  -14.93   931.63   0.000000
  -31.60  0.00   0.00   0.000000
  0.00  3.95   0.00   0.000000
  13.00  11.20   0.00   0.000000
  13.10  11.20   250.00   0.000000
  140.00  11.20   250.00   0.000000

ANALYSIS/COMPUTATION
  Circular
  -30.00    130.00   158.00

PLOT Output activated
COMPUTE Results


          Factor of Safety - - - - - - - - -    2.245
          Side Force Inclination - - - - - -     5.12
          Number of Iterations - - - - - -      4
1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date:  6:18:1997   Time: 14:43: 4   Input file: marg51s1.in
             Puerto Nuevo Sheet Pile Wall/South Side Margarita
             Sta. 51+00
             S Case
```



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```
HEADING
   Puerto Nuevo Sheet Pile Wall/South Side Margarita
   Sta. 51+00
   80% R strength for Seismic condition
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   10.50
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   0.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -151.00   -14.93
   -31.60   0.00
   0.00   3.95
   0.00   5.00
   140.00   5.00

  4  4  CH
   -151.00   -14.93
   140.00   -14.93

  5  5  CH
   -151.00   -28.00
   140.00   -28.00

  6  6  LS
   -151.00   -46.00
   140.00   -46.00


MATERIAL PROPERTIES
  1  SC-H
    115.00 Fill
    Conventional Shear
     0.00   26.00
     No pore pressure
  2  CL
    100.00
    Conventional Shear
     0.00   24.00
     No pore pressure
  3  CH
    95.00
    Conventional Shear
     0.00   20.00
     Piezometric Line
     1 GW
  4  CH
    115.00
    Conventional Shear
     0.00   27.00
     Piezometric Line
     1 gw
  5  CH
    115.00
    Conventional Shear
     0.00   24.00
     Piezometric Line
```

```
     1 gw
   6  LS
     135.00
     Conventional Shear
      0.00  38.00
      Piezometric Line
      1 gw

 PIEZOMETRIC LINE DATA
   1  62.5  GW
     -151.00  0.00
     -31.60  0.00
     0.00  3.00
     140.00  5.00


 SURFACE PRESSURE
   -151.00  -14.93    931.63    0.000000
   -31.60  0.00    0.00    0.000000
   0.00  3.95    0.00    0.000000
   13.00  11.20    0.00    0.000000
   13.10  11.20    250.00    0.000000
   140.00  11.20    250.00    0.000000

 SECond-Stage Data Activated
 MATERIAL PROPERTIES
   1  sc-h
     110.00 sc-h
     2-stage Linear
      0.00  26.00    300.00    11.00
      No pore pressure
   2  CL
     95.00 CL
     2-stage Linear
      0.00  24.00    240.00    10.00
      No pore pressure
   3  CH
     95.00 CH
     2-stage Linear
      0.00  20.00    200.00    9.00
      Piezometric Line
      1 gw
   4  CH
     115.00 CH
     2-stage Linear
      0.00  27.00    800.00    10.00
      Piezometric Line
      1 GW
   5  CH
     115.00 CH
     2-stage Linear
      0.00  24.00    500.00    9.00
      Piezometric Line
      1 GW
   6  LS
     135.00 LS
     2-stage Linear
      0.00  38.00    2000.00    17.00
      Piezometric Line
      1 GW

 PIEZOMETRIC LINE DATA
   1  62.5  GW
     -151.00  0.00
     -31.60  0.00
```

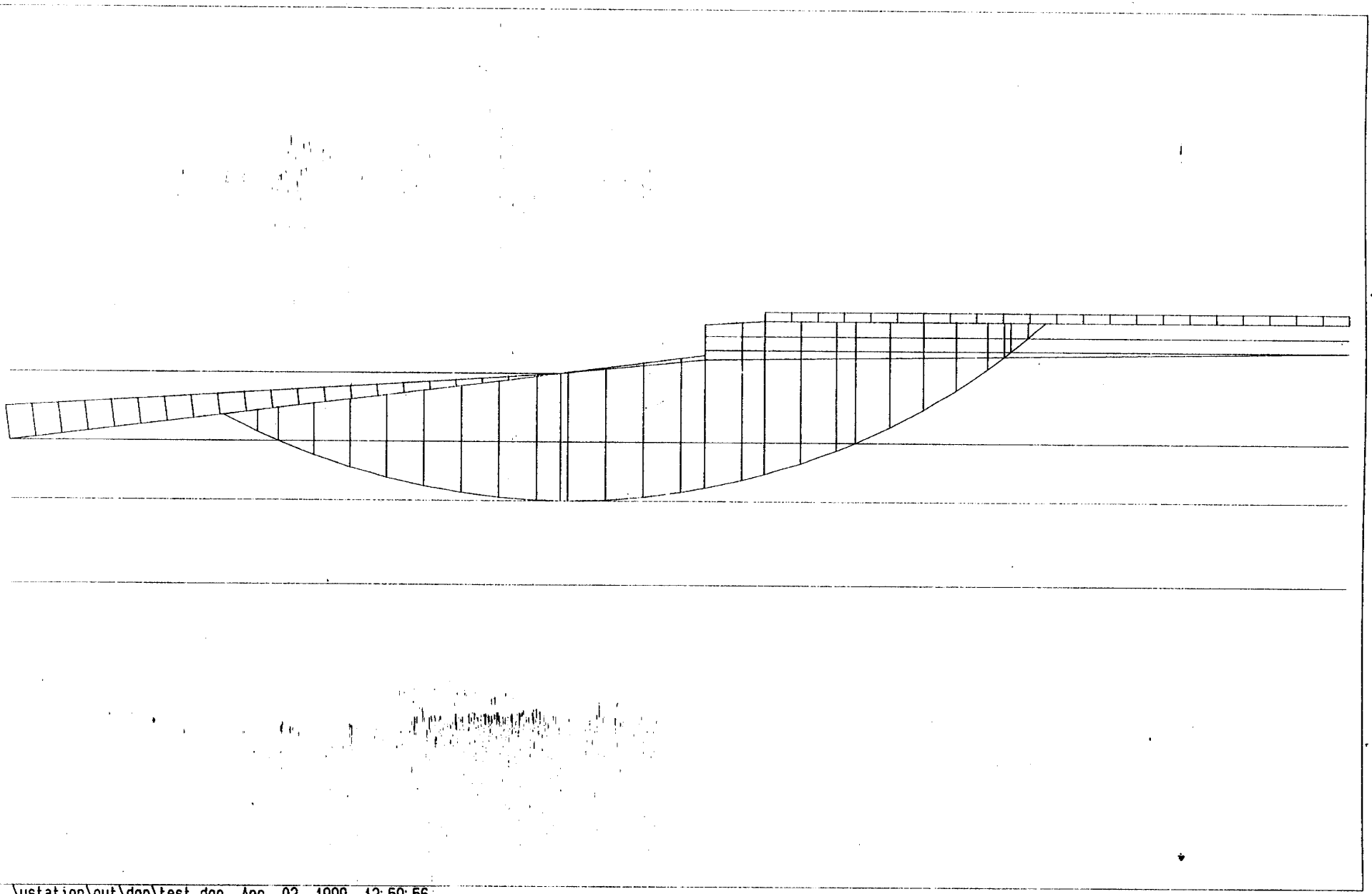
```
    0.00   3.00
    140.00   5.00


SURFACE PRESSURE
  -151.00   -14.93-   931.63    0.000000
  -31.60   0.00    0.00    0.000000
  0.00   3.95    0.00    0.000000
  13.00   11.20    0.00    0.000000
  13.10   11.20    250.00    0.000000
  140.00   11.20    250.00    0.000000

ANALYSIS/COMPUTATION
  Circular
  -30.00     130.00    158.00
  TWO-STAGE COMPUTATIONS To Be Performed
   SEISMIC COEFFICIENT
    0.15

PLOT Output activated
COMPUTE Results


  Factor of Safety - - - - - - - -      1.069
          Side Force Inclination - - - - -      12.23
          Number of Iterations - - - - - -      5
1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date:  6:18:1997   Time: 14:20:52   Input file: marg51r1.in
             Puerto Nuevo Sheet Pile Wall/South Side Margarita
             Sta. 51+00
```



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```
HEADING
   Puerto Nuevo Sheet Pile Wall/South Side Margarita
   Sta. 52+00
   Q strength - short term
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   11.00
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   0.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -130.00   -14.91
   -10.72   0.00
   0.00   1.34
   0.00   5.00
   140.00   5.00

  4  4  CH
   -130.00   -14.91
   140.00   -14.91

  5  5  CH
   -130.00   -28.00
   140.00   -28.00

  6  6  LS
   -130.00   -46.00
   140.00   -46.00


MATERIAL PROPERTIES
  1  SC-H
    115.00 Fill
    Conventional Shear
     600.00   0.00
     No pore pressure
  2  CL
    100.00
    Conventional Shear
     550.00   0.00
     No pore pressure
  3  CH
    95.00
    Conventional Shear
     320.00   0.00
     No pore pressure
  4  CH
    115.00
    Conventional Shear
     1200.00   0.00
     No pore pressure
  5  CH
    115.00
    Conventional Shear
     850.00   0.00
     No pore pressure
  6  LS
    135.00
```

```
    Conventional Shear
     4000.00  0.00
     No pore pressure

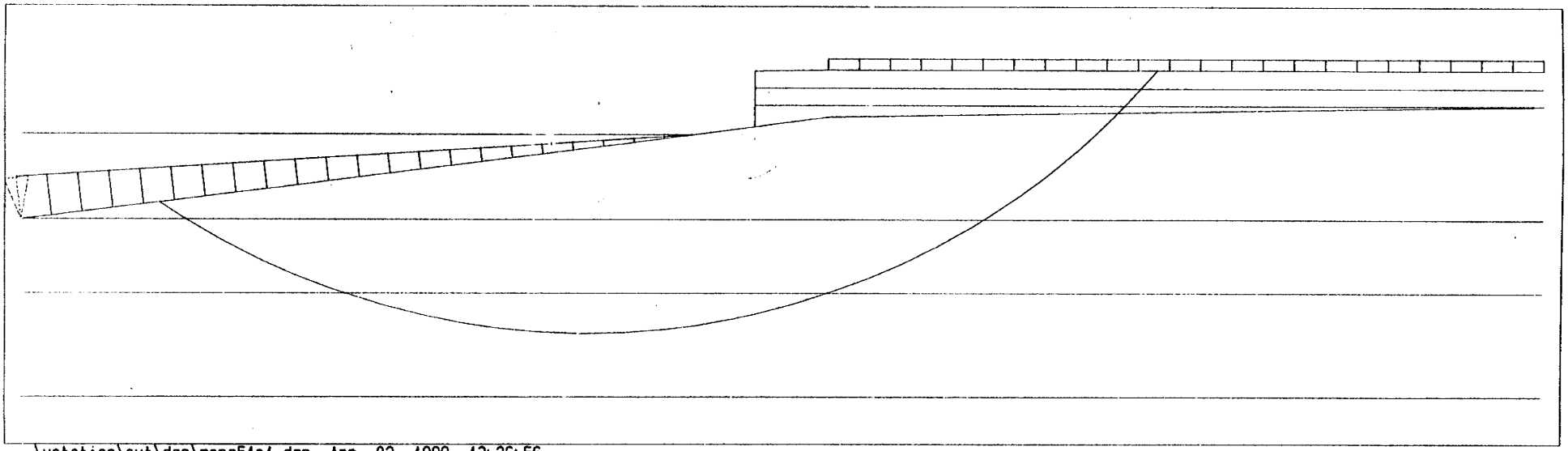
PIEZOMETRIC LINE DATA
  1  62.5  GW
    -130.00  0.00
    -10.72  0.00
    0.00  1.34
    13.00  3.00
    140.00  5.00


SURFACE PRESSURE
  -130.00  -14.91   931.88   0.000000
  -10.72  0.00   0.00   0.000000
  0.00  1.34   0.00   0.000000
  13.00  11.20   0.00   0.000000
  13.10  11.20   250.00   0.000000
  140.00  11.20   250.00   0.000000

ANALYSIS/COMPUTATION
  Circular
  -30.00    100.00   135.00

PLOT Output activated
COMPUTE Results


  Factor of Safety - - - - - - - -     3.214
          Side Force Inclination - - - - -      4.27
          Number of Iterations - - - - - -     4
1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date: 10:15:1997   Time: 10:42:50   Input file: marg52q.in
             Puerto Nuevo Sheet Pile Wall/South Side Margarita
             Sta. 52+00
             Q strength - short term
```



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```
HEADING
   Puerto Nuevo Pipe Pile Wall/South Side Margarita
   Sta. 52+00
   Long Term Case
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   11.00
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   0.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -130.00   -14.91
   -10.72   0.00
   0.00   1.34
   0.00   5.00
   140.00   5.00

  4  4  CH
   -130.00   -14.91
   140.00   -14.91

  5  5  CH
   -130.00   -28.00
   140.00   -28.00

  6  6  LS
   -130.00   -46.00
   140.00   -46.00


MATERIAL PROPERTIES
  1  SC-H
     115.00 Fill
     Conventional Shear
      0.00   26.00
      No pore pressure
  2  CL
     100.00
     Conventional Shear
      0.00   24.00
      No pore pressure
  3  CH
     95.00
     Conventional Shear
      0.00   20.00
      Piezometric Line
      1 GW
  4  CH
     115.00
     Conventional Shear
      0.00   27.00
      Piezometric Line
      1 gw
  5  CH
     115.00
     Conventional Shear
      0.00   24.00
      Piezometric Line
```

```
    1 gw
  6  LS
    135.00
    Conventional Shear
     0.00   38.00
     Piezometric Line
     1 gw

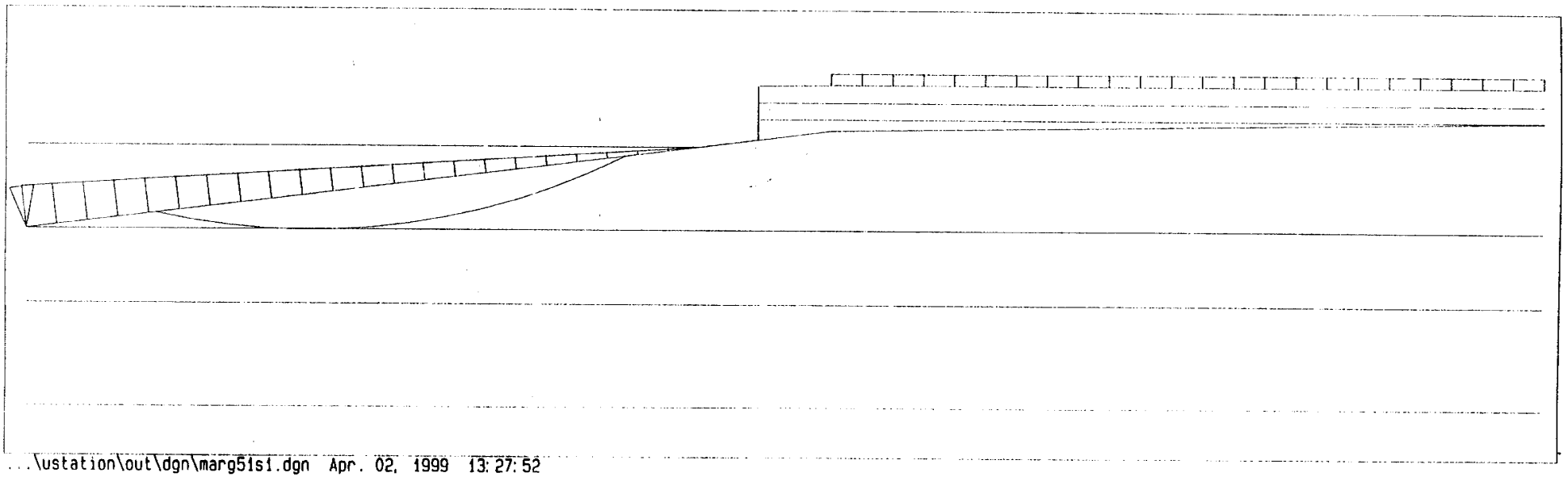
PIEZOMETRIC LINE DATA
  1  62.5  GW
    -130.00  0.00
    -10.72  0.00
    0.00  1.34
    13.00  3.00
    140.00  5.00


SURFACE PRESSURE
  -130.00  -14.91   931.88   0.000000
  -10.72  0.00   0.00   0.000000
  0.00  1.34   0.00   0.000000
  13.00  11.20   0.00   0.000000
  13.10  11.20   250.00   0.000000
  140.00  11.20   250.00   0.000000

ANALYSIS/COMPUTATION
  Circular
  -80.00    110.00   125.00

PLOT Output activated
COMPUTE Results


 Factor of Safety - - - - - - - -     3.280
          Side Force Inclination - - - - -      1.42
          Number of Iterations - - - - - -     4
1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date: 12:17:1997   Time: 14:59:37   Input file: marg52s.in
             Puerto Nuevo Pipe Pile Wall/South Side Margarita
             Sta. 52+00
             Long Term Case
```



...\ustation\out\dgn\marg51s1.dgn Apr. 02, 1999 13:27:52

```
HEADING
   Puerto Nuevo Sheet Pile Wall/South Side Margarita
   Sta. 52+00
   80% R strength for Seismic condition
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   11.00
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   0.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -130.00   -14.91
   -10.72   0.00
   0.00   1.34
   0.00   5.00
   140.00   5.00

  4  4  CH
   -130.00   -14.91
   140.00   -14.91

  5  5  CH
   -130.00   -28.00
   140.00   -28.00

  6  6  LS
   -130.00   -46.00
   140.00   -46.00


MATERIAL PROPERTIES
  1  SC-H
     115.00 Fill
     Conventional Shear
      0.00   26.00
      No pore pressure
  2  CL
     100.00
     Conventional Shear
      0.00   24.00
      No pore pressure
  3  CH
     95.00
     Conventional Shear
      0.00   20.00
      Piezometric Line
      1 GW
  4  CH
     115.00
     Conventional Shear
      0.00   27.00
      Piezometric Line
      1 gw
  5  CH
     115.00
     Conventional Shear
      0.00   24.00
      Piezometric Line
```

```
     1 gw
  6  LS
     135.00
     Conventional Shear
      0.00  38.00
      Piezometric Line
      1 gw

PIEZOMETRIC LINE DATA
  1  62.5  GW
     -130.00  0.00
     -10.72  0.00
     0.00  1.34
     13.00  3.00
     140.00  5.00


SURFACE PRESSURE
  -130.00  -14.91   931.88   0.000000
  -10.72  0.00   0.00   0.000000
  0.00  1.34   0.00   0.000000
  13.00  11.20   0.00   0.000000
  13.10  11.20   250.00   0.000000
  140.00  11.20   250.00   0.000000

SECond-Stage Data Activated
MATERIAL PROPERTIES
  1  sc-h
     110.00 sc-h
     2-stage Linear
      0.00  26.00   300.00   11.00
      No pore pressure
  2  CL
     95.00 CL
     2-stage Linear
      0.00  24.00   240.00   10.00
      No pore pressure
  3  CH
     95.00 CH
     2-stage Linear
      0.00  20.00   200.00   9.00
      Piezometric Line
      1 gw
  4  CH
     115.00 CH
     2-stage Linear
      0.00  27.00   800.00   10.00
      Piezometric Line
      1 GW
  5  CH
     115.00 CH
     2-stage Linear
      0.00  24.00   500.00   9.00
      Piezometric Line
      1 GW
  6  LS
     135.00 LS
     2-stage Linear
      0.00  38.00   2000.00   17.00
      Piezometric Line
      1 GW

PIEZOMETRIC LINE DATA
  1  62.5  GW
     -130.00  0.00
```

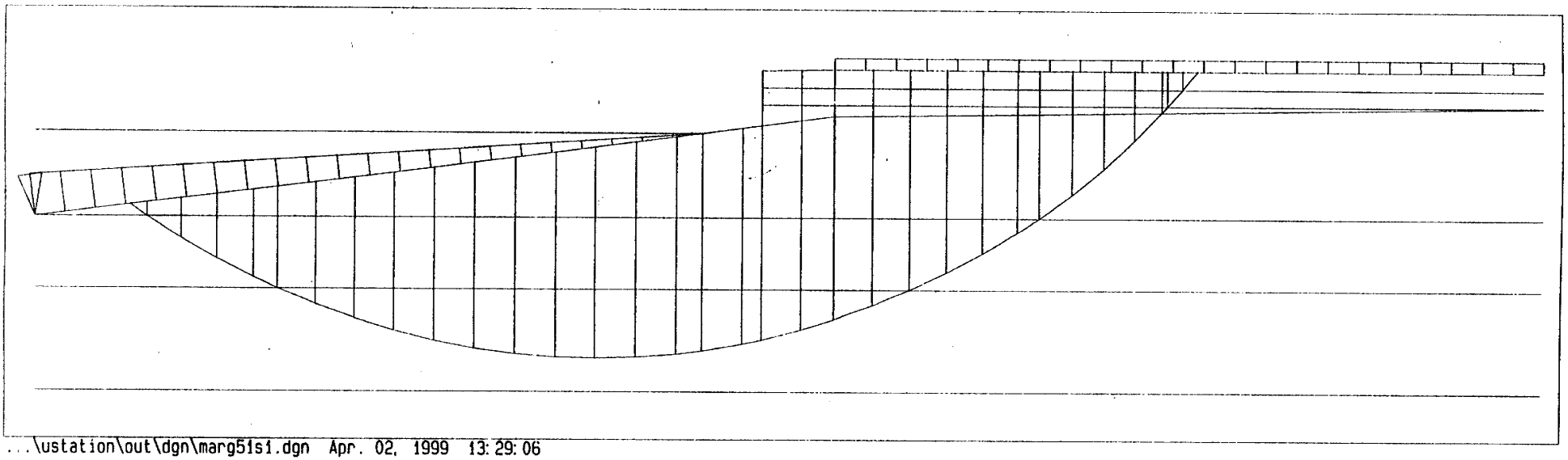
```
    -10.72  0.00
    0.00  1.34
    13.00  3.00
    140.00  5.00

SURFACE PRESSURE
  -130.00  -14.91   931.88   0.000000
  -10.72  0.00   0.00   0.000000
  0.00  1.34   0.00   0.000000
  13.00  11.20   0.00   0.000000
  13.10  11.20   250.00   0.000000
  140.00  11.20   250.00   0.000000

ANALYSIS/COMPUTATION
  Circular
  -30.00    100.00   140.00
  TWO-STAGE COMPUTATIONS To Be Performed
   SEISMIC COEFFICIENT
    0.15

PLOT Output activated
COMPUTE Results


          Factor of Safety - - - - - - - - -     1.048
          Side Force Inclination - - - - -       10.35
          Number of Iterations - - - - - -       6
1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date:  6:18:1997   Time: 15:47:35   Input file: marg52r2.in
             Puerto Nuevo Sheet Pile Wall/South Side Margarita
             Sta. 52+00
             80% R strength for Seismic condition
```



...\ustation\out\dgn\marg51s1.dgn Apr. 02, 1999 13:29:06

```
HEADING
   Puerto Nuevo Sheet Pile Wall/South Side Margarita
   Sta. 50+00 to Sta. 53+00
   Q case
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   13.00
   13.00  13.00
   140.00  13.00

  2  2  CL
   0.00   5.00
   0.00   8.00
   140.00  8.00

  3  3  CH
   -120.00  -15.00
   0.00   0.00
   0.00   5.00
   140.00  5.00

  4  4  CH
   -120.00  -15.00
   140.00  -15.00

  5  5  CH
   -120.00  -28.00
   140.00  -28.00

  6  6  LS
   -120.00  -46.00
   140.00  -46.00


MATERIAL PROPERTIES
  1  SC-H
     115.00 Fill
     Conventional Shear
      600.00  0.00
      No pore pressure
  2  CL
     100.00
     Conventional Shear
      550.00  0.00
      No pore pressure
  3  CH
     95.00
     Conventional Shear
      320.00  0.00
      No pore pressure
  4  CH
     115.00
     Conventional Shear
      1200.00  0.00
      No pore pressure
  5  CH
     115.00
     Conventional Shear
      850.00  0.00
      No pore pressure
  6  LS
     135.00
     Conventional Shear
      4000.00  0.00
```

```
     No pore pressure

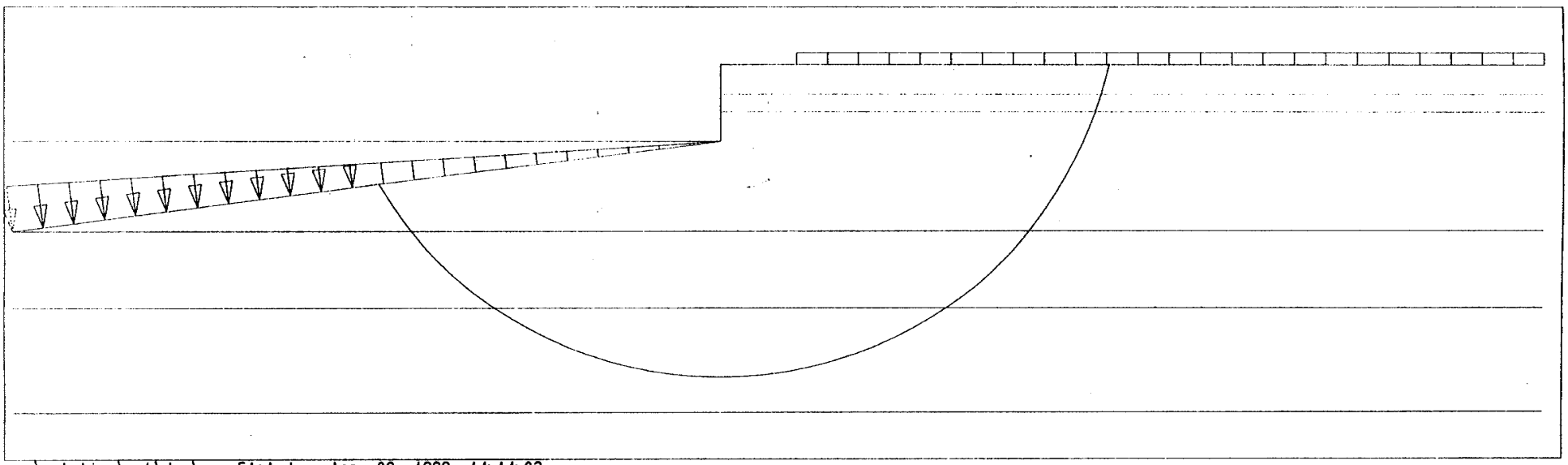
PIEZOMETRIC LINE DATA
  1   62.5  GW
     -120.00  0.00
     0.00  0.00
     0.00  5.00
     140.00  5.00


SURFACE PRESSURE
  -120.00  -15.00    937.50    0.000000
  0.00  0.00    0.00    0.000000
  0.00  5.00    0.00    0.000000
  0.00  8.00    0.00    0.000000
  0.00  13.00    0.00    0.000000
  12.99  13.00    0.00    0.000000
  13.00  13.00    250.00    0.000000
  140.00  13.00    250.00    0.000000

ANALYSIS/COMPUTATION
  Circular
  0.00     28.00    68.00

PLOT Output activated
COMPUTE Results


Factor of Safety - - - - - - - - -     2.457
          Side Force Inclination - - - - -      3.47
          Number of Iterations - - - - - -     4
1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date:  6:12:1997   Time: 10:22: 0   Input file: marg53q1.in
             Puerto Nuevo Sheet Pile Wall/South Side Margarita
             Sta. 50+00 to Sta. 53+00
             Q case
```



...\ustation\out\dgn\marg51si.dgn Apr. 02, 1999 14:14:03

```
HEADING
   Puerto Nuevo Pipe Pile Wall/South Side Margarita
   Sta. 53+00
   Long Term Case
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   11.00
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   0.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -130.00   -14.91
   -10.72   0.00
   0.00   1.34
   0.00   5.00
   140.00   5.00

  4  4  CH
   -130.00   -14.91
   140.00   -14.91

  5  5  CH
   -130.00   -28.00
   140.00   -28.00

  6  6  LS
   -130.00   -46.00
   140.00   -46.00


MATERIAL PROPERTIES
  1  SC-H
    115.00 Fill
    Conventional Shear
     0.00   26.00
     No pore pressure
  2  CL
    100.00
    Conventional Shear
     0.00   24.00
     No pore pressure
  3  CH
    95.00
    Conventional Shear
     0.00   20.00
     Piezometric Line
     1 GW
  4  CH
    115.00
    Conventional Shear
     0.00   27.00
     Piezometric Line
     1 gw
  5  CH
    115.00
    Conventional Shear
     0.00   24.00
     Piezometric Line
```

```
    1 gw
  6  LS
    135.00
    Conventional Shear
     0.00  38.00
     Piezometric Line
     1 gw

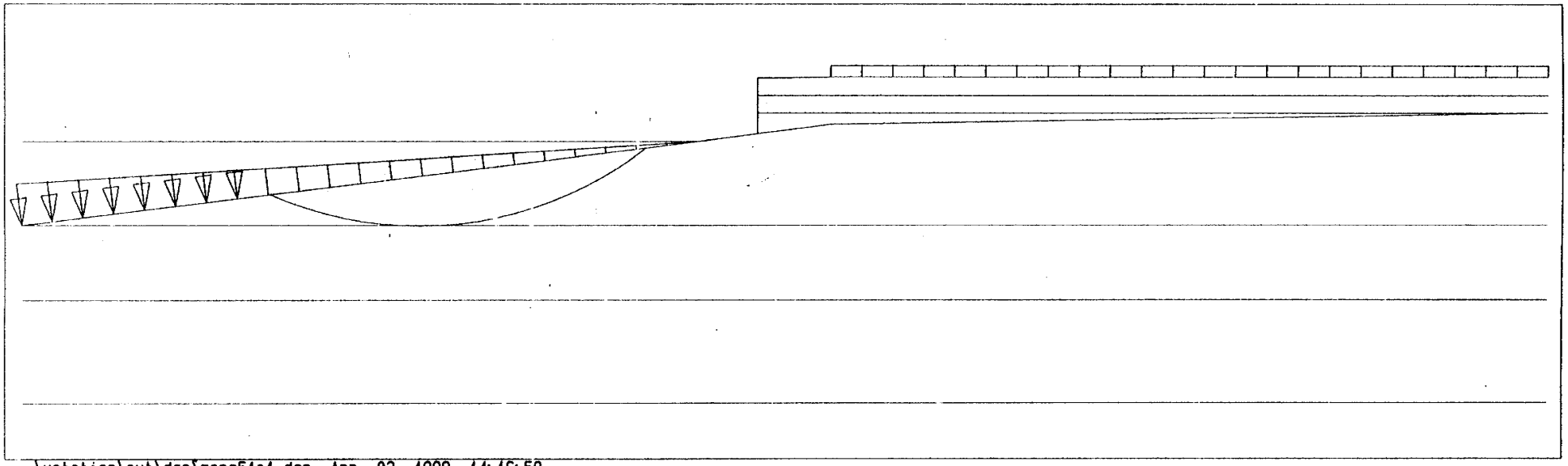
PIEZOMETRIC LINE DATA
  1  62.5  GW
    -130.00  0.00
    -10.72  0.00
    0.00  1.34
    13.00  3.00
    140.00  5.00


SURFACE PRESSURE
  -130.00  -14.91   931.88   0.000000
  -10.72  0.00   0.00   0.000000
  0.00  1.34   0.00   0.000000
  13.00  11.20   0.00   0.000000
  13.10  11.20   250.00   0.000000
  140.00  11.20   250.00   0.000000

ANALYSIS/COMPUTATION
  Circular
  -60.00    50.00   65.00

PLOT Output activated
COMPUTE Results


  Factor of Safety - - - - - - - - -    3.494
          Side Force Inclination - - - - - -    1.31
          Number of Iterations - - - - - -    5
1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date: 12:17:1997   Time: 15:58:10   Input file: marg53s.in
             Puerto Nuevo Pipe Pile Wall/South Side Margarita
             Sta. 53+00
             Long Term Case
```



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```
HEADING
   Puerto Nuevo Sheet Pile Wall/South Side Margarita
   Sta. 52+00
   80% R strength for Seismic condition
PROFILE LINES
  1  1  SC-H
   0.00   8.00
   0.00   11.00
   13.00   11.20
   13.10   11.20
   140.00   11.20

  2  2  CL
   0.00   5.00
   0.00   8.00
   140.00   8.00

  3  3  CH
   -130.00   -14.91
   -10.72   0.00
   0.00   1.34
   0.00   5.00
   140.00   5.00

  4  4  CH
   -130.00   -14.91
   140.00   -14.91

  5  5  CH
   -130.00   -28.00
   140.00   -28.00

  6  6  LS
   -130.00   -46.00
   140.00   -46.00


MATERIAL PROPERTIES
  1  SC-H
     115.00 Fill
     Conventional Shear
      0.00   26.00
      No pore pressure
  2  CL
     100.00
     Conventional Shear
      0.00   24.00
      No pore pressure
  3  CH
     95.00
     Conventional Shear
      0.00   20.00
      Piezometric Line
      1 GW
  4  CH
     115.00
     Conventional Shear
      0.00   27.00
      Piezometric Line
      1 gw
  5  CH
     115.00
     Conventional Shear
      0.00   24.00
      Piezometric Line
```

```
    1 gw
  6 LS
    135.00
    Conventional Shear
     0.00  38.00
     Piezometric Line
     1 gw

PIEZOMETRIC LINE DATA
  1  62.5  GW
    -130.00  0.00
    -10.72  0.00
    0.00  1.34
    13.00  3.00
    140.00  5.00


SURFACE PRESSURE
  -130.00  -14.91   931.88   0.000000
  -10.72  0.00   0.00   0.000000
  0.00  1.34   0.00   0.000000
  13.00  11.20   0.00   0.000000
  13.10  11.20   250.00   0.000000
  140.00  11.20   250.00   0.000000

SECond-Stage Data Activated
MATERIAL PROPERTIES
  1  sc-h
    110.00 sc-h
    2-stage Linear
     0.00  26.00   300.00   11.00
     No pore pressure
  2  CL
    95.00 CL
    2-stage Linear
     0.00  24.00   240.00   10.00
     No pore pressure
  3  CH
    95.00 CH
    2-stage Linear
     0.00  20.00   200.00   9.00
     Piezometric Line
     1 gw
  4  CH
    115.00 CH
    2-stage Linear
     0.00  27.00   800.00   10.00
     Piezometric Line
     1 GW
  5  CH
    115.00 CH
    2-stage Linear
     0.00  24.00   500.00   9.00
     Piezometric Line
     1 GW
  6  LS
    135.00 LS
    2-stage Linear
     0.00  38.00   2000.00   17.00
     Piezometric Line
     1 GW

PIEZOMETRIC LINE DATA
  1  62.5  GW
    -130.00  0.00
```

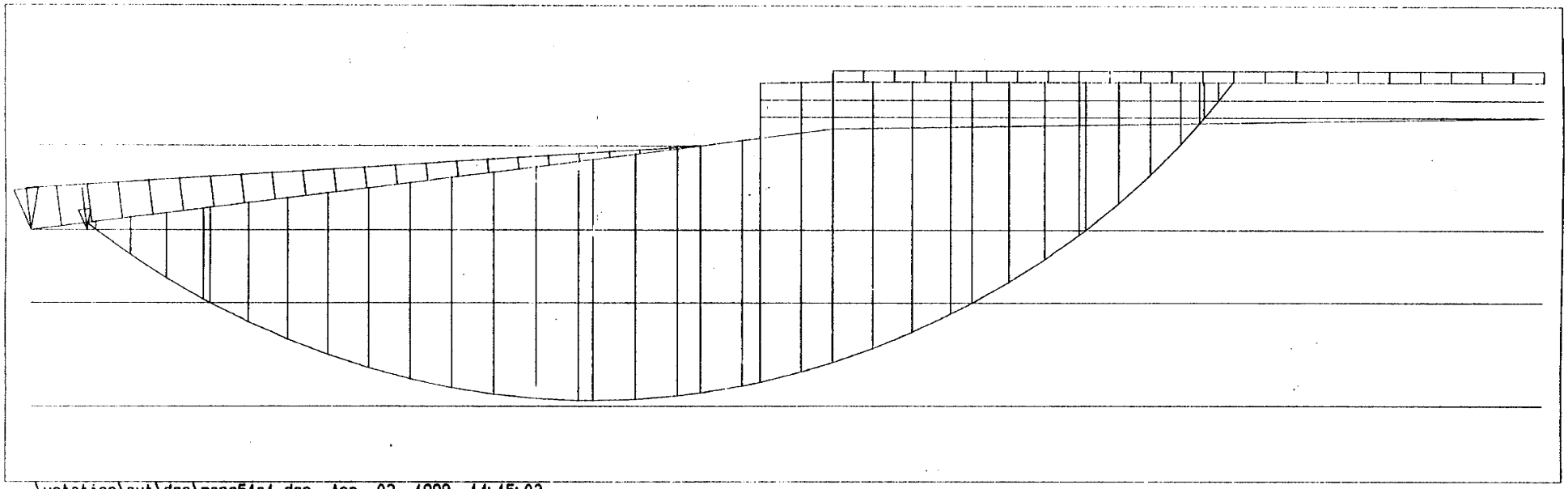
```
    -10.72  0.00
    0.00  1.34
    13.00  3.00
    140.00  5.00

SURFACE PRESSURE
  -130.00  -14.91   931.88   0.000000
  -10.72  0.00    0.00   0.000000
  0.00  1.34    0.00   0.000000
  13.00  11.20    0.00   0.000000
  13.10  11.20    250.00   0.000000
  140.00  11.20    250.00   0.000000

ANALYSIS/COMPUTATION
  Circular
  -30.00    100.00   145.00
  TWO-STAGE COMPUTATIONS To Be Performed
   SEISMIC COEFFICIENT
    0.15

PLOT Output activated
COMPUTE Results


          Factor of Safety - - - - - - - - -     1.037
          Side Force Inclination - - - - -       9.83
          Number of Iterations - - - - - -       6
1         UTEXAS3 - VER. 1.120 - 10/08/92 - (C) 1985-1992 S. G. WRIGHT
          Date:  6:18:1997   Time: 16: 0:12   Input file: marg53r3.in
             Puerto Nuevo Sheet Pile Wall/South Side Margarita
             Sta. 52+00
             80% R strength for Seismic condition
```



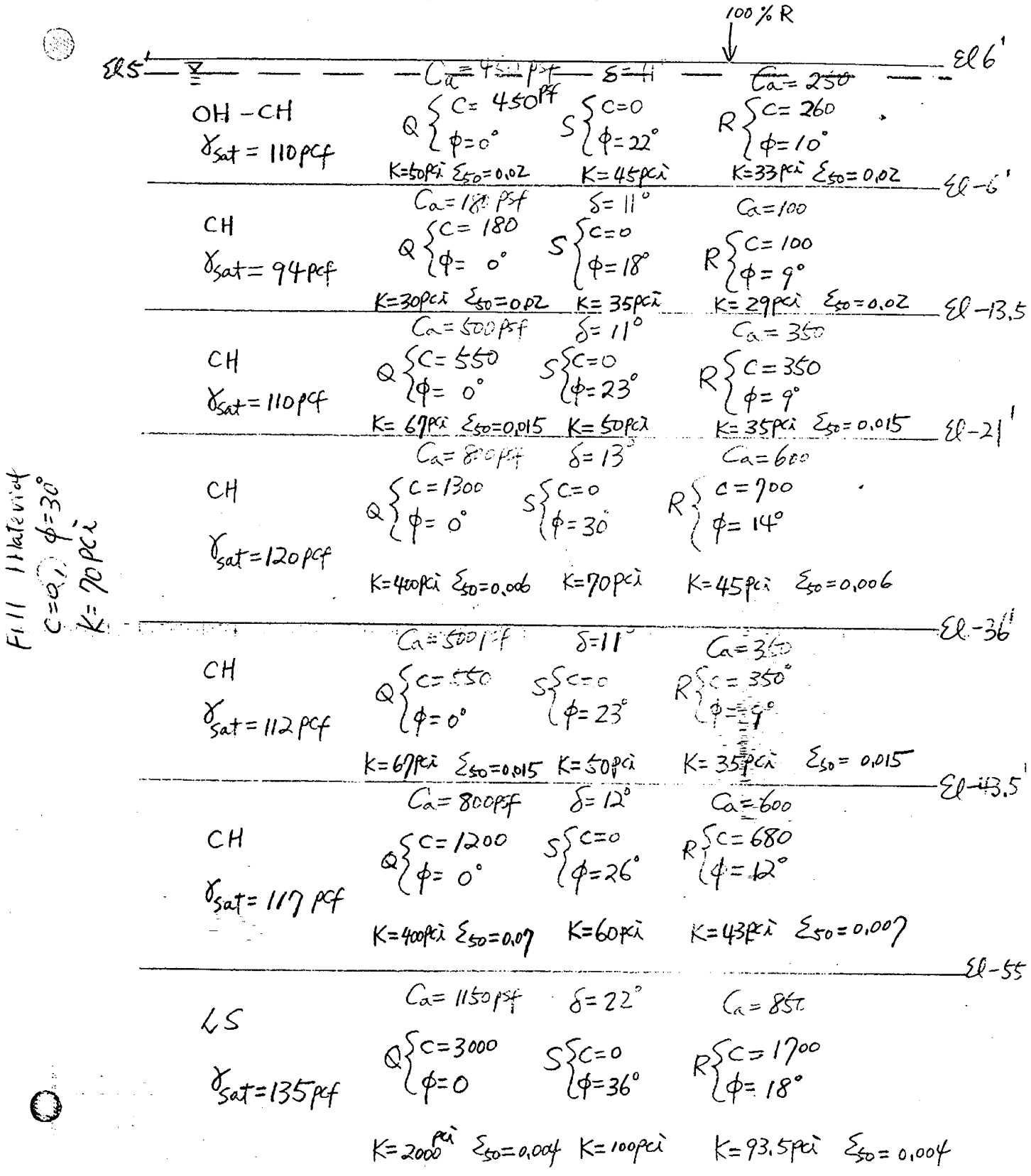
...\ustation\out\dgn\marg51s1.dgn Apr. 02, 1999 14:15:02

APPENDIX B-3

36" & 48" PIPE PILES
DRIVABILITY ANALYSIS

Margarita Channel Stilling Basin Wing Wall (STA 54+10) JP

CB-MC-52 & CB-MC-34 combined



Fill Material
C = 0, φ = 30°
K = 70 pci

36-inch pipe pile
Sta. 49+50 and 53+00

FLORIDA DEPARTMENT OF TRANSPORTATION
STRUCTURES DESIGN OFFICE
STATIC PILE BEARING CAPACITY ANALYSIS PROGRAM
SPT97 - VERSION 1.2 FEBRUARY, 1997
BASED ON RESEARCH BULLETIN RB-121
"GUIDELINES FOR USE IN THE SOILS INVESTIGATION
AND DESIGN OF FOUNDATIONS FOR
BRIDGE STRUCTURES IN THE STATE OF FLORIDA" AND
RESEARCH STUDY REPORT BY UNIVERSITY OF FLORIDA
"DESIGN OF STEEL PIPE AND H PILES"

NOTE - THIS PROGRAM IS EXPANDED FROM SPT91
IS ALSO KNOWN AS SPT94
TO INCLUDE STEEL H AND PIPE PILES

A. GENERAL INFORMATION

INPUT FILE NAME	marg236.in
RUN DATE	03/31/99
RUN TIME	11:56:25
PROJECT NUMBER	Puerto Nuevo FDM2
JOB NAME	Margarita Stilling Basin Wing Wall
SUBMITTING ENGINEER	P. Smith
BORING NO.	CB-MC-52
DRILLING DATE	01/96
STATION NO.	Sta. 53+00
GROUND SURFACE ELEVATION	3.00 FEET
TYPE OF ANALYSIS	2 - DETERMINATION OF STATIC PILE BEARING CAPACITIES FOR A RANGE OF PILE LENGTHS (CAPACITY VS. TIP ELEVATION)

B. BORING LOG

ENTRY NO.	DEPTH (FT) D(I)	ELEVATION (FT)	SPT BLOWS/FT N(I)	SOIL TYPE ST(I)
1	1.5	1.5	7.0	2
2	3.0	.0	7.0	2
3	4.5	-1.5	6.0	2
4	6.0	-3.0	10.0	2
5	7.5	-4.5	8.0	2
6	9.0	-6.0	3.0	1
7	10.5	-7.5	2.0	2

8	12.0	-9.0	6.0	2
9	13.5	-10.5	4.0	2
10	15.0	-12.0	1.0	2
11	16.5	-13.5	1.0	2
12	18.0	-15.0	1.0	2
13	19.5	-16.5	1.0	1
14	21.0	-18.0	2.0	1
15	22.5	-19.5	3.0	1
16	24.0	-21.0	3.0	1
17	25.5	-22.5	15.0	2
18	27.0	-24.0	28.0	2
19	28.5	-25.5	22.0	2
20	30.0	-27.0	22.0	2
21	31.5	-28.5	29.0	2
22	33.0	-30.0	48.0	2
23	34.5	-31.5	13.0	2
24	36.0	-33.0	23.0	2
25	37.5	-34.5	22.0	2
26	39.0	-36.0	25.0	2
27	40.5	-37.5	16.0	2
28	42.0	-39.0	16.0	2
29	43.5	-40.5	20.0	2
30	45.0	-42.0	21.0	2
31	46.5	-43.5	23.0	2
32	48.0	-45.0	19.0	2
33	49.5	-46.5	11.0	1
34	51.0	-48.0	14.0	1
35	52.5	-49.5	17.0	2
36	54.0	-51.0	19.0	2
37	55.5	-52.5	11.0	2
38	57.0	-54.0	17.0	2
39	58.5	-55.5	22.0	4
40	60.0	-57.0	126.0	4
41	61.5	-58.5	96.0	4
42	63.0	-60.0	100.0	4
43	64.5	-61.5	60.0	4

STATIC PILE BEARING CAPACITY ANALYSIS - SPT97	Page 3
Project No: Puerto Nuevo FDM2	Margarita Stilling Basin Wing Wall
Boring No: CB-MC-52	

B. BORING LOG (CONTINUED)

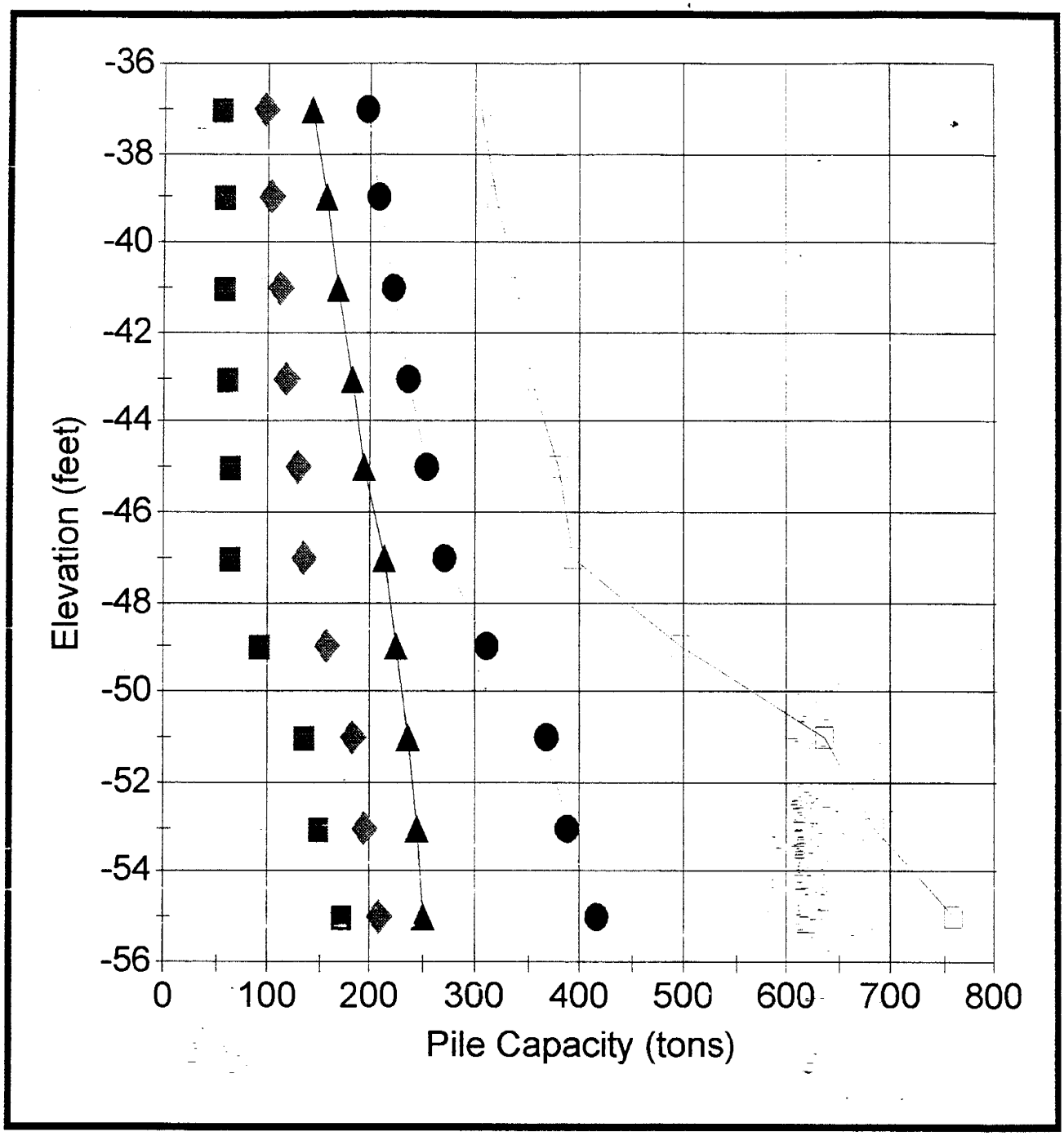
ENTRY NO.	DEPTH (FT) D(I)	ELEVATION (FT)	SPT BLOWS/FT N(I)	SOIL TYPE ST(I)
44	66.0	-63.0	64.0	4
45	67.5	-64.5	77.0	4
46	69.0	-66.0	96.0	4
47	70.5	-67.5	104.0	4
48	72.0	-69.0	98.0	4
49	73.5	-70.5	100.0	4
50	75.0	-72.0	95.0	4
51	77.5	-74.5	95.0	4
52	79.0	-76.0	95.0	4
53	80.5	-77.5	95.0	4
54	82.0	-79.0	95.0	4
55	83.5	-80.5	95.0	4
56	85.0	-82.0	95.0	4
57	86.5	-83.5	95.0	4
58	88.0	-85.0	95.0	4

B-3-3

PROBLEM COMPLETED ANALYSIS NO. 1

B-3-4

Pile Capacities for Pile Width of: 36.00 in



Ultimate Side Friction
Mobilized End Bearing
Estimated Davisson Capacity
Allowable Pile Capacity
Ultimate Pile Capacity

B-3-5

Input File: D:\WEAP94\DATA\MARG54.GWI
Hammer File: HAMMER.ALT

Echo Print of Input Data

```
   Margarita Stilling Basin Wing Wall
 0   0 346   0   0   0   0   0   0   1  33   0   1   0   0   0   0   0     .000
   5.700  1018.000     470.0     2.000      .800      .010        .0
    .000        .0      .000      .500      .010        .0
  60.000    55.800 30000.000   492.000   113.000    36.000      .850      .010
IHC HydhSC 150     3   4   0
   24.25    117.32     28.90    4.2600     .0000     .9500     .0000
     .00       .00     1.000      .010     0
   .0000     .0000     .0000     .0000     .0000     .0000     .0000     .0000
    .100      .100      .200      .150      .000      .000      .000      .000
    .000      .000      .000      .000
    .000      .000      .000      .000
1000.0  1250.0  1500.0  1600.0        .0        .0        .0        .0        .0        .0
```

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of an impact driven pile. The program contains mathematical models which describe hammer, driving system, pile and soil during the hammer blow. Under certain conditions, the models only crudely approximate often complex dynamic situations.

A wave equation analysis also relies on input data which represents normal situations. The data may be the best available information at the time of the analysis, however, it may greatly differ from actual field conditions.

The program authors, therefore, recommend prudent use of GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic measurements. Estimates of bending or other local non-axial stresses and prestress effects must also be accounted for by the user.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of a safety factor to yield a design or working load.

Margarita Stilling Basin Wing Wall
CESAJ-EN-GS

03/31/99
GRLWEAP(TM) Version 1.996-1

PILE PROFILE:

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Circmf ft	Strength ksi	Wave Sp ft/s	EA/c k/ft/s
.0	55.80	30000.	492.0	113.0	36.000	16807.	99.6
60.0	55.80	30000.	492.0	113.0	36.000	16807.	99.6

Wave Travel Time 2L/c (ms) 7.140

Pile and Soil Model — Total Capacity (kips) 1000.0 — Rut

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Circmf ft	Area in2
1	.636	41850.	.010	.000	.85	1.0	.200	.100	3.33	113.0	55.8
2	.636	41850.	.000	.000	1.00	3.1	.200	.100	6.67	113.0	55.8
3	.636	41850.	.000	.000	1.00	5.1	.200	.100	10.00	113.0	55.8
4	.636	41850.	.000	.000	1.00	7.1	.200	.100	13.33	113.0	55.8
5	.636	41850.	.000	.000	1.00	9.2	.200	.100	16.67	113.0	55.8
6	.636	41850.	.000	.000	1.00	11.2	.200	.100	20.00	113.0	55.8
7	.636	41850.	.000	.000	1.00	13.2	.200	.100	23.33	113.0	55.8
8	.636	41850.	.000	.000	1.00	15.3	.200	.100	26.67	113.0	55.8
9	.636	41850.	.000	.000	1.00	17.3	.200	.100	30.00	113.0	55.8
10	.636	41850.	.000	.000	1.00	19.4	.200	.100	33.33	113.0	55.8
11	.635	41850.	.000	.000	1.00	21.4	.200	.100	36.67	113.0	55.8
12	.635	41850.	.000	.000	1.00	23.4	.200	.100	40.00	113.0	55.8
13	.635	41850.	.000	.000	1.00	25.5	.200	.100	43.33	113.0	55.8
14	.635	41850.	.000	.000	1.00	27.5	.200	.100	46.67	113.0	55.8
15	.635	41850.	.000	.000	1.00	29.5	.200	.100	50.00	113.0	55.8
16	.635	41850.	.000	.000	1.00	31.6	.200	.100	53.33	113.0	55.8
17	.635	41850.	.000	.000	1.00	33.6	.200	.100	56.67	113.0	55.8
18	.635	41850.	.000	.000	1.00	35.6	.200	.100	60.00	113.0	55.8
Toe						670.0	.150	.100			

PILE, SOIL, ANALYSIS OPTIONS:

Uniform/Non-Uniform/2-Pile	0	Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact. (k/ft/s)	1.992
% Skin Friction	33	% End Bearing	67
Soil Resistance Distr. No.	1		
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Residual Stress Analysis	0	Output Option	0
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Segment Generation	Automatic		

B-3-8

Margarita Stilling Basin Wing Wall
CESAJ-EN-GS

03/31/99
GRLWEAP(TM) Version 1.996

Rut= 1000.0, Rtoe = 670.0 (kips), Time Inc. = .081 ms

No.	min F, (kips)	t	max F, (kips)	t	min Str, (ksi)	t	max Str, (ksi)	t	max V, (ft/s)	t	max D, (in)	t	max Et (kip-ft)
1	.0,	0	1937.7,	2	.00,	0	34.73,	2	19.54,	3	.816,	12	84.45
2	-30.9,	24	1956.2,	3	-.55,	24	35.06,	3	19.52,	3	.788,	13	82.65
3	-57.4,	24	1964.3,	3	-1.03,	24	35.20,	3	19.56,	3	.760,	13	80.55
4	-78.0,	24	1956.1,	3	-1.40,	24	35.05,	3	19.41,	3	.733,	13	78.20
5	-96.3,	24	1951.2,	3	-1.73,	24	34.97,	3	19.22,	3	.707,	13	75.62
6	-110.7,	24	1934.9,	3	-1.98,	24	34.68,	3	18.98,	4	.681,	14	72.83
7	-121.1,	24	1911.3,	4	-2.17,	24	34.25,	4	18.64,	4	.655,	14	69.86
8	-124.5,	24	1888.2,	4	-2.23,	24	33.84,	4	18.31,	4	.630,	14	66.75
9	-120.3,	24	1851.8,	4	-2.16,	24	33.19,	4	17.88,	4	.605,	14	63.56
10	-114.2,	24	1821.6,	4	-2.05,	24	32.65,	4	17.47,	4	.581,	14	60.34
11	-106.7,	25	1776.8,	4	-1.91,	25	31.84,	4	16.99,	5	.557,	15	57.11
12	-95.4,	25	1739.1,	5	-1.71,	25	31.17,	5	16.49,	5	.535,	15	53.86
13	-88.1,	25	1689.2,	5	-1.58,	25	30.27,	5	15.99,	5	.513,	15	50.62
14	-77.7,	25	1643.2,	5	-1.39,	25	29.45,	5	15.43,	5	.492,	15	47.40
15	-62.2,	25	1585.3,	5	-1.12,	25	28.41,	5	15.10,	5	.472,	15	44.21
16	-43.8,	25	1490.2,	5	-.79,	25	26.71,	5	15.36,	6	.453,	16	41.09
17	-25.6,	25	1359.9,	6	-.46,	25	24.37,	6	15.47,	6	.435,	16	38.11
18	-11.1,	25	1649.7,	6	-.20,	25	29.56,	6	12.36,	6	.418,	16	36.45

Rut= 1250.0, Rtoe= 837.5 (kips), Time Inc. = .071 ms

No.	min F, (kips)	t	max F, (kips)	t	min Str, (ksi)	t	max Str, (ksi)	t	max V, (ft/s)	t	max D, (in)	t	max Et (kip-ft)
1	.0,	0	1944.3,	2	.00,	0	34.84,	2	19.56,	2	.775,	12	83.17
2	-33.5,	23	1962.2,	3	-.60,	23	35.16,	3	19.62,	3	.741,	12	80.64
3	-62.4,	23	1968.5,	3	-1.12,	23	35.28,	3	19.56,	3	.706,	13	77.69
4	-87.5,	23	1964.8,	3	-1.57,	23	35.21,	3	19.41,	3	.673,	13	74.47
5	-108.5,	23	1952.4,	3	-1.94,	23	34.99,	3	19.17,	3	.640,	13	71.04
6	-124.5,	23	1932.4,	3	-2.23,	23	34.63,	3	18.85,	4	.608,	13	67.44
7	-135.9,	23	1905.1,	4	-2.44,	23	34.14,	4	18.46,	4	.576,	13	63.69
8	-136.7,	23	1871.3,	4	-2.45,	23	33.54,	4	18.00,	4	.545,	14	59.83
9	-127.1,	23	1835.8,	4	-2.28,	23	32.90,	4	17.55,	4	.515,	14	55.91
10	-114.1,	23	1795.0,	4	-2.05,	23	32.17,	4	17.06,	4	.484,	14	52.02
11	-96.8,	23	1748.8,	4	-1.74,	23	31.34,	4	16.51,	5	.455,	14	48.19
12	-76.5,	24	1697.3,	5	-1.37,	24	30.42,	5	15.91,	5	.426,	14	44.40
13	-63.3,	24	1641.0,	5	-1.13,	24	29.41,	5	15.33,	5	.399,	15	40.69
14	-49.8,	25	1584.3,	5	-.89,	25	28.39,	5	14.76,	5	.372,	15	37.11
15	-35.5,	25	1522.4,	5	-.64,	25	27.28,	5	14.26,	5	.347,	15	33.71
16	-25.0,	25	1427.6,	5	-.45,	25	25.58,	5	14.25,	6	.323,	15	30.51
17	-16.2,	25	1406.6,	6	-.29,	25	25.21,	6	13.97,	6	.299,	16	27.59
18	-5.8,	24	1635.6,	6	-.10,	24	29.31,	6	10.71,	6	.278,	16	25.86

Margarita Stilling Basin Wing Wall
CESAJ-EN-GS

03/31/99
GRLWEAP(TM) Version 1.996-1

Rut= 1500.0, Rtoe = 1005.0 (kips), Time Inc. = .063 ms

No.	min F, (kips)	t	max F, (kips)	t	min Str, (ksi)	t	max Str, (ksi)	t	max V, (ft/s)	t	max D, (in)	t	max Et (kip-ft)
1	.0,	0	1946.8,	2	.00,	0	34.89,	2	19.57,	3	.744,	12	81.95
2	-39.0,	22	1963.0,	3	-.70,	22	35.18,	3	19.62,	3	.707,	12	78.94
3	-70.1,	22	1972.2,	3	-1.26,	22	35.34,	3	19.49,	3	.668,	12	75.32
4	-93.9,	22	1964.8,	3	-1.68,	22	35.21,	3	19.33,	3	.629,	12	71.27
5	-111.5,	22	1950.1,	3	-2.00,	22	34.95,	3	19.05,	3	.592,	13	67.05
6	-122.6,	23	1928.9,	3	-2.20,	23	34.57,	3	18.68,	4	.555,	13	62.67
7	-128.2,	22	1896.7,	4	-2.30,	22	33.99,	4	18.21,	4	.518,	13	58.18
8	-128.4,	22	1856.8,	4	-2.30,	22	33.28,	4	17.72,	4	.483,	13	53.63
9	-117.8,	22	1814.9,	4	-2.11,	22	32.52,	4	17.19,	4	.448,	14	49.06
10	-95.9,	23	1779.4,	8	-1.72,	23	31.89,	8	16.61,	4	.413,	14	44.55
11	-75.0,	23	1764.6,	8	-1.34,	23	31.62,	8	16.00,	5	.379,	14	40.17
12	-51.9,	24	1652.1,	5	-.93,	24	29.61,	5	15.36,	5	.345,	14	35.90
13	-38.1,	24	1589.9,	5	-.68,	24	28.49,	5	14.71,	5	.313,	14	31.76
14	-24.8,	25	1525.4,	5	-.44,	25	27.34,	5	14.06,	5	.282,	15	27.84
15	-9.2,	25	1456.7,	5	-.16,	25	26.11,	5	13.48,	5	.252,	15	24.22
16	.0,	0	1398.5,	9	.00,	0	25.06,	9	13.26,	5	.224,	15	20.94
17	.0,	0	1394.4,	6	.00,	0	24.99,	6	12.77,	6	.197,	15	18.07
18	.0,	0	1569.0,	6	.00,	0	28.12,	6	9.40,	6	.171,	15	16.21

Rut= 1600.0, Rtoe= 1072.0 (kips), Time Inc. = .060 ms

No.	min F, (kips)	t	max F, (kips)	t	min Str, (ksi)	t	max Str, (ksi)	t	max V, (ft/s)	t	max D, (in)	t	max Et (kip-ft)
1	.0,	0	1948.5,	2	.00,	0	34.92,	2	19.57,	3	.734,	12	81.51
2	-38.4,	22	1964.2,	3	-.69,	22	35.20,	3	19.61,	3	.696,	12	78.35
3	-71.0,	22	1973.0,	3	-1.27,	22	35.36,	3	19.50,	3	.656,	12	74.57
4	-93.3,	22	1964.7,	3	-1.67,	22	35.21,	3	19.31,	3	.616,	12	70.34
5	-109.7,	22	1950.9,	3	-1.97,	22	34.96,	3	18.96,	3	.578,	11	66.02
6	-118.7,	22	1923.8,	3	-2.13,	22	34.48,	3	18.61,	4	.540,	12	61.37
7	-121.6,	22	1893.4,	4	-2.18,	22	33.93,	4	18.14,	4	.501,	12	56.43
8	-118.8,	22	1850.5,	4	-2.13,	22	33.16,	4	17.59,	4	.463,	13	51.53
9	-107.9,	22	1805.7,	4	-1.93,	22	32.36,	4	17.04,	4	.426,	13	46.72
10	-86.9,	22	1791.0,	8	-1.56,	22	32.10,	8	16.44,	4	.390,	14	41.99
11	-61.9,	23	1775.1,	8	-1.11,	23	31.81,	8	15.79,	5	.355,	13	37.43
12	-40.7,	24	1675.1,	8	-.73,	24	30.02,	8	15.11,	5	.320,	13	33.02
13	-30.4,	25	1603.7,	8	-.55,	25	28.74,	8	14.44,	5	.286,	13	28.74
14	-17.4,	25	1535.8,	8	-.31,	25	27.52,	8	13.78,	5	.254,	13	24.68
15	.0,	0	1467.8,	9	.00,	0	26.30,	9	13.19,	5	.222,	15	20.92
16	.0,	0	1409.4,	9	.00,	0	25.26,	9	12.91,	5	.192,	15	17.60
17	.0,	0	1383.8,	9	.00,	0	24.80,	9	12.33,	6	.164,	15	14.74
18	.0,	0	1543.2,	6	.00,	0	27.66,	6	8.96,	6	.136,	15	12.83

48-inch pipe pile
Sta 53+00 to 54+10

FLORIDA DEPARTMENT OF TRANSPORTATION
STRUCTURES DESIGN OFFICE
STATIC PILE BEARING CAPACITY ANALYSIS PROGRAM
SPT97 - VERSION 1.2 FEBRUARY, 1997
BASED ON RESEARCH BULLETIN RB-121
"GUIDELINES FOR USE IN THE SOILS INVESTIGATION
AND DESIGN OF FOUNDATIONS FOR
BRIDGE STRUCTURES IN THE STATE OF FLORIDA" AND
RESEARCH STUDY REPORT BY UNIVERSITY OF FLORIDA
"DESIGN OF STEEL PIPE AND H PILES"

NOTE - THIS PROGRAM IS EXPANDED FROM SPT91
IS ALSO KNOWN AS SPT94
TO INCLUDE STEEL H AND PIPE PILES

A. GENERAL INFORMATION

INPUT FILE NAME	Marg54.2
RUN DATE	03/31/99
RUN TIME	11:16:57
PROJECT NUMBER	Puerto Nuevo FDM2
JOB NAME	Margarita Stilling Basin Wing Wall
SUBMITTING ENGINEER	P. Smith
BORING NO.	CB-MC-52
DRILLING DATE	01/96
STATION NO.	Sta. 54+10
GROUND SURFACE ELEVATION	3.00 FEET
TYPE OF ANALYSIS	2 - DETERMINATION OF STATIC PILE BEARING CAPACITIES FOR A RANGE OF PILE LENGTHS (CAPACITY VS. TIP ELEVATION)

B. BORING LOG

ENTRY NO.	DEPTH (FT) D(I)	ELEVATION (FT)	SPT BLOWS/FT N(I)	SOIL TYPE ST(I)
1	1.5	1.5	7.0	2
2	3.0	.0	7.0	2
3	4.5	-1.5	6.0	2
4	6.0	-3.0	10.0	2
5	7.5	-4.5	8.0	2
6	9.0	-6.0	3.0	1
7	10.5	-7.5	2.0	2

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8	12.0	-9.0	6.0	2
9	13.5	-10.5	4.0	2
10	15.0	-12.0	1.0	2
11	16.5	-13.5	1.0	2
12	18.0	-15.0	1.0	2
13	19.5	-16.5	1.0	1
14	21.0	-18.0	2.0	1
15	22.5	-19.5	3.0	1
16	24.0	-21.0	3.0	1
17	25.5	-22.5	15.0	2
18	27.0	-24.0	28.0	2
19	28.5	-25.5	22.0	2
20	30.0	-27.0	22.0	2
21	31.5	-28.5	29.0	2
22	33.0	-30.0	48.0	2
23	34.5	-31.5	13.0	2
24	36.0	-33.0	23.0	2
25	37.5	-34.5	22.0	2
26	39.0	-36.0	25.0	2
27	40.5	-37.5	16.0	2
28	42.0	-39.0	16.0	2
29	43.5	-40.5	20.0	2
30	45.0	-42.0	21.0	2
31	46.5	-43.5	23.0	2
32	48.0	-45.0	19.0	2
33	49.5	-46.5	11.0	1
34	51.0	-48.0	14.0	1
35	52.5	-49.5	17.0	2
36	54.0	-51.0	19.0	2
37	55.5	-52.5	11.0	2
38	57.0	-54.0	17.0	2
39	58.5	-55.5	22.0	4
40	60.0	-57.0	126.0	4
41	61.5	-58.5	96.0	4
42	63.0	-60.0	100.0	4
43	64.5	-61.5	60.0	4

B. BORING LOG (CONTINUED)

ENTRY NO.	DEPTH (FT) D(I)	ELEVATION (FT)	SPT BLOWS/FT N(I)	SOIL TYPE ST(I)
44	66.0	-63.0	64.0	4
45	67.5	-64.5	77.0	4
46	69.0	-66.0	96.0	4
47	70.5	-67.5	104.0	4
48	72.0	-69.0	98.0	4
49	73.5	-70.5	100.0	4
50	75.0	-72.0	95.0	4
51	77.5	-74.5	95.0	4
52	79.0	-76.0	95.0	4
53	80.5	-77.5	95.0	4
54	82.0	-79.0	95.0	4
55	83.5	-80.5	95.0	4
56	85.0	-82.0	95.0	4
57	86.5	-83.5	95.0	4
58	88.0	-85.0	95.0	4

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59	89.5	-86.5	95.0	4
60	91.0	-88.0	95.0	4
61	92.5	-89.5	95.0	4

SOIL TYPE LEGEND

0 - BOTTOM OF BORING
1 - PLASTIC CLAYS
2 - CLAY/SILT SAND MIXTURES, SILTS & MARLS
3 - CLEAN SAND
4 - SOFT LIMESTONE, VERY SHELLY SANDS
5 - VOID (NO CAPACITY)

C. PILE INFORMATION

TEST PILE SECTION ISECT = 3
{open-end steel pipe pile}
DIAMETER OF PILE WP = 48.00 INCHES
THICKNESS OF PILE THICK = .75 INCHES

D. PILE CAPACITY VS. PENETRATION

TEST PILE LENGTH (FT)	PILE TIP ELEV (FT)	WT. OF PILE (TONS)	ULT. SIDE FRICTION (TONS)	MOBILIZED END BEARING (TONS)	ESTIMATED DAVISSON CAPACITY (TONS)	ALLOWABLE PILE CAPACITY (TONS)	ULTIMATE PILE CAPACITY (TONS)
40.0	-37.0	7.58	199.12	85.34	276.89	138.44	447.58
42.0	-39.0	7.96	214.25	87.31	293.60	146.80	468.22
44.0	-41.0	8.33	231.13	91.22	314.02	157.01	496.46
46.0	-43.0	8.71	248.52	116.42	356.22	178.11	589.06
48.0	-45.0	9.09	265.93	162.93	419.77	209.88	745.63
50.0	-47.0	9.47	284.47	177.56	452.56	226.28	807.69
52.0	-49.0	9.85	302.14	232.07	524.36	262.18	988.50
54.0	-51.0	10.23	317.55	277.04	584.37	292.19	1138.46
56.0	-53.0	10.61	328.80	292.04	610.23	305.12	1194.31
58.0	-55.0	10.99	338.50	317.93	645.44	322.72	1281.30
60.0	-57.0	11.36	362.02	413.12	701.36	350.68	1590.00
62.0	-59.0	11.74	374.80	417.49	726.15	363.08	1615.52
64.0	-61.0	12.12	386.90	424.72	749.59	374.80	1648.93
66.0	-63.0	12.50	398.67	434.16	772.38	386.19	1688.66
68.0	-65.0	12.88	409.81	447.71	793.93	396.97	1740.06
70.0	-67.0	13.26	420.82	464.06	815.24	407.62	1799.76
72.0	-69.0	13.64	431.80	483.43	836.47	418.23	1868.45

*** THE MAXIMUM PILE LENGTH HAS BEEN REACHED

NOTES

1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.

2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.

B-B3-13

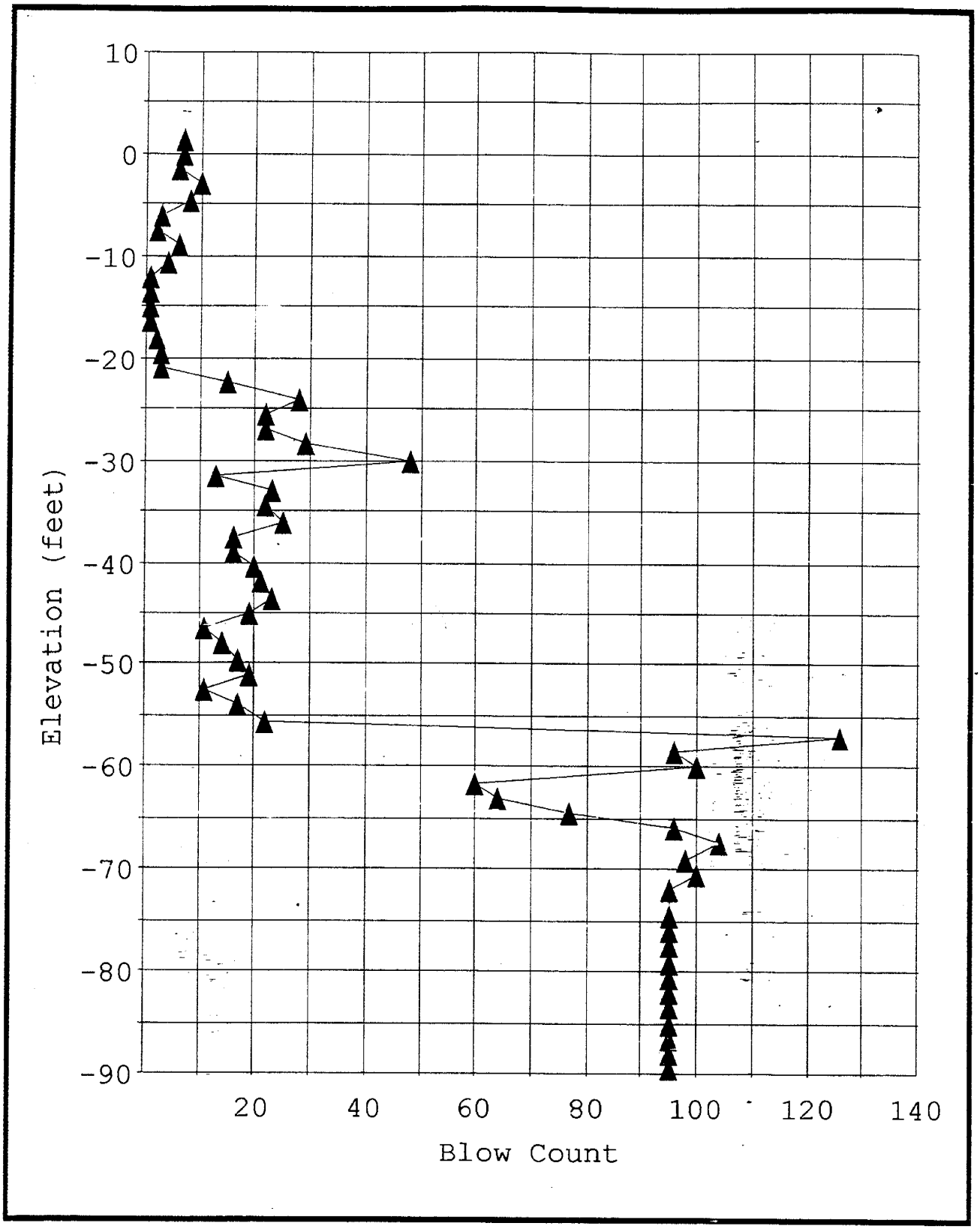
3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.

4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS
   3 x THE MOBILIZED END BEARING.

PROBLEM COMPLETED ANALYSIS NO. 6

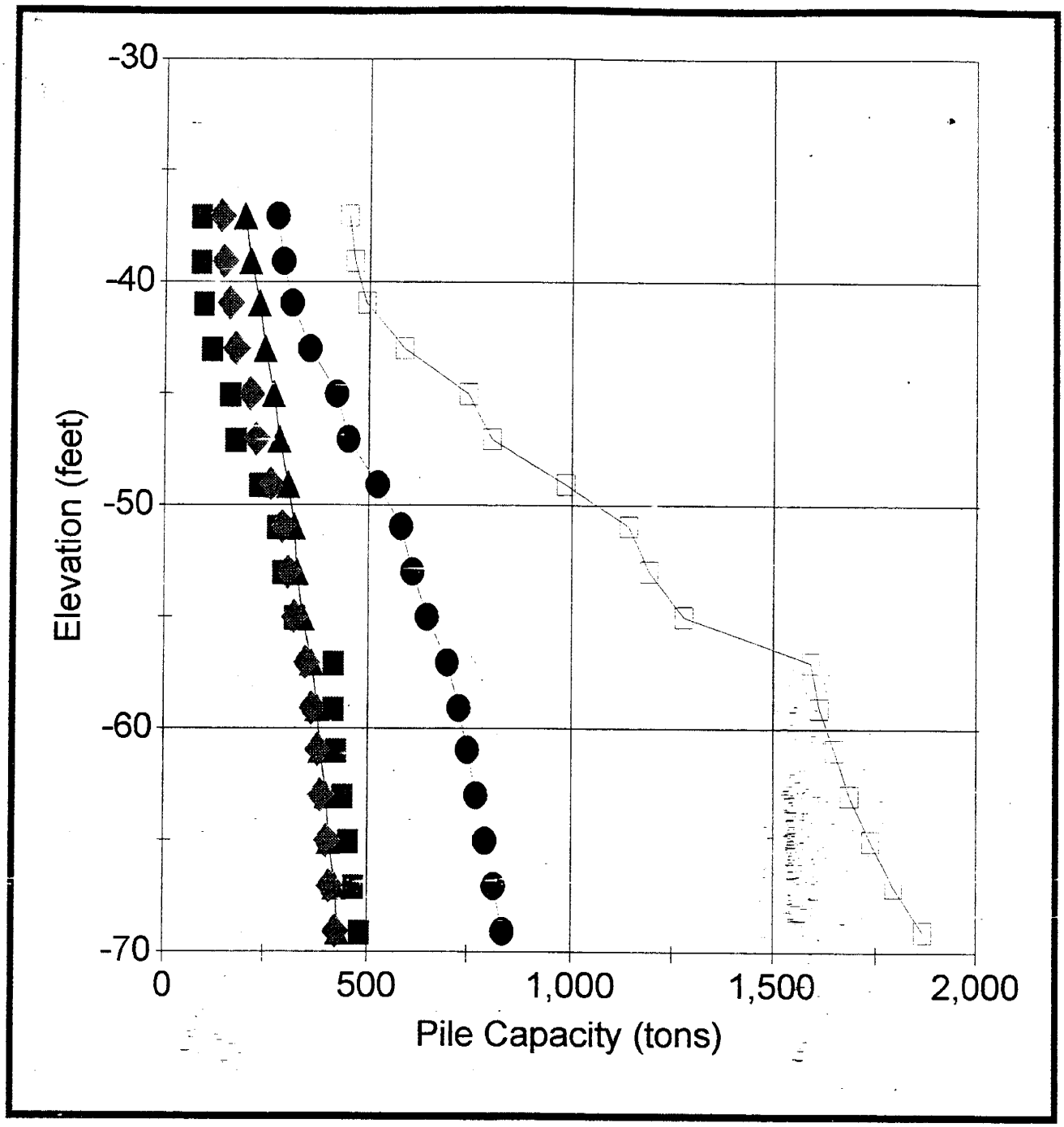
B-3-14

SPT N-Value vs. Elevation



B-3-15

Pile Capacities for Pile Width of: 48.00 in



Ultimate Side Friction
Mobilized End Bearing
Estimated Davisson Capacity
Allowable Pile Capacity
Ultimate Pile Capacity

B-3-16

Input File: D:\WEAP94\DATA\MARGMARG.GWI
Hammer File: HAMMER.ALT

Echo Print of Input Data

```
   Margarita Stilling Basin Wing Wall
 0   0 346   0   0   0   0   0   0   1  23   0   1   0   0   0   0   0     .000
   5.700 1810.000     470.0     2.000      .800      .010        .0
    .000       .0      .000      .500      .010       .0
  75.000  111.800 30000.000   492.000   150.800    36.000      .850      .010
IHC HydhSC 150     3   4   0
   24.25    117.32     28.90    4.2600     .0000     .9500     .0000
     .00       .00     1.000      .010     0
   .0000     .0000     .0000     .0000     .0000     .0000     .0000     .0000
    .100      .100      .200      .150      .000      .000      .000      .000
    .000      .000      .000      .000
    .000      .000      .000      .000
1000.0  2000.0  3000.0  3500.0  3700.0  4000.0       .0       .0       .0       .0
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ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of an impact driven pile. The program contains mathematical models which describe hammer, driving system, pile and soil during the hammer blow. Under certain conditions, the models only crudely approximate often complex dynamic situations.

A wave equation analysis also relies on input data which represents normal situations. The data may be the best available information at the time of the analysis, however, it may greatly differ from actual field conditions.

The program authors, therefore, recommend prudent use of GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic measurements. Estimates of bending or other local non-axial stresses and prestress effects must also be accounted for by the user.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of a safety factor to yield a design or working load.

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS SHORT PILE VERSION
Version 1.996-1
English Units

Margarita Stilling Basin Wing Wall

Hammer Model: SC 150 Made by: IHC Hydh

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	6.063				
2	6.063	648575.3	1.000	.0100	
3	6.063	648575.3	1.000	.0100	
4	6.063	648575.3	1.000	.0100	
Helmet	5.700	256881.5	.800	.0100	30.5

HAMMER OPTIONS:

Hammer File ID No.	346	Hammer Type	3
Stroke Option	0	Hammer Damping	2

HAMMER DATA:

Ram Weight	(kips)	24.25	Ram Length	(inch)	117.32
Maximum Stroke	(ft)	4.26	Actual Stroke	(ft)	4.26
			Efficiency		.950
Maximum Energy	(kip-ft)	103.31	Potential Energy	(kip-ft)	103.31
Kinetic Energy	(kip-ft)	98.14	Impact Velocity	(ft/s)	16.14

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	1810.00	Cross Sect. Area	(in2)	.00
Elastic-Modulus	(ksi)	470.0	Elastic-Modulus	(ksi)	.0
Thickness	(inch)	2.00	Thickness	(inch)	.00
Coeff of Restitution		.8	Coeff of Restitution		.5
RoundOut	(ft)	.0	RoundOut	(ft)	.0
Stiffness	(kips/in)	425350.0	Stiffness	(kips/in)	.0

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PILE PROFILE:

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Circmf ft	Strength ksi	Wave Sp ft/s	EA/c k/ft/s
.0	111.80	30000.	492.0	150.8	36.000	16807.	199.6
75.0	111.80	30000.	492.0	150.8	36.000	16807.	199.6

Wave Travel Time 2L/c (ms) 8.925

Pile and Soil Model — Total Capacity Rut (kips) 1000.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Circmf ft	Area in2
1	1.246	85713.	.010	.000	.85	.4	.200	.100	3.26	150.8	111.8
2	1.246	85713.	.000	.000	1.00	1.3	.200	.100	6.52	150.8	111.8
3	1.246	85713.	.000	.000	1.00	2.2	.200	.100	9.78	150.8	111.8
4	1.246	85713.	.000	.000	1.00	3.0	.200	.100	13.04	150.8	111.8
5	1.246	85713.	.000	.000	1.00	3.9	.200	.100	16.30	150.8	111.8
6	1.246	85713.	.000	.000	1.00	4.8	.200	.100	19.57	150.8	111.8
7	1.246	85713.	.000	.000	1.00	5.7	.200	.100	22.83	150.8	111.8
8	1.246	85713.	.000	.000	1.00	6.5	.200	.100	26.09	150.8	111.8
9	1.246	85713.	.000	.000	1.00	7.4	.200	.100	29.35	150.8	111.8
10	1.246	85713.	.000	.000	1.00	8.3	.200	.100	32.61	150.8	111.8
11	1.246	85713.	.000	.000	1.00	9.1	.200	.100	35.87	150.8	111.8
12	1.246	85713.	.000	.000	1.00	10.0	.200	.100	39.13	150.8	111.8
13	1.246	85713.	.000	.000	1.00	10.9	.200	.100	42.39	150.8	111.8
14	1.246	85713.	.000	.000	1.00	11.7	.200	.100	45.65	150.8	111.
15	1.246	85713.	.000	.000	1.00	12.6	.200	.100	48.91	150.8	111.
16	1.246	85713.	.000	.000	1.00	13.5	.200	.100	52.17	150.8	111.8
17	1.246	85713.	.000	.000	1.00	14.3	.200	.100	55.43	150.8	111.8
18	1.246	85713.	.000	.000	1.00	15.2	.200	.100	58.70	150.8	111.8
19	1.246	85713.	.000	.000	1.00	16.1	.200	.100	61.96	150.8	111.8
20	1.246	85713.	.000	.000	1.00	17.0	.200	.100	65.22	150.8	111.8
21	1.246	85713.	.000	.000	1.00	17.8	.200	.100	68.48	150.8	111.8
22	1.246	85713.	.000	.000	1.00	18.7	.200	.100	71.74	150.8	111.8
23	1.246	85713.	.000	.000	1.00	19.6	.200	.100	75.00	150.8	111.8
Toe					770.0	.150	.100				

PILE, SOIL, ANALYSIS OPTIONS:

Uniform/Non-Uniform/2-Pile	0	Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	3.991
% Skin Friction	23	% End Bearing	77
Soil Resistance Distr. No.	1		
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Residual Stress Analysis	0	Output Option	0
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Segment Generation	Automatic		

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Margarita Stilling Basin Wing Wall
CESAJ-EN-GS

03/31/99
GRLWEAP(TM) Version 1.996-1

Rut= 1000.0, Rtoe = 770.0 (kips), Time Inc. = .097 ms

No.	min F, (kips)	t	max F, (kips)	t	min Str, (ksi)	t	max Str, (ksi)	t	max V, (ft/s)	t	max D, (in)	t	max Et (kip-ft)
1	.0,	0	3400.3,	2	.00,	0	30.41,	2	17.07,	2	.637,	11	86.61
2	-73.0,	23	3401.4,	2	-.65,	23	30.42,	2	17.01,	3	.632,	11	86.22
3	-128.3,	23	3397.0,	3	-1.15,	23	30.38,	3	17.01,	3	.626,	12	85.68
4	-153.9,	23	3402.0,	3	-1.38,	23	30.43,	3	17.00,	3	.618,	12	84.95
5	-150.3,	23	3393.7,	3	-1.34,	23	30.35,	3	16.93,	3	.609,	12	84.03
6	-150.1,	26	3376.1,	3	-1.34,	26	30.20,	3	16.82,	3	.600,	12	83.06
7	-142.6,	26	3352.1,	4	-1.28,	26	29.98,	4	16.68,	4	.593,	12	82.09
8	-130.0,	26	3323.6,	4	-1.16,	26	29.73,	4	16.53,	4	.586,	12	81.06
9	-130.7,	27	3291.9,	4	-1.17,	27	29.44,	4	16.36,	4	.578,	13	79.90
10	-131.1,	27	3265.8,	4	-1.17,	27	29.21,	4	16.19,	4	.569,	13	78.63
11	-138.4,	25	3244.2,	4	-1.24,	25	29.02,	4	16.06,	4	.561,	13	77.26
12	-147.0,	25	3219.1,	5	-1.31,	25	28.79,	5	15.92,	5	.551,	13	75.79
13	-141.0,	25	3191.3,	5	-1.26,	25	28.54,	5	15.76,	5	.542,	13	74.25
14	-122.8,	25	3161.0,	5	-1.10,	25	28.27,	5	15.60,	5	.533,	13	72.67
15	-107.6,	28	3128.7,	5	-.96,	28	27.98,	5	15.42,	5	.524,	14	71.01
16	-101.0,	25	3094.7,	5	-.90,	25	27.68,	5	15.23,	5	.515,	14	69.27
17	-92.3,	25	3059.2,	6	-.83,	25	27.36,	6	15.04,	6	.505,	14	67.47
18	-96.1,	29	3022.2,	6	-.86,	29	27.03,	6	14.85,	6	.496,	14	65.63
19	-120.4,	29	2981.7,	6	-1.08,	29	26.67,	6	14.69,	6	.487,	14	63.77
20	-130.1,	29	2918.5,	6	-1.16,	29	26.10,	6	14.80,	6	.477,	14	61.87
21	-122.8,	29	2744.6,	6	-1.10,	29	24.55,	6	16.06,	7	.468,	14	59.87
22	-96.8,	29	2365.6,	6	-.87,	29	21.16,	6	17.27,	7	.459,	14	57.78
23	-53.3,	29	2461.8,	7	-.48,	29	22.02,	7	15.37,	7	.450,	14	56.57

Margarita Stilling Basin Wing Wall
CESAJ-EN-GS

03/31/99
GRLWEAP(TM) Version 1.996

Rut= 2000.0, Rtoe = 1540.0 (kips), Time Inc. = .075 ms

No.	min F, (kips)	t	max F, (kips)	t	min Str, (ksi)	t	max Str, (ksi)	t	max V, (ft/s)	t	max D, (in)	t	max Et (kip-ft)
1	.0,	0	3415.1,	2	.00,	0	30.55,	2	17.12,	2	.570,	11	85.73
2	-76.1,	24	3439.3,	2	-.68,	24	30.76,	2	17.21,	3	.560,	11	85.02
3	-136.7,	24	3444.1,	3	-1.22,	24	30.81,	3	17.23,	3	.549,	10	84.06
4	-184.3,	24	3432.6,	3	-1.65,	24	30.70,	3	17.17,	3	.538,	10	82.92
5	-227.0,	24	3429.5,	3	-2.03,	24	30.68,	3	17.05,	3	.525,	10	81.49
6	-250.6,	24	3418.7,	3	-2.24,	24	30.58,	3	16.93,	3	.511,	10	79.82
7	-274.7,	24	3395.4,	4	-2.46,	24	30.37,	4	16.83,	4	.498,	10	78.03
8	-283.5,	24	3359.8,	4	-2.54,	24	30.05,	4	16.65,	4	.483,	10	75.95
9	-263.0,	24	3335.6,	4	-2.35,	24	29.84,	4	16.41,	4	.465,	9	73.47
10	-249.3,	24	3306.0,	4	-2.23,	24	29.57,	4	16.26,	4	.447,	9	70.84
11	-247.2,	24	3263.1,	4	-2.21,	24	29.19,	4	16.05,	4	.429,	9	68.03
12	-220.2,	24	3222.2,	4	-1.97,	24	28.82,	4	15.76,	5	.408,	9	64.86
13	-200.7,	22	3185.0,	5	-1.79,	22	28.49,	5	15.57,	5	.388,	9	61.71
14	-211.3,	23	3134.0,	5	-1.89,	23	28.03,	5	15.30,	5	.369,	9	58.66
15	-222.1,	23	3086.3,	5	-1.99,	23	27.61,	5	15.01,	5	.346,	8	55.11
16	-224.6,	22	3040.0,	5	-2.01,	22	27.19,	5	14.76,	5	.321,	8	51.05
17	-222.7,	22	2980.0,	6	-1.99,	22	26.66,	6	14.45,	6	.300,	9	47.74
18	-219.6,	22	2931.5,	6	-1.96,	22	26.22,	6	14.17,	6	.278,	9	44.49
19	-204.8,	22	2873.7,	6	-1.83,	22	25.70,	6	13.90,	6	.257,	9	41.34
20	-167.4,	22	2800.0,	6	-1.50,	22	25.05,	6	13.75,	6	.236,	10	38.24
21	-126.2,	22	2659.3,	6	-1.13,	22	23.79,	6	14.18,	6	.216,	10	35.27
22	-90.2,	22	2419.6,	6	-.81,	22	21.64,	6	14.17,	7	.197,	10	32.55
23	-48.4,	21	3110.9,	7	-.43,	21	27.83,	7	11.03,	7	.178,	10	30.67

Margarita Stilling Basin Wing Wall
CESAJ-EN-GS

03/31/99
GRLWEAP(TM) Version 1.996-1

Rut= 3000.0, Rtoe = 2310.0 (kips), Time Inc. = .057 ms

No.	min F, (kips)	t	max F, (kips)	t	min Str, (ksi)	t	max Str, (ksi)	t	max V, (ft/s)	t	max D, (in)	t	max Et (kip-ft)
1	.0,	0	3419.8,	2	.00,	0	30.59,	2	17.22,	2	.537,	10	84.73
2	-77.5,	24	3455.9,	2	-.69,	24	30.91,	2	17.30,	3	.525,	10	83.86
3	-151.6,	24	3466.1,	3	-1.36,	24	31.00,	3	17.26,	3	.513,	10	82.71
4	-221.1,	24	3458.3,	3	-1.98,	24	30.93,	3	17.23,	3	.500,	10	81.20
5	-280.0,	23	3454.7,	3	-2.50,	23	30.90,	3	17.12,	3	.486,	10	79.35
6	-317.0,	23	3432.0,	3	-2.84,	23	30.70,	3	16.96,	3	.472,	10	77.35
7	-330.9,	23	3405.5,	3	-2.96,	23	30.46,	3	16.80,	4	.457,	9	75.08
8	-339.5,	23	3374.7,	4	-3.04,	23	30.19,	4	16.56,	4	.440,	9	72.37
9	-335.3,	23	3332.0,	4	-3.00,	23	29.80,	4	16.35,	4	.422,	9	69.35
10	-328.1,	23	3293.1,	4	-2.94,	23	29.45,	4	16.06,	4	.404,	9	66.27
11	-320.1,	23	3240.0,	4	-2.86,	23	28.98,	4	15.80,	4	.384,	9	62.85
12	-287.6,	23	3191.9,	5	-2.57,	23	28.55,	5	15.48,	5	.363,	9	59.20
13	-265.6,	25	3132.2,	5	-2.38,	25	28.02,	5	15.16,	5	.344,	9	55.82
14	-260.3,	24	3074.2,	5	-2.33,	24	27.50,	5	14.83,	5	.324,	8	52.26
15	-248.4,	24	3010.7,	5	-2.22,	24	26.93,	5	14.46,	5	.300,	8	48.09
16	-229.3,	25	2942.7,	5	-2.05,	25	26.32,	5	14.13,	5	.275,	8	43.68
17	-206.1,	25	2877.4,	5	-1.84,	25	25.74,	5	13.75,	6	.247,	8	39.04
18	-169.2,	25	2802.4,	6	-1.51,	25	25.07,	6	13.38,	6	.217,	8	34.06
19	-117.8,	21	2733.1,	6	-1.05,	21	24.45,	6	13.03,	6	.193,	7	30.20
20	-82.6,	21	2651.9,	6	-.74,	21	23.72,	6	12.72,	6	.174,	7	27.29
21	-65.6,	21	2527.2,	6	-.59,	21	22.60,	6	12.77,	6	.153,	7	24.29
22	-55.6,	21	2385.6,	6	-.50,	21	21.34,	6	12.11,	6	.127,	7	20.57
23	-29.3,	21	3133.2,	7	-.26,	21	28.03,	7	8.53,	6	.098,	7	17.03

Margarita Stilling Basin Wing Wall 03/31/99
CESAJ-EN-GS GRLWEAP(TM) Version 1.996

Rut= 2213.5, Rtoe = 1704.4 (kips), Time Inc. = .071 ms

No.	min F, (kips)	t	max F, (kips)	t	min Str, (ksi)	t	max Str, (ksi)	t	max V, (ft/s)	t	max D, (in)	t	max Et (kip-ft)
1	.0,	0	3417.7,	2	.00,	0	30.57,	2	17.15,	2	.562,	11	85.48
2	-75.1,	24	3445.2,	2	-.67,	24	30.82,	2	17.21,	3	.551,	11	84.72
3	-136.8,	24	3455.4,	3	-1.22,	24	30.91,	3	17.21,	3	.540,	10	83.74
4	-192.7,	24	3453.1,	3	-1.72,	24	30.89,	3	17.16,	3	.528,	10	82.54
5	-239.3,	24	3442.2,	3	-2.14,	24	30.79,	3	17.08,	3	.515,	10	81.02
6	-262.2,	24	3424.2,	3	-2.35,	24	30.63,	3	16.98,	3	.501,	10	79.27
7	-277.9,	24	3399.7,	4	-2.49,	24	30.41,	4	16.84,	4	.488,	10	77.39
8	-291.0,	24	3369.3,	4	-2.60,	24	30.14,	4	16.66,	4	.472,	10	75.16
9	-278.1,	24	3333.0,	4	-2.49,	24	29.81,	4	16.46,	4	.454,	9	72.55
10	-269.2,	24	3298.2,	4	-2.41,	24	29.50,	4	16.23,	4	.436,	9	69.82
11	-262.7,	24	3263.7,	4	-2.35,	24	29.19,	4	15.96,	4	.418,	9	66.87
12	-230.1,	24	3223.7,	5	-2.06,	24	28.83,	5	15.74,	5	.397,	9	63.57
13	-203.4,	25	3178.2,	5	-1.82,	25	28.43,	5	15.50,	5	.377,	9	60.38
14	-210.9,	25	3127.0,	5	-1.89,	25	27.97,	5	15.23,	5	.358,	9	57.22
15	-208.4,	26	3070.3,	5	-1.86,	26	27.46,	5	14.92,	5	.335,	8	53.50
16	-205.3,	26	3018.6,	5	-1.84,	26	27.00,	5	14.60,	5	.309,	8	49.30
17	-200.7,	26	2966.6,	5	-1.80,	26	26.54,	5	14.33,	6	.283,	9	45.03
18	-188.0,	26	2909.1,	6	-1.68,	26	26.02,	6	14.03,	6	.260,	9	41.45
19	-177.9,	22	2844.8,	6	-1.59,	22	25.45,	6	13.72,	6	.237,	9	38.03
20	-154.0,	22	2770.1,	6	-1.38,	22	24.78,	6	13.54,	6	.214,	9	34.64
21	-120.4,	22	2639.3,	6	-1.08,	22	23.61,	6	13.87,	6	.191,	10	31.30
22	-89.3,	21	2420.7,	6	-.80,	21	21.65,	6	13.68,	6	.170,	10	28.31
23	-47.3,	21	3137.4,	7	-.42,	21	28.06,	7	10.37,	6	.149,	10	26.19

Rut (kips)	Bl Ct (bpf)	Stroke(eq.) (ft)	min Str (ksi)	i,t	max Str (ksi)	i,t	ENTHRU (kip-ft)
1000.0	34.3	4.26	-1.38(	4, 23)	30.43(	4, 3)	86.6
2000.0	153.8	4.26	-2.54(	8, 24)	30.81(	3, 3)	85.7
2213.5	244.5	4.26	-2.60(	8, 24)	30.91(	3, 3)	85.5
3000.0	9999.0	4.26	-3.04(	0, 0)	31.00(	0, 0)	84.7

APPENDIX B-4

MARGARITA STILLING BASIN
BEARING CAPACITY AND SETTLEMENT ANALYSES

Bearing Capacity Analysis —

Margarita Stilling Basin, Sta 54+10 to 54+75 (CB-MC-52)

JP

Short Term Condition: (Basin empty, structure complete w/ backfill not in place)

$q_u = cN_c + qN_q + \frac{1}{2}\gamma B N_\gamma$ (strip foundation) $c = 1300$ psf

($N_c \to 5.7$, $N_q \to 0$ [1], $N_\gamma \to 0$)

$q_u = 1200(5.7) + 0 = 7{,}410$ psf

Long Term Condition:

$q_u = \underset{0}{c}N_c + qN_q + \frac{1}{2}\gamma B N_\gamma$ for $\phi = 21°$ $\begin{cases} N_c = 28 \\ N_q = 15 \\ N_\gamma = 12 \end{cases}$

$= 0 + \left[(7.5)(52.5) + (16.5)(37.5)\right](15) + \left[\frac{1}{2}(52.5)(35)(12)\right]$

$= 0 + 15{,}187.5 + 11{,}025 = 26{,}212.5$ psf

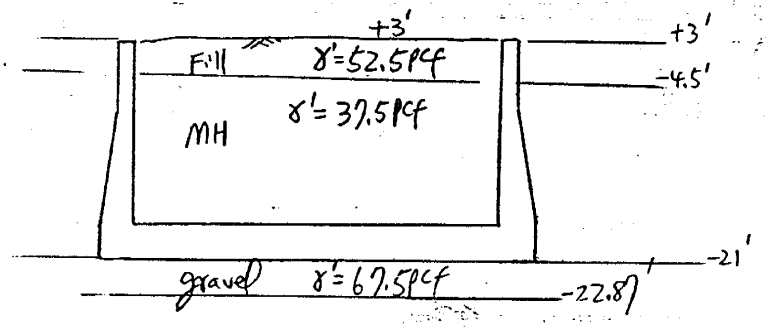
Short term ultimate Bearing Capacity $\cong$ 7,410 psf

Long term ultimate Bearing Capacity $\cong$ 26,210 psf

Settlement Analysis -

Margarita Stilling Basin, Sta. 54+10 to 54+75

Foundation pressure ($q_o \cong 2000$ psf) is selected to represent Load Case 1 (Ref = Structural Plate – Stilling Basin Stability Analysis)



$q_o \cong 2{,}000$ psf

$P_o = (52.5\text{pcf})(7.5') + (37.5\text{pcf})(16.5') + (67.5\text{pcf})(1') + (64.4\text{pcf})(15.75')$

$= 2094.3$ psf

$\Delta P_{av} = \frac{1}{6}(\Delta P_t + 4\Delta P_m + \Delta P_b)$

$\Delta P = \frac{q_o \times B \times L}{(B+z)(L+z)}$

$\Delta P_m = \frac{(2000)\times(35)(65)}{(35+15.5)(65+15.5)} = 1119.25$ lbs

$\Delta P_b = \frac{(2000)(35)(65)}{(35+31)(65+31)} = 718.12$ lbs

$\Delta P_{av} = \frac{1}{6}\left[2000 + 4(1119.25) + 718.12\right] = 1199$ lbs

$S_c = \frac{C_c H}{1+e_o} \log \frac{P_o + \Delta P_{av}}{P_o}$

$= \frac{(0.064)(31')}{1+0.68} \log \frac{(2094)(1199)}{2094}$

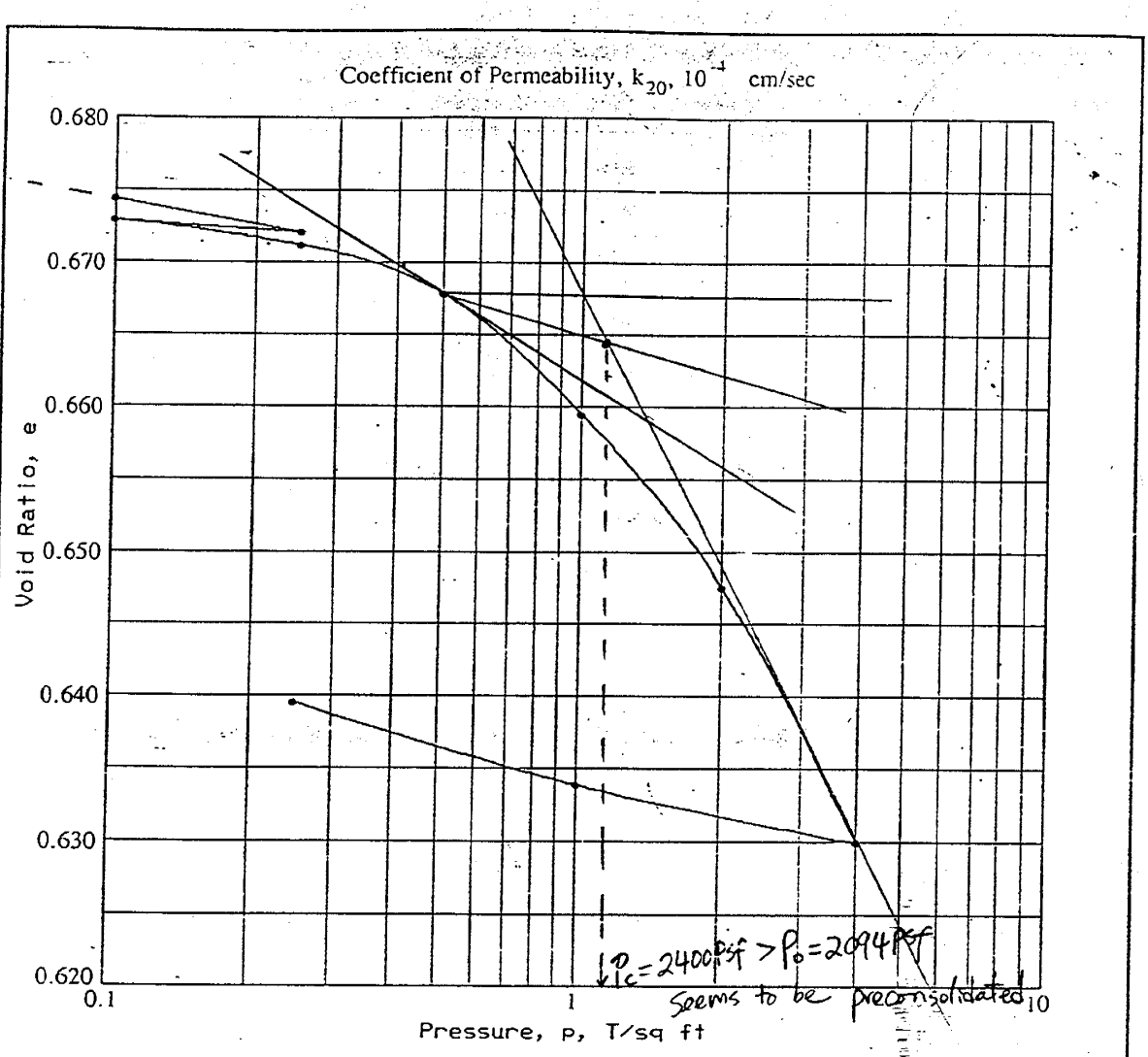
$= 0.23' = 2.78''$ - small, OK

from Consolidation test (CB-MC-52)

- $e_o = 0.68$
- $P_c \cong 2400$ psf $> P_o = 2094$ psf, however to be Conservative use normally consolidated appr
- $C_c = \frac{e_1 - e_2}{\log\left(\frac{P_2}{P_1}\right)} = \frac{0.638 - 0.630}{\log\left(\frac{4}{3}\right)} = 0.064$

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038

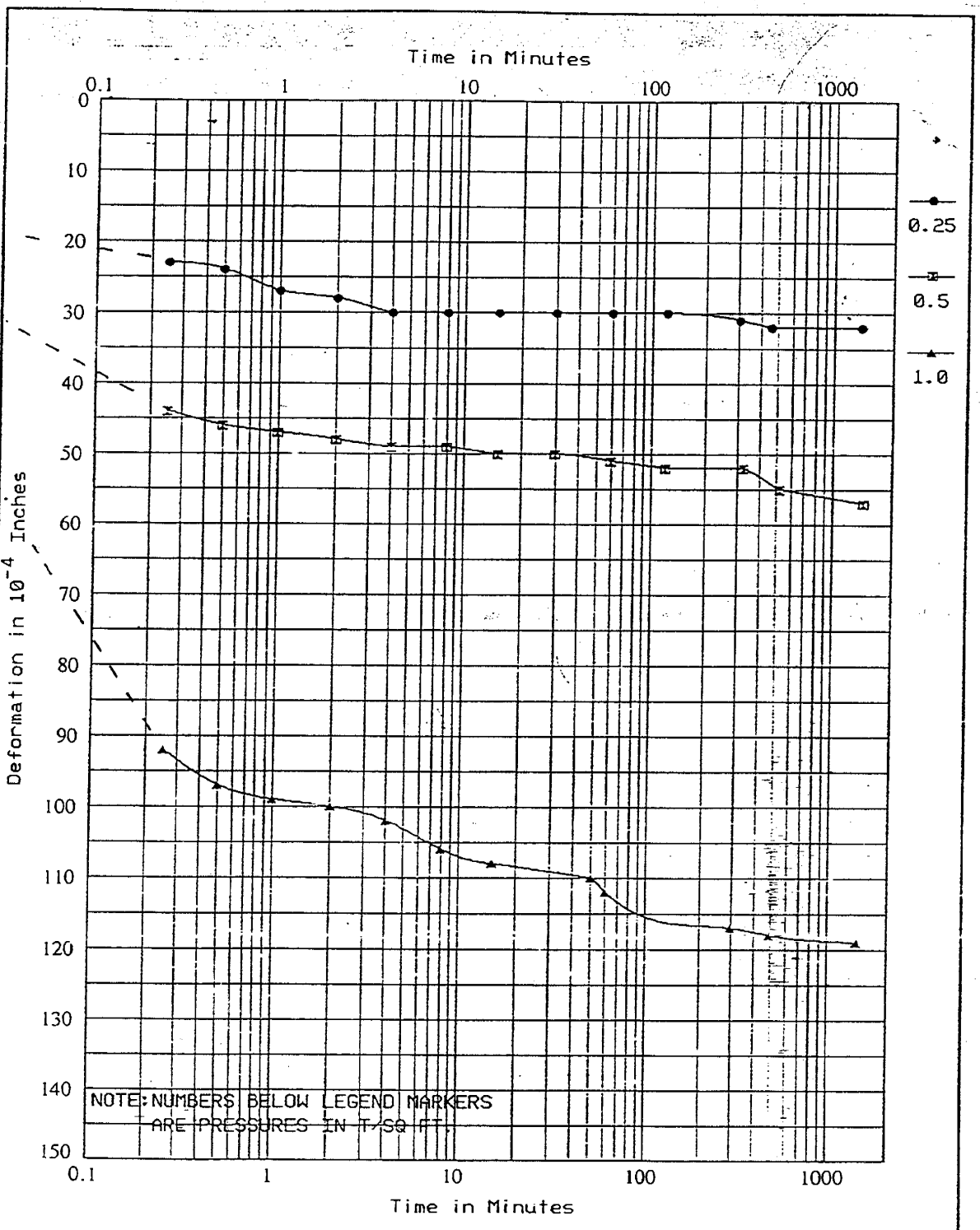


Type of Specimen UNDISTURBED			Before Test			After Test	
Diam. 3.990 in.	Height 1.240 in.	Water Content	w_o	23.8 %	w_f	23.3 %	
Overburden Pressure, p_o T/sq ft		Void Ratio	e_o	0.675	e_f	0.640	
Preconsol. Pressure, p_c T/sq ft		Saturation	S_o	96.9 %	S_f	100.0 %	
Compression Index, C_c		Dry Density	γ_d	102.5 lb/ft^3			
Classification LT. BROWN, REDDISH TAN, & GRAY, SANDY FAT CLAY (CH).							
LL 72	G_s 2.75	Project RIO PUERTO NEUVO					
PL 21	D_{10} < 0.002 MM						
Remarks 1. SPECIMEN FLOODED				Lab No. 73/7184			
THROUGHOUT TEST. 2. TIME CURVES		Boring No. CB-MC-52		Sample No. -			
FURNISHED FOR LOADS OF 0.25,		Depth (ft) 31.0-33.0		Date 01/06/96			
0.5, 1.0, 2.0, AND 4.0 T/SF.		**CONSOLIDATION TEST REPORT**					

B-4-3

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038



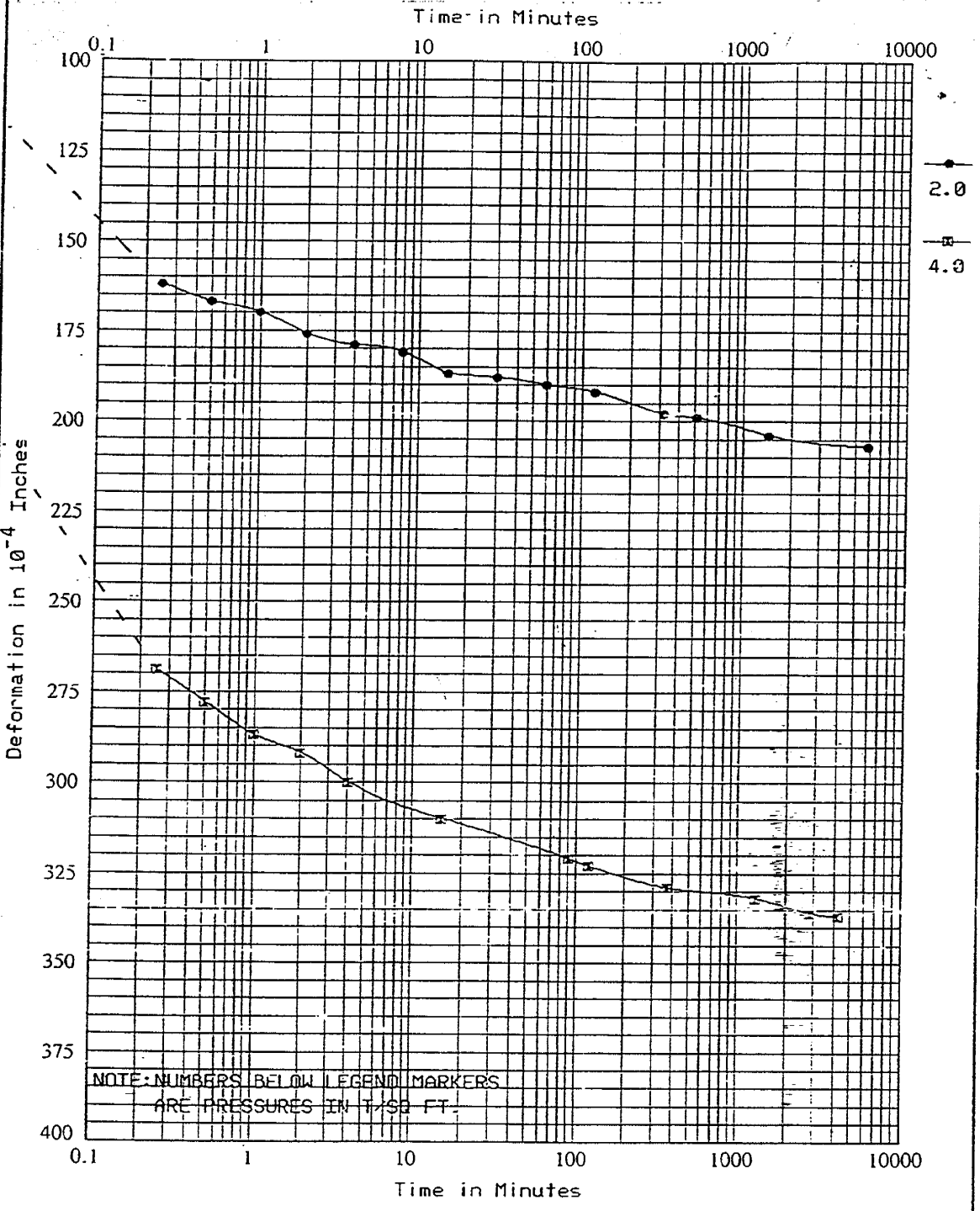
Project RIO PUERTO NEUVO			
Area			Lab No. 73/7184
Boring No. CB-CM-52	Sample No. ---	Depth (ft) 31.0-33.0	Date 01/06/96

CONSOLIDATION TEST - TIME CURVES

B-4-4

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA 30066

WORK ORDER: 7825
REQUSITION: RM-CW-96-0038



Project RIO PUERTO NEUVO			
Area			Lab No. 73/7184
Boring No. CB-CM-52	Sample No. ---	Depth (ft) 31.0-33.0	Date 01/06/96

CONSOLIDATION TEST - TIME CURVES

B-4-5

APPENDIX B-5

MARGARITA STILLING BASIN
STONE PROTECTION DESIGN

Station 54+00 to 54+10

$V = 11$ ft/s Depth $= 18'$ $S = 0$ $\gamma_{stone} = 160$ pcf $y = 0.86$

$D_{50} = 19.54"$ $W_{50} = 361.79$ lbs

① $2 W_{50} \cong 723.6$ lbs from riprap gradation curve $\Rightarrow W_{65} = 450$ lbs

② Desired $(W_{100})_{min} = 2 \times W_{65} = 2 \times 450 = 900$ lbs

③ Let W_{65} have 45 ~ 65% passing

④ Let $\frac{1}{4} W_{65} \cong 113$ lbs have 10 ~ 30% passing

⑤ get $W_{100(max)} = 1200$ lbs

⑥ Check (a) $W_{100(max)} = 1200 < 5 \times W_{50(min)} = 5 \times 260 = 1300$ ∴ OK

(b) $W_{100(min)} = 900 > 2 \times W_{50(min)} = 2 \times 260 = 520$ ∴ OK.

Thickness of Riprap:

$t = 2(D_{50})_{max}$ or $1.5(D_{100})_{max}$ whichever is larger

$$D_{50_{max}} = \left[\frac{6 \times 500}{\pi (160)}\right]^{1/3} = 1.81 \text{ ft} \cong 22" \qquad T \cong 44"$$

or

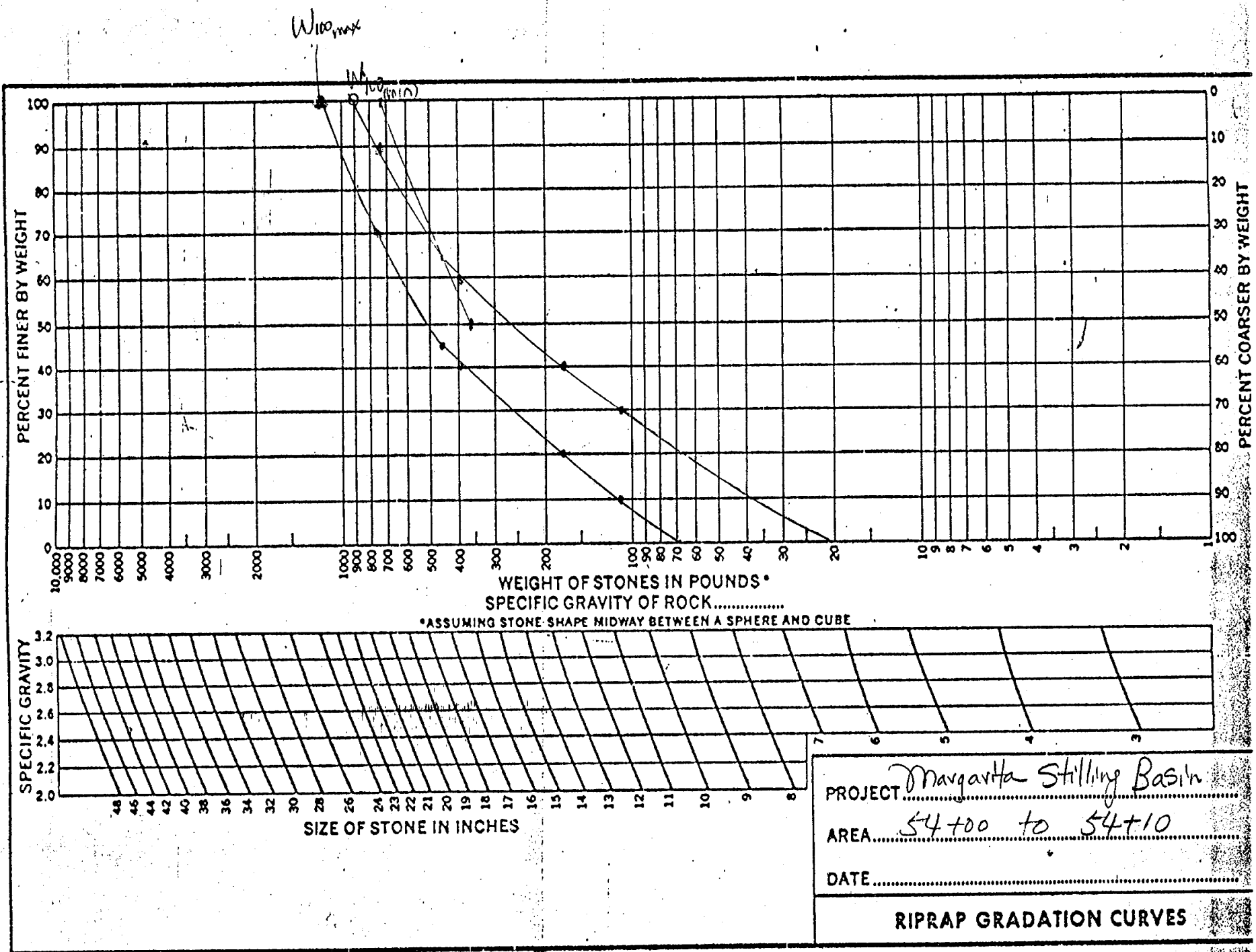
$$D_{100(max)} = \left[\frac{6 \times W_{100\,max}}{\pi \gamma_s}\right]^{1/3} = \left[\frac{6 \times 1200}{\pi (160)}\right]^{1/3} = 2.43 \text{ ft} = 29"$$

$T = 1.5(29") = 43.7" \cong 44"$

increase 50% for underwater placement

$T = 1.5(44") = 66"$

Weight of Stones in pounds	Percent finer by weight
1200	100
750	70-90
400	40-60
170	20-40
20	0-20



ENG FORM 4055
APR 87

Bedding design

From riprap design—

$$D_{15\,max} = \left[\frac{6(W_{15\,max})_{riprap}}{\pi \gamma_s}\right]^{1/3} = \left[\frac{6\,(150)}{\pi(160)}\right]^{1/3} = 1.214\,ft = 14.57'' = 370\,mm$$

$$D_{15\,min} = \left[\frac{6\,(W_{15\,min})_{riprap}}{\pi \gamma_s}\right]^{1/3} = \left[\frac{6(50)}{\pi(160)}\right]^{1/3} = 0.84\,ft = 10.1'' = 256.7\,mm$$

$$D_{50\,max} = \left[\frac{6\,(W_{50\,max})_{riprap}}{\pi \gamma_s}\right]^{1/3} = \left[\frac{6\,(500)}{\pi(160)}\right]^{1/3} = 1.81\,ft = 21.75'' = 552.6\,mm$$

① $D_{15\,max} < 5\,D_{85\,bedding}$ $\quad D_{85\,bedding} > 370/5 = 74\,mm$.

② $D_{15\,min} > 5\,D_{15\,max\,bedding}$ $\quad D_{15\,max\,bedding} < D_{15\,min\,riprap}/5 = 256.7/5 = 51.3\,m$

③ $D_{50\,min\,bedding} \geq \dfrac{D_{50\,max\,riprap}}{25} = 5526/25 = 22.1\,mm$

thickness of bedding = $\gamma_{bedding} = 145\,pcf$

$t = 2\,(D_{50})_{max}$ or $t = 1.5\,(D_{100})_{max}$

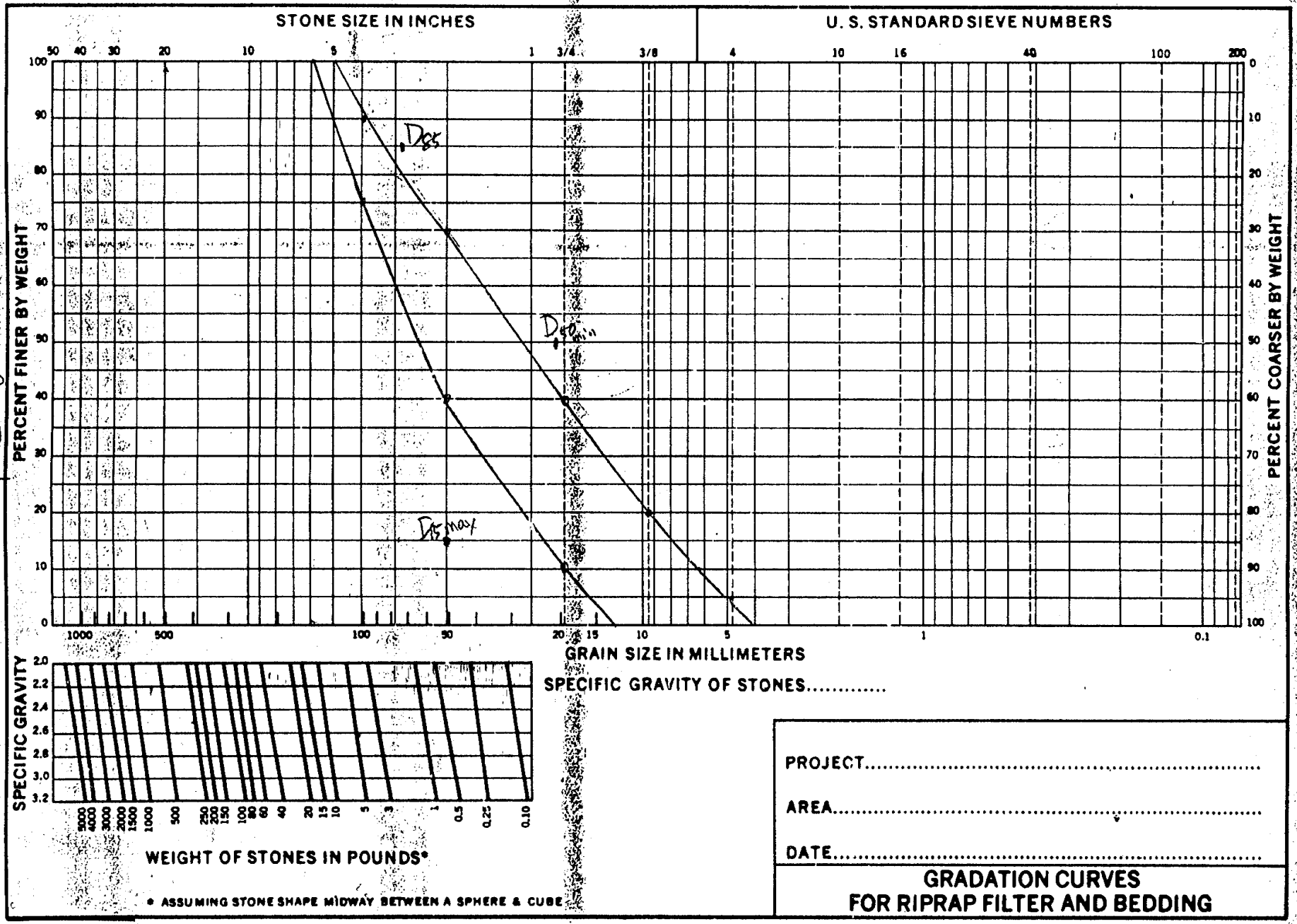
① $D_{50\,max} = 65\,mm$ (from curve) $\quad t = 130\,mm = 5.1''$

② $D_{100\,max} = 150\,mm$ (from curve) $\quad t = 225\,mm = 8.8''$

increase by 50% for underwater placement = 13.2" say 14"

Bedding Stone Weight not less than 145 pcf (Saturated surface Dry)

U.S. Standard Sieve Opening in inches or Sieve Designation	percent finer by weight
6 in	100
4 in	75–90
2 in	40–70
3/4 in	10–40
No. 4	0–5



ENG FORM 4056
APR 67

Margarita Stilling Basin — Stone Protection Design ①

Station 51+50 to 53+70

$V = 7.4$ ft/sec Depth = 15' $S = -0.1$ $\gamma_{stone} = 160$ pcf $Y = 0.86$ (Isbash Constant for turbulent wate

$D_{50} = 8.08''$ $W_{50} = 25.57$ lbs

$D_{50} = \left(\frac{6 W_{50}}{\pi \gamma_s}\right)^{1/3} \Rightarrow W_{50} = \frac{\pi \gamma_s}{6} (D_{50})^3$ from Riprap program $\Rightarrow W_{50} = 25.57$ lb

① $2 \times W_{50} \cong 52$ lbs from riprap gradation curve $\Rightarrow W_{65} = 30$ lbs

② Desired $(W_{100})_{min} = 2 \times W_{65} = 60$ lbs

③ Let W_{65} have 45~65% passing

④ Let $\frac{1}{4} W_{65} \cong 8$ have 10 ~ 30% passing

⑤ get $W_{100(max)} = 70$ lbs

⑥ check (a) $W_{100(max)} < 5 \times W_{50(min)}$ $70 < 5 \times 25.57 = 128$ ∴ OK

(b) $W_{100(min)} > 2 \times W_{50(min)}$ $60 > 2 \times 25.57 = 51$ ∴ OK.

Thickness of Riprap:

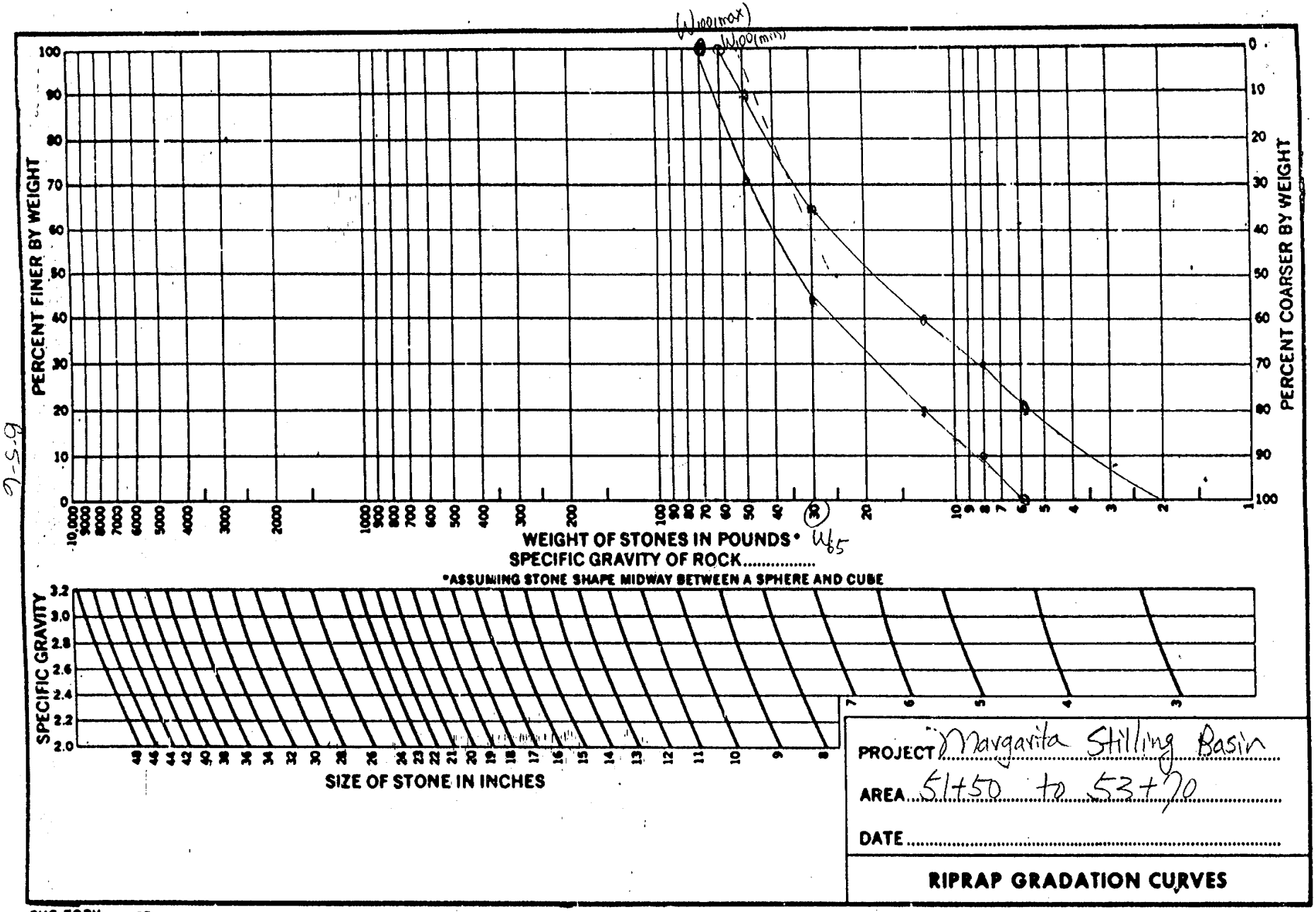
$t = 2 (D_{50})_{max}$ or $1.5 (D_{100})_{max}$ Whichever is larger

$D_{50\,max} = \left(\frac{6 \times W_{50}}{\pi \gamma_s}\right)^{1/3} = \left[\frac{6 \times 33}{\pi (160)}\right]^{1/3} = 0.73\text{ft} \cong 9''$ $T \cong 18''$

or $D_{100\,max} = \left(\frac{6 \times W_{100\,max}}{\pi \gamma_s}\right)^{1/3} = \left[\frac{6 \times 70}{\pi (160)}\right]^{1/3} = 0.94\text{ft} \cong 11.28''$ $T \cong 17''$

Select $T \cong 18''$, for underwater placement $\Rightarrow T = (1.5)(18'') = 27''$

wt. of Stones in pounds	Percent finer by weight
70	100
50	70–90
30	45–65
13	20–40
6	0–20



D-S-9

ENG FORM 4055
APR 67

Bedding design

From Riprap design –

$$D_{15\,max} = \left[\frac{6\,(W_{15max})_{riprap}}{\pi\,\gamma_s}\right]^{1/3} = \left[\frac{6(10)}{\pi(160)}\right]^{1/3} = 0.49\,ft = 5.9'' = 149.9\,mm$$

$$D_{15\,min} = \left[\frac{6\,(W_{15\,min})_{riprap}}{\pi\,\gamma_s}\right]^{1/3} = \left[\frac{6(4.5)}{\pi(160)}\right]^{1/3} = 0.38\,ft = 4.5'' = 114.3\,mm$$

$$D_{50\,max} = \left[\frac{6\,(W_{50max})_{riprap}}{\pi\,\gamma_s}\right]^{1/3} = \left[\frac{6(33)}{\pi(160)}\right]^{1/3} = 0.73\,ft = 8.8'' = 223.5\,mm$$

① $D_{15\,max} < 5\,D_{85\,bedding}$ $\quad D_{85_{max\,bedding}} > 149.9/5 = 30\,mm$

② $D_{15\,min} > 5\,D_{15\,max\,bedding}$ $\quad D_{15_{max\,bedding}} < D_{15\,min\,riprap}/5 = \frac{114.3}{5} = 22.86\,mm$

③ $D_{50_{max\,riprap}} \le 25\,D_{50\,min\,bedding}$ $\quad D_{50_{min\,bedding}} \ge \frac{223.5}{25} = 8.94\,mm$

thickness of bedding : $\quad \gamma_{bedding} = 145\,lb/ft^3$

$t = 2(D_{50})_{max}$ or $t = 1.5(D_{100})_{max}$

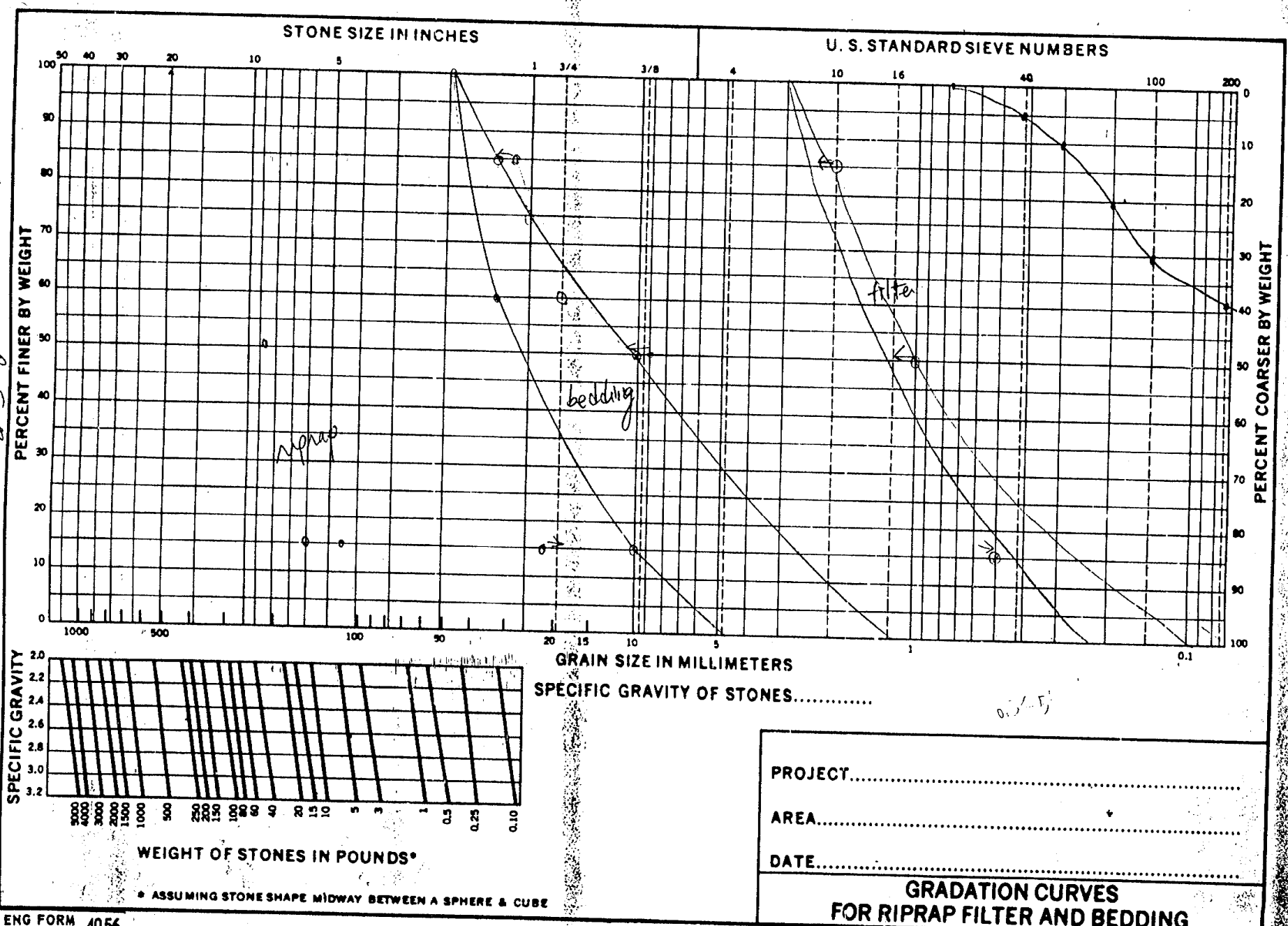
① $D_{50(max)} = 30$ mm (from curve), $t = 60\,mm = 2.4''$

② $D_{100(max)} = 50$ mm (from curve) $\quad t = 75\,mm = 3''$

Increase by 50% for underwater placement $\Rightarrow t = 4.5''$ say $6''$

Bedding Stone weight not less than 145 pcf (Saturated surface dry)

U.S. Standard Sieve Opening in inches or Sieve Designation	Percent finer by weight
2 in	100
1¼ in	60-85
⅜ in	15-50
No. 10	0-10



ENG FORM 4056
APR 67

Riprap Design for Channel sideslopes

$V = 11$ ft/s
$Y \cong 18$ ft

for slope > 1v on 3½H multiply V by 0.

$\therefore V = 9.79$ ft/s $\cong 10$ ft/s.

use chart to locate $D_{50} \cong 0.4' \cong 5''$ $W_{50} = 5.5$ lbs.

① $2W_{50} = 11$ lbs $\Rightarrow$ $W_{65} = 7$ lbs

② Desired $W_{100\,min} = 2W_{65} = 14$ lbs

③ Let W_{65} have 45 ~ 65% passing

④ let $\frac{1}{4} W_{65} = 1.75$ have 10 ~ 30% passing

⑤ $W_{100\,max} = 20$ lbs

⑥ check (a) $W_{100\,max} = 20 < 5\, W_{50\,min} = 5(5.5)$ $\therefore$ OK

(b) $W_{100\,min} = 14 > 2\, W_{50\,min} = 2(5.5)$ $\therefore$ OK.

Thickness of Riprap:

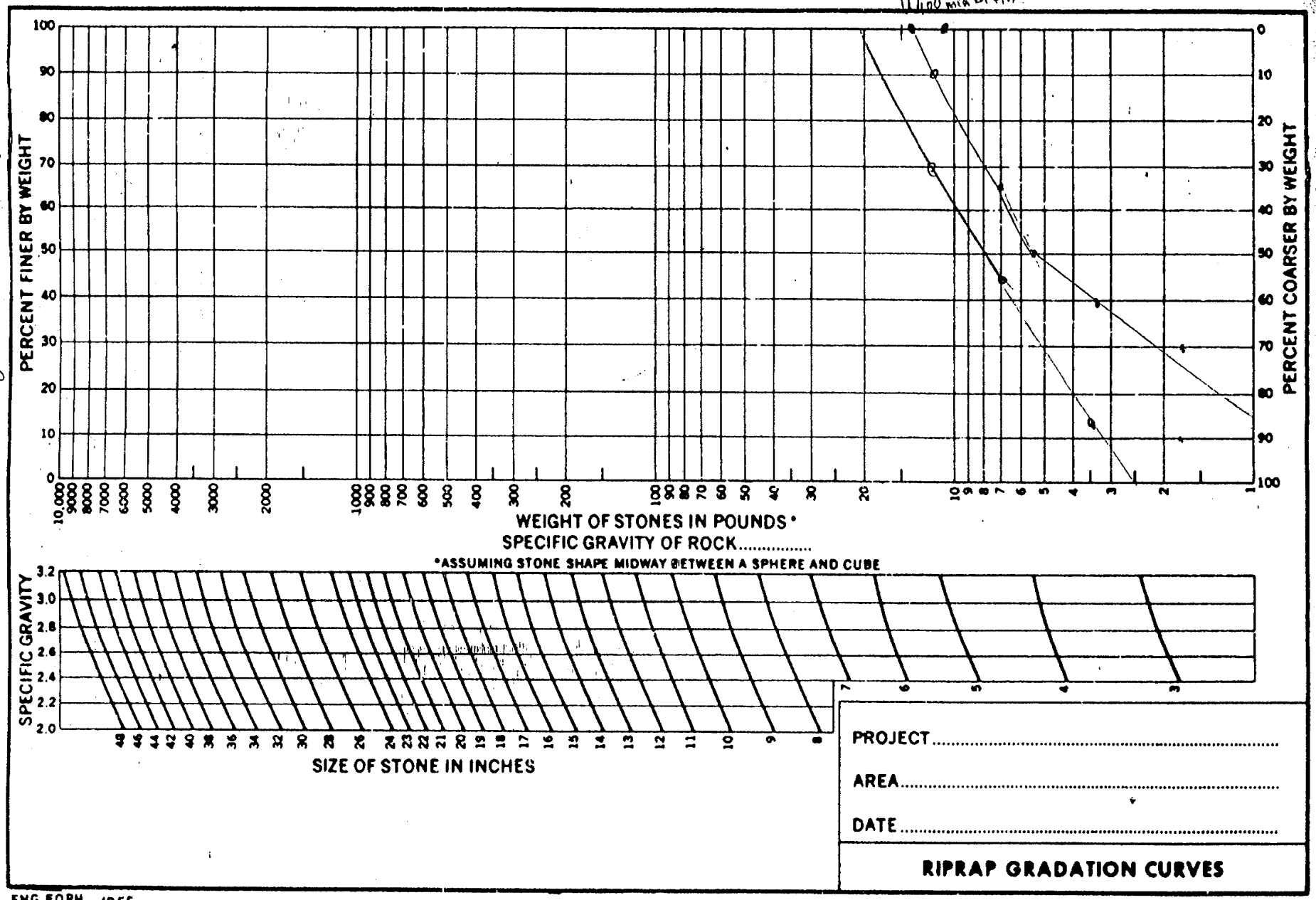
$t = 2\,(D_{50})_{max}$ or $1.5\,(D_{100})_{max}$ whichever is larger

$D_{50_{max}} = \left[\frac{6(8)}{\pi(160)}\right]^{1/3} = 0.45' = 5.5''$ $t = 11''$ use $18''$ for underwater placement

$D_{100\,max} = \left[\frac{6(20)}{\pi(160)}\right]^{1/3} = 0.62' = 7.5'$ $t = 11''$ $\therefore$ also use $\underline{\underline{18''}}$

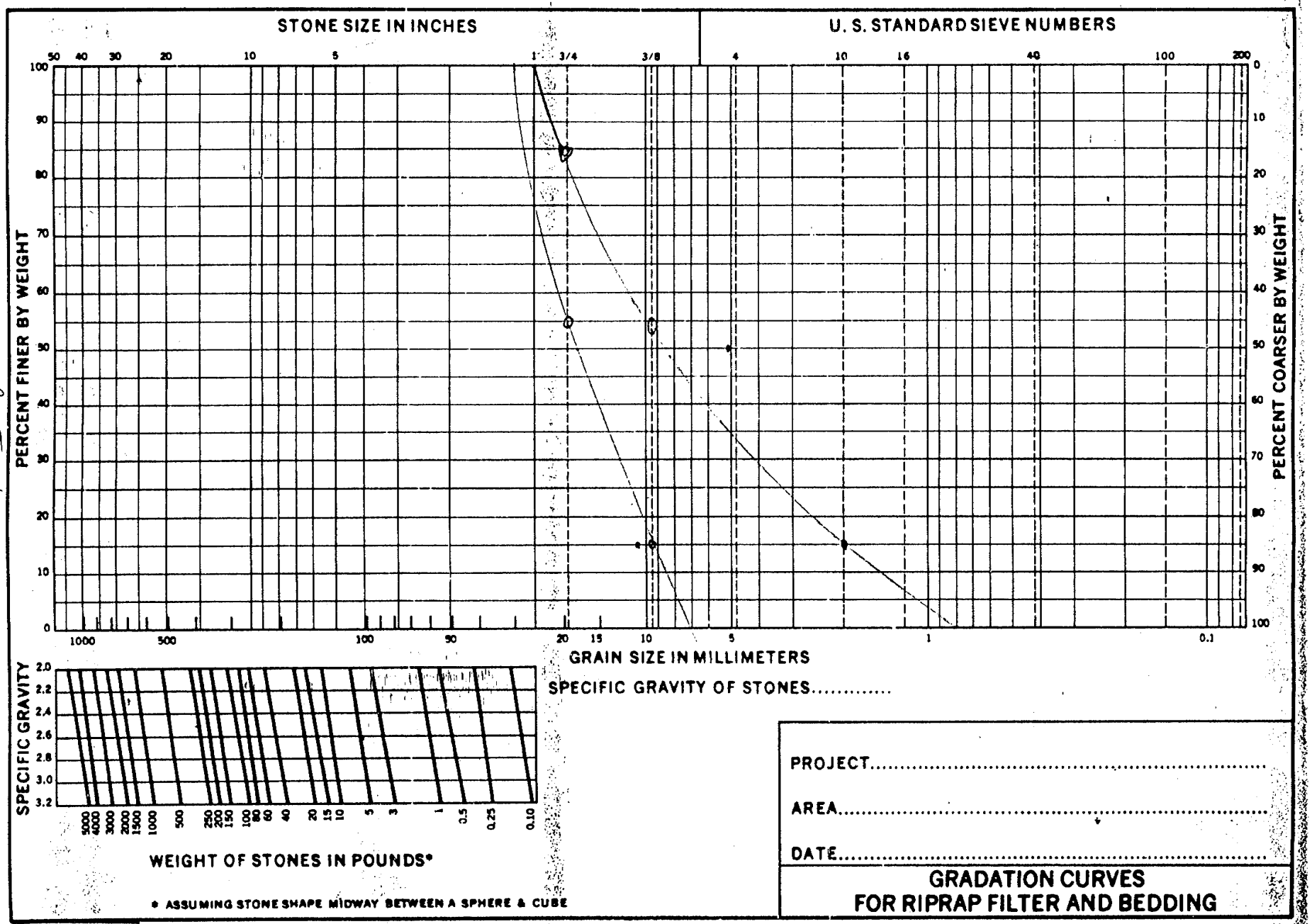
Weight of stones in pounds	Percent finer by weight
20	100
11	70-90
8	50-70
3.5	15-40
1	0-15

bs 9



ENG FORM 4055
APR 67

11-5-9



ENG FORM 4056
APR 67

Bedding design —

From riprap design —

$$D_{15max} = \left[\frac{(6\,W_{15max})_{riprap}}{\pi\gamma_s}\right]^{1/3} = \left[\frac{6(3.5)}{\pi(160)}\right]^{1/3} = 0.35' = 4'' = 106\ mm$$

$$D_{15min} = \left[\frac{(6\,W_{15min})_{riprap}}{\pi\gamma_s}\right]^{1/3} = \left[\frac{6(0.5)}{\pi(160)}\right]^{1/3} = 0.18' = 2'' = 55\ mm$$

$$D_{50max} = \left[\frac{6\,W_{50max}}{\pi\gamma_s}\right]^{1/3} = \left[\frac{6(8)}{\pi(160)}\right]^{1/3} = 0.46' = 5.5'' = 139\ mm$$

① $D_{15max} < 5\,D_{85\,bedding}$ $\quad D_{85\,bedding} > \frac{106}{5} = 22\ mm$

② $D_{15min} > 5\,D_{15max\,bedding}$ $\quad D_{15max\,bedding} < D_{15min\,riprap}/5 = \frac{55}{5} = 11\ m$

③ $D_{50min\,bedding} \geq \frac{D_{50max\,riprap}}{25} = \frac{139}{25} = 5.6\ mm$

$\gamma_{bedding} = 145\ pcf$

thickness of bedding =

① $t = 2\,D_{50max}$ $\quad D_{50max} = 18\ mm$ $\quad t = 36\ mm = 1.4''$

② $t = 1.5\,D_{100max}$ $\quad D_{100max} = 30\ mm$ $\quad t = 45\ mm = 1.8''$

underwater placement ⇒ increase by 50% ⇒ $t = 3''$ use $6''$

U.S. Standard Sieve Opening in inches or Sieve Designation	Percent finer by weight
1 in	100
3/4 in	55–85
3/8 in	15–55
NO.10	0–15

B-5-12

SQUARE 4 X 4 TO THE INCH
KEUFFEL & ESSER CO. LANCASTER N.Y.

RIPRAP DESIGN FOR CHANNEL SIDESLOPES

Graphical solution of a $(\gamma_s - \gamma) D_{50} K_1 = 1.5 \frac{\gamma^{\theta} \bar{v}^2 \gamma_b / \gamma_a}{(32.6 \log 12.2y/D_{50})}$ for $\gamma_b/\gamma_a = 1$

LEGEND

y = 16 — WHERE y = FLOW DEPTH IN FEET

$\bar{v}$ = 18 — WHERE $\bar{v}$ = AVERAGE LOCAL VELOCITY IN THE VERTICAL IN FEET PER SECOND

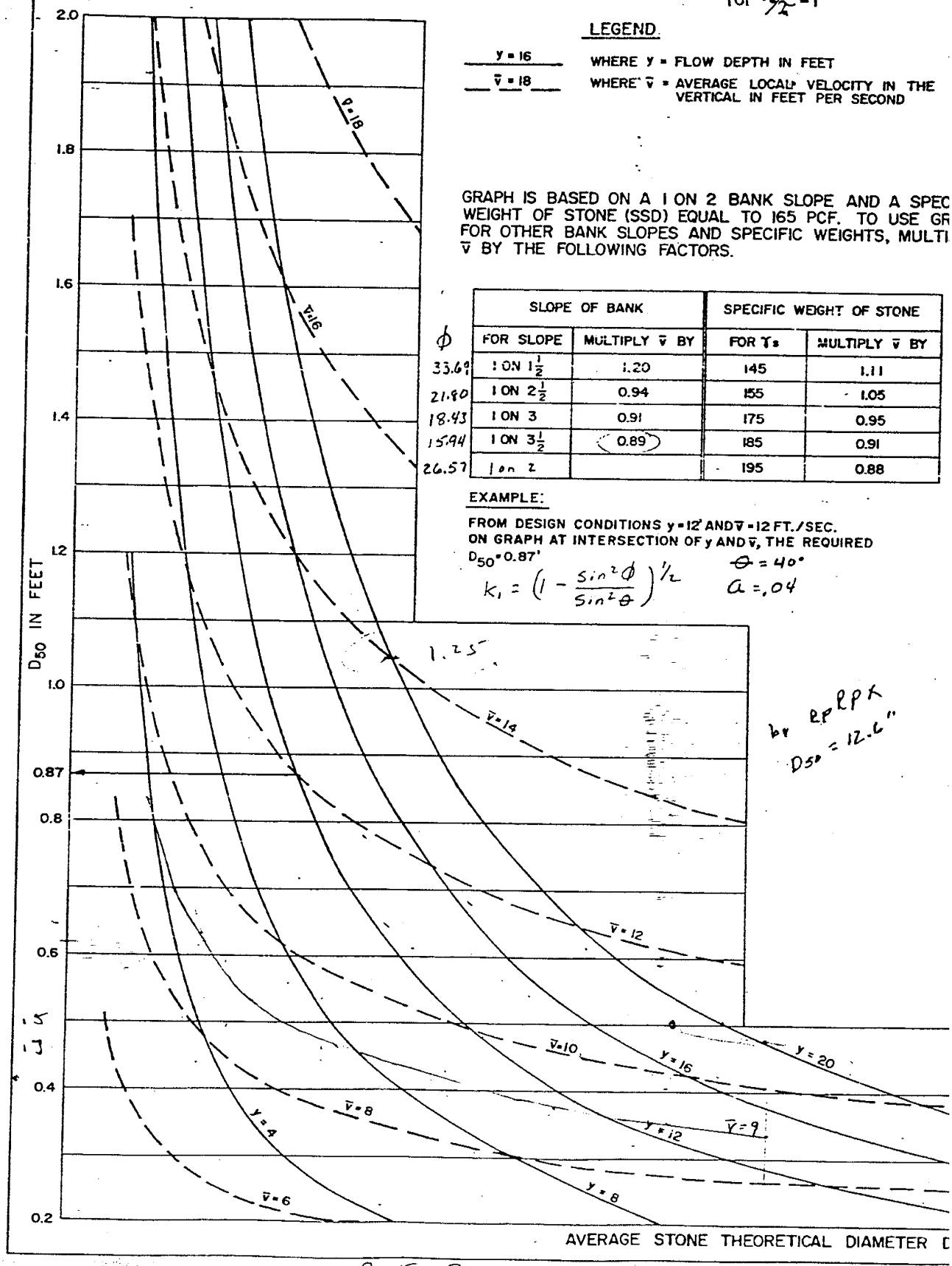
GRAPH IS BASED ON A 1 ON 2 BANK SLOPE AND A SPEC WEIGHT OF STONE (SSD) EQUAL TO 165 PCF. TO USE GR FOR OTHER BANK SLOPES AND SPECIFIC WEIGHTS, MULTI $\bar{v}$ BY THE FOLLOWING FACTORS.

ϕ	SLOPE OF BANK		SPECIFIC WEIGHT OF STONE	
	FOR SLOPE	MULTIPLY $\bar{v}$ BY	FOR γ_s	MULTIPLY $\bar{v}$ BY
33.69°	1 ON $1\frac{1}{2}$	1.20	145	1.11
21.80°	1 ON $2\frac{1}{2}$	0.94	155	1.05
18.43°	1 ON 3	0.91	175	0.95
15.94°	1 ON $3\frac{1}{2}$	0.89	185	0.91
26.57°	1 on 2		195	0.88

EXAMPLE:

FROM DESIGN CONDITIONS y = 12' AND $\bar{v}$ = 12 FT./SEC. ON GRAPH AT INTERSECTION OF y AND $\bar{v}$, THE REQUIRED D_{50} = 0.87'

$K_1 = \left(1 - \frac{\sin^2\phi}{\sin^2\theta}\right)^{1/2}$ $\theta = 40°$ $a = .04$



by RPRR $D_{50} = 12.6''$

APPENDIX B-6

CORE BORING PROFILES AND SOIL PARAMETERS

PUERTO NUEVO
DE DIEGO BRIDGE

EASTBOUND SOUTH ABUTMENT CB-PNB-4

EL. 24.1 (FT)		
FILL CL	$\gamma_{moist} = (60)(1.25) = 75$ pcf	Nave = 6
	ϕ —	S_u = 600 psf
	ε_{50} = 0.01	A = 2.2
EL. 21.1	K = 100 pci	F = 0.9
FILL GC	$\gamma_{moist} = (76)(1.25) = 95$ pcf	Nave = 12
	ϕ = 32°	K = 25 pci
	ε_{50} —	
EL. 6.1		
CLAY OH	$\gamma_{moist} = (57)(1.30) = 74$ pcf	Nave = 6
	ϕ —	S_u = 600 psf
	ε_{50} = 0.01	A = 2.2
EL. 1.6	K = 100 pci	F = 0.9
CLAY CH	$\gamma_{SATURATED} = (50)(1.5) = 75$ pcf	Nave = 12
EL. - 5.92	ϕ —	S_u = 1200 psf
	ε_{50} = 0.007	A = 1.6
EL. -11.9	K = 300 pci	F = 0.8
CLAY CL	$\gamma_{SAT} = (73)(1.48) = 108$ pcf	Nave = 12
	ϕ —	S_u = 1200 psf
	ε_{50} = 0.007	A = 1.6
EL. -22.4	K = 300 pci	F = 0.8
SAND SM	$\gamma_{SAT.} = (100)(1.25) = 125$ pcf	Nave = 19
	ϕ = 33°	K = 28 pci
	ε_{50} —	
EL. -25.4		
CLAY CL	$\gamma_{SAT.} = (84)(1.31) = 110$ pcf	Nave = 18
	ϕ —	S_u = 1800 psf
	ε_{50} = 0.007	A = 1.0
EL. -28.4	K = 300 pci	F = 0.65
CLAY CH	$\gamma_{SAT} = (104)(1.24) = 129$ pcf	Nave = 32
	ϕ —	S_u = 3200 psf
	ε_{50} = 0.005	A = 0.20
EL. -35.9	K = 1000 pci	F = 0.3

WESTBOUND SOUTH ABUTMENT

EL. 10.27 FT

FILL CH $\gamma_{SAT} = (50)(1.60) = 80$ pcf $N_{ave} = 5$
GWT EL. -3.23 $S_u = 500$ psf
$\varepsilon_{50} = 0.02$ $A = 2.3$
EL. -1.7 $K = 30$ pci $F = 0.95$

SAND SP $\gamma_{SAT} = (90)(1.32) = 119$ pcf $N_{ave} = 13$
$\phi = 30°$
$K = 15$ pci

EL. -10.7

CLAY CH $\gamma_{SAT} = (50)(1.60) = 80$ pcf $N_{ave} = 11$
$\varepsilon_{50} = 0.007$ $S_u = 1100$ psf
$K = 300$ pci $A = 1.7$
EL. -24.7 $F = 0.8$

CLAY CL $\gamma_{SAT} = (76)(1.47) = 112$ pcf $N_{ave} = 13$
$\varepsilon_{50} = 0.007$ $S_u = 1300$ psf
$K = 300$ pci $A = 1.5$
EL. -27.2 $F = 0.75$

CLAY CH $\gamma_{SAT} = (50)(1.6) = 80$ pcf $N_{ave} = 8$
$\varepsilon_{50} = 0.01$ $S_u = 600$ psf
$K = 100$ pci $A = 2.0$
EL. -30.2 $F = 0.9$

SAND SW $\gamma_{SAT} = (101)(1.24) = 125$ pcf $N_{ave} = 18$
$\phi = 32°$
$K = 18$ pci

EL. -36.7

CLAY CH $\gamma_{SAT} = (103)(1.24) = 128$ pcf $N_{ave} = 29$
$\varepsilon_{50} = 0.005$ $S_u = 2900$ psf
$K = 1000$ pcf $A = 0.2$
EL. -46.7 $F = 0.4$

SAND SC $\gamma_{SAT} = (108)(1.20) = 130$ pcf $N_{ave} = 31$
$\phi = 35°$
$K = 33$ pci

EL -48.2

CLAY CH $\gamma_{SAT} = (103)(1.24) = 128$ pcf $N_{ave} = 28$
$\varepsilon_{50} = 0.005$ $S_u = 2800$ psf
$K = 1000$ pci $A = 0.2$
EL. -52.7 $F = 0.4$

OGILVIE PRESS LANCASTER, N.Y.

WESTBOUND SOUTH ABUTMENT (CONT.)

EL -52.7		
SILT ML	γ_{SAT} = 136 pcf	N_{ave} = 110
	ε_{50} = 0.004	S_u = 6000 psf
	K = 3000 pci	A = 0.2
EL. -54.2		F = 0.2
LIMESTONE (SILT)	γ_{SAT} = 134 pcf	N_{ave} = 99
	ε_{50} = 0.004	S_u = 6000 psf
	K = 3000 pci	A = 0.2
EL. -67.7		F = 0.2
LIMESTONE (GRAVEL)	γ_{SAT} = 146 pcf	N_{ave} = 156
	ϕ = 42°	
	K = 62 pci	
EL. -76.7		
LIMESTONE (WEATHERED)		

FDM 2 PUERTO NUEVO

EASTBOUND NORTH ABUTMENT CB-PNB-6 1 of 2

EL. 23.5 FT

FILL GC $\gamma_{MOIST} = (90)(1.20) = 108$ pcf Nave = 15
$\phi = 32°$
$K = 20$ pci

EL. 21.5

FILL SM $\gamma_{MOIST} = (95)(1.20) = 114$ pcf Nave = 9
$\phi = 29°$
$K = 12$ pci

EL. 14.5

FILL GC $\gamma_{MOIST} = (90)(1.22) = 110$ pcf Nave = 15
$\phi = 32°$ $\gamma_{SAT} = (95)(1.32) = 119$ pcf
GWT EL 2.47 $K = 13$ pci

EL. -5.5

CLAY OH $\gamma_{SAT} = (40)(1.70) = 68$ pcf Nave = 4
$\varepsilon_{50} = 0.02$ $S_u = 400$ psf
$K = 30$ pci $A = 2.4$
EL. -8.5 $F = 1.0$

CLAY CL $\gamma_{SAT} = (70)(1.53) = 107$ pcf Nave = 10
$\varepsilon_{50} = 0.01$ $S_u = 1000$ psf
$K = 100$ pci $A = 1.8$
EL. -12.5 $F = 0.85$

CLAY CH $\gamma_{SAT} = (40)(1.80) = 72$ Nave = 10
$\varepsilon_{50} = 0.01$ $S_u = 1000$ psf
$K = 100$ pci $A = 1.8$
EL. -23.0 $F = 0.85$

SAND SC $\gamma_{SAT} = (60)(1.62) = 97$ Nave = 6
$\phi = 28°$
$K = 4$ pci

EL. -24.5

CLAY CH $\gamma_{SAT} = (60)(1.66) = 100$ pcf Nave = 16
$\varepsilon_{50} = 0.007$ $S_u = 1600$ psf
$K = 300$ pci $A = 1.2$
EL. -29.0 $F = 0.7$

CLAY CL $\gamma_{SAT} = (68)(1.55) = 105$ pcf Nave = 10
$\varepsilon_{50} = 0.01$ $S_u = 1000$ psf.
$K = 100$ pci $A = 1.8$
EL. -33.5 $F = 0.85$

SQUARE TO THE INCH
OGILVIE PRESS LANCASTER N Y

EASTBOUND NORTH ABUTMENT

EL. -33.5

CLAY CH — $\gamma_{SAT} = (54)(1.7) = 92$ pcf — $N_{ave} = 15$
$\varepsilon_{50} = 0.007$ — $S_u = 1500$ psf
$k = 300$ pci — $A = 1.3$
$F = 0.75$

EL. -36.2

CLAY CL — $\gamma_{SAT} = (76)(1.46) = 111$ — $N_{ave} = 14$
$\varepsilon_{50} = 0.007$ — $S_u = 1400$ psf
$k = 300$ pci — $A = 1.4$
$F = 0.75$

EL. -39.2

SAND SC — $\gamma_{SAT} = (135)(1.08) = 146$ — $N_{ave} = 46$
$\phi = 38°$
$k = 59$ pci

EL. -46.7

CLAY CL — $\gamma_{SAT} = (112)(1.18) = 132$ — $N_{ave} = 51$
$\varepsilon_{50} = 0.004$ — $S_u = 5100$ psf
$k = 3{,}000$ pci — $A = 0.2$
$F = 0.2$

EL. -49.7

SILT ML — $\gamma_{SAT} = (118)(1.16) = 137$ — $N_{ave} = 73$
$\varepsilon_{50} = 0.004$ — $S_u = 7300$ psf
$k = 3000$ pci — $A = 0.2$
$F = 0.2$

EL. -55.7

CLAY CL — $\gamma_{SAT} = (120)(1.15) = 138$ — $N_{ave} = 106$
$\varepsilon_{50} = 0.004$ — $S_u = 8000$
$k = 3{,}000$ pci — $A =$
$F =$

EL. -58.7

LIMESTONE GC — $\gamma_{SAT} = (135)(1.08) = 146$ — $N_{ave} = 52$
$\phi = 40°$
$k = 64$ pci

EL. -78.2

OGILVIE PRESS LANCASTER, N Y
SQUARE 4 X 4 TO THE INCH

PUERTO NUEVO
CB-PNB-7, 7D

WESTBOUND NORTH ABUTMENT

EL. 9.6 FT

FILL CL — $\gamma_{MOIST} = (62)(1.63) = 101$ pcf; $\varepsilon_{50} = 0.01$; $K = 100$ pci; Nave = 7; $S_u = 700$ psf; A = 2.1; F = 0.9

EL. 8.1 FT

FILL GC — $\gamma_{MOIST} = (85)(1.37) = 116$ pcf; $\phi = 30°$; $K = 6$ pci; Nave = 6

EL. -1.4

WT EL. -2.4 CLAY OH — $\gamma_{SAT} = (33)(2.5) = 83$ pcf; $\varepsilon_{50} = 0.03$; $K = 30$ pci; Nave = 2; $S_u = 200$ psf; A = 2.5; F = 1.1

EL. -3.9

SAND SP — $\gamma_{SAT} = (82)(1.38) = 113$ pcf; $\phi = 26°$; $K = 2$ pci; Nave = 2

EL. -5.4

CLAY OL — $\gamma_{SAT} = (40)(2.18) = 87$ pcf; $\varepsilon_{50} = 0.04$; $K = 30$ pci; Nave = 1; $S_u = 100$ psf; A = 2.7; F = 1.1

EL. -6.9

CLAY OH — $\gamma_{SAT} = (30)(2.7) = 81$ pcf; $\varepsilon_{50} = 0.04$; $K = 30$ pci; Nave = 1; $S_u = 100$ psf; A = 2.7; F = 1.1

EL. -8.9

CLAY CH — $\gamma_{SAT} = (50)(1.75) = 88$; $\varepsilon_{50} = 0.007$; $K = 300$ pci; Nave = 13; $S_u = 1300$ psf; A = 1.5; F = 0.8

EL. -38.4

SAND SW — $\gamma_{SAT} = (125)(1.12) = 140$; $\phi = 36°$; $K = 30$ pci; Nave = 31

EL. -52.8

SAND SP — $\gamma_{SAT} = (100)(1.19) = 130$; $\phi = 37°$; $K = 48$ pci; Nave = 38

EL. -55.8

OGILVIE PRESS LANCASTER N Y

WESTBOUND NORTH ABUTMENT

EL -55.8		
SAND SM	$\gamma_{SAT} = (122)(1.13) = 138$ $\phi = 38°$ $K = 48$ pci	$N_{AVE} = 40$
EL -58.8		
CLAY CH	$\gamma_{SAT} = (103)(1.25) = 129$ $\varepsilon_{50} = 0.005$ $K = 1000$ pci	$N_{AVE} = 30$ $S_u = 3000$ psf $A = 0.2$ $F = 0.2$
EL -66.3		
CLAY CL	$\gamma_{SAT} = (112)(1.18) = 132$ $\varepsilon_{50} = 0.005$ $K = 1000$ pci	$N_{AVE} = 38$ $S_u = 3800$ psf $A = 0.2$ $F = 0.2$
EL. -69.8		
CLAY CH	$\gamma_{SAT} = (74)(1.49) = 110$ $\varepsilon_{50} = 0.005$ $K = 1000$ pci	$N_{AVE} = 21$ $S_u = 2100$ psf $A = 0.75$ $F = 0.6$
EL. -72.3		
CLAY CL	$\gamma_{SAT} = (112)(1.18) = 132$ $\varepsilon_{50} = 0.004$ $K = 3000$ pci	$N_{AVE} = 73$ $S_u = 7300$ psf $A = 0.2$ $F = 0.2$
EL. -76.8		
LIMESTONE SM	$\gamma_{SAT} = (127)(1.12) = 142$ $\phi = 40°$ $K = 64$ pci	$N_{AVE} = 79$
EL. -82.3		

CB-PNB-4

El.=24′

---------▽----------El.=7.7′

FILL (80%R) C=300, ϕ=14°
(GC)
N≈11
γ_{sat}=120 pcf

c=1260 ϕ=0 (Q)
c=0 ϕ=30° (S)
δ=14°
C_a=800 psf

El.=6′

OH-CH (80%R) C=320, ϕ=6°
(GC)
N≈5
γ_{sat}=110 pcf

c=700 ϕ=0 (Q)
c=0 ϕ=18° (S)
δ=11°
C_a=600 psf

El.=0′

CH (80%R) C=500, ϕ=7°
N≈5
γ_{sat}=112 pcf

c=1060 ϕ=0 (Q)
c=0 ϕ=22° (S)
δ=11°
C_a=750 psf

El.=-12′

CL (80% R) C=350, ϕ=12°
N≈12
γ_{sat}=115 pcf

c=1500 ϕ=0 (Q)
c=0 ϕ=28° (S)
δ=12°
C_a=800 psf

El.=-22.5′

CH (80% R) C=800, ϕ=6°
N≈24
γ_{sat}=112 pcf

c=1100 ϕ=0 (Q)
c=0 ϕ=18° (S)
δ=11°
C_a=750 psf

El.=-36′

CH (80%R) C=1000, ϕ=9°
N≈59
γ_{sat}=120 pcf

c=2000 ϕ=0 (Q)
c=0 ϕ=24° (S)
δ=11°
C_a=950 psf

El.=-47′

LS
(highly weathered)
γ_{sat}=135 pcf (80%R) C=1000, ϕ=15°

c=3000 ϕ=0 (Q)
c=0 ϕ=36° (S)
δ=17°
C_a=1100 psf

CB-PNB-7

El.=10′

▽ El.=7.7′

FILL	c=1000 ϕ=0 (Q)
(GC)	c=0 ϕ=28° (S)
N≈6	δ=14°
γ_{sat}=117 pcf	C_a=750 psf

El.=-1′

OH	c=500 ϕ=0 (Q)
	c=0 ϕ=18° (S)
N≈1	δ=11°
γ_{sat}=107 pcf	C_a=500 psf

El.=-8.5′

CH	c=1060 ϕ=0 (Q)
	c=0 ϕ=22° (S)
N≈13	δ=11°
γ_{sat}=117 pcf	C_a=750 psf

El.=-37′

SP	c=0 ϕ=33° (Q)
	c=0 ϕ=33° (S)
N≈33	δ=17°
γ_{sat}=125 pcf	C_a=0 psf

El.=-58′

CH	c=1100 ϕ=0 (Q)
	c=0 ϕ=18° (S)
N≈30	δ=11°
γ_{sat}=115 pcf	C_a=800 psf

El.=-66′

CL	c=2000 ϕ=0 (Q)
N≈48	c=0 ϕ=28° (S)
	δ=12°
γ_{sat}=120 pcf	C_a=950 psf

El.=-76′

LS	c=4000 ϕ=0 (Q)
(highly weathered)	c=0 ϕ=38° (S)
	δ=17°
γ_{sat}=135 pcf	C_a=1100 psf

B-6-10

CB-PNB-8

El.=10′

-----▽----------El.=7.7′

FILL	c=1500 ϕ=0 (Q)
(CL)	c=0 ϕ=30° (S)
N≈19	δ=12°
γ_{sat}=125 pcf	C_a=850 psf

El.=4′

CH	c=1000 ϕ=0 (Q)
	c=0 ϕ=20° (S)
N≈10	δ=11°
γ_{sat}=110 pcf	C_a=750 psf

El.=-13′

CH	c=1100 ϕ=0 (Q)
N≈22	c=0 ϕ=22° (S)
γ_{sat}=112 pcf	δ=11°
	C_a=800 psf

El.=-34′

CH	c=3500 ϕ=0 (Q)
N≈75	c=0 ϕ=32° (S)
γ_{sat}=125 pcf	δ=12°
	C_a=1200 psf

El.=-40′

B-6-11

		El.=10′
CL	c=1000	ϕ=0 (Q)
	c=0	ϕ=26° (S)
N≈6	δ=12°	
γ_{sat}=110 pcf	C_a=750 psf	
		El.=-1′
CH	c=320	ϕ=0 (Q)
	c=0	ϕ=20° (S)
N≈1.5	δ=11°	
γ_{sat}=95 pcf	C_a=250 psf	
		El.=-15′
CH-SC	c=1200	ϕ=0 (Q)
	c=0	ϕ=27° (S)
N≈15	δ=12°	
γ_{sat}=115 pcf	C_a=800 psf	
		El.=-39′
ML	c=2500	ϕ=0 (Q)
	c=0	ϕ=30° (S)
N≈33	δ=14°	
γ_{sat}=125 pcf	C_a=1000 psf	
		El.=-48′
GC or LS	c=4000	ϕ=0 (Q)
(highly weathered)	c=0	ϕ=38° (S)
	δ=17°	
γ_{sat}=135 pcf	C_a=1100 psf	

B-6-12

		El.=8′
----------▽----------		El.=7.7′
CH	c=550 ϕ=0 (Q)	
(soft)	c=0 ϕ=26° (S)	
	δ=11°	
γ_{sat}=110 pcf	C_a=500 psf	
		El.=2′
CH	c=1000 ϕ=0 (Q)	
(medium)	c=0 ϕ=27° (S)	
	δ=11°	
γ_{sat}=115 pcf	C_a=750 psf	
		El.=-2′
CH	c=1260 ϕ=0 (Q)	
(stiff)	c=0 ϕ=27° (S)	
	δ=11°	
γ_{sat}=117 pcf	C_a=750 psf	
		El.=-16′
CH	c=1600 ϕ=0 (Q)	
(stiff)	c=0 ϕ=30° (S)	
	δ=12°	
γ_{sat}=120 pcf	C_a=800 psf	
		El.=-26′
CH	c=1600 ϕ=0 (Q)	
(very stiff)	c=0 ϕ=28° (S)	
	δ=11°	
γ_{sat}=120 pcf	C_a=800 psf	
		El.=-32′
CL	c=1600 ϕ=0 (Q)	
(stiff)	c=0 ϕ=30° (S)	
	δ=12°	
γ_{sat}=120 pcf	C_a=800 psf	
		El.=-48′
LS	c=4000 ϕ=0 (Q)	
(highly weathered)	c=0 ϕ=38° (S)	
	δ=17°	
γ_{sat}=135 pcf	C_a=1100 psf	
		El.=-58′

B-6-13

		El.=10′
----------▽----------		El.=7.7′
CH	c=1000 ϕ=0 (Q)	
(medium)	c=0 ϕ=27° (S)	
	δ=11°	
γ_{sat}=115 pcf	C_a=750 psf	
		El.=-6′
CL	c=550 ϕ=0 (Q)	
(soft)	c=0 ϕ=26° (S)	
	δ=12°	
γ_{sat}=110 pcf	C_a=500 psf	
		El.=-19′
CL	c=1600 ϕ=0 (Q)	
(stiff)	c=0 ϕ=30° (S)	
	δ=12°	
γ_{sat}=120 pcf	C_a=800 psf	
		El.=-33′
SC	c=2000 ϕ=0 (Q)	
(dense)	c=0 ϕ=32° (S)	
	δ=14°	
γ_{sat}=130 pcf	C_a=950 psf	
		El.=-40′
LS	c=4000 ϕ=0 (Q)	
(highly weathered)	c=0 ϕ=38° (S)	
	δ=17°	
γ_{sat}=135 pcf	C_a=1100 psf	
		El.=-57′

B-6-14

El.=6′

---∇---El.=5.5′

CH	c=550	ϕ=0	(Q)
	c=0	ϕ=19°	(S)

N≈4

γ_{sat}=112 pcf

El.=-2.5′

CL	c=800	ϕ=0	(Q)
	c=0	ϕ=28°	(S)

N≈10

γ_{sat}=117 pcf

El.=-7′

CL	c=2500	ϕ=0	(Q)
	c=0	ϕ=31°	(S)

N≈31

γ_{sat}=125 pcf

El.=-13′

CL	c=4000	ϕ=0	(Q)
(hard)	c=0	ϕ=32°	(S)

γ_{sat}=135 pcf

El.=-37′

LS	c=4000	ϕ=0	(Q)
(highly weathered)	c=0	ϕ=38°	(S)

γ_{sat}=135 pcf

El.=-45′

CB-PNM-48

El.=9′

FILL (80% R) C=350, ϕ=12° c=1600 ϕ=0 (Q)
(CL) c=0 ϕ=28° (S)
N≈12
γ_{sat}=120 pcf

El.=4.5′

CH (80% R C=250, ϕ=8° c=500 ϕ=0 (Q)
c=0 ϕ=20° (S)
N≈1.5
γ_{sat}=107 pcf

El.=-4′

CL (80% R) C=350, ϕ=12° c=1600 ϕ=0 (Q)
c=0 ϕ=28° (S)
N≈11
γ_{sat}=118 pcf

El.=-22.5′

SC (80% R) C=700, ϕ=13° c=1600 ϕ=0 (Q)
c=0 ϕ=31° (S)
N≈20
γ_{sat}=120 pcf

El.=-33′

ML (80% R) C=750, ϕ=12° c=1600 ϕ=0
c=0 ϕ=30°
N≈30
γ_{sat}=120 pcf

El.=-36′

B-6-16

CB-PNM-55

El.=7.5′

---------▽----------El.=6′

CH c=700 ϕ=0 (Q)
c=0 ϕ=24° (S)

N≈6

γ_{sat}=115 pcf

El.=1.5′

SP-SM c=300 ϕ=0 (Q)
c=0 ϕ=30° (S)

N≈4

γ_{sat}=100 pcf

El.=-6′

CL c=1000 ϕ=0 (Q)
c=0 ϕ=28° (S)

N≈9

γ_{sat}=115 pcf

El.=-7.5′

SC c=550 ϕ=0 (Q)
c=0 ϕ=30° (S)

N≈9

γ_{sat}=110 pcf

El.=-24′

SP-SM c=4000 ϕ=0 (Q)
LS c=0 ϕ=38° (S)
(highly weathered)

N≈55

γ_{sat}=135 pcf

El.=-67.5′

B-6-17

CB-MC-43

El.=10.6′

----▽----El.=6′

FILL c=1000 ϕ=0 (Q)
c=0 ϕ=30° (S)

N≈8

γ_{sat}=120 pcf

El.=4.6′

CH c=320 ϕ=0 (Q)
(very soft) c=0 ϕ=18° (S)

N≈1.5

γ_{sat}=105 pcf

El.=-6′

CH c=700 ϕ=0 (Q)
(medium) c=0 ϕ=20° (S)

N≈7

γ_{sat}=115 pcf

El.=-12′

CH c=1600 ϕ=0 (Q)
(very stiff) c=0 ϕ=27° (S)

N≈16

γ_{sat}=120 pcf

El.=-34′

LS c=4000 ϕ=0 (Q)
(highly weathered) c=0 ϕ=38° (S)
(hard)

γ_{sat}=135 pcf

Backfill properties:
γ_{moist}=110 pcf
γ_{sat}=125 pcf
γ_{sub}=62.6 pcf
ϕ'= 32°, c=0

(For non-sloping backfill)
k_a= 0.31
k_o= 0.5
k_p= 3.2

CB-MC-44

El.=8′

▽ El.=6′

CL	c=600	ϕ=0 (Q)
(soft)	c=0	ϕ=26° (S)
N≈3.5		
γ_{sat}=110 pcf		

El.=2′

CH	c=550	ϕ=0 (Q)
(soft)	c=0	ϕ=18° (S)
N≈2		
γ_{sat}=110 pcf		

El.=-7′

CL	c=1600	ϕ=0 (Q)
(stiff)	c=0	ϕ=30° (S)
N≈15		
γ_{sat}=120 pcf		

El.=-23.5′

CL	c=4000	ϕ=0 (Q)
(hard)	c=0	ϕ=32° (S)
γ_{sat}=135 pcf		

El.=-43.5′

CB-MC-45

El.=13.5′

CH c=760 ϕ=0 (Q)
c=0 ϕ=22° (S)

N≈9

γ_{sat}=115 pcf

----------▽----------El.=6′

SC c=500 ϕ=0 (Q)
c=0 ϕ=28° (S)

N≈3.5

γ_{sat}=115 pcf

El.=-9′

CL c=3000 ϕ=0 (Q)
c=0 ϕ=31° (S)

N≈47

γ_{sat}=130 pcf

El.=-32′

CL c=4000 ϕ=0 (Q)
(hard) c=0 ϕ=32° (S)

γ_{sat}=135 pcf

El.=-46.5′

B-6-20

CB-MC-46

El.=11′

----------▽----------El.=6′

CH c=550 ϕ=0 (Q)
c=0 ϕ=19° (S)

N≈4

γ_{sat}=112 pcf

El.=-2.5′

CL c=800 ϕ=0 (Q)
c=0 ϕ=28° (S)

N≈10

γ_{sat}=117 pcf

El.=-7′

CL c=2500 ϕ=0 (Q)
c=0 ϕ=31° (S)

N≈31

γ_{sat}=125 pcf

El.=-13′

CL c=4000 ϕ=0 (Q)
(hard) c=0 ϕ=32° (S)

γ_{sat}=135 pcf

El.=-37′

LS c=4000 ϕ=0 (Q)
(highly weathered) c=0 ϕ=38° (S)

γ_{sat}=135 pcf

El.=-45′

B-6-21

APPENDIX B-7

CBEAR RESULTS

```
10 Bearing capacity analysis of U-frame channel, sta. 55+00, CB-MC-34
20 Continuous Net
30 Base 0 -20.43 37 -20.43
40 Soil -100 -20.43 137 -20.43 115 120 0 1500
50 Subs -33 110 115 0 800
60 Water 5 62.5
70 End
```

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CBEAR/PC - BEARING CAPACITY ANALYSIS

* EFFECTIVE BASE DIMENSIONS : WIDTH = 37.00 LENGTH = 1.00

*** SUMMARY OF BEARING CAPACITY FACTORS ***

FACTORS	C	Q	G	BEARING CAPACITY (kips/ft**2)
BEARING CAP.	5.14	1.00	0.00	7.710
SHAPE - CONC.	1.00000	1.00000	1.00000	7.710
SHAPE ECC.	1.00000	1.00000	1.00000	7.710
INCLINATION	1.00000	1.00000	1.00000	7.710
BASE TILT	1.00000	1.00000	1.00000	7.710
GROUND SLOPE	1.00000	1.00000	1.00000	7.710
EMBEDMENT	1.00000	1.00000	1.00000	7.710

	FNC	+	FNQ	+	FNG	=	Q
COMBINE EFFECTS of FACTORS	7.710		0.000		0.000		7.710

```
10 Bearing capacity analysis of U-frame channel, sta. 67+00, CB-MC-43
20 Continuous Net
30 Base 0 -4.63 37 -4.63
40 Soil -100 -4.63 137 -4.63 100 105 0 320
50 Subs -6 110 115 0 700
60 Water 5 62.5
70 End
```

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CBEAR/PC - BEARING CAPACITY ANALYSIS

* EFFECTIVE BASE DIMENSIONS : WIDTH = 37.00 LENGTH = 1.00

*** SUMMARY OF BEARING CAPACITY FACTORS ***

FACTORS	C	Q	G	BEARING CAPACITY (kips/ft**2)
BEARING CAP.	5.14	1.00	0.00	1.645
SHAPE - CONC.	1.00000	1.00000	1.00000	1.645
SHAPE ECC.	1.00000	1.00000	1.00000	1.645
INCLINATION	1.00000	1.00000	1.00000	1.645
BASE TILT	1.00000	1.00000	1.00000	1.645
GROUND SLOPE	1.00000	1.00000	1.00000	1.645
EMBEDMENT	1.00000	1.00000	1.00000	1.645

	FNC	+	FNQ	+	FNG	=	Q
COMBINE EFFECTS of FACTORS	3.022		0.000		0.000		3.022

```
10 Bearing capacity analysis of U-frame channel, sta. 71+00, CB-MC-44
20 Continuous Net
30 Base 0 -2.75 37 -2.75
40 Soil -100 -2.75 137 -2.75 105 110 0 500
50 Subs -7 115 120 0 1600
60 Water 5 62.5
70 End
```

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CBEAR/PC - BEARING CAPACITY ANALYSIS

* EFFECTIVE BASE DIMENSIONS : WIDTH = 37.00 LENGTH = 1.00

*** SUMMARY OF BEARING CAPACITY FACTORS ***

FACTORS	C	Q	G	BEARING CAPACITY (kips/ft**2)
BEARING CAP.	5.14	1.00	0.00	2.570
SHAPE - CONC.	1.00000	1.00000	1.00000	2.570
SHAPE ECC.	1.00000	1.00000	1.00000	2.570
INCLINATION	1.00000	1.00000	1.00000	2.570
BASE TILT	1.00000	1.00000	1.00000	2.570
GROUND SLOPE	1.00000	1.00000	1.00000	2.570
EMBEDMENT	1.00000	1.00000	1.00000	2.570

	FNC	+	FNQ	+	FNG	=	Q
COMBINE EFFECTS of FACTORS	3.491		0.000		0.000		3.491

```
0 Bearing capacity analysis of U-frame channel, sta. 77+00, CB-MC-45
0 Continuous Net
0 Base 0 -0.17 37 -0.17
0 Soil -100 -0.17 137 -0.17 110 115 0 500
0 Subs -9 125 130 0 3000
0 Water 5 62.5
0 End
```

U.S. Army Engineer Waterways Experiment Station

CBEAR/PC - BEARING CAPACITY ANALYSIS

* EFFECTIVE BASE DIMENSIONS : WIDTH = 37.00 LENGTH = 1.00

*** SUMMARY OF BEARING CAPACITY FACTORS ***

FACTORS	C	Q	G	BEARING CAPACITY (kips/ft**2)
BEARING CAP.	5.14	1.00	0.00	2.570
SHAPE - CONC.	1.00000	1.00000	1.00000	2.570
SHAPE ECC.	1.00000	1.00000	1.00000	2.570
INCLINATION	1.00000	1.00000	1.00000	2.570
BASE TILT	1.00000	1.00000	1.00000	2.570
GROUND SLOPE	1.00000	1.00000	1.00000	2.570
EMBEDMENT	1.00000	1.00000	1.00000	2.570

	FNC	+	FNQ	+	FNG	=	Q
COMBINE EFFECTS of FACTORS	2.949		0.000		0.000		2.949

```
10 Bearing capacity analysis of U-frame channel, sta. 81+00, CB-MC-46
20 Continuous Net
30 Base 0 1.19 37 1.19
40 Soil -100 1.19 137 1.19 107 112 0 550
50 Subs -2.5 112 117 0 800
60 Water 6 62.5
70 End
```

U.S. Army Engineer Waterways Experiment Station

CBEAR/PC - BEARING CAPACITY ANALYSIS

* EFFECTIVE BASE DIMENSIONS : WIDTH = 37.00 LENGTH = 1.00

*** SUMMARY OF BEARING CAPACITY FACTORS ***

FACTORS	C	Q	G	BEARING CAPACITY (kips/ft**2)
BEARING CAP.	5.14	1.00	0.00	2.827
SHAPE - CONC.	1.00000	1.00000	1.00000	2.827
SHAPE ECC.	1.00000	1.00000	1.00000	2.827
INCLINATION	1.00000	1.00000	1.00000	2.827
BASE TILT	1.00000	1.00000	1.00000	2.827
GROUND SLOPE	1.00000	1.00000	1.00000	2.827
EMBEDMENT	1.00000	1.00000	1.00000	2.827

	FNC	+	FNQ	+	FNG	=	Q
COMBINE EFFECTS of FACTORS	2.827		0.000		0.000		2.827

```
.0 Bearing capacity analysis of U-frame channel, sta. 89+00, CB-MC-47
!0 Continuous Net
!0 Base 0 9.03 37 9.03
!0 Soil -100 9.03 137 9.03 107 120 0 1260
!0 Subs -19 125 130 0 1500
!0 Water 6 62.5
'0 End
```

U.S. Army Engineer Waterways Experiment Station

CBEAR/PC - BEARING CAPACITY ANALYSIS

* EFFECTIVE BASE DIMENSIONS : WIDTH = 37.00 LENGTH = 1.00

*** SUMMARY OF BEARING CAPACITY FACTORS ***

FACTORS	C	Q	G	BEARING CAPACITY (kips/ft**2)
BEARING CAP.	5.14	1.00	0.00	6.476
SHAPE - CONC.	1.00000	1.00000	1.00000	6.476
SHAPE ECC.	1.00000	1.00000	1.00000	6.476
INCLINATION	1.00000	1.00000	1.00000	6.476
BASE TILT	1.00000	1.00000	1.00000	6.476
GROUND SLOPE	1.00000	1.00000	1.00000	6.476
EMBEDMENT	1.00000	1.00000	1.00000	6.476

	FNC	+	FNQ	+	FNG	=	Q
COMBINE EFFECTS of FACTORS	6.476		0.000		0.000		6.476

APPENDIX B-8

CSETT ANALYSES RESULTS

APPENDIX B-9

42″ OD x 1.0″ WALL PIPE PILES
DRIVABILITY ANALYSIS

Drivability GRLWP97

The 73 ft. 42" OD x 1.0" wall pipe pile was analyzed for driveability. Using CB-PNB-62 as being representative (CB-PNB-62 was selected as it is approximately 85 ft. deep, with limerock at about EL. –55, and other boring were too shallow), SPT 94 analyses were performed to determine shaft resistance and tip resistance for GRLWP97 input. These SPT94 results are presented in Figure 3 and attached Table 4.

For driveability analyses, an input file (PNPIPE.GWI) was prepared as summarized in the attached GRLWEAP input summary sheets. The shaft resistance and end bearing for driveability were calculated from SPT94 as follows:

1. Based upon the SPT 94 shaft resistance/end bearing (Figure 3), "key" elevations were selected. These were 0, 24, 34, 42, and 72 ft.
2. The incremental shaft resistance, f_{su}, (ksf) was calculated as shown in Table 5

Table 5 Example Calculation of Shaft Resistance for GRLWP97

Depth, ft.	SPT 94 Results			GRLWP Input	
	Ult. Skin Friction, Tons	Mob. End Bearing Tons	Calculated Unit Skin Friction, KSF	Shaft Resistance (ksf)	End Bearing (kips)
0	0	0	0	0	0
24	153 (306^k)	68	306 = 24 x 11 x ½ x fsu fsu = 2.32	2.32	274
24				0.96	274
34	206 (412^k)	90.8	412-306 = (34-24) x 11 x fsu fsu = 0.96	0.96	363.2
34				1.57	363.2
42	275 (550^k)	203	550-412 = (42-34) x 11 x fsu fsu = 1.57	1.57	812
42				1.28	812
72	486 (972^k)	348	972-550 = (72-42) x 11 x fsu fsu = 1.28	1.28	1392

Two GRLWP97 analyses were performed to evaluate the IHC 150 hammer; (a) a simple bearing graph using 42% skin friction ($485.8^T/1161.5^T = 41.8\%$), and (b) a driveability with varying skin friction and end bearing (Table 5). These results are presented in the attached output (GRLWP97 Appendix) and summarized in Table 6

Table 6 Summary of GRLWP97 Analyses – IHC 150

Analyses	Ultimate Capacity, Kips	Max. Comp Stress, ksi	Max Tensile Stress, ksi	Blow Count, bpf
Bearing	2323	19.052	2.21	105.6
Driveability	2358.3	25.266	1.138	220.1
Allowable		0.9fy = 40.5	0.9fy = 40.5	120 – 240

Driving Conclusions – The agreement between SPT94 skin friction and end bearing and GRLWP97 driveability values for the various depths show that the input files are correctly interpreted. A comparison between GRLWP97 output and allowable values indicate that the IHC 150 hammer can successfully drive this 42" pipe pile. The blow count (bpf) could be reduced by considering pre-boring the upper 27 ft.

Table 4

STATIC PILE BEARING CAPACITY ANALYSIS - SPT94	Page 4
Project No: Driveability of 42" pipe pile	
Boring No: CB-PNB-62	

C. PILE INFORMATION

TEST PILE SECTION — ISECT = 3
(open-end steel pipe pile)

DIAMETER OF PILE — WP = 42.00 INCHES

THICKNESS OF PILE — THICK = 1.00 INCHES

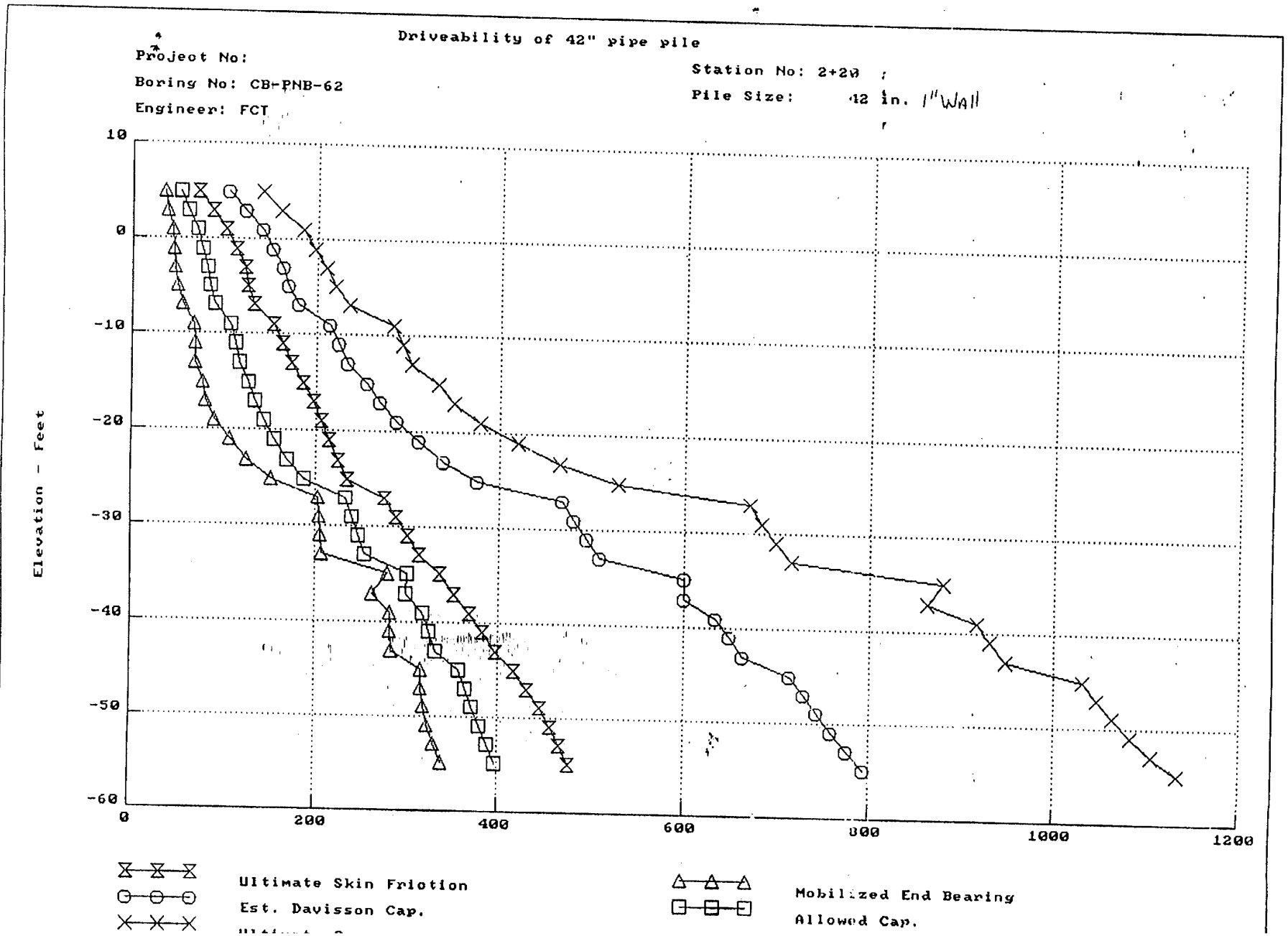
D. PILE CAPACITY VS. PENETRATION

TEST PILE LENGTH (FT)	PILE TIP ELEV (FT)	WT. OF PILE (TONS)	ULT. SIDE FRICTION (TONS)	MOBILIZED END BEARING (TONS)	ESTIMATED FAILURE CAPACITY (TONS)	ALLOWABLE PILE CAPACITY (TONS)	ULTIMATE PILE CAPACITY (TONS)
10.0	5.0	2.91	72.10	35.84	105.03	52.52	140.87
12.0	3.0	3.49	87.56	38.21	122.28	61.14	160.49
14.0	1.0	4.07	101.62	43.53	141.08	70.54	184.61
16.0	-1.0	4.65	112.50	44.73	152.58	76.29	197.31
18.0	-3.0	5.23	122.17	46.63	163.57	81.78	210.20
20.0	-5.0	5.81	125.65	49.96	169.79	84.90	219.75
22.0	-7.0	6.40	132.20	55.27	181.08	90.54	236.36
24.0	-9.0	6.98	153.28	68.46	214.76	107.38	283.22
26.0	-11.0	7.56	163.36	68.73	224.53	112.26	293.26
28.0	-13.0	8.14	173.80	68.90	234.55	117.28	303.45
30.0	-15.0	8.72	186.10	77.62	254.99	127.50	332.61
32.0	-17.0	9.30	197.77	80.67	269.13	134.56	349.80
34.0	-19.0	9.88	206.35	90.85	287.31	143.66	378.16
36.0	-21.0	10.47	214.64	107.71	311.89	155.94	419.60
38.0	-23.0	11.05	224.86	125.37	339.19	169.59	464.56
40.0	-25.0	11.63	233.70	153.0[illegible]	375.17	187.58	528.26
42.0	-27.0	12.21	275.51	203.31	466.61	233.31	669.92
44.0	-29.0	12.79	288.56	204.04	479.81	239.90	683.85
46.0	-31.0	13.37	301.42	205.72	493.77	246.89	699.50
48.0	-33.0	13.95	313.59	208.18	507.81	253.91	715.99
50.0	-35.0	14.54	335.70	279.02	600.18	300.09	879.20
52.0	-37.0	15.12	351.37	263.06	599.31	299.65	862.36
54.0	-39.0	15.70	368.62	281.67	634.59	317.30	916.26
56.0	-41.0	16.28	383.10	282.12	648.95	324.47	931.07
58.0	-43.0	16.86	397.11	283.69	663.94	331.97	947.62
60.0	-45.0	17.44	416.22	316.21	714.99	357.49	1031.20
62.0	-47.0	18.02	430.73	316.69	729.40	364.70	1046.08
64.0	-49.0	18.61	444.20	318.42	744.01	372.00	1062.43
66.0	-51.0	19.19	455.78	322.83	759.42	379.71	1082.25
68.0	-53.0	19.77	466.07	329.84	776.15	388.07	1105.99
70.0	-55.0	20.35	475.77	338.88	794.31	397.15	1133.19
72.0	-57.0	20.93	485.83	348.29	813.18	406.59	1161.47

*** ERROR *** PILE TIP TOO NEAR END OF BORING LOG FOR LENGTH = 74.00 FT

B-9-2

Figure 3


Driveability of 42" pipe pile
Project No:
Boring No: CB-PNB-62
Engineer: FCT
Station No: 2+20
Pile Size: 42 in. 1"WALL
Elevation - Feet
10
0
-10
-20
-30
-40
-50
-60
0
200
400
600
800
1000
1200
Ultimate Skin Friction
Est. Davisson Cap.
Mobilized End Bearing
Allowed Cap.

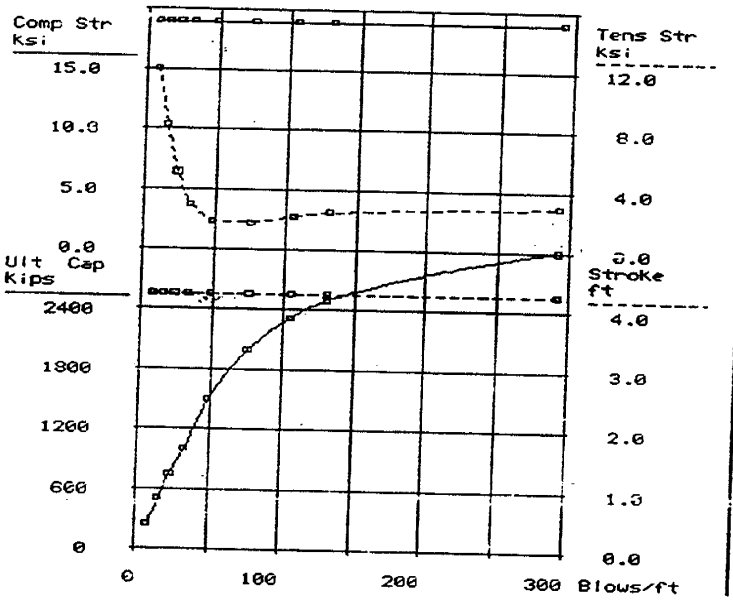
B-9-3

Puerto Nuevo 42" Pipe Pile CB-PNB-62 #A
Professor F.C. Townsend

06/16/97
GRLWEAP(TM) Version 1997-1

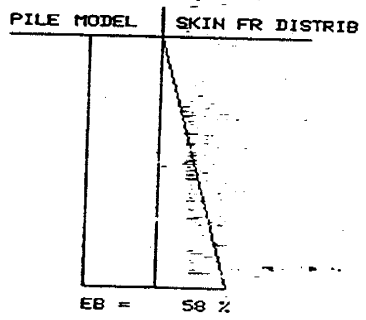
No.	Ultimate Capacity kips	Max C. Stress ksi	Max T. Stress ksi	Blow Count BPF	Stroke ft	Energy k-ft
1	250.0	19.026	12.083	7.7	4.26	85.80
2	500.0	19.028	8.289	15.3	4.26	85.50
3	750.0	19.030	5.135	23.2	4.26	85.13
4	1000.0	19.032	2.993	32.6	4.26	84.70
5	1500.0	19.038	1.901	48.6	4.26	83.62
6	2000.0	19.047	1.791	75.7	4.26	82.85
7	2323.0	19.052	2.210	105.6	4.26	82.43
8	2500.0	19.055	2.479	130.4	4.26	82.21
9	3000.0	19.058	2.907	292.6	4.26	81.59

Professor F.C. Townsend
GRLWEAP(TM) Version 1997-1
Puerto Nuevo 42" Pipe Pile CB-PNB-62 #A
06/16/97



IHC Hydh SC 150

Efficiency	0.950	
Helmet	5.70	Kips
H Cushion	25649	K/in
P Cushion	41033	K/in
Q Skin =	0.100	in
Q Toe =	0.100	in
J Skin =	0.200	s/ft
J Toe =	0.150	s/ft
Pile Length	72.00	ft
P-Top Area	191.00	in2



This is rough check using SPT94 & SF% = $475^T/_{1128}^T$ = 42.3%

PNPIPEA.GWI

GRLWEAP INPUT SUMMARY

ITEM	VALUE	DESCRIPTION
TITLE	NONE	Puerto Nuevo 42" Pipe 1" WALL CB-PNB-62
ANALYSIS DATA		
IOUT	-100	print out use 0 or driveability = -100 (min)
IJJ		DEFAULT = 0
IHAMMER	346	Select Hammer # from HELP IHC 160
IOSRT		DEFAULT = 0
IFUEL		DEFAULT = 0
N		# of Segments, 0 = Automatic or try to have segment length of . 5 ft.
ISPL		# of Splices
NCROSS		0 = Uniform Pile
IBEDAM	i steel	3 = Concrete Piles
IPERCS	42.3%	% Skin friction from SPT91, or 0 = Driveability
ISMITH		0 = Std. Smith
ITYS	1	(1) = Triangular, 0 = Driveability See HELP
DMPEXP		0 = default, use 0.2 if not using Smith & ISMITH = 3
IPHI		0 = Default, Time increment factor
IRSAO		0 = Default, residual Stress
ITER		0 = Default, # of Iterations
IDAHA		0 = default, same as using "2" for hammer damping
IMAXT		0 = default, analysis duration

PNPipeA.GWI

GRLWEAP INPUT SUMMARY (Continued)

ITEM	VALUE	DESCRIPTION
HAMMER & HAMMER CUSHION INFORMATION		
HELMET WEIGHT	5.70	See Help Data No Help for IHC Guessed Using 42" Delmag Pipe
AREA	191	See help data Probably should be $\frac{\pi(42^2)}{4} = 1385$
E. Mod	470	See Help Data 1" Al + 1" Micarta
Thickness	2"	See Help Data Guessed
COR	0.8	See Help Data
Round out		Default is 0.01 (?)
Stiffness		0 = Default, over-rides AE/t
PILE CUSHION		
AREA	191	Same as top of Pile area
E.MOD	430	30 = Plywood or See Help
THICKNESS	2"	Trial, this controlls stresses in pile
COR	0.8	0.50 = Plywood or see HELP
ROUND OUT		Default = 0.1 (?)
PILE TOP INFORMATION		
LENGTH	72'	Pile length
X-section	191	Area of pile Circumference = $\pi(42/12) = 11$ ft
E. MOD	30,000	E = 57000 $(f_c')^{0.5}$, f_c' = (psi)
Unit WT.	492	Concrete = 150 pcf. Steel = 492 pcf
COR		Default = 1.0 for concrete w/cushion
SOIL PARAMETERS		
SKIN Q	0.1	0.1 = default
TOE Q	0.1	d/120 sec/ft
Skin J	0.2	0.05 = Sand, 0.2 = Clay
TOE J	0.15	Default = 0.15

GRLWEAP INPUT SUMMARY (Continued)

SFT94 Quit = 1161.5 T x 2 = 2323 K

ULTIMATE CAPACITIES									
ULT CAP K/S		List various capacities for bearing graph							
		250	500	750	1000	2000	2323	2500	3000
DRIVEABILITY IPERCS = 0 (Check Pile Circumference & Yield)									
Friction Loss/Gain		Since friction reduces during driving, f_{s1} used: Sands = 0.9, Clays = 0.5. Can use up to 10 values							
Toe Loss/Gain		Must have equal # t_{s1} as f_{s1}. Usually t_{s1} = 1.0							
DEPTH & DRIVING SYSTEM MODIFIERS									
DEPTH		Specify various depths for driving analysis							
TEMP Length		Used if splices added for pile length 0 = no splice (?)							
WAIT TIME		Waiting time for splice. 0= no splice time							
STROKE		0 = No change from original							
IFUEL		0 = Original values							
EFFICIENCY		0 = Orginal values							
Stiff Fac		Since pile cushion stiffens, after 500 blows increase plywood to 1.25 to 1.5							
COR		Cushion COR, 0 * original value							

SKIN FRICTION DISTRIBUTION VS DEPTH		
DEPTH		Input 0 depth & other depths
SKIN f_{su}		Units = kips/ft. For SPT91 use (ult F @ depth)÷(pile segment length)
END BEARING		Units = Kips, Use SPT91 (mob. end bearing)x 3 = ult end bearing
Skin Q		0.1 = default
Toe Q		d/120 sec/ft
Skin J		0.05 = Sand, 0.2 = Clay
Toe J		Default = 0.15
SET-UP		GRLWEAP1994.1 doesn't use "sensitivity", but uses Set-up. S-U = 1/(1-est Friction loss). Est friction loss = 20%,33%,50% for sand,silt,clay
ENERGY		Energy rqd for FULL remolding of friction. Zero means full remolding = begining driving
SETUP TIME		Time rqd for FULL remolded friction to regain long term capacity.

't Nuevo 42" 1"wall Pipe CB-PNB-62 Drive 06/16/97
'rofessor F.C. Townsend GRLWEAP(TM) Version 1997-1

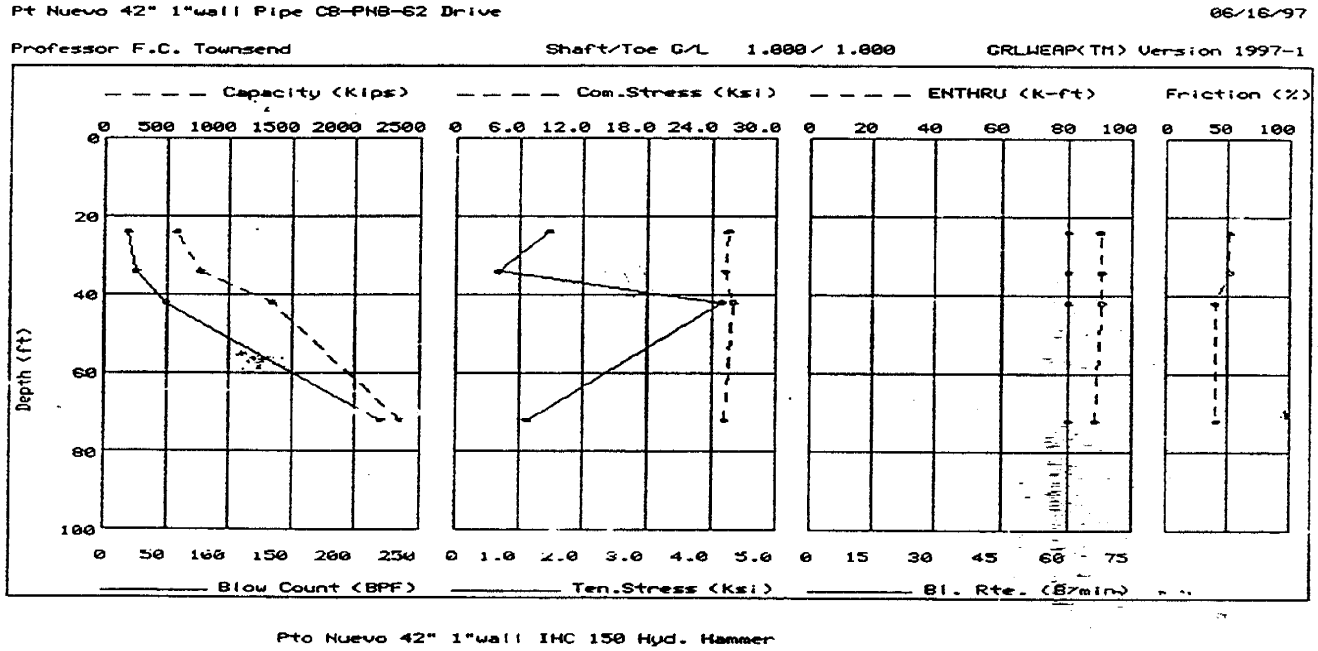
Shaft/Toe Gain/Loss Factor 1.000/ 1.000

Depth feet	Ultimate Capacity kips	Shaft Resistance kips	End Bearing kips	Blow Count bl/ft	Max C. Stress ksi	Max T. Stress ksi	Blow Rate bpm	ENTHRU kip-ft
24.0	570.1	300.8	269.3	19.4	25.585	1.464	60.0	90.1
34.0	769.2	408.7	360.5	25.2	25.307	.680	60.0	90.5
42.0	1343.1	542.3	800.9	48.7	25.953	4.151	60.0	90.5
72.0	2358.3	969.7	1388.6	220.1	25.266	1.138	60.0	88.5

otal Driving Time 79.72 min. for 60.0 bl/min; Total No. of Blows 4783

Blow Rate:	50 bl/min	40 bl/min	30 bl/min
Total Driving Time:	95.66 min	119.58 min	159.44 min

rive time for continuously running hammer; any waiting times not included



B-9-9

GRLWEAP INPUT SUMMARY

ITEM	VALUE	DESCRIPTION
TITLE	NONE	Pueblo Nuevo 42" Pipe CB-PNB-62 File PNPIPE.GWI
ANALYSIS DATA		
IOUT		print out use 0 or driveability = -100
IJJ		DEFAULT = 0
IHAMMER	346	Select Hammer # from HELP IHC SC-150 Hydraulic E=103.31 Ram=24.25
IOSRT		DEFAULT = 0
IFUEL		DEFAULT = 0
N		# of Segments, 0 = Automatic of try to have segment length of . 5 ft. or
ISPL		# of Splices
NCROSS		0 = Uniform Pile
IBEDAM	1 Steel	3 = Concrete Piles
IPERCS	0 Driveab	% Skin friction from SPT91, or 0 = Driveability
ISMITH		0 = Std. Smith
ITYS		1 = Triangular, 0 = Driveability See HELP
DMPEXP		0 = default, use 0.2 if not using Smith & ISMITH = 3
IPHI		0 = Default, Time increment factor
IRSAO		0 = Default, residual Stress
ITER		0 = Default, # of Iterations
IDAHA		0 = default, same as using "2" for hammer damping
IMAXT		0 = default, analysis duration

GRLWEAP INPUT SUMMARY (Continued)

ITEM	VALUE	DESCRIPTION
HAMMER & HAMMER CUSHION INFORMATION		
HELMET WEIGHT	None given 5.7	See Help Data Using 42" Pipe in Delmag
AREA	1385	See help data $\frac{\pi}{4}(42^2) = 1385$
E. Mod	280	See Help Data
Thickness	5"	See Help Data
COR	0.8	See Help Data
Round out		Default is 0.01 (?)
Stiffness		0 = Default, over-rides AE/t
PILE CUSHION		
AREA	0	Same as top of Pile area
E.MOD	0	30 = Plywood or See Help Al + Micarta
THICKNESS	0	Trial, this controlls stresses in pile
COR	0.95	0.50 = Plywood or see HELP Steel on Steel
ROUND OUT	0	Default = 0.1 (?)
PILE TOP INFORMATION		
LENGTH	72ft	Pile length 80ft
X-section	128.81	Area of pile $\frac{\pi}{4}(42^2 - 40^2) = 128.8$ Circumference = 11ft
E. MOD	30,000	E = 57000 $(f_c')^{0.5}$, f_c' = (psi) Yield 36 ksi
Unit WT.	492	Concrete = 150 pcf. Steel = 492 pcf
COR	0.85	Default = 1.0 for concrete w/cushion
SOIL PARAMETERS		
SKIN Q	0.1	0.1 = default
TOE Q	0.1	d/120 sec/ft
Skin J	0.2	0.05 = Sand, 0.2 = Clay
TOE J	0.15	Default = 0.15

B-9-11

GRLWEAP INPUT SUMMARY (Continued)

ULTIMATE CAPACITIES										
ULT CAP	--	List various capacities for bearing graph								
DRIVEABILITY IPERCS = 0 (Check Pile Circumference & Yield)										
Friction Loss/Gain	Guess 0.7	Since friction reduces during driving, f_{g1} used: Sands = 0.9, Clays = 0.5. Can use up to 10 values								
Toe Loss/Gain	1.0	Must have equal # t_{g1} as f_{g1}. Usually t_{g1} = 1.0								
	1.0	0.7								
	1.0	1.0								

DEPTH & DRIVING SYSTEM MODIFIERS		
DEPTH		Specify various depths for driving analysis
TEMP Length	Assume 40' long	Used if splices added for pile length 0 = no splice (?)
WAIT TIME		Waiting time for splice. 0= no splice time
STROKE		0 = No change from original
IFUEL		0 = Original values
EFFICIENCY		0 = Orginal values
Stiff Fac		Since pile cushion stiffens, after 500 blows increase plywood to 1.25 to 1.5
COR		Cushion COR, 0 = original value

Depth	Temp Length	Time	Stroke	IFuel	Eff	Stiff	COR
			0	0	0	0	0.95
24'	36	0	0	0	0		0.95
34'	36	1.0	0	0	0		0.95
92'	72	0	0	0	0		0.95
72'	72	0					0.95

Driveability

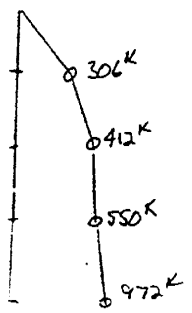
PNPipe.GWI

SKIN FRICTION DISTRIBUTION VS DEPTH		
DEPTH		Input 0 depth & other depths
SKIN f_{su}		Units = kips/ft. For SPT91 use (ult F @ depth)÷(pile segment length)
END BEARING		Units = Kips, Use SPT91 (mob. end bearing)x 3 = ult end bearing
Skin Q		0.1 = default
Toe Q		d/120 sec/ft
Skin J		0.05 = Sand, 0.2 = Clay
Toe J		Default = 0.15
SET-UP		GRLWEAP1994.1 doesn't use "sensitivity", but uses Set-up. S-U = 1/(1-est Friction loss). Est friction loss = 20%,33%,50% for sand,silt,clay
ENERGY		Energy rqd for FULL remolding of friction. Zero means full remolding = begining driving
SETUP TIME		Time rqd for FULL remolded friction to regain long term capacity.

Depth	f_{su}	EB	Qskin	Qtoe	Jsk	Jte	set-up	NRC	Time
0	0	0	0.1	0.1	0.2	0.15	1.10 (50%)	0	24hrs
24.0	2.32	274					1.10		
24.0	0.96	274					1.10		
34.0	0.96	363.2					1.10		
34.0	1.57	363.2					1.10		
42.0	1.57	812					1.05 (5%)		
42.0	1.28	812					1.05		
72.0	1.28	1392	↓	↓	↓	↓	1.05		1.0

=118ft

79



$306 = 24' \times 11 \times 1/2 \times f_{su}$, $f_{su} = 2.32$ ksf

$412 - 306 = (34-24)(11)\, f_{su}$, $f_{su} = 0.96$ ksf

$550 - 412 = (42-34)(11)\, f_{su}$, $f_{su} = 1.57$

$972 - 550 = (72-42)(11)\, f_{su}$, $f_{su} = 1.28$ ksf

Cap = $1161.47^{T} \times 2 = 2323^{K}$

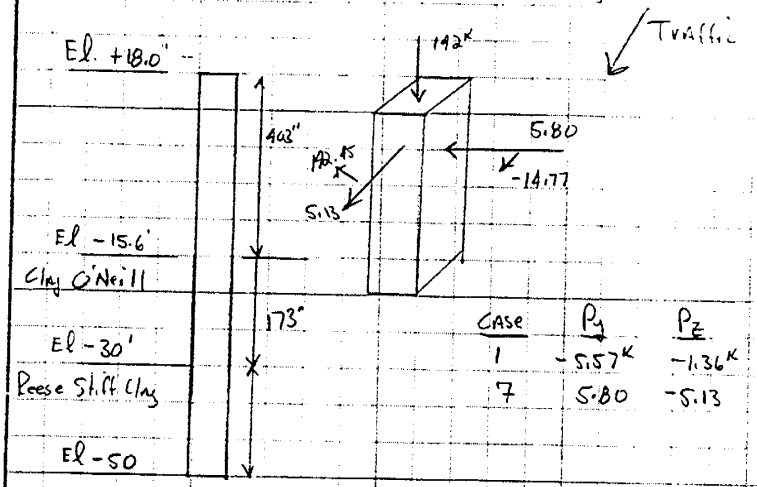
B-9-13

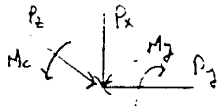
APPENDIX B-10

SOIL PARAMETERS FOR O'NEILL'S P-Y CURVES

PROJECT		Page 1 of —	COMPUTED BY	DATE
de Diego			FCT	7/1/96
SUBJECT			CHECKED BY	DATE
Lateral loading				

Evaluate Post-excavation Lateral loads





Case	P_y	P_z	M_y	M_z	P_x
1	-5.57K	-1.36K	-61.46 K-ft	113.59 K-ft	232K
7	5.80	-5.13	-14.77	-142.45	192K

total pile length 68ft (816")

$E = 4.821\ E6\ Psi$

$I = 60,016$

$f_r = 7.5\sqrt{7000} = 628 psi$

$S_b = \frac{I_{gross}}{y_t} = \frac{60,016}{18} = 3334\ in^3$

$M_{crack} = 3334(628) \div 12,000$

$= 175$ ft-Kips

FL PIER - Soil

Sand $E(Psf) = 20,000N$

Silty " $E(Psf) = 10,000N$

$G = 0.5KE/(1+\mu)$ K=pci

$= 50c_u/(1+\mu)$

$G(Psi) = 500N$ Sand, Silt

$= 500N$ Clay $N<10$

$= 5000 + 100(N-10)$ $N>10$

$= 5000 + 175(N-16)$ $N>10$ Silt

$C_u(ksf) = 0.039N$ low Plasticity

$= 0.075N$ med "

$= 0.125N$ High "

Clay #1 (use O'Neill)

$\Delta_u = .04N$ $\bar{N}$ from 5 & 50 & 70 ≈ 12 $\therefore \Delta_u = 0.04(12) \times 2 \div 144 = .0067$ Ksi

$E_{50} = 0.02$ $E_{100} \approx 0.06$

From SPT94 $\tau_{Ave} \approx 41.50^T \times 2 / \pi \cdot 3' \times 15' = 0.587 Ksf \div 144 = .0041$ Ksi

$G(Psi) = 5000 + 100(12-10) = 5200 = 5.2$ Ksi

Clay #2 (O'Neill)

$\Delta_u = 0.075N$ $\bar{N} \approx 22$ $\therefore \Delta_u = .075(22) \times 2 \div 144 = 0.023$ Ksi

$E_{50} = 0.015$ $E_{100} = 0.05$

Peese Stiff below wt $K = 75 Kcf \div 1728 = .043K$ Kci

$\delta' = 50 pcf \div 1728 \div 1000 = 2.89E-5$ Kci

SPT94 $\tau = 171^T \times 2 / \pi \times 3 \times 15 = 2.42 Ksf \div 144 = 0.017$ Ksi

End Bearing @ 50 $\approx 151^T \times 2 = 300$ Kips

$G = 5000 + 100(22-10) = 6.2$ Ksi

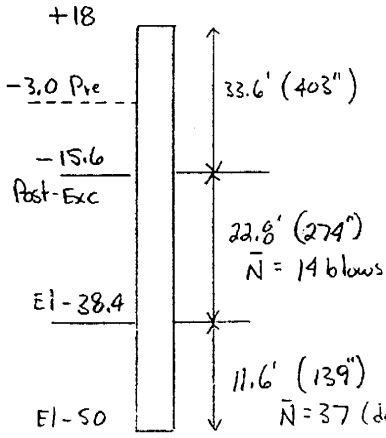
APPENDIX B-11

FLPIER AND CBEAR RESULTS

PROJECT	Page 2 of —	COMPUTED BY	DATE
de Diego Expressway			
SUBJECT		CHECKED BY	DATE
Final Design Recommendations			

Design Concerns (cont) [REVISED SOIL PROFILE]

2. Using FLPIER, what is post-excavation w/o the settlements

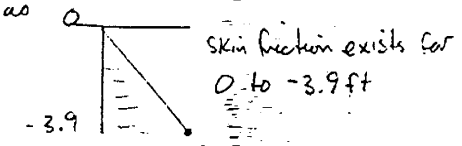


Clay (O'Neill)
Su = .04 N(tsf) = 0.56 tsf × 2 ÷ 144 = .0078 Ksi
E_{50} = .02 E_{100} = .06

Clay
Su(tsf) = .075N = 2.775 × 2 ÷ 144 = .0356 Ksi
E_{50} = .015 E_{100} = 0.05

Total Pile length 68' (816")
E = 4030 Ksi
I = 60,016 in⁴ J = 2I = 120,032
Diam = 36"
Area = 487 in²

Using CB-PNB-7 & 7D Elev of Top of Boring is +9.60', but I entered data starting at El. -3.9 which means that Ground Surface is @ 0.00. So SPT 94 depth = Pile Tip El. but this is slightly in error as



SPT94File PN7A.DAT uses Soil Type 5 (Void) to elevation -16 (good) but this means CAPACITY is for Tip El. -50 [Not -46 as used in previous memos]

Clay #1

From SPT94 El -16 to -38.4 $\bar{\tau}_{Ave}$ = 44.57ᵀ / π × 3 × 22.8' = 0.207 tsf × 2 ÷ 144 = .0029 Ksi
G(psi) = 5000 + 100(14-10) = 5400 psi = 5.4 Ksi

Clay #2

SPT94 El -38.4 to -50 $\bar{\tau}_{Ave}$ = 195ᵀ / π × 3 × 11.6 = 1.326ᵀ × 2 ÷ 144 = 0.018 Ksi
G(psi) = 5000 + 100(37-10) = 7.7 Ksi

End Bearing @ -50 = 104.34ᵀ = 208.7 Kips

End Bearing @ -58 = 98.5ᵀ = 197ᴷ

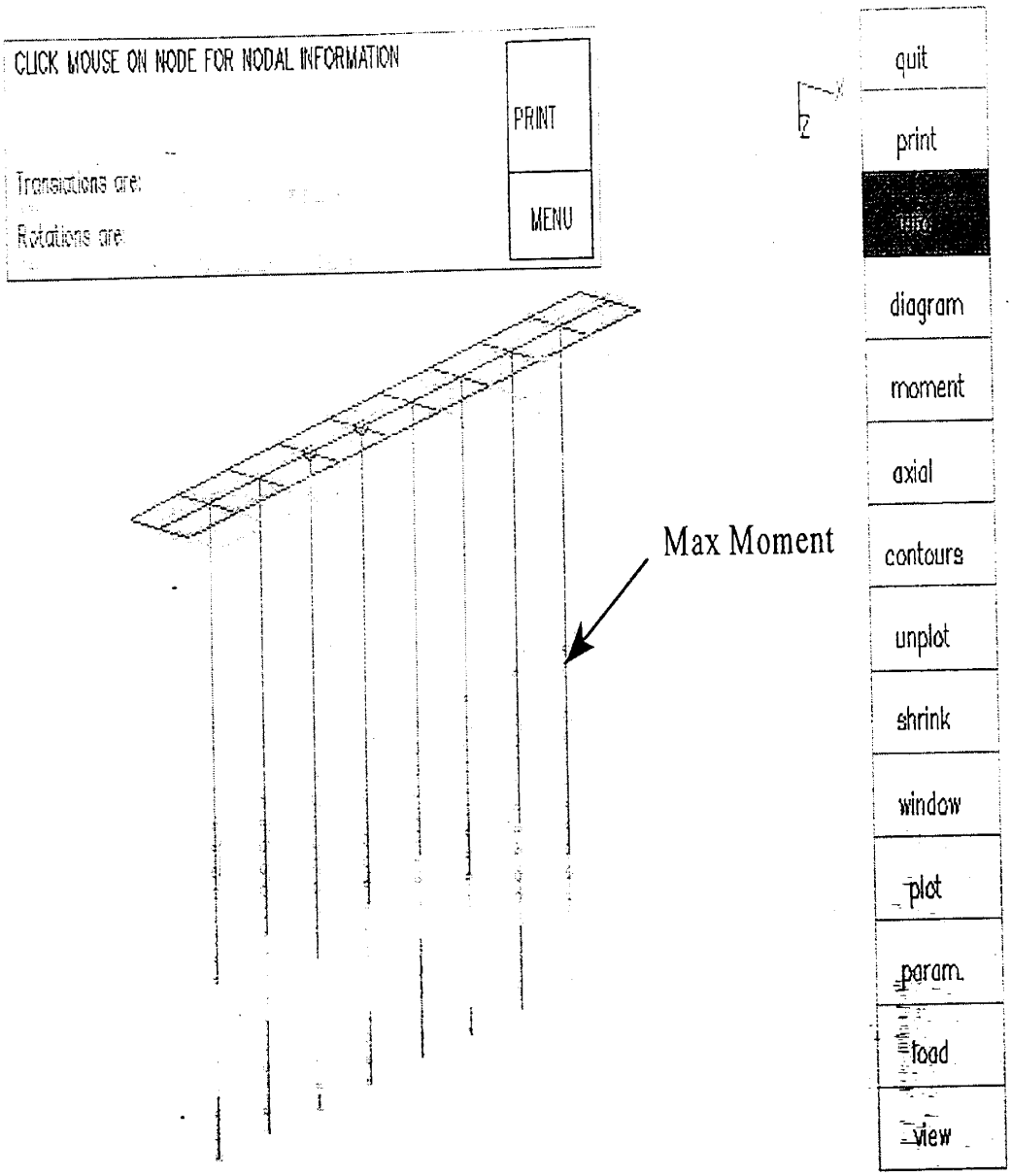


Figure 1 Condition 1 Post Excavation Eight Piles

B-11-2

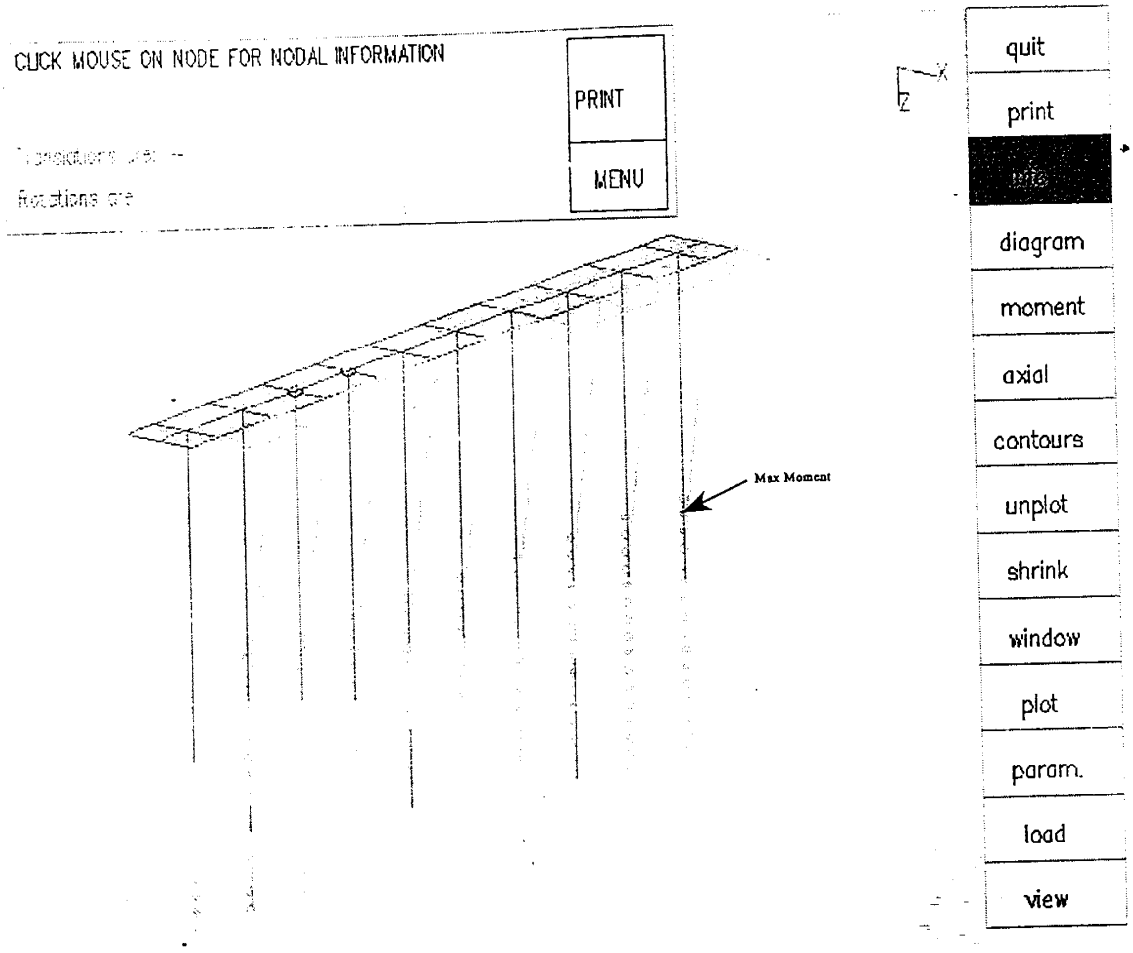


Figure 2 Condition 2 Eight Piles + Two "Outrigger" Piles

B-11-3

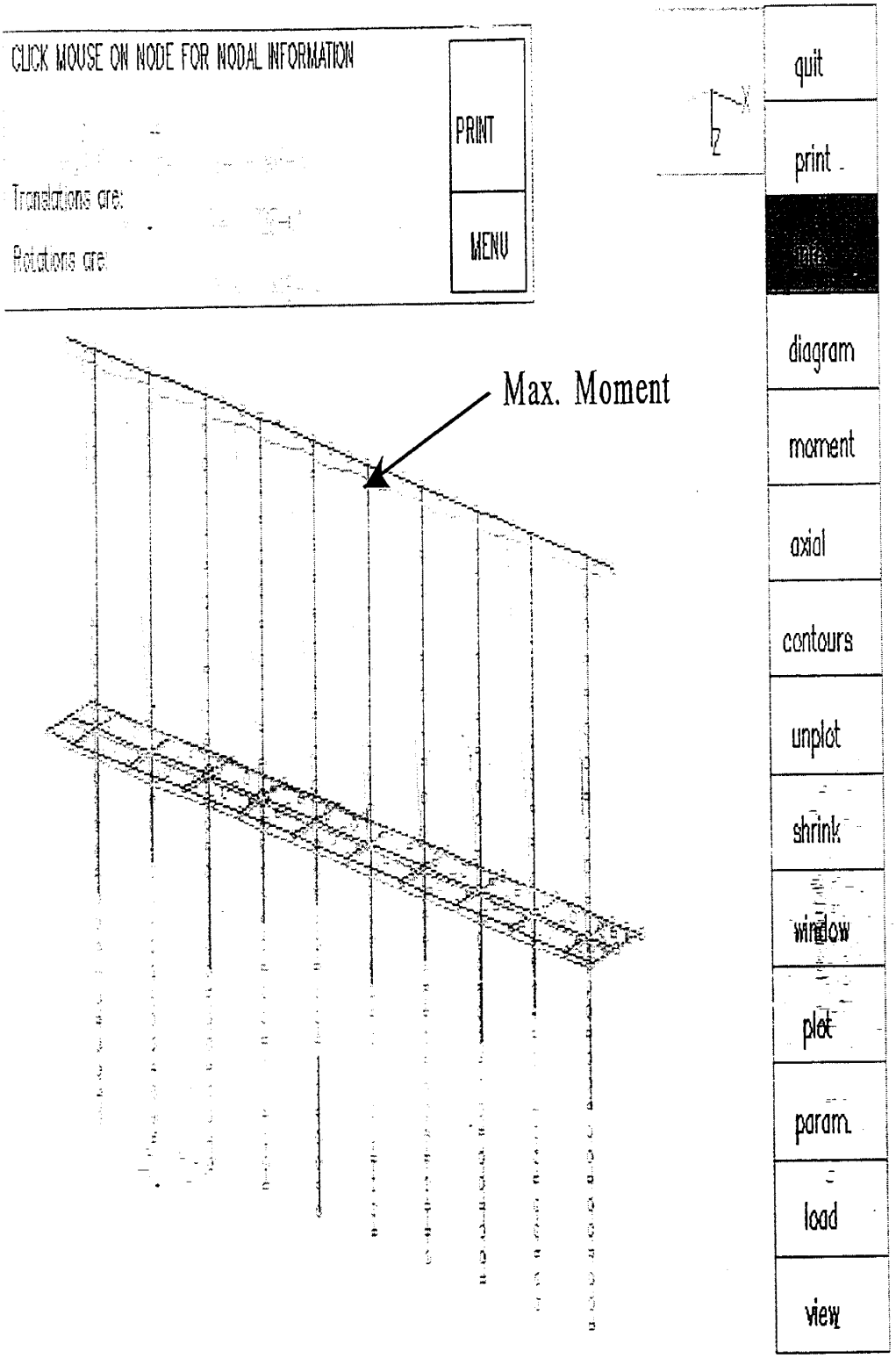


Figure 3 Condition 3 Ten Piles + Stiffening Spread Footing

B-11-4

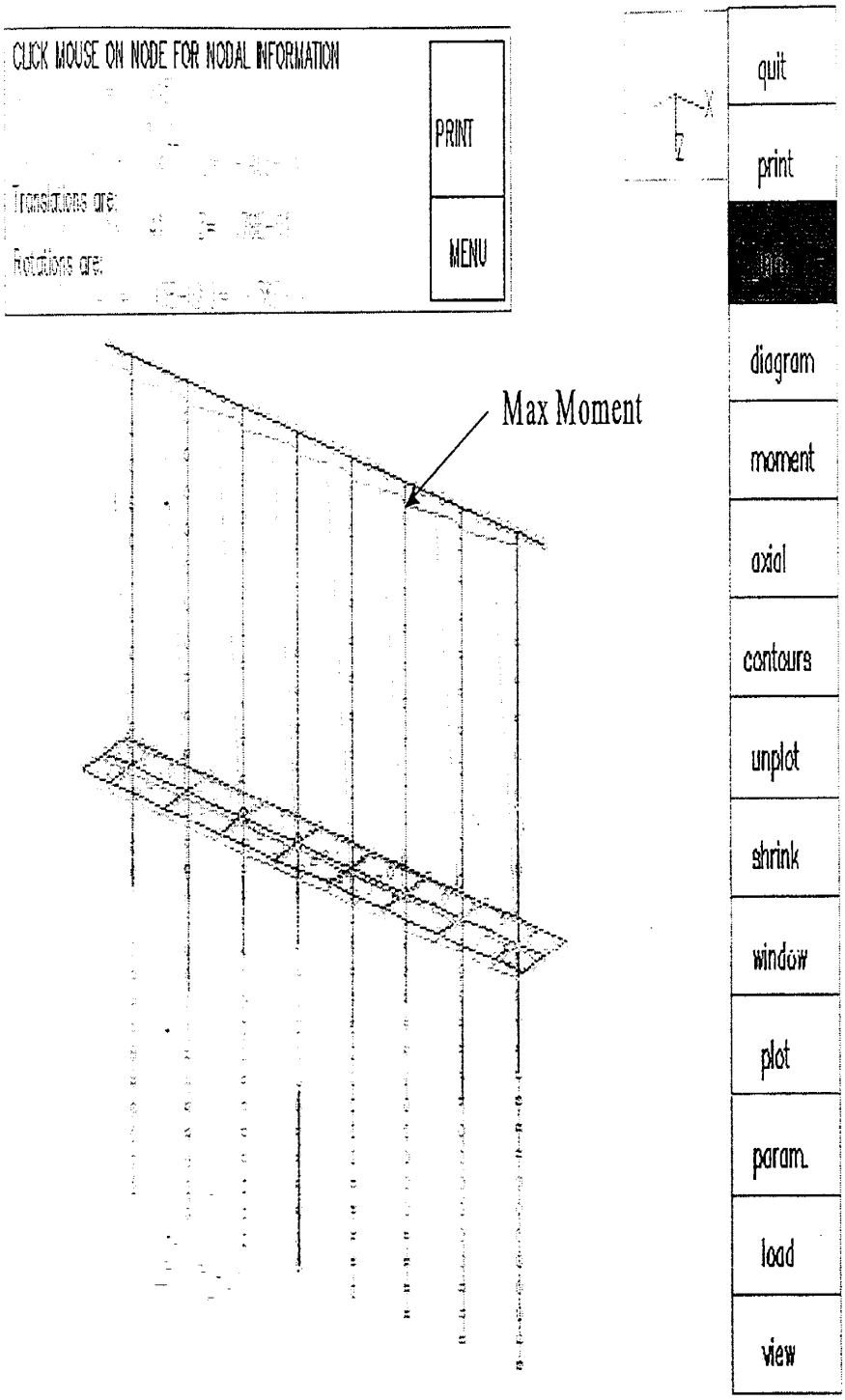
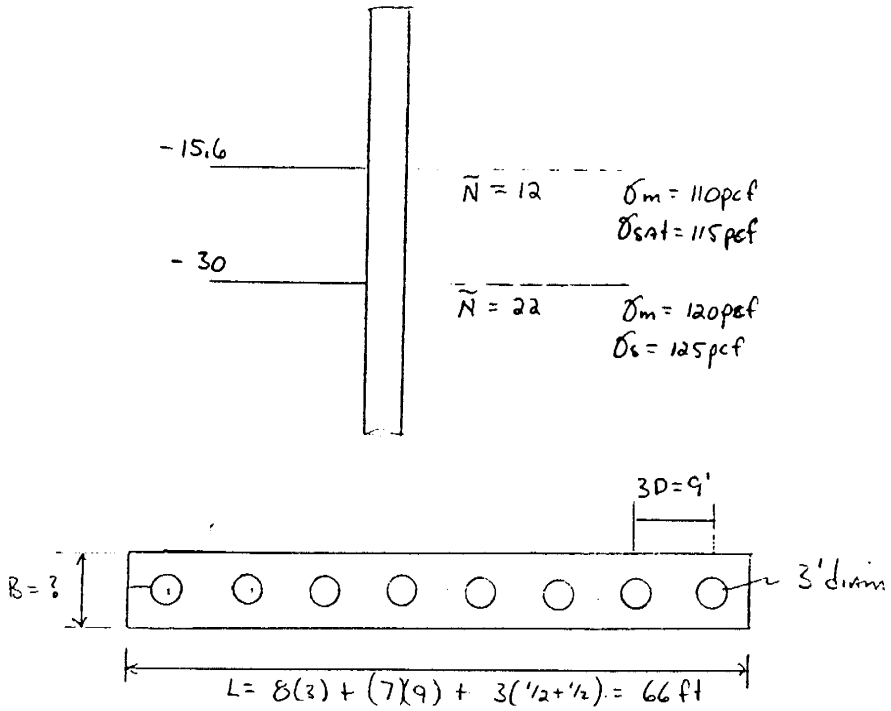


Figure 4 Eight Piles + Footing

B-11-5

PROJECT		Page 1 of —	COMPUTED BY	DATE
CBEAR			FCT	6/15/2...
SUBJECT			CHECKED BY	DATE
& Diego - Shallow Fdn				



Soil Properties

Clay $S_u = 0.04N = 0.04(12) = 0.48 tsf = 960 psf \quad \phi = 0°$
$= 0.07N = 0.04(22) = 0.88 tsf = 1760 psf \quad \phi = 0°$

Sand : $\phi = 53.86 - 27.6034\, e^{-0.0147N}$

$N = 12 \quad \phi = 30.74°$
$N = 22 \quad \phi = 33.90°$

Applied Loading

1) Assume Average friction loss = 65T/pile x 8 = 520T (1040 Kips)

Alt 2) Average pile load = 272.9 Kips
Worst case elev -46 Allowable = 121.9T (243.8K)
∴ Load rqd by ftn = (272.9 - 243.6) x 8 = 232.8 Kips

Results

Case	B	Area	Soil 1	Soil 2	CBEAR ksf	Allow FS=3 Kips
1	6'	339.5ft²	960psf	1760psf	15.455	1748.7
2	6'	339.5ft²	0, ϕ=30.7	0, ϕ=33.9	1008.89	114165.9

APPENDIX B-12

SNAIL WALL ANALYSIS

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**************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION     *
* DIVISION OF NEW TECHNOLOGY, MATERIALS& RESEARCH *
*       OFFICE OF GEOTECHNICAL ENGINEERING       *
* Reinforced Soil Systems & Earthquake Engineering*
*    Date: 06-30-1997          Time: 13:12:34     *
**************************************************
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--------- WALL GEOMETRY ---------

Vertical Wall Height	=	23.24 ft
Wall Batter	=	0.0 degrees
First Slope Angle-above the wall	=	26.6 degrees
First Slope Length from Wallcrest	=	32.10 ft
Second Slope Angle	=	0.0 degrees
Second Slope Length from 1st Slope	=	50.00 ft
Third Slope Angle	=	0.0 degrees
Third Slope Length from 2nd Slope	=	100.00 ft
Fourth Slope Angle	=	0.0 degrees

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

THE SURCHARGES IMPOSED ON THE SYSTEM ARE:

Begin Surcharge - Distance from toe	=	0.0 ft
End Surcharge - Distance from toe	=	32.0 ft
Loading Intensity - Begin	=	200.0 psf/ft
Loading Intensity - End	=	200.0 psf/ft

--------- SOIL PARAMETERS ---------

Unit Weight, GAM1	=	107.00 pcf
Friction Angle, PHI1	=	18.0 degrees
Cohesion, COH1	=	0.0 psf
Ultimate bond Stress, SIG	=	2.80 psi
Unit Weight, GAM2	=	117.00 pcf
Friction Angle, PHI2	=	22.0 degrees
Cohesion, COH2	=	0.0 psf
Ultimate bond Stress, SIG2	=	6.90 psi

Coordinates of Two points Defining Boundary for soil 2

POINT	X-Direction	Y-Direction
1	XS1= 0.0 ft	YS1= 8.5 ft
2	XS2= 100.0 ft	YS2= 8.5 ft

B-12-1

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.00 (a/g)
Vertical Earthquake Coefficient = 0.00
Horiz. Force applied to the Wall = 0.0 Kips

--------- WATER SURFACE ---------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = 0.00 ft Y(1)-Coordinate = 0.00 ft
X(2)-Coordinate = 20.00 ft Y(2)-Coordinate = 1.00 ft
X(3)-Coordinate = 150.00 ft Y(3)-Coordinate = 2.00 ft

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 150.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 8
Horizontal Spacing = 5.00 ft
Diameter of Reinforcement Element = 0.00 in
Yield Stress of Reinforcement = 60.00 ksi
Diameter of Grouted Hole = 6.00 in
Punching Shear Capacity = 43.00 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (Inch)	Ultimate Bond Stress (psi)
1	50.0	15.0	2.0	1.00	20.8
2	50.0	15.0	3.0	1.00	20.8
3	50.0	15.0	3.0	1.00	20.8
4	50.0	15.0	3.0	1.00	2.8
5	50.0	15.0	3.0	1.00	2.8
6	50.0	15.0	3.0	1.00	6.9
7	50.0	15.0	3.0	1.00	6.9
8	50.0	15.0	3.0	1.00	6.9

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)

B-12-2

Toe	1.545	15.0	49.5	16.2	76.3	19.0

Reinf. Stress at Level
1 = 38.844 Ksi (Yield Stress controls.)
2 = 38.844 Ksi (Yield Stress controls.)
3 = 38.844 Ksi (Yield Stress controls.)
4 = 21.508 Ksi (Pullout controls...)
5 = 22.634 Ksi (Pullout controls...)
6 = 38.844 Ksi (Yield Stress controls.)
7 = 38.443 Ksi (Punching Shear controls..)
8 = 35.667 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	1.462	30.0	43.2	16.5	55.6	31.9

Reinf. Stress at Level
1 = 41.043 Ksi (Yield Stress controls.)
2 = 41.043 Ksi (Yield Stress controls.)
3 = 41.043 Ksi (Yield Stress controls.)
4 = 21.796 Ksi (Pullout controls...)
5 = 23.214 Ksi (Pullout controls...)
6 = 41.043 Ksi (Yield Stress controls.)
7 = 41.043 Ksi (Yield Stress controls.)
8 = 37.731 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.478	45.0	39.9	58.6	89.9	0.0

Reinf. Stress at Level
1 = 40.591 Ksi (Yield Stress controls.)
2 = 40.591 Ksi (Yield Stress controls.)
3 = 40.591 Ksi (Yield Stress controls.)
4 = 21.014 Ksi (Pullout controls...)
5 = 22.549 Ksi (Pullout controls...)
6 = 40.591 Ksi (Yield Stress controls.)
7 = 40.591 Ksi (Yield Stress controls.)
8 = 37.342 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.552	60.0	32.1	70.8	89.9	0.0

Reinf. Stress at Level
1 = 38.665 Ksi (Yield Stress controls.)
2 = 38.665 Ksi (Yield Stress controls.)
3 = 38.665 Ksi (Yield Stress controls.)
4 = 18.624 Ksi (Pullout controls...)
5 = 20.428 Ksi (Pullout controls...)
6 = 38.665 Ksi (Yield Stress controls.)
7 = 38.665 Ksi (Yield Stress controls.)
8 = 35.637 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.652	75.0	26.6	83.9	89.9	0.0

Reinf. Stress at Level
1 = 36.315 Ksi (Yield Stress controls.)
2 = 36.315 Ksi (Yield Stress controls.)
3 = 36.315 Ksi (Yield Stress controls.)
4 = 16.366 Ksi (Pullout controls...)
5 = 18.336 Ksi (Pullout controls...)
6 = 36.315 Ksi (Yield Stress controls.)
7 = 36.315 Ksi (Yield Stress controls.)
8 = 33.526 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.763	90.0	22.7	97.5	89.9	0.0

Reinf. Stress at Level
1 = 34.024 Ksi (Yield Stress controls.)
2 = 34.024 Ksi (Yield Stress controls.)
3 = 34.024 Ksi (Yield Stress controls.)
4 = 14.416 Ksi (Pullout controls...)
5 = 16.486 Ksi (Pullout controls...)
6 = 34.024 Ksi (Yield Stress controls.)
7 = 34.024 Ksi (Yield Stress controls.)
8 = 31.455 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 7	1.883	105.0	19.7	111.5	89.9	0.0

Reinf. Stress at Level
1 = 31.871 Ksi (Yield Stress controls.)
2 = 31.871 Ksi (Yield Stress controls.)
3 = 31.871 Ksi (Yield Stress controls.)
4 = 12.749 Ksi (Pullout controls...)
5 = 14.874 Ksi (Pullout controls...)
6 = 31.871 Ksi (Yield Stress controls.)
7 = 31.871 Ksi (Yield Stress controls.)
8 = 29.501 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 8	2.007	120.0	17.4	125.8	89.9	0.0

Reinf. Stress at Level
1 = 29.896 Ksi (Yield Stress controls.)
2 = 29.896 Ksi (Yield Stress controls.)
3 = 29.896 Ksi (Yield Stress controls.)
4 = 11.333 Ksi (Pullout controls...)
5 = 13.479 Ksi (Pullout controls...)
6 = 29.896 Ksi (Yield Stress controls.)
7 = 29.896 Ksi (Yield Stress controls.)
8 = 27.703 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 9	2.135	135.0	15.6	140.1	89.9	0.0

Reinf. Stress at Level
1 = 27.411 Ksi (Pullout controls...)
2 = 28.107 Ksi (Yield Stress controls.)
3 = 28.107 Ksi (Yield Stress controls.)
4 = 10.130 Ksi (Pullout controls...)
5 = 12.276 Ksi (Pullout controls...)
6 = 28.107 Ksi (Yield Stress controls.)
7 = 28.107 Ksi (Yield Stress controls.)
8 = 26.070 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE10	2.239	150.0	14.1	154.6	89.9	0.0

Reinf. Stress at Level
1 = 20.357 Ksi (Pullout controls...)
2 = 26.803 Ksi (Yield Stress controls.)
3 = 26.803 Ksi (Yield Stress controls.)
4 = 9.211 Ksi (Pullout controls...)
5 = 11.368 Ksi (Pullout controls...)
6 = 26.803 Ksi (Yield Stress controls.)
7 = 26.803 Ksi (Yield Stress controls.)
8 = 24.883 Ksi (Punching Shear controls..)

* FOLLOWING IS LOCATION WHERE MAX. REINFORCEMENT FORCE OCCURS *

LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)	DISTANCE BEHIND THE WALL TOE (ft)	FACTOR OF SAFETY F.S.
51.4	48.1	89.9	0.0	30.0	1.473

Maximum Average Reinforcement Working Force = 21.575 kips/level

B-12-6

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**************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION     *
* DIVISION OF NEW TECHNOLOGY, MATERIALS& RESEARCH *
*       OFFICE OF GEOTECHNICAL ENGINEERING       *
* Reinforced Soil Systems & Earthquake Engineering*
*    Date: 06-30-1997          Time: 14:15:00     *
**************************************************
```

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	23.24 ft
Wall Batter	=	0.0 degrees
First Slope Angle-above the wall	=	26.6 degrees
First Slope Length from Wallcrest	=	32.10 ft
Second Slope Angle	=	0.0 degrees
Second Slope Length from 1st Slope	=	50.00 ft
Third Slope Angle	=	0.0 degrees
Third Slope Length from 2nd Slope	=	100.00 ft
Fourth Slope Angle	=	0.0 degrees

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

Allowable bond Stress, SIG2 = 6.90 psi

Coordinates of Two points Defining Boundary for soil 2

POINT	X-Direction	Y-Direction
1	XS1= 0.0 ft	YS1= 8.5 ft
2	XS2= 100.0 ft	YS2= 8.5 ft

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.00 (a/g)
Vertical Earthquake Coefficient = 0.00
Horiz. Force applied to the Wall = 0.0 Kips

--------- WATER SURFACE ---------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = 0.00 ft Y(1)-Coordinate = 12.72 ft
X(2)-Coordinate = 20.00 ft Y(2)-Coordinate = 13.00 ft
X(3)-Coordinate = 150.00 ft Y(3)-Coordinate = 14.00 ft

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 150.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 8
Horizontal Spacing = 5.00 ft
Diameter of Reinforcement Element = 0.00 in
Yield Stress of Reinforcement = 60.00 ksi
Diameter of Grouted Hole = 6.00 in
Punching Shear Capacity = 43.00 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (Inch)	Ultimate Bond Stress (psi)
1	50.0	15.0	2.0	1.00	20.8
2	50.0	15.0	3.0	1.00	20.8
3	50.0	15.0	3.0	1.00	20.8
4	50.0	15.0	3.0	1.00	2.8
5	50.0	15.0	3.0	1.00	2.8
6	50.0	15.0	3.0	1.00	6.9
7	50.0	15.0	3.0	1.00	6.9
8	50.0	15.0	3.0	1.00	6.9

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)

B-12-8

Toe	1.627	15.0	49.5	16.2	76.3	19.0

Reinf. Stress at Level
1 = 36.887 Ksi (Yield Stress controls.)
2 = 36.887 Ksi (Yield Stress controls.)
3 = 36.887 Ksi (Yield Stress controls.)
4 = 20.423 Ksi (Pullout controls...)
5 = 21.493 Ksi (Pullout controls...)
6 = 36.887 Ksi (Yield Stress controls.)
7 = 36.505 Ksi (Punching Shear controls..)
8 = 33.869 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	1.553	30.0	22.7	9.8	58.2	39.8

Reinf. Stress at Level
1 = 38.637 Ksi (Yield Stress controls.)
2 = 38.637 Ksi (Yield Stress controls.)
3 = 38.637 Ksi (Yield Stress controls.)
4 = 19.390 Ksi (Pullout controls...)
5 = 20.248 Ksi (Pullout controls...)
6 = 38.637 Ksi (Yield Stress controls.)
7 = 38.637 Ksi (Yield Stress controls.)
8 = 35.719 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.505	45.0	22.7	9.8	43.2	49.4

Reinf. Stress at Level
1 = 39.864 Ksi (Yield Stress controls.)
2 = 39.864 Ksi (Yield Stress controls.)
3 = 39.864 Ksi (Yield Stress controls.)
4 = 19.011 Ksi (Pullout controls...)
5 = 20.389 Ksi (Pullout controls...)
6 = 39.864 Ksi (Yield Stress controls.)
7 = 39.864 Ksi (Yield Stress controls.)
8 = 36.854 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.558	60.0	22.7	19.5	35.6	51.7

Reinf. Stress at Level
1 = 38.503 Ksi (Yield Stress controls.)
2 = 38.503 Ksi (Yield Stress controls.)
3 = 38.503 Ksi (Yield Stress controls.)
4 = 16.313 Ksi (Pullout controls...)
5 = 18.657 Ksi (Pullout controls...)
6 = 38.503 Ksi (Yield Stress controls.)
7 = 38.503 Ksi (Yield Stress controls.)
8 = 35.595 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.637	75.0	26.6	83.9	89.9	0.0

Reinf. Stress at Level
1 = 36.656 Ksi (Yield Stress controls.)
2 = 36.656 Ksi (Yield Stress controls.)
3 = 36.656 Ksi (Yield Stress controls.)
4 = 16.520 Ksi (Pullout controls...)
5 = 18.508 Ksi (Pullout controls...)
6 = 36.656 Ksi (Yield Stress controls.)
7 = 36.656 Ksi (Yield Stress controls.)
8 = 33.841 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.728	90.0	22.7	97.5	89.9	0.0

Reinf. Stress at Level
1 = 34.728 Ksi (Yield Stress controls.)
2 = 34.728 Ksi (Yield Stress controls.)
3 = 34.728 Ksi (Yield Stress controls.)
4 = 14.714 Ksi (Pullout controls...)
5 = 16.827 Ksi (Pullout controls...)
6 = 34.728 Ksi (Yield Stress controls.)
7 = 34.728 Ksi (Yield Stress controls.)
8 = 32.106 Ksi (Punching Shear controls..)

6-12-10

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 7	1.797	105.0	5.1	42.2	28.3	71.5

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 7.910 Ksi (Pullout controls...)
3 = 20.768 Ksi (Pullout controls...)
4 = 6.532 Ksi (Pullout controls...)
5 = 10.431 Ksi (Pullout controls...)
6 = 33.393 Ksi (Yield Stress controls.)
7 = 33.393 Ksi (Yield Stress controls.)
8 = 31.239 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 8	1.853	120.0	0.0	36.0	24.1	92.0

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.967 Ksi (Pullout controls...)
3 = 14.992 Ksi (Pullout controls...)
4 = 3.906 Ksi (Pullout controls...)
5 = 6.221 Ksi (Pullout controls...)
6 = 27.758 Ksi (Pullout controls...)
7 = 32.372 Ksi (Yield Stress controls.)
8 = 30.533 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 9	1.940	135.0	0.0	27.0	19.2	114.4

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 10.985 Ksi (Pullout controls...)
3 = 26.547 Ksi (Pullout controls...)
4 = 5.669 Ksi (Pullout controls...)
5 = 7.763 Ksi (Pullout controls...)
6 = 26.518 Ksi (Pullout controls...)
7 = 30.925 Ksi (Yield Stress controls.)
8 = 29.168 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE10	2.028	150.0	0.0	30.0	17.4	125.8

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 2.293 Ksi (Pullout controls...)
3 = 18.075 Ksi (Pullout controls...)
4 = 4.558 Ksi (Pullout controls...)
5 = 6.682 Ksi (Pullout controls...)
6 = 25.374 Ksi (Pullout controls...)
7 = 29.591 Ksi (Yield Stress controls.)
8 = 27.910 Ksi (Punching Shear controls..)

* FOLLOWING IS LOCATION WHERE MAX. REINFORCEMENT FORCE OCCURS *

LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)	DISTANCE BEHIND THE WALL TOE (ft)	FACTOR OF SAFETY F.S.
39.9	58.6	89.9	0.0	45.0	1.526

Maximum Average Reinforcement Working Force = 19.959 kips/level

B-12-12

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*    CALIFORNIA DEPARTMENT OF TRANSPORTATION     *
* DIVISION OF NEW TECHNOLOGY, MATERIALS& RESEARCH *
*       OFFICE OF GEOTECHNICAL ENGINEERING       *
* Reinforced Soil Systems & Earthquake Engineering*
*    Date: 06-30-1997          Time: 14:22:50     *
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--------- WALL GEOMETRY ---------

Vertical Wall Height	=	23.24 ft
Wall Batter	=	0.0 degrees
First Slope Angle-above the wall	=	26.6 degrees
First Slope Length from Wallcrest	=	32.10 ft
Second Slope Angle	=	0.0 degrees
Second Slope Length from 1st Slope	=	50.00 ft
Third Slope Angle	=	0.0 degrees
Third Slope Length from 2nd Slope	=	100.00 ft
Fourth Slope Angle	=	0.0 degrees

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

Allowable bond Stress, SIG2 = 6.90 psi

Coordinates of Two points Defining Boundary for soil 2

POINT	X-Direction	Y-Direction
1	XS1= 0.0 ft	YS1= 8.5 ft
2	XS2= 100.0 ft	YS2= 8.5 ft

B-12-13

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.00 (a/g)
Vertical Earthquake Coefficient = 0.00
Horiz. Force applied to the Wall = 0.0 Kips

--------- WATER SURFACE ---------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = 0.00 ft Y(1)-Coordinate = 23.24 ft
X(2)-Coordinate = 20.00 ft Y(2)-Coordinate = 24.00 ft
X(3)-Coordinate = 150.00 ft Y(3)-Coordinate = 25.00 ft

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 150.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 8
Horizontal Spacing = 5.00 ft
Diameter of Reinforcement Element = 0.00 in
Yield Stress of Reinforcement = 60.00 ksi
Diameter of Grouted Hole = 6.00 in
Punching Shear Capacity = 43.00 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (Inch)	Ultimate Bond Stress (psi)
1	50.0	15.0	2.0	1.00	20.8
2	50.0	15.0	3.0	1.00	20.8
3	50.0	15.0	3.0	1.00	20.8
4	50.0	15.0	3.0	1.00	2.8
5	50.0	15.0	3.0	1.00	2.8
6	50.0	15.0	3.0	1.00	6.9
7	50.0	15.0	3.0	1.00	6.9
8	50.0	15.0	3.0	1.00	6.9

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)

6-12-14

Toe	1.572	15.0	49.5	16.2	76.3	19.0

Reinf. Stress at Level
1 = 38.163 Ksi (Yield Stress controls.)
2 = 38.163 Ksi (Yield Stress controls.)
3 = 38.163 Ksi (Yield Stress controls.)
4 = 21.130 Ksi (Pullout controls...)
5 = 22.237 Ksi (Pullout controls...)
6 = 38.163 Ksi (Yield Stress controls.)
7 = 37.769 Ksi (Punching Shear controls..)
8 = 35.042 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	1.472	30.0	26.6	16.8	63.5	33.6

Reinf. Stress at Level
1 = 40.757 Ksi (Yield Stress controls.)
2 = 40.757 Ksi (Yield Stress controls.)
3 = 40.757 Ksi (Yield Stress controls.)
4 = 18.708 Ksi (Pullout controls...)
5 = 20.579 Ksi (Pullout controls...)
6 = 40.757 Ksi (Yield Stress controls.)
7 = 40.757 Ksi (Yield Stress controls.)
8 = 37.626 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.415	45.0	22.7	19.5	48.1	40.4

Reinf. Stress at Level
1 = 42.396 Ksi (Yield Stress controls.)
2 = 42.396 Ksi (Yield Stress controls.)
3 = 42.396 Ksi (Yield Stress controls.)
4 = 17.963 Ksi (Pullout controls...)
5 = 20.543 Ksi (Pullout controls...)
6 = 42.396 Ksi (Yield Stress controls.)
7 = 42.396 Ksi (Yield Stress controls.)
8 = 39.195 Ksi (Punching Shear controls..)

B-12-15

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.439	60.0	22.7	19.5	35.6	51.7

Reinf. Stress at Level
1 = 41.697 Ksi (Yield Stress controls.)
2 = 41.697 Ksi (Yield Stress controls.)
3 = 41.697 Ksi (Yield Stress controls.)
4 = 17.667 Ksi (Pullout controls...)
5 = 20.204 Ksi (Pullout controls...)
6 = 41.697 Ksi (Yield Stress controls.)
7 = 41.697 Ksi (Yield Stress controls.)
8 = 38.548 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.500	75.0	18.5	23.7	29.8	60.5

Reinf. Stress at Level
1 = 40.003 Ksi (Yield Stress controls.)
2 = 40.003 Ksi (Yield Stress controls.)
3 = 40.003 Ksi (Yield Stress controls.)
4 = 15.570 Ksi (Pullout controls...)
5 = 18.343 Ksi (Pullout controls...)
6 = 40.003 Ksi (Yield Stress controls.)
7 = 40.003 Ksi (Yield Stress controls.)
8 = 37.049 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.531	90.0	4.8	45.2	37.0	56.3

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 3.740 Ksi (Pullout controls...)
3 = 20.025 Ksi (Pullout controls...)
4 = 7.349 Ksi (Pullout controls...)
5 = 12.003 Ksi (Pullout controls...)
6 = 39.192 Ksi (Yield Stress controls.)
7 = 39.192 Ksi (Yield Stress controls.)
8 = 36.679 Ksi (Punching Shear controls..)

B-10-16

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 7	1.551	105.0	0.0	42.0	30.8	73.4

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 6.748 Ksi (Pullout controls...)
4 = 2.775 Ksi (Pullout controls...)
5 = 7.433 Ksi (Pullout controls...)
6 = 33.164 Ksi (Pullout controls...)
7 = 38.675 Ksi (Yield Stress controls.)
8 = 36.478 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 8	1.597	120.0	0.0	36.0	24.1	92.0

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 1.123 Ksi (Pullout controls...)
3 = 17.402 Ksi (Pullout controls...)
4 = 4.534 Ksi (Pullout controls...)
5 = 7.221 Ksi (Pullout controls...)
6 = 32.220 Ksi (Pullout controls...)
7 = 37.574 Ksi (Yield Stress controls.)
8 = 35.440 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 9	1.664	135.0	0.0	40.5	21.7	101.7

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 4.499 Ksi (Pullout controls...)
4 = 2.865 Ksi (Pullout controls...)
5 = 6.929 Ksi (Pullout controls...)
6 = 30.914 Ksi (Pullout controls...)
7 = 36.052 Ksi (Yield Stress controls.)
8 = 34.004 Ksi (Punching Shear controls..)

B-12-17

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE10	1.723	150.0	0.0	30.0	17.4	125.8

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 2.698 Ksi (Pullout controls...)
3 = 21.268 Ksi (Pullout controls...)
4 = 5.363 Ksi (Pullout controls...)
5 = 7.863 Ksi (Pullout controls...)
6 = 29.857 Ksi (Pullout controls...)
7 = 34.819 Ksi (Yield Stress controls.)
8 = 32.841 Ksi (Punching Shear controls..)

* FOLLOWING IS LOCATION WHERE MAX. REINFORCEMENT FORCE OCCURS *

LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)	DISTANCE BEHIND THE WALL TOE (ft)	FACTOR OF SAFETY F.S.
22.7	9.8	43.2	49.4	45.0	1.418

Maximum Average Reinforcement Working Force = 23.084 kips/level

B-12-18

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*    CALIFORNIA DEPARTMENT OF TRANSPORTATION     *
* DIVISION OF NEW TECHNOLOGY, MATERIALS& RESEARCH *
*       OFFICE OF GEOTECHNICAL ENGINEERING       *
* Reinforced Soil Systems & Earthquake Engineering*
*    Date: 06-30-1997          Time: 14:36:59     *
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--------- WALL GEOMETRY ---------

Vertical Wall Height	=	23.24 ft
Wall Batter	=	0.0 degrees
First Slope Angle-above the wall	=	26.6 degrees
First Slope Length from Wallcrest	=	32.10 ft
Second Slope Angle	=	0.0 degrees
Second Slope Length from 1st Slope	=	50.00 ft
Third Slope Angle	=	0.0 degrees
Third Slope Length from 2nd Slope	=	100.00 ft
Fourth Slope Angle	=	0.0 degrees

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

Allowable bond Stress, SIG2 = 6.90 psi

Coordinates of Two points Defining Boundary for soil 2

POINT	X-Direction	Y-Direction
1	XS1= 0.0 ft	YS1= 8.5 ft
2	XS2= 100.0 ft	YS2= 8.5 ft

B-12-19

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.15 (a/g)
Vertical Earthquake Coefficient = 0.00
Horiz. Force applied to the Wall = 0.0 Kips

--------- WATER SURFACE ---------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = 0.00 ft Y(1)-Coordinate = 12.72 ft
X(2)-Coordinate = 20.00 ft Y(2)-Coordinate = 13.00 ft
X(3)-Coordinate = 150.00 ft Y(3)-Coordinate = 14.00 ft

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 150.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 8
Horizontal Spacing = 5.00 ft
Diameter of Reinforcement Element = 0.00 in
Yield Stress of Reinforcement = 60.00 ksi
Diameter of Grouted Hole = 6.00 in
Punching Shear Capacity = 43.00 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (Inch)	Ultimate Bond Stress (psi)
1	50.0	15.0	2.0	1.00	20.8
2	50.0	15.0	3.0	1.00	20.8
3	50.0	15.0	3.0	1.00	20.8
4	50.0	15.0	3.0	1.00	2.8
5	50.0	15.0	3.0	1.00	2.8
6	50.0	15.0	3.0	1.00	6.9
7	50.0	15.0	3.0	1.00	6.9
8	50.0	15.0	3.0	1.00	6.9

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)

B-12-20

Toe	1.530	15.0	49.5	16.2	76.3	19.0

Reinf. Stress at Level
1 = 39.225 Ksi (Yield Stress controls.)
2 = 39.225 Ksi (Yield Stress controls.)
3 = 39.225 Ksi (Yield Stress controls.)
4 = 21.718 Ksi (Pullout controls...)
5 = 22.855 Ksi (Pullout controls...)
6 = 39.225 Ksi (Yield Stress controls.)
7 = 38.819 Ksi (Punching Shear controls..)
8 = 36.016 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	1.363	30.0	26.6	16.8	63.5	33.6

Reinf. Stress at Level
1 = 44.018 Ksi (Yield Stress controls.)
2 = 44.018 Ksi (Yield Stress controls.)
3 = 44.018 Ksi (Yield Stress controls.)
4 = 20.205 Ksi (Pullout controls...)
5 = 22.225 Ksi (Pullout controls...)
6 = 44.018 Ksi (Yield Stress controls.)
7 = 44.018 Ksi (Yield Stress controls.)
8 = 40.636 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.276	45.0	18.5	23.7	53.2	37.6

Reinf. Stress at Level
1 = 47.027 Ksi (Yield Stress controls.)
2 = 47.027 Ksi (Yield Stress controls.)
3 = 47.027 Ksi (Yield Stress controls.)
4 = 18.304 Ksi (Pullout controls...)
5 = 21.563 Ksi (Pullout controls...)
6 = 47.027 Ksi (Yield Stress controls.)
7 = 47.027 Ksi (Yield Stress controls.)
8 = 43.554 Ksi (Punching Shear controls..)

B-12-21

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.255	60.0	0.0	12.0	38.1	61.0

Reinf. Stress at Level
1 = 47.791 Ksi (Yield Stress controls.)
2 = 47.791 Ksi (Yield Stress controls.)
3 = 47.791 Ksi (Yield Stress controls.)
4 = 18.429 Ksi (Pullout controls...)
5 = 20.326 Ksi (Pullout controls...)
6 = 47.791 Ksi (Yield Stress controls.)
7 = 47.791 Ksi (Yield Stress controls.)
8 = 45.077 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.253	75.0	4.8	45.2	48.5	45.2

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 7.735 Ksi (Pullout controls...)
3 = 24.472 Ksi (Pullout controls...)
4 = 8.981 Ksi (Pullout controls...)
5 = 14.669 Ksi (Pullout controls...)
6 = 47.894 Ksi (Yield Stress controls.)
7 = 47.894 Ksi (Yield Stress controls.)
8 = 44.824 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.201	90.0	0.0	45.0	39.9	58.6

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 2.134 Ksi (Pullout controls...)
4 = 2.176 Ksi (Pullout controls...)
5 = 9.600 Ksi (Pullout controls...)
6 = 42.832 Ksi (Pullout controls...)
7 = 49.950 Ksi (Yield Stress controls.)
8 = 47.113 Ksi (Punching Shear controls..)

B-12-22

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 7	1.185	105.0	0.0	42.0	30.8	73.4

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 8.836 Ksi (Pullout controls...)
4 = 3.634 Ksi (Pullout controls...)
5 = 9.734 Ksi (Pullout controls...)
6 = 43.429 Ksi (Pullout controls...)
7 = 50.647 Ksi (Yield Stress controls.)
8 = 47.770 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 8	1.192	120.0	0.0	36.0	24.1	92.0

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 1.504 Ksi (Pullout controls...)
3 = 23.306 Ksi (Pullout controls...)
4 = 6.072 Ksi (Pullout controls...)
5 = 9.671 Ksi (Pullout controls...)
6 = 43.152 Ksi (Pullout controls...)
7 = 50.323 Ksi (Yield Stress controls.)
8 = 47.465 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 9	1.199	135.0	0.0	40.5	21.7	101.7

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 6.244 Ksi (Pullout controls...)
4 = 3.977 Ksi (Pullout controls...)
5 = 9.616 Ksi (Pullout controls...)
6 = 42.905 Ksi (Pullout controls...)
7 = 50.036 Ksi (Yield Stress controls.)
8 = 47.194 Ksi (Punching Shear controls..)

B-12-23

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE10	1.231	150.0	0.0	45.0	19.7	111.5

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 0.000 Ksi
4 = 2.038 Ksi (Pullout controls...)
5 = 9.365 Ksi (Pullout controls...)
6 = 41.785 Ksi (Pullout controls...)
7 = 48.729 Ksi (Yield Stress controls.)
8 = 45.961 Ksi (Punching Shear controls..)

* FOLLOWING IS LOCATION WHERE MAX. REINFORCEMENT FORCE OCCURS *

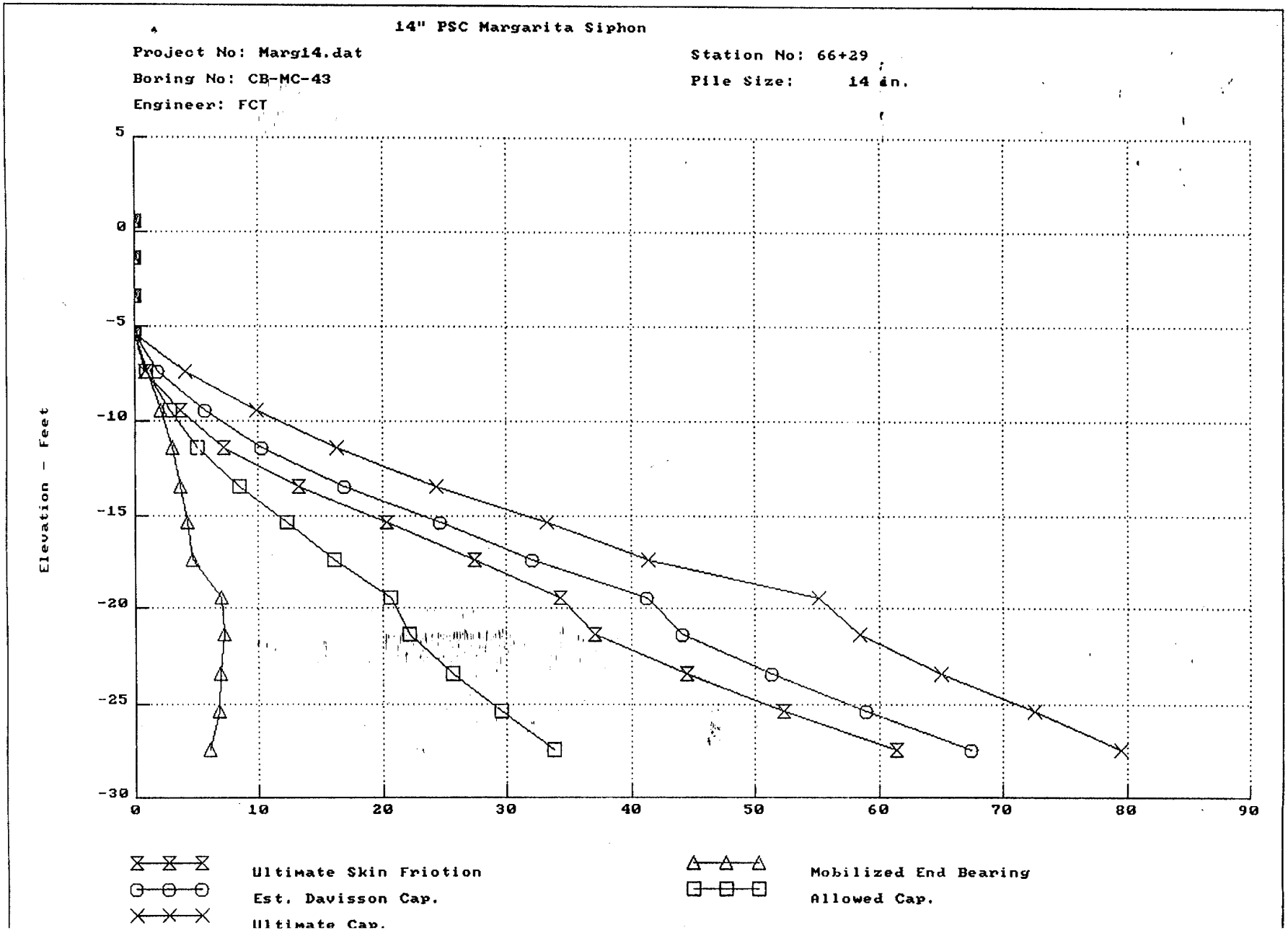
LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)	DISTANCE BEHIND THE WALL TOE (ft)	FACTOR OF SAFETY F.S.
22.7	9.8	43.2	49.4	45.0	1.283

Maximum Average Reinforcement Working Force = 27.074 kips/level

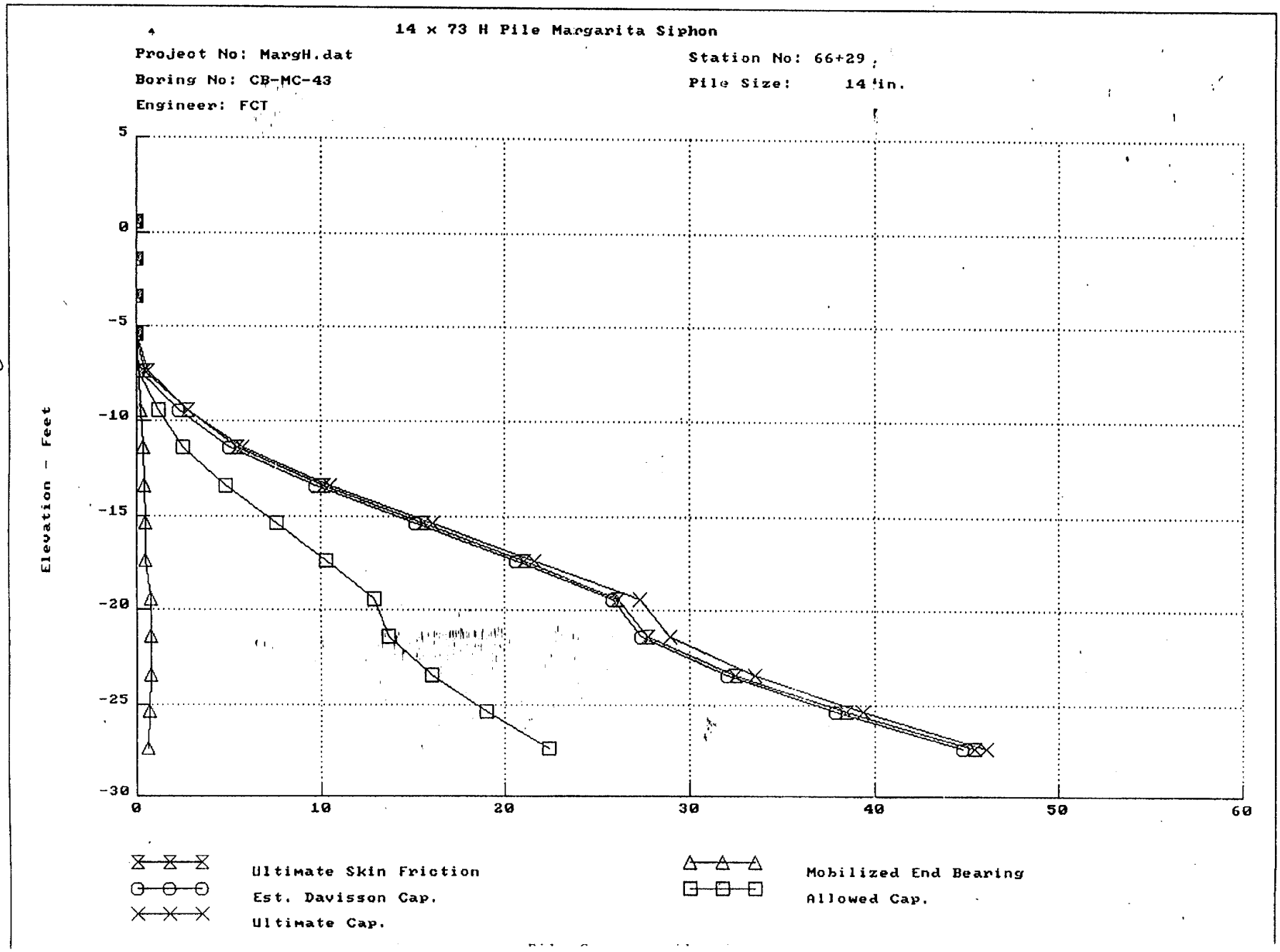
B-12-24

APPENDIX B-13

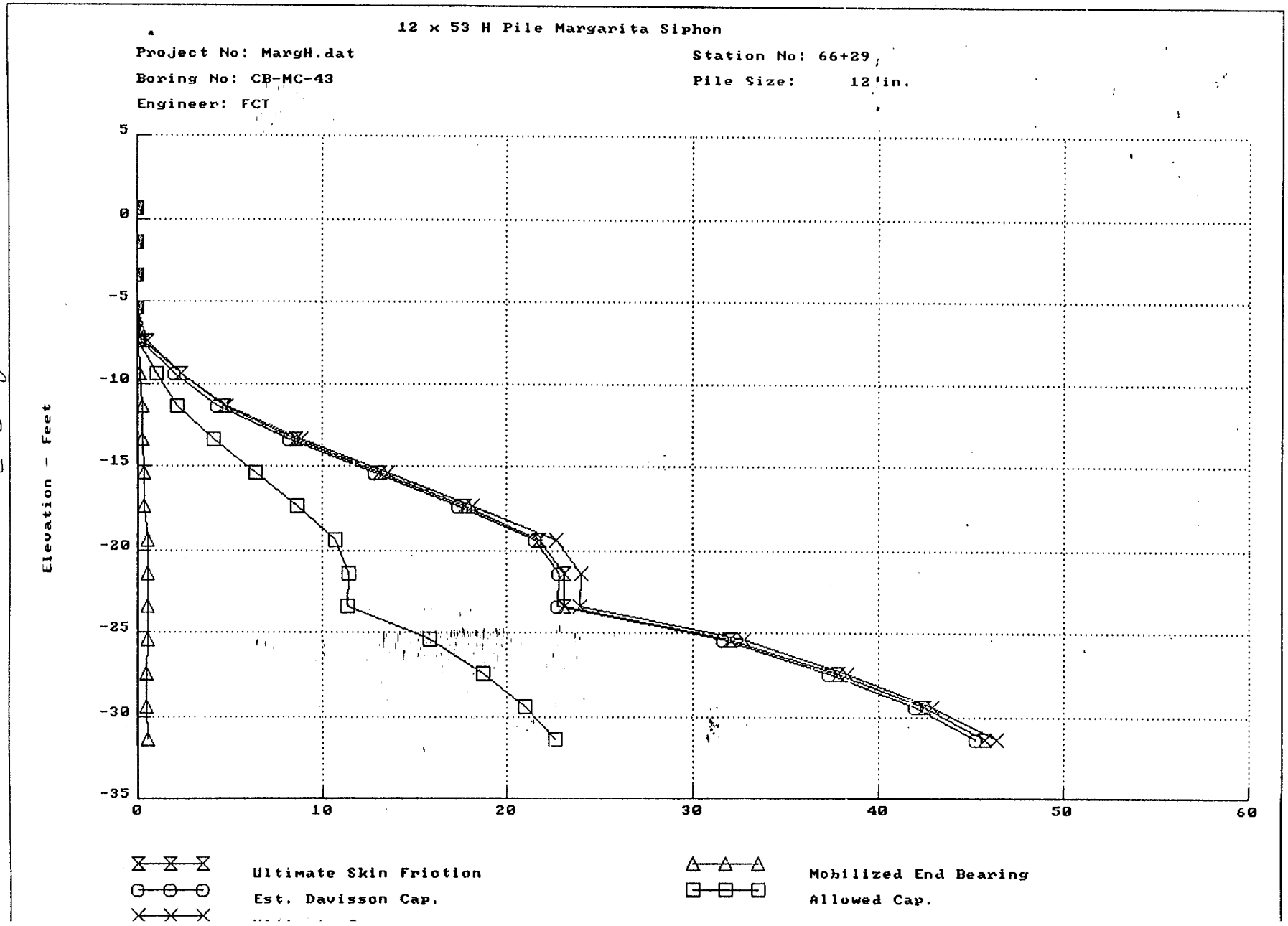
MARGARITA & PUERTO NUEVO SIPHON
FOUNDATION ANALYSIS


14" PSC Margarita Siphon
Project No: Marg14.dat
Station No: 66+29
Boring No: CB-MC-43
Pile Size: 14 in.
Engineer: FCT
Elevation - Feet
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
Ultimate Skin Friction
Est. Davisson Cap.
Ultimate Cap.
Mobilized End Bearing
Allowed Cap.

B-13-1


14 x 73 H Pile Margarita Siphon
Project No: MargH.dat
Station No: 66+29
Boring No: CB-MC-43
Pile Size: 14 in.
Engineer: FCT
Elevation - Feet
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
Ultimate Skin Friction
Est. Davisson Cap.
Ultimate Cap.
Mobilized End Bearing
Allowed Cap.

B-13-2


12 x 53 H Pile Margarita Siphon
Project No: MargH.dat
Station No: 66+29
Boring No: CB-MC-43
Pile Size: 12 in.
Engineer: FCT
Elevation - Feet
5
0
-5
-10
-15
-20
-25
-30
-35
0
10
20
30
40
50
60
Ultimate Skin Friction
Est. Davisson Cap.
Mobilized End Bearing
Allowed Cap.

B-13-3

10"Round PSC Margarita Siphon

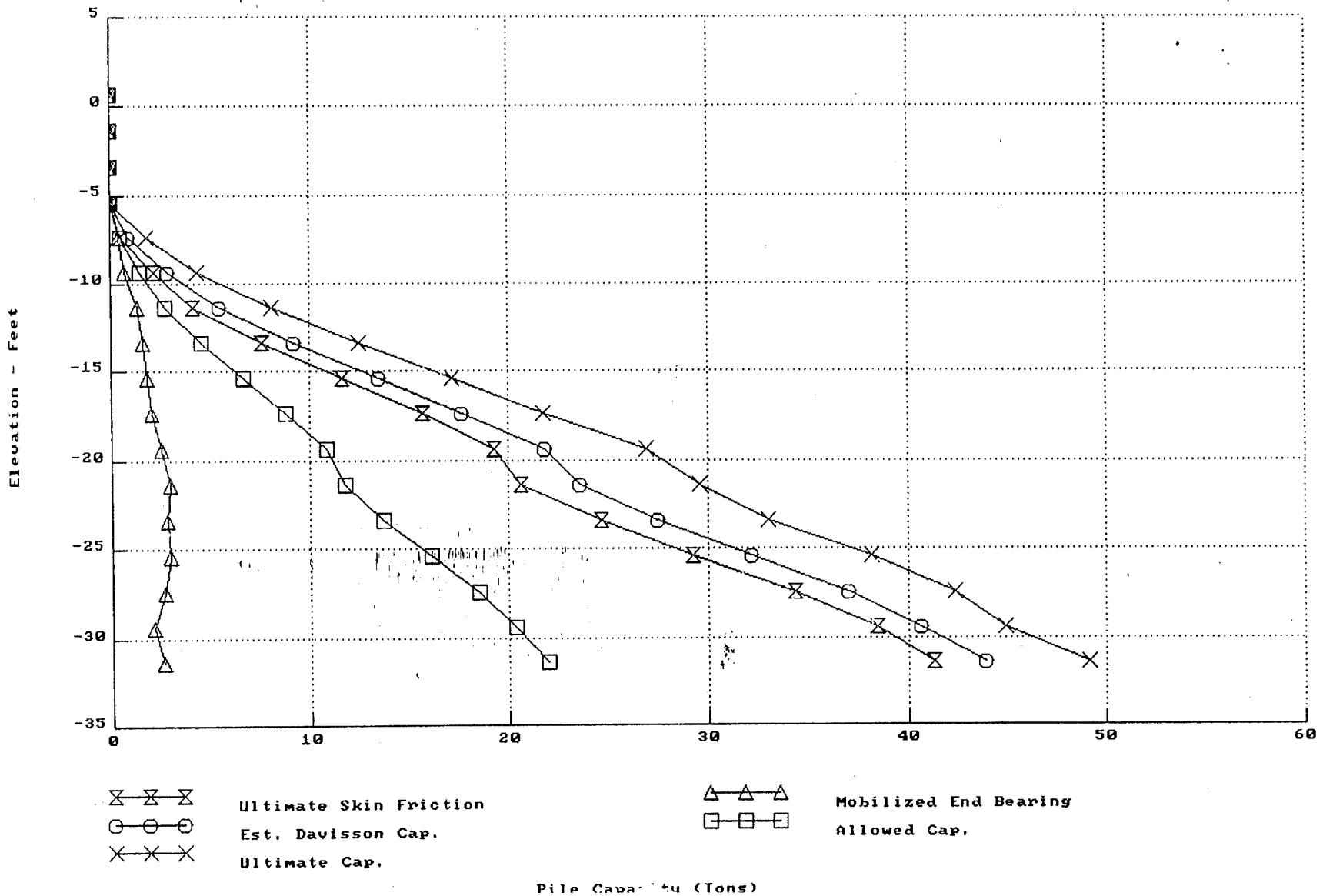
Project No: Marg10.dat

Station No: 66+29

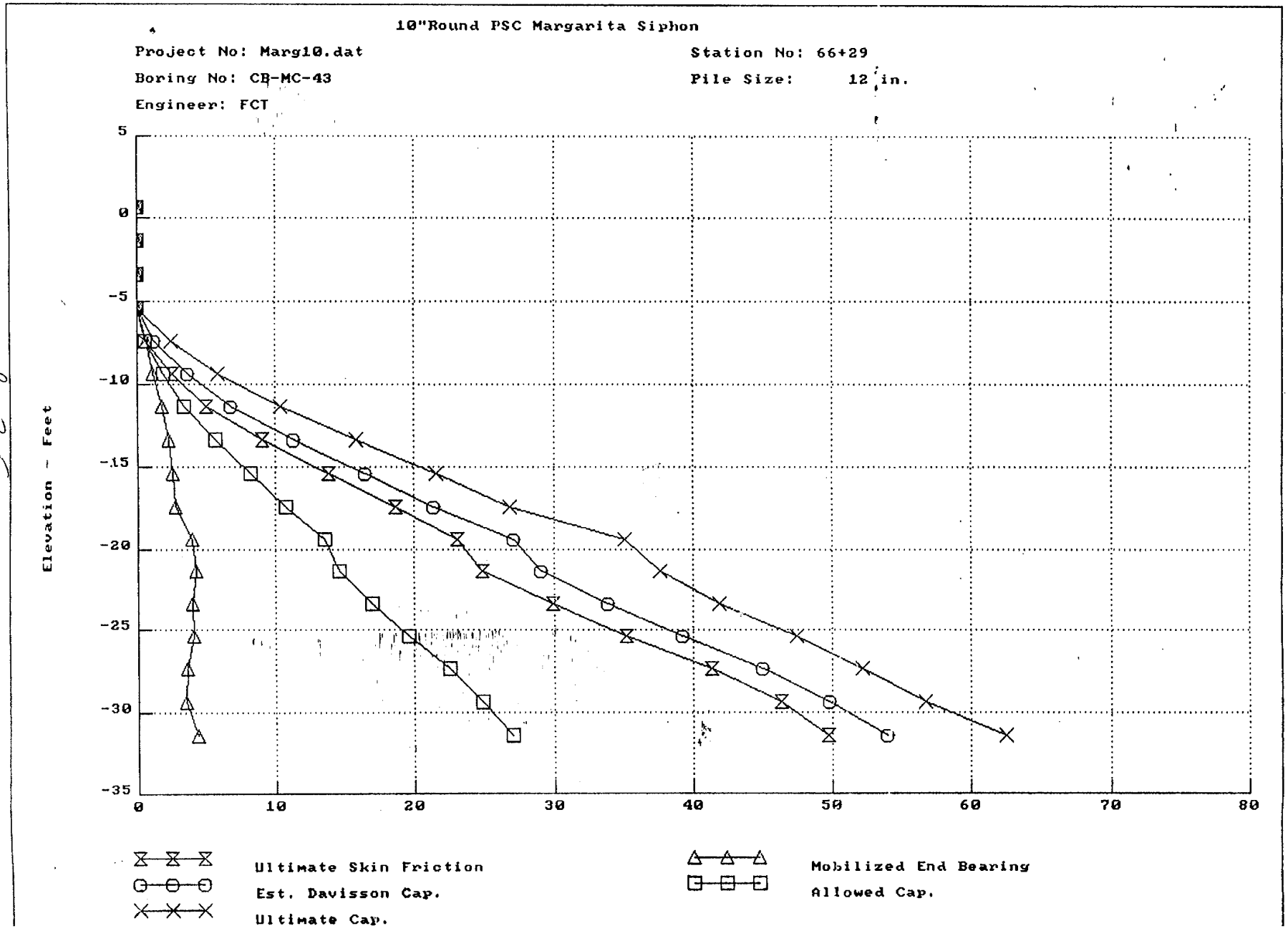
Boring No: CB-MC-43

Pile Size: 10 in.

Engineer: FCT



B-13-4


10"Round PSC Margarita Siphon
Project No: Marg10.dat
Station No: 66+29
Boring No: CB-MC-43
Pile Size: 12 in.
Engineer: FCT
Elevation - Feet
5
0
-5
-10
-15
-20
-25
-30
-35
0
10
20
30
40
50
60
70
80
Ultimate Skin Friction
Est. Davisson Cap.
Ultimate Cap.
Mobilized End Bearing
Allowed Cap.

B-13.5

Project No: Pto nuevo Siphon
Boring No: CB-PNM-44 & -44D

C. PILE INFORMATION

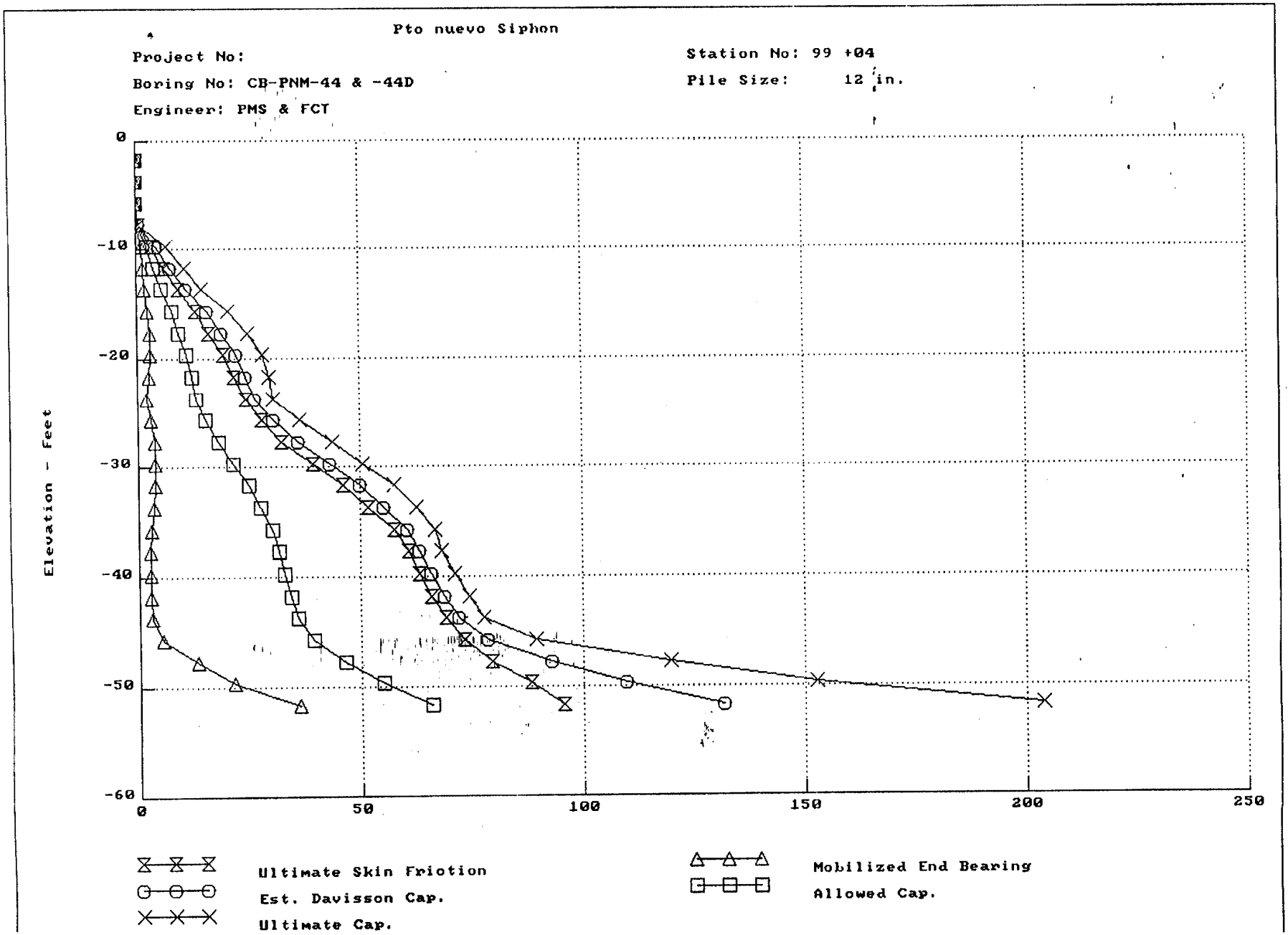
TEST PILE SECTION ISECT = 2
{concrete pile, round section}

DIAMETER OF PILE WP = 10.00 INCHES

D. PILE CAPACITY VS. PENETRATION

TEST PILE LENGTH (FT)	PILE TIP ELEV (FT)	ULTIMATE SIDE FRICTION (TONS)	MOBILIZED END BEARING (TONS)	ESTIMATED DAVISSON CAPACITY (TONS)	ALLOWABLE PILE CAPACITY (TONS)	ULTIMATE PILE CAPACITY (TONS)
10.0	-1.7	.00	.00	.00	.00	.00
12.0	-3.7	.00	.00	.00	.00	.00
14.0	-5.7	.00	.00	.00	.00	.00
16.0	-7.7	.48	.00	.48	.24	.48
18.0	-9.7	2.76	.81	3.57	1.79	5.20
20.0	-11.7	5.26	1.13	6.39	3.19	8.64
22.0	-13.7	8.02	1.34	9.36	4.68	12.04
24.0	-15.7	11.23	1.53	12.76	6.38	15.82
26.0	-17.7	13.53	2.08	15.60	7.80	19.75
28.0	-19.7	16.26	2.15	18.41	9.20	22.71
30.0	-21.7	18.20	1.88	20.08	10.04	23.84
32.0	-23.7	20.43	1.34	21.77	10.88	24.46
34.0	-25.7	23.29	1.89	25.18	12.59	28.96
36.0	-27.7	27.21	2.63	29.85	14.92	35.11
38.0	-29.7	33.05	2.60	35.65	17.82	40.84
40.0	-31.7	38.61	2.77	41.38	20.69	46.92
42.0	-33.7	43.28	2.72	45.99	23.00	51.43
44.0	-35.7	48.25	2.09	50.33	25.17	54.51
46.0	-37.7	50.82	1.64	52.46	26.23	55.73
48.0	-39.7	52.96	1.64	54.60	27.30	57.87
50.0	-41.7	55.11	1.80	56.91	28.46	60.52
52.0	-43.7	57.72	1.84	59.56	29.78	63.23
54.0	-45.7	61.10	3.56	64.65	32.33	71.76
56.0	-47.7	66.66	8.26	74.92	37.46	91.44
58.0	-49.7	73.45	14.06	87.51	43.76	115.63
60.0	-51.7	79.73	25.91	105.64	52.82	157.45
62.0	-53.7	82.43	28.09	110.52	55.26	166.71

*** ERROR *** PILE TIP TOO NEAR END OF BORING LOG FOR LENGTH = 64.00 FT


Pto nuevo Siphon
Project No:
Boring No: CB-PNM-44 & -44D
Engineer: PMS & FCT
Station No: 99 +04
Pile Size: 12 in.
Elevation - Feet
0
-10
-20
-30
-40
-50
-60
0
50
100
150
200
250
Ultimate Skin Friction
Est. Davisson Cap.
Ultimate Cap.
Mobilized End Bearing
Allowed Cap.

L-13-9

Project No: Pto nuevo Siphon
Boring No: CB-PNM-44 & -44D

C. PILE INFORMATION

TEST PILE SECTION ISECT = 2
{concrete pile, round section}

DIAMETER OF PILE WP = 12.00 INCHES

D. PILE CAPACITY VS. PENETRATION

TEST PILE LENGTH (FT)	PILE TIP ELEV (FT)	ULTIMATE SIDE FRICTION (TONS)	MOBILIZED END BEARING (TONS)	ESTIMATED DAVISSON CAPACITY (TONS)	ALLOWABLE PILE CAPACITY (TONS)	ULTIMATE PILE CAPACITY (TONS)
10.0	-1.7	.00	.00	.00	.00	.00
12.0	-3.7	.00	.00	.00	.00	.00
14.0	-5.7	.00	.00	.00	.00	.00
16.0	-7.7	.58	.00	.58	.29	.58
18.0	-9.7	3.31	1.11	4.41	2.21	6.63
20.0	-11.7	6.23	1.54	7.77	3.89	10.86
22.0	-13.7	9.53	1.73	11.26	5.63	14.73
24.0	-15.7	13.38	2.40	15.78	7.89	20.58
26.0	-17.7	16.14	2.93	19.07	9.53	24.92
28.0	-19.7	19.51	2.90	22.41	11.21	28.22
30.0	-21.7	21.84	2.65	24.48	12.24	29.78
32.0	-23.7	24.51	2.00	26.51	13.26	30.52
34.0	-25.7	27.82	2.90	30.72	15.36	36.53
36.0	-27.7	32.50	3.74	36.24	18.12	43.72
38.0	-29.7	39.48	3.70	43.18	21.59	50.59
40.0	-31.7	46.13	3.82	49.95	24.97	57.58
42.0	-33.7	51.73	3.61	55.34	27.67	62.57
44.0	-35.7	57.69	3.02	60.71	30.36	66.75
46.0	-37.7	60.79	2.51	63.30	31.65	68.31
48.0	-39.7	63.38	2.58	65.95	32.98	71.11
50.0	-41.7	65.96	2.78	68.74	34.37	74.29
52.0	-43.7	69.26	2.80	72.06	36.03	77.65
54.0	-45.7	73.13	5.43	78.56	39.28	89.43
56.0	-47.7	79.50	13.37	92.86	46.43	119.60
58.0	-49.7	88.29	21.46	109.75	54.87	152.66
60.0	-51.7	95.67	36.06	131.73	65.87	203.85
62.0	-53.7	98.95	38.29	137.24	68.62	213.81

*** ERROR *** PILE TIP TOO NEAR END OF BORING LOG FOR LENGTH = 64.00 FT

B-13-8

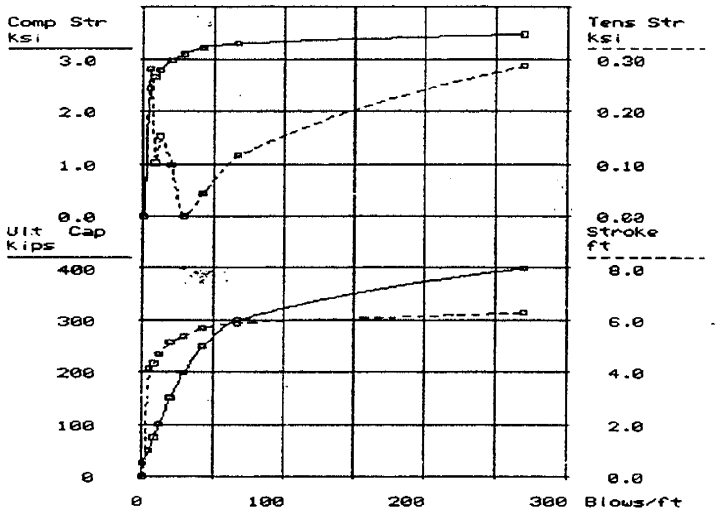
Pto. Nuevo Siphon 12" 45ft
Professor F.C. Townsend

06/25/97
GRLWEAP(TM) Version 1997-1

No.	Ultimate Capacity kips	Max C. Stress ksi	Max T. Stress ksi	Blow Count BPF	Stroke ft	Energy k-ft
1	25.0	.000	.000	-1.0	.00	.00
2	50.0	2.453	.283	4.8	4.16	19.80
3	75.0	2.650	.102	8.2	4.35	16.61
4	100.0	2.801	.153	12.4	4.70	15.35
5	150.0	2.988	.099	20.4	5.15	14.08
6	200.0	3.108	.000	29.5	5.37	13.49
7	250.0	3.236	.045	42.6	5.70	13.59
8	300.0	3.307	.116	67.5	5.87	13.32
9	400.0	3.480	.287	270.4	6.27	13.24

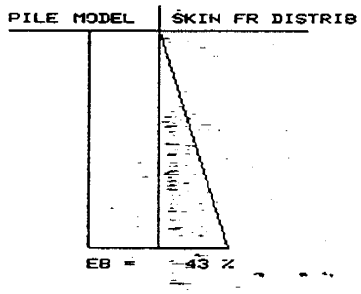
Professor F.C. Townsend
Pto. Nuevo Siphon 12" 45ft

GRLWEAP(TM) Version 1997-1
06/25/97



KOBE K 25

Efficiency	0.800	
Helmet	1.55	Kips
H Cushion	17486	K/in
P Cushion	566	K/in
Q Skin =	0.100	in
Q Toe =	0.100	in
J Skin =	0.200	s/ft
J Toe =	0.150	s/ft
Pile Length	65.00	ft
P-Top Area	113.10	in2



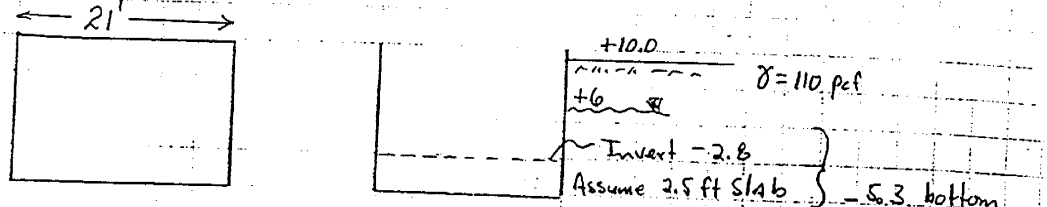
Pto nuevo siphon L=65ft. 12"diam sta 99 No Splice

B-13-9

PROJECT: Margarita Siphon Sta 66+29 | Page 1 of ___ | COMPUTED BY: RCT | DATE: 6/6
SUBJECT: | CHECKED BY: | DATE:

1. Applied load (including roof) = 289.5^T (unfactored)

2. Plan



3. Rough check of Applied Stress

∇_f = 289.5^T / (14×21) = 0.98 tsf

must consider Shallow fdn

4. Using Soil Boring CB-MC-43 CB-MC-44 (Lab)

Elev

-1.4 ~ Fill $\bar{N}$ = 5

Soft CH
$\bar{N}$ ≈ 8.8 blows

-17.9

Smd SC
$\bar{N}$ = 11.5

-22.4

Clay CH stiff
$\bar{N}$ = 16.8

-32.9

stiff Clay
$\bar{N}$ = 50

-37.4

+1.9 LL = 66%

-6.5' TX1 e_o = 1.185 LL = 99%
DS e_o = 1.12
Consolid e_o = 1.076
P_c ≈ 1 tsf
C_c = 0.183 Very flat for LL = 99%
C_r = 0.057

0.301

5. C_c or E_s Correlations (see Bowles 5th Ed P316)

A) $E_s \approx$ (100 to 500) S_u Clays $S_u/P_a = 0.06N$ $P_a \approx$ 1 tsf

B) E_s (kPa) = 250(N+15) 100 kPa ≈ 1 tsf

6. Soil model used in UniSettl

Elevs

-1.4 to -17.9 C_c = 0.183, C_r = 0.057, P_c' = 1 tsf, 1.076 = e_o m = 26.092 & 83.768

-17.9 to -22.4 E_s = (250)(11.5+15) = 6,625 kPa ÷ 100 = 66.25 tsf = 1325 ksf

-22.4 to -32.9 S_u = 0.06(16.8) = 1.008 tsf; E_s = 300 S_u = 300 tsf

-32.9 to -37.4 S_u = 0.06(50) = 3 tsf; E_s = 400 S_u = 1200 tsf

7. OCR: P_c from Lab = 1 tsf, but excavation (110)(6) + (110-62.4)(6-(-5.3)) = 1198 psf

Center of clay layer σ_o' = 1198 + (110.5/2)[90-62.4] = 1425.6 psf

So OCR = 1425.6 / [1425.6 - 1198] = 6.26 [use 3 to be V. Conservative]

8. UniSettl - Settlement 2.2" or 1.9" (Alt)

SAJ Form 1000
14 Mar 78

B-13-10

PROJECT			
Margarita Siphon Sta 66+29 (Continued)	Page 2 of —	COMPUTED BY FCT	DATE 6/20/97
SUBJECT		CHECKED BY	DATE

9. Retry Unisettl, but excavate 5' & replace w/gravel → Case #2

Elev

+10 to −1.4 Fill $\gamma = 90$ $S_u = 0.06(s) = .3$ tsf $E_s = 100 S_u = 30$ tsf $= 60$ ksf

−1.4 to −5.3 Soft CH $\gamma = 90$ $C_c = 0.183$ $C_r = 0.057$ $C_0 = 1.076$ $P_c = 1$ ksf OCR = 3

Same −5.3 to −10.3 Gravel Backfill $\gamma = 120$ pcf $J = 1.0$ Use $M \approx 100$

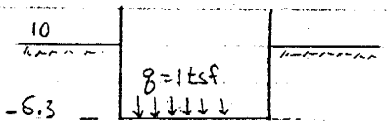
E_s gravel Assume $N \approx 20$ $E_s = 250(20+15) = 8750$ kPa $\div 50 = 175$ ksf

−10.3 to −17.9 Soft CH $\gamma = 90$ Same as

−17.9 to 22.4 $E_s = 132.5$ ksf

10. Using 5' of Backfill has a settlement of 1.5"

11. Rough Check of Unisettl (Case #1, no gravel Backfill)



$\bar{N} = 8.8$ $S_u = 0.06(8.8) = 0.53$ tsf $E_s = 200 S_u = 105.6$ tsf ≈ 210 ksf

−17.9 $E_s \approx 132.5$ ksf

−22.4 $E_s \approx 600$ ksf

−32.9 $E_s \approx 2400$ ksf

−37.4

$E_{s\,Ave} = \dfrac{2646 + 596 + 6300 + 10,800}{12.6 + 4.5 + 10.4 + 4.5} = \dfrac{20,342}{32} = 635.7$ ksf

$F_1 = 0.48$ $F_2 = 0.048 \rightarrow 0.4966$

$\Delta H = \dfrac{(2\text{ ksf})(14)(1-0.4^2)(4)(.4966)}{635.6\text{ ksf}} = 0.07\text{ft} \times 12 = 0.88"$ vs 2" So-so agreement

Depth	thickness	E_s ksf	E_s/m_v	$I_{6.3}$ = 1.11 $I_{10.5/6.3}$ = 1.617	ΔH
−17.9	12.6	210	450	②.2037	0.0456
−22.4	4.5	132.5	284	0.0996	0.0126
−32.9	10.4	600	1286	0.0658	0.0036
−37.4	4.5	2400	5143	0.0345	0.0005

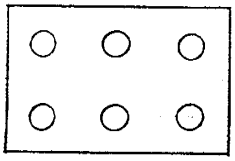
$\Sigma = 0.0623 \times 12" = 0.75"$

$E_s = 1/m_v = \dfrac{(1-u)E_s}{(1+u)(1-2u)} = \dfrac{(1-0.4)E_s}{(1.4)(1-0.8)} = 2.14\,E_s$ $\Delta H = \left[(2\text{ksf})(4)(I)/E_s\right]H$

12. Unisettl has higher settlement → but I believe!

PROJECT		Page 3 of —	COMPUTED BY	DATE
Margarita Siphon Sta 66+29			FCT	6/23/97
SUBJECT			CHECKED BY	DATE
Pile Fdns				

13. Since shallow fdn has anticipated (NO FS) 1.5" to 2.0" settlement - Design for
A) 14" □ PSC & B) 14" H pile Fdn



Run SPT94 CB-MC-43 : Marg14.DAT MargH.DAT

Ground surface = 10.6ft & invert = -5.3 so Soil Type = 5 til depth 15.9ft

A) Design load ÷ # Piles = Cap/pile
300^T ÷ 6 = 50^T/pile Allowable
SPT94 L @ El -19.4ft Lpile = -19.4-(-5.3) = 14.1 ft

Note: SPT94 is conservative in Soil Type 1 (clays)

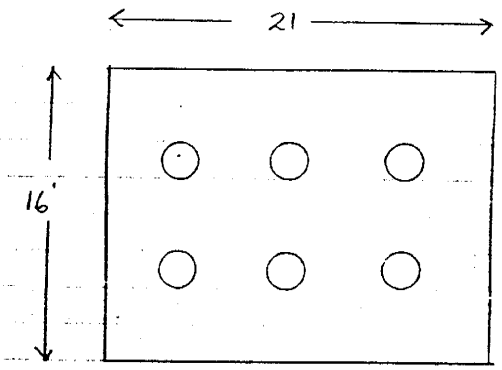
Pile Type	EL for 50^T	Pile Length	Cost, total	File	
14 □ psc	-19.4	14.1		Marg14	
14x73 H	-29.4	24.1	#3694 + install	Marg1473	
12x53 H	-33.4	28.1	#3127 + install	Marg1253	
10" ⊙	-33.4	28.1	#2,866	Marg10	2nd Choice
12" ⊙	-25.4	20.1	#2291	Marg10	1st choice

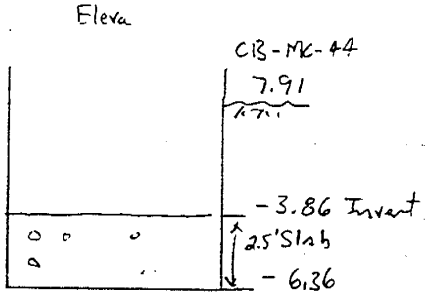
Cost estimate (C. Torres from Fuentes-Santiago)
Round 10" = $17/LF , Round 12" = $19/ft H Piles: 1253, 1473, 1469, 1057 = Steel @ $1.35/lb + installation

14x73: (73)(.35)(24.1)(6 piles) =

PROJECT	Page 4 of —	COMPUTED BY	DATE
Puerto Nuevo Siphon Sta 99+04		FCT	6/30/97
SUBJECT		CHECKED BY	DATE

1. Unfactored Design Load including roof = 335.8^T
2. Use Boring CB-MC-44
3. Profile & Elevs



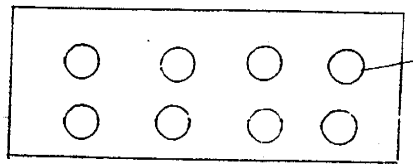


4. Previous Analyses Suggest 10" ⓞ or 12" ⓞ piles - best design
   ↑ PIN 10.DAT

5. Using 6 pile design Load/pile = 336/6 = 56^T
   8 pile design Load/pile = 336/8 = 42^T

Pile	L for 56^T	Cost	L for 42^T	Cost
10" ⓞ	~~-51.7~~	50'X $5100	-49.7, 45'	6120
12" ⓞ	-50	45'X $5150	-46.7 (use 45')	$6840

Use 6 piles - 12" ⓞ 45' long



6" S

Length
10, 15, 20, 25'

6. Assumed and Piles are SOLID. Manf lengths are 10', 15', 20' & 25' segments

7. Drivenability Kobe 25

$S_{apt} = 0.7 f_c - 0.75 f_{pe}$ (f_{pe} = 0) $= 0.7(5\text{ksi}) = 3.5\text{ksi}$

$S_{apt\ L>50} = 3.25\sqrt{f_c} + 1.05 f_{pe}$ (f_{pe} = 0) $= 3.25\sqrt{5000} = 230\text{psi} \div 1000 = 0.23\text{ksi}$

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

APPENDIX C

STRUCTURAL COMPUTATIONS

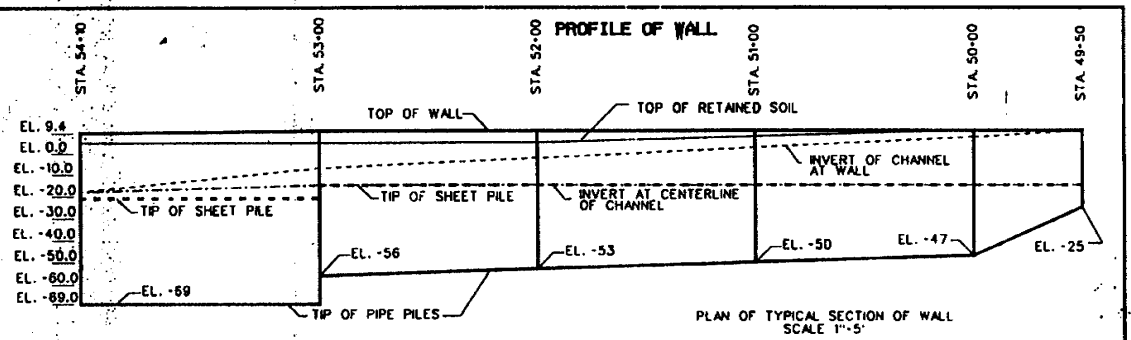
APPENDIX C-1

SAMPLE CALCULATIONS
RETAINING WALL ALONG DE DIEGO EXPRESSWAY
AT MARGARITA STATION M49+50 TO M54+10

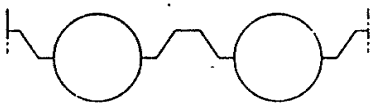
NOTES:
1. SEE PLATE S-XXX FOR PLAN VEIW OF THE WALL
2. ALL OF THE UNDRAINED (Q) LOAD CASES INCLUDED A WATER FILLED CRACK NEXT TO THE SHEET PILE FROM THE GROUND SURFACE TO A DEPTH EQUAL TO Dc=2(C)/GAMMA.
3. EN-GS DID NOT EVALUATE THIS STATION BECAUSE THE STABILITY REQUIRED PENETRATION INTO THE LIMESTONE LAYER, THEREFORE, THE DEEP SEATED STABILITY DID NOT CONTROL.

EN-GS REQUIRED PILE TIP ELEVATIONS		
STATION	PIPE PILES	SHEET PILES
54+10	SEE NOTE 3	-21
53+00	-43	-15
52+00	-37	-15
51+00	-28	-15
50+00	-25	-15

PROFILE OF WALL

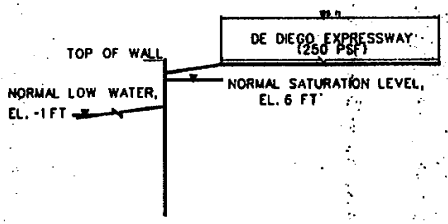


PLAN OF TYPICAL SECTION OF WALL
SCALE 1"=5'

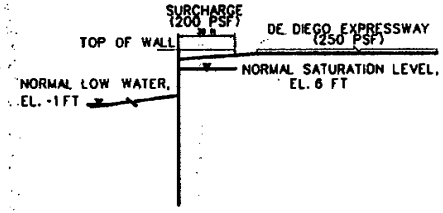


LOAD CASES:

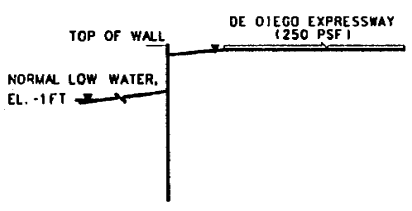
LOAD CASE 1:
USUAL LOAD CASE
NORMAL SATURATION LEVEL
NORMAL LOW WATER
DRAINED SOIL CONDITIONS (S)



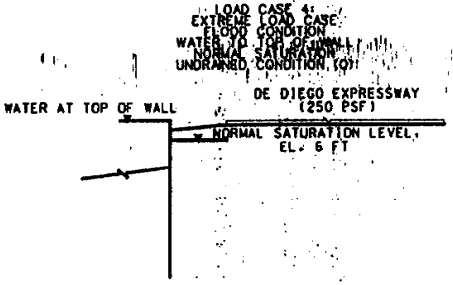
LOAD CASE 2:
UNUSUAL LOAD CASE
CONSTRUCTION LOAD
NORMAL SATURATION LEVEL
200 PSF SURCHARGE
UNDRAINED SOIL CONDITION (Q)



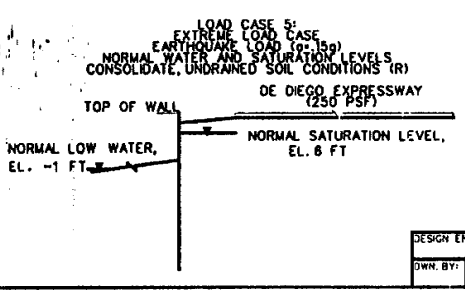
LOAD CASE 3:
EXTREME LOAD CASE
POST FLOOD CONDITION
WATER HAS BEEN TO TOP OF WALL AND HAS SATURATED THE SOIL
FLOOD WATERS HAVE SUBSIDED IN CHANNEL
UNDRAINED SOIL CONDITIONS (Q) (3B: S)



LOAD CASE 4:
EXTREME LOAD CASE
FLOOD CONDITION
WATER TO TOP OF WALL
NORMAL SATURATION
UNDRAINED CONDITION (Q)



LOAD CASE 5:
EXTREME LOAD CASE
EARTHQUAKE LOAD (a=.15g)
NORMAL WATER AND SATURATION LEVELS
CONSOLIDATE, UNDRAINED SOIL CONDITIONS (R)



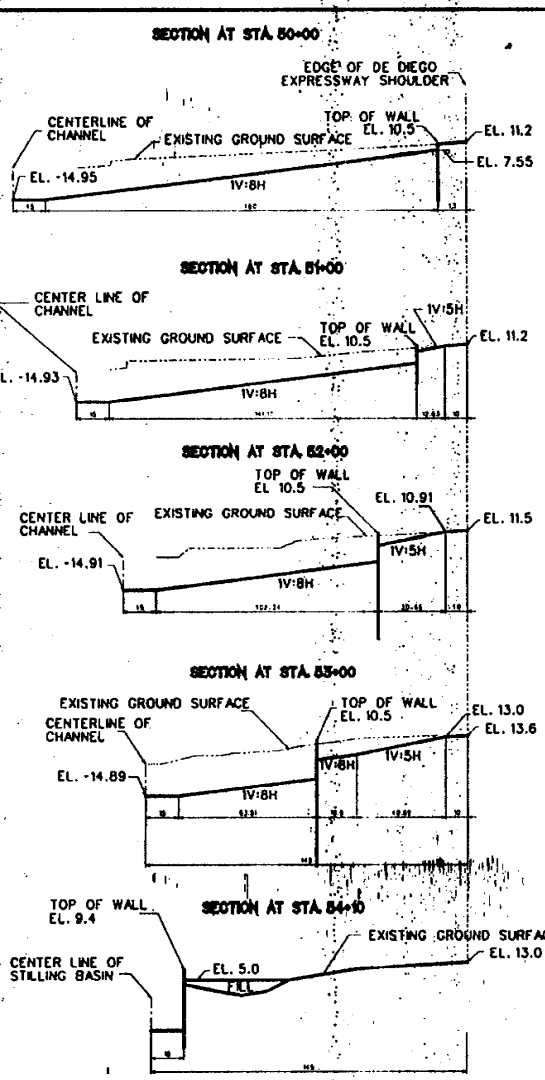
50 25 0 50 100FT
SCALE: 1"= 50'

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2
MARGARITA CHANNEL
DE DIEGO EXPRESSWAY WALL
ELEVATION, SECTIONS, LOADING CONDITIONS
STRUCTURAL
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
O.O. FILE NO. 101-36,XXX NOVEMBER 1997

DESIGN ENG.:
DWN. BY: CKD. BY:

PLATE

C-1-1



SUMMARY OF ANALYSIS RESULTS						
	LOAD CASE AND SOIL CONDITION					
STATION	1 S	2 Q	3 Q	3B S	4 Q	5 R
	PIPE PILE TIP ELEVATION (FT)					
50+00	-46.2	-16.2	-16.2	-46.2	-26.2	-37.4
51+00	-49.9	-26.2	-37.8	-49.9	-42.8	-41.6
52+00	-52.8	-34.5	-47.8	-52.8	-42.8	-42.8
53+00	-55.3	-47.8	-48.7	-55.3	-47.0	-47.8
54+10	-68.9	-59.8	-66.4	-68.1	-58.9	-63.1
	MAXIMUM BENDING MOMENT (IN LBS)					
50+00	5,607,000	159,200	159,200	9,277,000	-808,700	2,118,000
51+00	7,567,000	576,300	3,603,000	7,828,000	-6,938,000	7,265,000
52+00	7,650,000	1,609,000	11,940,000	7,636,000	-5,457,000	5,272,000
53+00	10,340,000	8,922,000	11,560,000	12,510,000	7,344,000	12,450,000
54+10	25,810,000	15,900,000	29,940,000	26,520,000	-13,330,000	44,180,000
	MAXIMUM DEFLECTION (INCHES)					
50+00	1.9	0.1	.1	3.3	-1.5	0.5
51+00	3.2	0.1	1.0	3.3	-2.1	2.0
52+00	3.5	0.4	4.7	3.5	-1.7	1.5
53+00	5.3	3.5	4.9	6.6	-2.7	4.4
54+10	5.1	2.7	6.3	5.3	-2.2	6.8
	REQUIRED SECTION MODULUS (IN^3)					
50+00	249	5	4	236	21	54
51+00	336	19	92	199	176	185
52+00	340	54	303	194	139	134
53+00	460	298	294	318	187	316
54+10	1147	531	760	673	339	1122

NOTES:

1. THE SOIL PROPERTIES WERE PROVIDED BY EN-GS AND WERE BASED ON BORINGS MC-30, MC-32, MC-33, MC-52 AND MC-34.
2. THE REQUIRED SECTION MODULUS IS BASED ON THE CONTROLLING MAXIMUM MOMENTS AND ALLOWABLE STRESSES EQUAL TO 0.5Fy FOR USUAL LOADS, 0.665Fy FOR UNUSUAL LOADS AND 0.875Fy FOR EXTREME LOADS.

50 25 0 50 100FT

SCALE: 1" = 50'

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA CHANNEL

DE DIEGO EXPRESSWAY WALL
ELEVATION, SECTIONS, LOADING CONDITIONS

STRUCTURAL

DEPARTMENT OF THE ARMY

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS

D.O. FILE NO. 101-36,XXX NOVEMBER 1997

DESIGN ENG.:	
DWN. BY:	CKD. BY:

PLATE

2-1-2

	$f_{ALLOWABLE}$
USUAL	.5 F_y
UNUSUAL	.665 F_y
EXTREME	.875 F_y

STA 53+000

LAYOUT 2 – FY=45 KSI – ASTM 252 GRADE 3

LOAD CONDITION	LOAD CASE		PILE SIZE	TIP EL. (FT.)	MAXIMUM MOMENT (IN LBS)	MAXIMUM DEFLECTION (IN)	REQUIRED SECTION MODULUS (IN^3) $\frac{M}{F_{allowable}}$	AVAILABLE SECTION MODULUS (IN^3)	
USUAL	1	S	36"/AZ18	-55.3	10,340 000	5.3	460	488	
UNUSUAL	2	Q	36"/AZ18	-47.8	8,922,000	3.5	298	488	
EXTREME	3	Q	36"/AZ18	-48.7	11,560,000	4.9	294	488	
EXTREME	3B	S	36"/AZ18	-55.3	12,510 000	6.6	318	488	
EXTREME	4	Q	36"/AZ 18	-47.0	7,344,000	-2.7	187	488	
EXTREME	5	80%R	36"/AZ 18	-47.8	12, 450,000	4.4	316	488	OK

C-1-3

PROJECT: RIO PUERTO NUEVO

SUBJECT: MARGARITA CHANNNEL – SUMMARY OF PILE ANALYSIS

PAGE -- OF --

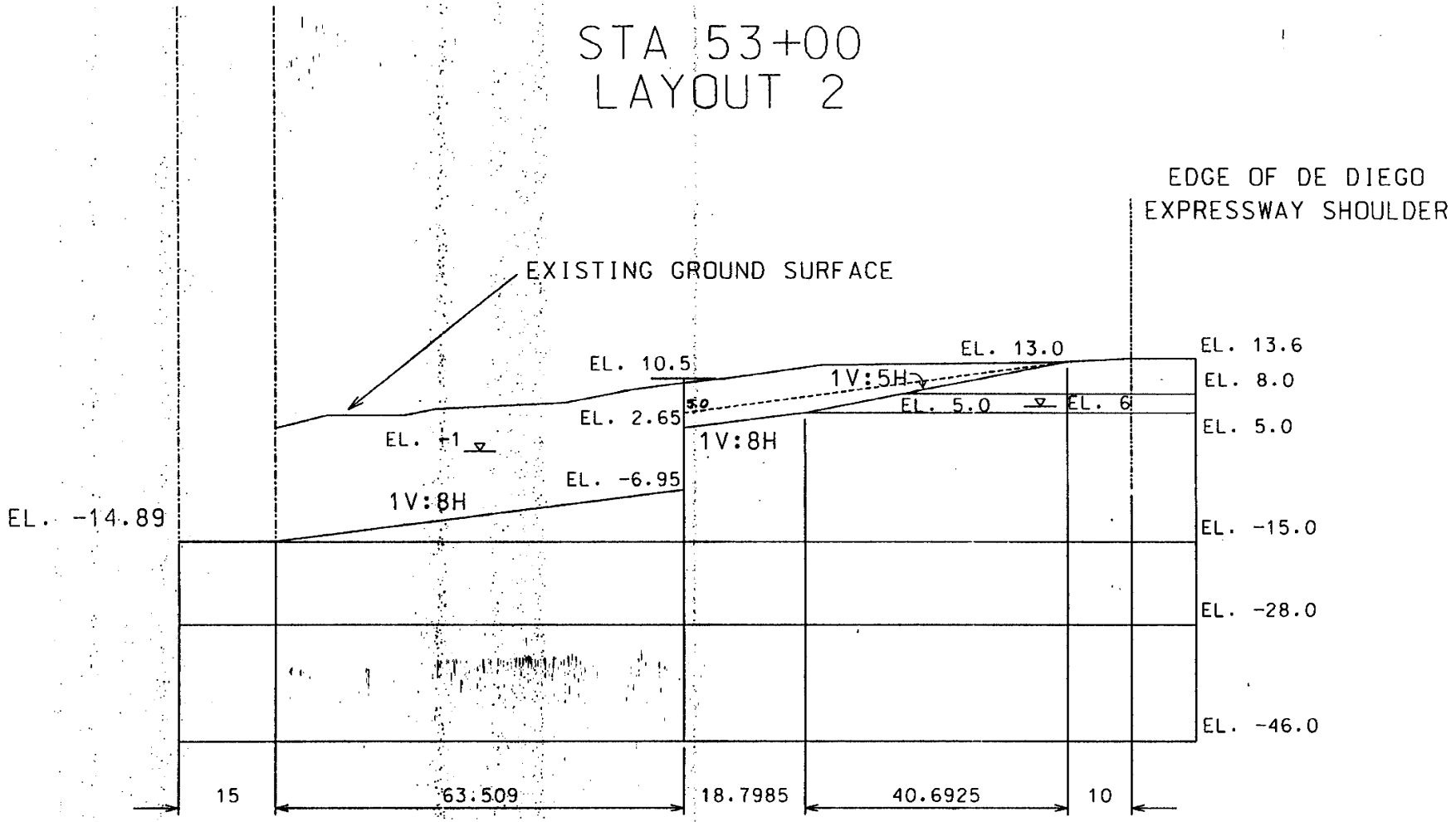
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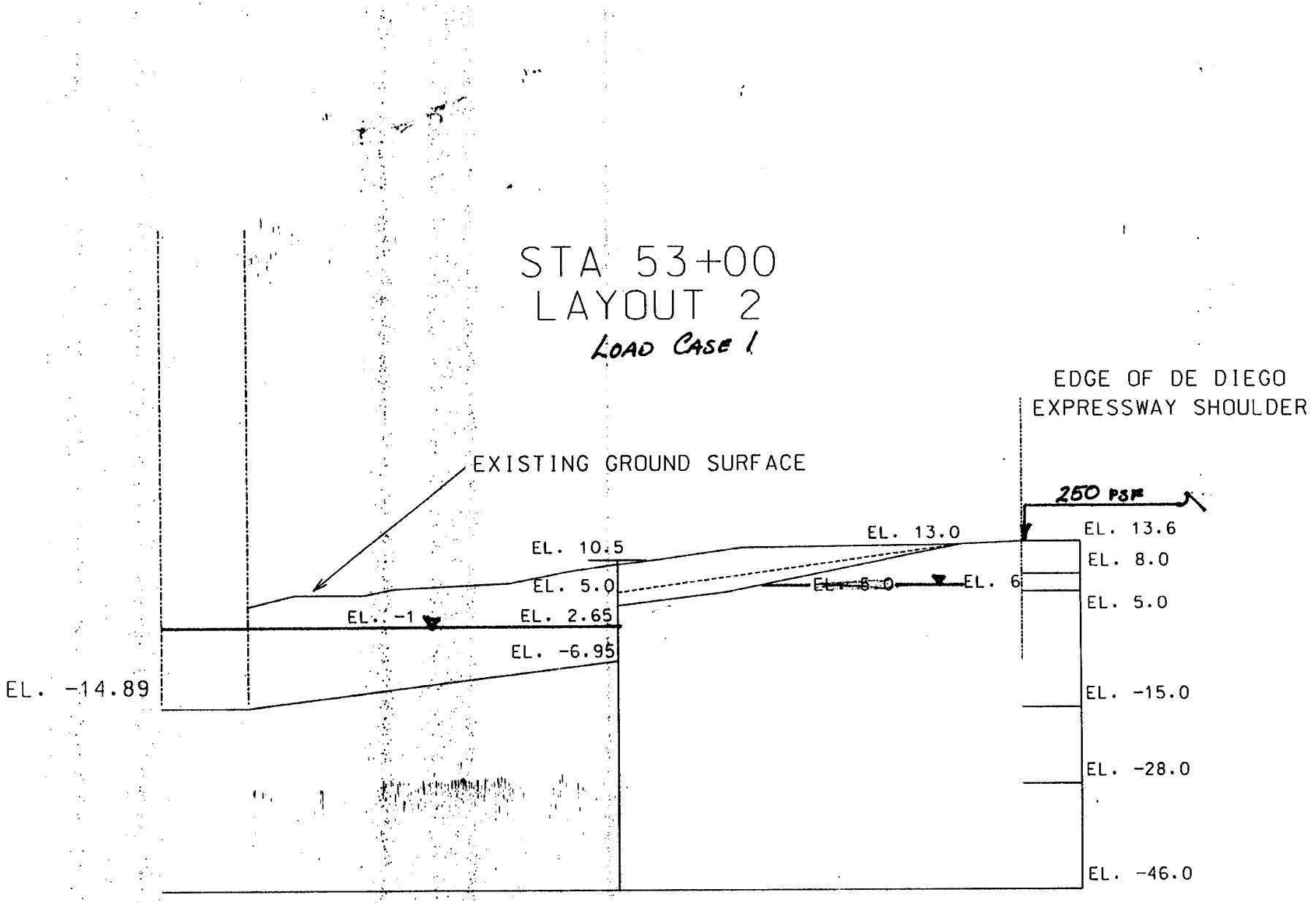
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DATE: AUG 97

DATE:

STA 53+00
LAYOUT 2



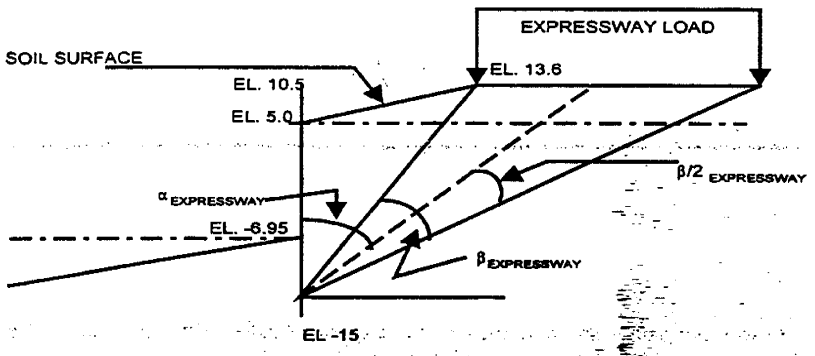

STA 53+00
LAYOUT 2
LOAD CASE 1
EDGE OF DE DIEGO
EXPRESSWAY SHOULDER
EXISTING GROUND SURFACE
250 PSF
EL. 13.6
EL. 8.0
EL. 5.0
EL. 13.0
EL. 10.5
EL. 5.0
EL. 6.0
EL. 6
EL. -1
EL. 2.65
EL. -6.95
EL. -14.89
EL. -15.0
EL. -28.0
EL. -46.0

STA 53+00 - LOAD CASE 1

CALCULATE THE SOIL PRESSURE ON THE SHEET PILES - FROM TOP OF WALL TO THE SHEET PILE TIP AT EL -15.0.

ASSUMPTIONS:

1. FULL ACTIVE PRESSURE ON THE RETAINED SOIL SIDE
2. FULL AT REST PRESSURES ON THE CHANNEL SIDE FROM THE DREDGE LINE TO THE PILE TIP. THE SLOPE IS IGNORED. THIS IS CONSIDERED OK SINCE WE KNOW THAT THE ACTUAL PRESSURES ARE BETWEEN AT REST AND FULL PASSIVE AND WE ARE ASSUMING AT REST WHICH IS CONSERVATIVE WHEN USED TO DETERMINE THE NET RIGHT SIDE PRESSURES TO APPLY TO THE MASTER PILE.
4. THIS LOAD CASE IS AN S-CASE; THEREFORE, C=0
5. K_O IS BASED ON COULOMB'S EQ. FOR Ka, WITH A STRENGTH MOBILIZATION FACTOR=2/3, EM 1110-2-2502, P.3-17
6. THE SLOPING RETAINED SOIL IS ACCOUNTED FOR BY INCLUDING THE FILL ANGLE IN THE CALCULATION FOR K_a.
7. K_a INCLUDES THE EFFECT OF WALL FRICTION AND A SLOPING FILL THAT CONTINUES INFINITELY (EQ. 16, EBELING, ITL-92-11)



THIS LOAD CASE HAS THE SATURATION LEVEL TO EL. 6 AND THE HYDROSTATIC LOAD TO EL. 5. THIS ASSUMES THAT THE WATER FROM THE GROUND WATER WILL BE DRAINED TO EL. 5 BY THE DRAINS AT THE ADJACENT STILLING BASIN.

DISTANCE TO EXPRESSWAY	69.491 FT
EXPRESSWAY SURCHARGE	250 PSF
WIDTH OF EXPRESSWAY=	125 FT
TOP OF SLOPE EL=	13.6 FT
TOP OF WALL EL=	10.5 FT
DREDGE LINE EL =	-6.95 FT
TOP OF SOIL EL=	5 FT
RIGHT SIDE WATER EL=	5 FT
RIGHT SIDE SATURATION EL	6 FT
WATER SURFACE EL. =	-1 FT

ANGLE OF BACKFILL=	7.05 DEGREES
ANGLE OF CHANNEL=	-7.13 DEGREES
ANGLE OF WALL FROM VERTICAL=	0 DEGREES
DENSITY OF WATER =	62.5 PCF

RIO PUERTO NUEVO
MARGARITA CHANNEL

STA 53+00 -LOAD CASE 1

DAVID DOLLAR
8/13/97

SOIL DATA:

LAYER	TOP EL. FT	BOTTOM EL FT	Φ DEGREES	C PSF	γSAT PCF	γMOIST PCF	δ DEGREES	KA	KP	K0
1	13.6	8	26	600	115	110	12	0.39077346	2.76014147	0.536352179
2	8	5	24	550	100	95	12	0.42308095	2.52999557	0.569335109
3	5	BOTTOM	20	320	95	92	11	0.49789152	2.08557383	0.644777579

Φ_d
18.01
16.53
13.64

REQUIRED CALCULATIONS

ELEV	LAYER	γEFF	KA	RIGHT SIDE VERTICAL PRESSURE	LEFT SIDE VERTICAL PRESSURE	ANGLE TO CENTER OF EXPRESSWAY α	ANGLE REPRESENTING WIDTH OF EXPRESSWAY β	K0	δ
10.5	1	110	0.3908	0.00	0.00	0.0000	0.0000	0.5364	12.0000
10	1	110	0.3908	0.00	0.00	0.0000	0.0000	0.5364	12.0000
9.5	1	110	0.3908	0.00	0.00	0.0000	0.0000	0.5364	12.0000
9	1	110	0.3908	0.00	0.00	0.0000	0.0000	0.5364	12.0000
8.5	1	110	0.3908	0.00	0.00	0.0000	0.0000	0.5364	12.0000
8	1	110	0.3908	0.00	0.00	0.0000	0.0000	0.5364	12.0000
7.5	2	95	0.4231	0.00	0.00	0.0000	0.0000	0.5693	12.0000
7	2	95	0.4231	0.00	0.00	0.0000	0.0000	0.5693	12.0000
6.5	2	95	0.4231	0.00	0.00	0.0000	0.0000	0.5693	12.0000
6	2	95	0.4231	0.00	0.00	0.0000	0.0000	0.5693	12.0000
5.5	2	100	0.4231	0.00	0.00	0.0000	0.0000	0.5693	12.0000
5	2	37.5	0.4231	0.00	0.00	1.5057	0.0000	0.5693	12.0000
4.5	3	32.5	0.4979	16.25	0.00	1.5020	0.0046	0.6448	11.0000
4	3	32.5	0.4979	32.50	0.00	1.4982	0.0092	0.6448	11.0000
3.5	3	32.5	0.4979	48.75	0.00	1.4944	0.0139	0.6448	11.0000
3	3	32.5	0.4979	65.00	0.00	1.4907	0.0185	0.6448	11.0000
2.5	3	32.5	0.4979	81.25	0.00	1.4869	0.0231	0.6448	11.0000
2	3	32.5	0.4979	97.50	0.00	1.4831	0.0277	0.6448	11.0000
1.5	3	32.5	0.4979	113.75	0.00	1.4794	0.0323	0.6448	11.0000
1	3	32.5	0.4979	130.00	0.00	1.4756	0.0369	0.6448	11.0000
0.5	3	32.5	0.4979	146.25	0.00	1.4719	0.0415	0.6448	11.0000
0	3	32.5	0.4979	162.50	0.00	1.4681	0.0461	0.6448	11.0000
-0.5	3	32.5	0.4979	178.75	0.00	1.4644	0.0507	0.6448	11.0000
-1	3	32.5	0.4979	195.00	0.00	1.4606	0.0553	0.6448	11.0000
-1.5	3	32.5	0.4979	211.25	0.00	1.4569	0.0599	0.6448	11.0000
-2	3	32.5	0.4979	227.50	0.00	1.4532	0.0644	0.6448	11.0000
-2.5	3	32.5	0.4979	243.75	0.00	1.4494	0.0690	0.6448	11.0000
-3	3	32.5	0.4979	260.00	0.00	1.4457	0.0735	0.6448	11.0000
-3.5	3	32.5	0.4979	276.25	0.00	1.4420	0.0780	0.6448	11.0000
-4	3	32.5	0.4979	292.50	0.00	1.4382	0.0826	0.6448	11.0000
-4.5	3	32.5	0.4979	308.75	0.00	1.4345	0.0871	0.6448	11.0000
-5	3	32.5	0.4979	325.00	0.00	1.4308	0.0916	0.6448	11.0000

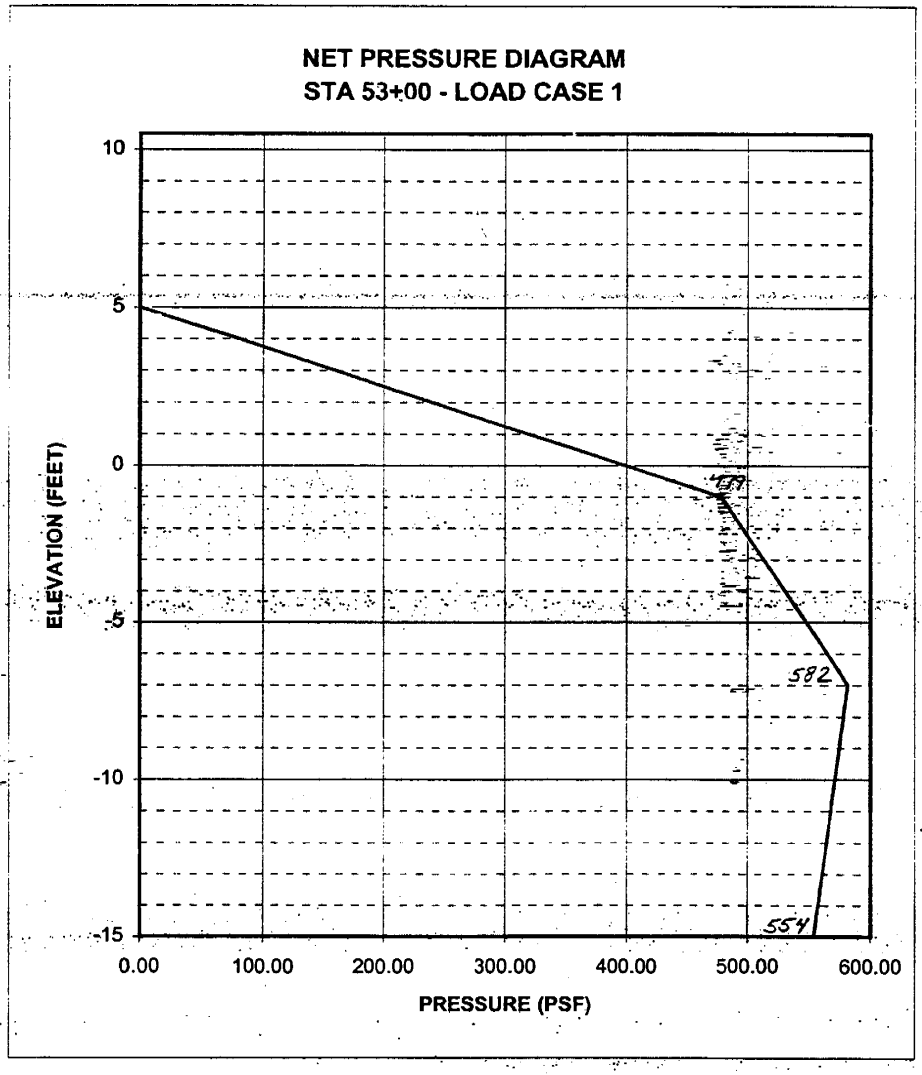
C-1-7

-5.5	3	32.5	0.4979	341.25	0.00	1.4271	0.0960	0.6448	11.0000
-6	3	32.5	0.4979	357.50	0.00	1.4234	0.1005	0.6448	11.0000
-6.5	3	32.5	0.4979	373.75	0.00	1.4197	0.1049	0.6448	11.0000
-7	3	32.5	0.4979	390.00	1.62	1.4160	0.1094	0.6448	11.0000
-7.5	3	32.5	0.4979	406.25	17.88	1.4123	0.1138	0.6448	11.0000
-8	3	32.5	0.4979	422.50	34.13	1.4086	0.1182	0.6448	11.0000
-8.5	3	32.5	0.4979	438.75	50.38	1.4049	0.1226	0.6448	11.0000
-9	3	32.5	0.4979	455.00	66.63	1.4012	0.1269	0.6448	11.0000
-9.5	3	32.5	0.4979	471.25	82.88	1.3975	0.1313	0.6448	11.0000
-10	3	32.5	0.4979	487.50	99.13	1.3939	0.1356	0.6448	11.0000
-10.5	3	32.5	0.4979	503.75	115.38	1.3902	0.1399	0.6448	11.0000
-11	3	32.5	0.4979	520.00	131.63	1.3865	0.1442	0.6448	11.0000
-11.5	3	32.5	0.4979	536.25	147.88	1.3829	0.1485	0.6448	11.0000
-12	3	32.5	0.4979	552.50	164.13	1.3792	0.1527	0.6448	11.0000
-12.5	3	32.5	0.4979	568.75	180.38	1.3756	0.1570	0.6448	11.0000
-13	3	32.5	0.4979	585.00	196.63	1.3719	0.1612	0.6448	11.0000
-13.5	3	32.5	0.4979	601.25	212.88	1.3683	0.1654	0.6448	11.0000
-14	3	32.5	0.4979	617.50	229.13	1.3647	0.1695	0.6448	11.0000
-14.5	3	32.5	0.4979	633.75	245.38	1.3610	0.1736	0.6448	11.0000
-15	3	32.5	0.4979	650.00	261.63	1.3574	0.1778	0.6448	11.0000

RESULTING HORIZONTAL PRESSURES

ELEV	HORIZONTAL PRESSURE FROM EXPRESSWAY	RIGHT SIDE SOIL PRESSURE	LEFT SIDE SOIL PRESSURE	RIGHT SIDE WATER PRESSURE	LEFT SIDE WATER PRESSURE	NET PRESSURE DIAGRAM
10.50	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	0.00	0.00	0.00
9.50	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	0.00	0.00	0.00
8.50	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	0.00	0.00	0.00
7.50	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	0.00	0.00	0.00
6.50	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	0.00	0.00	0.00
5.50	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00
4.50	0.73	7.94	0.00	31.25	0.00	39.92
4.00	1.46	15.88	0.00	62.50	0.00	79.85
3.50	2.19	23.83	0.00	93.75	0.00	119.77
3.00	2.92	31.77	0.00	125.00	0.00	159.69
2.50	3.65	39.71	0.00	156.25	0.00	199.61
2.00	4.38	47.65	0.00	187.50	0.00	239.53
1.50	5.10	55.59	0.00	218.75	0.00	279.45
1.00	5.82	63.54	0.00	250.00	0.00	319.36
0.50	6.54	71.48	0.00	281.25	0.00	359.27
0.00	7.26	79.42	0.00	312.50	0.00	399.18
-0.50	7.98	87.36	0.00	343.75	0.00	439.09
-1.00	8.69	95.31	0.00	375.00	0.00	479.00
-1.50	9.40	103.25	0.00	406.25	31.25	487.65
-2.00	10.11	111.19	0.00	437.50	62.50	496.30
-2.50	10.81	119.13	0.00	468.75	93.75	504.94
-3.00	11.51	127.07	0.00	500.00	125.00	513.59
-3.50	12.21	135.02	0.00	531.25	156.25	522.22
-4.00	12.90	142.96	0.00	562.50	187.50	530.86
-4.50	13.59	150.90	0.00	593.75	218.75	539.49
-5.00	14.28	158.84	0.00	625.00	250.00	548.12
-5.50	14.96	166.78	0.00	656.25	281.25	556.74
-6.00	15.64	174.73	0.00	687.50	312.50	565.36
-6.50	16.31	182.67	0.00	718.75	343.75	573.98
-7.00	16.98	190.61	1.03	750.00	375.00	581.56
-7.50	17.64	198.55	11.31	781.25	406.25	579.88
-8.00	18.30	206.49	21.60	812.50	437.50	578.20
-8.50	18.95	214.44	31.88	843.75	468.75	576.51
-9.00	19.60	222.38	42.17	875.00	500.00	574.81
-9.50	20.25	230.32	52.45	906.25	531.25	573.11
-10.00	20.89	238.26	62.74	937.50	562.50	571.41
-10.50	21.52	246.20	73.02	968.75	593.75	569.70

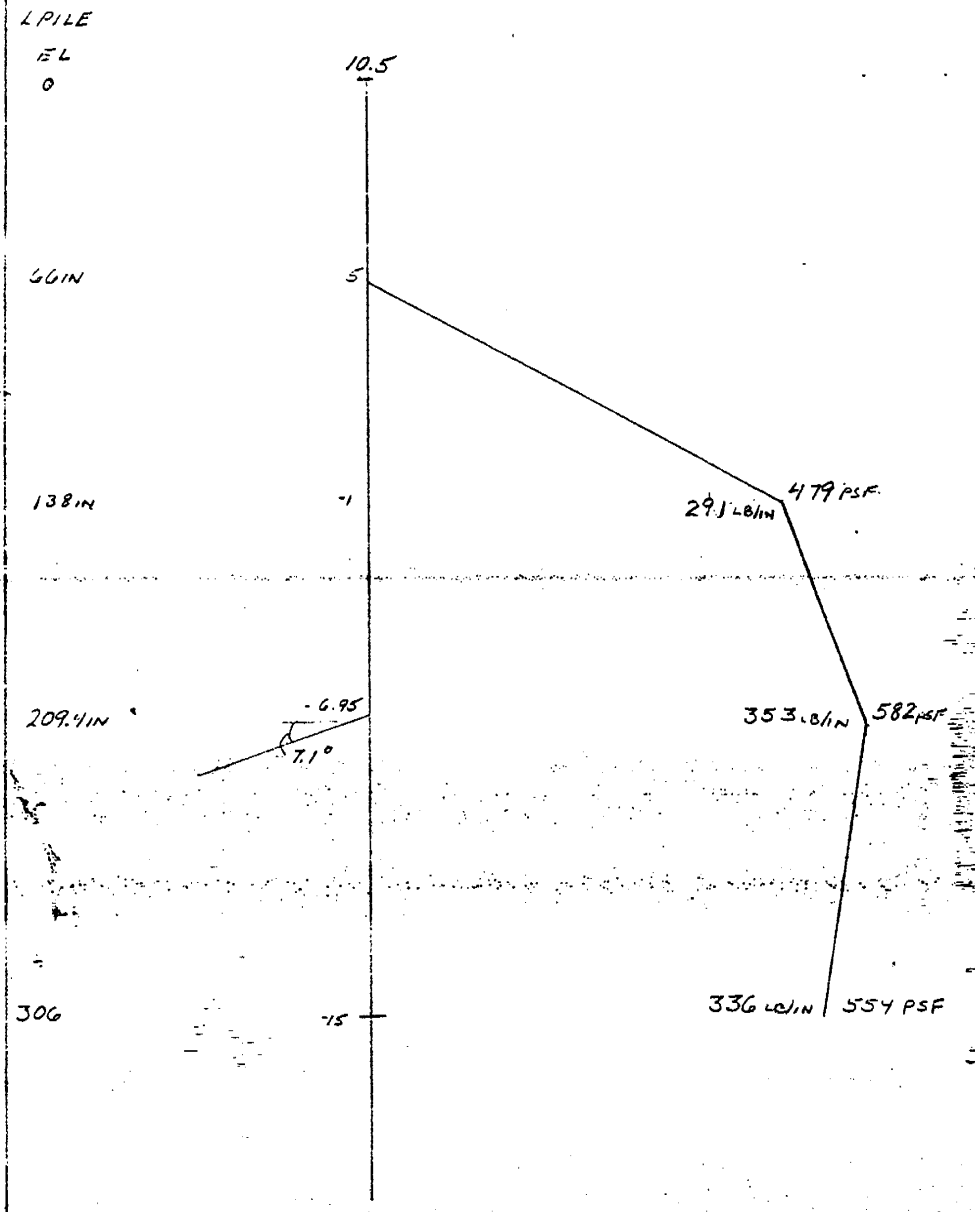
-11.00	22.15	254.15	83.31	1000.00	625.00	567.98
-11.50	22.77	262.09	93.59	1031.25	656.25	566.26
-12.00	23.38	270.03	103.88	1062.50	687.50	564.54
-12.50	23.99	277.97	114.16	1093.75	718.75	562.80
-13.00	24.60	285.92	124.45	1125.00	750.00	561.06
-13.50	25.20	293.86	134.74	1156.25	781.25	559.32
-14.00	25.79	301.80	145.02	1187.50	812.50	557.57
-14.50	26.38	309.74	155.31	1218.75	843.75	555.81
-15.00	26.96	317.68	165.59	1250.00	875.00	554.05



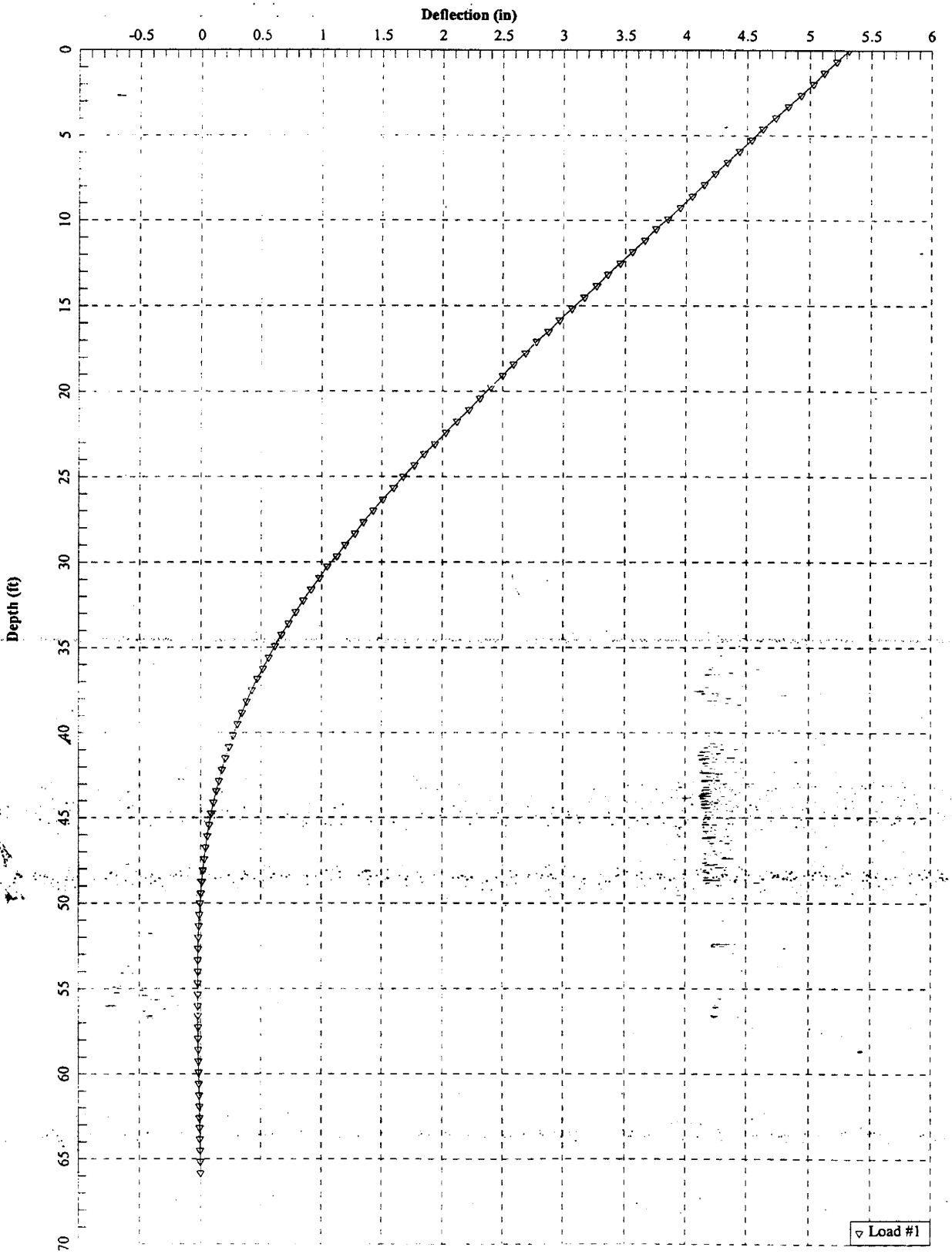
PROJECT	Page __ of __	COMPUTED BY	DATE
SUBJECT: STA 53+00 CALCULATION OF LOADS FOR LPILE.		CHECKED BY	DATE

LOAD CASE 1

FIRST TRY:
36"-DIA. W/ AZ18
SPACING = 87.34 IN.

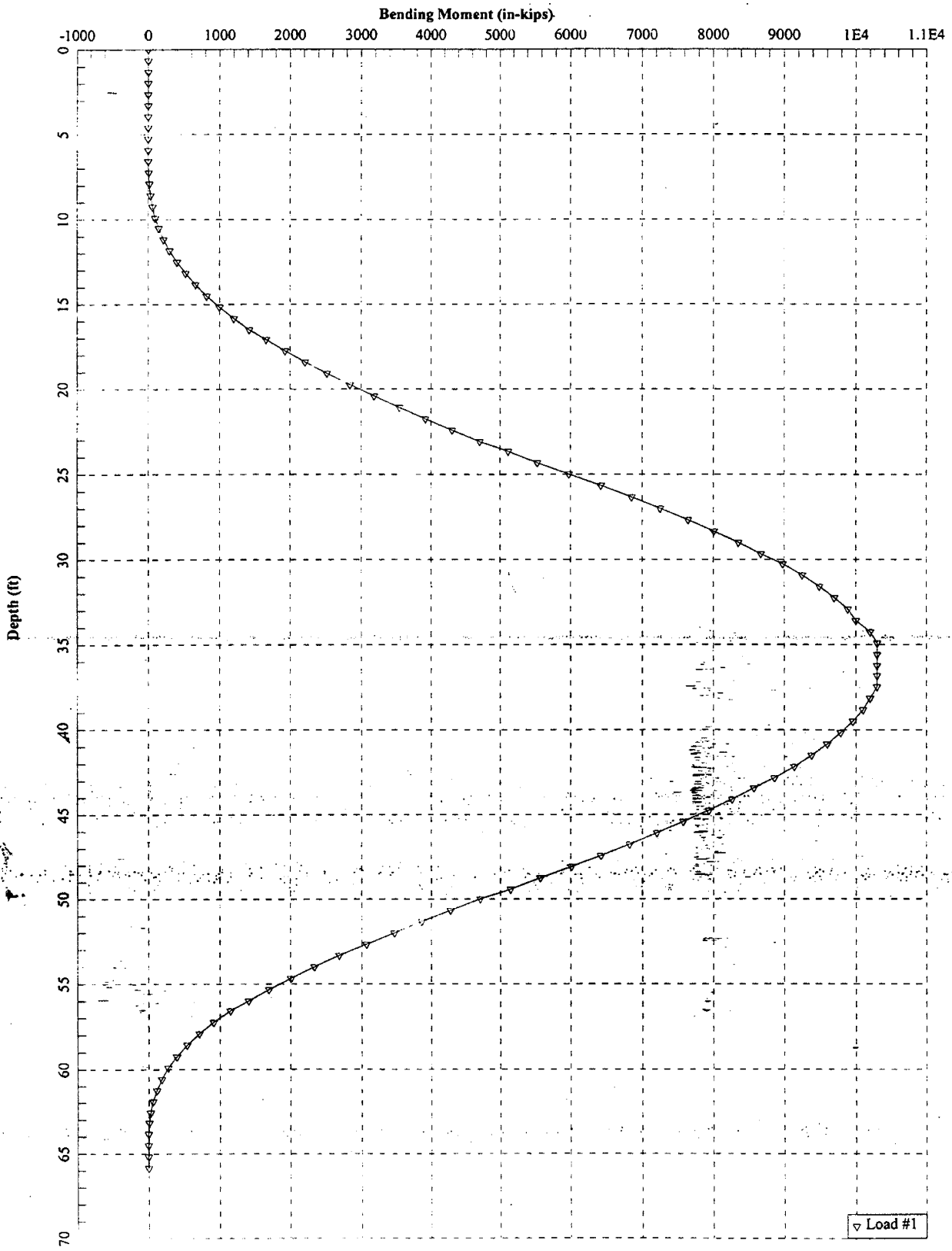


STA 53+00 LOAD CASE 1 - 36DIA/AZ18.5 .5"WALL THICKNESS - MAXIMUM MOMENT=10,340,000 IN LBS - MAXIMUM DEFL. 5.3 IN



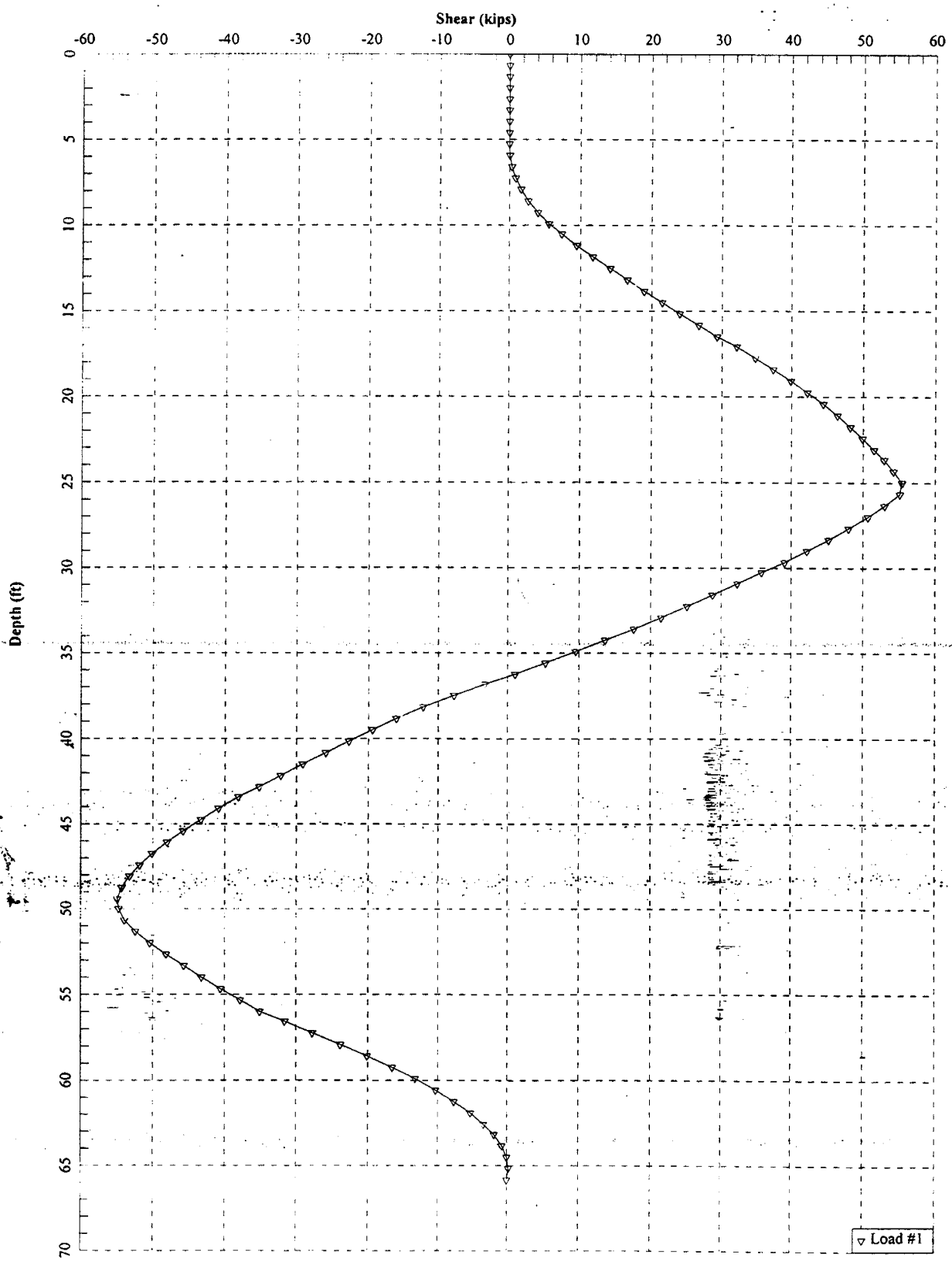
C-1-12

STA 53+00 LOAD CASE 1 - 36DIA/AZ18 .5"WALL THICKNESS - MAXIMUM MOMENT=10,340,000 IN LBS - MAXIMUM DEFL. 5.3 IN



C-1-13

STA 53+00 LOAD CASE 1 - 36DIA/AZ18 .5"WALL THICKNESS - MAXIMUM MOMENT=10,340,000 IN LBS - MAXIMUM DEFL. 5.3



C-1-14

Licensed to: David A. Dollar
CESAJ-EN-DS

PROGRAM LPILE plus Version 3.1
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DE DIEGO EXP. - Margarita - Sta 53 36/18 comb. - LOAD CASE 1 - LAYOUT 2

UNITS--ENGLISH UNITS

I N P U T I N F O R M A T I O N

THE LOADING IS STATIC

PILE GEOMETRY AND PROPERTIES

PILE LENGTH = 790.00 IN
4 POINTS

X	DIAMETER	MOMENT OF INERTIA	AREA	MODULUS OF ELASTICITY
IN	IN	IN**4	IN**2	LBS/IN**2
.00	36.000	.879E+04	.558E+02	.290E+08
209.40	36.000	.879E+04	.558E+02	.290E+08
209.50	36.000	.879E+04	.558E+02	.290E+08
846.00	36.000	.879E+04	.558E+02	.290E+08

SOILS INFORMATION

X AT THE GROUND SURFACE = 209.40 IN

SLOPE ANGLE AT THE GROUND SURFACE = 7.10 DEG.

4 LAYER(S) OF SOIL

LAYER 1
THE SOIL IS A SAND - P-Y CRITERIA BY REESE ET AL, 1974
X AT THE TOP OF THE LAYER = 209.40 IN
X AT THE BOTTOM OF THE LAYER = 306.00 IN
MODULUS OF SUBGRADE REACTION = .400E+02 LBS/IN**3

LAYER 2
THE SOIL IS A SAND - P-Y CRITERIA BY REESE ET AL, 1974
X AT THE TOP OF THE LAYER = 306.00 IN
X AT THE BOTTOM OF THE LAYER = 462.00 IN
MODULUS OF SUBGRADE REACTION = .600E+02 LBS/IN**3

LAYER 3
THE SOIL IS A SAND - P-Y CRITERIA BY REESE ET AL, 1974
X AT THE TOP OF THE LAYER = 462.00 IN
X AT THE BOTTOM OF THE LAYER = 678.00 IN
MODULUS OF SUBGRADE REACTION = .500E+02 LBS/IN**3

LAYER 4
THE SOIL IS A SAND - P-Y CRITERIA BY REESE ET AL, 1974
X AT THE TOP OF THE LAYER = 678.00 IN
X AT THE BOTTOM OF THE LAYER = 900.00 IN
MODULUS OF SUBGRADE REACTION = .100E+03 LBS/IN**3

DISTRIBUTION OF EFFECTIVE UNIT WEIGHT WITH DEPTH
8 POINTS

X,IN	WEIGHT,LBS/IN**3
209.40	.19E-01

306.00	.19E-01
306.10	.30E-01
462.00	.30E-01
462.10	.30E-01
678.00	.30E-01
678.10	.42E-01
1000.00	.42E-01

DISTRIBUTION OF STRENGTH PARAMETERS WITH DEPTH
8 POINTS

X,IN	C,LBS/IN**2	PHI,DEGREES	E50
209.40	.000E+00	.200E+02	-----
306.00	.000E+00	.200E+02	-----
306.10	.000E+00	.270E+02	-----
462.00	.000E+00	.270E+02	-----
462.10	.000E+00	.240E+02	-----
678.00	.000E+00	.240E+02	-----
678.10	.000E+00	.380E+02	-----
1000.00	.000E+00	.380E+02	-----

DISTRIBUTION OF P AND Y MULTIPLIERS VERSUS DEPTH
2 POINTS

X,IN	P-MULTIPLIER	Y-MULTIPLIER
209.40	.10E+01	.11E+01
1000.00	.10E+01	.11E+01

BOUNDARY AND LOADING CONDITIONS

DISTRIBUTED LOAD CURVE 5 POINTS

X,IN	LOAD,LBS/IN
66.00	.000E+00
138.00	.291E+03
209.40	.353E+03
306.00	.336E+03
306.10	.000E+00

LOADING NUMBER 1

BOUNDARY-CONDITION CODE = 1
LATERAL LOAD AT THE PILE HEAD = .000E+00 LBS
MOMENT AT THE PILE HEAD = .000E+00 IN-LBS
AXIAL LOAD AT THE PILE HEAD = .000E+00 LBS

FINITE-DIFFERENCE PARAMETERS
NUMBER OF PILE INCREMENTS = 100
DEFLECTION TOLERANCE ON DETERMINATION OF CLOSURE = .100E-02 IN
MAXIMUM NUMBER OF ITERATIONS ALLOWED FOR PILE ANALYSIS = 300
MAXIMUM ALLOWABLE DEFLECTION = .50E+03 IN

OUTPUT CODES
KOUTPT = 1
KPYOP = 1
INC = 1

DEPTH IN	DIAM IN	PHI	GAMMA AVG LBS/IN**3	A	B	PST	PSD
40.60	36.00	20.0	.190E-01	2.02	1.47	.527E+02	.239E+03

Y IN	P LBS/IN
.000E+00	.000E+00
.550E-01	.369E+02
.110E+00	.454E+02
.165E+00	.512E+02
.220E+00	.558E+02
.275E+00	.597E+02
.330E+00	.630E+02
.385E+00	.660E+02
.440E+00	.687E+02

.495E+00	.711E+02
.550E+00	.734E+02
.605E+00	.755E+02
.660E+00	.775E+02
.149E+01	.107E+03
.411E+02	.107E+03
.807E+02	.107E+03
.120E+03	.107E+03

DEPTH IN	DIAM IN	PHI	GAMMA AVG LBS/IN**3	A	B	PST	PSD
190.60	36.00	27.0	.244E-01	.89	.52	.900E+03	.272E+04

Y IN	P LBS/IN
.000E+00	.000E+00
.550E-01	.113E+03
.110E+00	.168E+03
.165E+00	.212E+03
.220E+00	.250E+03
.275E+00	.284E+03
.330E+00	.315E+03
.385E+00	.344E+03
.440E+00	.372E+03
.495E+00	.398E+03
.550E+00	.422E+03
.605E+00	.446E+03
.660E+00	.469E+03
.149E+01	.804E+03
.411E+02	.804E+03
.807E+02	.804E+03
.120E+03	.804E+03

DEPTH IN	DIAM IN	PHI	GAMMA AVG LBS/IN**3	A	B	PST	PSD
390.60	36.00	24.0	.273E-01	.88	.50	.330E+04	.470E+04

Y IN	P LBS/IN
.000E+00	.000E+00
.550E-01	.364E+03
.110E+00	.555E+03
.165E+00	.710E+03
.220E+00	.846E+03
.275E+00	.969E+03
.330E+00	.108E+04
.385E+00	.119E+04
.440E+00	.129E+04
.495E+00	.139E+04
.550E+00	.148E+04
.605E+00	.157E+04
.660E+00	.165E+04
.149E+01	.290E+04
.411E+02	.290E+04
.807E+02	.290E+04
.120E+03	.290E+04

OUTPUT INFORMATION

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****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-DEFLECTION *
* CURVES FOR LATERAL LOADING *
****

DISTRIBUTED LOAD CURVE 5 POINTS

X,IN	LOAD,LBS/IN
66.00	.000E+00
138.00	.291E+03
209.40	.353E+03

306.00	.336E+03
306.10	.000E+00

LOADING NUMBER 1

BOUNDARY CONDITION CODE	=	1
LATERAL LOAD AT THE PILE HEAD	=	.000E+00 LBS
MOMENT AT THE PILE HEAD	=	.000E+00 IN-LBS
AXIAL LOAD AT THE PILE HEAD	=	.000E+00 LBS

X	DEFLECTION	MOMENT	SHEAR	SLOPE	TOTAL STRESS	FLEXURAL RIGIDITY	SOIL REACTION
IN	IN	LBS-IN	LBS	RAD.	LBS/IN**2	LBS-IN**2	LBS/IN
.0	.532E+01	.326E-04	-.230E-06	-.124E-01	.669E-07	.255E+12	.000E+00
7.9	.522E+01	-.399E-04	-.482E-05	-.124E-01	.817E-07	.255E+12	.000E+00
15.8	.512E+01	-.435E-04	-.230E-06	-.124E-01	.891E-07	.255E+12	.000E+00
23.7	.503E+01	-.435E-04	-.115E-05	-.124E-01	.891E-07	.255E+12	.000E+00
31.6	.493E+01	-.616E-04	-.161E-05	-.124E-01	.126E-06	.255E+12	.000E+00
39.5	.483E+01	-.689E-04	-.115E-05	-.124E-01	.141E-06	.255E+12	.000E+00
47.4	.473E+01	-.798E-04	-.918E-06	-.124E-01	.163E-06	.255E+12	.000E+00
55.3	.463E+01	-.834E-04	-.918E-06	-.124E-01	.171E-06	.255E+12	.000E+00
63.2	.454E+01	-.943E-04	-.115E-05	-.124E-01	.193E-06	.255E+12	.000E+00
71.1	.444E+01	-.102E-03	.814E+02	-.124E-01	.208E-06	.255E+12	.000E+00
79.0	.434E+01	.129E+04	.370E+03	-.124E-01	.264E+01	.255E+12	.000E+00
86.9	.424E+01	.585E+04	.912E+03	-.124E-01	.120E+02	.255E+12	.000E+00
94.8	.415E+01	.157E+05	.171E+04	-.124E-01	.321E+02	.255E+12	.000E+00
102.7	.405E+01	.328E+05	.275E+04	-.124E-01	.672E+02	.255E+12	.000E+00
110.6	.395E+01	.592E+05	.405E+04	-.124E-01	.121E+03	.255E+12	.000E+00
118.5	.385E+01	.968E+05	.560E+04	-.124E-01	.198E+03	.255E+12	.000E+00
126.4	.375E+01	.148E+06	.740E+04	-.124E-01	.302E+03	.255E+12	.000E+00
134.3	.366E+01	.214E+06	.946E+04	-.124E-01	.438E+03	.255E+12	.000E+00
142.2	.356E+01	.297E+06	.117E+05	-.124E-01	.608E+03	.255E+12	.000E+00
150.1	.346E+01	.399E+06	.141E+05	-.124E-01	.817E+03	.255E+12	.000E+00
158.0	.336E+01	.519E+06	.165E+05	-.123E-01	.106E+04	.255E+12	.000E+00
165.9	.327E+01	.659E+06	.189E+05	-.123E-01	.135E+04	.255E+12	.000E+00
173.8	.317E+01	.818E+06	.215E+05	-.123E-01	.168E+04	.255E+12	.000E+00
181.7	.307E+01	.998E+06	.240E+05	-.123E-01	.204E+04	.255E+12	.000E+00
189.6	.297E+01	.120E+07	.267E+05	-.122E-01	.245E+04	.255E+12	.000E+00
197.5	.288E+01	.142E+07	.293E+05	-.122E-01	.291E+04	.255E+12	.000E+00
205.4	.278E+01	.166E+07	.321E+05	-.121E-01	.340E+04	.255E+12	.000E+00
213.3	.269E+01	.193E+07	.348E+05	-.121E-01	.395E+04	.255E+12	-.860E+01
221.2	.259E+01	.221E+07	.374E+05	-.120E-01	.453E+04	.255E+12	-.271E+02
229.1	.250E+01	.252E+07	.399E+05	-.120E-01	.516E+04	.255E+12	-.464E+02
237.0	.240E+01	.284E+07	.422E+05	-.119E-01	.582E+04	.255E+12	-.659E+02
244.9	.231E+01	.318E+07	.444E+05	-.118E-01	.652E+04	.255E+12	-.849E+02
252.8	.222E+01	.354E+07	.464E+05	-.117E-01	.726E+04	.255E+12	-.103E+03
260.7	.212E+01	.392E+07	.482E+05	-.116E-01	.802E+04	.255E+12	-.120E+03
268.6	.203E+01	.431E+07	.499E+05	-.114E-01	.882E+04	.255E+12	-.136E+03
276.5	.194E+01	.471E+07	.515E+05	-.113E-01	.964E+04	.255E+12	-.152E+03
284.4	.185E+01	.512E+07	.529E+05	-.111E-01	.105E+05	.255E+12	-.166E+03
292.3	.177E+01	.554E+07	.542E+05	-.110E-01	.114E+05	.255E+12	-.178E+03
300.2	.168E+01	.598E+07	.554E+05	-.108E-01	.122E+05	.255E+12	-.189E+03
308.1	.160E+01	.642E+07	.551E+05	-.106E-01	.131E+05	.255E+12	-.242E+03
316.0	.151E+01	.685E+07	.530E+05	-.104E-01	.140E+05	.255E+12	-.279E+03
323.9	.143E+01	.726E+07	.507E+05	-.102E-01	.149E+05	.255E+12	-.315E+03
331.8	.135E+01	.765E+07	.480E+05	-.995E-02	.157E+05	.255E+12	-.348E+03
339.7	.128E+01	.801E+07	.452E+05	-.971E-02	.164E+05	.255E+12	-.369E+03
347.6	.120E+01	.836E+07	.422E+05	-.945E-02	.171E+05	.255E+12	-.389E+03
355.5	.113E+01	.868E+07	.391E+05	-.919E-02	.178E+05	.255E+12	-.406E+03
363.4	.105E+01	.898E+07	.358E+05	-.891E-02	.184E+05	.255E+12	-.428E+03
371.3	.985E+00	.925E+07	.323E+05	-.863E-02	.189E+05	.255E+12	-.445E+03
379.2	.918E+00	.949E+07	.288E+05	-.834E-02	.194E+05	.255E+12	-.456E+03
387.1	.853E+00	.970E+07	.252E+05	-.804E-02	.199E+05	.255E+12	-.461E+03
395.0	.791E+00	.989E+07	.215E+05	-.774E-02	.203E+05	.255E+12	-.476E+03
402.9	.731E+00	.100E+08	.176E+05	-.743E-02	.206E+05	.255E+12	-.495E+03
410.8	.673E+00	.102E+08	.136E+05	-.712E-02	.208E+05	.255E+12	-.511E+03
418.7	.618E+00	.103E+08	.956E+04	-.680E-02	.210E+05	.255E+12	-.524E+03
426.6	.566E+00	.103E+08	.538E+04	-.648E-02	.211E+05	.255E+12	-.535E+03
434.5	.516E+00	.103E+08	.110E+04	-.616E-02	.212E+05	.255E+12	-.549E+03
442.4	.469E+00	.103E+08	-.328E+04	-.584E-02	.212E+05	.255E+12	-.560E+03
450.3	.424E+00	.103E+08	-.773E+04	-.552E-02	.211E+05	.255E+12	-.568E+03
458.2	.381E+00	.102E+08	-.122E+05	-.520E-02	.209E+05	.255E+12	-.572E+03
466.1	.341E+00	.101E+08	-.161E+05	-.489E-02	.207E+05	.255E+12	-.415E+03

474.0	.304E+00	.996E+07	-.194E+05	-.458E-02	.204E+05	.255E+12	-.414E+03
481.9	.269E+00	.979E+07	-.227E+05	-.427E-02	.201E+05	.255E+12	-.412E+03
489.8	.237E+00	.960E+07	-.259E+05	-.397E-02	.197E+05	.255E+12	-.406E+03
497.7	.206E+00	.938E+07	-.291E+05	-.368E-02	.192E+05	.255E+12	-.398E+03
505.6	.178E+00	.914E+07	-.322E+05	-.339E-02	.187E+05	.255E+12	-.388E+03
513.5	.153E+00	.887E+07	-.352E+05	-.311E-02	.182E+05	.255E+12	-.375E+03
521.4	.129E+00	.858E+07	-.381E+05	-.284E-02	.176E+05	.255E+12	-.359E+03
529.3	.108E+00	.827E+07	-.409E+05	-.258E-02	.169E+05	.255E+12	-.340E+03
537.2	.885E-01	.794E+07	-.434E+05	-.233E-02	.163E+05	.255E+12	-.318E+03
545.1	.711E-01	.758E+07	-.459E+05	-.209E-02	.155E+05	.255E+12	-.294E+03
553.0	.555E-01	.721E+07	-.481E+05	-.186E-02	.148E+05	.255E+12	-.266E+03
560.9	.417E-01	.682E+07	-.501E+05	-.164E-02	.140E+05	.255E+12	-.235E+03
568.8	.296E-01	.642E+07	-.518E+05	-.144E-02	.132E+05	.255E+12	-.201E+03
576.7	.190E-01	.601E+07	-.532E+05	-.124E-02	.123E+05	.255E+12	-.161E+03
584.6	.994E-02	.558E+07	-.543E+05	-.106E-02	.114E+05	.255E+12	-.114E+03
592.5	.222E-02	.515E+07	-.549E+05	-.898E-03	.105E+05	.255E+12	-.339E+02
600.4	-.424E-02	.471E+07	-.547E+05	-.745E-03	.966E+04	.255E+12	.664E+02
608.3	-.955E-02	.428E+07	-.539E+05	-.605E-03	.877E+04	.255E+12	.153E+03
616.2	-.138E-01	.386E+07	-.524E+05	-.479E-03	.791E+04	.255E+12	.226E+03
624.1	-.171E-01	.346E+07	-.504E+05	-.366E-03	.708E+04	.255E+12	.264E+03
632.0	-.196E-01	.307E+07	-.482E+05	-.264E-03	.628E+04	.255E+12	.294E+03
639.9	-.213E-01	.269E+07	-.458E+05	-.175E-03	.552E+04	.255E+12	.316E+03
647.8	-.224E-01	.234E+07	-.433E+05	-.972E-04	.480E+04	.255E+12	.333E+03
655.7	-.228E-01	.201E+07	-.406E+05	-.297E-04	.412E+04	.255E+12	.344E+03
663.6	-.228E-01	.170E+07	-.378E+05	.278E-04	.348E+04	.255E+12	.352E+03
671.5	-.224E-01	.141E+07	-.351E+05	.760E-04	.289E+04	.255E+12	.355E+03
679.4	-.216E-01	.115E+07	-.316E+05	.116E-03	.235E+04	.255E+12	.510E+03
687.3	-.206E-01	.912E+06	-.277E+05	.148E-03	.187E+04	.255E+12	.500E+03
695.2	-.193E-01	.709E+06	-.238E+05	.173E-03	.145E+04	.255E+12	.482E+03
703.1	-.178E-01	.536E+06	-.201E+05	.192E-03	.110E+04	.255E+12	.459E+03
711.0	-.163E-01	.392E+06	-.166E+05	.206E-03	.803E+03	.255E+12	.430E+03
718.9	-.146E-01	.274E+06	-.133E+05	.217E-03	.562E+03	.255E+12	.396E+03
726.8	-.128E-01	.182E+06	-.103E+05	.224E-03	.373E+03	.255E+12	.358E+03
734.7	-.110E-01	.112E+06	-.765E+04	.228E-03	.229E+03	.255E+12	.316E+03
742.6	-.922E-02	.610E+05	-.534E+04	.231E-03	.125E+03	.255E+12	.270E+03
750.5	-.739E-02	.273E+05	-.339E+04	.232E-03	.558E+02	.255E+12	.222E+03
758.4	-.555E-02	.740E+04	-.184E+04	.233E-03	.152E+02	.255E+12	.171E+03
766.3	-.371E-02	-.181E+04	-.704E+03	.233E-03	.371E+01	.255E+12	.117E+03
774.2	-.187E-02	-.373E+04	-.542E+01	.233E-03	.765E+01	.255E+12	.602E+02
782.1	-.304E-04	-.190E+04	.236E+03	.233E-03	.389E+01	.255E+12	.100E+01
790.0	.181E-02	.000E+00	.000E+00	.233E-03	.000E+00	.255E+12	-.608E+02

OUTPUT VERIFICATION

THE MAXIMUM MOMENT IMBALANCE FOR ANY ELEMENT = .381E-04 IN-LBS
THE MAX. LATERAL FORCE IMBALANCE FOR ANY ELEMENT = .252E-05 LBS

OUTPUT SUMMARY

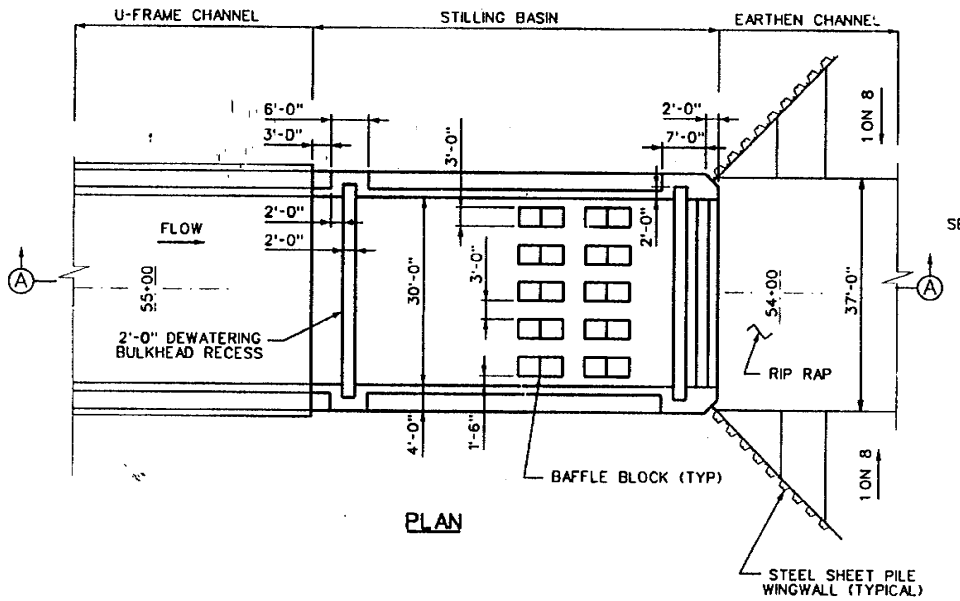
PILE-HEAD DEFLECTION = .532E+01 IN
COMPUTED SLOPE AT PILE HEAD = -.124E-01
MAXIMUM BENDING MOMENT = .103E+08 LBS-IN
MAXIMUM SHEAR FORCE = .554E+05 LBS
NO. OF ITERATIONS = 13
NO. OF ZERO DEFLECTION POINTS = 2

S U M M A R Y T A B L E
****

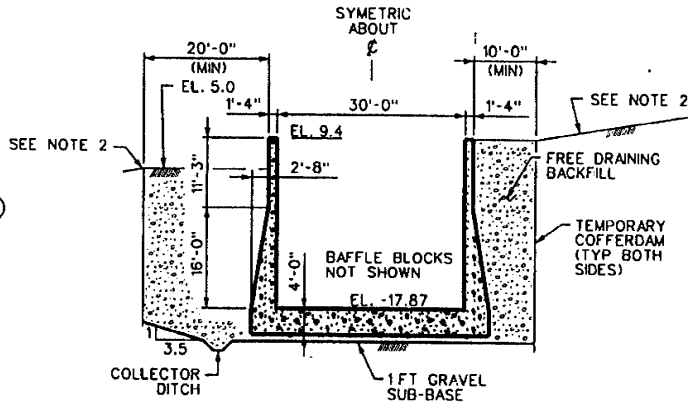
BOUNDARY CONDITION BC1	BOUNDARY CONDITION BC2	AXIAL LOAD LBS	PILE HEAD DEFLECTION IN	MAX. MOMENT IN-LBS	MAX. SHEAR LBS
.0000E+00	.0000E+00	.0000E+00	.5320E+01	.1034E+08	.5544E+05

APPENDIX C-2

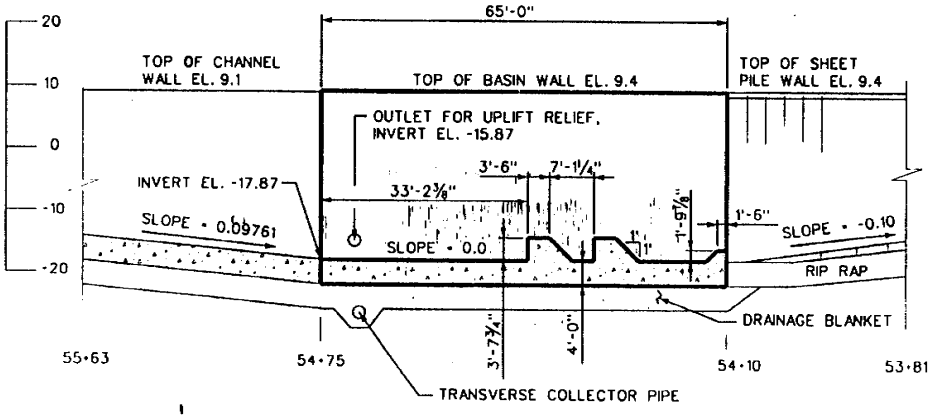
SAMPLE CALCULATIONS
MARGARITA CHANNEL STILLING BASIN
STATION M54+10 TO M54+75



PLAN



STA 54+10 - 54+75
(LOOKING UPSTREAM)



SECTION A

NOTES:

1. ELEVATIONS ARE WITH RESPECT TO NATIONAL GEODETIC VERTICAL DATUM (NGVD).
2. GRADE TO MATCH EXISTING CONTOURS.

SCALE: 1" = 20'

20' 0 20'

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

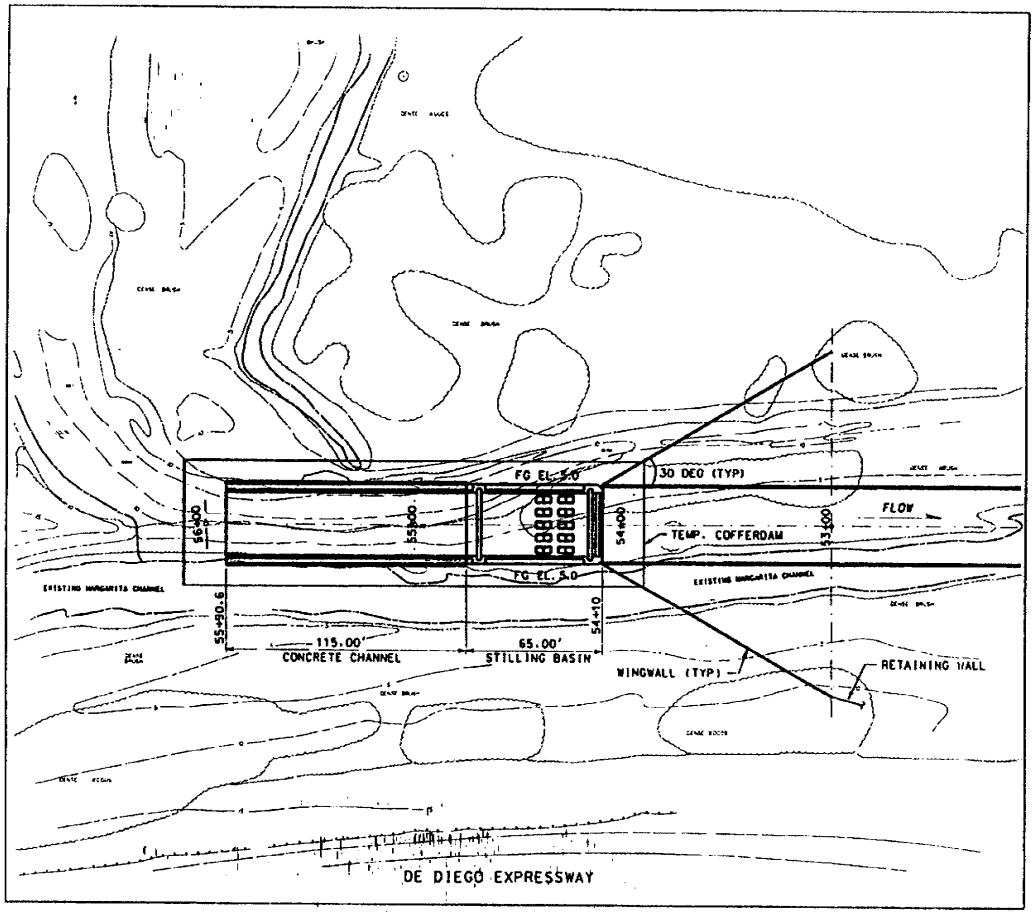
MARGARITA TRIBUTARY STA. 54+10 TO 54+75

STILLING BASIN
PLAN, PROFILE, AND SECTION
STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-36,XXX APRIL 1997

DESIGN ENG.: MWW	
DWN. BY: MWW	CKD. BY:

PLATE S-3



SITE PLAN

CONSTRUCTION SEQUENCE:

1. CONSTRUCT COFFERDAM AS INDICATED. ACTUAL LIMITS WILL BE BASED ON CONTRACTOR PROVIDED DEWATERING SYSTEM.
2. DIVERT EXISTING CHANNEL FLOW SOUTH OF COFFERDAM INTO COMPLETED CHANNEL.
3. CONSTRUCT BASIN AND CHANNEL FROM STA. 54+10 TO 56+00.
4. CUT PARTIAL TEMPLATE AT MOUTH OF BASIN. DIVERT FLOW THRU CONSTRUCTED CHANNEL.
5. CONSTRUCT WINGWALLS FOR BASIN.
6. COMPLETE TEMPLATE AND INSTALL RIP RAP.
7. GRADE AS INDICATED ON GRADING PLANS.

NOTES:

1. EXISTING CONTOURS ARE SHOWN. FINISHED GRADE (FG) ELEVATIONS ARE THOSE ASSUMED IN STRUCTURAL DESIGN. ALL ELEVATIONS ARE NATIONAL GEODETIC VERTICAL DATUM (NGVD).
2. UTILITIES AND SOIL BORING LOCATIONS NOT SHOWN.

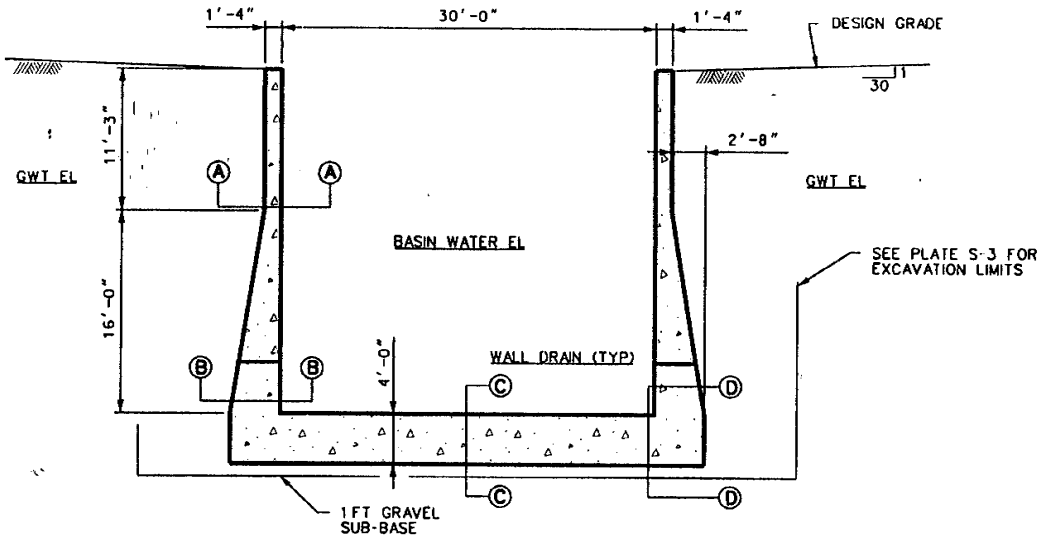
SCALE: 1" = 60'

DESIGN ENG.: MWW	
DWN. BY: MWW	CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2
MARGARITA TRIBUTARY STA 54+10 TO 54+75
STILLING BASIN
CONSTRUCTION SEQUENCE
STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-36,XXX NOVEMBER 1997

PLATE S-4



STA 54+10 - 54+75

STATION	LOCATION	VU (KIPS)	MU (K-FT)	A(ST) (SQ IN)	LOAD CASE
54+10	A	4.42	11.05	0.06	3
	B	46.41	448.63	2.49	3
	C	1.65	232.05	1.25	1(SHEAR)/3(MOMENT)
	D	28.73	477.36	2.66	3
54+75	A	4.42	11.05	0.06	2
	B	55.25	475.15	2.65	2
	C	0	238.68	1.29	2
	D	33.15	510.51	2.86	2

LOAD CASE DESCRIPTIONS:

1: POST-CONSTRUCTION CONDITION: UNUSUAL; BASIN EMPTY STRUCTURE COMPLETE WITH BACKFILL NOT IN PLACE; WIND LOAD 50 PSF, Q-STATE SOILS.

2: SPF CONDITION: USUAL; BASIN WATER VARIES WITH HYDRAULIC JUMP, GWT EL. 6.0 NGVD, WALL DRAINS 50% EFFECTIVE, S-STATE SOILS.

3: DRAWDOWN CONDITIONS: UNUSUAL, BASIN WATER EL -1.0 NGVD, GWT EL 7.0 NGVD, WALL DRAINS 50% EFFECTIVE; S-STATE SOILS.

NOTES:

1. SHEAR FORCES AND BENDING MOMENTS SHOWN ARE MAXIMUM FOR ALL LOAD CASES.
2. REQUIRED REINFORCING STEEL BASED ON EM 1110-2-2104, ASSUMING 28-DAY CONCRETE STRENGTH OF 3000 PSI AND ASTM A615 GR 60 STEEL. MINIMUM REINFORCEMENT FOR TEMPERATURE AND SHRINKAGE REQUIRED AT ALL OTHER SECTIONS.

LEGEND:
VU = FACTORED SHEAR FORCE
MU = FACTORED MOMENT BENDING
A(ST) = AREA OF TENSION REINFORCING STEEL REQUIRED

SCALE: 1" = 10'

10' 0 10'

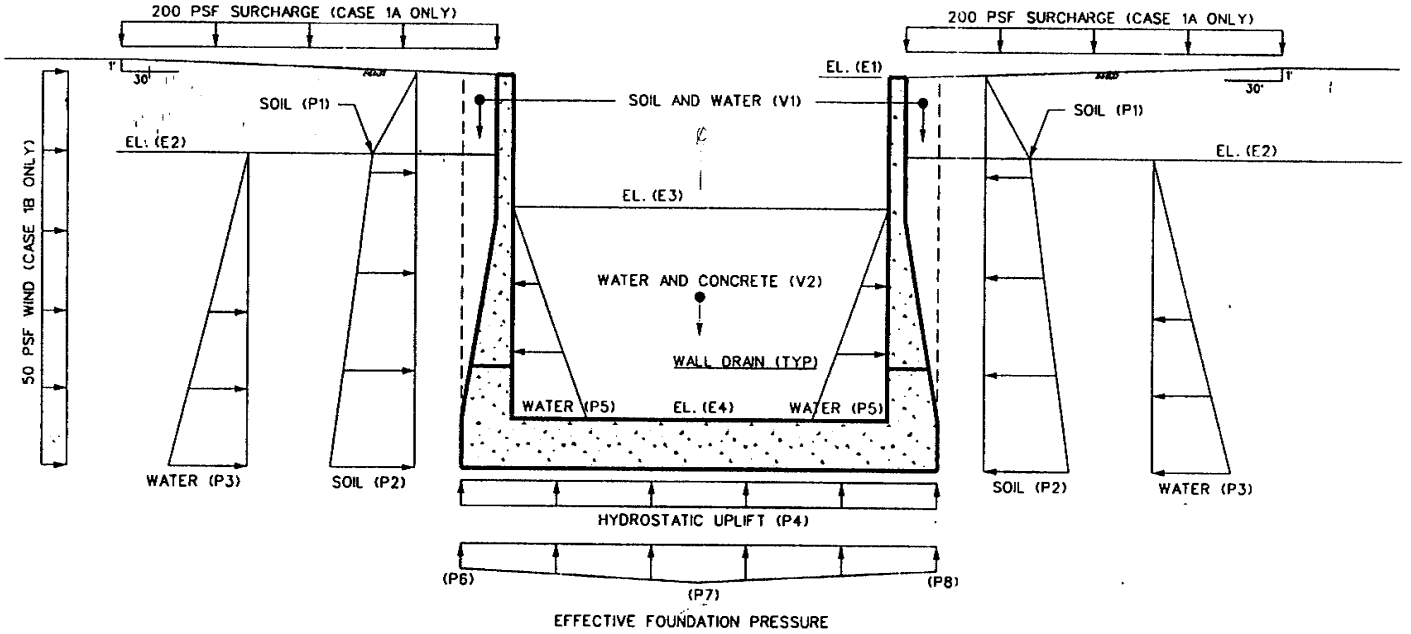
RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2
MARGARITA TRIBUTARY STA 54+10 TO 54+75
STILLING BASIN
STRUCTURAL ANALYSIS
STRUCTURAL

DESIGN ENG.: MWW
DWN. BY: MWW
CKD. BY:

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-36,XXX
APRIL 1997

PLATE S-5

PNF2505.DGN



EFFECTIVE FOUNDATION PRESSURE

STA	LOAD CASE	ELEVATION E1 FT	E2 FT	E3 FT	E4 FT	PRESSURE P1 KSF	P2 KSF	P3 KSF	P4 KSF	P5 KSF	P6 KSF	P7 KSF	P8 KSF	LOAD V1 KIP	V2 KIP	FS: CALCULATED / ALLOWABLE BEARING	FLOTATION
54+10	1	9.40	-17.87	-17.87	-17.87	1.50	0.94	-1.12	-1.12	0.00	1.04	1.56	1.04	10.77	14.59	5.00 / 2.0	5.87 / 1.30
	1	9.40	-17.87	-17.87	-17.87	1.50	0.94	-1.12	-1.12	0.00	1.82	1.44	1.97	10.77	14.59	3.97 / 2.0	5.76 / 1.30
	2	9.40	6.00	6.40	-17.87	0.19	0.37	0.38	0.38	1.52	0.80	1.19	0.80	11.97	60.10	6.55 / 3.0	1.58 / 1.50
	2	9.40	6.00	9.30	-17.87	0.19	0.37	0.38	0.38	1.70	1.08	1.18	1.08	11.97	65.54	6.63 / 2.0	1.67 / 1.30
	3	9.40	6.00	-1.00	-17.87	0.19	0.37	0.38	0.38	1.05	0.52	1.20	0.52	11.97	46.22	6.51 / 3.0	1.55 / 1.50
	3	9.40	7.00	-1.00	-17.87	0.13	0.35	0.44	0.44	1.05	0.47	1.18	0.47	12.05	46.22	6.60 / 2.0	1.52 / 1.30
	3	9.40	7.00	-1.00	-17.87	0.13	0.35	0.44	0.44	1.05	0.28	1.11	0.28	12.05	46.22	7.05 / 1.0	1.41 / 1.10
54+75	2	9.40	6.00	-8.10	-17.87	0.19	0.37	0.38	0.38	0.61	0.36	1.10	0.36	11.97	32.91	7.12 / 3.0	1.53 / 1.50

LOAD CASE DESCRIPTIONS:

1: POST-CONSTRUCTION CONDITION: UNUSUAL: BASIN EMPTY STRUCTURE COMPLETE WITH BACKFILL NOT IN PLACE: WIND LOAD 50 PSF, Q-STATE SOILS.

2: SPF CONDITION: USUAL: BASIN WATER VARIES WITH HYDRAULIC JUMP, GWT EL. 6.0 NGVD, WALL DRAINS 50% EFFECTIVE, S-STATE SOILS.

3: DRAWDOWN CONDITIONS: UNUSUAL, BASIN WATER EL -1.0 NGVD, GWT EL 7.0 NGVD, WALL DRAINS 50% EFFECTIVE: S-STATE SOILS.

SCALE: 1" = 10'

10' 0 10'

DESIGN ENG.: MWW
DWN. BY: MWW
CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2
MARGARITA TRIBUTARY STA 54+10 TO 54+75
STILLING BASIN
STABILITY ANALYSIS
STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-36,XXX
APRIL 1997

PLATE S-6

PNF2506.DGN

PROJECT			COMPUTED BY	DATE
Rio Puerto Nuevo FDN.2		Page 1 of —	MWM	5/3/96
SUBJECT			CHECKED BY	DATE
Margarita Tributary				

Stilling Basin Design

I) General:

1. Review of available CORPS software indicates program CUFRBC, "Design of U-Frame Concrete Structures" is most appropriate for design of the basin structural components. Program CBASIN, "Structural Design of Stilling Basins," or hand calculations will be used for 3-D stability checks.

2. The design presented in the subject project General Design Memorandum was based on hydraulic requirements only. The stem width of 1 ft and base slab thickness of 2 ft were assumptions, not based on structural calculations.

3. Use loading conditions from project quality control plan

4. For U-Frame concrete basin use:

   A. EM 1110-2-2007, Design of U-Frame Hydraulic Concrete.

   B. EM 1110-2-2104, Str. Design for Concrete Hydraulic Structures

   C. CUFRBC User's Guide

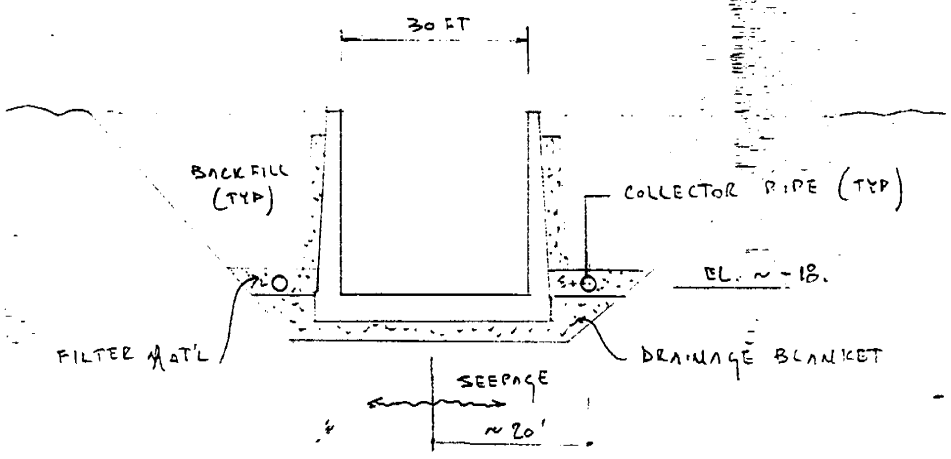
5. Use EM 1110-2-2504, Design of Sheetpile Walls, for wingwalls.

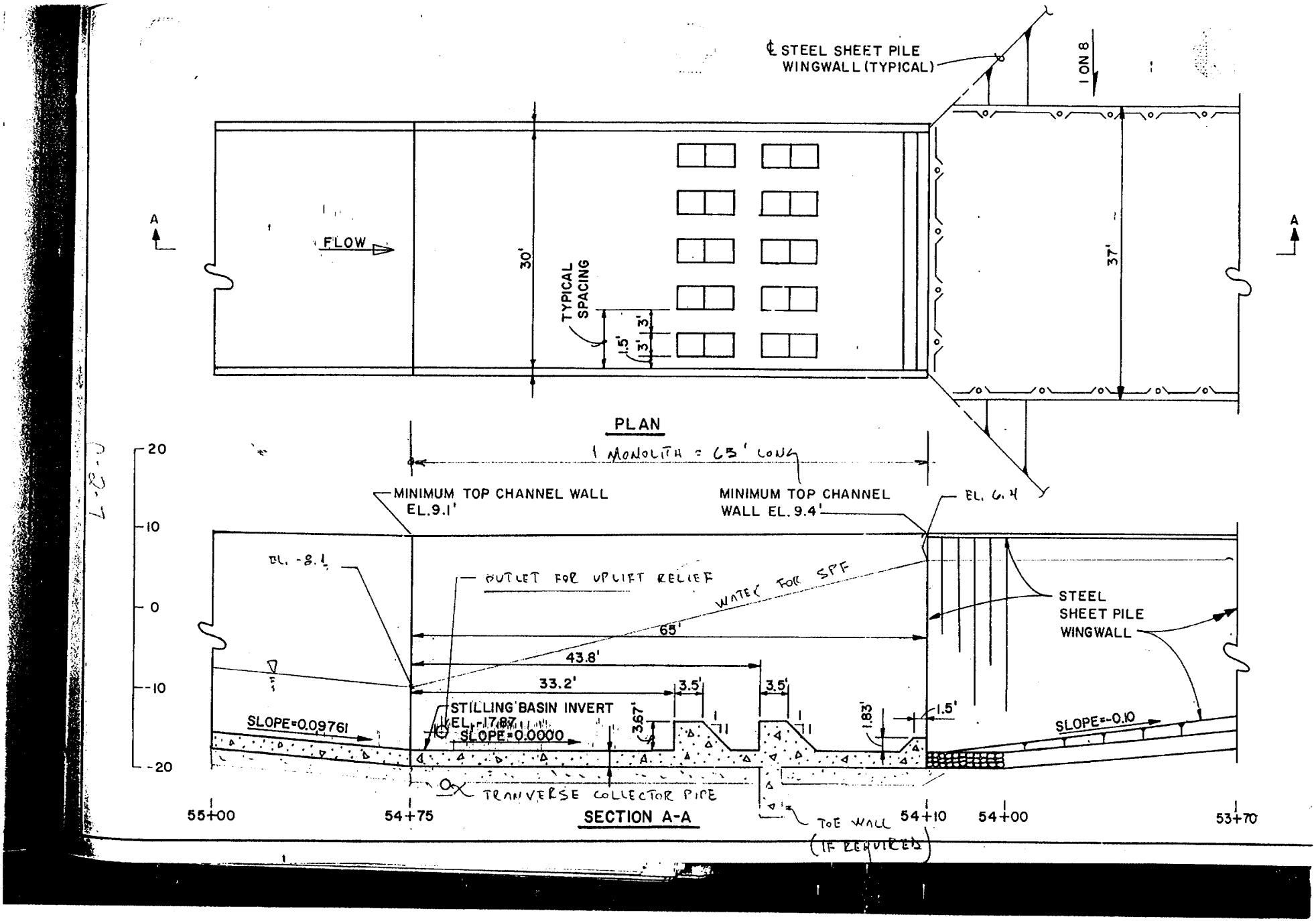
II) DESIGN CONSIDERATIONS :

1. DRAINAGE SYSTEM. (PER EM 1110-2-2007)

A. USE SIDE COLLECTOR PIPES FOR THE DRAINAGE SYSTEM TO AVOID INTERFERENCE W/ TOE WALL (IF REQUIRED) @ STA. 54+75.

B. ASSUME 1 OUTLET IN THIS MONOLITH IS ADEQUATE. LOCATE THE OUTLET NEAR STA 54+75, AT AN ELEVATION ~ 2' FT ABOVE THE TOP OF THE BASE SLAB => EL. -15.87 NGVD





GDM PLATE S-78

PLATE 5

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SUBJECT		CHECKED BY	DATE

III) DESIGN PROCEDURE

1. DESIGN 1 FT STRIPS ACROSS BASIN USING PROGRAM "CUFRBC."

   A. SECTIONS TO CHECK ← STANDARD PROJECT FLOOD

      1. STA 54 + 10, WHERE SPF WATER IS MAXIMUM

      2. STA 54 + 75, WHERE SPF WATER IS MINIMUM

2. CHECK STABILITY:

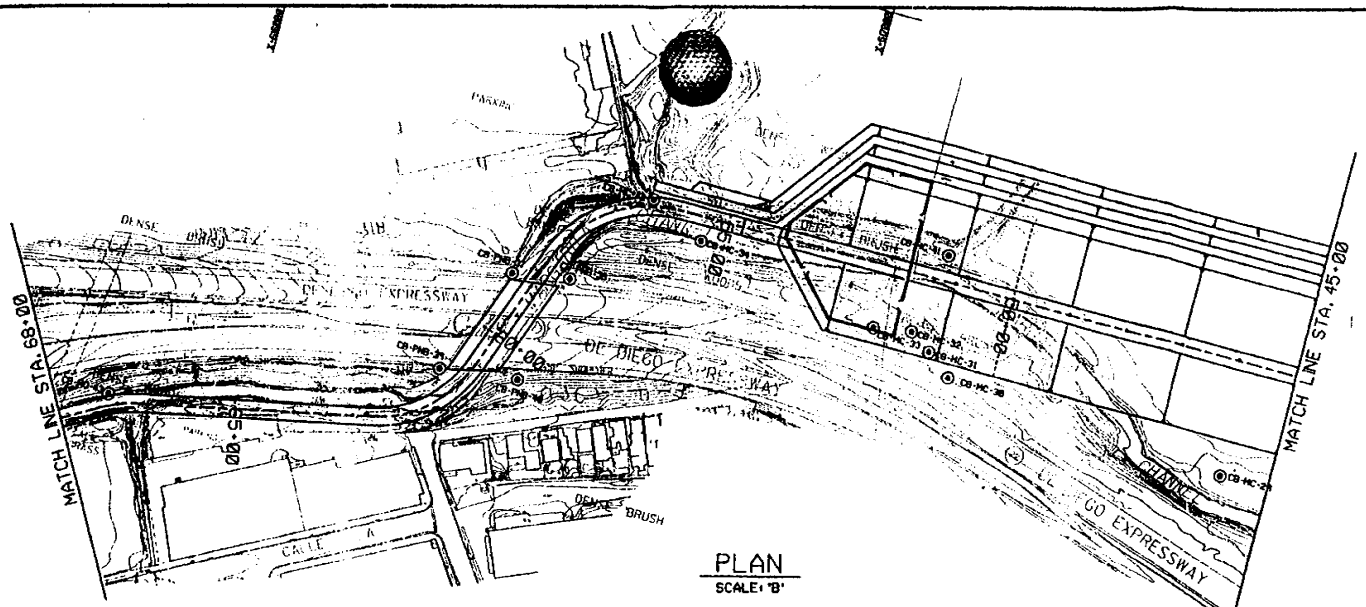
   A. SLIDING ⇒ HAND CALCULATIONS

   B. BEARING ⇒ USE CUFRBC RESULTS

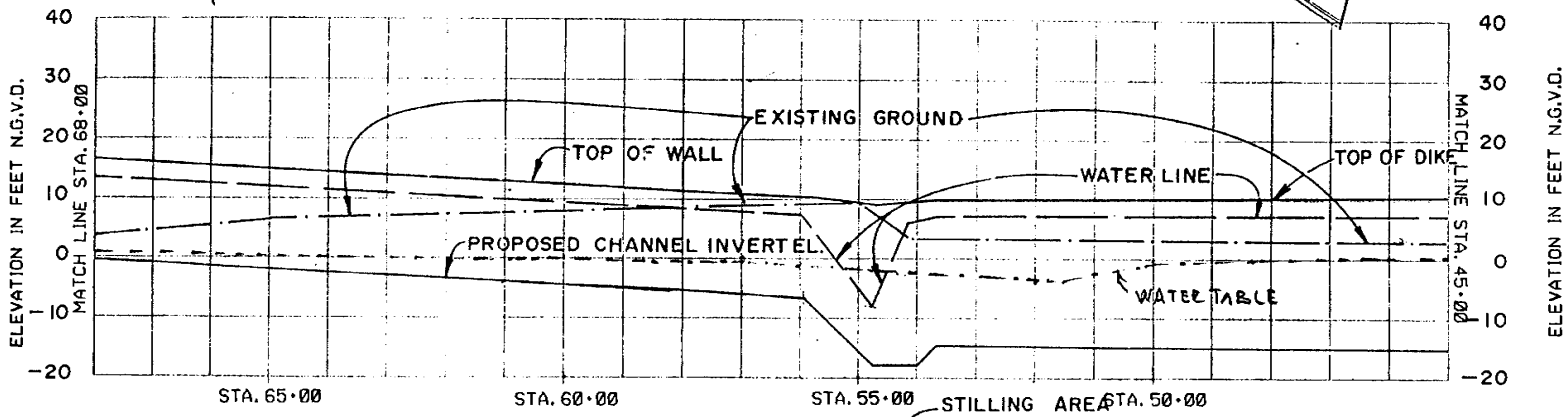
   C. FLOTATION ⇒ USE CUFRBC RESULTS

3. DESIGN BAFFLE BLOCKS.

4. DESIGN SHEET PILE WINGWALLS.



PLAN
SCALE: 'B'



* NOTE THAT WATER TABLE IS ABOVE PROPOSED CHANNEL INVERT

℄ CHANNEL PROFILE
SCALE: HORIZ. 'B'
VERT. 'A'

GRAPHIC SCALES
'A' 10' 0 10' 20'
'B' 100' 0 100' 200'

CONCRETE U-FRAME CHANNEL
TRAPEZOIDAL EARTH CHANNEL

RIO PUERTO NUEVO, PUERTO RICO
GENERAL DESIGN MEMORANDUM
MARGARITA TRIBUTARY
STA 45+00 TO STA 68+00
PLAN AND PROFILE
STRUCTURAL
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 102-35,578
DECEMBER 1990
PLATE S-40

b-2-d

PAGE 2

PROJECT	Page __ of __	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

I) WALL AND SLAB DESIGN :

1. DESIGN 1 FT WIDE STRIPS ACROSS BASIN.

   USE DESIGN MODE FOR EACH LOAD CASE TO FIND THE REQUIRED MEMBER THICKNESSES BASED ON THE ASSUMED REINFORCEMENT LIMITS.

   A. STA 54+10 : CHECK 1A, 1B, 2A, 2B, 3A, 3B, 3C

   B. STA 54+25 : CHECK 2A, 2B ; BY INSPECTION OTHER LOAD CASES WILL NOT GOVERN.

2. COMPUTE CASE 4A LATERAL WALL SHEAR AND MOMENT.

3. BASED ON RESULTS OF STEPS (1) AND (2), FIND THE FINAL BASIN GEOMETRY AND REINFORCING REQUIREMENTS.

4. RE-ANALYZE BASIN FROM STEP 3 WITH GOVERNING LOAD CONDITION

PROJECT	Page 5 of ___	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

CUFRBC CONCRETE DESIGN PARAMETERS:

1.) USE STRENGTH DESIGN OPTION:

A. f'_c = 3000 PSI , γ_{conc} = 150 PCF

B. f_y = 60000 PSI

C. $\rho = .25\rho_b = .00535$

D. REINFORCEMENT LIMITS: NO MORE THAN 2 LAYERS / FACE

1. ABOVE BREAK LINE IN STEM:

$A_s = \rho b d = .00535(12)(9) = 0.58\ IN^2$

USE #6 $A_s = .44\ IN^2$, $D = 0.75$ IN

2. BELOW BREAK LINE IN STEM:

INITIAL THICKNESS = 36", $d = 32.5$"

$A_s = .00535(12)(32.5) = 2.09\ IN^2$

USE #9, $A_s = 1.0\ IN^2$, $D = 1.128$ IN

3. SLAB:

INITIAL THICKNESS = 36", $d = 32.5$ (TOP STEEL)

$A_s = 2.09\ IN^2$

USE #11, $A_s = 1.56\ IN^2$, $D = 1.41$ IN

PROJECT	Page __ of __	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

E. - SINGLE LOAD FACTORS: (EM 1110-2-2104)

1. USUAL : $1.3(1.7) = 2.21$

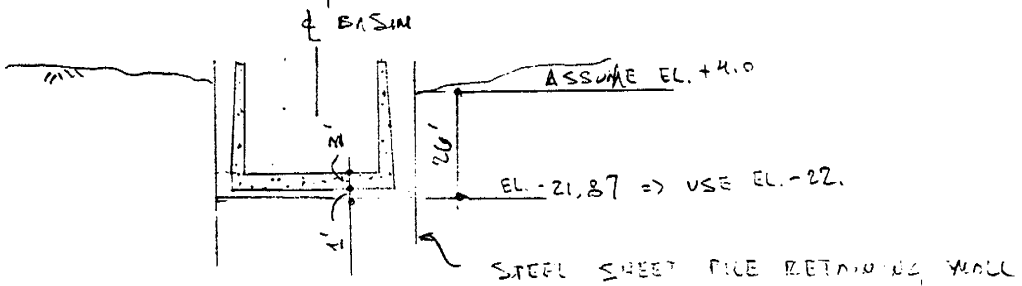
2. UNUSUAL : $0.75(1.3)(1.7) = 1.65$

3. EXTREME : $0.50(1.3)(1.7) = 1.10$

PROJECT	Page __ of __	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

CONSTRUCTION SEQUENCE :

1. AS PROPOSED IN GDM :

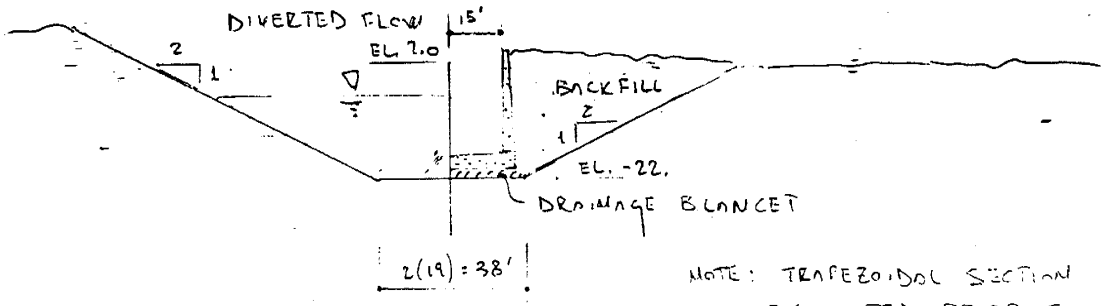


⑥ STA. 54+60
LOOKING UPSTREAM

COMMENTS: 26' UNSUPPORTED CANTILEVER STEEL SHEET PILE WALL IS TOO HIGH BY INSPECTION, TIE-BACKS OR EXCAVATION TO REDUCE THE UNSUPPORTED HEIGHT IS REQUIRED.

2. AS PRESENTED IN HYDRAULICS PROPOSED SEQUENCE OF CONSTRUCTION (APP 9C MEMO)

℄ BASIN AND STEEL SHEET PILE FOR DIVERSION OF WATER DURING CONSTRUCTION



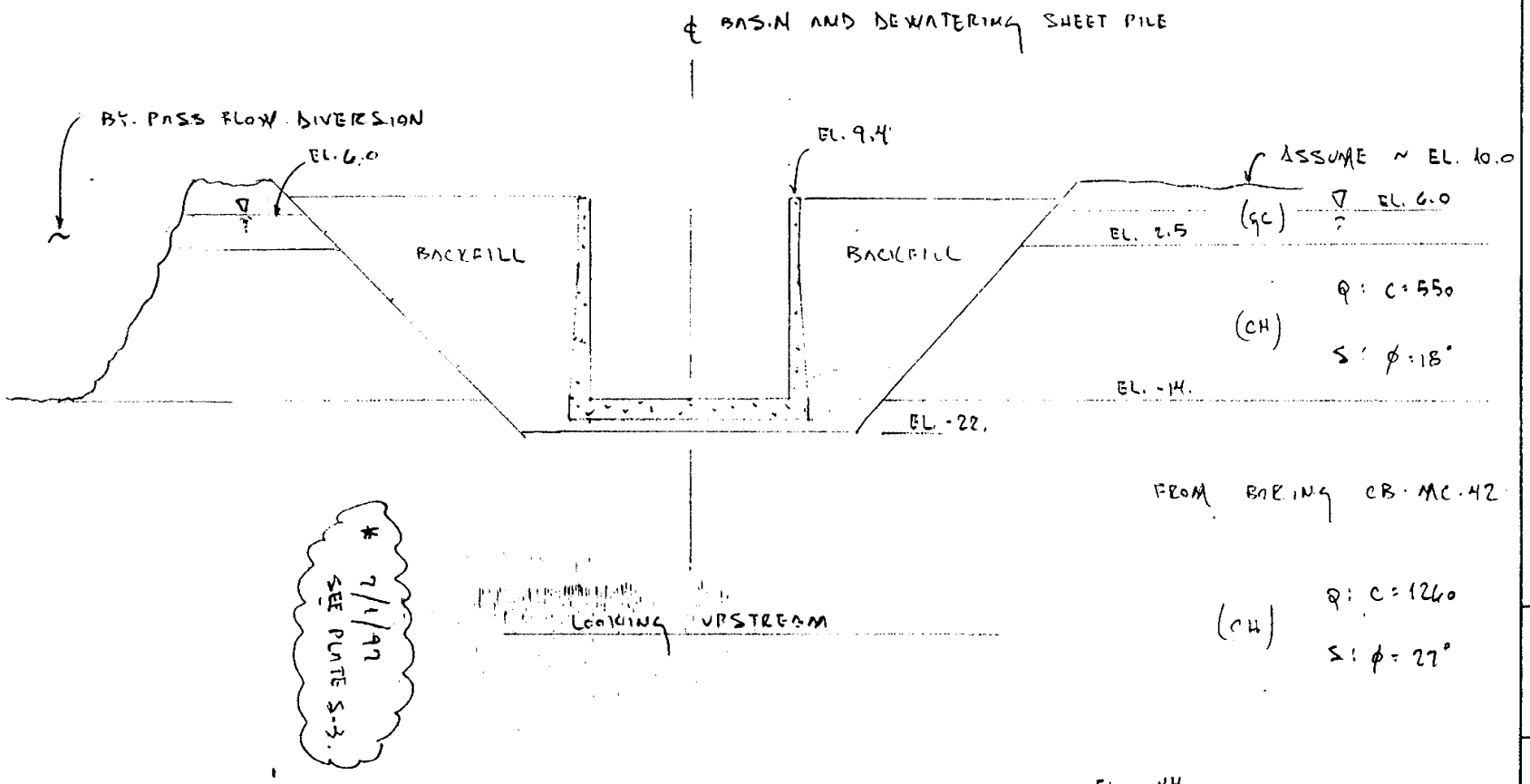
NOTE: TRAPEZOIDAL SECTION EXCAVATED PRIOR TO BEGINNING OF CONSTRUCTION

⑨ STA. 54+60
LOOKING UPSTREAM

SAJ Form 1000
14 Mar 78

PROJECT | SUBJECT | Page — of — | COMPUTED BY | DATE | CHECKED BY | DATE

3. AS AGREED, BETWEEN EN-DS AND EN-HW (CHRIS SMITH). BASIN TO BE BUILT MONOLITHICALLY. BY-PASS FLOW DIVERSION TO BE INCORPORATED INTO WINGWALL DESIGN.



SAJ Form 1000
14 Mar 78

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Summary of Results for "Design" Mode

Load Case	Member	Location	M (k-ft)	SLF	Mu	V (k)	A (k)	d (in)	As (in²)	ρ
STA 54+10										
1A	2	0.	235	1.65	388	-17.	31	42.9	1.77	.0034
		6.	149	1.65	246	-11.	31	43.3	0.87	.0017
		15.	97	1.65	160	0.	33 3/	43.3	0.35	.0007
	11	0.	-225	1.65	-371	24	17	43.1	1.82	.0035
		5.4	-117	1.65	-193.	16.	11	33.5	1.20	.0030
		19.	-7	1.65	-12.	2.	2.	8.6	0.28	.0027
2A	2	0.	140.	2.21	309	-10.	24.	40.3	1.40	.0029
		6.	88.	2.21	194	-7.	24.	40.3	0.63	.0013
		15.	56.	2.21	124	0.	24.	40.3	0.18	.0004
	11	0.	-132.	2.21	-292	14.	15.	37.3	1.41	.0036
		5.4	-68.	2.21	-150.	9.	10.	29.7	1.02	.0028
		19.	-4.	2.21	-9.	2.	2.	8.6	0.18	.0017
3A	2	0.	219.	2.21	484	-13.	33.	52.2	1.62	.0026
		6.	155.	2.21	342	-8.	33.	52.3	0.88	.0014
		15.	115.	2.21	254	0.	33.	52.3	0.43	.0007
	11	0.	-201.	2.21	-444	21.	18.	49.1	1.33	.0031
		5.4	-104.	2.21	-230.	14.	11.	32.7	1.23	.0027
		19.	-5.	2.21	-11.	2.	2.	8.6	0.22	.0021
STA 54+75										
2A	2	0	243.	2.21	537	-14.	37	55.1	1.68	.0025
		6.	170.	2.21	376	-9.	37	55.3	0.87	~~.0031~~ .0013
		15.	122.	2.21	278	0.	37	55.3	0.41	.0006
	11	0	-219.	2.21	-484.	25.	18	52.0	1.88	.0030
		5.4	-108.	2.21	-239.	16.	12	49.0	1.18	.0025
		19.	-4	2.21	-9.	2.	2.	8.6	0.22	.0021

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SUBJECT		CHECKED BY	DATE

2) FIND LOAD CASE 4D (SEISMIC) WALL SHEAR AND MOMENT

1. USE THE GENERAL WEDGE METHOD PER EM 1110-2-2502 (3-65)

2. GIVEN : $k_h = .15$ g, $k_v = 0$ } ACCELERATION COEFFICIENTS

BACKFILL: $\gamma = 0.110$ K/FT^3

$\gamma_{SAT} = 0.125$ K/FT^3

$\gamma_{BUOYANT} = 0.0625$ K/FT^3

3. DRAINS ARE 50% EFFECTIVE.

ASSUME CHANNEL WATER EL. 9.0

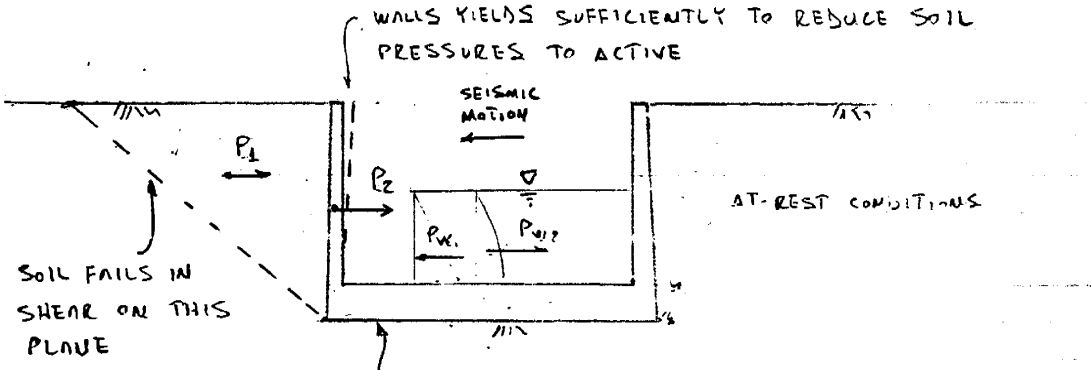
NORMAL GWT EL. 6.0

∴ USE GWT EL. 9.0

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4) ASSUME THE FOLLOWING SEQUENCE OF EVENTS

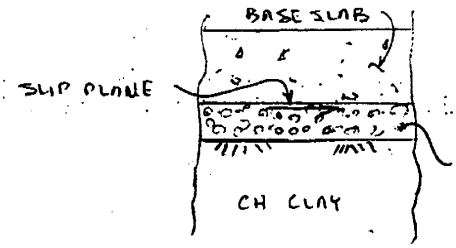
A) BASIN IS ACCELERATED TO THE LEFT.



P_1 : SOIL + STATIC AND INERTIAL FORCES
P_2 : INERTIAL FORCE OF WALL
P_W : WATER FORCES

B) CHECK IF $P_1 + P_2 + P_W$ IS SUFFICIENT TO FAIL BASE SLAB SOIL.

A. ASSUME DRAINAGE BLANKET BELOW BASE SLAB PRODUCES:



WEIGHT: (SLAB) $(38)4(.15) + 30(17.8)(.0625) - 38(20.8)(.0625)$ (WATER IN CHANNEL) (UPLIFT) $+ 2(7.7)$ (WALLS) =

$= 22.8 + 33.4 - 49.4 + 15.4 = 22.2$ k

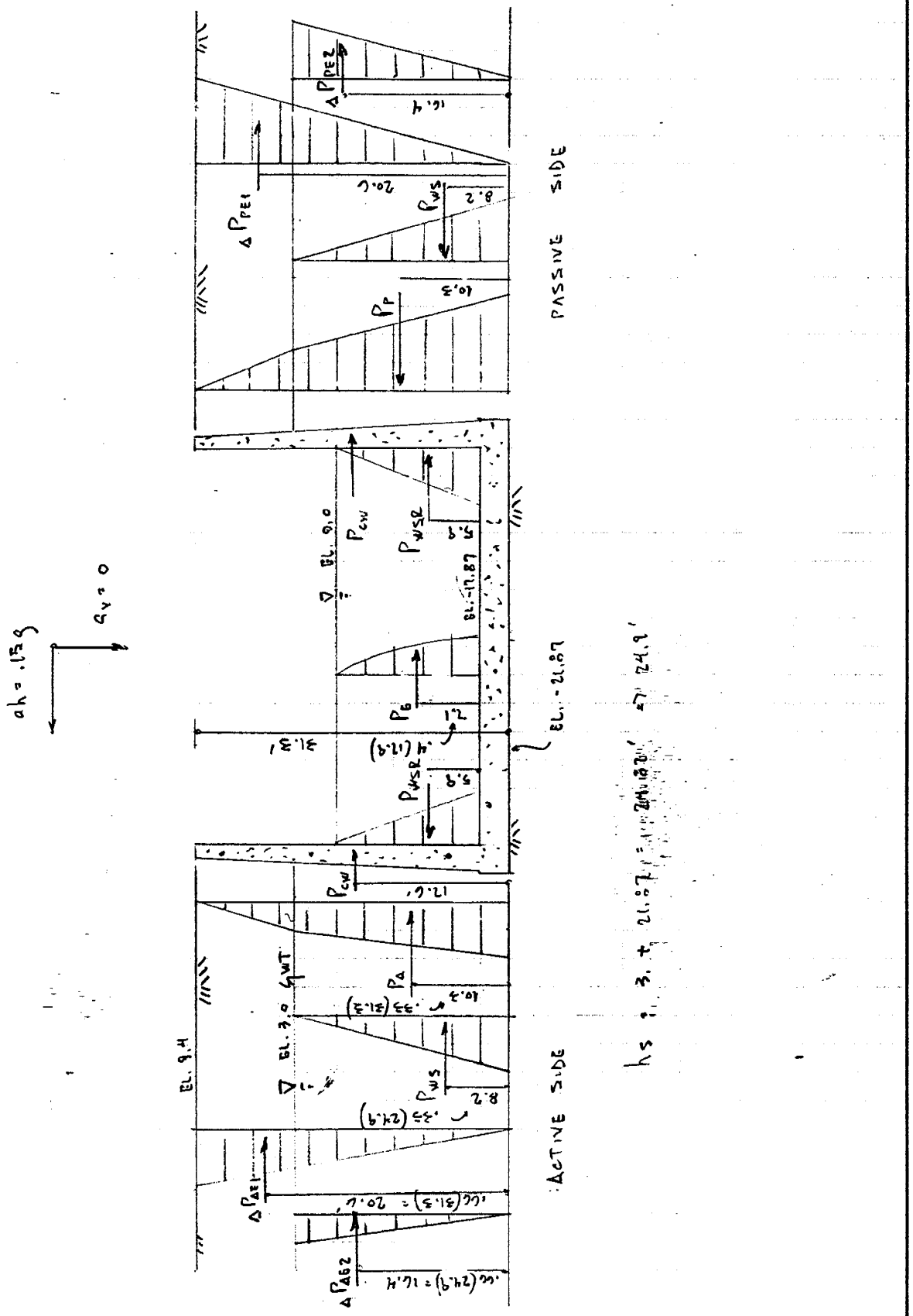
FOR SLIDING, DRIVING FORCE $> W / \tan\phi = 22.2 / \tan 32 = 35.5$ k

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c) IF $P_1 + P_2 > W/\tan\phi$ => FIND PASSIVE SIDE FORCES

IF $P_1 + P_2 < W/\tan\phi$ => NO PASSIVE SIDE FORCES I.E. AT-REST CONDITIONS STILL APPLY

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I) ACTIVE SIDE FORCES

$$C_1 = \frac{2(\tan\phi - k_h)}{1 + k_h \tan\phi} = \frac{2(\tan 32 - .15)}{1 + (.15)\tan 32} = 0.868$$

$$C_2 = \frac{\tan\phi / - k_h}{\tan\phi\,(1 + k_h \tan\phi)} = \frac{\tan 32 - .15}{\tan 32\,(1 + .15 \tan 32)} = 0.695$$

$$\alpha = \tan^{-1}\left[\frac{C_1 + [C_1^2 + 4C_2]^{1/2}}{2}\right] = \tan^{-1}\left[\frac{.868 + [.868^2 + 4(.695)]^{1/2}}{2}\right] = 57.9^\circ$$

$$K = \frac{1 - \tan\phi \cot\alpha}{1 + \tan\phi \tan\alpha} = \frac{1 - \tan 32 \cot 54}{1 + \tan 32 \tan 54} = 0.293$$

$$K_A = K_b + K = .293$$

$$P_A = .5 K_A \gamma (h - h_s)^2 + .5 h_s \left[2K\gamma(h - h_s) + k_h \gamma_b h_s\right]$$

$$= .5(.293)(.11)(31.3 - 24.9)^2 + .5(24.9)\left[2(.293)(.11)(6.4) + .293(.062)(24.9)\right]$$

$$= .66 + 10.8 = 11.4 \text{ k}$$

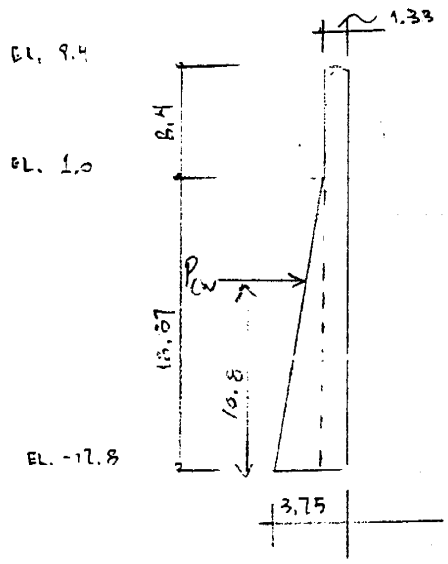
$$\Delta P_{AE} = k_h \left[\frac{\gamma h^2}{2 \tan\alpha} + \frac{(\gamma_s - \gamma) h_s^2}{2 \tan\alpha}\right] = .15 \left[\frac{.11(31.3)^2}{2 \tan 54} + \frac{(.015)(24.9)^2}{2 \tan 54}\right]$$

$$= \underset{\Delta P_{AE1}}{5.9} + \underset{\Delta P_{AE2}}{0.51} = 6.4 \text{ k}$$

$$P_{ws} = .5 \gamma_w h_s^2 = .5(.062)(24.9)^2 = 19.2 \text{ k}$$

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P_{IE} = INERTIAL FORCE OF WALL = $k_h W_w$



$A = 1.33(27.3) + .5(3.75 - 1.33)(18.87)$

$= 25.6 + 22.8 = 51.4 \text{ FT}^2$ (51.1)

$W_w = .15(51.4)(1) = 7.7 \text{ k/FT}$ (8.1) 7.9 K/FT

$\therefore P_{IW} = .15(7.7) = 1.1 \text{ k}$ (1.3)

$P_{WRS} = .5\gamma h_w^2 = .5(.0625)(17.87)^2 = 10.0 \text{ K}$

$P_E = .66\, C_E\, k_h\, h_w^2 = .66(.051)(.15)(17.87)^2 = 1.6 \text{ k}$ (FROM P. 3-78)

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ACTIVE SIDE WALL:

1) FACTORED SLENE @ TOP OF BASE SLAB:

$= 1.7\left(P_A + P_{WS} - P_{WSR}\right) + 1.9\left(\Delta P_{AE} + P_{CW} + P_E\right)$

$= 1.7\left(11.4 + 19.3 - 10.\right) + 1.9\left(6.4 + 1.1 + 1.6\right)$

$= 1.7\left(20.7\right) + 1.9\left(9.1\right) = \underline{52.5}\ k\ /\ FT$

2) FACTORED (Moment) @ TOP OF BASE SLAB

$= 1.7\left[P_A(6.3) + P_{WS}(4.2) - P_{WSR}(5.9)\right] + 1.9\left[\Delta P_{AE1}(16.4) + \Delta P_{AE2}(12.4) + P_{CW}(10.8) + P_E(7.0)\right]$

$= 1.7\left[71.8 + 81.1 - 59.1\right] + 1.9\left[96.8 + 6.2 + 14. + 11.\right]$

$= 159.6 + 245.1 = \underline{404.7}\ k \cdot FT\ /\ FT$ < M from load case 2A @ sta 54+75

3) CHECK IF ACTIVE SIDE FORCES CAUSE BASE SLAB SLIP

$29.7 + 9.1 = 39.8\ k < 39.4\ k$ ⇒ NO SLIP

∴ NO PASSIVE SIDE FORCES ACTIVATED

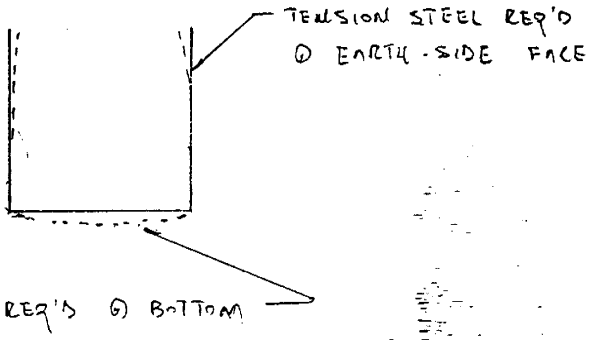
PROJECT	Page __ of __	COMPUTED BY	DATE
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3) FIND FINAL MEMBER SIZES AND REINFORCEMENT

1. SELECT STEM AND SLAB THICKNESSES THAT SATISFY ALL LOAD CASES. USE "INVESTIGATION" MODE OF CURBC TO CHECK.

A. REVIEW OF "DESIGN" MODE RESULTS:

1. DUE TO THE HIGH BACKFILL LEVEL, THE DEFLECTED SHAPE FOR EACH LOAD CASE WAS:



2. THE GOVERNING CASE FOR MEMBER STRENGTH WAS 2A @ STA. 54+75 WHERE THE SPF WATER LEVEL DROPS TO EL -5.1. SEE SUMMARY PAGE.

3. THE FOUNDATION UPLIFT ANCHORS WERE NOT LOADED. THE SLAB THICKNESS REQUIRED FOR STRENGTH WAS HEAVY ENOUGH TO PROVIDE THE UPLIFT SAFETY FACTOR IN EACH CASE.

```
**************************************************
*  CUFRBC - PROGRAM FOR DESIGN AND ANALYSIS OF   *
*             BASINS AND CHANNELS                *
*                BY C. O. HAYS                   *
*            REVISED 16 APRIL 1990               *
**************************************************
```

I. INPUT DATA

I.1 HEADING

```
 4 MARGARITA STILLING BASIN; CASE 2A AT STA. 54+75
 INV. MODE; TOP OF WALL EL. 9.4; 1 LEVEL OF WALL DRAINS, NO SLAB DRAIN
 48" BASE; 48" STEM
 VERTICAL SUBGRADE = 0.07 KCI; SURCHARGE = .0 KSF
```

I.2 MODE AND PROCEDURE

```
      INVESTIGATION MODE
      STRENGTH DESIGN
      1 BASIN STRUCTURE
      INPUT FILE NAME IS 'B2I75F.TXT  '
      OUTPUT FILE NAME IS 'O2I75F      '
      PLOT STORAGE FILE NAME IS 'P2I75F      '

      WALL DRAIN DATA INCLUDED
      BASE SLAB DRAIN DATA OMITTED
```

I.3 MATERIAL PROPERTIES

```
   CONCRETE,
     ULTIMATE STRENGTH          = 3.000   KSI
     MODULUS OF ELASTICITY      = 3123.   KSI
     UNIT WEIGHT                = 0.150   KCF

   REINFORCEMENT:
     YIELD STRENGTH             =   60.0  KSI
     MODULUS OF ELASTICITY      = 29000.  KSI
     MAX. TENSION STEEL RATIO =  0.250
```

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ACI CODE STRENGTH DESIGN PARAMETERS

MAXIMUM CONCRETE STRAIN	= 0.0030
STRESS BLOCK DEPTH RATIO	= 0.8500
STRESS BLOCK STRESS RATIO	= 0.8500
USABLE COMPRESSION RATIO	= 0.8000
PHI FACTOR (PURE AXIAL)	= 0.70
PHI FACTOR (PURE FLEXURE)	= 0.90
PHI FACTOR (SHEAR)	= 0.85

I.4 GEOMETRY *** ALL UNITS ARE FEET ***

EXTERIOR WALL DIMENSIONS

ELEVATIONS				/	WIDTHS	
TOP	BREAK	SLAB	DRAIN	SLOPE	TOP	BOTTOM
ELTOP1	ELBRK1	ELSLAB	ELDR	WSLOP1	WALLT1	WALLB1
9.40	1.00	-17.87	-15.87	0.00	1.33	4.00

SLAB AND HEEL DIMENSIONS

SLAB	WIDTHS	
DEPTH	HEEL	BASIN (HALF)
DEPTHS	WHEEL	WIDTH1
4.00	0.00	15.00

I.6 REINFORCEMENT FOR INVESTIGATION OPTION

2 MEMBERS INVESTIGATED * AREA OPTION FOR REINFORCEMENT

CLEAR COVER AND CL TO CL LAYER DISTANCE(CCLAY)

COVER (IN)				CCLAY(IN)
COVER(1)	COVER(2)	COVER(3)	COVER(4)	CCLAY
4.00	3.00	6.00	4.00	3.00

MEMBER # 2 ***** 2 SECTIONS INVESTIGATED

REINFORCEMENT DESCRIPTION

LOCATION	DISTANCE	NUMBER OF LAYERS	
		TOP	BOTTOM
LOC	DR(FT)	NTOPL	NBOTL
1	0.00	1	2

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```
                                  ***** TOP STEEL *****
                                  BAR DIAMETER       AREA PER LAYER
                                  OUTER    LAYER - 1
                                  DIAMB     AREAB(1)
                                   0.63         0.31
                                  ***** BOTTOM STEEL *****
                                  BAR DIAMETER       AREA PER LAYER
                                  OUTER    LAYER - 1 LAYER - 2
                                  DIAMB     AREAB(1)  AREAB(2)
                                   1.41         1.56      1.56
      2      6.00        1        2
                                  ***** TOP STEEL *****
                                  BAR DIAMETER       AREA PER LAYER
                                  OUTER    LAYER - 1
                                  DIAMB     AREAB(1)
                                   0.63         0.31
                                  ***** BOTTOM STEEL *****
                                  BAR DIAMETER       AREA PER LAYER
                                  OUTER    LAYER - 1 LAYER - 2
                                  DIAMB     AREAB(1)  AREAB(2)
                                   1.12         1.00      1.00

MEMBER # 11 *****  2 SECTIONS INVESTIGATED

REINFORCEMENT DESCRIPTION

LOCATION DISTANCE  NUMBER OF LAYERS
                       TOP  BOTTOM
     LOC    DR(FT)    NTOPL   NBOTL

       1      0.00        2        1
                                  ***** TOP STEEL *****
                                  BAR DIAMETER       AREA PER LAYER
                                  OUTER    LAYER - 1 LAYER - 2
                                  DIAMB     AREAB(1)  AREAB(2)
                                   1.41         1.56      1.56
                                  ***** BOTTOM STEEL *****
                                  BAR DIAMETER       AREA PER LAYER
                                  OUTER    LAYER - 1
                                  DIAMB     AREAB(1)
                                   0.63         0.31
       2     19.00        1        1
                                  ***** TOP STEEL *****
                                  BAR DIAMETER       AREA PER LAYER
                                  OUTER    LAYER - 1
                                  DIAMB     AREAB(1)
                                   0.63         0.31
                                  ***** BOTTOM STEEL *****
                                  BAR DIAMETER       AREA PER LAYER
                                  OUTER    LAYER - 1
                                  DIAMB     AREAB(1)
                                   0.63         0.31
```

I.7 LOADING CONTROL

1 EM-LIKE LOAD CASES
USING ACTIVE WEDGE METHOD FOR SOIL PRESSURES
0 SPECIAL LOAD CASES WITH DIRECT LOAD INPUT
ELASTIC SPRING FOUNDATION

I.8 HYDRAULIC STRESS AND STRENGTH DATA

******** EM-LIKE LOAD CASE 1 ********CASE 2A ********
STRENGTH DESIGN LOAD FACTOR = 2.21
****

SYMMETRICAL WATER ELEVATIONS (FT)

BACKFILL LEFT ELBWSL	CHANNEL LEFT ELCWSL
6.00	-8.10

DRAIN FACTORS AND AT REST MULTIPLIERS

% EFFECTIVE / MULTIPLIER

WALL PDRNW	BACKFILL, ATRESTS
50.00	1.61

I.9 SOILS DATA FOR WEDGE METHOD

BACKFILL SOIL PROPERTIES

UNIT WEIGHTS DRAINED UWSD (KCF)	SAT. UWSS (KCF)	PHI ANGLE SPHI (DEG)	COHESION SCOHE (KSF)	WALL FRICTION ANGLE DELFW (DEG)
0.122	0.139	32.000	0.000	21.000

BACKFILL DATA LEFT SIDE (SYMMETRICAL)

DISTANCES /

BACKFILL SLOPE SOJL (FT)	HORZ. SOKL (FT)	SURCHARGE START SOLL (FT)	LENGTH SOML (FT)	WEIGHT UWSURL (KSF)	BACKFILL ELEV. ELGSL (FT)	ANGLE ANBSL (DEG)	ROCK ELEV. ELRSL (FT)
0.00	100.00	0.00	30.00	0.00	9.40	0.00	-100.00

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I.13 ELASTIC SPRING FOUNDATION PROPERTIES

SOIL STRENGTH	SPRING MODULI VERT.	HORZ.	COHESION	FRICTION	ANCHORS NUMBER	SPRING MODULUS	MAXIMUM FORCE
FPF (KSF)	SCFV (KCI)	SCFH (KCI)	FCOHE (KSF)	DELFF (DEG)	NANCK	AKP (KSF)	AKM (K/F)
7.82	0.070	0.035	0.00	21.00	2	1.00	0.05

DISTANCES TO ELASTIC ANCHORS (FT)

ASP(1)	ASP(2).....
4.500	9.000

O. OUTPUT RESULTS

O.1 FACTOR OF SAFETY AND ANCHOR FORCES

FACTOR OF SAFETY AGAINST UPLIFT	BEARING	HORIZONTAL EQUILIBRIUM FACTOR	EM-LIKE LOAD CASE	SPECIAL LOAD CASE
1.53	7.12	9999.99	1	

******** EM-LIKE LOAD CASE 1 ********CASE 2A ********
****

ANCHOR FORCES AND FACTORS OF SAFETY

DISTANCE FROM LEFT END OF SLAB (FT)	ANCHOR FORCE (KIP/FT)	ANCHOR SAFETY FACTOR
5.50	0.00	9999.99
14.50	0.00	9999.99
23.50	0.00	9999.99
32.50	0.00	9999.99

O.3 OUTPUT OF MEMBER PRESSURES *** BY LOAD CASE ***

******** EM-LIKE LOAD CASE 1 ********CASE 2A ********
****

****** PRESSURES AND RESULTANT FORCES WITH ECCENTRICITIES ******
ON RIGID BLOCK UNDER WALL **** 11 ****

	VERTICAL PRESSURES / BOTTOM SURFACE (KSF) / LEFT EDGE	RIGHT EDGE	RESULTANT FORCES (K/FT) VERT. WALL FACE AT SLAB / BACKFILL HORZ.	VERTICAL	HYDRAULIC HORZ.	BOT. OF SLAB EFF. FDN. HORZ.	
EFF. FDN.	0.00	0.36	4.47	-1.07	4.71	0.32	FORCE
HYDRAULIC	1.30	1.30	0.00	-2.00	0.00	-2.00	ECC.

********** MEMBER 2 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	EFFECTIVE FOUNDATION
0.00	-0.61	1.30	0.36
3.00	-0.61	1.30	0.65
6.00	-0.61	1.30	0.86
9.00	-0.61	1.30	1.00
12.00	-0.61	1.30	1.07
15.00	-0.61	1.30	1.10
18.00	-0.61	1.30	1.07
21.00	-0.61	1.30	1.00
24.00	-0.61	1.30	0.86
27.00	-0.61	1.30	0.65
30.00	-0.61	1.30	0.36

RESULTANT HORIZONTAL FORCE ON BOTTOM OF SLAB (K/FT)
AND CORRESPONDING ECCENTRICITY (FT)

EFFECTIVE FOUNDATION	
0.00	FORCE
0.00	ECC.

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********** MEMBER 11 **********

HORIZONTAL PRESSURES (KSF)

DISTANCE (FT)	BACKFILL	HYDRAULIC LEFT	HYDRAULIC RIGHT	EFFECTIVE FORCE-DEF.
27.27	0.00	0.00	0.00	0.00
24.54	0.14	0.00	0.00	0.00
21.82	0.28	0.00	0.00	0.00
19.09	0.44	0.00	0.00	0.00
16.36	0.61	0.06	0.00	0.00
13.64	0.72	0.20	0.00	0.00
10.91	0.82	0.37	-0.01	0.00
8.18	0.92	0.54	-0.10	0.00
5.45	1.02	0.71	-0.27	0.00
2.73	1.12	0.88	-0.44	0.00
0.00	1.22	1.05	-0.61	0.00
-2.00	1.12	1.18		

RESULTANT VERTICAL FORCES (K/FT) ON WALL
AND CORRESPONDING ECCENTRICITIES (FT)

BACKFILL	HYDRAULIC	
-6.10	-1.25	FORCE
-0.73	-1.20	ECC.

0.4 OUTPUT OF MEMBER FORCES / STRENGTH RATIOS *** BY LOAD CASE ***

OUPUT FORCES AND MOMENTS DO NOT INCLUDE LOAD FACTOR.
HOWEVER, STRENGTH RATIOS COMPUTED USING LOAD FACTOR.

******** EM-LIKE LOAD CASE 1 ********CASE 2A *********

****

********** MEMBER 2 **********

DISTANCE (FT)	BENDING MOMENT (K-FT/FT)	FORCES SHEAR (K/FT)	FORCES AXIAL (K/FT)	LATERAL DEFLECT. (FT)	NET LATR. PRESSURE (KSF)	THICKNESS (FT)
0.00	230.6	-14.28	33.56	-0.003	1.05	4.00
3.00	189.3	-12.49	33.81	-0.005	1.34	4.00
6.00	154.8	-9.96	33.98	-0.007	1.55	4.00
9.00	129.0	-6.90	34.09	-0.008	1.69	4.00
12.00	113.1	-3.53	34.16	-0.009	1.76	4.00
15.00	107.7	0.00	34.18	-0.009	1.79	4.00
18.00	113.1	3.53	34.16	-0.009	1.76	4.00
21.00	129.0	6.90	34.09	-0.008	1.69	4.00

24.00	154.8	9.96	33.98	-0.007	1.55	4.00
27.00	189.3	12.49	33.81	-0.005	1.34	4.00
30.00	230.6	14.28	33.56	-0.003	1.05	4.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE	STEEL AREAS TENSION	COMPRESS.	STEEL RATIO	FLEX-AXIAL STRENGTH	DUCTILITY RATIO	SHEAR STRENGTH
(FT)	(SI/FT)	(SI/FT)	ASTOT/12*H	RATIO		RATIO
0.00	3.12	0.31	0.0060	0.85	1.78	0.68
6.00	2.00	0.31	0.0040	0.74	1.09	0.47

********** MEMBER 11 **********

DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(FT)
27.27	0.0	0.00	0.00	0.057	0.00	1.33
24.54	-0.2	0.28	0.61	0.050	0.14	1.33
21.82	-1.4	0.84	1.29	0.043	0.28	1.33
19.09	-4.5	1.82	2.12	0.036	0.44	1.33
16.36	-11.2	3.33	3.24	0.030	0.66	1.68
13.63	-22.8	5.49	4.68	0.024	0.92	2.07
10.91	-41.3	8.36	6.44	0.018	1.18	2.46
8.18	-68.6	11.82	8.52	0.013	1.36	2.84
5.45	-106.0	15.67	10.91	0.009	1.46	3.23
2.73	-154.2	19.78	13.62	0.005	1.56	3.61
0.00	-214.3	24.10	16.57	0.002	1.66	4.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE	STEEL AREAS TENSION	COMPRESS.	STEEL RATIO	FLEX-AXIAL STRENGTH	DUCTILITY RATIO	SHEAR STRENGTH
(FT)	(SI/FT)	(SI/FT)	ASTOT/12*H	RATIO		RATIO
0.00	3.12	0.31	0.0060	0.82	1.12	1.14
19.00	0.31	0.31	0.0032	0.43	0.44	0.32

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Summary of Bearing Safety Factors

I) ULTIMATE BEARING CAPACITY:

"Q" CONDITIONS: $C = 1260$ PSF

$p_u = cN_c = 1260(5.7) = 7182$ PSF $= 7.18$ KSF

II) FROM CURBC RESULTS: AT STA 54+10; "DESIGN" MODE

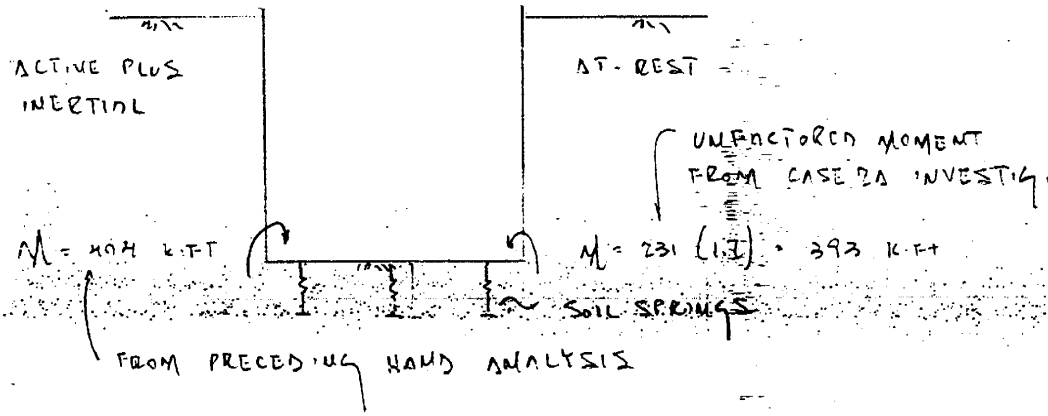
LOAD CASE	BEARING S.F.	REQ'D S.F.
1A	4.69	2.0
1B	5.78	2.0
2A	6.75	3.0
2B	6.94	2.0
3A	6.63	3.0
3B	6.75	2.0
3C	7.84	1.0

NOTE: THESE BEARING S.F.'S ARE BASED ON SLAB THICKNESSES FROM 3' TO 5'. IN ANY CASE, THEY ARE ALL WELL ABOVE THE REQ'D S.F.

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III) LOAD CASE 4A : EARTHQUAKE



UNBALANCED MOMENT : 404 - 393 = 11 K-FT

THIS MOMENT IS ONLY 11/393 => 2.7% OF SMALLER END MOMENT AND WILL NOT SIGNIFICANTLY AFFECT THE FOUNDATION PRESSURE DISTRIBUTION IN COMPARISON LOAD CASE 2A. => ∴ OK.

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SUMMARY OF FLOTATION SAFETY FACTORS

I) CALCULATION OF FLOTATION SAFETY FACTORS

1.) THE PROGRAM CALCULATES THE FLOTATION SAFETY FACTOR IN ACCORDANCE WITH ETL 1110-2-307, "FLOTATION STABILITY".

A) TERM COMPARISON:

PROGRAM		ETL	REMARKS
WSOIL + WUF	=	W_s	SOIL WT.
WSPEC	=	S	SURCHARGE
WWATI	=	W_c	WATER IN CHANNEL
UWAT	=	$U - W_s$	UPLIFT
FHOLD	=	NO EQUIVALENT	

TENSION-ONLY ANCHOR FORCES

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II)- FROM CUFRBC RESULTS: AT STA 54+10 "DESIGN" MODE

LOAD CASE	FLOTATION S.F.		REQ. S.F.
1A	10.1	*	1.3
1B	10.4	*	1.3
2A	2.21	*	1.5
2B	2.31	*	1.3
3A	2.31	*	1.5
3B	2.26	*	1.3
3C	1.96	*	1.1

* S.F. INCLUDES ANCHOR FORCES => 4 (10) = 40 K OF HOLDING CAPACITY.

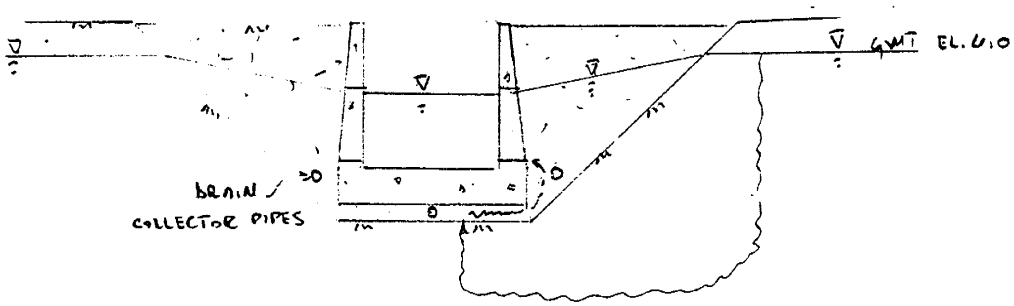
THE ANCHORS TAKE NO LOAD.

THE S.F. WITHOUT ANCHORS WILL BE VERIFIED IN THE FINAL "INVESTIGATION" CHECKS.

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COMMENTS ON UPLIFT:

1. THE DRAINAGE BLANKET IS CONTINUOUS UNER THE BASIN.

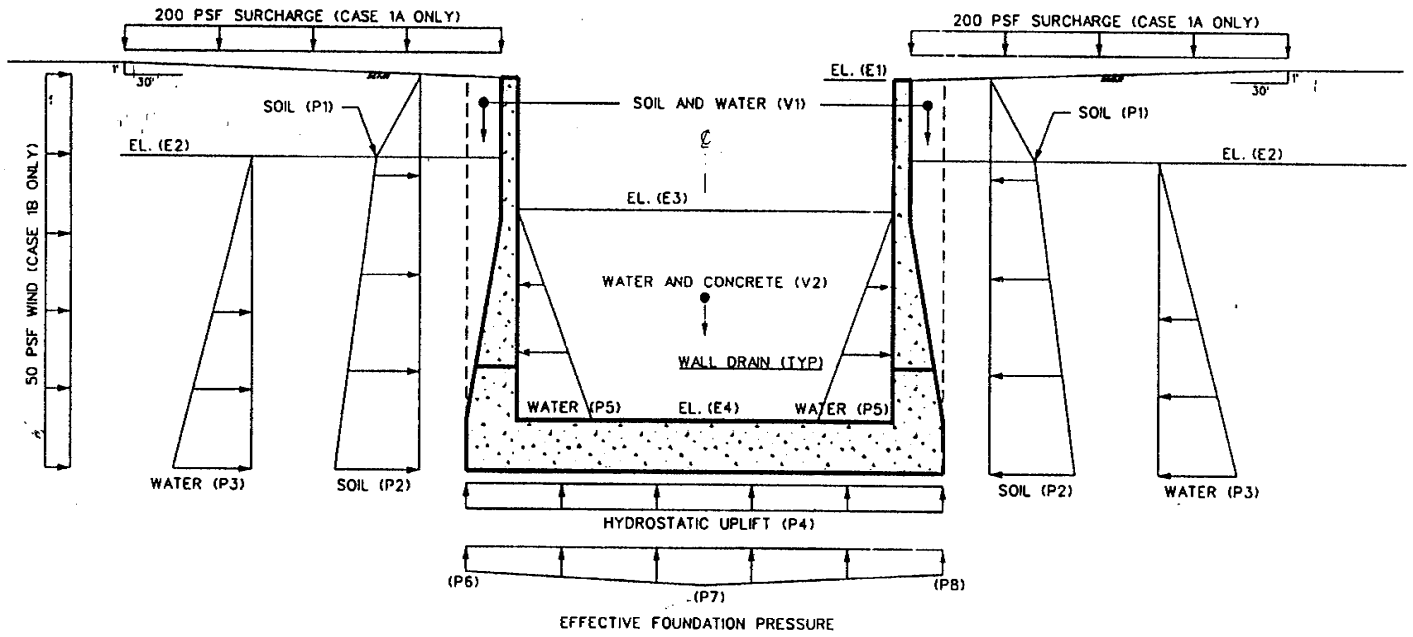


2. UPLIFT PRESSURES WILL NOT DEVELOP AS MODELED IN THE PROGRAM. POTENTIAL UPLIFT PRESSURES WILL BE REDUCED TO NEAR ZERO BY A FULLY EFFECTIVE DRAIN SYSTEM.

3. FOR THE PROPOSED DRAINAGE SYSTEM, COLLECTOR PIPES AND WALL DRAINS, A 0% EFFECTIVE DRAINAGE CASE IS UNREALISTIC. THEREFORE, FOR LOAD CASE 3C, IS 25% EFFECTIVE SYSTEM IS USED, PER EM 1110-2-2007, IN THE FINAL DESIGN CHECK RUNS.

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IV.) LOAD CASE #4 : EARTHQUAKE ; VERTICAL ACCELERATION IS ASSUMED TO BE ZERO. THEREFORE, SEISMIC EFFECTS DO NEED AFFECT THE CALCULATION OF THE FLOTATION S.F.



EFFECTIVE FOUNDATION PRESSURE

STA	LOAD CASE	ELEVATION E1 FT	E2 FT	E3 FT	E4 FT	PRESSURE P1 KSF	P2 KSF	P3 KSF	P4 KSF	P5 KSF	P6 KSF	P7 KSF	P8 KSF	LOAD V1 KIP	V2 KIP	FS: CALCULATED / ALLOWABLE BEARING	FLOTATION
54+10	1	9.40	-17.87	-17.87	-17.87	1.50	0.94	-1.12	-1.12	0.00	1.04	1.56	1.04	10.77	14.59	5.00 / 2.0	5.87 / 1.30
	1	9.40	-17.87	-17.87	-17.87	1.50	0.94	-1.12	-1.12	0.00	1.82	1.44	1.97	10.77	14.59	3.97 / 2.0	5.76 / 1.30
	2	9.40	6.00	6.40	-17.87	0.19	0.37	0.38	0.38	1.52	0.80	1.19	0.80	11.97	60.16	6.55 / 3.0	1.58 / 1.50
	2	9.40	6.00	9.30	-17.87	0.19	0.37	0.38	0.38	1.70	1.08	1.18	1.08	11.97	65.54	6.63 / 2.0	1.57 / 1.30
	3	9.40	6.00	-1.00	-17.87	0.19	0.37	0.38	0.38	1.05	0.52	1.20	0.52	11.97	46.22	6.51 / 3.0	1.55 / 1.50
	3	9.40	7.00	-1.00	-17.87	0.13	0.35	0.44	0.44	1.05	0.47	1.18	0.47	12.05	46.22	6.60 / 2.0	1.52 / 1.30
	3	9.40	7.00	-1.00	-17.87	0.13	0.35	0.44	0.44	1.05	0.28	1.11	0.28	12.05	46.22	7.05 / 1.0	1.41 / 1.10
54+75	2	9.40	6.00	-8.10	-17.87	0.19	0.37	0.38	0.38	0.61	0.36	1.10	0.36	11.97	32.91	7.12 / 3.0	1.53 / 1.50

LOAD CASE DESCRIPTIONS:

1: POST-CONSTRUCTION CONDITION: UNUSUAL; BASIN EMPTY STRUCTURE COMPLETE WITH BACKFILL NOT IN PLACE; WIND LOAD 50 PSF, O-STATE SOILS.

2: SPF CONDITION: USUAL; BASIN WATER VARIES WITH HYDRAULIC JUMP, GWT EL. 6.0 NGVD, WALL DRAINS 50% EFFECTIVE, S-STATE SOILS.

3: DRAWDOWN CONDITIONS: UNUSUAL, BASIN WATER EL -1.0 NGVD, GWT EL 7.0 NGVD, WALL DRAINS 50% EFFECTIVE; S-STATE SOILS.

SCALE: 1" = 10'

10' 0 10'

DESIGN ENG.: WWW
DWN. BY: WWW
CKD. BY:

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2
MARGARITA TRIBUTARY STA 54+10 TO 54+75
STILLING BASIN
STABILITY ANALYSIS
STRUCTURAL
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-36,XXX
APRIL 1997

PLATE S-6

C-2-38

PMF2506.DGN

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SLIDING ANALYSIS

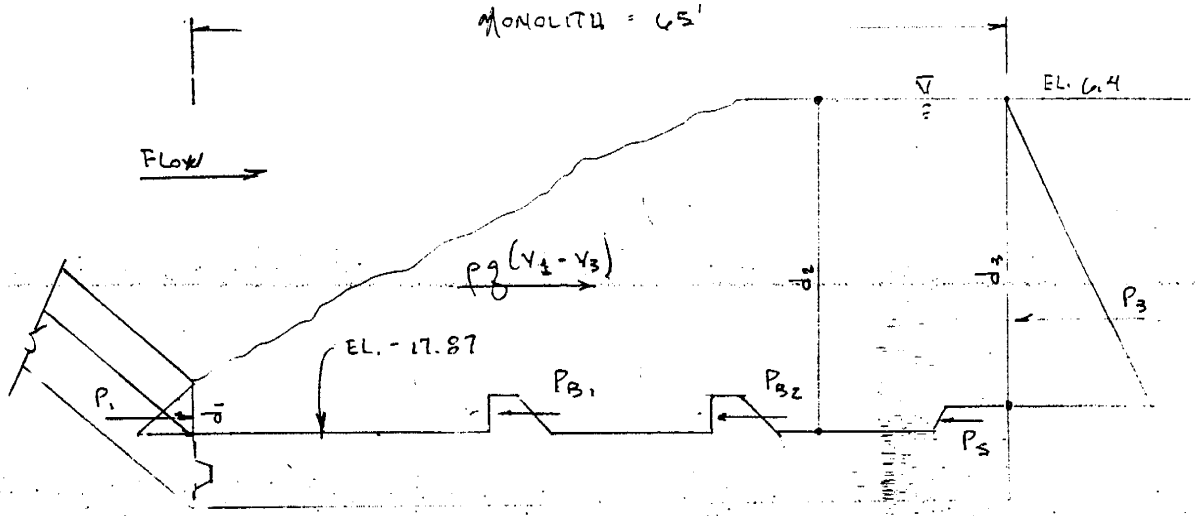
LOAD CASE 2A, SPF CONDITIONS, WILL PRODUCE THE HIGHEST DRIVING FORCES IN THE DOWNSTREAM DIRECTION

1) DRIVING FORCES

1. MOMENTUM: EM 1110-2-1603 p. 2-10 TO 2-12

$$\rho q V_1 - \rho q V_3 = P_3 - P_1 + P_B + P_S \quad (\text{EQN. } 2\text{-}34)$$

WHERE $P_B = P_{B1} + P_{B2}$



PARTIAL SECTION THRU BASIN

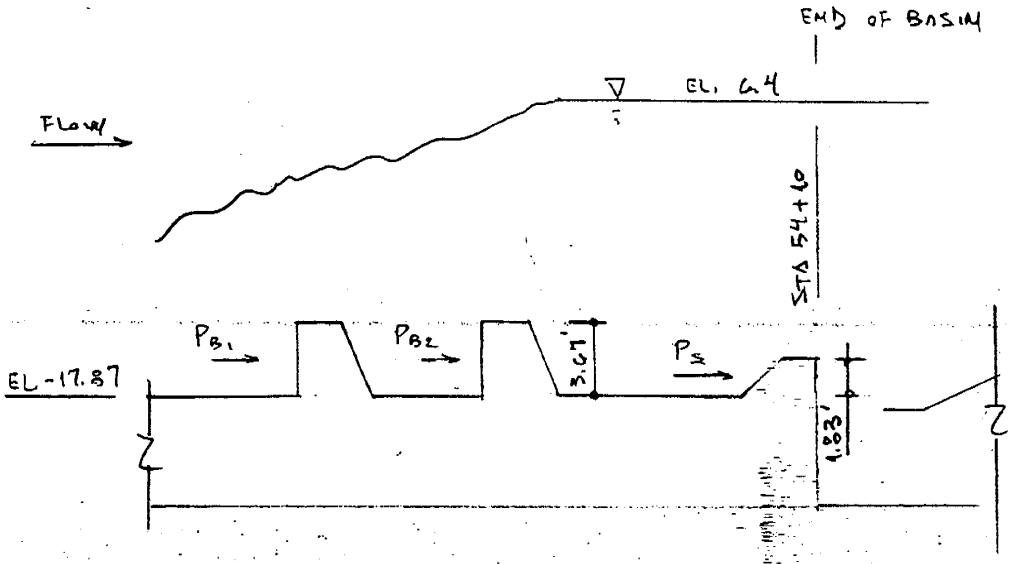
A. FROM HYDRAULICS TABLE 12 IN GDM:

STA 54+10: AVG VEL = 11.0 FT/S, d = 24.3'

STA 54+75: AVG VEL = 38.4 FT/S, d = 7.4'

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FORCES P_{B1}, P_{B2}, AND P_S CAUSE SLIDING. FOR THE PURPOSES OF THIS ANALYSIS, ASSUME THE EQUILIBRIUM EQUATION BALANCES, AND THE NET HYDRAULIC MOMENTUM IS 0.



$P_{B1} = P_{B2} = C_D \rho V_s^2 h / 2$ WHERE

C_D = DRAG COEFF. ⇒ USE P. 40

ρ = MASS DENSITY OF WATER = $\frac{62.4}{32.2}$ = 1.94 SLUGS/FT^3

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V_B = VELOCITY @ BAFFLE

FROM PLATE 2.3 :

- ASSUME JUMP BEGINS @ 54+75
- USE AVG. DISTANCE TO 2 ROWS OF BAFFLES

$(33.2 + 43.8)/2 = 38.5'$ => x

$x/d_2 = 38.5/23.87 = 1.61$

USE $x/d_2 = 2$ GRAPH

- FROUDE NUMBER = 2.6 (GIVEN)
- y = MID-HEIGHT OF BAFFLE = $3.67/2 = 1.83'$
- $y/d_2 = 1.83/23.87 = 0.0768$

FROM GRAPH : $\bar{V}/V_1 = 0.55$

$\bar{V} = .55\, V_1 = .55(38.4) = 21.1$ FT/S => V_B

$P_B = .4(1.94)(21.1)^2(3.67)/2 = 635.1$ LB/FT

PER ROW : 5 BLOCKS @ 3' WIDE EACH = 15'

$P_B = 635.1(15) = 9527.4$ LB / ROW

$= 9.5$ K / ROW

$P_{B\ TOTAL} = 2(9.5) = 19.0$ K

(2 ROWS)

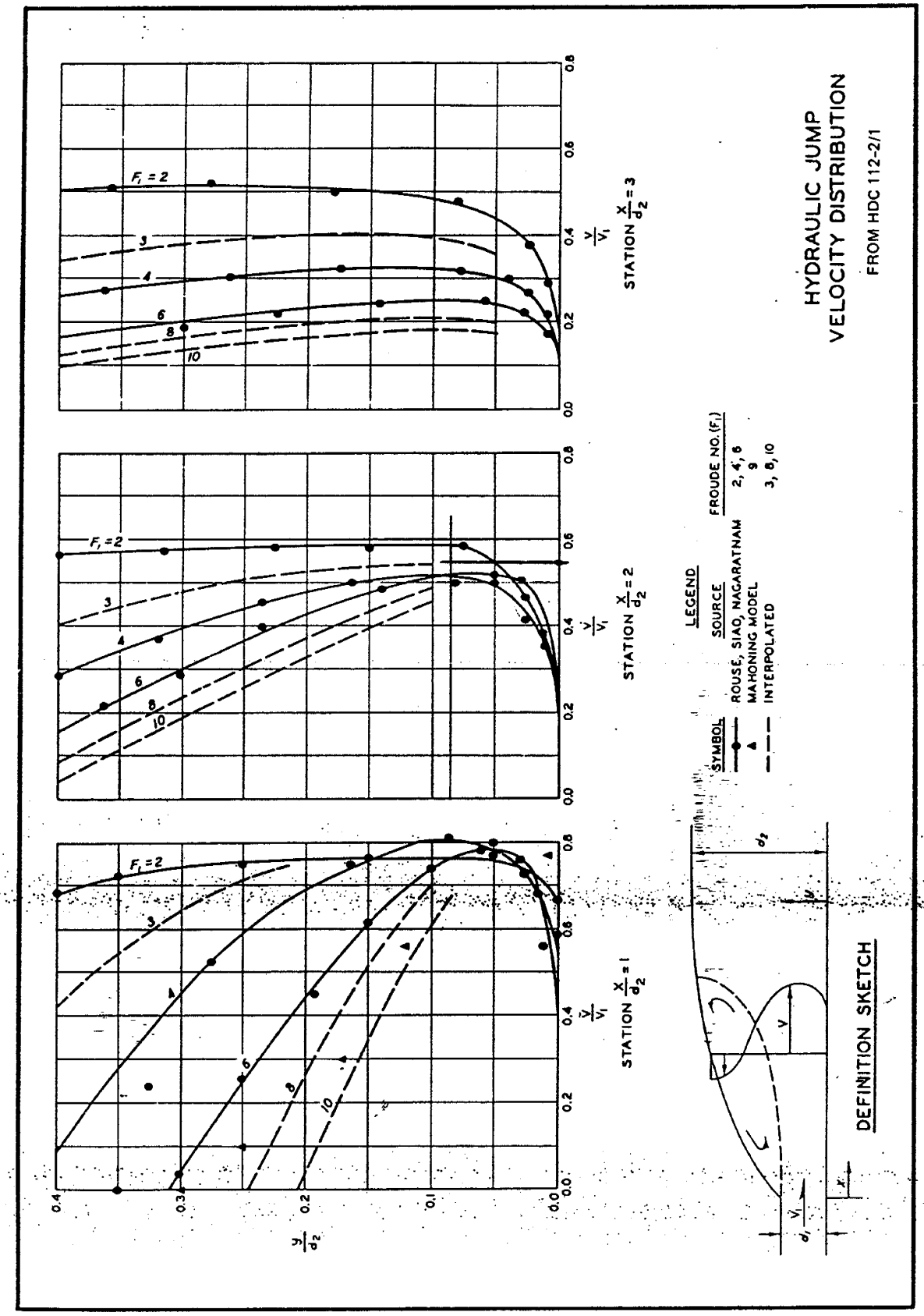


PLATE 2-3

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B) P_s (ENDSILL) $= \gamma h_s \left[d_3 + h_s/2 \right]$ (EQN. 2-33)

$h_s = 1.83'$

$d_3 = 6.4 + (17.87 - 1.83) = 22.44$

$P_s = 62.4 (1.83)(22.4 + 1.83/2) = 2062.$ LB/FT $= 2.7$ K/FT

$P_{S\ TOTAL} = 2.7$ K/FT (30 FT) $= 81.$ K

C) $P_{B\ TOTAL} + P_{S\ TOTAL} = 19. + 81. = 100.$ K

2) SOIL/WATER FORCES: ASSUME NO DRIVING SOIL OR HYDROSTATIC FORCES FROM THE UPSTREAM SLOPING MONOLITHS ACT ON THIS MONOLITH.

3) ∴ TOTAL DRIVING FORCE = 100. K (LOAD CASE 21)

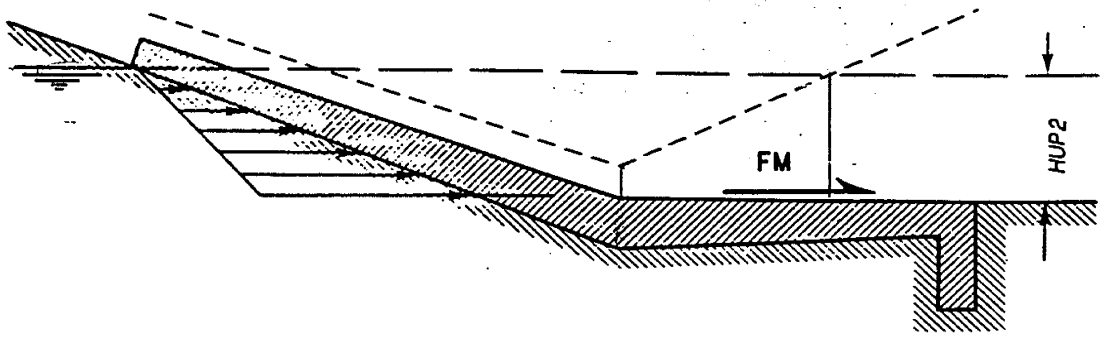


Figure 9. Sliding forces, load condition No. 2

Momentum considerations. Figure 10 shows two tailwater conditions with the force FM shown as the horizontal force acting on the water due to

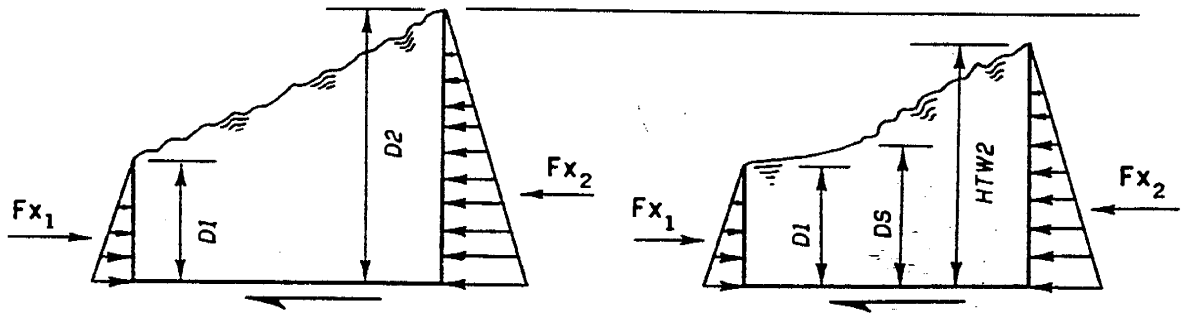


Figure 10. Momentum relations in basin

the basin. In sketch (A) the tailwater is D2, the sequent depth to depth, D1. In sketch (B) the tailwater is HTW2 which is shown as less than D2. From momentum principles, letting V1, D1, and V2, HTW2 be velocity and depth of flow at beginning and end sections respectively,

$$F_{x_1} - F_{x_2} - FM = \frac{\gamma}{g} Q(V2 - V1)$$

or

$$FM = (F_{x_1} + \frac{\gamma}{g} QV1) - (F_{x_2} + \frac{\gamma}{g} QV2)$$

for rectangular channels, and in terms of per foot of width

$$FM = (\frac{\gamma D1^2}{2} + \frac{\gamma}{g} q\ V1) - (\frac{\gamma\ \overline{HTW2}^2}{2} + \frac{\gamma}{g} q\ V2)$$

W/ BAFFLE PIERS AND ENDSILL

$$FM = \left(F_{x_1} + \frac{\gamma}{g} q V_1\right) - \left(F_{x_3} + \frac{\gamma}{g} q V_3\right) - P_B - P_S = 0$$ (FOR BALANCED MOMENTUM)

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which by substitution can be written

$$FM = FM1 - FM2$$

where, with depths in ft, velocities in fps

FM ≡ net force due to horizontal change in momentum, lbs per ft width of channel

FM1 ≡ momentum force at section of depth, D1, $= (\frac{\gamma D1^2}{2} + \frac{\gamma}{g} q\ V1)$, lbs per ft width of channel

FM2 ≡ momentum force at section of depth, HTW2, $= (\frac{\gamma\ \overline{HTW2}^2}{2} + \frac{\gamma}{g} q\ V2)$, lbs per ft of width of channel

γ = 62.4 lbs per cu ft

g = 32.2 ft per sec^2

q = discharge, cfs per ft width of channel

V2 = V1 x D1/HTW2

Taking FM = 0 defines the case of a hydraulic jump. The beginning and end depths are sequent depths, the end depth is given by

$$D2 = \frac{1}{2} D1 \left(\sqrt{8F_1 + 1} - 1 \right)$$

where

F_1 = Froude's number = $V1^2/gD1$

When the tailwater is less than D2, as in sketch (B), FM2 is less than FM1, that is, FM > 0. Hence the force, FM, acting on the basin tends to push the basin downstream. The depth, DS, is the sequent depth to the depth, HTW2. The water surface profile is roughly that shown.

When the tailwater is more than D2, sketch not shown, FM2 is more than FM1, that is FM < 0. Hence the force, FM, acting on the basin tends to push the basin upstream. The jump tends to move upstream since somewhere between the depth, D1, and tailwater depth there is a depth, DS, that is sequent to D1.

However, the sum of FM and the horizontal component of the hydrostatic force due to HUP2, see Figure 9, is of more concern than consideration of the variation of FM alone. Let FH2 be the hydrostatic force and FS2 be the sum force, then in lbs per ft width of channel

$$FS2 = FH2 + FM.$$

For purposes of study, take the particular case of HUP2 = HTW2, then -

$$FS2 = \frac{\gamma\ \overline{HTW2}^2}{2} + FM1 - \left(\frac{\gamma\ \overline{HTW2}^2}{2} + \frac{\gamma}{g} \frac{q^2}{HTW2}\right)$$

or

$$FS2 = FM1 - \frac{\gamma}{g} \frac{q^2}{HTW2}$$

differentiating with respect to HTW2 to find the value of HTW2 making

C-2-25

FS2 a maximum gives

$$HTW2 = \infty.$$

Thus FS2 approaches FM1 as HTW2 approaches ∞. The height of the sidewalls, J is the control, so that FS2 maximum would occur when HTW2 = HUP2 = J.

In design, the condition resulting in the minimum actual factor of safety against sliding should be checked. This condition probably occurs when HTW2 = D2. For higher tailwaters than D2, the basin becomes essentially full of water so that an increase in FS2 is offset by an increase in frictional resistance due to increased water weight.

Possible modification of load condition No. 2. As explained in the next section, HTW2 and HUP2 are selected by the user. If HUP2 and/or HTW2 are selected greater than the sequent depth, D2, they are reduced during design to D2. This is done for the reasons discussed immediately above, namely, HTW2 = D2 represents a more critical situation than when HUP2 and/or HTW2 are more than D2.

Design Parameters

There are some twenty-two independent parameters involved in the structural design of the aforementioned three types of SAF stilling basins. These parameters are classified as either primary parameters or secondary parameters. Values for primary parameters must be supplied by the user for each design run. Secondary parameters will be assigned default values if values are not supplied by the user. The methods of supplying parameter values are discussed under the section, "Computer Designs."

Primary Parameters

W ≡ width of SAF stilling basin, in ft

J ≡ height of basin sidewalls, in ft

LB ≡ length of basin, in ft

N ≡ height of sidewalls at upstream end section, in ft

D1 ≡ entrance depth of water to SAF stilling basin, in ft

V1 ≡ entrance velocity of water to SAF stilling basin, in fps

Secondary Parameters

The secondary parameters and their default values are listed in Table 1. The user should make an effort to evaluate the secondary parameter values he wishes to use. Use of default values may result in an overly conservative (or unconservative) design. Usage of the various parameters is explained where first encountered. The default value for HTW2 is a function of D2, the sequent depth to depth D1. The value of Froude's number is computed and it, and D2 are output with the parameter values selected for the design run.

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B) RESISTING FORCES:

1. FRICTION @ FOUNDATION OVER 65' LENGTH (SEE NEXT PAGE)

A. FIND NET VERTICAL FORCE

1. CONCRETE:

(C_W ← FROM BEFORE) $C_W = 2(2.7)(65) =$ 1001 k

$C_S = 4(37.5)(.15)(65) =$ 1462.5 k

$C_B = 3.67(3)(.15)(10) =$ 16.5

2480. k ↓

2. SOIL: $S = S_M + S_{SUB}$

$S_M = (3.75)(9.4-3)(.11) =$ 2.64 k/FT

$S_{SUB} = [3.75(2) + .5(3.75)(13.87)](.125) =$ 5.4 k/FT

$\therefore S = (2.6 + 5.4)(65) =$ 520 k ↓

3. WATER IN CHANNEL:

USE AVG. EL. $= (-8.1 + 6.4)/2 = -.85$

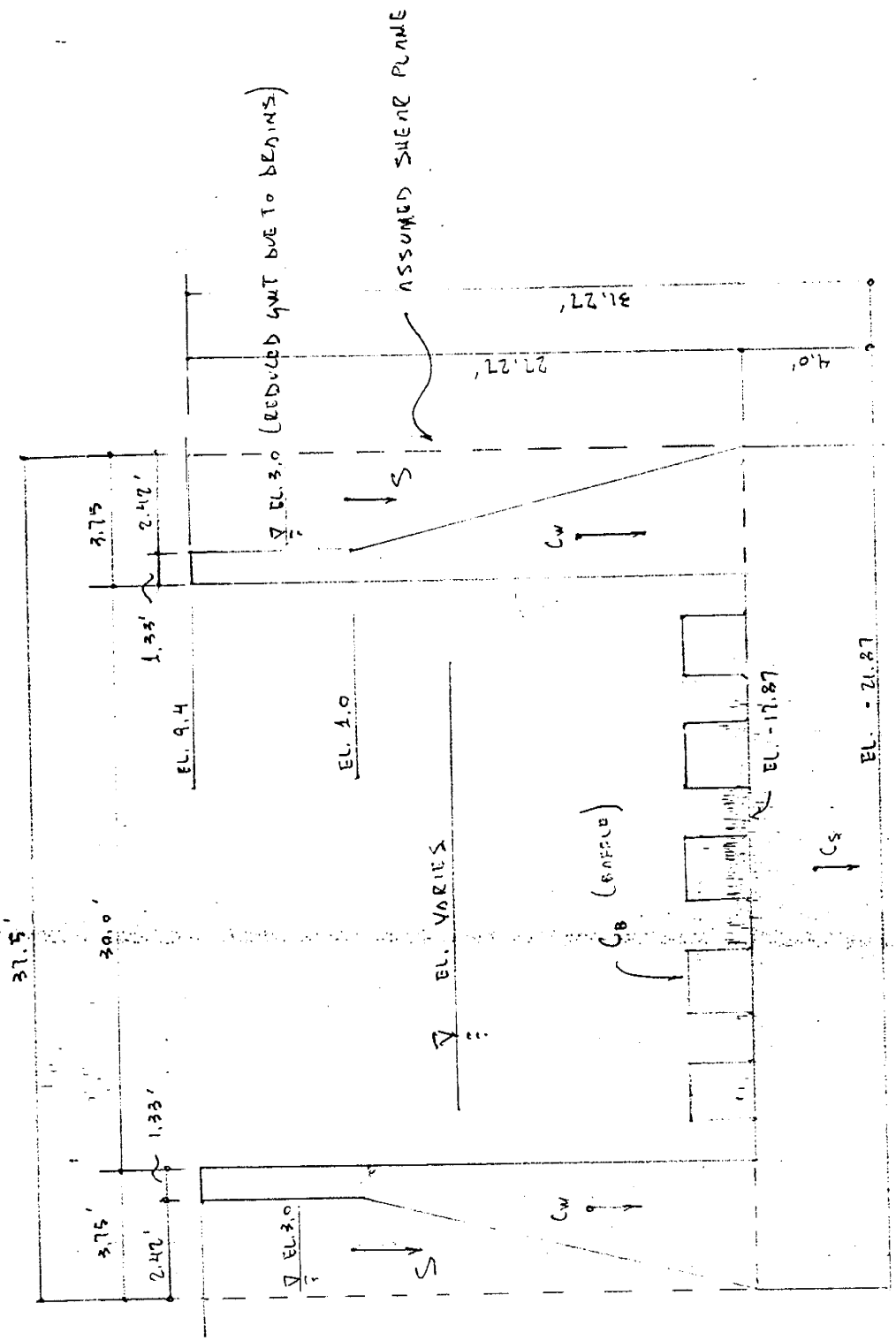
AVG DEPTH $= -.85 - 17.81 \Rightarrow 17.02'$

$W = 17(65)(.0625) =$ 69.1 k ↓

4. UPLIFT:

$U = 24.87(65)(.0625) =$ 101.0 k ↑

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5. TOTAL : 2480 + 520 + 69 - 101 = 2968 ↓

B. FIND FRICTIONAL RESISTANCE

- DUE TO DRAINAGE BLANKET, $c = 0$, $\phi = 32°$

$R_F = W / \tan\phi$: 2968 k / TAN 32 : 4749.8 k

2. FRICTION @ SIDEWALLS : ASSUME ZERO => THIS FORCE VARIES WITH DEPTH AND IS HIGHLY UNRELIABLE.

3. RESISTANCE DUE TO WINGWALLS : ASSUME ZERO

4. RESISTANCE DUE TO TOE WALL : ASSUME NO TOE WALL

5. TOTAL RESISTING FORCES = 4750. k

C) FACTOR OF SAFETY FOR LOAD CASE 2A

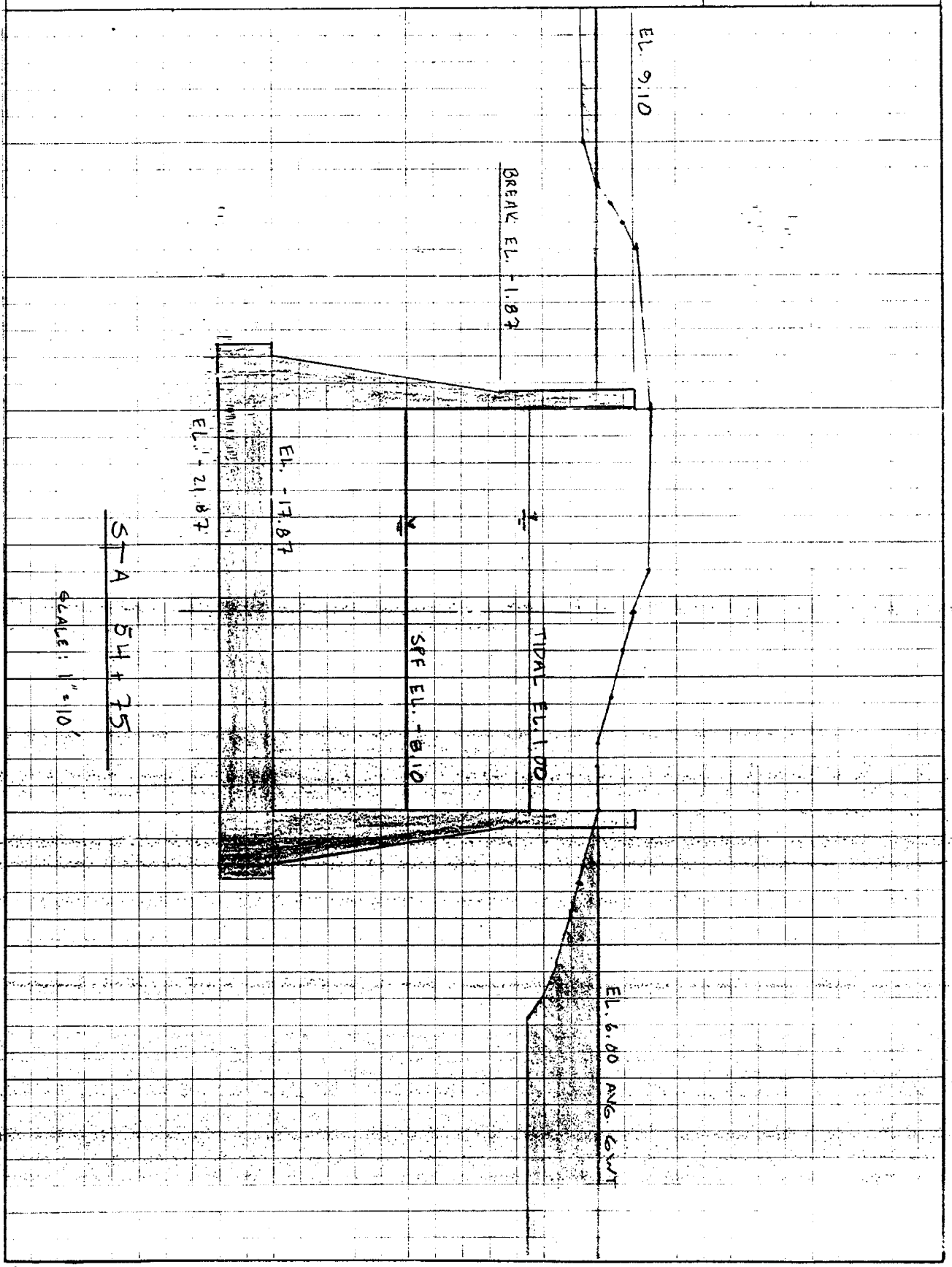
FS = 4750 k / 100 k = 47.5 > 1.5 OK

APPENDIX C-3

SAMPLE CALCULATIONS
MARGARITA CONCRETE U-FRAME CHANNEL
STATION M54+75 TO M89+60

C-3-1

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PUEBLO VIEJO FDM 2			SLL	6/96
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U-CHANNEL DESIGN MARGARITA TRIBUTARY				

BACKFILL PROPERTIES (CB-MC-42 BACKFILL)

γ_w = 110 pcf ϕ' = 32° K_a = 0.31

γ_{sat} = 125 pcf c = 0 K_p = 3.2

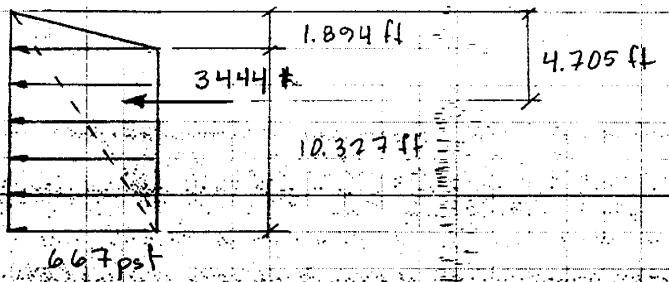
γ_{buoy} = 62.6 pcf K_o = 0.5 $q_u = cN_c = (1260)(5.7) = 7182$ psf

PRESSURE DIAGRAM FOR COMPACTION ROLLER

$$Z_{cr} = \sqrt{\frac{2K_aK_oP}{\pi\gamma}} = \sqrt{\frac{2(0.31)(0.5)(4000)}{\pi(110)}} = 1.894 \text{ ft}$$

$$Z_z = \sqrt{\frac{2P}{K_aK_o\pi\gamma}} = \sqrt{\frac{2(4000)}{(0.31)(0.5)\pi(110)}} = 12.221 \text{ ft}$$

$$P'_{hm} = K_p\gamma Z_{cr} = (3.2)(110)(1.894) = 667 \text{ psf}$$



NOTE: MAGNITUDE & LOCATION OF EQUIV. FORCE DETERMINED GRAPHICALLY (CADD)

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PUERTO NUEVO FDM 2		ER	6/96
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U-CHANNEL DESIGN MARGARITA TRIBUTARY			

EARTHQUAKE LOADS $k_h = 0.15$ (ZONE 3)

USE GENERAL WEDGE ANALYSIS:

$$P_A = P_{A1} + P_{A2} = \frac{1}{2} K_A \gamma (h-h_s)^2 + \frac{1}{2} h_s \left[2 K_A \gamma (h-h_s) + K_b \gamma_b h_s \right]$$

$$P_{W_s} = \frac{1}{2} \gamma_w h_s^2$$

$$\Delta P_{AE} = \Delta P_{AE1} + \Delta P_{AE2} = k_h \left[\frac{\gamma h^2}{2(\tan\alpha - \tan\beta)} \right] + k_h \left[\frac{(\gamma_s - \gamma) h_s^2}{2 \tan\alpha} \right]$$

WHERE:

$$K_A = \left(\frac{1 - \tan\phi \cot\alpha}{1 + \tan\phi \tan\alpha} \right) \left(\frac{\tan\alpha}{\tan\alpha - \tan\beta} \right)$$

$$K_b = \left(\frac{1 - \tan\phi \cot\alpha}{1 + \tan\phi \tan\alpha} \right) \left[1 + \left(\frac{\tan\alpha}{\tan\alpha - \tan\beta} - 1 \right) \frac{\gamma}{\gamma_b} \right]$$

$$\alpha = \tan^{-1} \left(\frac{c_1 + \sqrt{c_1^2 + 4c_2}}{2} \right)$$

$$c_1 = \frac{2(\tan\phi - k_h)}{1 + k_h \tan\phi} \qquad c_2 = \frac{\tan\phi (1 - \tan\phi \tan\beta) - (\tan\beta + k_h)}{\tan\phi (1 + k_h \tan\phi)}$$

$\gamma = 110$ pcf
$\gamma_s = 125$ pcf
$\gamma_b = 62.6$ pcf
$\phi = 32°$ $c = 0$

$$c_1 = \frac{2(\tan 32° - 0.15)}{1 + 0.15 \tan 32°} = \boxed{0.8683} \checkmark$$

$$c_2 = \frac{\tan 32° (1 - \tan 32° \tan 0°) - (\tan 0° + 0.15)}{\tan 32° (1 + 0.15 \tan 32°)} = \boxed{0.6948} \checkmark$$

$$\alpha = \tan^{-1} \left(\frac{0.8683 + \sqrt{(0.8683)^2 + 4(0.6948)}}{2} \right) = \boxed{53.952°} \checkmark$$

DRIVING SIDE

PROJECT		Page 3 of —	COMPUTED BY	DATE
PUERTO NUEVO FDMZ			SP	6/96
SUBJECT			CHECKED BY	DATE
LI-CHANNEL DESIGN MARGARITA TRIBUTARY				

$$K_A = \left(\frac{1-\tan 32^\circ \cot 53.952^\circ}{1+\tan 32^\circ \tan 53.952^\circ}\right)\left(\frac{\tan 53.952^\circ}{\tan 53.952^\circ - \tan 0^\circ}\right)$$

$$= \boxed{0.2934} \checkmark$$

$$K_b = \left(\frac{1-\tan 32^\circ \cot 53.952^\circ}{1+\tan 32^\circ \tan 53.952^\circ}\right)\left[1+\left(\frac{\tan 53.952^\circ}{\tan 53.952^\circ - \tan 0^\circ}-1\right)\frac{110}{62.6}\right]$$

$$= \boxed{0.2934} \checkmark$$

$$P_{A1} = \frac{1}{2}(0.2934)(110)(30.97-25.37)^2 = \boxed{506\ \#}$$

$$P_{A2} = \frac{1}{2}(25.37)\left[2(0.2934)(110)(30.97-25.37)+(0.2934)(62.6)(25.37)\right]$$

$$= \boxed{10,496\ \#} \checkmark$$

$$P_{WS} = \frac{1}{2}(62.4)(25.37)^2 = \boxed{20,081\ \#}$$

$$\Delta P_{AE1} = 0.15\left[\frac{110(30.97)^2}{2(\tan 53.952^\circ - \tan 0^\circ)}\right] = \boxed{5,759\ \#} \checkmark$$

$$\Delta P_{AE2} = 0.15\left[\frac{(125-110)(25.37)^2}{2\tan 53.952^\circ}\right] = \boxed{527\ \#}$$

RESISTING SIDE

$$\Delta P_{PE} = \Delta P_{PE1} + \Delta P_{PE2} = k_h\left[\frac{\gamma h^2}{2(\tan\alpha - \tan\beta)}\right] + k_h\left[\frac{(\gamma_s-\gamma)h_s^2}{2\tan\alpha}\right]$$

$$\Delta P_{PE1} = 0.15\left[\frac{110(30.97)^2}{2(\tan 26.825^\circ - \tan 0^\circ)}\right] = \boxed{15,648}$$

$$\Delta P_{PE2} = 0.15\left[\frac{(125-110)(25.37)^2}{2\tan 26.825^\circ}\right] = \boxed{1,432\ \#}$$

$P_{WS} = \boxed{20,081\ \#}$ (AS BEFORE)

PASSIVE SIDE FORCES CANNOT BE

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PUERTO NUEVO FDMZ		EAC	6/96
SUBJECT		CHECKED BY	DATE
L-CHANNEL DESIGN MARGARITA TRIBUTARY			

$$P_p = P_{p1} + P_{p2} = \frac{1}{2} K_p \gamma (h-h_s)^2 + \frac{1}{2} h_s \left[2 K_p \gamma (h-h_s) + K_b \gamma_b h_s \right]$$

$$P_{ws} = \frac{1}{2} \gamma_w h_s^2$$

$$K_p = \left(\frac{1 + \tan\phi \cot\alpha}{1 - \tan\phi \tan\alpha} \right) \left(\frac{\tan\alpha}{\tan\alpha - \tan\beta} \right)$$

$$K_b = \left(\frac{1 + \tan\phi \cot\alpha}{1 - \tan\phi \tan\alpha} \right) \left[1 + \left(\frac{\tan\alpha}{\tan\alpha - \tan\beta} - 1 \right) \frac{\gamma}{\gamma_b} \right]$$

$$K_p = \left(\frac{1 + \tan 32^\circ \cot 26.825^\circ}{1 - \tan 32^\circ \tan 26.825^\circ} \right) \left(\frac{\tan 26.825^\circ}{\tan 26.825^\circ - \tan 0^\circ} \right) = \boxed{3.268}$$

$$K_b = \left(\frac{1 + \tan 32^\circ \cot 26.825^\circ}{1 - \tan 32^\circ \tan 26.825^\circ} \right) \left[1 + \left(\frac{\tan 26.825^\circ}{\tan 26.825^\circ - \tan 0^\circ} - 1 \right) \frac{116}{62.6} \right]$$

$$= \boxed{3.268}$$

$$\alpha = \tan^{-1} \left(\frac{-C_1 + \sqrt{C_1^2 + 4C_2}}{2} \right) \qquad C_1 = \frac{2(\tan\phi + k_h)}{1 + k_h \tan\phi}$$

$$C_2 = \frac{\tan\phi \left(1 + \tan\phi \tan\beta\right) + \left(\tan\beta - k_h\right)}{\tan\phi \left(1 + k_h \tan\phi\right)}$$

$C_1 = \boxed{0.8683}$ (AS BEFORE)

$$C_2 = \frac{\tan 32^\circ \left(1 + \tan 32^\circ \tan 0^\circ\right) + \left(\tan 0^\circ - 0.15\right)}{\tan 32^\circ \left(1 + 0.15 \tan 32^\circ\right)} = \boxed{0.6948}$$

$$\alpha = \tan^{-1} \left(\frac{-0.8683 + \sqrt{(0.8683)^2 + 4(0.6948)}}{2} \right) = \boxed{26.825^\circ}$$

PROJECT	Page 5 of —	COMPUTED BY	DATE
PUERTO NUEVO FDMZ		EP	6/96
SUBJECT		CHECKED BY	DATE
U-CHANNEL DESIGN MARGARITA TRIBUTARY			

$$P_{P_1} = \frac{1}{2}(3.268)(110)(30.97-25.37)^2 = \boxed{5,637\ \#}$$

$$P_{P_2} = \frac{1}{2}(25.37)\left[2(3.268)(110)(30.97-25.37) + (3.268)(62.6)(25.37)\right]$$

$$= \boxed{116,909\ \#}$$

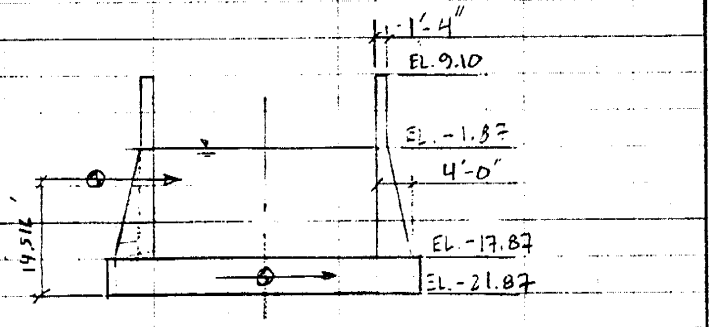
PROJECT	Page 6 of —	COMPUTED BY	DATE
PUERTO NUEVO FDM2		[illegible]	6/95
SUBJECT		CHECKED BY	DATE
U-CHANNEL DESIGN MARGARITA TRIBUTARY			

WALL INERTIA FORCE

$F = k_h W$

$F_W = (0.15)(8,598)$

$= \boxed{1,290\#}$ ✓



$CG_{WALL} = [(35.96)(17.485) + (21.36)(9.33)] \div 57.319$

$= \boxed{14.446 \text{ ft}}$ ✓

WALL AREA $= [(1.33)(26.97) + 10.5(2.67)(16)]$

$= \boxed{57.319 \text{ sf}}$

$W = (150 \#/\text{ft}^3)(57.319) = \boxed{8,598 \#/\text{ft}}$

HYDRODYNAMIC FORCE

$P_E = \left(\frac{2}{3}\right) C_E k_h h^2$ $\quad C_E \approx 0.051$

$= \left(\frac{2}{3}\right)(0.051)(0.15)(18.87)^2 = \boxed{1,816 \#}$

ACTING @ $0.4(18.87) = \boxed{7.548 \text{ ft FROM INVERT}}$ ✓

SLAB INERTIA FORCE

$W = (4)(40)(150) = \boxed{24,000 \#/\text{ft}}$ ✓

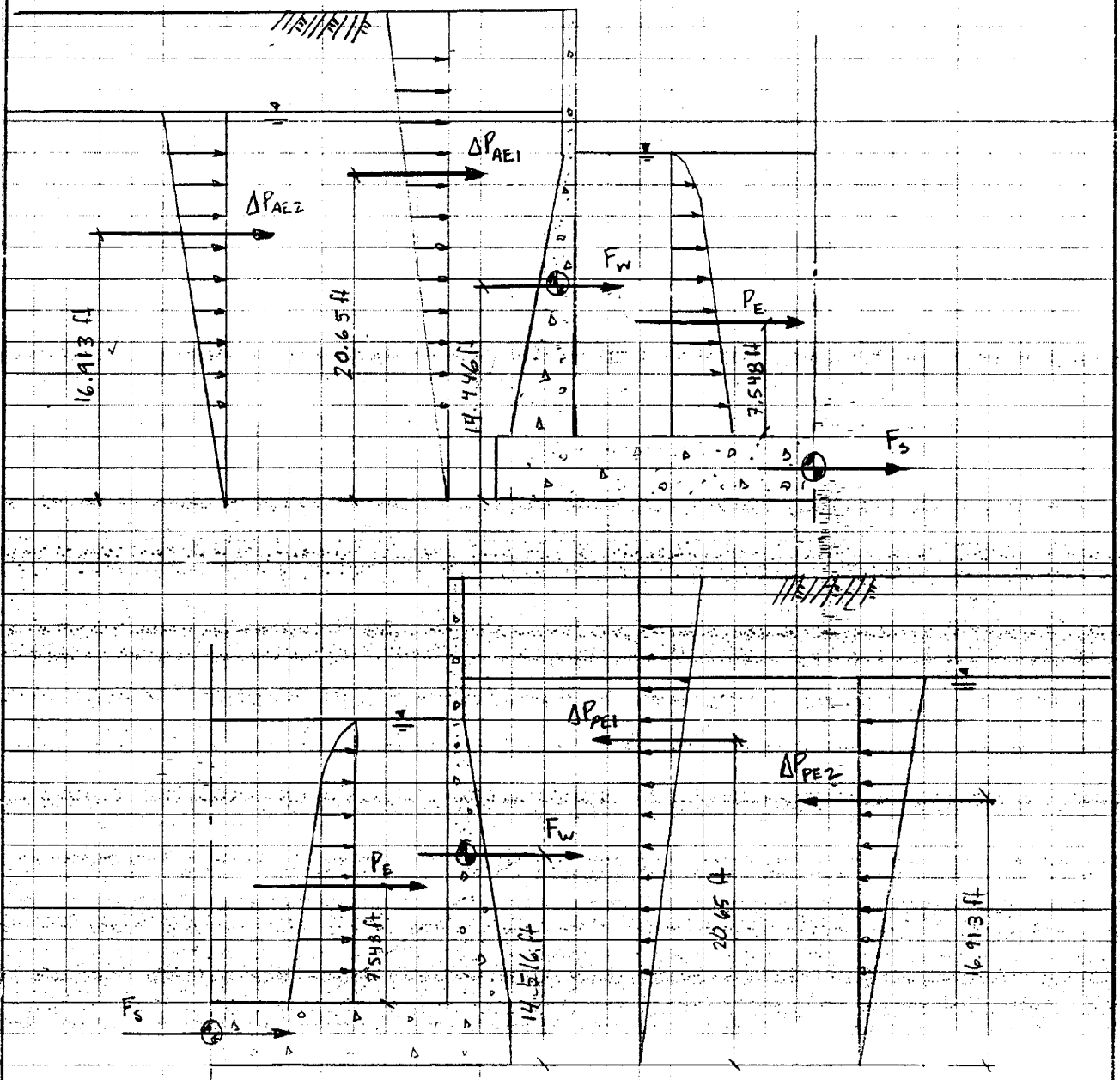
$F_S = (0.15)(24,000) = \boxed{3,600 \#}$ ✓

PROJECT	Page 7 of —	COMPUTED BY	DATE
PUERTO NUEVO FDMZ		EK	6/14/78
SUBJECT		CHECKED BY	DATE
U-CHANNEL DESIGN MARGARITA TRIBUTARY			

PRESSURE DIAGRAM
FOR
EARTHQUAKE LOADING

*DYNAMIC FORCES SHOWN ONLY

DRIVING SIDE



RESISTING SIDE

PROJECT		COMPUTED BY	DATE
PUERTO NUEVO FCM 2	Page 2 of —	SK	6/06
SUBJECT		CHECKED BY	DATE
U-CHANNEL DESIGN MARGARITA TRIBUTARY			

CASE	WALL THK.	WALL REINF.	SLAB THK.	SLAB REINF.
1A	44 in.	2.26 in^2	53 in.	1.84 in^2
2A	47 in.	2.29 in^2	57 in.	1.86 in^2
2B	31 in.	1.47 in^2	53 in.	0.65 in^2
3A	48 in.	2.30 in^2	83 in.	0.99 in^2
3B	42 in.	2.13 in^2	54 in.	1.58 in^2
3C	39 in.	1.97 in^2	64 in.	1.05 in^2

RESULTS FROM CUFRBC "DESIGN MODE"

PROGRAM DEFAULTS TO THICKER BASE SLAB THAN ACTUALLY REQUIRED. TRY A 48" THICK SLAB WITH 2.793 in^2

```
01010 3 PUERTO NUEVO FDM#2
  020   MARGARITA TRIBUTARY STA 54+75
  030   EARTHQUAKE LOADING CONDITIONS CASE 4A (EXTREME)
02010   INV  SD   CHA    1   54754AI.IN   54754AI.OUT   54754AI.PLT
02020   YES   NO   SYM
03010     3.000    0.150   60.000    0.250  ACI
04010    9.1000    -1.787  -17.870    16.000   48.000   -15.870
04020    48.000   48.000    1.000    30.000
06010   3  ARE
06020     3.000    3.000    3.000    4.000
06030    11    1
06040     0.000    1    0
06050     1.128    2.600
06060     2    1
06070     0.000    0    1
06080     1.128    2.793
06090    12    1
06100     0.000    0    1
06110     1.128    2.340
07010  1  WEDA   1    SPR
08010    SYM   1.700   TIDAL AT EL. 1.00
08020    6.000   1.000
08030    50.000   50.000    1.000
09010     0.110    0.125   32.000    0.000    0.000   SYM
09020     0.000   30.000    0.000   30.000    0.000   9.100   0.000  -44.000
12010     3     1     1.9   EARTHQUAKE LOADS
12020     11     2     2
12030     10.446     1.290     0.000     0.000
12040     7.548     1.816     0.000     0.000
12050     X     0.000     0.048     26.970     0.372
12060     X     0.000     0.00660   21.370     0.0415
12070     12     2     2
12080     10.446     1.290     0.000     0.000
12090     7.548     1.816     0.000     0.000
12100     X     0.000     -0.048     26.970     -0.372
  110     X     0.000     -0.00660   21.370     -0.0415
  120     2     1     0
12130     15.000    3.600    0.000    0.000
13010     7.182    0.070    0.035    1260.000    0.000    0   250.000   18.214
13020     -3.000
```

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**************************************************
   CUFRBC - PROGRAM FOR DESIGN AND ANALYSIS OF   *
            BASINS AND CHANNELS                  *
*             BY C. O. HAYS                      *
*           REVISED 16 APRIL 1990                *
**************************************************
```

I. INPUT DATA

I.1 HEADING

3 PUERTO NUEVO FDM#2
MARGARITA TRIBUTARY STA 54+75
EARTHQUAKE LOADING CONDITIONS CASE 4A (EXTREME)

I.2 MODE AND PROCEDURE

INVESTIGATION MODE
STRENGTH DESIGN
1 CHANNEL STRUCTURE
INPUT FILE NAME IS '54754A1.IN '
OUTPUT FILE NAME IS '54754A1.OUT '
PLOT STORAGE FILE NAME IS '54754A1.PLT '

WALL DRAIN DATA INCLUDED
BASE SLAB DRAIN DATA OMITTED
CHANNEL IS GEOMETRICALLY SYMMETRICAL

I.3 MATERIAL PROPERTIES

CONCRETE,

ULTIMATE STRENGTH	= 3.000	KSI
MODULUS OF ELASTICITY	= 3123.	KSI
UNIT WEIGHT	= 0.150	KCF

REINFORCEMENT:

YIELD STRENGTH	= 60.0	KSI
MODULUS OF ELASTICITY	= 29000.	KSI
MAX. TENSION STEEL RATIO	= 0.250	

ACI CODE STRENGTH DESIGN PARAMETERS

MAXIMUM CONCRETE STRAIN	= 0.0030
STRESS BLOCK DEPTH RATIO	= 0.8500
STRESS BLOCK STRESS RATIO	= 0.8500
USABLE COMPRESSION RATIO	= 0.8000
PHI FACTOR (PURE AXIAL)	= 0.70
PHI FACTOR (PURE FLEXURE)	= 0.90
PHI FACTOR (SHEAR)	= 0.85

I.4 GEOMETRY *** UNITS ARE FEET OR INCHES ***

LEFT EXTERIOR WALL

ELEVATION			WIDTH		ELEV.
TOP	BREAK	SLAB	TOP	BOTTOM	DRAIN
ELTOPL	ELBRKL	ELSLAB	WALLTL	WALLBL	ELDRL
(FT)	(FT)	(FT)	(IN)	(IN)	(FT)
9.10	-1.79	-17.87	16.00	48.00	-15.87

USING ACTIVE WEDGE METHOD FOR SOIL PRESSURES
1 SPECIAL LOAD CASES WITH DIRECT LOAD INPUT
ELASTIC SPRING FOUNDATION

I.8 HYDRAULIC STRESS AND STRENGTH DATA

******** EM-LIKE LOAD CASE 1 ********TIDAL AT EL. 1.00 ********
STRENGTH DESIGN LOAD FACTOR = 1.70
****

SYMMETRICAL WATER ELEVATIONS (FT)

BACKFILL LEFT ELBWSL	CHANNEL LEFT ELCWSL
6.00	1.00

DRAIN FACTORS AND AT REST MULTIPLIERS

PERCENT EFFECTIVE / MULTIPLIER

LEFTWALL PDRNWL	RIGHTWALL PDRNWR	BACKFILL ATRESTS
50.00	50.00	1.00

I.9 SOILS DATA FOR WEDGE METHOD

CKFILL SOIL PROPERTIES

UNIT WEIGHTS DRAINED UWSD (KCF)	SAT. UWSS (KCF)	PHI ANGLE SPHI (DEG)	COHESION SCOHE (KSF)	WALL FRICTION ANGLE DELFW (DEG)
0.110	0.125	32.000	0.000	0.000

BACKFILL DATA LEFT SIDE (SYMMETRICAL)

BACKFILL SLOPE SOJL (FT)	HORZ. SOKL (FT)	DISTANCES / START SOLL (FT)	SURCHARGE LENGTH SOML (FT)	WEIGHT UWSURL (KSF)	BACKFILL ELEV. ELGSL (FT)	ANGLE ANBSL (DEG)	ROCK ELEV. ELRSL (FT)
0.00	30.00	0.00	30.00	0.00	9.10	0.00	-44.00

I.12 SPECIAL LOAD CASES

******** SPECIAL LOAD CASE 1 ********EARTHQUAKE LOADS ********
****

NUMBER OF LOADED MEMEBRS = 3
REFERENCE EM-LIKE LOAD CASE = 1
STRENGTH DESIGN LOAD FACTOR = 1.90

LOAD DATA FOR EACH LOADED MEMBER

MEMBER NUMBER = 11
NUMBER OF CONCENTRATED LOADS = 2

NUMBER OF DISTRIBUTED LOADS = 2

CONCENTRATED LOADS

DISTANCE DC (FT)	LOAD FORCE-X FXM (K/FT)	FORCE-Y FYM (K/FT)	COUPLE FCM (KF/FT)
10.45	1.29	0.00	0.00
7.55	1.82	0.00	0.00

DISTRIBUTED LOADS

TYPE IDIR	DISTANCE TO LOAD D1M (FT)	MAGNITUDE @ START Q1M (KSF)*	DISTANCE TO LOAD D2M (FT)	MAGNITUDE @ END Q2M (KSF)*	(* UNITS FOR COUPLES KF/SF)
X	0.00	0.05	26.97	0.37	
X	0.00	0.01	21.37	0.04	

MEMBER NUMBER = 12
NUMBER OF CONCENTRATED LOADS = 2
NUMBER OF DISTRIBUTED LOADS = 2

CONCENTRATED LOADS

DISTANCE DC (FT)	LOAD FORCE-X FXM (K/FT)	FORCE-Y FYM (K/FT)	COUPLE FCM (KF/FT)
10.45	1.29	0.00	0.00
7.55	1.82	0.00	0.00

DISTRIBUTED LOADS

TYPE IDIR	DISTANCE TO LOAD D1M (FT)	MAGNITUDE @ START Q1M (KSF)*	DISTANCE TO LOAD D2M (FT)	MAGNITUDE @ END Q2M (KSF)*	(* UNITS FOR COUPLES KF/SF)
X	0.00	-0.05	26.97	-0.37	
X	0.00	-0.01	21.37	-0.04	

MEMBER NUMBER = 2
NUMBER OF CONCENTRATED LOADS = 1
NUMBER OF DISTRIBUTED LOADS = 0

CONCENTRATED LOADS

DISTANCE DC (FT)	LOAD FORCE-X FXM (K/FT)	FORCE-Y FYM (K/FT)	COUPLE FCM (KF/FT)
15.00	3.60	0.00	0.00

1.13 ELASTIC SPRING FOUNDATION PROPERTIES

STRENGTH	SOIL SPRING MODULI VERT.	HORZ.	COHESION	FRICTION	/ ANCHORS NUMBER
FPF (KSF)	SCFV (KCI)	SCFH (KCI)	FCOHE (KSF)	DELFF (DEG)	NANCK
7.18	0.070	0.035	1260.00	0.00	0

O. OUTPUT RESULTS

O.1 FACTORS OF SAFETY

FACTOR OF SAFETY AGAINST UPLIFT	FACTOR OF SAFETY AGAINST BEARING	HORIZONTAL EQUILIBRIUM FACTOR	EM-LIKE LOAD CASE	SPECIAL LOAD CASE
1.48	7.79	9999.99	1	
1.48	6.05	5136.57		1

O.3 OUTPUT OF MEMBER PRESSURES *** BY LOAD CASE ***

******** EM-LIKE LOAD CASE 1 ********TIDAL AT EL. 1.00 ********
****

********** MEMBER 1 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	BACKFILL	EFFECTIVE FOUNDATION
0.00	-1.34	1.59	-1.95	0.17
0.50	-1.34	1.59	-1.95	0.20
1.00	-1.34	1.59	-1.95	0.24

RESULTANT HORIZONTAL FORCES ON HEEL (K/FT)
AND CORRESPONDING ECCENTRICITIES (FT)

	VERTICAL HEELFACE BACKFILL	HYDRAULIC	BOTTOM SURFACE HYDRAULIC	EFF. FDN.	
	2.53	5.84	0.00	0.05	FORCE
	0.00	0.00	0.00	-2.00	ECC.

****** PRESSURES AND RESULTANT FORCES WITH ECCENTRICITIES ******

ON RIGID BLOCK UNDER WALL **** 11 ****

	VERT. PRESS.(KSF) / BOTTOM SURFACE LEFT EDGE	RIGHT EDGE /	RES. HORZ. FORCES(K/FT) / BOT. OF SLAB HYDRAULIC EFF. FDN.		
EFF. FDN.	0.24	0.50	0.00	0.22	FORCE
HYDRAULIC	1.59	1.59	0.00	-2.00	ECC.

********** MEMBER 2 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	EFFECTIVE FOUNDATION
0.00	-1.18	1.59	0.50
3.00	-1.18	1.59	0.67
6.00	-1.18	1.59	0.79

9.00	-1.18	1.59	0.86
12.00	-1.18	1.59	0.91
15.00	-1.18	1.59	0.92
18.00	-1.18	1.59	0.91
21.00	-1.18	1.59	0.86
24.00	-1.18	1.59	0.79
27.00	-1.18	1.59	0.67
30.00	-1.18	1.59	0.50

RESULTANT HORIZONTAL FORCES ON BOTTOM OF SLAB (K/FT)
AND CORRESPONDING ECCENTRICITIES (FT)

HYDRAULIC	EFF.FDN.	
0.00	0.00	FORCE
0.00	0.00	ECC.

********** MEMBER 11 **********

HORIZONTAL PRESSURES (KSF)

DISTANCE (FT)	BACKFILL	HYDRAULIC LEFT	HYDRAULIC RIGHT	EFFECTIVE FORCE-DEF.
26.97	0.00	0.00	0.00	0.00
24.27	0.09	0.00	0.00	0.00
21.58	0.17	0.04	0.00	0.00
18.88	0.24	0.16	-0.04	0.00
16.18	0.32	0.32	-0.17	0.00
13.49	0.41	0.49	-0.34	0.00
10.79	0.47	0.66	-0.51	0.00
8.09	0.53	0.83	-0.67	0.00
5.39	0.60	1.00	-0.84	0.00
2.70	0.66	1.17	-1.01	0.00
0.00	0.72	1.34	-1.18	0.00
-2.00	0.63	1.46		

RESULTANT VERTICAL FORCES (K/FT) ON WALL
AND CORRESPONDING ECCENTRICITIES (FT)

BACKFILL	HYDRAULIC	
-1.43	-2.23	FORCE
-0.81	-0.92	ECC.

******** SPECIAL LOAD CASE 1 ********EARTHQUAKE LOADS ********
****

********** MEMBER 1 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	BACKFILL	EFFECTIVE FOUNDATION
0.00	-1.34	1.59	-1.95	0.00
0.50	-1.34	1.59	-1.95	0.00
1.00	-1.34	1.59	-1.95	0.00

RESULTANT HORIZONTAL FORCES ON HEEL (K/FT)
AND CORRESPONDING ECCENTRICITIES (FT)

VERTICAL HEELFACE BACKFILL	HEELFACE HYDRAULIC	BOTTOM SURFACE HYDRAULIC	EFF. FDN.	
2.53	5.84	0.00	0.00	FORCE
0.00	0.00	0.00	0.00	ECC.

****** PRESSURES AND RESULTANT FORCES WITH ECCENTRICITIES ******

ON RIGID BLOCK UNDER WALL **** 11 ****

VERT. PRESS.(KSF) / BOTTOM SURFACE / LEFT EDGE	RIGHT EDGE	RES. HORZ. FORCES(K/FT) / BOT. OF SLAB / HYDRAULIC	EFF. FDN.	
EFF. FDN. 0.00	0.00	0.00	0.00	FORCE

HYDRAULIC	1.59	1.59	0.00	-2.00	ECC.

********** MEMBER 2 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	EFFECTIVE FOUNDATION
0.00	-1.18	1.59	0.00
3.00	-1.18	1.59	0.22
6.00	-1.18	1.59	0.59
9.00	-1.18	1.59	0.86
12.00	-1.18	1.59	1.04
15.00	-1.18	1.59	1.15
18.00	-1.18	1.59	1.19
21.00	-1.18	1.59	1.16
24.00	-1.18	1.59	1.05
27.00	-1.18	1.59	0.88
30.00	-1.18	1.59	0.61

RESULTANT HORIZONTAL FORCES ON BOTTOM OF SLAB (K/FT)
AND CORRESPONDING ECCENTRICITIES (FT)

HYDRAULIC	EFF.FDN.	
0.00	-7.87	FORCE
0.00	-2.00	ECC.

****** PRESSURES AND RESULTANT FORCES WITH ECCENTRICITIES ******

ON RIGID BLOCK UNDER WALL **** 12 ****

	VERT. PRESS.(KSF) / BOTTOM SURFACE		RES. HORZ. FORCES(K/FT) / BOT. OF SLAB		
	LEFT EDGE	RIGHT EDGE /	HYDRAULIC	EFF. FDN.	
EFF. FDN.	0.61	0.19	0.00	-1.55	FORCE
DRAULIC	1.59	1.59	0.00	-2.00	ECC.

********** MEMBER 3 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	BACKFILL	EFFECTIVE FOUNDATION
0.00	-1.34	1.59	-1.95	0.19
0.50	-1.34	1.59	-1.95	0.14
1.00	-1.34	1.59	-1.95	0.09

RESULTANT HORIZONTAL FORCES ON HEEL (K/FT)
AND CORRESPONDING ECCENTRICITIES (FT)

VERTICAL HEELFACE		BOTTOM SURFACE		
BACKFILL	HYDRAULIC	HYDRAULIC	EFF. FDN.	
-2.53	-5.84	0.00	-0.39	FORCE
0.00	0.00	0.00	-2.00	ECC.

********** MEMBER 11 **********

HORIZONTAL PRESSURES (KSF)

DISTANCE (FT)	BACKFILL	HYDRAULIC LEFT	HYDRAULIC RIGHT	EFFECTIVE FORCE-DEF.
26.97	0.00	0.00	0.00	0.00
24.27	0.09	0.00	0.00	0.00
21.58	0.17	0.04	0.00	0.00
18.88	0.24	0.16	-0.04	0.00
16.18	0.32	0.32	-0.17	0.00
13.49	0.41	0.49	-0.34	0.00
10.79	0.47	0.66	-0.51	0.00
8.09	0.53	0.83	-0.67	0.00
5.39	0.60	1.00	-0.84	0.00
2.70	0.66	1.17	-1.01	0.00

0.00	0.72	1.34	-1.18	0.00
-2.00	0.63	1.46		

RESULTANT VERTICAL FORCES (K/FT) ON WALL
AND CORRESPONDING ECCENTRICITIES (FT)

BACKFILL	HYDRAULIC	
-1.43	-2.23	FORCE
-0.81	-0.92	ECC.

********** MEMBER 12 **********

DISTANCE	BACKFILL	HORIZONTAL PRESSURES (KSF) HYDRAULIC		EFFECTIVE
(FT)		LEFT	RIGHT	FORCE-DEF.
26.97	0.00	0.00	0.00	0.00
24.27	-0.09	0.00	0.00	0.00
21.58	-0.17	0.00	-0.04	0.00
18.88	-0.24	0.04	-0.16	0.00
16.18	-0.32	0.17	-0.32	0.00
13.49	-0.41	0.34	-0.49	0.00
10.79	-0.47	0.51	-0.66	0.00
8.09	-0.53	0.67	-0.83	0.00
5.39	-0.60	0.84	-1.00	0.00
2.70	-0.66	1.01	-1.17	0.00
0.00	-0.72	1.18	-1.34	0.00
-2.00	-0.63		-1.46	

RESULTANT VERTICAL FORCES (K/FT) ON WALL
AND CORRESPONDING ECCENTRICITIES (FT)

BACKFILL	HYDRAULIC	
-1.43	-2.23	FORCE
0.81	0.92	ECC.

0.4 OUTPUT OF MEMBER FORCES / STRENGTH RATIOS *** BY LOAD CASE ***

OUPUT FORCES AND MOMENTS DO NOT INCLUDE LOAD FACTOR.
HOWEVER, STRENGTH RATIOS COMPUTED USING LOAD FACTOR.

******** EM-LIKE LOAD CASE 1 *********TIDAL AT EL. 1.00 *********

********** MEMBER 1 **********

DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
0.00	0.0	0.00	0.00	-0.001	-1.53	48.00
0.50	-0.3	-1.06	8.40	-0.002	-1.50	48.00
1.00	-1.2	-2.10	8.43	-0.002	-1.46	48.00

********** MEMBER 2 **********

DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
0.00	135.4	-8.93	22.20	-0.004	0.91	48.00
3.00	109.7	-7.75	22.33	-0.006	1.08	48.00
6.00	88.4	-6.14	22.43	-0.007	1.19	48.00
9.00	72.6	-4.24	22.49	-0.007	1.27	48.00

12.00	62.8	-2.16	22.52	-0.008	1.31	48.00
15.00	59.5	0.00	22.53	-0.008	1.33	48.00
18.00	62.8	2.16	22.52	-0.008	1.31	48.00
21.00	72.6	4.24	22.49	-0.007	1.27	48.00
24.00	88.4	6.14	22.43	-0.007	1.19	48.00
27.00	109.7	7.75	22.33	-0.006	1.08	48.00
30.00	135.4	8.93	22.20	-0.004	0.91	48.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE	STEEL AREAS TENSION	COMPRESS.	STEEL RATIO	FLEX-AXIAL STRENGTH	DUCTILITY RATIO	SHEAR STRENGTH
(FT)	(SI/FT)	(SI/FT)	ASTOT/12*H	RATIO		RATIO
0.00	2.79	0.00	0.0048	0.40	0.56	0.31

********** MEMBER 11 **********

DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
26.97	0.0	0.00	0.00	0.040	0.00	16.00
24.27	-0.2	0.18	0.54	0.034	0.09	16.00
21.58	-1.0	0.59	1.08	0.029	0.21	16.00
18.88	-3.3	1.35	1.62	0.024	0.35	16.00
16.18	-8.2	2.46	2.27	0.019	0.47	16.00
13.48	-16.8	3.86	3.20	0.015	0.56	21.17
10.79	-29.6	5.46	4.46	0.011	0.63	26.54
8.09	-47.1	7.24	6.00	0.008	0.69	31.90
5.39	-69.7	9.19	7.83	0.005	0.75	37.27
2.70	-97.9	11.31	9.94	0.003	0.82	42.63
0.00	-132.4	13.55	12.27	0.001	0.88	48.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE	STEEL AREAS TENSION	COMPRESS.	STEEL RATIO	FLEX-AXIAL STRENGTH	DUCTILITY RATIO	SHEAR STRENGTH
(FT)	(SI/FT)	(SI/FT)	ASTOT/12*H	RATIO		RATIO
0.00	2.60	0.00	0.0045	0.42	0.47	0.46

******** SPECIAL LOAD CASE 1 ********EARTHQUAKE LOADS ********

********** MEMBER 1 **********

DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
0.00	0.0	-0.01	0.00	0.010	-1.70	48.00
0.50	-0.3	-1.16	8.37	0.009	-1.70	48.00
1.00	-1.2	-2.31	8.37	0.008	-1.70	48.00

********** MEMBER 2 **********

DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
0.00	281.1	-10.63	31.21	0.002	0.41	48.00
3.00	248.8	-10.88	30.95	-0.002	0.62	48.00
6.00	217.4	-10.26	30.40	-0.005	0.99	48.00

9.00	189.7	-8.67	29.75	-0.007	1.26	48.00
12.00	168.1	-6.40	29.03	-0.009	1.45	48.00
15.00	154.3	-3.69	30.04	-0.010	1.56	48.00
18.00	149.2	-0.76	30.98	-0.010	1.59	48.00
21.00	153.2	2.17	30.07	-0.010	1.56	48.00
24.00	166.0	4.91	29.10	-0.009	1.46	48.00
27.00	186.7	7.22	28.06	-0.007	1.28	48.00
30.00	213.7	8.87	26.94	-0.005	1.02	48.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE	STEEL AREAS TENSION	COMPRESS.	STEEL RATIO	FLEX-AXIAL STRENGTH	DUCTILITY RATIO	SHEAR STRENGTH
(FT)	(SI/FT)	(SI/FT)	ASTOT/12*H	RATIO		RATIO
0.00	2.79	0.00	0.0048	0.96	1.51	0.42

********** MEMBER 3 **********

DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
0.00	-1.9	2.16	8.76	-0.002	-1.51	48.00
0.50	-0.7	1.09	8.56	-0.001	-1.56	48.00
1.00	0.0	0.00	0.00	-0.001	-1.62	48.00

********** MEMBER 11 **********

DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
26.97	0.0	0.00	0.00	0.108	0.00	16.00
24.27	-1.5	1.13	0.54	0.093	0.09	16.00
21.58	-6.1	2.43	1.08	0.079	0.21	16.00
18.88	-14.6	4.04	1.62	0.065	0.35	16.00
16.18	-27.8	5.95	2.27	0.052	0.47	16.00
13.48	-46.9	8.04	3.20	0.042	0.56	21.17
10.79	-71.8	10.81	4.46	0.033	0.63	26.54
8.09	-106.0	14.45	6.00	0.025	0.69	31.90
5.39	-150.8	17.78	7.83	0.018	0.75	37.27
2.70	-203.1	20.38	9.94	0.013	0.82	42.63
0.00	-262.4	22.84	12.27	0.008	0.88	48.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE	STEEL AREAS TENSION	COMPRESS.	STEEL RATIO	FLEX-AXIAL STRENGTH	DUCTILITY RATIO	SHEAR STRENGTH
(FT)	(SI/FT)	(SI/FT)	ASTOT/12*H	RATIO		RATIO
0.00	2.60	0.00	0.0045	0.98	1.05	0.87

********** MEMBER 12 **********

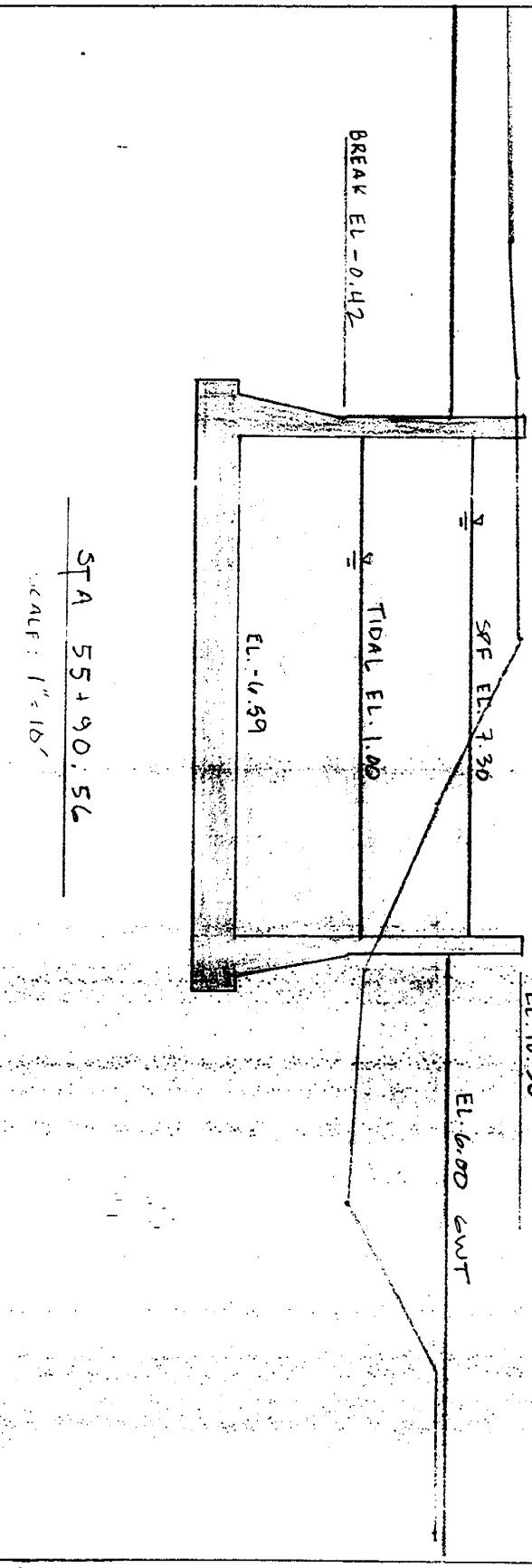
DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
26.97	0.0	0.00	0.00	-0.075	0.00	16.00
24.27	1.5	-1.13	0.54	-0.062	-0.09	16.00
21.58	6.1	-2.43	1.08	-0.050	-0.21	16.00
18.88	14.6	-4.04	1.62	-0.039	-0.35	16.00
16.18	27.8	-5.95	2.27	-0.028	-0.47	16.00
13.48	46.9	-8.04	3.20	-0.020	-0.56	21.17
10.79	71.8	-9.68	4.46	-0.013	-0.63	26.54

8.09	99.9	-10.58	6.00	-0.008	-0.69	31.90
5.39	129.9	-11.94	7.83	-0.003	-0.75	37.27
2.70	165.5	-14.17	9.94	0.000	-0.82	42.63
0.00	208.0	-16.63	12.27	0.003	-0.88	48.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE	STEEL AREAS		STEEL	FLEX-AXIAL	DUCTILITY	SHEAR
	TENSION	COMPRESS.	RATIO	STRENGTH	RATIO	STRENGTH
(FT)	(SI/FT)	(SI/FT)	ASTOT/12*H	RATIO		RATIO
0.00	2.34	0.00	0.0041	0.84	0.82	0.64

PROJECT	Page __ of __	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

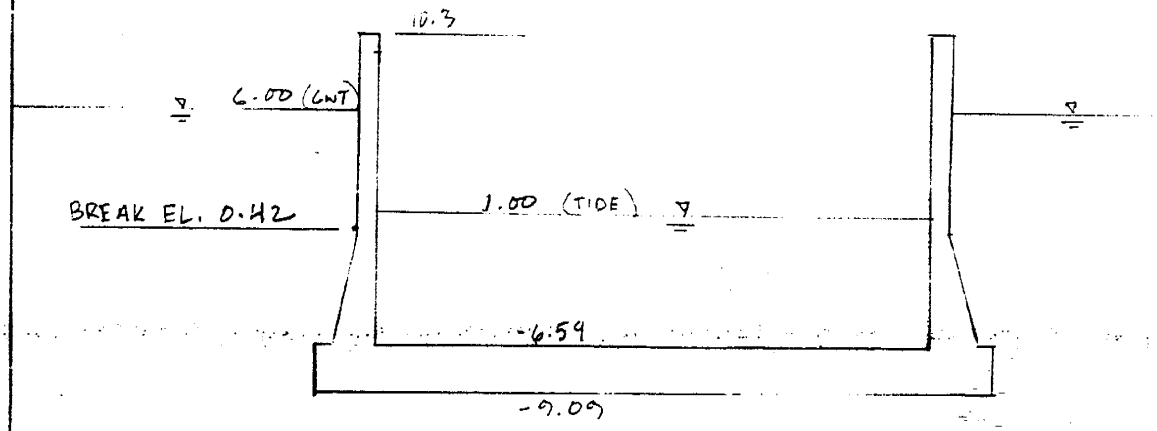


STA 55+90.56

SCALE: 1" = 10'

PROJECT		Page 1 of —	COMPUTED BY	DATE
PUERTO NUEVO FDM2			SJC	7/96
SUBJECT			CHECKED BY	DATE
U-CHANNEL DESIGN MARGARITA TRIBUTARY				

CASE	WALL THK.	WALL REINF	SLAB THK.	SLAB REINF.
1A	24	1.13	28	1.00
2A	24	0.70	31	0.47
2B	24	0.43	29	0.32
3A	25	1.16	30	0.98
3B	24	0.96	27	0.90
3C	24	0.93	27	0.89



EARTHQUAKE LOADS

$$\Delta P_{AE1} = 0.15 \left[\frac{110\,(10.39)^2}{2(\tan 53.952^\circ - \tan 0^\circ)} \right] = \boxed{2,258\ \#}$$

$$\Delta P_{AE2} = 0.15 \left[\frac{(125-110)(12.59)^2}{2\tan 53.952^\circ} \right] = \boxed{130\ \#}$$

$$P_E = \left(\tfrac{2}{3}\right)(0.051)(0.15)(7.59)^2 = \boxed{294\ \#} \quad \text{ACTING @ } 0.4(7.59) = \boxed{3.036\ \text{ft}}$$

EL. -3.554

$$W = (2.5)(37)(150) = \boxed{13,875\ \#} \quad \text{(WEIGHT OF SLAB)}$$

$$F_s = 0.15\,(13,875) = \boxed{2081\ \#}$$

PROJECT		Page 2 of —	COMPUTED BY	DATE
PUERTO NUEVO FDN 2			SK	7/96
SUBJECT			CHECKED BY	DATE
U-CHANNEL DESIGN MARGARITA TRIBUTARY				

WALL AREA = $[(1.33)(16.89) + 10.5)(1.167)(7.01)]$ = **26.55 sf**

$F_W = (0.15)(150)(26.55)$ = **598 #**

CG OF WALL = $[(22.46)(8.445) + (4.09)(2.34)] \div 26.55$

= **7.50 ft FROM INVERT**

$q_u = cN_c$

$= 550\ (5.7) = 3135$ psf

```
01010 3 PUERTO NUEVO FDM#2
 020   MARGARITA TRIBUTARY STA 55+90.56
 030   CONSTRUCTION CONDITIONS CASE 1AB (UNUSUAL)
 2010   INV  SD  CHA    1   55901ABI.IN   55901ABI.OUT   55901ABI.PLT
02020   YES   NO   SYM
03010     3.000    0.150   60.000    0.250  ACI
04010    10.300    0.410  -6.590   16.000   30.000   -4.590
04020    30.000   30.000    1.000   30.000
06010   2  ARE
06020     3.000    3.000    3.000    4.000
06030    11    1
06040     0.000    1    0
06050     1.128    1.280
06060     2    1
06070     0.000    0    1
06080     1.128    1.320
07010  1  WEDA   1    SPR
08010    SYM   1.658   NO GROUNDWATER
08020    -6.590   -6.590
08030    50.000   50.000    1.613
09010     0.110    0.125   32.000    0.000    0.000   SYM
09020     0.000  30.000    0.000   30.000    0.000   10.300   0.000  -44.000
12010     1     1     1.658     COMPACTION EFFECTS
12020     11     1     0
12030     12.185     3.444    0.000     0.000
13010     3.135    0.070    0.035   550.000    0.000    0   250.000   18.214
13020     -2.000
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C-3-24

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**************************************************
*  CUFRBC - PROGRAM FOR DESIGN AND ANALYSIS OF   *
*           BASINS AND CHANNELS                  *
*           BY C. O. HAYS                        *
*           REVISED 16 APRIL 1990                *
**************************************************
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I. INPUT DATA

I.1 HEADING

3 PUERTO NUEVO FDM#2
MARGARITA TRIBUTARY STA 55+90.56
CONSTRUCTION CONDITIONS CASE 1AB (UNUSUAL).

I.2 MODE AND PROCEDURE

INVESTIGATION MODE
STRENGTH DESIGN
1 CHANNEL STRUCTURE
INPUT FILE NAME IS '55901ABI.IN '
OUTPUT FILE NAME IS '55901ABI.OUT'
PLOT STORAGE FILE NAME IS '55901ABI.PLT'

WALL DRAIN DATA INCLUDED
BASE SLAB DRAIN DATA OMITTED
CHANNEL IS GEOMETRICALLY SYMMETRICAL

I.3 MATERIAL PROPERTIES

CONCRETE,

ULTIMATE STRENGTH	= 3.000	KSI
MODULUS OF ELASTICITY	= 3123.	KSI
UNIT WEIGHT	= 0.150	KCF

REINFORCEMENT:

YIELD STRENGTH	= 60.0	KSI
MODULUS OF ELASTICITY	= 29000.	KSI
MAX. TENSION STEEL RATIO	= 0.250	

ACI CODE STRENGTH DESIGN PARAMETERS

MAXIMUM CONCRETE STRAIN	= 0.0030
STRESS BLOCK DEPTH RATIO	= 0.8500
STRESS BLOCK STRESS RATIO	= 0.8500
USABLE COMPRESSION RATIO	= 0.8000
PHI FACTOR (PURE AXIAL)	= 0.70
PHI FACTOR (PURE FLEXURE)	= 0.90
PHI FACTOR (SHEAR)	= 0.85

I.4 GEOMETRY *** UNITS ARE FEET OR INCHES ***

LEFT EXTERIOR WALL

ELEVATION			WIDTH		ELEV.
TOP	BREAK	SLAB	TOP	BOTTOM	DRAIN
ELTOPL	ELBRKL	ELSLAB	WALLTL	WALLBL	ELDRL
(FT)	(FT)	(FT)	(IN)	(IN)	(FT)
10.30	0.41	-6.59	16.00	30.00	-4.59

SLAB AND HEEL DIMENSIONS

DEPTH SLAB LEFT DEPTHL (IN)	SLAB CENTER DEPTHC (IN)	/ WIDTHS(LEFT) HEEL WHEELL (FT)	CHANNEL WIDTHL (FT)
30.00	30.00	1.00	30.00

I.6 REINFORCEMENT FOR INVESTIGATION OPTION

2 MEMBERS INVESTIGATED * AREA OPTION FOR REINFORCEMENT

CLEAR COVER (IN)

COVER(1)	COVER(2)	COVER(3)	COVER(4)
3.00	3.00	3.00	4.00

MEMBER # 11 ***** 1 SECTIONS INVESTIGATED

REINFORCEMENT DESCRIPTION

LOCATION LOC	DISTANCE DR(FT)	NUMBER OF LAYERS TOP NTOPL	BOTTOM NBOTL
1	0.00	1	0

***** TOP STEEL *****

BAR DIAMETER OUTER DIAMB	AREA PER LAYER LAYER - 1 AREAB(1)
1.13	1.28

MEMBER # 2 ***** 1 SECTIONS INVESTIGATED

REINFORCEMENT DESCRIPTION

LOCATION LOC	DISTANCE DR(FT)	NUMBER OF LAYERS TOP NTOPL	BOTTOM NBOTL
1	0.00	0	1

***** BOTTOM STEEL *****

BAR DIAMETER OUTER DIAMB	AREA PER LAYER LAYER - 1 AREAB(1)
1.13	1.32

I.7 LOADING CONTROL

1 EM-LIKE LOAD CASES
USING ACTIVE WEDGE METHOD FOR SOIL PRESSURES
1 SPECIAL LOAD CASES WITH DIRECT LOAD INPUT
ELASTIC SPRING FOUNDATION

I.8 HYDRAULIC STRESS AND STRENGTH DATA

******** EM-LIKE LOAD CASE 1 ********NO GROUNDWATER ********
STRENGTH DESIGN LOAD FACTOR = 1.66
****

SYMMETRICAL WATER ELEVATIONS (FT)

STRENGTH	SPRING MODULI VERT.	HORZ.	COHESION	FRICTION	NUMBER
FPF (KSF)	SCFV (KCI)	SCFH (KCI)	FCOHE (KSF)	DELFF (DEG)	NANCK
3.13	0.070	0.035	550.00	0.00	0

O. OUTPUT RESULTS

O.1 FACTORS OF SAFETY

FACTOR OF SAFETY AGAINST UPLIFT	BEARING	HORIZONTAL EQUILIBRIUM FACTOR	EM-LIKE LOAD CASE	SPECIAL LOAD CASE
4.64	4.72	9999.99	1	
4.64	3.90	5908.83		1

O.3 OUTPUT OF MEMBER PRESSURES *** BY LOAD CASE ***

******** EM-LIKE LOAD CASE 1 ********NO GROUNDWATER ********
****

********** MEMBER 1 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	BACKFILL	EFFECTIVE FOUNDATION
0.00	0.00	0.16	-1.86	0.26
0.50	0.00	0.16	-1.86	0.29
1.00	0.00	0.16	-1.86	0.32

RESULTANT HORIZONTAL FORCES ON HEEL (K/FT)
AND CORRESPONDING ECCENTRICITIES (FT)

VERTICAL HEELFACE BACKFILL	HYDRAULIC	BOTTOM SURFACE HYDRAULIC	EFF. FDN.	
2.46	0.20	0.00	0.02	FORCE
0.00	0.00	0.00	-1.25	ECC.

****** PRESSURES AND RESULTANT FORCES WITH ECCENTRICITIES ******

ON RIGID BLOCK UNDER WALL **** 11 ****

	VERT. PRESS.(KSF) / BOTTOM SURFACE LEFT EDGE	RIGHT EDGE /	RES. HORZ. FORCES(K/FT) BOT. OF SLAB HYDRAULIC EFF. FDN.		
EFF. FDN.	0.32	0.45	0.00	0.06	FORCE
HYDRAULIC	0.16	0.16	0.00	-1.25	ECC.

********** MEMBER 2 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	EFFECTIVE FOUNDATION
0.00	0.00	0.16	0.45
3.00	0.00	0.16	0.57
6.00	0.00	0.16	0.63
9.00	0.00	0.16	0.66
12.00	0.00	0.16	0.66
15.00	0.00	0.16	0.66
18.00	0.00	0.16	0.66
21.00	0.00	0.16	0.66
24.00	0.00	0.16	0.63
27.00	0.00	0.16	0.57
30.00	0.00	0.16	0.45

RESULTANT HORIZONTAL FORCES ON BOTTOM OF SLAB (K/FT)
AND CORRESPONDING ECCENTRICITIES (FT)

HYDRAULIC	EFF.FDN.	
0.00	0.00	FORCE
0.00	0.00	ECC.

********** MEMBER 11 **********

HORIZONTAL PRESSURES (KSF)

DISTANCE (FT)	BACKFILL	HYDRAULIC LEFT	HYDRAULIC RIGHT	EFFECTIVE FORCE-DEF.
16.89	0.00	0.00	0.00	0.00
15.20	0.09	0.00	0.00	0.00
13.51	0.18	0.00	0.00	0.00
11.82	0.28	0.00	0.00	0.00
10.13	0.37	0.00	0.00	0.00
8.45	0.47	0.00	0.00	0.00
6.76	0.62	0.00	0.00	0.00
5.07	0.77	0.00	0.00	0.00
3.38	0.89	0.00	0.00	0.00
1.69	1.00	0.00	0.00	0.00
0.00	1.11	0.00	0.00	0.00
-1.25	0.98	0.08		

RESULTANT VERTICAL FORCES (K/FT) ON WALL
AND CORRESPONDING ECCENTRICITIES (FT)

BACKFILL	HYDRAULIC	
-0.62	0.00	FORCE
-0.73	0.00	ECC.

******** SPECIAL LOAD CASE 1 ********COMPACTION EFFECTS ********

****

********** MEMBER 1 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	BACKFILL	EFFECTIVE FOUNDATION
0.00	0.00	0.16	-1.86	0.00
0.50	0.00	0.16	-1.86	0.00
1.00	0.00	0.16	-1.86	0.00

RESULTANT HORIZONTAL FORCES ON HEEL (K/FT)
AND CORRESPONDING ECCENTRICITIES (FT)

VERTICAL HEELFACE BACKFILL	BOTTOM SURFACE HYDRAULIC	HYDRAULIC	EFF. FDN.	
2.46	0.20	0.00	0.00	FORCE
0.00	0.00	0.00	0.00	ECC.

****** PRESSURES AND RESULTANT FORCES WITH ECCENTRICITIES ******

ON RIGID BLOCK UNDER WALL **** 11 ****

	VERT. PRESS.(KSF) / BOTTOM SURFACE / LEFT EDGE	RIGHT EDGE	RES. HORZ. FORCES(K/FT) / BOT. OF SLAB / HYDRAULIC	EFF. FDN.	
EFF. FDN.	0.00	0.02	0.00	0.00	FORCE
HYDRAULIC	0.16	0.16	0.00	-1.25	ECC.

********** MEMBER 2 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	EFFECTIVE FOUNDATION
0.00	0.00	0.16	0.02
3.00	0.00	0.16	0.38
6.00	0.00	0.16	0.59
9.00	0.00	0.16	0.72
12.00	0.00	0.16	0.78
15.00	0.00	0.16	0.80
18.00	0.00	0.16	0.80
21.00	0.00	0.16	0.78
24.00	0.00	0.16	0.74
27.00	0.00	0.16	0.66
30.00	0.00	0.16	0.52

RESULTANT HORIZONTAL FORCES ON BOTTOM OF SLAB (K/FT)
AND CORRESPONDING ECCENTRICITIES (FT)

HYDRAULIC	EFF.FDN.	
0.00	-2.96	FORCE
0.00	-1.25	ECC.

****** PRESSURES AND RESULTANT FORCES WITH ECCENTRICITIES ******

ON RIGID BLOCK UNDER WALL **** 12 ****

	VERT. PRESS.(KSF) / BOTTOM SURFACE / LEFT EDGE	RIGHT EDGE	RES. HORZ. FORCES(K/FT) / BOT. OF SLAB / HYDRAULIC	EFF. FDN.	
EFF. FDN.	0.52	0.36	0.00	-0.34	FORCE
HYDRAULIC	0.16	0.16	0.00	-1.25	ECC.

********** MEMBER 3 **********

VERTICAL PRESSURES (KSF)

DISTANCE (FT)	HYDRAULIC TOP	HYDRAULIC BOTTOM	BACKFILL	EFFECTIVE FOUNDATION
0.00	0.00	0.16	-1.86	0.36
0.50	0.00	0.16	-1.86	0.33
1.00	0.00	0.16	-1.86	0.30

RESULTANT HORIZONTAL FORCES ON HEEL (K/FT)
AND CORRESPONDING ECCENTRICITIES (FT)

VERTICAL HEELFACE BACKFILL	BOTTOM SURFACE HYDRAULIC	HYDRAULIC	EFF. FDN.	
-2.46	-0.20	0.00	-0.14	FORCE
0.00	0.00	0.00	-1.25	ECC.

********** MEMBER 11 **********

HORIZONTAL PRESSURES (KSF)

DISTANCE (FT)	BACKFILL	HYDRAULIC LEFT	HYDRAULIC RIGHT	EFFECTIVE FORCE-DEF.
16.89	0.00	0.00	0.00	0.00
15.20	0.09	0.00	0.00	0.00
13.51	0.18	0.00	0.00	0.00
11.82	0.28	0.00	0.00	0.00
10.13	0.37	0.00	0.00	0.00

8.45	0.47	0.00	0.00	0.00
6.76	0.62	0.00	0.00	0.00
5.07	0.77	0.00	0.00	0.00
3.38	0.89	0.00	0.00	0.00
1.69	1.00	0.00	0.00	0.00
0.00	1.11	0.00	0.00	0.00
-1.25	0.98	0.08		

RESULTANT VERTICAL FORCES (K/FT) ON WALL
AND CORRESPONDING ECCENTRICITIES (FT)

BACKFILL	HYDRAULIC	
-0.62	0.00	FORCE
-0.73	0.00	ECC.

********** MEMBER 12 **********

DISTANCE	BACKFILL	HORIZONTAL PRESSURES (KSF) HYDRAULIC		EFFECTIVE
(FT)		LEFT	RIGHT	FORCE-DEF.
16.89	0.00	0.00	0.00	0.00
15.20	-0.09	0.00	0.00	0.00
13.51	-0.18	0.00	0.00	0.00
11.82	-0.28	0.00	0.00	0.00
10.13	-0.37	0.00	0.00	0.00
8.45	-0.47	0.00	0.00	0.00
6.76	-0.62	0.00	0.00	0.00
5.07	-0.77	0.00	0.00	0.00
3.38	-0.89	0.00	0.00	0.00
1.69	-1.00	0.00	0.00	0.00
0.00	-1.11	0.00	0.00	0.00
-1.25	-0.98		-0.08	

RESULTANT VERTICAL FORCES (K/FT) ON WALL
AND CORRESPONDING ECCENTRICITIES (FT)

BACKFILL	HYDRAULIC	
-0.62	0.00	FORCE
0.73	0.00	ECC.

0.4 OUTPUT OF MEMBER FORCES / STRENGTH RATIOS *** BY LOAD CASE ***

OUPUT FORCES AND MOMENTS DO NOT INCLUDE LOAD FACTOR.
HOWEVER, STRENGTH RATIOS COMPUTED USING LOAD FACTOR.

******** EM-LIKE LOAD CASE 1 ********NO GROUNDWATER ********

********** MEMBER 1 **********

DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
0.00	0.0	0.00	0.00	-0.002	-1.44	30.00
0.50	-0.2	-0.90	2.66	-0.002	-1.41	30.00
1.00	-0.9	-1.78	2.68	-0.003	-1.38	30.00

********** MEMBER 2 **********

DISTANCE	BENDING MOMENT	FORCES SHEAR	AXIAL	LATERAL DEFLECT.	NET LATR. PRESSURE	THICKNESS

(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
0.00	48.9	-5.97	11.56	-0.004	0.61	30.00
3.00	31.9	-5.08	11.61	-0.005	0.73	30.00
6.00	18.3	-3.93	11.63	-0.005	0.79	30.00
9.00	8.3	-2.66	11.63	-0.005	0.81	30.00
12.00	2.3	-1.33	11.62	-0.005	0.82	30.00
15.00	0.3	0.00	11.62	-0.005	0.82	30.00
18.00	2.3	1.33	11.62	-0.005	0.82	30.00
21.00	8.3	2.66	11.63	-0.005	0.81	30.00
24.00	18.3	3.93	11.63	-0.005	0.79	30.00
27.00	31.9	5.08	11.61	-0.005	0.73	30.00
30.00	48.9	5.97	11.56	-0.004	0.61	30.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE	STEEL AREAS		STEEL	FLEX-AXIAL	DUCTILITY	SHEAR
	TENSION	COMPRESS.	RATIO	STRENGTH	RATIO	STRENGTH
(FT)	(SI/FT)	(SI/FT)	ASTOT/12*H	RATIO		RATIO
0.00	1.32	0.00	0.0037	0.48	0.54	0.35

********** MEMBER 11 **********

DISTANCE	BENDING	FORCES		LATERAL	NET LATR.	THICKNESS
	MOMENT	SHEAR	AXIAL	DEFLECT.	PRESSURE	
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
16.89	0.0	0.00	0.00	0.019	0.00	16.00
15.20	-0.1	0.12	0.34	0.017	0.09	16.00
13.51	-0.4	0.35	0.68	0.014	0.18	16.00
11.82	-1.2	0.74	1.01	0.012	0.28	16.00
10.13	-2.9	1.28	1.35	0.010	0.37	16.00
8.45	-5.6	1.99	1.69	0.008	0.47	16.00
6.76	-9.6	2.92	2.07	0.006	0.62	16.49
5.07	-15.7	4.10	2.56	0.004	0.77	19.87
3.38	-24.0	5.50	3.16	0.003	0.89	23.24
1.69	-34.8	7.08	3.85	0.002	1.00	26.62
0.00	-48.6	8.82	4.61	0.001	1.11	30.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE	STEEL AREAS		STEEL	FLEX-AXIAL	DUCTILITY	SHEAR
	TENSION	COMPRESS.	RATIO	STRENGTH	RATIO	STRENGTH
(FT)	(SI/FT)	(SI/FT)	ASTOT/12*H	RATIO		RATIO
0.00	1.28	0.00	0.0036	0.52	0.44	0.50

******** SPECIAL LOAD CASE 1 ********COMPACTION EFFECTS ********
****

********** MEMBER 1 **********

DISTANCE	BENDING	FORCES		LATERAL	NET LATR.	THICKNESS
	MOMENT	SHEAR	AXIAL	DEFLECT.	PRESSURE	
(FT)	(K-FT/FT)	(K/FT)	(K/FT)	(FT)	(KSF)	(IN)
0.00	0.0	0.00	0.00	0.004	-1.70	30.00
0.50	-0.3	-1.04	2.65	0.003	-1.70	30.00
1.00	-1.0	-2.08	2.65	0.003	-1.70	30.00

********** MEMBER 2 **********

DISTANCE	BENDING	FORCES	LATERAL	NET LATR.	THICKNESS

(FT)	MOMENT (K-FT/FT)	SHEAR (K/FT)	AXIAL (K/FT)	DEFLECT. (FT)	PRESSURE (KSF)	(IN)
0.00	93.3	-7.23	14.91	0.000	0.18	30.00
3.00	70.9	-7.28	14.78	-0.003	0.53	30.00
6.00	50.0	-6.49	14.56	-0.005	0.75	30.00
9.00	32.5	-5.18	14.30	-0.006	0.87	30.00
12.00	19.6	-3.59	14.00	-0.006	0.94	30.00
15.00	11.8	-1.87	13.69	-0.007	0.96	30.00
18.00	9.2	-0.12	13.36	-0.007	0.96	30.00
21.00	11.9	1.60	13.03	-0.006	0.94	30.00
24.00	19.6	3.24	12.70	-0.006	0.90	30.00
27.00	32.1	4.68	12.34	-0.005	0.82	30.00
30.00	48.7	5.79	11.95	-0.004	0.67	30.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE (FT)	STEEL AREAS TENSION (SI/FT)	COMPRESS. (SI/FT)	STEEL RATIO ASTOT/12*H	FLEX-AXIAL STRENGTH RATIO	DUCTILITY RATIO	SHEAR STRENGTH RATIO
0.00	1.32	0.00	0.0037	0.96	1.09	0.42

********** MEMBER 3 **********

DISTANCE (FT)	BENDING MOMENT (K-FT/FT)	FORCES SHEAR (K/FT)	AXIAL (K/FT)	LATERAL DEFLECT. (FT)	NET LATR. PRESSURE (KSF)	THICKNESS (IN)
0.00	-1.0	1.74	2.79	-0.003	-1.34	30.00
0.50	-0.3	0.88	2.72	-0.003	-1.37	30.00
1.00	0.0	0.00	0.00	-0.002	-1.40	30.00

********** MEMBER 11 **********

DISTANCE (FT)	BENDING MOMENT (K-FT/FT)	FORCES SHEAR (K/FT)	AXIAL (K/FT)	LATERAL DEFLECT. (FT)	NET LATR. PRESSURE (KSF)	THICKNESS (IN)
16.89	0.0	0.00	0.00	0.050	0.00	16.00
15.20	-0.1	0.12	0.34	0.044	0.09	16.00
13.51	-0.4	0.72	0.68	0.038	0.18	16.00
11.82	-2.5	2.83	1.01	0.032	0.28	16.00
10.13	-10.0	4.73	1.35	0.026	0.37	16.00
8.45	-18.5	5.44	1.69	0.021	0.47	16.00
6.76	-28.3	6.36	2.07	0.016	0.62	16.49
5.07	-40.2	7.54	2.56	0.012	0.77	19.87
3.38	-54.3	8.94	3.16	0.009	0.89	23.24
1.69	-71.0	10.53	3.85	0.006	1.00	26.62
0.00	-90.6	12.27	4.61	0.004	1.11	30.00

INVESTIGATION OF CONCRETE STRENGTH

DISTANCE (FT)	STEEL AREAS TENSION (SI/FT)	COMPRESS. (SI/FT)	STEEL RATIO ASTOT/12*H	FLEX-AXIAL STRENGTH RATIO	DUCTILITY RATIO	SHEAR STRENGTH RATIO
0.00	1.28	0.00	0.0036	1.00	0.82	0.69

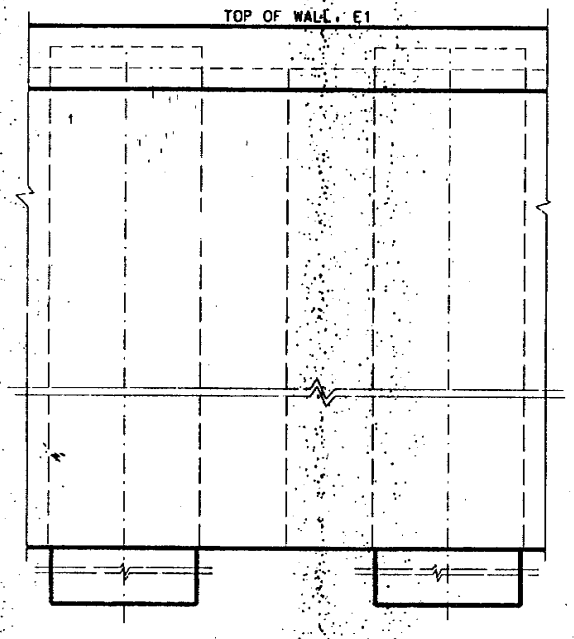
********** MEMBER 12 **********

DISTANCE (FT)	BENDING MOMENT (K-FT/FT)	FORCES SHEAR (K/FT)	AXIAL (K/FT)	LATERAL DEFLECT. (FT)	NET LATR. PRESSURE (KSF)	THICKNESS (IN)
16.89	0.0	0.00	0.00	-0.018	0.00	16.00
15.20	0.1	-0.12	0.34	-0.016	-0.09	16.00

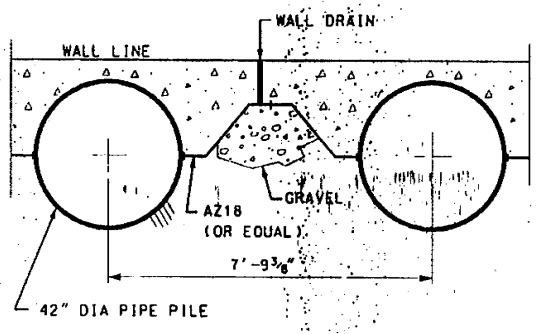
13.51	0.4	-0.35	0.68	-0.014	-0.18	16.00
11.82	1.2	-0.74	1.01	-0.011	-0.28	16.00
10.13	2.9	-1.28	1.35	-0.009	-0.37	16.00
8.45	5.6	-1.99	1.69	-0.007	-0.47	16.00
6.76	9.6	-2.92	2.07	-0.005	-0.62	16.49
5.07	15.7	-4.10	2.56	-0.003	-0.77	19.87
3.38	24.0	-5.50	3.16	-0.001	-0.89	23.24
1.69	-34.8	-7.08	3.85	0.000	-1.00	26.62
0.00	48.6	-8.82	4.61	0.001	-1.11	30.00

APPENDIX C-4

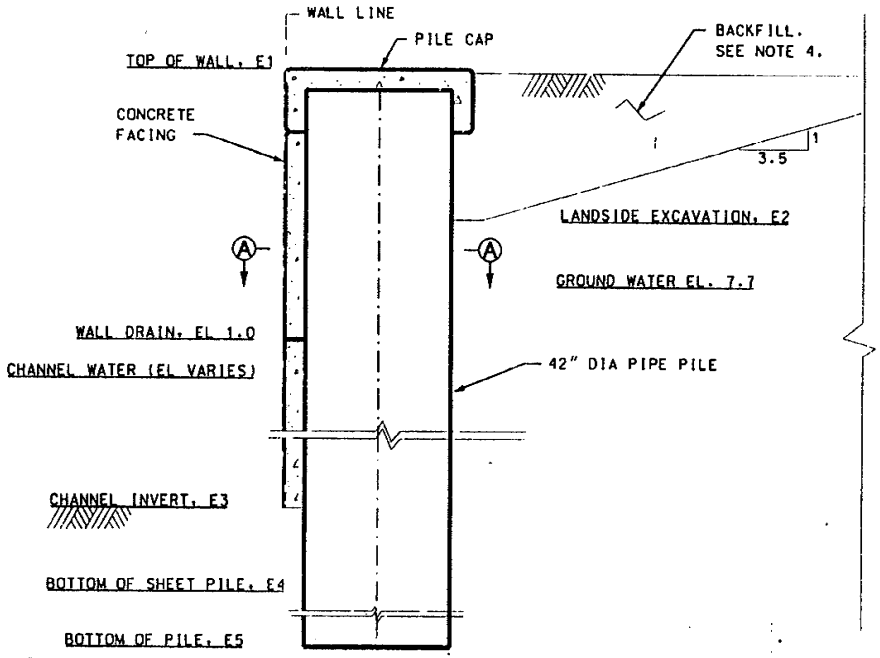
SAMPLE CALCULATIONS
PUERTO NUEVO MAIN CHANNEL RETAINING WALL
STATION 88+33.2 TO 147+40



CHANNEL SIDE ELEVATION



SECTION A



TYPICAL WALL SECTION

NOTES:
1. ALL ELEVATIONS WITH RESPECT TO NATIONAL GEODETIC VERTICAL DATUM (NGVD).
2. INTERMEDIATE ELEVATIONS MAY BE DETERMINED BY INTERPOLATION.
3. DESIGN BASED ON ASTM A252 (GRADE 3) 42" O.D. PIPE WITH 1" WALL THICKNESS. LARGER PILES WITH EQUAL SECTION PROPERTIES MAY ALSO BE USED.
4. WALL DESIGN IS BASED ON LANDSIDE SOIL TO THE TOP OF WALL. ACTUAL LANDSIDE FINISH GRADE ELEVATIONS MAY BE LOWER THAN THE TOP OF WALL, AND WILL BE SET IN ACCORDANCE WITH THE GRADING PLAN FOR THE SECONDARY DRAINAGE SYSTEM.

STATION	E1	E2	E3	E4	E5
88+33	9.2	6.2	-15.9	-18.9	-70.8
92+00	9.0	6.0	-15.5	-18.5	-71.0
98+00	10.0	7.0	-15.0	-18.0	-70.0
114+00	11.0	8.0	-14.5	-17.5	-59.0
140+50	14.0	11.0	-13.0	-16.0	-59.0
147+40	14.5	11.5	-12.7	-15.7	-59.0

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MAIN CHANNEL STA 88+33 TO 147+40

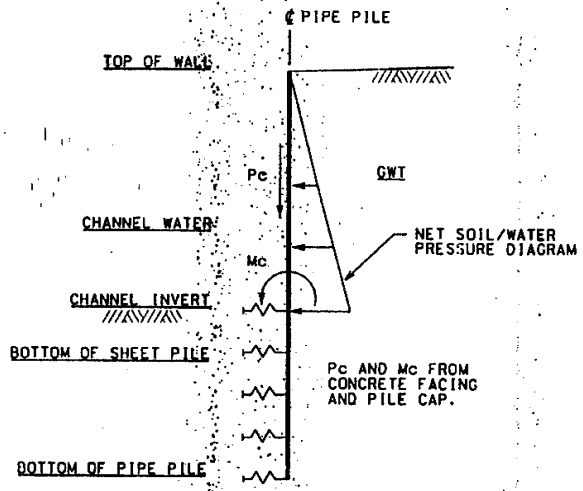
RETAINING WALL
PLAN, ELEVATION, AND SECTION
STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-36,XXX NOVEMBER 1997

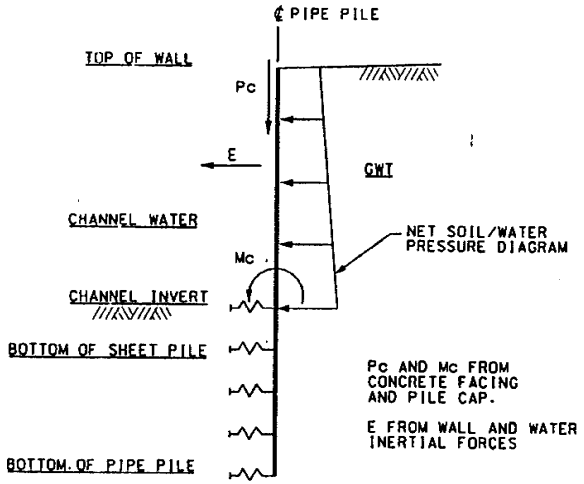
DESIGN ENG.	
MWW	
DWN. BY: MWW	CKD. BY:

PLATE S-11

C-4-1



STATIC LOADING DIAGRAM



SEISMIC LOADING DIAGRAM

SOIL BORING	STATION	LOAD CASE	DEFL (IN)	BENDING MOMENT (K-IN)	PILE CSR
CB-PNB-7	92+00	2	6.7	28100	0.87
CB-PNB-4	98+00	2	6.8	28210	0.88
		3	3.6	22990	0.71
CB-PNM-45	114+00	2	6.0	28280	0.88
CB-PNM-48	140+50	2	6.7	30790	0.96
		1	1.1	9467	0.29
		3	12.7	51760	0.92

LOAD CASE DESCRIPTIONS:

1: POST-CONSTRUCTION CONDITION: UNUSUAL, CHANNEL WATER EL. 0. NGVD, GWT EL 7.7 NGVD, WALL DRAINS 50% EFFECTIVE, SURCHARGE = 200 PSF, O-STATE SOILS.

2: DAILY CONDITION: USUAL, CHANNEL WATER EL. 0 NGVD, GWT EL. 7.7 NGVD, WALL DRAINS 50% EFFECTIVE, S-STATE SOILS.

3: SEISMIC CONDITION: UNUSUAL, CHANNEL WATER EL 0. NGVD, GWT EL 7.7 NGVD, WALL DRAINS 50% EFFECTIVE; R-STATE SOILS, WALL SYSTEM SUBJECT TO INERTIAL FORCES. 75% INCREASE IN ALLOWABLE STEEL STRESSES.

NOTES:

1. DEFLECTIONS ARE THE MAXIMUM LATERAL DEFLECTIONS AT THE TOP OF WALL
2. BENDING MOMENTS ARE THE MAXIMUM PILE BENDING MOMENTS, TYPICALLY OCCURING IN THE MIDDLE THIRD OF THE PILE.
3. PILE COMBINED STRESS RATIOS (CSR) INCLUDE AXIAL AND BENDING STRESSES.

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MAIN CHANNEL STA 98+33 TO 147+40

RETAINING WALL
WALL ANALYSIS
STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 101-36,XXX NOVEMBER 1997

DESIGN ENG.: MWW	
DWN. BY: MWW	CKD. BY:

PLATE S-12

C-4-2

PROJECT		Page __ of __	COMPUTED BY	DATE
	Puerto Nuevo FDM2		MWW	Jul 97
SUBJECT			CHECKED BY	DATE
	Main channel retaining wall sta 88+32 to 147+40			

LOADING CASES:

FROM PREVIOUS ANALYSES, THE FOLLOWING LOAD CASES WILL GOVERN:

A) LOAD CASE 1D: USUAL, CHANNEL WATER EL. 0, $\frac{1}{2}$ MT EL. 7.7 W/ WALL DRAINS 50% EFFECTIVE, NO SURCHARGE, "S" SOIL STATE

B) LOAD CASE 2A: UNUSUAL; LIKE 1D EXCEPT SURCHARGE = 200 PSF, WITH "Q" SOIL STATE.

C) LOAD CASE 3B: UNUSUAL; LIKE 1D EXCEPT SEISMIC LOADS WITH "R" SOIL STATE

DESIGN PROCEDURE:

1. ASSUME ONLY SOIL BELOW CHANNEL INVERT WILL TAKE LOAD.
2. FIND NET PRESSURE FROM SOIL ABOVE DREDGELINE.
3. FIND CONCRETE FACING LOADS.
4. ESTIMATE TOTAL PILE LENGTH AND ANALYZE VARIOUS WALL SYSTEMS.

DESIGN CRITERIA:

1. USE A TOP OF WALL LATERAL DEFLECTION LIMIT OF 2% OF UNSUPPORTED WALL HEIGHT

25 FT : $.02(25)(12) \Rightarrow 6.0"$

27 FT : $.02(27)(12) \Rightarrow 6.5"$

2. USE PILE STRESS LIMITS PER EM 1110-2-2906.

PROJECT	Page __ of __	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

3. P-Y CURVES :

A.) LOAD CASE 1A : S-STATE SOILS

USE SAND P-Y CURVE BY REESE ET AL 1974

ASSUME CLAYS LIKE ACT LOOSE - MEDIUM SAND

B.) LOAD CASE 3B : C-STATE SOILS

USE "SOIL WITH COHESION AND FRICTION" P-Y CURVE

BY REESE AND WANG 1993

USE K_i BASED ON ϕ, AND ε_{50} BASED ON C

C) LOAD CASE 2A : Q-STATE SOILS

USE STIFF CLAY BELOW WATERTABLE P-Y CURVE

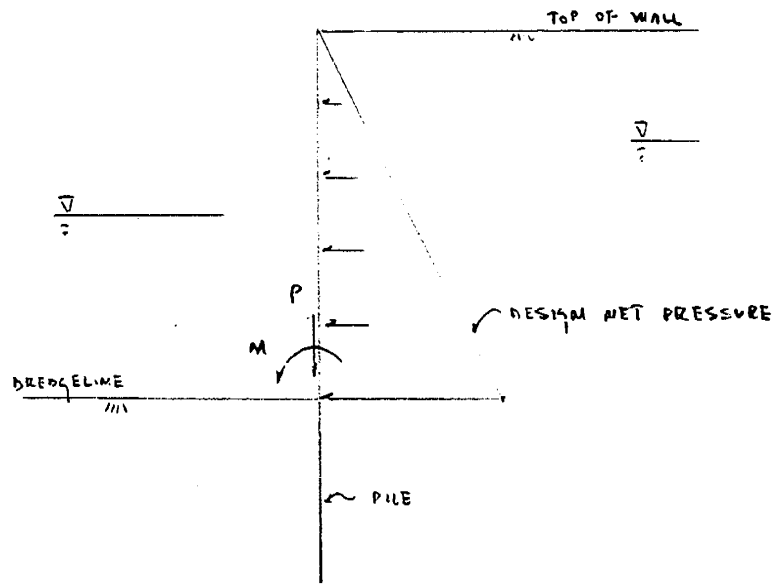
BY REESE ET AL 1975

4. AXIAL LOAD CONSIDERATIONS :

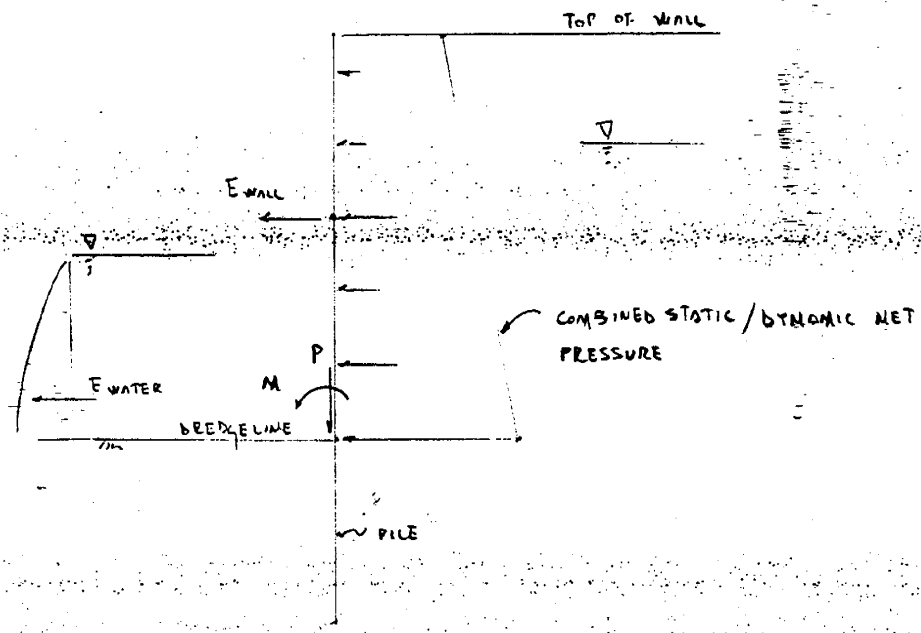
THIS ANALYSIS EXCLUDES TRANSFER OF AXIAL LOAD TO THE SOIL. ASSUME AXIAL SOIL CAPACITIES FAR EXCEED LOADS, AND THAT THE AXIAL PERFORMANCE OF THE PILE DOES NOT AFFECT THE LATERAL PERFORMANCE.

PROJECT	Page __ of __	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

TYPICAL STATIC LOADING DIAGRAM:

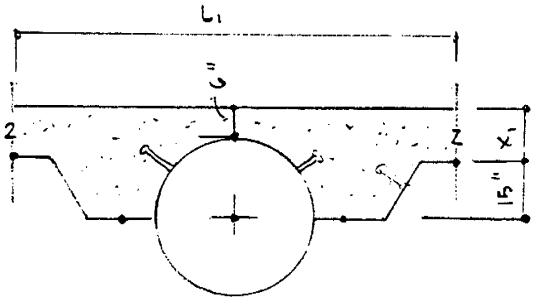


TYPICAL SEISMIC LOADING DIAGRAM:



PROJECT	Page — of —	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

CONCRETE WALL FACING LOADS :



FOR 36" ϕ : $L_1 = 87.3"$, USE $X_1 = 9"$

USE $W_c = .135 \text{ kcf} \left[9 (87.3)(27') / 144 \right] = 19.9 \text{ k}$

$M_c = 20. \text{k} \left[24. - 4.5 \right] = 329 \text{ k.in}$

FOR 48" ϕ : $L_1 = 99.3"$, USE $X_1 = 15"$

USE $W_c = .135 \left[.15 (99.3)(27) / 144 \right] = 37.8 \text{ k}$

$M_c = 37.8 \text{ k} \left[30 - 7.5 \right] = 850.5 \text{ k.in}$

FOR 52" ϕ : $L_1 = 103.3"$, USE $X_1 = 17"$

USE $W_c = .135 \left[17 (103.3)(27) / 144 \right] = 44.4 \text{ k}$

$M_c = 44.4 \left[32 - 8.5 \right] = 1043.4 \text{ k.in}$

SOIL DATA SUMMARY

Station	Boring	Top of Wall el.	Dredge-line el.	Pile Length	Pile Tip el.	Soil Layers	Q-state c (psf)	S-state Ki (pci)	S-state phi angle (deg)	R-state Ki (pci)	R-state c (psf)	R-state E50	R-state phi angle (deg)	P-Y curve factor
92+00	cb-pnb-7	9.00	-15.50	80.00	-71.00									
						above el. -37: CH	1060.00	50.00	22.00					1.10
						el. -37 to -58: SP	0.00	50.00	33.00					1.10
						el. -58 to -76: CL	1630.00	100.00	26.00					1.00
98+00	cb-pnb-4	10.00	-15.00	80.00	-70.00									
						above el. -23: CL	1500.00	50.00	28.00	50.00	440.00	0.01	14.00	1.10
						el. -23 to -36: CH	1100.00	50.00	18.00	50.00	1100.00	0.007	8.00	1.10
						el. -36 to -47: CH	2000.00	100.00	24.00	50.00	1000.00	0.007	12.00	1.10
						el. -47 to -76: LS	3000.00	100.00	36.00	100.00	n/a	n/a	36.00	1.00
114+00	cb-pnm-45	11.00	-14.50	70.00	-59.00									
						above el. -33: CL	1600.00	50.00	28.00					1.10
						el. -33 to -40: SC	2000.00	50.00	32.00					1.10
						el. -40 to -53: LS	3500.00	100.00	38.00					1.10
						below -53: LM	0.00	500.00	40.00					1.00
140+50	cb-pnm-48	14.00	-13.00	73.00	-59.00									
						above el. -23: CL	1600.00	50.00	30.00	50.00	350.00	0.01	12.00	1.10
						el. -23 to -33: SC	1600.00	50.00	30.00	50.00	700.00	0.01	13.00	1.10
						el. -33 to -55: ML	1600.00	100.00	30.00	50.00	750.00	0.007	12.00	1.10
						below -55: LM	0.00	500.00	40.00	500.00	n/a	n/a	40.00	1.00

1. Where pile lengths are < 80 ft, lengths are based on penetration into LM (limestone) required to achieve 2 points of zero deflection for the long term load case.
2. Ki is the initial lateral subgrade constant used in the eqn Es = K*depth.
3. p-y curve factor is for group effects on lateral deflections, due to pile spacing < 2.5B. At lower depths, this affect diminishes.

D-4-7

PROJECT	Page __ of __	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

48" ϕ PIPE : FIND DEPTH TO FIXITY (FROM HWY DESIGN MANUAL)

"Q" STATE : $D = 1.4\,[EI/E_s]^{1/4}$, $E_s = .222\,(2)(1600)(.38)/1000 = 0.27$ KSI (C, B)

USE $E_s = .222\,q_u\,\beta = .222\,(2)(1600)(.38)/1000 = 0.27$ KSI (β : PORE PRESSURE DISSIPATION)

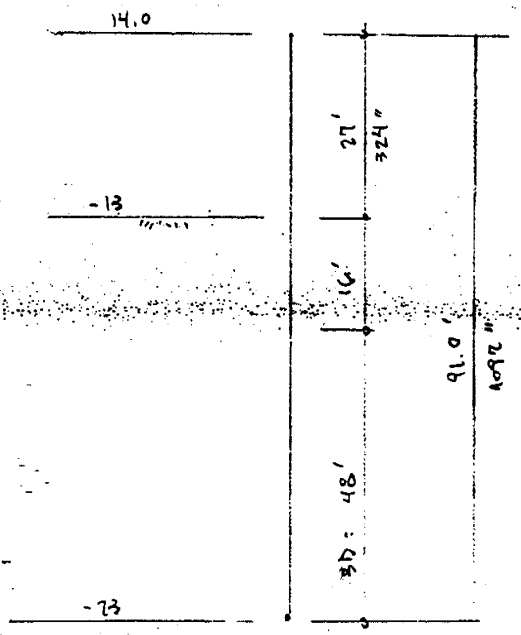
$D = 1.4\,[29000\,(22266)/0.27]^{.25} = 221" = 18.4$ FT

"S" STATE : $D = 1.8\,[EI/n_h]^{1/5}$, USE $n_h = 60$ PCI (LOOSE)

$D = 1.8\,[29000\,(22266)/.06]^{.20} = 182" = 15.2$ FT

USE 16.0 FT

STA 140+50



PROJECT	Page __ of __	COMPUTED BY	DATE
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LPILE MODELS:

STA 92+00

EL	X
9.	0
-15.5	294
-37	552
-58	804
-71	960

L = 80'

CH

SP

CL

STA 98+00

EL	X
10.	0
-15	700
-23	396
-36	552
-47	684
-70	960

L = 80'

CL

CH

CH

LS

PROJECT	Page __ of __	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

STA 114+00

EL	x	
11.0	0	
-14.50	304	CL
-33.	528	SC
-40.	612	LS
-53.	768	LM
-59	840	

L = 90'

STA 140+50

EL	x	
14.0	0	
-13	324	CL
-23	444	SC
-33	564	ML
-55	828	LM
-59	876	

L = 73'

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS

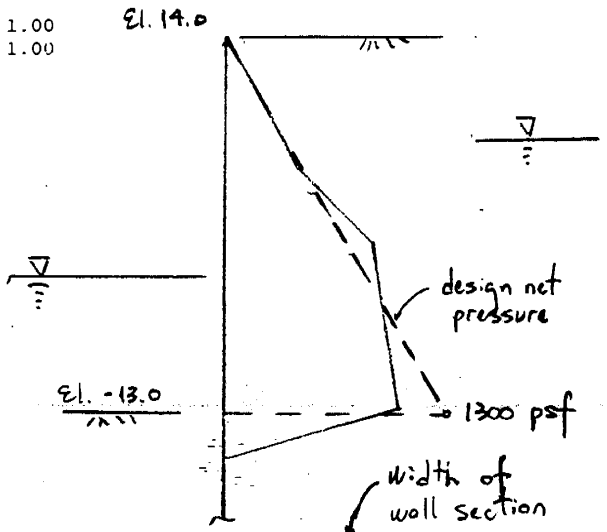
DATE: 02-JUN-1997 TIME: 12.56.56

INPUT DATA

I.--HEADING:
'REN FDM2; MASTER PILE WALL;STA 140+50; S-CASE; DAILY CONDS load case 1b
'DRAINS 50% EFFECTIVE

II.--CONTROL
CANTILEVER WALL DESIGN

LEVEL 1 FACTOR OF SAFETY FOR ACTIVE PRESSURES = 1.00
LEVEL 1 FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.00



1300 (93/12) = 10075 lb/f
= 839 lb/in
use in LPILE

III.--WALL DATA
ELEVATION AT TOP OF WALL = 14.00 (FT)

IV.--SURFACE POINT DATA

IV.A--RIGHTSIDE

DIST. FROM WALL (FT)	ELEVATION (FT)
.00	13.90
30.00	15.00
40.00	15.00

IV.B-- LEFTSIDE

DIST. FROM WALL (FT)	ELEVATION (FT)
.00	-13.00

V.--SOIL LAYER DATA

V.A.--RIGHTSIDE LAYER DATA
LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURES = DEFAULT
LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURES = DEFAULT

SAT. WGHT. (PCF)	MOIST WGHT. (PCF)	ANGLE OF INTERNAL FRICTION (DEG)	COH-ESION (PSF)	ANGLE OF WALL FRICTION (DEG)	ADH-ESION (PSF)	<--BOTTOM--> ELEV. (FT)	SLOPE (FT/FT)	<-SAFETY-> <-FACTOR-> ACT.	PASS.
125.00	110.00	32.00	.0	.00	.0	5.00	.00	DEF	DEF
110.00	100.00	28.00	.0	.00	.0	-4.00	.00	DEF	DEF
115.00	105.00	31.00	.0	.00	.0	-22.50	.00	DEF	DEF
120.00	110.00	30.00	.0	.00	.0			DEF	DEF

V.B.-- LEFTSIDE LAYER DATA
LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURES = DEFAULT
LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURES = DEFAULT

SAT. WGHT. (PCF)	MOIST WGHT. (PCF)	ANGLE OF INTERNAL FRICTION (DEG)	COH-ESION (PSF)	ANGLE OF WALL FRICTION (DEG)	ADH-ESION (PSF)	<--BOTTOM--> ELEV. (FT)	SLOPE (FT/FT)	<-SAFETY-> <-FACTOR-> ACT.	PASS.
150.00	150.00	45.00	.0	.00	.0	-16.00	.00	DEF	DEF
115.00	105.00	31.00	.0	.00	.0	-22.50	.00	DEF	DEF

120.00 110.00 30.00 .0 .00 .0 DEF DEF

VI.--WATER DATA

UNIT WEIGHT = 62.50 (PCF)
RIGHTSIDE ELEVATION = 6.50 (FT)
LEFTSIDE ELEVATION = .00 (FT)
NO SEEPAGE

VII.--SURFACE LOADS
NONE

VIII.--HORIZONTAL LOADS
NONE

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS
DATE: 02-JUN-1997 TIME: 12.58.21

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° SUMMARY OF RESULTS FOR °
° CANTILEVER WALL DESIGN °
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I.--HEADING

'RPN FDM2; MASTER PILE WALL;STA 140+50; S-CASE; DAILY CONDS
'DRAINS 50% EFFECTIVE

II.--SUMMARY

RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

LEFTSIDE SOIL PRESSURES DETERMINED BY COULOMB COEFFICIENTS
AND THEORY OF ELASTICITY EQUATIONS FOR SURCHARGE LOADS.

WALL BOTTOM ELEV. (FT) : -52.89
PENETRATION (FT) : 39.89

MAX. BEND. MOMENT (LB-FT) : 414903.
AT ELEVATION (FT) : -33.38

MAX. SCALED DEFL. (LB-IN3): 9.0849E+11
AT ELEVATION (FT) : 14.00

(NOTE: DIVIDE SCALED DEFLECTION BY MODULUS OF
ELASTICITY IN PSI TIMES PILE MOMENT OF INERTIA
IN IN**4 TO OBTAIN DEFLECTION IN INCHES.)

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS

DATE: 02-JUN-1997 TIME: 12.58.21

COMPLETE RESULTS FOR
CANTILEVER WALL DESIGN

I.--HEADING

'RPN FDM2; MASTER PILE WALL;STA 140+50; S-CASE; DAILY CONDS
'DRAINS 50% EFFECTIVE

II.--RESULTS

ELEVATION (FT)	BENDING MOMENT (LB-FT)	SHEAR (LB)	SCALED DEFLECTION (LB-IN3)	NET PRESSURE (PSF)
14.00	0.	0.	9.0849E+11	.00
13.90	0.	0.	9.0639E+11	.00
13.00	4.	14.	8.8752E+11	31.05
12.00	39.	62.	8.6656E+11	65.55
11.00	140.	145.	8.4559E+11	100.05
10.00	341.	262.	8.2463E+11	134.55
9.00	676.	414.	8.0366E+11	169.05
8.00	1181.	600.	7.8270E+11	203.55
7.00	1889.	821.	7.6174E+11	238.05
6.50	2330.	944.	7.5126E+11	253.47
6.00	2835.	1082.	7.4078E+11	296.50
5.00	4083.	1431.	7.1982E+11	402.33
4.00	5733.	1886.	6.9888E+11	507.53
3.00	7886.	2434.	6.7794E+11	588.84
2.00	10628.	3064.	6.5702E+11	669.85
1.00	14040.	3774.	6.3611E+11	750.39
.00	18202.	4564.	6.1523E+11	830.93
-1.00	23185.	5404.	5.9438E+11	848.97
-2.00	29017.	6262.	5.7358E+11	867.02
-3.00	35716.	7138.	5.5282E+11	885.06
-4.00	43295.	8018.	5.3212E+11	875.24
-5.00	51749.	8889.	5.1150E+11	865.18
-6.00	61073.	9763.	4.9097E+11	882.74
-7.00	71280.	10654.	4.7054E+11	900.31
-8.00	82387.	11563.	4.5024E+11	917.87
-9.00	94413.	12490.	4.3008E+11	935.44
-10.00	107373.	13434.	4.1008E+11	953.00
-11.00	121287.	14396.	3.9027E+11	970.56
-12.00	136171.	15375.	3.7067E+11	988.13
-13.00	152043.	16372.	3.5131E+11	1005.69
-14.00	168836.	17132.	3.3220E+11	513.27
-15.00	186142.	17399.	3.1339E+11	20.84
-15.15	188780.	17400.	3.1057E+11	.00
-15.58	196160.	17388.	3.0270E+11	-58.31
-16.00	203528.	17351.	2.9490E+11	-116.63
-17.00	220855.	17338.	2.7676E+11	91.88
-18.00	238215.	17357.	2.5901E+11	-54.57
-19.00	255521.	17229.	2.4166E+11	-201.02
-20.00	272625.	16955.	2.2476E+11	-347.47
-21.00	289382.	16534.	2.0833E+11	-493.92
-22.00	305645.	15967.	1.9239E+11	-640.36
-22.50	313548.	15642.	1.8462E+11	-660.18
-23.00	321285.	15306.	1.7699E+11	-683.64
-24.00	336224.	14546.	1.6214E+11	-836.17
-25.00	350327.	13634.	1.4787E+11	-988.69
-26.00	363441.	12569.	1.3421E+11	-1141.22
-27.00	375414.	11351.	1.2118E+11	-1293.74
-28.00	386093.	9981.	1.0879E+11	-1446.27
-29.00	395325.	8459.	9.7069E+10	-1598.79
-30.00	402959.	6784.	8.6032E+10	-1751.32

C-4-13

-31.00	408842.	4956.	7.5692E+10	-1903.84
-32.00	412821.	2976.	6.6057E+10	-2056.37
-33.00	414743.	843.	5.7136E+10	-2208.89
-34.00	414457.	-1442.	4.8931E+10	-2361.42
-35.00	411809.	-3880.	4.1442E+10	-2514.16
-36.00	406647.	-6470.	3.4664E+10	-2667.28
-37.00	398817.	-9214.	2.8588E+10	-2820.57
-38.00	388167.	-12111.	2.3201E+10	-2973.85
-39.00	374543.	-15162.	1.8485E+10	-3127.13
-40.00	357792.	-18366.	1.4415E+10	-3280.42
-41.00	337761.	-21723.	1.0963E+10	-3433.70
-42.00	314296.	-25233.	8.0943E+09	-3586.98
-43.00	287244.	-28897.	5.7680E+09	-3740.27
-44.00	256451.	-32714.	3.9376E+09	-3893.55
-44.46	240936.	-34527.	3.2455E+09	-3964.31
-45.00	221819.	-36384.	2.5497E+09	-2934.32
-46.00	184287.	-38362.	1.5448E+09	-1021.50
-47.00	145732.	-38427.	8.5813E+08	891.32
-48.00	108070.	-36580.	4.2342E+08	2804.15
-49.00	73211.	-32819.	1.7586E+08	4716.97
-50.00	43069.	-27146.	5.5493E+07	6629.80
-51.00	19557.	-19559.	1.0500E+07	8542.62
-52.00	4588.	-10060.	5.3334E+05	10455.44
-52.89	0.	0.	0.0000E+00	12157.45

(NOTE: DIVIDE SCALED DEFLECTION BY MODULUS OF ELASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN**4 TO OBTAIN DEFLECTION IN INCHES.)

III.--SOIL PRESSURES

ELEVATION	< LEFTSIDE PRESSURE (PSF)>		<RIGHTSIDE PRESSURE (PSF)>	
(FT)	PASSIVE	ACTIVE	ACTIVE	PASSIVE
14.00	0.	0.	0.	0.
13.90	0.	0.	0.	0.
13.00	0.	0.	31.	344.
12.00	0.	0.	66.	727.
11.00	0.	0.	100.	1110.
10.00	0.	0.	135.	1492.
9.00	0.	0.	169.	1875.
8.00	0.	0.	204.	2258.
7.00	0.	0.	238.	2640.
6.50	0.	0.	253.	2812.
6.00	0.	0.	265.	2945.
5.00	0.	0.	309.	2929.
4.00	0.	0.	351.	2874.
3.00	0.	0.	370.	3025.
2.00	0.	0.	389.	3177.
1.00	0.	0.	407.	3328.
.00	0.	0.	425.	3480.
-1.00	0.	0.	443.	3632.
-2.00	0.	0.	461.	3782.
-3.00	0.	0.	479.	3926.
-4.00	0.	0.	469.	4314.
-5.00	0.	0.	459.	4712.
-6.00	0.	0.	476.	4871.
-7.00	0.	0.	494.	5035.
-8.00	0.	0.	512.	5198.
-9.00	0.	0.	529.	5362.
-10.00	0.	0.	547.	5525.
-11.00	0.	0.	564.	5689.
-12.00	0.	0.	582.	5852.
-13.00	0.	0.	599.	6016.
-14.00	510.	15.	617.	6182.
-15.00	1020.	30.	635.	6349.
-15.15	1097.	32.	637.	6374.
-15.58	1314.	39.	645.	6445.
-16.00+	1530.	45.	652.	6516.
-16.00-	820.	84.	652.	6516.
-17.00	984.	101.	670.	6682.
-18.00	1148.	118.	687.	6849.

-19.00	1312.	134.	705.	7016.
-20.00	1476.	151.	722.	7182.
-21.00	1640.	168.	740.	7349.
-22.00	1804.	185.	758.	7516.
-22.50+	1886.	193.	782.	7452.
-22.50-	1811.	201.	782.	7452.
-23.00	1898.	211.	808.	7390.
-24.00	2070.	230.	828.	7562.
-25.00	2243.	249.	848.	7733.
-26.00	2415.	268.	868.	7905.
-27.00	2588.	288.	888.	8077.
-28.00	2760.	307.	907.	8249.
-29.00	2933.	326.	927.	8420.
-30.00	3105.	345.	947.	8592.
-31.00	3278.	364.	967.	8764.
-32.00	3450.	383.	987.	8936.
-33.00	3623.	403.	1007.	9108.
-34.00	3795.	422.	1027.	9279.
-35.00	3968.	441.	1047.	9451.
-36.00	4140.	460.	1066.	9623.
-37.00	4312.	479.	1086.	9795.
-38.00	4485.	498.	1105.	9967.
-39.00	4657.	518.	1124.	10138.
-40.00	4830.	537.	1143.	10310.
-41.00	5002.	556.	1163.	10482.
-42.00	5175.	575.	1182.	10655.
-43.00	5347.	594.	1201.	10828.
-44.00	5520.	613.	1220.	11000.
-44.46	5600.	622.	1229.	11080.
-45.00	5692.	633.	1239.	11173.
-46.00	5865.	652.	1258.	11345.
-47.00	6037.	671.	1278.	11518.
-48.00	6210.	690.	1297.	11691.
-49.00	6382.	709.	1316.	11863.
-50.00	6555.	728.	1335.	12036.
-51.00	6727.	748.	1354.	12209.
-52.00	6900.	767.	1373.	12381.
-52.89	7072.	786.	1392.	12554.
-54.00	7245.	805.	1411.	12727.

STA 140+50, LC 1D

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42" Pipe

UNITS--ENGLISH UNITS

I N P U T I N F O R M A T I O N

THE LOADING IS STATIC

PILE GEOMETRY AND PROPERTIES

PILE LENGTH = 876.00 IN
3 POINTS

X	DIAMETER	MOMENT OF INERTIA	AREA	MODULUS OF ELASTICITY
IN	IN	IN**4	IN**2	LBS/IN**2
.00	93.000	.271D+05	.128D+03	.290D+08
360.00	42.000	.271D+05	.128D+03	.290D+08
876.00	42.000	.271D+05	.128D+03	.290D+08

SOILS INFORMATION

X AT THE GROUND SURFACE = 324.00 IN

SLOPE ANGLE AT THE GROUND SURFACE = .00 DEG.

4 LAYER(S) OF SOIL

LAYER 1
THE SOIL IS A SAND - P-Y CRITERIA BY REESE ET AL, 1974

X AT THE TOP OF THE LAYER = 324.00 IN
X AT THE BOTTOM OF THE LAYER = 444.00 IN
MODULUS OF SUBGRADE REACTION = .500D+02 LBS/IN**3

LAYER 2
THE SOIL IS A SAND - P-Y CRITERIA BY REESE ET AL, 1974
X AT THE TOP OF THE LAYER = 444.00 IN
X AT THE BOTTOM OF THE LAYER = 564.00 IN
MODULUS OF SUBGRADE REACTION = .500D+02 LBS/IN**3

LAYER 3
THE SOIL IS A SAND - P-Y CRITERIA BY REESE ET AL, 1974
X AT THE TOP OF THE LAYER = 564.00 IN
X AT THE BOTTOM OF THE LAYER = 828.00 IN
MODULUS OF SUBGRADE REACTION = .100D+03 LBS/IN**3

LAYER 4
THE SOIL IS A SAND - P-Y CRITERIA BY REESE ET AL, 1974
X AT THE TOP OF THE LAYER = 828.00 IN
X AT THE BOTTOM OF THE LAYER = 2000.00 IN
MODULUS OF SUBGRADE REACTION = .500D+03 LBS/IN**3

DISTRIBUTION OF EFFECTIVE UNIT WEIGHT WITH DEPTH
2 POINTS

X,IN	WEIGHT,LBS/IN**3
324.00	.33D-01
2000.00	.33D-01

DISTRIBUTION OF STRENGTH PARAMETERS WITH DEPTH
6 POINTS

X,IN	C,LBS/IN**2	PHI,DEGREES	E50
324.00	.000D+00	.300D+02	-----
444.00	.000D+00	.300D+02	-----
564.00	.000D+00	.300D+02	-----
828.00	.000D+00	.300D+02	-----
829.00	.000D+00	.400D+02	-----
2000.00	.000D+00	.400D+02	-----

DISTRIBUTION OF P AND Y MULTIPLIERS VERSUS DEPTH
3 POINTS

X,IN	P-MULTIPLIER	Y-MULTIPLIER
324.00	.10D+01	.11D+01
828.00	.10D+01	.11D+01
829.00	.10D+01	.10D+01

INPUT P-Y CURVES 2 CURVES, 3 POINTS ON EACH

X,IN	Y,IN	P,LBS/IN
828.00	.00	.00
	.02	1000.00
	.06	1500.00

X,IN	Y,IN	P,LBS/IN
2000.00	.00	.00
	.02	1000.00
	.06	1500.00

BOUNDARY AND LOADING CONDITIONS

9-2-17

DISTRIBUTED LOAD CURVE 2 POINTS

X,IN	LOAD,LBS/IN
.00	.000D+00
324.00	.839D+03

LOADING NUMBER 1

BOUNDARY-CONDITION CODE	=	1
LATERAL LOAD AT THE PILE HEAD	=	.000D+00 LBS
MOMENT AT THE PILE HEAD	=	.619D+06 IN-LBS
AXIAL LOAD AT THE PILE HEAD	=	.290D+05 LBS

FINITE-DIFFERENCE PARAMETERS

NUMBER OF PILE INCREMENTS	=	73
DEFLECTION TOLERANCE ON DETERMINATION OF CLOSURE	=	.100D-02 IN
MAXIMUM NUMBER OF ITERATIONS ALLOWED FOR PILE ANALYSIS	=	500
MAXIMUM ALLOWABLE DEFLECTION	=	.10D+03 IN

OUTPUT CODES

KOUTPT	=	1
KPYOP	=	1
INC	=	1

DEPTH IN	DIAM IN	PHI	GAMMA AVG LBS/IN**3	A	B	PST	PSD
226.00	42.00	30.0	.330D-01	.88	.50	.387D+04	.876D+04

Y IN	P LBS/IN
.000D+00	.000D+00
.642D-01	.427D+03
.135D+00	.670D+03
.212D+00	.883D+03
.298D+00	.109D+04
.392D+00	.128D+04
.495D+00	.148D+04
.609D+00	.168D+04
.734D+00	.188D+04
.871D+00	.209D+04
.102D+01	.232D+04
.119D+01	.257D+04
.137D+01	.285D+04
.173D+01	.340D+04
.481D+02	.340D+04
.991D+02	.340D+04
.155D+03	.340D+04

DEPTH IN	DIAM IN	PHI	GAMMA AVG LBS/IN**3	A	B	PST	PSD
502.00	42.00	30.0	.330D-01	.88	.50	.171D+05	.196D+05

Y IN	P LBS/IN
.000D+00	.000D+00
.642D-01	.189D+04
.135D+00	.296D+04
.212D+00	.390D+04
.298D+00	.480D+04
.392D+00	.567D+04
.495D+00	.653D+04
.609D+00	.741D+04

.734D+00	.830D+04
.871D+00	.923D+04
.102D+01	.102D+05
.119D+01	.114D+05
.137D+01	.126D+05
.173D+01	.150D+05
.481D+02	.150D+05
.991D+02	.150D+05
.155D+03	.150D+05

DEPTH IN	DIAM IN	PHI	GAMMA AVG LBS/IN**3	A	B	PST	PSD
1576.00	42.00	40.0	.330D-01	.88	.50	.381D+06	.225D+06

Y IN	P LBS/IN
.000D+00	.000D+00
.583D-01	.249D+05
.117D+00	.379D+05
.175D+00	.485D+05
.233D+00	.578D+05
.292D+00	.662D+05
.350D+00	.739D+05
.408D+00	.812D+05
.467D+00	.881D+05
.525D+00	.946D+05
.583D+00	.101D+06
.642D+00	.107D+06
.700D+00	.113D+06
.158D+01	.198D+06
.436D+02	.198D+06
.856D+02	.198D+06
.128D+03	.198D+06

O U T P U T I N F O R M A T I O N

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****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-DEFLECTION *
* CURVES FOR LATERAL LOADING *
****

DISTRIBUTED LOAD CURVE 2 POINTS

X,IN	LOAD,LBS/IN
.00	.000D+00
324.00	.839D+03

LOADING NUMBER 1

BOUNDARY CONDITION CODE = 1
LATERAL LOAD AT THE PILE HEAD = .000D+00 LBS
MOMENT AT THE PILE HEAD = .619D+06 IN-LBS
AXIAL LOAD AT THE PILE HEAD = .290D+05 LBS

X	DEFLECTION	MOMENT	SHEAR	SLOPE	TOTAL STRESS	FLEXURAL RIGIDITY	SOIL REACTION
IN	IN	LBS-IN	LBS	RAD.	LBS/IN**2	LBS-IN**2	LBS/IN
*****	*********	*********	*********	*********	*********	*********	*********
.0	.674D+01	.619D+06	-.751D-07	-.141D-01	.129D+04	.785D+12	.000D+00
12.0	.657D+01	.624D+06	.186D+03	-.141D-01	.128D+04	.785D+12	.000D+00
24.0	.640D+01	.633D+06	.746D+03	-.141D-01	.127D+04	.785D+12	.000D+00
36.0	.623D+01	.652D+06	.168D+04	-.140D-01	.128D+04	.785D+12	.000D+00
48.0	.606D+01	.683D+06	.298D+04	-.140D-01	.131D+04	.785D+12	.000D+00
60.0	.590D+01	.733D+06	.466D+04	-.140D-01	.137D+04	.785D+12	.000D+00
72.0	.573D+01	.805D+06	.671D+04	-.140D-01	.146D+04	.785D+12	.000D+00
84.0	.556D+01	.904D+06	.914D+04	-.140D-01	.158D+04	.785D+12	.000D+00
96.0	.539D+01	.103D+07	.119D+05	-.140D-01	.174D+04	.785D+12	.000D+00
108.0	.522D+01	.120D+07	.151D+05	-.140D-01	.195D+04	.785D+12	.000D+00
120.0	.506D+01	.141D+07	.186D+05	-.139D-01	.220D+04	.785D+12	.000D+00
132.0	.489D+01	.166D+07	.226D+05	-.139D-01	.250D+04	.785D+12	.000D+00
144.0	.472D+01	.196D+07	.268D+05	-.139D-01	.285D+04	.785D+12	.000D+00
156.0	.455D+01	.231D+07	.315D+05	-.139D-01	.325D+04	.785D+12	.000D+00
168.0	.439D+01	.272D+07	.365D+05	-.138D-01	.371D+04	.785D+12	.000D+00
180.0	.422D+01	.320D+07	.419D+05	-.138D-01	.421D+04	.785D+12	.000D+00
192.0	.406D+01	.374D+07	.477D+05	-.137D-01	.477D+04	.785D+12	.000D+00
204.0	.389D+01	.435D+07	.539D+05	-.137D-01	.538D+04	.785D+12	.000D+00
216.0	.373D+01	.504D+07	.604D+05	-.136D-01	.604D+04	.785D+12	.000D+00
228.0	.357D+01	.581D+07	.673D+05	-.135D-01	.674D+04	.785D+12	.000D+00
240.0	.341D+01	.667D+07	.746D+05	-.134D-01	.749D+04	.785D+12	.000D+00
252.0	.325D+01	.761D+07	.822D+05	-.133D-01	.828D+04	.785D+12	.000D+00
264.0	.309D+01	.865D+07	.902D+05	-.132D-01	.911D+04	.785D+12	.000D+00
276.0	.293D+01	.979D+07	.986D+05	-.130D-01	.997D+04	.785D+12	.000D+00
288.0	.277D+01	.110D+08	.107D+06	-.129D-01	.109D+05	.785D+12	.000D+00
300.0	.262D+01	.124D+08	.117D+06	-.127D-01	.118D+05	.785D+12	.000D+00
312.0	.247D+01	.138D+08	.126D+06	-.125D-01	.127D+05	.785D+12	.000D+00
324.0	.232D+01	.154D+08	.136D+06	-.123D-01	.136D+05	.785D+12	.000D+00
336.0	.217D+01	.171D+08	.140D+06	-.120D-01	.146D+05	.785D+12	-.137D+03
348.0	.203D+01	.188D+08	.138D+06	-.118D-01	.154D+05	.785D+12	-.286D+03
360.0	.189D+01	.204D+08	.133D+06	-.115D-01	.161D+05	.785D+12	-.433D+03
372.0	.176D+01	.220D+08	.127D+06	-.111D-01	.173D+05	.785D+12	-.590D+03
384.0	.162D+01	.235D+08	.119D+06	-.108D-01	.184D+05	.785D+12	-.738D+03
396.0	.150D+01	.249D+08	.110D+06	-.104D-01	.195D+05	.785D+12	-.862D+03
408.0	.137D+01	.261D+08	.987D+05	-.100D-01	.205D+05	.785D+12	-.949D+03
420.0	.126D+01	.272D+08	.869D+05	-.962D-02	.213D+05	.785D+12	-.102D+04
432.0	.114D+01	.282D+08	.745D+05	-.920D-02	.221D+05	.785D+12	-.106D+04
444.0	.104D+01	.290D+08	.618D+05	-.876D-02	.227D+05	.785D+12	-.105D+04
456.0	.934D+00	.297D+08	.491D+05	-.831D-02	.233D+05	.785D+12	-.107D+04
468.0	.837D+00	.302D+08	.360D+05	-.785D-02	.236D+05	.785D+12	-.111D+04
480.0	.745D+00	.306D+08	.226D+05	-.739D-02	.239D+05	.785D+12	-.112D+04
492.0	.659D+00	.308D+08	.921D+04	-.692D-02	.241D+05	.785D+12	-.110D+04
504.0	.579D+00	.308D+08	-.399D+04	-.645D-02	.241D+05	.785D+12	-.110D+04
516.0	.504D+00	.307D+08	-.173D+05	-.598D-02	.240D+05	.785D+12	-.112D+04
528.0	.436D+00	.304D+08	-.307D+05	-.551D-02	.238D+05	.785D+12	-.112D+04
540.0	.372D+00	.299D+08	-.440D+05	-.505D-02	.234D+05	.785D+12	-.110D+04
552.0	.314D+00	.293D+08	-.572D+05	-.460D-02	.230D+05	.785D+12	-.110D+04
564.0	.262D+00	.286D+08	-.700D+05	-.416D-02	.224D+05	.785D+12	-.105D+04
576.0	.214D+00	.276D+08	-.824D+05	-.373D-02	.217D+05	.785D+12	-.102D+04
588.0	.172D+00	.266D+08	-.943D+05	-.332D-02	.208D+05	.785D+12	-.970D+03
600.0	.135D+00	.254D+08	-.106D+06	-.292D-02	.199D+05	.785D+12	-.909D+03
612.0	.102D+00	.241D+08	-.116D+06	-.254D-02	.189D+05	.785D+12	-.832D+03
624.0	.739D-01	.226D+08	-.125D+06	-.218D-02	.178D+05	.785D+12	-.738D+03
636.0	.497D-01	.210D+08	-.134D+06	-.185D-02	.165D+05	.785D+12	-.625D+03
648.0	.295D-01	.194D+08	-.140D+06	-.154D-02	.153D+05	.785D+12	-.489D+03
660.0	.127D-01	.177D+08	-.145D+06	-.126D-02	.139D+05	.785D+12	-.314D+03
672.0	-.737D-03	.159D+08	-.147D+06	-.100D-02	.126D+05	.785D+12	.226D+02
684.0	-.113D-01	.141D+08	-.145D+06	-.772D-03	.112D+05	.785D+12	.334D+03
696.0	-.193D-01	.124D+08	-.140D+06	-.569D-03	.987D+04	.785D+12	.492D+03
708.0	-.250D-01	.108D+08	-.133D+06	-.392D-03	.860D+04	.785D+12	.611D+03
720.0	-.287D-01	.924D+07	-.125D+06	-.239D-03	.739D+04	.785D+12	.705D+03
732.0	-.307D-01	.779D+07	-.116D+06	-.109D-03	.627D+04	.785D+12	.778D+03
744.0	-.313D-01	.645D+07	-.107D+06	.237D-06	.523D+04	.785D+12	.832D+03

756.0	-.307D-01	.523D+07	-.965D+05	.894D-04	.428D+04	.785D+12	.869D+03
768.0	-.291D-01	.413D+07	-.860D+05	.161D-03	.343D+04	.785D+12	.887D+03
780.0	-.268D-01	.316D+07	-.753D+05	.217D-03	.268D+04	.785D+12	.888D+03
792.0	-.239D-01	.232D+07	-.648D+05	.258D-03	.203D+04	.785D+12	.871D+03
804.0	-.206D-01	.161D+07	-.546D+05	.288D-03	.147D+04	.785D+12	.835D+03
816.0	-.170D-01	.101D+07	-.451D+05	.308D-03	.101D+04	.785D+12	.745D+03
828.0	-.132D-01	.524D+06	-.365D+05	.320D-03	.633D+03	.785D+12	.688D+03
840.0	-.932D-02	.136D+06	-.233D+05	.325D-03	.332D+03	.785D+12	.150D+04
852.0	-.541D-02	-.361D+05	-.760D+04	.326D-03	.255D+03	.785D+12	.113D+04
864.0	-.150D-02	-.464D+05	.151D+04	.325D-03	.263D+03	.785D+12	.393D+03
876.0	.240D-02	.000D+00	.000D+00	.325D-03	.227D+03	.785D+12	-.646D+03

OUTPUT VERIFICATION

THE MAXIMUM MOMENT IMBALANCE FOR ANY ELEMENT = .339D-04 IN-LBS
THE MAX. LATERAL FORCE IMBALANCE FOR ANY ELEMENT = -.166D-05 LBS

OUTPUT SUMMARY

PILE-HEAD DEFLECTION	=	.674D+01 IN
COMPUTED SLOPE AT PILE HEAD	=	-.141D-01
MAXIMUM BENDING MOMENT	=	.308D+08 LBS-IN
MAXIMUM SHEAR FORCE	=	-.147D+06 LBS
NO. OF ITERATIONS	=	10
NO. OF ZERO DEFLECTION POINTS	=	2

S U M M A R Y T A B L E
****

BOUNDARY CONDITION BC1	BOUNDARY CONDITION BC2	AXIAL LOAD LBS	PILE HEAD DEFLECTION IN	MAX. MOMENT IN-LBS	MAX. SHEAR LBS
.0000D+00	.6190D+06	.2900D+05	.6738D+01	.3079D+08	-.1469D+06

LPILE PLUS ANALYSIS SUMMARY

Station	Load Case	Pile OD in	Wall Thick in	Weight lb/ft	I in^4	S in^3	A in^2	Group Lateral Defl (in)	Bending Moment k-in
92+00	1d	42.00	1.00	437.00	27081.00	1289.00	128.00	6.70	28100
98+00	1d							6.80	28210
	3b							3.60	22990
114+00	1d							6.00	28280
140+50	1d							6.70	30790
	2a							1.10	9467
	3b							12.70	51760
	3b	48.00	0.625	316.00	26101.00	1087.00	93.00	10.90	53210
	3b	48.00	0.750	378.00	31076.00	1294.00	111.00	9.20	52520

Check pile stresses: Use ASTM A252 Gr 3 (fy = 45 ksi)

1. Case 1d: Sta. 140+50:

For 42" OD x 1.00" wall:

bending: M max = 30790 k-in @ x = 516 (el. -29)
f(b) = 30790 k-in / 1289 in^3 = 23.9 ksi
compact limit = D/t = 42/1 = 42 < 3300/fy = 73.3 OK
F(b) = (5/6) * (.66) * fy = 0.555 * fy = 24.97 ksi

axial: Estimate compression load @ el. -29:
assume load is proportional to embedded depth. (516-324) / 552 = 0.35 i.e. 65% of load acting
total axial load: 29 k (concrete facing) + 19 k (pipe self-weight) = 48 k
f(a) = (.65)*48 k / 128 in^2 = 0.25 ksi (ignore).
F(a) = 0.5 * fy = 22.5 ksi

combined: f(a) / F(a) + f(b) / F(b) = 0 + 23.9 / 24.97 = 0.96 < 1.0 OK

shear: f(v) = 146.9 k / 128 in^2 = 1.14 ksi
F(v) = 0.4 * fy = 18.0 ksi

2. Case 3b: Sta. 140+50:

For 42" OD x 1.00" wall:

bending: M max = 51760 k-in @ x = 528 (el. -30)
f(b) = 51760 k-in / 1289 in^3 = 40.1 ksi
F(b) = 1.75 * (5/6) * (.66) * fy = 43.71 ksi

axial: from above, f(a) = .25 ksi
F(a) = 1.75 * 0.5 * fy = 39.37 ksi

combined: f(a) / F(a) + f(b) / F(b) = 0.25 / 39.37 + 40.1 / 43.71 = 0.92 < 1.0 OK

shear: f(v) = 257.6 k / 128 in^2 = 2.04 ksi
F(v) = 1.75 * 0.4 * fy = 31.5 ksi

For 48" OD x 0.625" wall:

bending: M max = 53210 k-in @ x = 504 (el. -28)
compact limit = D/t = 48/.625 = 76.8 > 3300/fy = 73.3
f(b) = 53210 k-in / 1087 in^3 = 48.95 ksi

F(b) = 1.75 * (5/6) * (.60) * fy = 39.37 ksi

axial: Estimate compression load @ el. -28:
assume load is proportional to embedded depth. (504-324) / 552 = 0.33 i.e. 67% of load acting
total axial load: 37.8 k (concrete facing) + 14 k (pipe self-weight) = 52 k
f(a) = (.67)*52 k / 93 in^2 = 0.37 ksi.
F(a) = 1.75 * 0.5 * fy = 39.37 ksi

combined: f(a) / F(a) + f(b) / F(b) = 0.37 / 39.37 + 48.95 / 39.37 = 1.23 > 1.0

total combined stress = 0.37 + 48.95 = 49.32 > 45.0 i.e. exceeds yield

shear: f(v) = 265. k / 93 in^2 = 2.85 ksi
F(v) = 1.75 * 0.4 * fy = 31.5 ksi

For 48" OD x 0.75" wall:

bending: M max = 52520 k-in @ x = 504 (el. -28)
compact limit = D/t = 48/.75 = 64 < 3300/fy = 73.3
f(b) = 52520 k-in / 1294 in^3 = 40.58 ksi
F(b) = 1.75 * (5/6) * (.66) * fy = 43.31 ksi

axial: Estimate compression load @ el. -28:
assume load is proportional to embedded depth. (504-324) / 552 = 0.33 i.e. 67% of load acting
total axial load: 37.8 k (concrete facing) + 14 k (pipe self-weight) = 52 k
f(a) = (.67)*52 k / 93 in^2 = 0.37 ksi.
F(a) = 1.75 * 0.5 * fy = 39.37 ksi

combined: f(a) / F(a) + f(b) / F(b) = 0.37 / 39.37 + 40.58 / 43.31 = 0.94 < 1.0

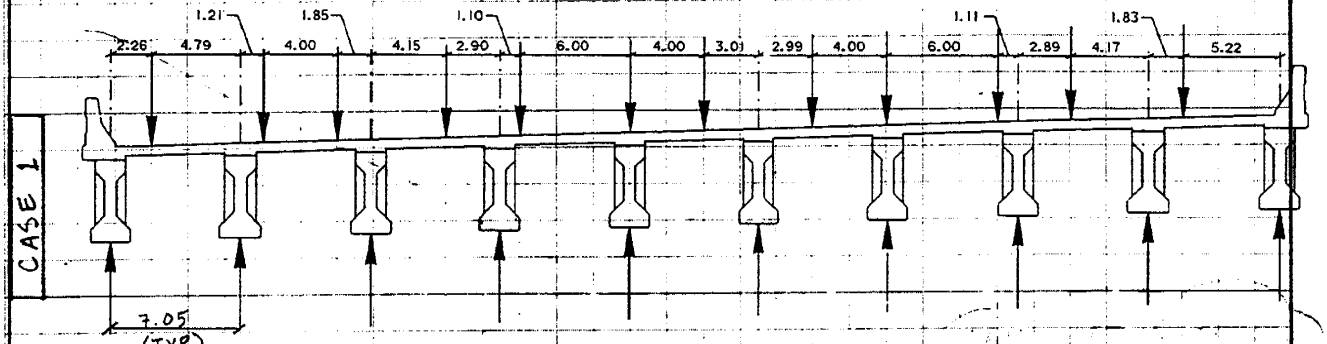
shear: f(v) = 251. k / 111 in^2 = 2.26 ksi
F(v) = 1.75 * 0.4 * fy = 31.5 ksi

APPENDIX C-5

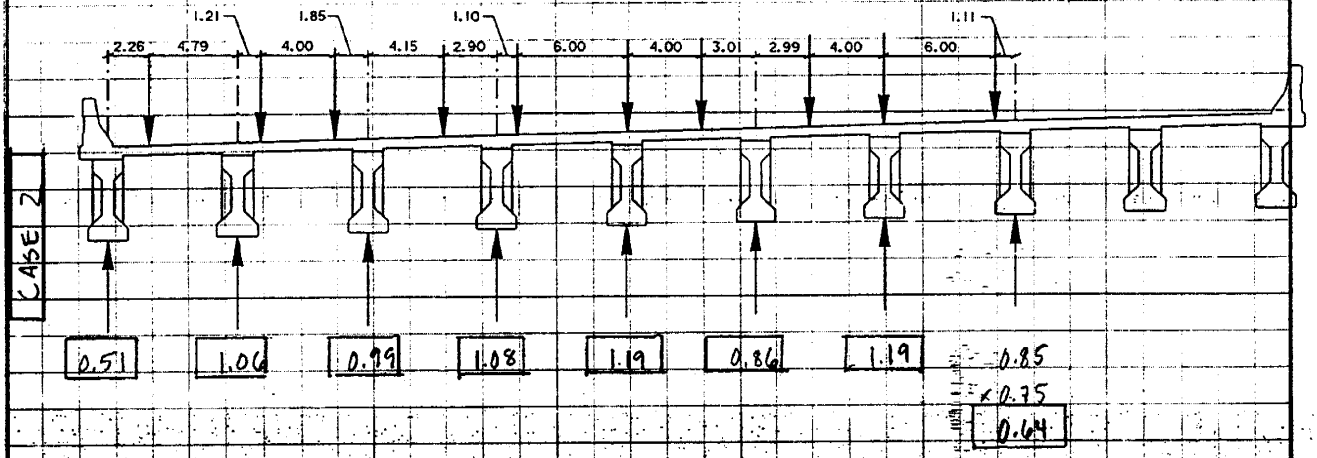
SAMPLE CALCULATIONS
DE DIEGO EXPRESSWAY OVER THE MAIN CHANNEL
BRIDGE MODIFICATION

PROJECT		COMPUTED BY	DATE
PUERTO NUEVO FDM #2	Page — of —	ER	11/95
SUBJECT		CHECKED BY	DATE
DE DIEGO BRIDGE MOD. @ MAIN CHANNEL			

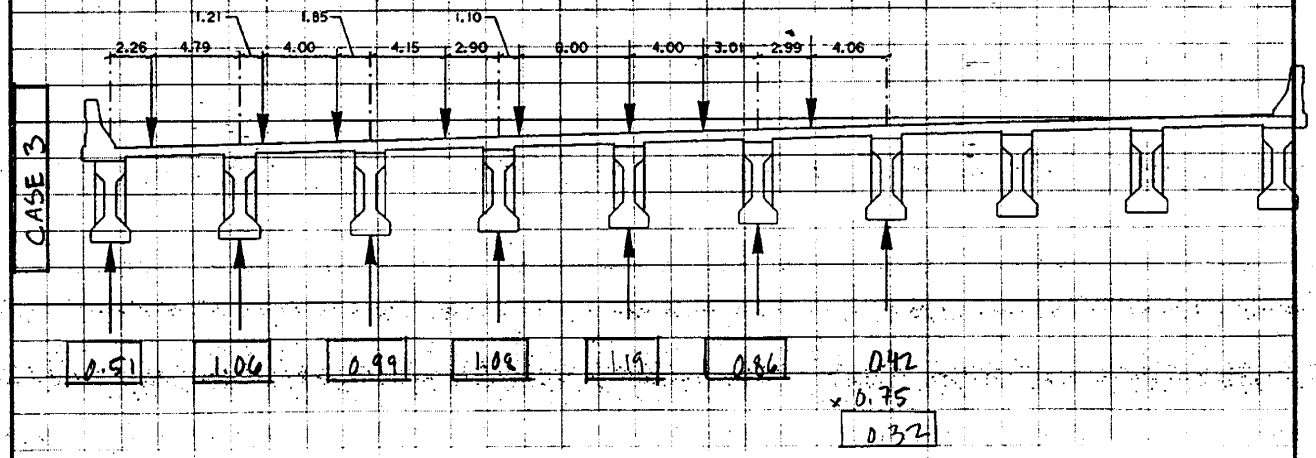
LIVE LOAD DISTRIBUTION



0.68	0.32	0.74		1.00		1.00			
	0.83	0.17	0.59	0.16	0.57	0.42	0.85	0.74	0.26
× 0.75	+ 0.26	+ 0.11	+ 0.85	+ 0.43	+ 0.57	+ 0.16	+ 0.59	+ 0.11	+ 0.75
0.51	× 0.75	× 0.75	× 0.75	× 0.75	× 0.75	× 0.75	× 0.75	× 0.75	0.19
	1.06	0.99	1.08	1.19	0.86	1.19	1.08	0.86	



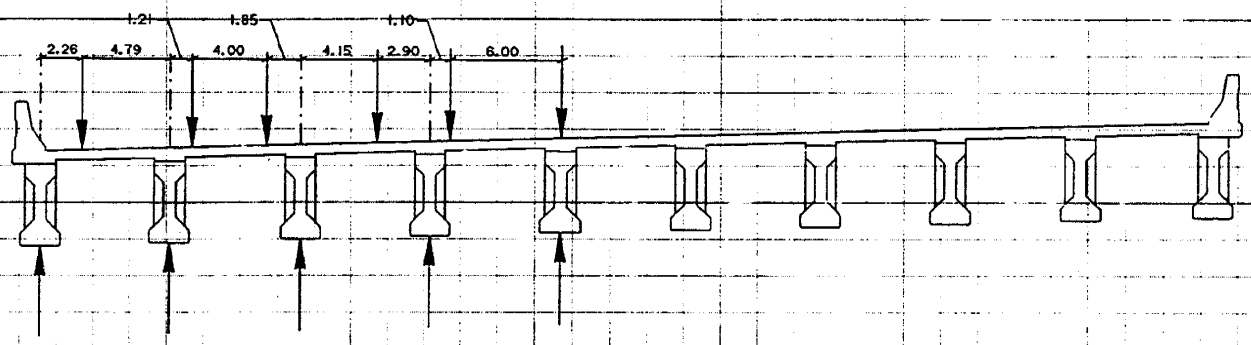
0.51 | 1.06 | 0.99 | 1.08 | 1.19 | 0.86 | 1.19 | 0.85 × 0.75 = 0.64



0.51 | 1.06 | 0.99 | 1.08 | 1.19 | 0.86 | 0.42 × 0.75 = 0.32

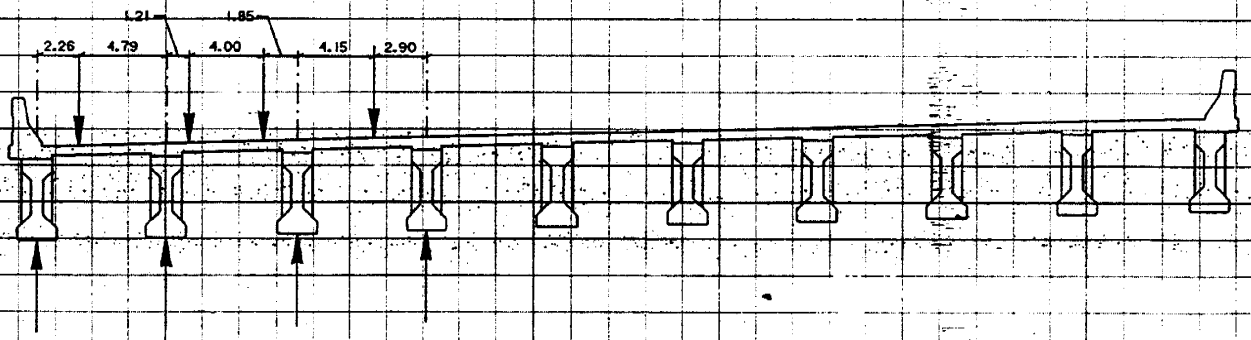
PROJECT	Page __ of __	COMPUTED BY	DATE
PUERTO NUEVO FDM #2		SR	11/95
SUBJECT		CHECKED BY	DATE
DE DIEGO BRIDGE MOD. @ MAIN CHANNEL			

CASE 4



0.68	0.32	0.74	0.59	1.00
x 0.9	0.83	0.17	+ 0.85	+ 0.16
0.61	+ 0.26	+ 0.41	x 0.9	x 0.9
	x 0.9	x 0.9	1.36	1.04
	1.27	1.19		

CASE 5

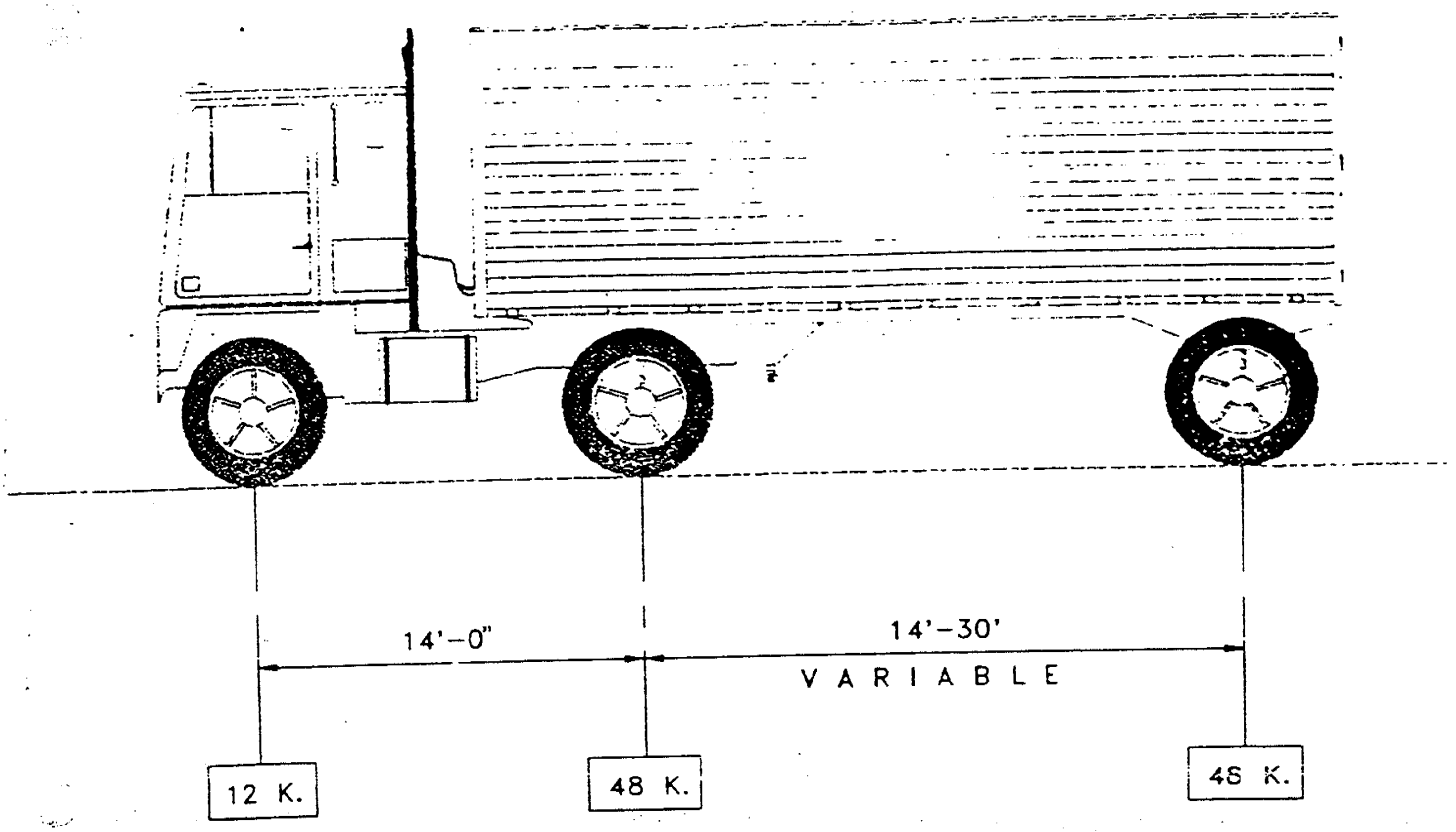


0.68	1.41	1.32	0.59

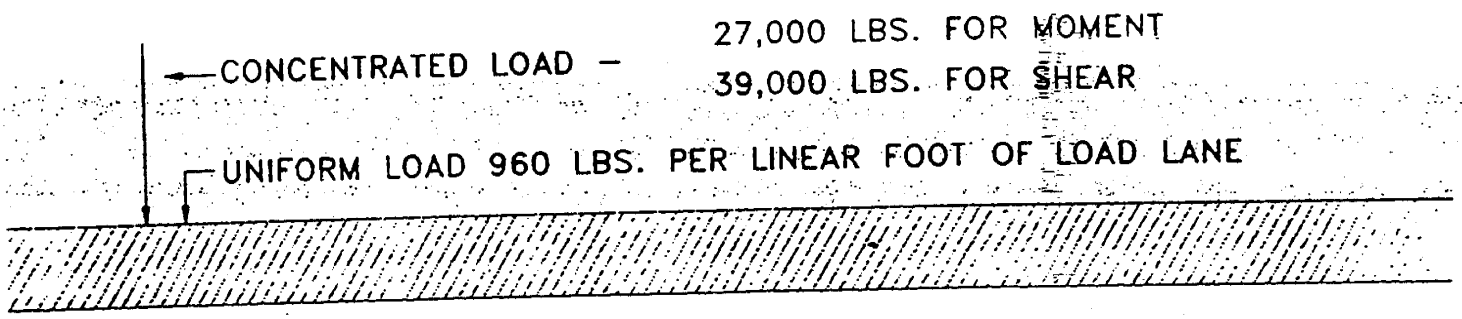
CARGA DE DISENO PARA PUENTES

HS30-44

TRUCK LOADING :



LANE LOADING :



DESIGN CONCRETE SLABS

CASE A : MAIN REINFORCEMENT PERPENDICULAR TO TRAFFIC

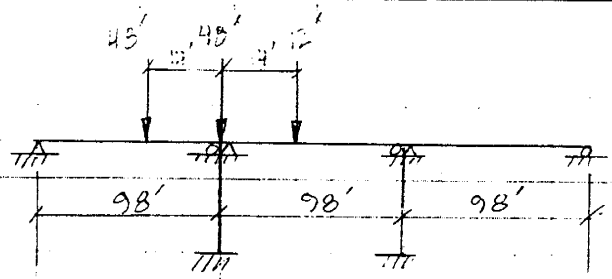
$\left(\frac{s+2}{32}\right) P_{30}$ = MOMENT IN FOOT POUNDS PER FOOT – WIDTH OF SLAB (EN FORMULA IMPACTO NO INCLUIDO)

P_{30} = 21,000LBS.

∴ AÑADIR IMPACTO SEGUN AASHTO

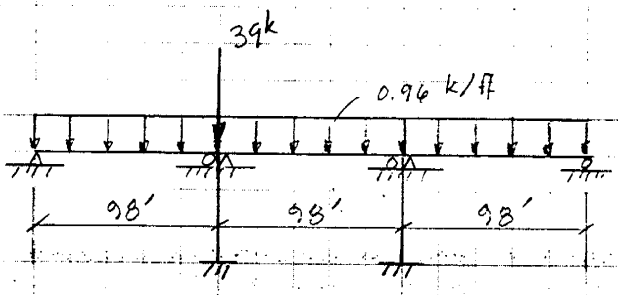
PROJECT		Page __ of __	COMPUTED BY	DATE
Puerto Nuevo FDM #2			EM	7/92
SUBJECT			CHECKED BY	DATE
De Diego Bridge Mid. & Main Channel				

HS30



MAX. REACTION PER LANE
W/O IMPACT = 99.4 k

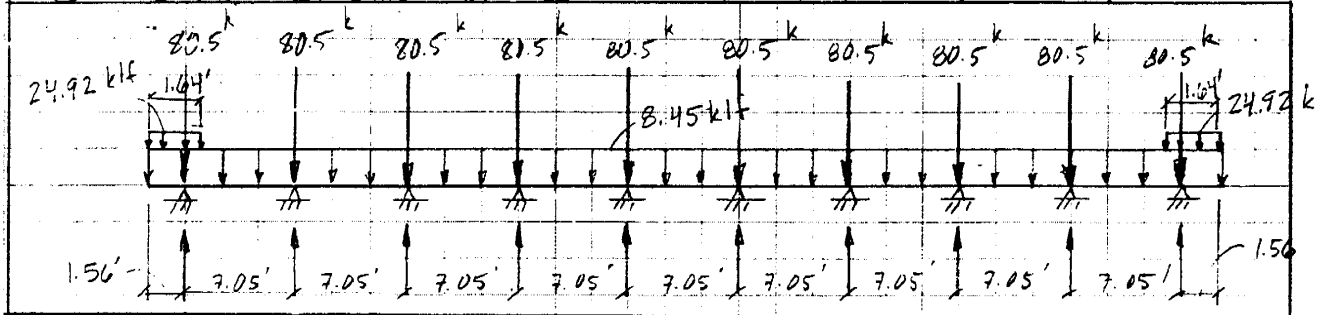
$$48 + 48\left(1-\frac{14}{98}\right) + 12\left(1-\frac{14}{98}\right) = 99.4^{k}$$



MAX. REACTION PER LANE
W/O IMPACT = **133.1 k** ← GOVERNS

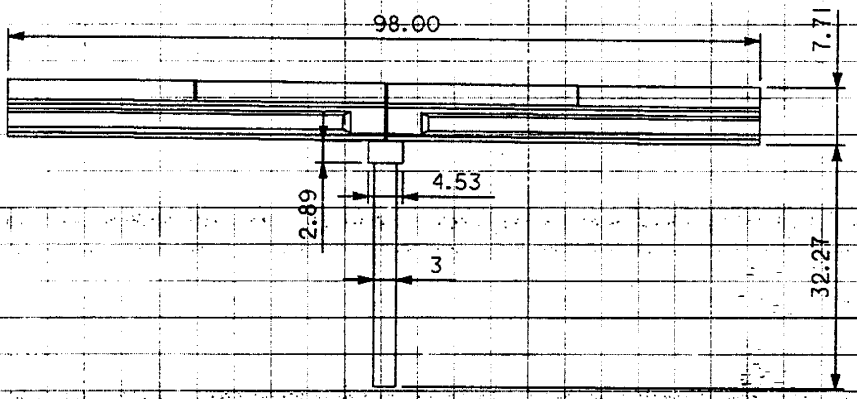
$$39 + 0.96(98) = 133.1^{k}$$

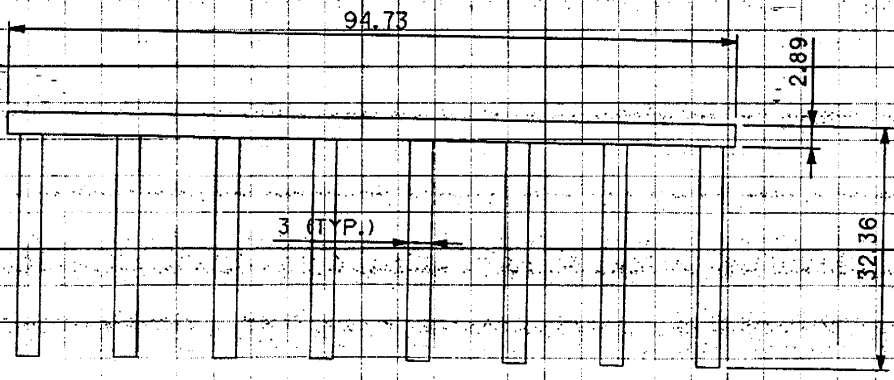
PROJECT		Page — of —	COMPUTED BY	DATE
PUERTO NUEVO FCMP #2			ED	11/05
SUBJECT			CHECKED BY	DATE
DE DIEGO BRIDGE MOD. @ MAIN CHANNEL				



165.3 k 138.8 k 140.4 k 140.0 k 140.1 k 140.1 k 140.0 k 140.4 k 138.8 k 165.3 k

WIND LOADS





PROJECT	Page — of —	COMPUTED BY	DATE
FUERTO NUEVO FLM #2		SK	11/05
SUBJECT		CHECKED BY	DATE
LE LIEVO BRIDGE MOD - MAIN CHANNEL			

FORCES FROM SUPERSTRUCTURE ✓

TRANSVERSE: AREA = (98 ft)(7.71 ft)
= 755.58 ft²

FORCE = (50 #/ft²)(755.58 ft²) = 37.78 k

NORMAL = (37.78) cos 44° = 27.18 k

PARALELL = (37.78) sin 44° = 26.24 k

LONGITUDINAL: AREA = 755.58 ft²

FORCE = (12 #/ft²)(755.58 ft²) = 9.07 k

NORMAL = (9.07) sin 44° = 6.3 k

PARALELL = (9.07) cos 44° = 6.52 k

WIND ON LIVE LOAD ✓

TRANSVERSE: (100 #/ft)(98 ft) = 9.8 k

LONGITUDINAL: (40 #/ft)(98 ft) = 3.92 k

} APPLY 6 ft ABOVE ROADWAY

NORMAL = (9.8) cos 44° + (3.92) sin 44° = 9.77 k

PARALLEL (9.8) sin 44° − (3.92) cos 44° = 4.00 k

FORCES DIRECTLY ON SUBSTRUCTURE ✓

SKEW ANGLE OF WIND DEG	TRANSVERSE LOAD PSF	LONG. LOAD PSF
0	40	0
15	38.6	10.4
30	34.6	20
45	28.3	28.3
60	20	34.6
75	10.4	38.6
90	0	40

OVERTURNING FORCES ✓

(66.57 ft)(20 #/ft²)(98 ft) = 130.5 k — Groups II & V

(66.57 ft)(6 #/ft²)(98 ft) = 39.1 k — Groups III & VI

Apply @ 1/4 POINT INWARD

66.57 / 4 = 16.64 ft

PROJECT	Page — of —	COMPUTED BY	DATE
PUERTO RICO FLT # —		[illegible]	11/05
SUBJECT		CHECKED BY	DATE
DE DIEGO BRIDGE MOD. @ MAIN CANAL			

STREAM FLOW

FROM GDM

$Q = 59,466$ cfs $\quad V = \frac{59,466}{(180)(20.64)} = 16$ ft/s

BW = 180 ft.

D = 20.64 ft

$P = KV^2 \qquad K = 0.66$ (FOR CIRCULAR PIERS)

$P = (0.667)(16)^2 = \boxed{171 \text{ psf}}$

LONGITUDINAL FORCE FROM LIVE LOAD.

$[(0.64 \times 98\text{ ft}) + 18] \times 6 \times 0.05 \times 0.75 = 18.2^{k}$ (4520)

$[(0.96 \times 98) + 27] \times 6 \times 0.05 \times 0.75 = 27.2$ (4530)

APPLIED 6 ft ABOVE ROAD

NORMAL $= (18.2)\sin 44^\circ = 12.64^{k}$ (18.96-4530)

PARALELL $= (18.2)\cos 44^\circ = 13.10^{k}$ (19.65-4530)

THERMAL FORCES

SHRINKAGE

$\Delta_s = \alpha_s L = 0.0002 \times 98 \times 12 = 0.235$ in

$I(\text{bent}) = 59,098 \text{ in}^4 \times 8 = 472,781 \text{ in}^4$

ΔT	40° F	FALL	$F = 13.59^{k}$	FROM STAAD
	30° F	RISE	$F = 6.51^{k}$	

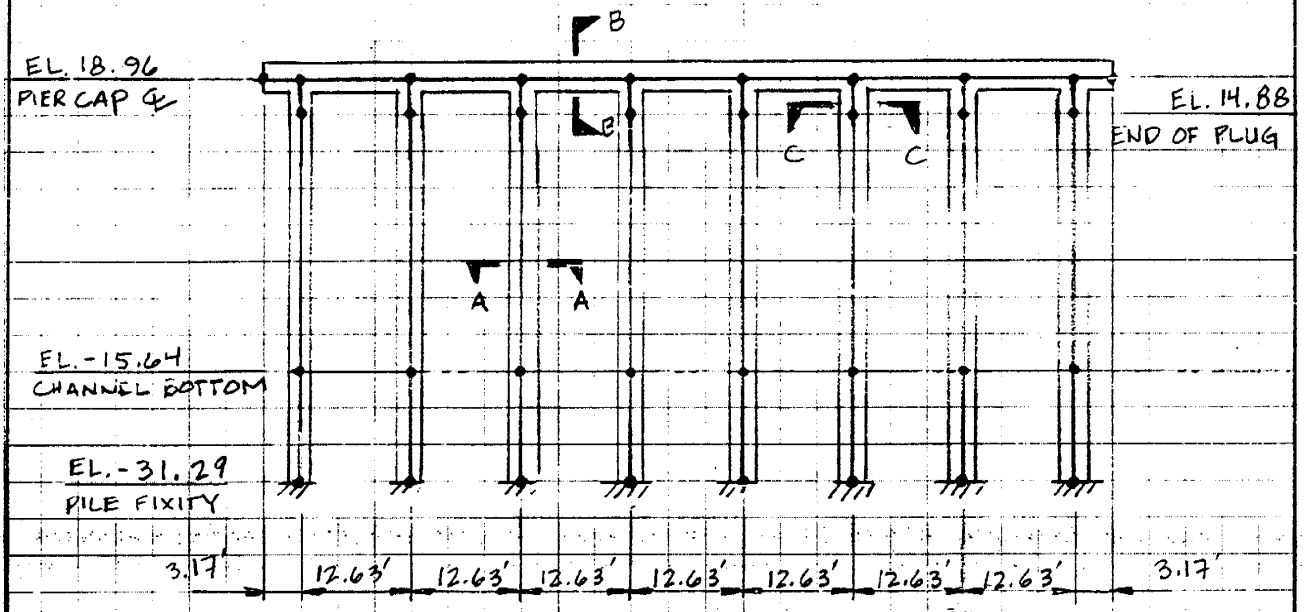
NORMAL $= (13.59)\cos 44^\circ = 9.44^{k}$

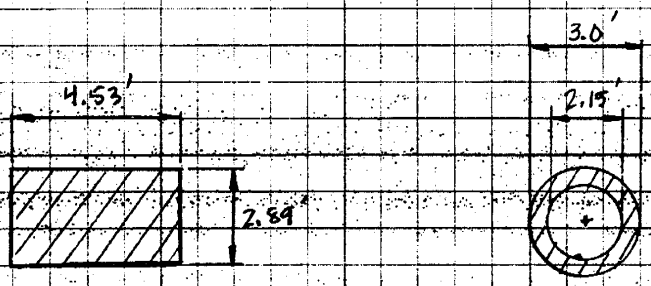
PARALELL $= (13.59)\cos 44^\circ = 9.78^{k}$

SAJ Form 1000
14 Mar 78

PROJECT		COMPUTED BY	DATE
PUERTO NUEVO FLM #2	Page — of —	ER	11/95
SUBJECT		CHECKED BY	DATE
DE DIEGO EXP. BRIDGE MOD. 2 MAIN CHANNEL			

STAAD 3 MODEL





AREA = 3.44 ft²
I = 2.85 ft⁴
J = 5.70 ft⁴

SECTION B-B

SECTION A-A



SECTION C-C

PROJECT: *De Diego Bridge Mod. @ Main Channel* *Filename:* *Pilefix.wk4*
DATE: *23-Feb-96* *Rev.Date:* *23 Feb 96*
ENGINEER: *EER*

Pile Fixity Depths for Circular Concrete Piling
In Clayey Soils (Estimated from Cohesion & Kh1)
(Assumes UNCracked Section Properties)

Print ranges
PG6

The following spreadsheet calculates the depth to fixity for circular concrete piles based on Method 1 as describ in "Capacity of Piles", by M.T. Davisson, Highway Research Record #333.

Values of qu and Kh1 for various soils (ref. Moser Shortcourse)

Kh1=48qu

Clay Consistency	Weak to Medium tsf	Weak to Medium ksf	Stiff tsf	Stiff ksf	Very Stiff tsf	Very Stiff ksf	Har tsf
Values of qu			1-2		2-4		56
Range of kh1	<30 to 50	<60 to 100	50-100	100 - 200	100-200	200-400	>200
Proposed value, kh1	30	60.00	75	150.00	150	300.00	34

Alternately, Kh1 = 96 * cohesion (qu=2*c, Kh1=48*qu)
Input cohesion(ksf): **2** Kh1= **192** (ksf)
Input outside pile diam. (in): **36.00** Kh1= **1333.3** (psi)
Input inside pile diam. (in): **26.00**
From Moser, Kh = .67 Kh1 *(1/B), where B is the width (diam.) of the pile
Kh= **24.81** (pci)
Kh= **42.88** (kcf)

Input Variables:	
Label	**VE**
Lu= Free standing Length in ft:	**0.00**
Coefficient of Hor Subgrade Reaction (Kh)(kcf):	**42.88**
OUTSIDE DIAMETER OF COLUMN(INCHES):	**36.00**
INSIDE DIAMETER OF COLUMN(INCHES):	**26.00**
F'C OF CONCRETE(PSI):	**7000.00**
Output Buckling Load (kips):	21587.88

CALCULATIONS:

I GROSS (IN^4)= PI/64(D1^4-D2^4)	60016.15
EC(KSI)=33W(W*FPC)^.5=	4820.8
EC*IG(KSI)=	289323090
I GROSS(FT^4)=	2.89
EC(KSF)=	694188.6
CRACKED SECTION PROPERTIES	
ASSUME BD=DL MOM/TL MOM =1/2	
EC*ICR(KSI)=(EC*IG/2.5)/(1+BD)=	77152824
EC*ICR(KSF)=(EC*IG/2.5)/(1+BD)=	535783.5
DETERMINE LT=LU+LF	
LU=FREE STANDING LENGTH(FT)	
LF = DEPTH TO FIXITY= 1.4*T	
SOIL PROPERTIES:	
Kh as input	42.88
ES=Kh*B (ksf)	128.64
T = (EI/ES)^.25 =(FT)=	11.18
LF = 1.4*T=(FT)=	15.65

STRUCTURE DATA

TYPE = SPACE

NJ = 34

NM = 33

NE = 0

NS = 8

NL = 111

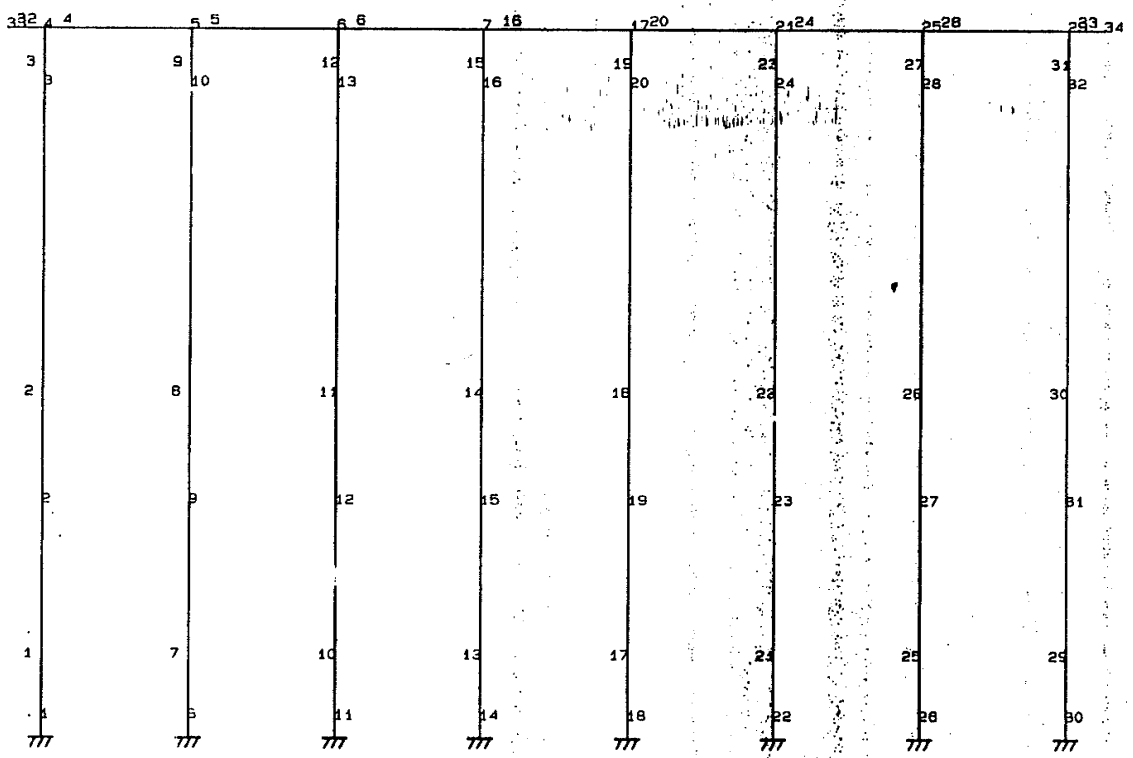
XMAX= 94.8

YMAX= 50.3

ZMAX= 0.0

1

MN/ELEM



J=34, M=33

UNIT FEE KIP

COMPANY: JACKSONVILLE DISTRICT COE

S T A A D P L - P L O T (REV: 19.0)

TITLE: PUERTO NUEVO FDM2

DATE: FEB 23, 1996

```
*****************************************************
*                                                   *
*           S T A A D - III                         *
*           Revision 21.0                           *
*           Proprietary Program of                  *
*           Research Engineers, Inc.                *
*           Date=    NOV 14, 1996                   *
*           Time=    13:45:11                       *
*                                                   *
*      USER ID: JACKSONVILLE DISTRICT COE           *
*****************************************************
```

H520 LOADING

FILENAME: BENT

```
 1. STAAD SPACE PUERTO NUEVO FDM2
 2. INPUT WIDTH 75
 3. UNIT FEET KIP
 4. JOINT COORDINATES
 5. 1 3.17 -31.29 0.; 2 3.17 -15.64 0.; 3 3.17 14.88 0.; 4 3.17 18.96 0.
 6. 5 15.8 18.96 0.; 6 28.43 18.96 0.; 7 41.06 18.96 0.; 8 15.8 -31.29 0.
 7. 9 15.8 -15.64 0.; 10 15.8 14.88 0.; 11 28.43 -31.29 0.; 12 28.43 -15.64
 8. 13 28.43 14.88 0.; 14 41.06 -31.29 0.; 15 41.06 -15.64 0.
 9. 16 41.06 14.88 0.; 17 53.69 18.96 0.; 18 53.69 -31.29 0.
10. 19 53.69 -15.64 0.; 20 53.69 14.88 0.; 21 66.32 18.96 0.
11. 22 66.32 -31.29 0.; 23 66.32 -15.64 0.; 24 66.32 14.88 0.
12. 25 78.95 18.96 0.; 26 78.95 -31.29 0.; 27 78.95 -15.64 0.
13. 28 78.95 14.88 0.; 29 91.58 18.96 0.; 30 91.58 -31.29 0.
14. 31 91.58 -15.64 0.; 32 91.58 14.88 0.; 33 0. 18.96 0.; 34 94.75 18.96 0
15. MEMBER INCIDENCES
16. 1 1 2; 2 2 3; 3 3 4; 4 4 5; 5 5 6; 6 6 7; 7 8 9; 8 9 10; 9 10 5; 10 11 1
17. 11 12 13; 12 13 6; 13 14 15; 14 15 16; 15 16 7; 16 7 17; 17 18 19; 18 1
18. 19 20 17; 20 17 21; 21 22 23; 22 23 24; 23 24 21; 24 21 25; 25 26 27
19. 26 27 28; 27 28 25; 28 25 29; 29 30 31; 30 31 32; 31 32 29; 32 4 33
20. 33 34 29
21. MEMBER PROPERTY AMER
22. 1 2 7 8 10 11 13 14 17 18 21 22 25 26 29 30 PRI YD 3.
23. 3 9 12 15 19 23 27 31 PRI AX 3.44 IX 5.7 IY 2.85 IZ 2.85
24. 4 TO 6 16 20 24 28 32 33 PRI YD 2.89 ZD 4.53
25. MEMBER OFFSET
26. 9 12 15 19 23 27 31 START 0. -1.445 0.
27. 3 END 0. -1.445 0.
28. CONSTANTS
29. E CONCRETE ALL
30. POISSON CONCRETE ALL
31. DENSITY CONCRETE ALL
32. BETA 0. ALL
33. SUPPORTS
34. 1 8 11 14 18 22 26 30 FIXED
35. LOAD 1 DEAD LOADS [DL]
36. SELFWEIGHT Y -1.
37. MEMBER LOAD
38. 32 CON Y -165.3 0.873 0.
39. 4 CON Y -138.8 9.12 0.
40. 5 CON Y -140.4 6.13 0.
41. 6 CON Y -140. 3.87 0.
```

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42. 16 CON Y -140.1 1.24 0.
43. 16 CON Y -140.1 11.24 0.
44. 20 CON Y -140. 8.76 0.
45. 24 CON Y -140.4 6.5 0.
46. 28 CON Y -138.8 3.51 0.
47. 33 CON Y -165.3 2.3 0.
48. LOAD 2 LIVE LOAD PLUS IMPACT CASE 1 [L1]
49. MEMBER LOAD
50. 32 CON Y -55.37 0.873 0.
51. 4 CON Y -115.08 9.12 0.
52. 5 CON Y -107.48 6.13 0.
53. 6 CON Y -117.25 3.87 0.
54. 16 CON Y -129.2 1.24 0.
55. 16 CON Y -93.37 11.24 0.
56. 20 CON Y -129.2 8.76 0.
57. 24 CON Y -117.25 6.5 0.
58. 28 CON Y -93.37 3.51 0.
59. 33 CON Y -20.63 2.3 0.
60. LOAD 3 LIVE LOAD PLUS IMPACT CASE 2 [L2]
61. MEMBER LOAD
62. 32 CON Y -55.37 0.873 0.
63. 4 CON Y -115.08 9.12 0.
64. 5 CON Y -107.48 6.13 0.
65. 6 CON Y -117.25 3.87 0.
66. 16 CON Y -129.2 1.24 0.
67. 16 CON Y -93.37 11.24 0.
68. 20 CON Y -129.2 8.76 0.
69. 24 CON Y -69.48 6.5 0.
70. LOAD 4 LIVE LOAD PLUS IMPACT CASE 3 [L3]
71. MEMBER LOAD
72. 32 CON Y -55.37 0.873 0.
73. 4 CON Y -115.08 9.12 0.
74. 5 CON Y -107.48 6.13 0.
75. 6 CON Y -117.25 3.87 0.
76. 16 CON Y -129.2 1.24 0.
77. 16 CON Y -93.37 11.24 0.
78. 20 CON Y -34.74 8.76 0.
79. LOAD 5 LIVE LOAD PLUS IMPACT CASE 4 [L4]
80. MEMBER LOAD
81. 32 CON Y -66.23 0.873 0.
82. 4 CON Y -137.88 9.12 0.
83. 5 CON Y -129.2 6.13 0.
84. 6 CON Y -141.14 3.87 0.
85. 16 CON Y -112.91 1.24 0.
86. LOAD 6 LIVE LOAD PLUS IMPACT CASE 5 [L5]
87. MEMBER LOAD
88. 32 CON Y -73.83 0.873 0.
89. 4 CON Y -153.08 9.12 0.
90. 5 CON Y -143.31 6.13 0.
91. 6 CON Y -64.06 3.87 0.
92. LOAD 7 WIND ON SUBSTRUCTURE AT 0 DEG. [W0]
93. MEMBER LOAD
94. 30 31 UNI GX -0.12
95. 24 CON GY 130.5 5.3 0.
96. LOAD 8 WIND ON SUBSTRUCTURE AT 15 DEG. [W15]
97. MEMBER LOAD
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 98. 30 31 UNI GX -0.116
 99. 4 TO 6 16 20 24 28 32 33 UNI GZ -0.03
100. 2 3 8 9 11 12 14 15 18 19 22 23 26 27 30 31 UNI GZ -0.031
101. LOAD 9 WIND ON SUBSTRUCTURE AT 30 DEG. [W30]
102. MEMBER LOAD
103. 30 31 UNI GX -0.104
104. 2 3 8 9 11 12 14 15 18 19 22 23 26 27 30 31 UNI GZ -0.06
105. 4 TO 6 16 20 24 28 32 33 UNI GZ -0.058
106. LOAD 10 WIND ON SUBSTRUCTURE AT 45 DEG. [W45]
107. MEMBER LOAD
108. 30 31 UNI GX -0.085
109. 2 3 8 9 11 12 14 15 18 19 22 23 26 27 30 31 UNI GZ -0.085
110. 4 TO 6 16 20 24 28 32 33 UNI GZ -0.082
111. LOAD 11 WIND ON SUBSTRUCTURE AT 60 DEG. [W60]
112. MEMBER LOAD
113. 30 31 UNI GX -0.06
114. 2 3 8 9 11 12 14 15 18 19 22 23 26 27 30 31 UNI GZ -0.104
115. 4 TO 6 16 20 24 28 32 33 UNI GZ -0.1
116. LOAD 12 WIND ON SUBSTRUCTURE AT 75 DEG. [W75]
117. MEMBER LOAD
118. 30 31 UNI GX -0.03
119. 4 TO 6 16 20 24 28 32 33 UNI GZ -0.116
120. 2 3 8 9 11 12 14 15 18 19 22 23 26 27 30 31 UNI GZ -0.112
121. LOAD 13 WIND ON SUBSTRUCTURE AT 90 DEG. [W90]
122. MEMBER LOAD
123. 2 3 8 9 11 12 14 15 18 19 22 23 26 27 30 31 UNI GZ -0.12
124. 4 TO 6 16 20 24 28 32 33 UNI GZ -0.116
 25. LOAD 14 WIND FROM SUPERSTRUCTURE [W]
126. MEMBER LOAD
127. 33 CON GX -33.48 2.3 5.3
128. 33 CON GZ -19.72 2.3 5.3
129. LOAD 15 WIND ON LIVE LOAD [WL]
130. MEMBER LOAD
131. 33 CON GX -9.77 2.3 12.5
132. 33 CON GZ -4. 2.3 12.5
133. LOAD 16 STREAM FLOW PRESSURE [SF]
134. MEMBER LOAD
135. 30 UNI GX -0.513 0. 20.64 0.
136. LOAD 17 LONGITUDINAL FORCE FROM LIVE LOAD [LF]
137. MEMBER LOAD
138. 16 CON GZ -13.1 6.315 12.5
139. 16 CON GX -12.64 6.315 12.5
140. LOAD 18 THERMAL LOADS [RST]
141. MEMBER LOAD
142. 16 CON GZ -9.44 0. 0.
143. 16 CON GX -9.78 0. 0.
144. LOAD COMB 19 GROUP I [L2]
145. 1 1. 3 2.17
146. LOAD COMB 20 GROUP I [L3]
147. 1 1. 4 2.17
148. LOAD COMB 21 GROUP I [L4]
149. 1 1.3 5 2.17 16 1.3
150. LOAD COMB 22 GROUP I [L5]
 51. 1 1. 6 2.17
152. LOAD COMB 23 GROUP II [W0]
153. 1 1.3 7 1.3 14 1.3 16 1.3
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154. LOAD COMB 24 GROUP II [W15]
155. 1 1.3 8 1.3 14 1.3 16 1.3
156. LOAD COMB 25 GROUP II [W30]
157. 1 1.3 9 1.3 14 1.3 16 1.3
158. LOAD COMB 26 GROUP II [W45]
159. 1 1.3 10 1.3 14 1.3 16 1.3
160. LOAD COMB 27 GROUP II [W60]
161. 1 1.3 11 1.3 14 1.3 16 1.3
162. LOAD COMB 28 GROUP II [W75]
163. 1 1.3 12 1.3 14 1.3 16 1.3
164. LOAD COMB 29 GROUP II [W90]
165. 1 1.3 8 1.3 14 1.3 16 1.3
166. LOAD COMB 30 GROUP III [L1 W0]
167. 1 1.3 2 1.3 7 0.39 14 0.39 15 1.3 16 1.3 17 1.3
168. LOAD COMB 31 GROUP III [L1 W15]
169. 1 1.3 2 1.3 8 0.39 14 0.39 15 1.3 16 1.3 17 1.3
170. LOAD COMB 32 GROUP III [L1 W30]
171. 1 1.3 2 1.3 9 0.39 14 0.39 15 1.3 16 1.3 17 1.3
172. LOAD COMB 33 GROUP III [L1 W45]
173. 1 1.3 2 1.3 10 0.39 14 0.39 15 1.3 16 1.3 17 1.3
174. LOAD COMB 34 GROUP III [L1 W60]
175. 1 1.3 2 1.3 11 0.39 14 0.39 15 1.3 16 1.3 17 1.3
176. LOAD COMB 35 GROUP III [L1 W75]
177. 1 1.3 2 1.3 12 0.39 14 0.39 15 1.3 16 1.3 17 1.3
178. LOAD COMB 36 GROUP III [L1 W90]
179. 1 1.3 2 1.3 13 0.39 14 0.39 15 1.3 16 1.3 17 1.3
180. LOAD COMB 37 GROUP III [L2 W0]
 81. 1 1.3 3 1.3 7 0.39 14 0.39 15 1.3 16 1.3 17 1.3
182. LOAD COMB 38 GROUP III [L2 W15]
183. 1 1.3 3 1.3 8 0.39 14 0.39 15 1.3 16 1.3 17 1.3
184. LOAD COMB 39 GROUP III [L2 W30]
185. 1 1.3 3 1.3 9 0.39 14 0.39 15 1.3 16 1.3 17 1.3
186. LOAD COMB 40 GROUP III [L2 W45]
187. 1 1.3 3 1.3 10 0.39 14 0.39 15 1.3 16 1.3 17 1.3
188. LOAD COMB 41 GROUP III [L2 W60]
189. 1 1.3 3 1.3 11 0.39 14 0.39 15 1.3 16 1.3 17 1.3
190. LOAD COMB 42 GROUP III [L2 W75]
191. 1 1.3 3 1.3 12 0.39 14 0.39 15 1.3 16 1.3 17 1.3
192. LOAD COMB 43 GROUP III [L2 W90]
193. 1 1.3 3 1.3 13 0.39 14 0.39 15 1.3 16 1.3 17 1.3
194. LOAD COMB 44 GROUP III [L3 W0]
195. 1 1.3 4 1.3 7 0.39 14 0.39 15 1.3 16 1.3 17 1.3
196. LOAD COMB 45 GROUP III [L3 W15]
197. 1 1.3 4 1.3 8 0.39 14 0.39 15 1.3 16 1.3 17 1.3
198. LOAD COMB 46 GROUP III [L3 W30]
199. 1 1.3 4 1.3 9 0.39 14 0.39 15 1.3 16 1.3 17 1.3
200. LOAD COMB 47 GROUP III [L3 W45]
201. 1 1.3 4 1.3 10 0.39 14 0.39 15 1.3 16 1.3 17 1.3
202. LOAD COMB 48 GROUP III [L3 W60]
203. 1 1.3 4 1.3 11 0.39 14 0.39 15 1.3 16 1.3 17 1.3
204. LOAD COMB 49 GROUP III [L3 W75]
205. 1 1.3 4 1.3 12 0.39 14 0.39 15 1.3 16 1.3 17 1.3
206. LOAD COMB 50 GROUP III [L3 W90]
 07. 1 1.3 4 1.3 13 0.39 14 0.39 15 1.3 16 1.3 17 1.3
208. LOAD COMB 51 GROUP III [L4 W0]
209. 1 1.3 5 1.3 7 0.39 14 0.39 15 1.3 16 1.3 17 1.3
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210. LOAD COMB 52 GROUP III [L4 W15]
211. 1 1.3 5 1.3 8 0.39 14 0.39 15 1.3 16 1.3 17 1.3
212. LOAD COMB 53 GROUP III [L4 W30]
213. 1 1.3 5 1.3 9 0.39 14 0.39 15 1.3 16 1.3 17 1.3
214. LOAD COMB 54 GROUP III [L4 W45]
215. 1 1.3 5 1.3 10 0.39 14 0.39 15 1.3 16 1.3 17 1.3
216. LOAD COMB 55 GROUP III [L4 W60]
217. 1 1.3 5 1.3 11 0.39 14 0.39 15 1.3 16 1.3 17 1.3
218. LOAD COMB 56 GROUP III [L4 W75]
219. 1 1.3 5 1.3 12 0.39 14 0.39 15 1.3 16 1.3 17 1.3
220. LOAD COMB 57 GROUP III [L4 W90]
221. 1 1.3 5 1.3 13 0.39 14 0.39 15 1.3 16 1.3 17 1.3
222. LOAD COMB 58 GROUP III [L5 W0]
223. 1 1.3 6 0.817 7 0.3 14 0.3 15 1. 16 1. 17 1.
224. LOAD COMB 59 GROUP III [L5 W15]
225. 1 1.3 6 1.3 8 0.39 14 0.39 15 1.3 16 1.3 17 1.3
226. LOAD COMB 60 GROUP III [L5 W30]
227. 1 1.3 6 1.3 9 0.39 14 0.39 15 1.3 16 1.3 17 1.3
228. LOAD COMB 61 GROUP III [L5 W45]
229. 1 1.3 6 1.3 10 0.39 14 0.39 15 1.3 16 1.3 17 1.3
230. LOAD COMB 62 GROUP III [L5 W60]
231. 1 1.3 6 1.3 11 0.39 14 0.39 15 1.3 16 1.3 17 1.3
232. LOAD COMB 63 GROUP III [L5 W75]
233. 1 1.3 6 1.3 12 0.39 14 0.39 15 1.3 16 1.3 17 1.3
234. LOAD COMB 64 GROUP III [L5 W90]
235. 1 1.3 6 1.3 13 0.39 14 0.39 15 1.3 16 1.3 17 1.3
236. LOAD COMB 65 GROUP IV [L1]
237. 1 1.3 2 1.3 16 1.3 18 1.3
238. LOAD COMB 66 GROUP IV [L2]
239. 1 1.3 3 1.3 16 1.3 18 1.3
240. LOAD COMB 67 GROUP IV [L3]
241. 1 1.3 4 1.3 16 1.3 18 1.3
242. LOAD COMB 68 GROUP IV [L4]
243. 1 1.3 5 1.3 16 1.3 18 1.3
244. LOAD COMB 69 GROUP IV [L5]
245. 1 1.3 6 1.3 16 1.3 18 1.3
246. LOAD COMB 70 GROUP V [W0]
247. 1 1.25 7 1.25 14 1.25 16 1.25 18 1.25
248. LOAD COMB 71 GROUP V [W15]
249. 1 1.25 8 1.25 14 1.25 16 1.25 18 1.25
250. LOAD COMB 72 GROUP V [W30]
251. 1 1.25 9 1.25 14 1.25 16 1.25 18 1.25
252. LOAD COMB 73 GROUP V [W45]
253. 1 1.25 10 1.25 14 1.25 16 1.25 18 1.25
254. LOAD COMB 74 GROUP V [W60]
255. 1 1.25 11 1.25 14 1.25 16 1.25 18 1.25
256. LOAD COMB 75 GROUP V [W75]
257. 1 1.25 12 1.25 14 1.25 16 1.25 18 1.25
258. LOAD COMB 76 GROUP V [W90]
259. 1 1.25 13 1.25 14 1.25 16 1.25 18 1.25
260. LOAD COMB 77 GROUP VI [L1 W0]
261. 1 1.25 2 1.25 7 0.375 14 0.375 15 1.25 16 1.25 17 1.25
262. LOAD COMB 78 GROUP VI [L1 W15]
263. 1 1.25 2 1.25 8 0.375 14 0.375 15 1.25 16 1.25 17 1.25
264. LOAD COMB 79 GROUP VI [L1 W30]
265. 1 1.25 2 1.25 9 0.375 14 0.375 15 1.25 16 1.25 17 1.25
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266. LOAD COMB 80 GROUP VI [L1 W45]
267. 1 1.25 2 1.25 10 0.375 14 0.375 15 1.25 16 1.25 17 1.25
268. LOAD COMB 81 GROUP VI [L1 W60]
269. 1 1.25 2 1.25 11 0.375 14 0.375 15 1.25 16 1.25 17 1.25
270. LOAD COMB 82 GROUP VI [L1 W75]
271. 1 1.25 2 1.25 12 0.375 14 0.375 15 1.25 16 1.25 17 1.25
272. LOAD COMB 83 GROUP VI [L1 W90]
273. 1 1.25 2 1.25 13 0.375 14 0.375 15 1.25 16 1.25 17 1.25
274. LOAD COMB 84 GROUP VI [L2 W0]
275. 1 1.25 3 1.25 7 0.375 14 0.375 15 1.25 16 1.25 17 1.25
276. LOAD COMB 85 GROUP VI [L2 W15]
277. 1 1.25 3 1.25 8 0.375 14 0.375 15 1.25 16 1.25 17 1.25
278. LOAD COMB 86 GROUP VI [L2 W30]
279. 1 1.25 3 1.25 9 0.375 14 0.375 15 1.25 16 1.25 17 1.25
280. LOAD COMB 87 GROUP VI [L2 W45]
281. 1 1.25 3 1.25 10 0.375 14 0.375 15 1.25 16 1.25 17 1.25
282. LOAD COMB 88 GROUP VI [L2 W60]
283. 1 1.25 3 1.25 11 0.375 14 0.375 15 1.25 16 1.25 17 1.25
284. LOAD COMB 89 GROUP VI [L2 W75]
285. 1 1.25 3 1.25 12 0.375 14 0.375 15 1.25 16 1.25 17 1.25
286. LOAD COMB 90 GROUP VI [L2 W90]
287. 1 1.25 3 1.25 13 0.375 14 0.375 15 1.25 16 1.25 17 1.25
288. LOAD COMB 91 GROUP VI [L3 W0]
289. 1 1.25 4 1.25 7 0.375 14 0.375 15 1.25 16 1.25 17 1.25
290. LOAD COMB 92 GROUP VI [L3 W15]
291. 1 1.25 4 1.25 8 0.375 14 0.375 15 1.25 16 1.25 17 1.25
292. LOAD COMB 93 GROUP VI [L3 W30]
293. 1 1.25 4 1.25 9 0.375 14 0.375 15 1.25 16 1.25 17 1.25
294. LOAD COMB 94 GROUP VI [L3 W45]
295. 1 1.25 4 1.25 10 0.375 14 0.375 15 1.25 16 1.25 17 1.25
296. LOAD COMB 95 GROUP VI [L3 W60]
297. 1 1.25 4 1.25 11 0.375 14 0.375 15 1.25 16 1.25 17 1.25
298. LOAD COMB 96 GROUP VI [L3 W75]
299. 1 1.25 4 1.25 12 0.375 14 0.375 15 1.25 16 1.25 17 1.25
300. LOAD COMB 97 GROUP VI [L3 W90]
301. 1 1.25 4 1.25 13 0.375 14 0.375 15 1.25 16 1.25 17 1.25
302. LOAD COMB 98 GROUP VI [L4 W0]
303. 1 1.25 5 1.25 7 0.375 14 0.375 15 1.25 16 1.25 17 1.25
304. LOAD COMB 99 GROUP VI [L4 W15]
305. 1 1.25 5 1.25 8 0.375 14 0.375 15 1.25 16 1.25 17 1.25
306. LOAD COMB 100 GROUP VI [L4 W30]
307. 1 1.25 5 1.25 9 0.375 14 0.375 15 1.25 16 1.25 17 1.25
308. LOAD COMB 101 GROUP VI [L4 W45]
309. 1 1.25 5 1.25 10 0.375 14 0.375 15 1.25 16 1.25 17 1.25
310. LOAD COMB 102 GROUP VI [L4 W60]
311. 1 1.25 5 1.25 11 0.375 14 0.375 15 1.25 16 1.25 17 1.25
312. LOAD COMB 103 GROUP VI [L4 W75]
313. 1 1.25 5 1.25 12 0.375 14 0.375 15 1.25 16 1.25 17 1.25
314. LOAD COMB 104 GROUP VI [L4 W90]
315. 1 1.25 5 1.25 13 0.375 14 0.375 15 1.25 16 1.25 17 1.25
316. LOAD COMB 105 GROUP VI [L5 W0]
317. 1 1.25 6 1.25 7 0.375 14 0.375 15 1.25 16 1.25 17 1.25
318. LOAD COMB 106 GROUP VI [L5 W15]
 19. 1 1.25 6 1.25 8 0.375 14 0.375 15 1.25 16 1.25 17 1.25
320. LOAD COMB 107 GROUP VI [L5 W30]
321. 1 1.25 6 1.25 9 0.375 14 0.375 15 1.25 16 1.25 17 1.25
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322. LOAD COMB 108 GROUP VI [L5 W45]
323. 1 1.25 6 1.25 10 0.375 14 0.375 15 1.25 16 1.25 17 1.25
324. LOAD COMB 109 GROUP VI [L5 W60]
325. 1 1.25 6 1.25 11 0.375 14 0.375 15 1.25 16 1.25 17 1.25
326. LOAD COMB 110 GROUP VI [L5 W75]
327. 1 1.25 6 1.25 12 0.375 14 0.375 15 1.25 16 1.25 17 1.25
328. LOAD COMB 111 GROUP VI [L5 W90]
329. 1 1.25 6 1.25 13 0.375 14 0.375 15 1.25 16 1.25 17 1.25
330. PERFORM ANALYSIS
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P R O B L E M S T A T I S T I C S

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NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    34/   33/    8
ORIGINAL/FINAL BAND-WIDTH =   29/    5
TOTAL PRIMARY LOAD CASES  =   18, TOTAL DEGREES OF FREEDOM =   156
SIZE OF STIFFNESS MATRIX =    4680 DOUBLE PREC. WORDS
REQRD/AVAIL. DISK SPACE =  12.13/  107.7 MB,  EXMEM = 30.27 MB

++ PROCESSING ELEMENT STIFFNESS MATRIX.              13:45:13
++ PROCESSING GLOBAL STIFFNESS MATRIX.               13:45:13
++ PROCESSING TRIANGULAR FACTORIZATION.              13:45:13
++ CALCULATING JOINT DISPLACEMENTS.                  13:45:13
++ CALCULATING MEMBER  FORCES.                       13:45:14

331. PRINT MAXFORCE ALL
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MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MAX AND MIN FORCE VALUES AMONGST ALL SECTION LOCATIONS

MEMB		FY/ FZ	DIST DIST	LD LD	MZ/ MY	DIST DIST	LD LD	FX	DIST	LD
1	MAX	0.02	0.00	1	0.46	0.00	1			
		6.32	0.00	76	1.54	0.00	23	558.70 C	0.00	21
	MIN	-8.63	15.65	70	-222.61	0.00	70			
		-1.76	15.65	23	-322.38	0.00	76	0.00	15.65	13
2	MAX	0.02	0.00	1	175.70	30.52	70			
		6.32	0.00	76	0.00	0.00	1	537.13 C	0.00	21
	MIN	-8.63	30.52	70	-87.59	0.00	70			
		-1.76	30.52	23	-223.48	0.00	76	0.00	30.52	13
3	MAX	0.02	0.00	1	198.43	2.63	70			
		1.85	0.00	13	0.00	0.00	1	495.06 C	0.00	21
	MIN	-8.62	2.63	70	-0.34	2.63	1			
		-1.76	2.63	23	-100.48	0.00	76	0.00	2.63	13
4	MAX	126.60	0.00	21	689.90	12.63	21			
		1.47	0.00	17	12.24	12.63	17	8.63 C	0.00	70
	MIN	-385.28	12.63	21	-617.66	8.42	22			
		-2.17	12.63	28	-58.83	12.63	23	0.02 T	12.63	1
5	MAX	247.76	0.00	21	798.20	12.63	21			
		3.85	0.00	36	47.87	12.63	17	16.55 C	0.00	70
	MIN	-247.36	12.63	21	-808.50	6.32	22			
		-2.24	12.63	28	-114.78	12.63	23	0.06 T	12.63	1
6	MAX	390.99	0.00	21	820.80	0.00	21			
		6.78	0.00	36	107.15	12.63	17	24.55 C	0.00	70
	MIN	-129.53	12.63	21	-636.62	4.21	21			
		-1.21	12.63	28	-159.34	12.63	23	0.03 T	12.63	1
7	MAX	0.04	0.00	1	0.86	0.00	1			
		8.58	0.00	76	0.00	0.00	1	700.39 C	0.00	21
	MIN	-7.92	15.65	70	-212.19	0.00	70			
		0.00	15.65	22	-384.57	0.00	76	4.65 T	15.65	14
8	MAX	0.04	0.00	1	153.65	30.52	70			
		8.58	0.00	76	0.00	0.00	1	678.82 C	0.00	21
	MIN	-7.92	30.52	70	-88.19	0.00	70			
		0.00	30.52	22	-250.25	0.00	76	4.65 T	30.52	14
9	MAX	0.04	0.00	1	185.98	5.52	70			
		4.00	0.00	76	0.00	0.00	1	636.75 C	0.00	21

	MIN	-7.92	5.52	70	-1.14	5.52	1			
		0.00	5.52	22	-63.95	0.00	76	4.65 T	5.52	14
10	MAX	1.34	0.00	22	22.73	0.00	22			
		9.83	0.00	76	0.00	0.00	1	705.69 C	0.00	21
	MIN	-8.00	15.65	70	-213.50	0.00	70			
		0.00	15.65	22	-431.76	0.00	76	0.44 T	15.65	14
11	MAX	1.34	0.00	22	155.76	30.52	70			
		9.83	0.00	76	0.00	0.00	1	684.12 C	0.00	21
	MIN	-8.00	30.52	70	-88.34	0.00	70			
		0.00	30.52	22	-277.85	0.00	76	0.44 T	30.52	14
12	MAX	1.34	0.00	22	188.39	5.52	70			
		5.26	0.00	76	3.06	5.52	65	642.05 C	0.00	21
	MIN	-8.00	5.52	70	-44.82	5.52	22			
		0.00	5.52	22	-60.72	0.00	64	0.44 T	5.52	14
13	MAX	0.70	0.00	22	11.77	0.00	22			
		10.98	0.00	76	0.00	0.00	1	613.81 C	0.00	21
	MIN	-8.04	15.65	70	-214.32	0.00	70			
		0.00	15.65	22	-478.90	0.00	76	0.00	15.65	13
14	MAX	0.70	0.00	22	156.97	30.52	70			
		10.98	0.00	76	0.00	0.00	1	592.23 C	0.00	21
	MIN	-8.04	30.52	70	-88.47	0.00	70			
		0.00	30.52	22	-307.10	0.00	76	0.00	30.52	13
15	MAX	0.70	0.00	22	189.78	5.52	70			
		6.40	0.00	76	5.85	5.52	65	550.17 C	0.00	21
	MIN	-8.04	5.52	70	-23.37	5.52	22			
		0.00	5.52	22	-74.14	0.00	64	0.00	5.52	13
16	MAX	431.75	0.00	20	490.79	12.63	19			
		9.86	0.00	36	146.47	6.31	17	32.59 C	0.00	70
	MIN	-365.87	12.63	19	-181.33	5.26	20			
		-7.75	12.63	63	-204.14	0.00	23	6.20 T	12.63	17
17	MAX	1.17	0.00	20	19.92	0.00	20			
		12.11	0.00	76	0.00	0.00	1	554.27 C	0.00	19
	MIN	-7.80	15.65	71	-210.23	0.00	71			
		0.00	15.65	22	-527.45	0.00	76	4.33 T	15.65	6
18	MAX	1.17	0.00	20	149.92	30.52	71			
		12.11	0.00	76	0.00	0.00	1	537.68 C	0.00	19
	MIN	-7.80	30.52	71	-88.16	0.00	71			
		0.00	30.52	22	-338.00	0.00	76	4.33 T	30.52	6
19	MAX	1.17	0.00	20	181.74	5.52	71			
		7.53	0.00	76	5.75	5.52	65	505.32 C	0.00	19
	MIN	-7.80	5.52	71	-38.72	5.52	20			
		0.00	5.52	22	-74.24	0.00	64	4.33 T	5.52	6
20	MAX	136.60	0.00	19	554.85	12.63	65			
		6.01	0.00	28	107.54	0.00	17	33.89 C	0.00	24

	MIN	-308.56	12.63	19	-593.95	8.42	19				
		-5.05	12.63	17	-233.24	0.00	23	4.63	T	12.63	17
21	MAX	0.91	0.00	19	15.09	0.00	19				
		13.36	0.00	76	0.00	0.00	1	522.86	C	0.00	36
	MIN	-7.88	15.65	71	-211.69	0.00	71				
		0.00	15.65	22	-580.27	0.00	76	75.72	T	15.65	7
22	MAX	0.91	0.00	19	152.19	30.52	71				
		13.36	0.00	76	0.00	0.00	1	502.68	C	0.00	19
	MIN	-7.88	30.52	71	-88.35	0.00	71				
		0.00	30.52	22	-371.25	0.00	76	75.72	T	30.52	7
23	MAX	0.91	0.00	19	184.34	5.52	71				
		8.78	0.00	76	2.72	5.52	65	470.32	C	0.00	19
	MIN	-7.88	5.52	71	-30.65	5.52	19				
		0.00	5.52	22	-59.62	0.00	64	75.72	T	5.52	7
24	MAX	201.56	6.32	30	653.48	0.00	31				
		10.71	0.00	28	48.75	0.00	17	40.50	C	0.00	24
	MIN	-178.75	12.63	65	-531.94	6.32	31				
		-3.29	12.63	17	-226.93	0.00	23	3.06	T	12.63	17
25	MAX	0.95	0.00	19	15.81	0.00	19				
		14.92	0.00	76	0.00	0.00	1	504.47	C	0.00	36
	MIN	-8.77	15.65	70	-226.99	0.00	70				
		0.00	15.65	22	-641.49	0.00	76	62.71	T	15.65	7
26	MAX	0.95	0.00	19	177.97	30.52	70				
		14.92	0.00	76	0.00	0.00	1	482.90	C	0.00	36
	MIN	-8.77	30.52	70	-89.72	0.00	70				
		0.00	30.52	22	-407.94	0.00	76	62.71	T	30.52	7
27	MAX	0.95	0.00	19	213.76	5.52	70				
		10.35	0.00	76	19.74	5.52	28	440.83	C	0.00	36
	MIN	-8.77	5.52	70	-32.07	5.52	19				
		0.00	5.52	22	-52.36	0.00	64	62.71	T	5.52	7
28	MAX	265.46	0.00	36	573.89	0.00	31				
		17.25	0.00	28	44.49	12.63	23	47.24	C	0.00	24
	MIN	-78.21	12.63	65	-328.58	4.21	30				
		-1.54	12.63	17	-165.64	0.00	23	1.48	T	12.63	17
29	MAX	0.61	0.00	2	14.32	15.65	21				
		16.91	0.00	76	0.00	0.00	1	395.35	C	0.00	65
	MIN	-16.62	15.65	70	-321.33	0.00	70				
		0.00	15.65	22	-712.12	0.00	76	10.91	T	15.65	14
30	MAX	5.71	22.89	21	113.68	22.89	70				
		16.91	0.00	76	18.52	30.52	23	373.78	C	0.00	65
	MIN	-16.62	0.00	70	-61.17	0.00	70				
		0.00	30.52	22	-447.47	0.00	76	10.91	T	30.52	14
1	MAX	5.71	0.00	21	110.69	0.00	70				
		12.33	0.00	76	55.50	5.52	27	331.71	C	0.00	65

	MIN	-3.96	5.52	14	-41.04	5.52	21			
		0.00	5.52	22	-48.49	0.00	64	10.91 T	5.52	14
32	MAX	366.70	0.00	21	325.89	0.00	21			
		0.01	3.17	28	0.75	0.00	28	0.00 C	0.00	15
	MIN	0.00	3.17	26	0.00	3.17	22			
		-0.47	0.00	28	0.00	3.17	51	0.00 T	3.17	29
33	MAX	0.00	0.00	14	223.11	3.17	65			
		26.13	3.17	28	23.08	3.17	28	43.53 C	3.17	24
	MIN	-249.80	3.17	65	0.00	3.17	14			
		0.00	0.00	11	-0.04	0.00	76	0.00 T	0.00	40

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

332. LOAD LIST 1 21 65 70 76
333. PRINT MEMBER FORCE ALL

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	265.56	0.02	0.00	0.00	0.00	0.46
		2	-248.96	-0.02	0.00	0.00	0.00	-0.20
	21	1	558.70	-2.49	0.00	0.00	0.00	-49.38
		2	-537.13	2.49	0.00	0.00	0.00	10.40
	65	1	458.41	-3.43	1.17	-5.25	-66.83	-81.11
		2	-436.84	3.43	-1.17	5.25	48.56	27.45
	70	1	356.08	-8.63	-0.57	-40.19	-62.79	-222.61
		2	-335.34	8.63	0.57	40.19	71.77	87.59
	76	1	354.74	-8.15	6.32	-41.82	-322.38	-210.29
		2	-334.00	8.15	-6.32	41.82	223.48	82.74
2	1	2	248.96	0.02	0.00	0.00	0.00	0.20
		3	-216.61	-0.02	0.00	0.00	0.00	0.30
	21	2	537.13	-2.49	0.00	0.00	0.00	-10.40
		3	-495.06	2.49	0.00	0.00	0.00	-65.61
	65	2	436.84	-3.43	1.17	-5.25	-48.56	-27.45
		3	-394.78	3.43	-1.17	5.25	12.93	-77.19
	70	2	335.34	-8.63	-0.57	-40.19	-71.77	-87.59
		3	-294.89	8.63	0.57	40.19	89.28	-175.70
	76	2	334.00	-8.15	6.32	-41.82	-223.48	-82.74
		3	-293.55	8.15	-1.74	41.82	100.48	-165.99
3	1	3	216.61	0.02	0.00	0.00	0.00	-0.30
		4	-215.25	-0.02	0.00	0.00	0.00	0.34
	21	3	495.06	-2.49	0.00	0.00	0.00	65.61
		4	-493.30	2.49	0.00	0.00	0.00	-72.18
	65	3	394.77	-3.43	1.17	-5.25	-12.93	77.19
		4	-393.01	3.43	-1.17	5.25	9.85	-86.22
	70	3	294.89	-8.62	-0.57	-40.19	-89.28	175.70
		4	-293.19	8.62	0.57	40.19	90.79	-198.43
	76	3	293.55	-8.15	1.74	-41.82	-100.48	-165.99
		4	-291.85	8.15	-1.34	41.82	96.40	-187.47
4	1	4	-0.02	43.72	0.00	0.00	0.00	153.81
		5	0.02	119.88	0.00	0.00	0.00	-245.40
	21	4	2.49	126.60	0.00	0.00	0.00	401.67
		5	-2.49	385.28	0.00	0.00	0.00	-689.90
	65	4	3.43	98.04	1.17	8.17	-5.25	354.44
		5	-3.43	264.24	-1.17	-8.17	-9.49	-478.19
	70	4	8.63	78.79	-0.57	91.62	-40.19	403.62
		5	-8.63	125.71	0.57	-91.62	47.44	-213.29
	76	4	8.15	77.45	0.89	94.46	-42.55	391.96
		5	-8.15	127.05	0.94	-94.46	42.92	-218.54
5	1	5	-0.06	83.14	0.00	0.00	0.00	244.26
		6	0.06	82.06	0.00	0.00	0.00	-263.39

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	21	5	3.48	247.76	0.00	0.00	0.00	715.11
		6	-3.48	247.36	0.00	0.00	0.00	-798.20
	65	5	5.91	179.59	2.64	8.97	4.71	537.08
		6	-5.91	174.90	-2.64	-8.97	-38.11	-567.05
	70	5	16.55	119.02	0.99	135.18	-86.18	399.27
		6	-16.55	87.48	-0.99	-135.18	73.72	-232.55
	76	5	15.63	118.32	2.23	138.58	-83.06	394.20
		6	-15.63	88.19	-0.40	-138.58	66.45	-236.39
6	1	6	-0.03	117.05	0.00	0.00	0.00	264.48
		7	0.03	47.75	0.00	0.00	0.00	-169.17
	21	6	4.39	390.99	0.00	0.00	0.00	820.80
		7	-4.39	129.53	0.00	0.00	0.00	-363.51
	65	6	8.49	272.26	4.32	5.91	34.08	629.47
		7	-8.49	94.41	-4.32	-5.91	-88.68	-324.01
	70	6	24.55	160.64	3.75	163.81	-115.31	420.94
		7	-24.55	45.36	-3.75	-163.81	67.94	-120.82
	76	6	23.19	159.90	4.83	166.97	-109.19	414.24
		7	-23.19	46.10	-3.00	-166.97	59.77	-123.49
7	1	8	254.82	0.04	0.00	0.00	0.00	0.86
		9	-238.23	-0.04	0.00	0.00	0.00	-0.24
	21	8	700.39	-0.99	0.00	0.00	0.00	-24.40
		9	-678.82	0.99	0.00	0.00	0.00	8.95
	65	8	511.17	-2.48	1.48	-4.79	-75.03	-65.62
		9	-489.60	2.48	-1.48	4.79	51.91	26.84
	70	8	309.49	-7.92	1.56	-38.74	-121.97	-212.19
		9	-288.75	7.92	-1.56	38.74	97.55	88.19
	76	8	310.12	-7.48	8.58	-40.14	-384.57	-200.43
		9	-289.38	7.48	-8.58	40.14	250.25	83.30
8	1	9	238.23	0.04	0.00	0.00	0.00	0.24
		10	-205.87	-0.04	0.00	0.00	0.00	0.98
	21	9	678.82	-0.99	0.00	0.00	0.00	-8.95
		10	-636.75	0.99	0.00	0.00	0.00	-21.18
	65	9	489.60	-2.48	1.48	-4.79	-51.91	-26.84
		10	-447.54	2.48	-1.48	4.79	6.83	-48.77
	70	9	288.75	-7.92	1.56	-38.74	-97.55	-88.19
		10	-248.30	7.92	-1.56	38.74	49.92	-153.65
	76	9	289.38	-7.48	8.58	-40.14	-250.25	-83.30
		10	-248.93	7.48	-4.00	40.14	58.17	-145.13
9	1	10	205.87	0.04	0.00	0.00	0.00	-0.92
		5	-203.02	-0.04	0.00	0.00	0.00	1.14
	21	10	636.75	-0.99	0.00	0.00	0.00	19.75
		5	-633.05	0.99	0.00	0.00	0.00	-25.21
	65	10	447.54	-2.48	1.48	-4.79	-8.97	45.19
		5	-443.83	2.48	-1.48	4.79	0.81	-58.88

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	70	10	248.30	-7.92	1.56	-38.74	-52.18	142.20
		5	-244.74	7.92	-1.56	38.74	43.56	-185.98
	76	10	248.93	-7.48	4.00	-40.14	-63.95	134.31
		5	-245.37	7.48	-3.18	40.14	44.12	-175.66
10	1	11	250.91	-0.03	0.00	0.00	0.00	-0.28
		12	-234.32	0.03	0.00	0.00	0.00	-0.15
	21	11	705.69	-0.91	0.00	0.00	0.00	-23.08
		12	-684.12	0.91	0.00	0.00	0.00	8.86
	65	11	514.50	-2.58	1.68	-4.02	-81.28	-67.45
		12	-492.93	2.58	-1.68	4.02	55.01	27.01
	70	11	312.87	-8.00	2.76	-41.59	-167.53	-213.50
		12	-292.13	8.00	-2.76	41.59	124.27	88.34
	76	11	312.84	-7.55	9.83	-42.73	-431.76	-201.62
		12	-292.09	7.55	-9.83	42.73	277.85	83.44
11	1	12	234.32	-0.03	0.00	0.00	0.00	0.15
		13	-201.96	0.03	0.00	0.00	0.00	-0.97
	21	12	684.12	-0.91	0.00	0.00	0.00	-8.86
		13	-642.05	0.91	0.00	0.00	0.00	-18.89
	65	12	492.93	-2.58	1.68	-4.02	-55.01	-27.01
		13	-450.86	2.58	-1.68	4.02	3.79	-51.87
	70	12	292.13	-8.00	2.76	-41.59	-124.27	-88.34
		13	-251.68	8.00	-2.76	41.59	39.91	-155.76
	76	12	292.09	-7.55	9.83	-42.73	-277.85	-83.44
		13	-251.65	7.55	-5.26	42.73	47.55	-147.04
12	1	13	201.96	-0.03	0.00	0.00	0.00	0.93
		6	-199.11	0.03	0.00	0.00	0.00	-1.08
	21	13	642.05	-0.91	0.00	0.00	0.00	17.57
		6	-638.35	0.91	0.00	0.00	0.00	-22.60
	65	13	450.86	-2.58	1.68	-4.02	-6.21	48.14
		6	-447.15	2.58	-1.68	4.02	-3.06	-62.42
	70	13	251.68	-8.00	2.76	-41.59	-43.91	144.20
		6	-248.12	8.00	-2.76	41.59	28.63	-188.39
	76	13	251.65	-7.55	5.26	-42.74	-55.14	136.13
		6	-248.08	7.55	-4.43	42.74	28.39	-177.85
13	1	14	253.13	-0.06	0.00	0.00	0.00	-0.79
		15	-236.54	0.06	0.00	0.00	0.00	-0.11
	21	14	613.81	0.13	0.00	0.00	0.00	-5.49
		15	-592.24	-0.13	0.00	0.00	0.00	7.47
	65	14	525.47	-2.52	1.82	-1.84	-85.67	-66.43
		15	-503.90	2.52	-1.82	1.84	57.17	26.95
	70	14	320.34	-8.04	3.88	-44.85	-213.51	-214.32
		15	-299.60	8.04	-3.88	44.85	152.86	88.47
	76	14	316.72	-7.57	10.98	-45.67	-478.90	-202.06
		15	-295.98	7.57	-10.98	45.67	307.10	83.54

1-8-24

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
14	1	15	236.54	-0.06	0.00	0.00	0.00	0.11
		16	-204.18	0.06	0.00	0.00	0.00	-1.85
	21	15	592.23	0.13	0.00	0.00	0.00	-7.47
		16	-550.17	-0.13	0.00	0.00	0.00	11.34
	65	15	503.90	-2.52	1.82	-1.84	-57.17	-26.95
		16	-461.83	2.52	-1.82	1.84	1.58	-50.05
	70	15	299.60	-8.04	3.88	-44.85	-152.86	-88.47
		16	-259.15	8.04	-3.88	44.85	34.59	-156.97
	76	15	295.98	-7.57	10.98	-45.67	-307.10	-83.54
		16	-255.54	7.57	-6.40	45.67	41.92	-147.61
15	1	16	204.18	-0.06	0.00	0.00	0.00	1.77
		7	-201.33	0.06	0.00	0.00	0.00	-2.09
	21	16	550.17	0.13	0.00	0.00	0.00	-11.15
		7	-546.46	-0.13	0.00	0.00	0.00	11.85
	65	16	461.83	-2.52	1.82	-1.84	-4.21	46.40
		7	-458.13	2.52	-1.82	1.84	-5.85	-60.34
	70	16	259.15	-8.04	3.88	-44.85	-40.19	145.35
		7	-255.59	8.04	-3.88	44.85	18.77	-189.78
	76	16	255.54	-7.57	6.40	-45.67	-51.17	136.66
		7	-251.97	7.57	-5.57	45.67	18.09	-178.51
16	1	7	0.03	153.58	0.00	0.00	0.00	171.26
		17	-0.03	151.42	0.00	0.00	0.00	-178.67
	21	7	4.26	416.94	0.00	0.00	0.00	351.66
		17	-4.26	224.58	0.00	0.00	0.00	-407.70
	65	7	11.01	363.72	6.14	0.06	86.84	384.35
		17	1.70	322.12	6.13	-0.06	-86.95	-403.58
	70	7	32.59	210.23	7.63	182.59	-112.79	310.59
		17	-20.36	171.02	4.17	-182.59	90.99	-89.23
	76	7	30.76	205.87	8.57	185.06	-105.45	302.00
		17	-18.53	175.38	5.06	-185.06	83.33	-135.71
17	1	18	251.52	0.12	0.00	0.00	0.00	2.14
		19	-234.93	-0.12	0.00	0.00	0.00	-0.34
	21	18	368.26	0.19	0.00	0.00	0.00	-4.49
		19	-346.69	-0.19	0.00	0.00	0.00	7.40
	65	18	504.96	-2.27	1.82	1.94	-85.57	-62.21
		19	-483.39	2.27	-1.82	-1.94	57.13	26.63
	70	18	312.64	-7.63	4.99	-47.81	-261.36	-207.47
		19	-291.90	7.63	-4.99	47.81	183.33	88.00
	76	18	314.44	-7.37	12.11	-48.30	-527.45	-198.64
		19	-293.70	7.37	-12.11	48.30	338.00	83.33
18	1	19	234.93	0.12	0.00	0.00	0.00	0.34
		20	-202.57	-0.12	0.00	0.00	0.00	3.17

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	21	19	346.69	0.19	0.00	0.00	0.00	-7.40
		20	-304.62	-0.19	0.00	0.00	0.00	13.09
	65	19	483.39	-2.27	1.82	1.94	-57.13	-26.63
		20	-441.33	2.27	-1.82	-1.94	1.67	-42.77
	70	19	291.90	-7.63	4.99	-47.81	-183.33	-88.00
		20	-251.45	7.63	-4.99	47.81	31.15	-144.99
	76	19	293.70	-7.37	12.11	-48.30	-338.00	-83.33
		20	-253.26	7.37	-7.53	48.30	38.40	-141.53
19	1	20	202.57	0.12	0.00	0.00	0.00	-3.01
		17	-199.72	-0.12	0.00	0.00	0.00	3.64
	21	20	304.62	0.19	0.00	0.00	0.00	-12.83
		17	-300.92	-0.19	0.00	0.00	0.00	13.86
	65	20	441.33	-2.27	1.82	1.94	-4.29	39.49
		17	-437.62	2.27	-1.82	-1.94	-5.75	-52.05
	70	20	251.45	-7.63	4.99	-47.81	-38.36	133.96
		17	-247.89	7.63	-4.99	47.81	10.81	-176.14
	76	20	253.26	-7.37	7.53	-48.30	-49.28	130.88
		17	-249.69	7.37	-6.70	48.30	9.97	-171.59
20	1	17	-0.09	48.29	0.00	0.00	0.00	175.02
		21	0.09	116.51	0.00	0.00	0.00	-263.48
	21	17	4.07	76.34	0.00	0.00	0.00	393.85
		21	-4.07	137.90	0.00	0.00	0.00	-337.63
	65	17	0.57	115.50	-4.31	-5.69	88.89	455.63
		21	-0.57	266.70	4.31	5.69	-34.45	-554.85
	70	17	28.00	76.87	0.81	193.40	-138.80	265.38
		21	-28.00	129.13	-0.81	-193.40	128.54	-167.57
	76	17	25.90	74.31	1.63	195.04	-131.63	307.30
		21	-25.90	131.69	0.20	-195.04	122.55	-241.76
21	1	22	249.32	0.06	0.00	0.00	0.00	1.18
		23	-232.73	-0.06	0.00	0.00	0.00	-0.26
	21	22	313.25	-0.75	0.00	0.00	0.00	-20.41
		23	-291.68	0.75	0.00	0.00	0.00	8.68
	65	22	522.48	-2.29	1.67	4.14	-80.96	-62.51
		23	-500.91	2.29	-1.67	-4.14	54.90	26.65
	70	22	217.56	-7.10	6.23	-52.57	-313.90	-198.44
		23	-196.82	7.10	-6.23	52.57	216.37	87.36
	76	22	312.21	-7.45	13.36	-52.75	-580.27	-200.13
		23	-291.47	7.45	-13.36	52.75	371.25	83.52
22	1	23	232.73	0.06	0.00	0.00	0.00	0.26
		24	-200.37	-0.06	0.00	0.00	0.00	1.54
	21	23	291.68	-0.75	0.00	0.00	0.00	-8.68
		24	-249.62	0.75	0.00	0.00	0.00	-14.21
	65	23	500.91	-2.29	1.67	4.14	-54.90	-26.65
		24	-458.84	2.29	-1.67	-4.14	4.07	-43.28

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	70	23	196.82	-7.10	6.23	-52.57	-216.36	-87.36
		24	-156.38	7.10	-6.23	52.57	26.16	-129.27
	76	23	291.47	-7.45	13.36	-52.75	-371.25	-83.52
		24	-251.02	7.45	-8.78	52.75	33.48	-143.88
23	1	24	200.37	0.06	0.00	0.00	0.00	-1.45
		21	-197.52	-0.06	0.00	0.00	0.00	1.78
	21	24	249.62	-0.75	0.00	0.00	0.00	13.12
		21	-245.91	0.75	0.00	0.00	0.00	-17.27
	65	24	458.84	-2.29	1.67	4.14	-6.48	39.97
		21	-455.14	2.29	-1.67	-4.14	-2.72	-52.63
	70	24	156.38	-7.10	6.23	-52.57	-35.16	119.01
		21	-152.81	7.10	-6.23	52.57	0.73	-158.23
	76	24	251.02	-7.45	8.78	-52.75	-46.16	133.11
		21	-247.46	7.45	-7.95	52.75	-0.05	-174.28
24	1	21	-0.15	81.01	0.00	0.00	0.00	261.70
		25	0.15	84.19	0.00	0.00	0.00	-255.80
	21	21	4.82	108.01	0.00	0.00	0.00	354.90
		25	-4.82	106.75	0.00	0.00	0.00	-313.18
	65	21	2.86	188.43	-2.65	-8.41	38.58	607.48
		25	-2.86	178.75	2.65	8.41	-5.17	-484.40
	70	21	35.10	23.68	7.04	194.13	-181.11	325.80
		25	-35.10	19.70	-7.04	-194.13	92.14	-102.61
	76	21	33.35	115.77	7.75	194.99	-175.30	416.04
		25	-33.35	90.73	-5.92	-194.99	88.94	-225.45
25	1	26	257.12	-0.06	0.00	0.00	0.00	-0.85
		27	-240.52	0.06	0.00	0.00	0.00	-0.10
	21	26	327.95	-0.88	0.00	0.00	0.00	-22.67
		27	-306.38	0.88	0.00	0.00	0.00	8.87
	65	26	501.95	-2.12	1.45	4.91	-74.40	-59.57
		27	-480.38	2.12	-1.45	-4.91	51.70	26.43
	70	26	243.13	-8.77	7.80	-57.43	-375.16	-226.99
		27	-222.39	8.77	-7.80	57.43	253.03	89.72
	76	26	321.52	-7.58	14.92	-57.39	-641.49	-202.46
		27	-300.78	7.58	-14.92	57.39	407.94	83.80
26	1	27	240.52	-0.06	0.00	0.00	0.00	0.10
		28	-208.17	0.06	0.00	0.00	0.00	-1.95
	21	27	306.38	-0.88	0.00	0.00	0.00	-8.87
		28	-264.31	0.88	0.00	0.00	0.00	-18.04
	65	27	480.38	-2.12	1.45	4.91	-51.70	-26.43
		28	-438.32	2.12	-1.45	-4.91	7.45	-38.21
	70	27	222.39	-8.77	7.80	-57.43	-253.03	-89.72
		28	-181.94	8.77	-7.80	57.43	14.85	-177.97
	76	27	300.78	-7.58	14.92	-57.39	-407.94	-83.80
		28	-260.33	7.58	-10.34	57.39	22.36	-147.60

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
27	1	28	208.17	-0.06	0.00	0.00	0.00	1.86
		25	-205.31	0.06	0.00	0.00	0.00	-2.19
	21	28	264.31	-0.88	0.00	0.00	0.00	16.76
		25	-260.61	0.88	0.00	0.00	0.00	-21.64
	65	28	438.32	-2.12	1.45	4.91	-9.54	35.15
		25	-434.61	2.12	-1.45	-4.91	1.53	-46.85
	70	28	181.94	-8.77	7.80	-57.43	-26.13	165.30
		25	-178.38	8.77	-7.80	57.43	-16.99	-213.76
	76	28	260.33	-7.58	10.35	-57.39	-37.31	136.65
		25	-256.77	7.58	-9.52	57.39	-17.56	-178.53
28	1	25	-0.09	121.13	0.00	0.00	0.00	258.00
		29	0.09	42.48	0.00	0.00	0.00	-150.66
	21	25	5.71	153.86	0.00	0.00	0.00	334.82
		29	-5.71	58.82	0.00	0.00	0.00	-240.82
	65	25	4.98	255.86	-1.20	-6.88	10.09	531.25
		29	-4.98	78.21	1.20	6.88	5.00	-256.00
	70	25	43.87	158.68	14.85	177.14	-149.56	316.36
		29	-43.87	45.82	-14.85	-177.14	-37.97	-90.27
	76	25	40.94	166.04	15.44	177.43	-146.32	403.98
		29	-40.94	38.46	-13.61	-177.43	-37.09	-85.02
29	1	30	265.80	-0.09	0.00	0.00	0.00	-1.27
		31	-249.21	0.09	0.00	0.00	0.00	-0.07
	21	30	349.15	-8.06	0.00	0.00	0.00	-111.81
		31	-327.58	8.06	0.00	0.00	0.00	-14.32
	65	30	395.35	-8.78	1.20	5.00	-66.93	-139.99
		31	-373.78	8.78	-1.20	-5.00	48.23	2.54
	70	30	324.97	-16.62	9.80	-59.41	-446.04	-321.33
		31	-304.23	16.62	-9.80	59.41	292.64	61.17
	76	30	317.62	-14.15	16.91	-59.26	-712.12	-282.61
		31	-296.88	14.15	-16.91	59.26	447.47	61.16
30	1	31	249.21	-0.09	0.00	0.00	0.00	0.07
		32	-216.85	0.09	0.00	0.00	0.00	-2.67
	21	31	327.58	-8.06	0.00	0.00	0.00	14.32
		32	-285.51	-5.71	0.00	0.00	0.00	17.76
	65	31	373.78	-8.78	1.20	5.00	-48.23	-2.54
		32	-331.71	-4.98	-1.20	-5.00	11.75	12.55
	70	31	304.23	-16.62	9.80	-59.41	-292.64	-61.17
		32	-263.79	-1.19	-9.80	59.41	-6.50	-108.97
	76	31	296.88	-14.15	16.91	-59.26	-447.47	-61.16
		32	-256.43	0.91	-12.33	59.26	1.24	-103.35
31	1	32	216.85	-0.09	0.00	0.00	0.00	2.55
		29	-214.00	0.09	0.00	0.00	0.00	-3.02

C-5-28

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

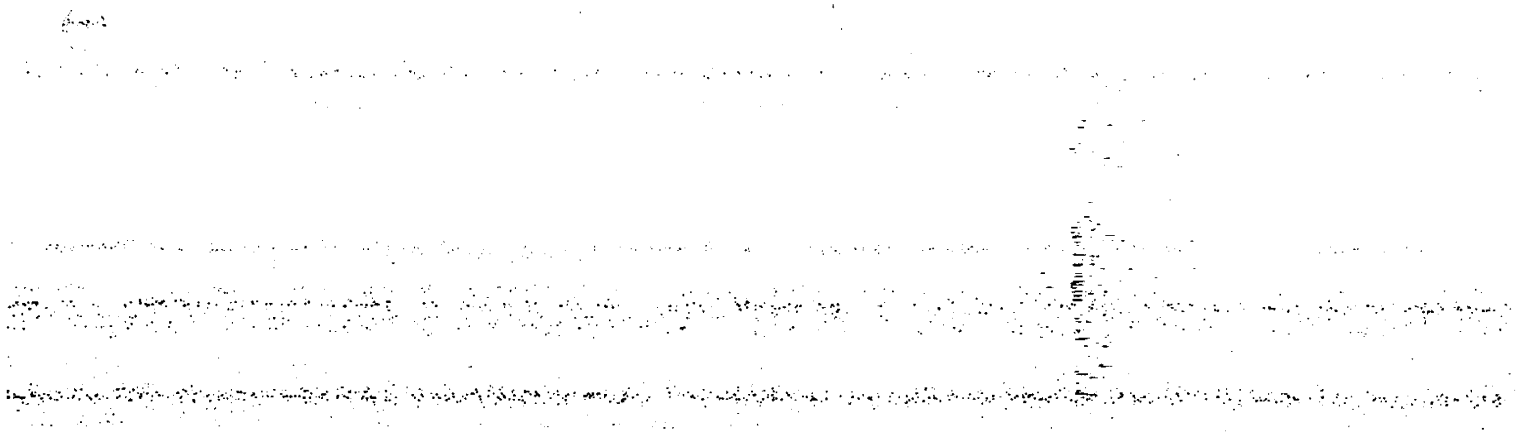
MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	21	32	285.51	5.71	0.00	0.00	0.00	-9.52
		29	-281.81	-5.71	0.00	0.00	0.00	41.04
	65	32	331.71	4.98	1.20	5.00	-13.48	-5.36
		29	-328.01	-4.98	-1.20	-5.00	6.88	32.88
	70	32	263.79	1.19	9.80	-59.41	-7.66	110.69
		29	-260.22	-2.02	-9.80	59.41	-46.49	-101.82
	76	32	256.43	-0.91	12.33	-59.26	-19.05	102.03
		29	-252.87	0.91	-11.50	59.26	-46.79	-107.08
32	1	4	0.00	171.52	0.00	0.00	0.00	154.17
		33	0.00	0.00	0.00	0.00	0.00	0.00
	21	4	0.00	366.70	0.00	0.00	0.00	325.89
		33	0.00	0.00	0.00	0.00	0.00	0.00
	65	4	0.00	294.96	0.00	0.00	0.00	263.26
		33	0.00	0.00	0.00	0.00	0.00	0.00
	70	4	0.00	214.41	0.00	0.00	0.00	192.72
		33	0.00	0.00	0.00	0.00	0.00	0.00
	76	4	0.00	214.41	-0.46	0.00	0.73	192.72
		33	0.00	0.00	0.00	0.00	0.00	0.00
33	1	34	0.00	0.00	0.00	0.00	0.00	0.00
		29	0.00	171.52	0.00	0.00	0.00	-153.68
	21	34	0.00	0.00	0.00	0.00	0.00	0.00
		29	0.00	222.98	0.00	0.00	0.00	-199.78
	65	34	0.00	0.00	0.00	0.00	0.00	0.00
		29	0.00	249.80	0.00	0.00	0.00	-223.11
	70	34	0.00	0.00	0.01	0.00	-0.02	0.00
		29	-41.85	214.41	-24.66	-130.64	-21.46	-192.10
	76	34	0.00	0.00	0.01	0.00	-0.04	0.00
		29	-41.85	214.41	-25.12	-130.64	-22.20	-192.10

********** END OF LATEST ANALYSIS RESULT **********

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334. START CONCRETE DESIGN

335. CODE ACI
336. UNIT INCHES KIP
337. FYMAIN 40. ALL
338. MINMAIN 9. ALL
339. FC 3. MEMB 4 TO 6 16 20 24 28 32 33
340. CLT 2. MEMB 4 TO 6 16 20 24 28 32 33
341. CLS 2. MEMB 4 TO 6 16 20 24 28 32 33
342. CLB 1.2 MEMB 4 TO 6 16 20 24 28 32 33
 43. SFACE 18. MEMB 4 TO 6 16 20 24 28 32 33
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344. EFACE 18. MEMB 4 TO 6 16 20 24 28 32 33
345. DESIGN BEAM 4 TO 6 16 20 24 28 32 33
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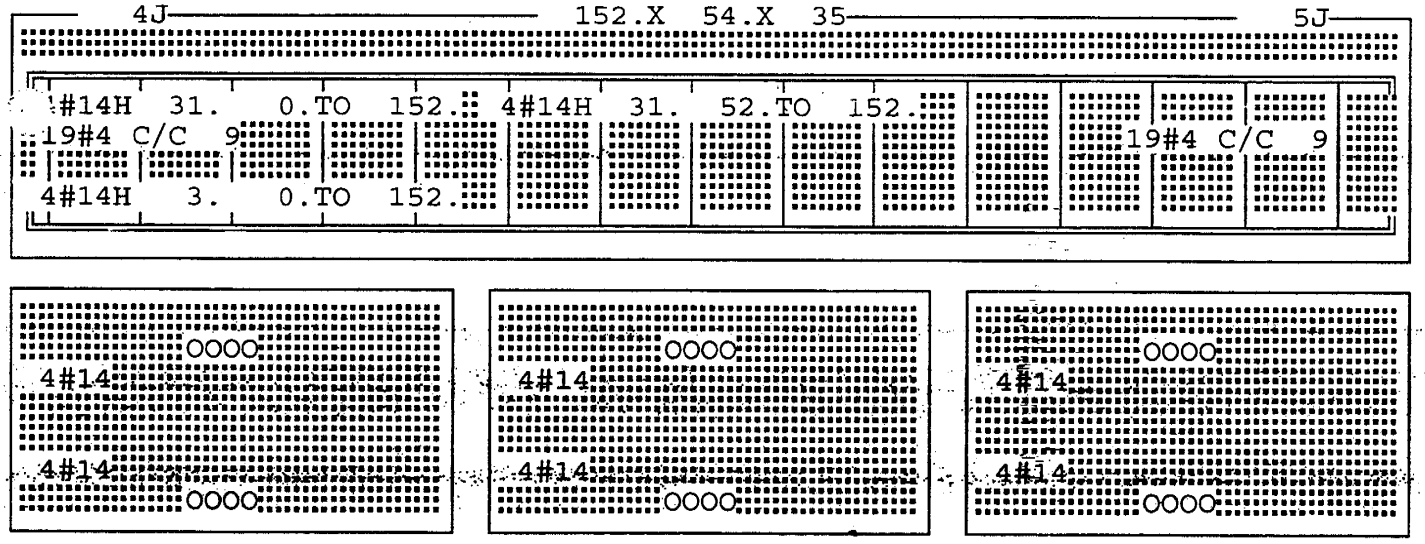
B E A M N O. 4 D E S I G N R E S U L T S - FLEXURE

LEN - 12.63FT. FY - 40000. FC - 3000. SIZE - 54.36 X 34.68 INCHES

LEVEL	HEIGHT FT.	HEIGHT IN.	BAR INFO	FROM FT.	FROM IN.	TO FT.	TO IN.	ANCHOR STA	ANCHOR END
1	0 +	2-5/8	4-NUM.14	0 +	0-0/0	12 +	7-5/8	YES	YES
2	2 +	7-1/8	4-NUM.14	0 +	0-0/0	12 +	7-5/8	YES	YES
3	2 +	7-1/8	4-NUM.14	4 +	4-0/0	12 +	7-5/8	NO	YES

B E A M N O. 4 D E S I G N R E S U L T S - SHEAR

AT START SUPPORT - Vu= 116.03 KIP Vc= 188.65 KIP Vs= 0.00 KIP
PROVIDE NUM. 4 BARS AT 8.8 IN. C/C FOR 152. IN.
AT END SUPPORT - Vu= 109.76 KIP Vc= 188.65 KIP Vs= 0.00 KIP
PROVIDE NUM. 4 BARS AT 8.8 IN. C/C FOR 152. IN.



B E A M N O. 5 D E S I G N R E S U L T S - FLEXURE

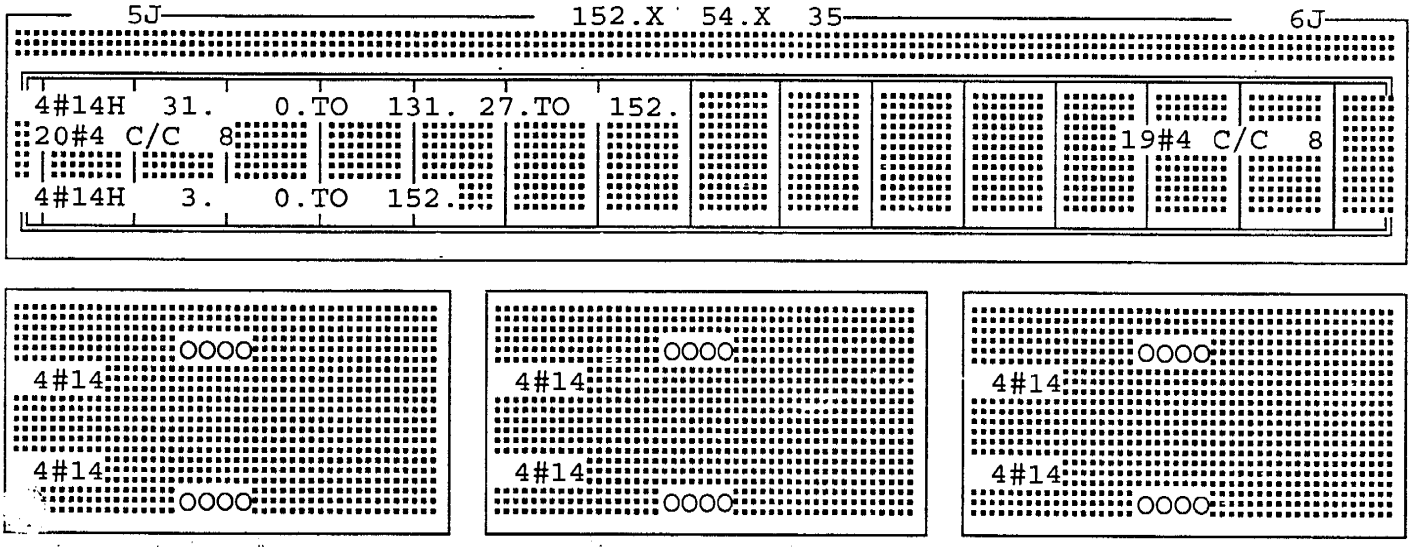
LEN - 12.63FT. FY - 40000. FC - 3000. SIZE - 54.36 X 34.68 INCHES

LEVEL	HEIGHT FT.	HEIGHT IN.	BAR INFO	FROM FT.	FROM IN.	TO FT.	TO IN.	ANCHOR STA	ANCHOR END
1	0 +	2-5/8	4-NUM.14	0 +	0-0/0	12 +	7-5/8	YES	YES

2	2 + 7-1/8	4-NUM.14	0 + 0-0/0	10 +11-1/4	YES	NO
3	2 + 7-1/8	4-NUM.14	2 + 2-3/4	12 + 7-5/8	NO	YES

B E A M N O. 5 D E S I G N R E S U L T S - SHEAR

AT START SUPPORT - Vu= 237.20 KIP Vc= 188.65 KIP Vs= 90.40 KIP
PROVIDE NUM. 4 BARS AT 8.4 IN. C/C FOR 152. IN.
AT END SUPPORT - Vu= 236.79 KIP Vc= 188.65 KIP Vs= 89.93 KIP
PROVIDE NUM. 4 BARS AT 8.5 IN. C/C FOR 152. IN.



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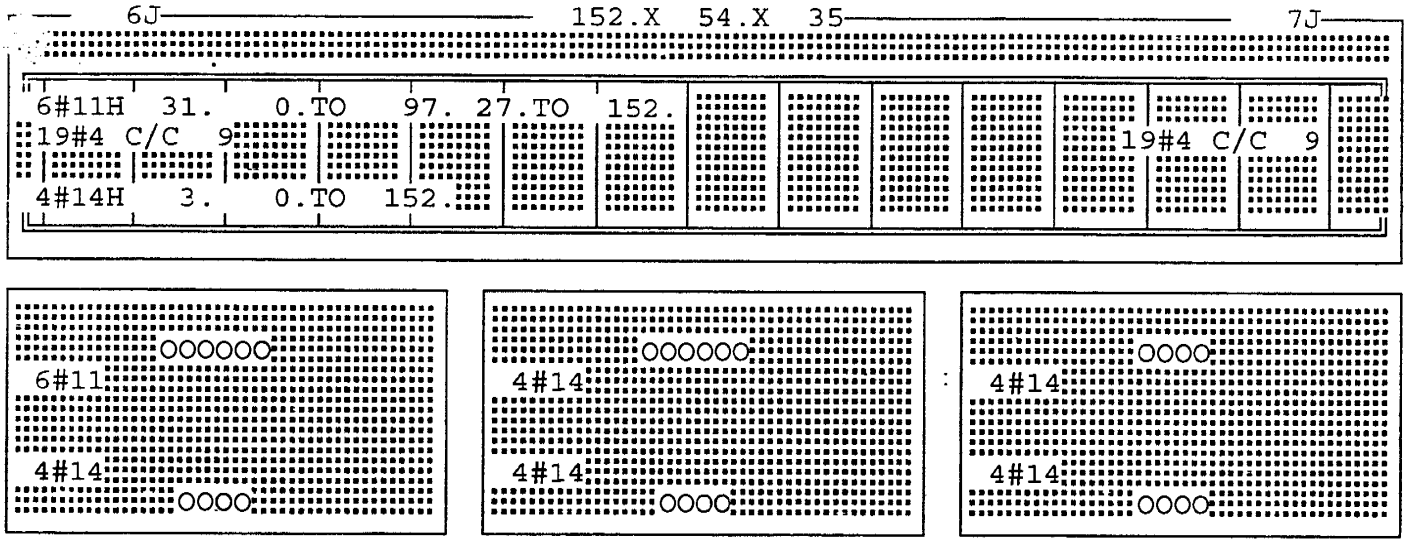
B E A M N O. 6 D E S I G N R E S U L T S - FLEXURE

LEN - 12.63FT. FY - 40000. FC - 3000. SIZE - 54.36 X 34.68 INCHES

LEVEL	HEIGHT FT.	HEIGHT IN.	BAR INFO	FROM FT.	FROM IN.	TO FT.	TO IN.	ANCHOR STA	ANCHOR END
1	0 +	2-5/8	4-NUM.14	0 +	0-0/0	12 +	7-5/8	YES	YES
2	2 +	7-1/4	6-NUM.11	0 +	0-0/0	8 +	1-1/4	YES	NO
3	2 +	7-1/8	4-NUM.14	2 +	2-3/4	12 +	7-5/8	NO	YES

B E A M N O. 6 D E S I G N R E S U L T S - SHEAR

AT START SUPPORT - Vu= 112.74 KIP Vc= 188.65 KIP Vs= 0.00 KIP
PROVIDE NUM. 4 BARS AT 8.8 IN. C/C FOR 152. IN.
AT END SUPPORT - Vu= 118.96 KIP Vc= 188.65 KIP Vs= 0.00 KIP
PROVIDE NUM. 4 BARS AT 8.8 IN. C/C FOR 152. IN.



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B E A M N O. 16 D E S I G N R E S U L T S - FLEXURE

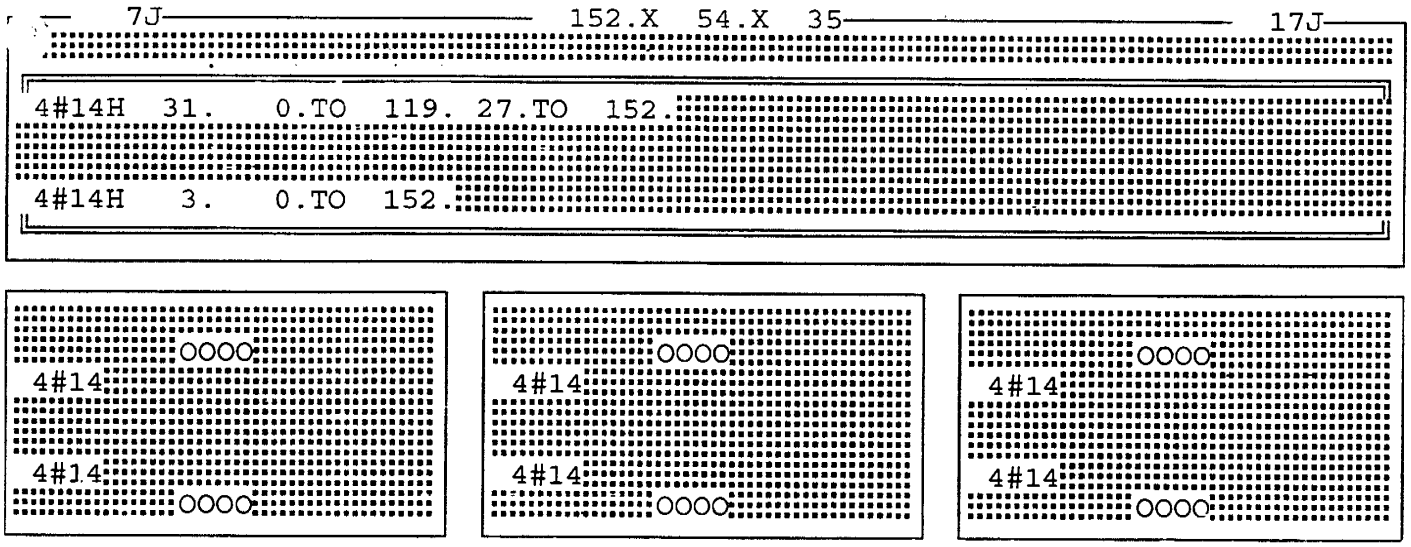
LEN - 12.63FT. FY - 40000. FC - 3000. SIZE - 54.36 X 34.68 INCHES

LEVEL	HEIGHT FT.	HEIGHT IN.	BAR INFO	FROM FT.	FROM IN.	TO FT.	TO IN.	ANCHOR STA	ANCHOR END
1	0 +	2-5/8	4-NUM.14	0 +	0-0/0	12 +	7-5/8	YES	YES
2	2 +	7-1/8	4-NUM.14	0 +	0-0/0	9 +	10-5/8	YES	NO
3	2 +	7-1/8	4-NUM.14	2 +	2-3/4	12 +	7-5/8	NO	YES

B E A M N O. 16 D E S I G N R E S U L T S - SHEAR

AT START SUPPORT - Vu= 27.54 KIP Vc= 188.65 KIP Vs= 0.15 KIP
STIRRUPS ARE NOT REQUIRED.
AT END SUPPORT - Vu= 13.09 KIP Vc= 188.65 KIP Vs= 0.15 KIP
STIRRUPS ARE NOT REQUIRED.

C-5-33



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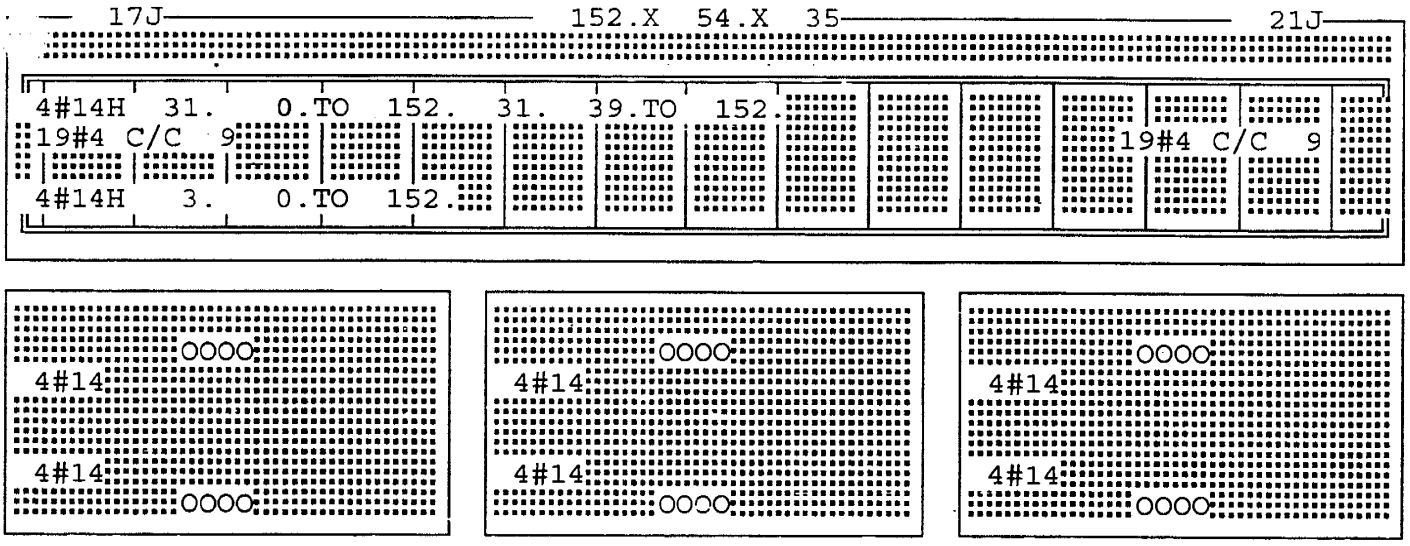
B E A M N O. 20 D E S I G N R E S U L T S - FLEXURE

LEN - 12.63FT. FY - 40000. FC - 3000. SIZE - 54.36 X 34.68 INCHES

LEVEL	HEIGHT FT.	IN.	BAR INFO	FROM FT.	IN.	TO FT.	IN.	ANCHOR STA	END
1	0 +	2-5/8	4-NUM.14	0 +	0-0/0	12 +	7-5/8	YES	YES
2	2 +	7-1/8	4-NUM.14	0 +	0-0/0	12 +	7-5/8	YES	YES
3	2 +	7-1/8	4-NUM.14	3 +	3-3/8	12 +	7-5/8	NO	YES

B E A M N O. 20 D E S I G N R E S U L T S - SHEAR

AT START SUPPORT - Vu= 104.93 KIP Vc= 188.65 KIP Vs= 0.00 KIP
PROVIDE NUM. 4 BARS AT 8.8 IN. C/C FOR 152. IN.
AT END SUPPORT - Vu= 96.87 KIP Vc= 188.65 KIP Vs= 0.00 KIP
PROVIDE NUM. 4 BARS AT 8.8 IN. C/C FOR 152. IN.



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B E A M N O. 24 D E S I G N R E S U L T S - FLEXURE

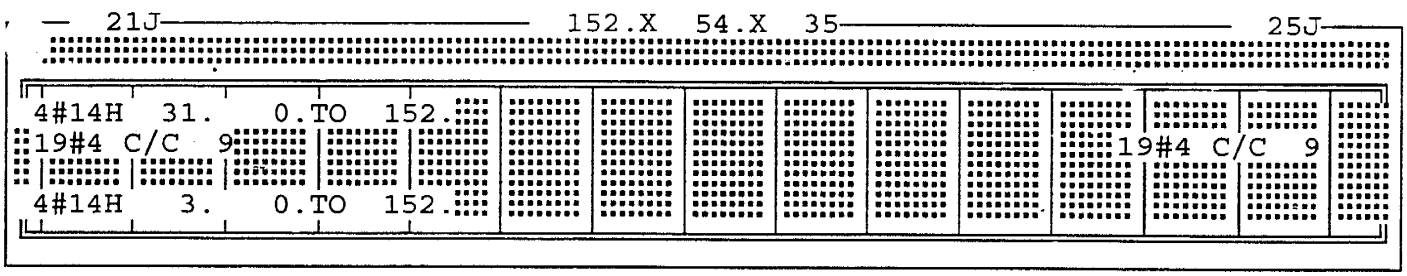
LEN - 12.63FT. FY - 40000. FC - 3000. SIZE - 54.36 X 34.68 INCHES

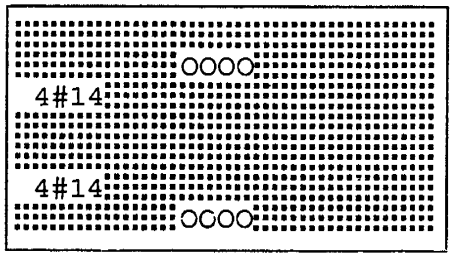
LEVEL	HEIGHT FT.	HEIGHT IN.	BAR INFO	FROM FT.	FROM IN.	TO FT.	TO IN.	ANCHOR STA	ANCHOR END
1	0 +	2-5/8	4-NUM.14	0 +	0-0/0	12 +	7-5/8	YES	YES
2	2 +	7-1/8	4-NUM.14	0 +	0-0/0	12 +	7-5/8	YES	YES

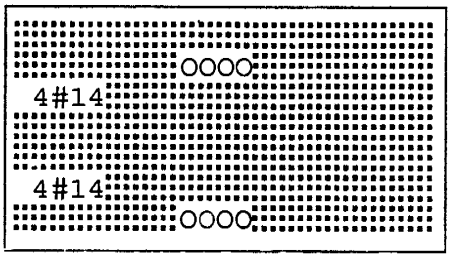
B E A M N O. 24 D E S I G N R E S U L T S - SHEAR

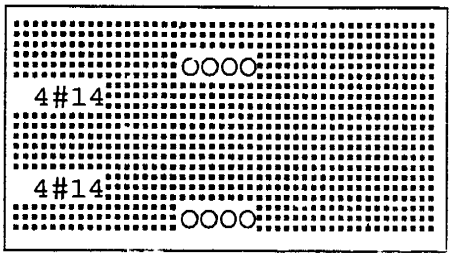
AT START SUPPORT - Vu= 177.86 KIP Vc= 188.65 KIP Vs= 20.60 KIP
PROVIDE NUM. 4 BARS AT 8.8 IN. C/C FOR 152. IN.

AT END SUPPORT - Vu= 168.19 KIP Vc= 188.65 KIP Vs= 9.22 KIP
PROVIDE NUM. 4 BARS AT 8.8 IN. C/C FOR 152. IN.









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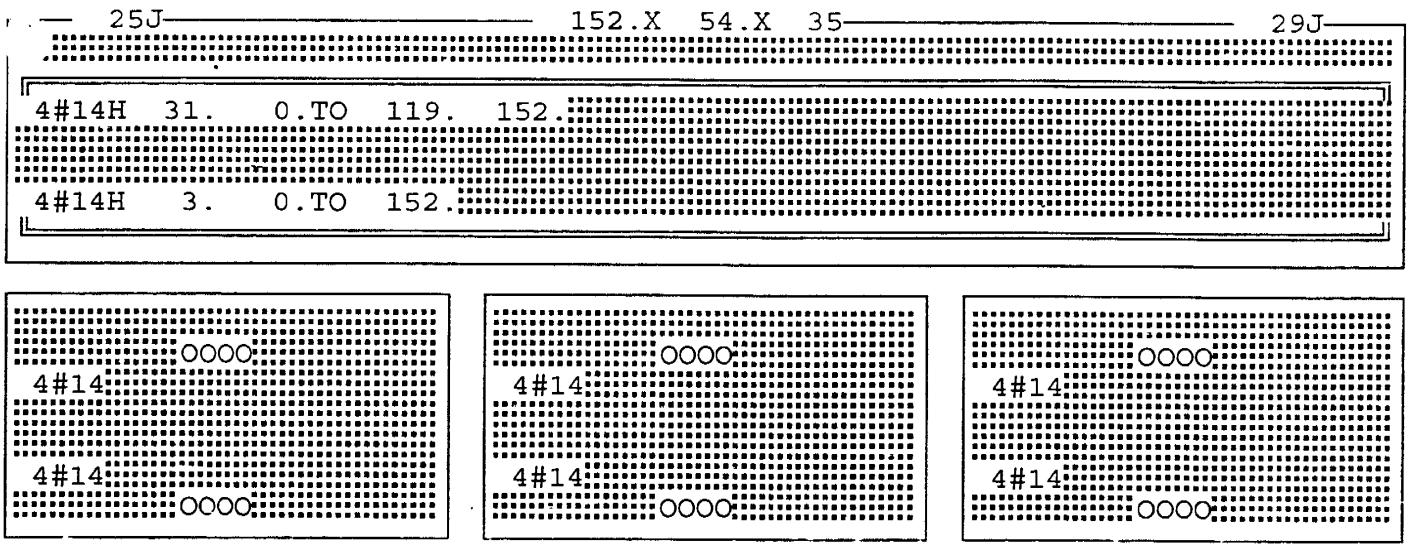
B E A M N O. 28 D E S I G N R E S U L T S - FLEXURE

LEN - 12.63FT. FY - 40000. FC - 3000. SIZE - 54.36 X 34.68 INCHES

LEVEL	HEIGHT FT.	HEIGHT IN.	BAR INFO	FROM FT.	FROM IN.	TO FT.	TO IN.	ANCHOR STA	ANCHOR END
1	0 +	2-5/8	4-NUM.14	0 +	0-0/0	12 +	7-5/8	YES	YES
2	2 +	7-1/8	4-NUM.14	0 +	0-0/0	9 +10	-5/8	YES	NO
3	2 +	7-1/8	4-NUM.14	1 +	2-1/8	12 +	7-5/8	NO	YES

B E A M N O. 28 D E S I G N R E S U L T S - SHEAR

AT START SUPPORT - Vu= 60.02 KIP Vc= 188.65 KIP Vs= 0.15 KIP
STIRRUPS ARE NOT REQUIRED.
AT END SUPPORT - Vu= 67.64 KIP Vc= 188.65 KIP Vs= 0.15 KIP
STIRRUPS ARE NOT REQUIRED.



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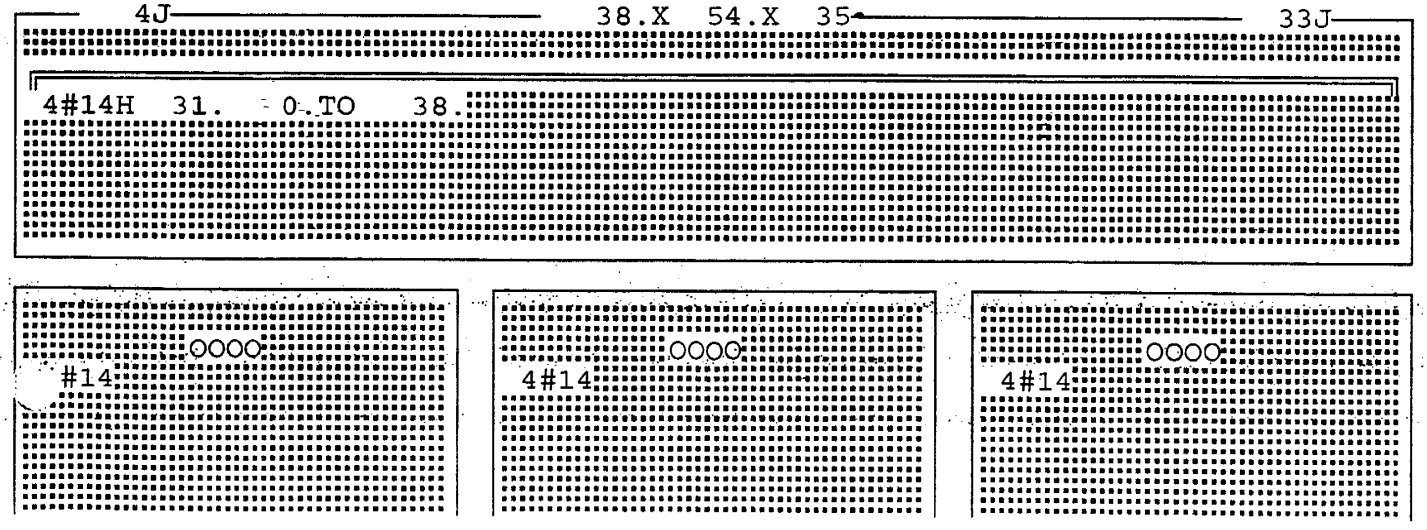
B E A M N O. 32 D E S I G N R E S U L T S - FLEXURE

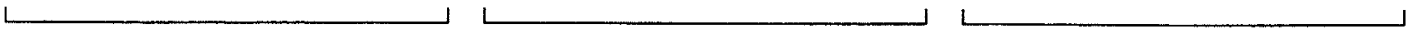
LEN - 3.17FT. FY - 40000. FC - 3000. SIZE - 54.36 X 34.68 INCHES

LEVEL	HEIGHT FT.	HEIGHT IN.	BAR INFO	FROM FT.	FROM IN.	TO FT.	TO IN.	ANCHOR STA	ANCHOR END
1	2 +	7-1/8	4-NUM.14	0 +	0-0/0	3 +	2-1/8	YES	YES

B E A M N O. 32 D E S I G N R E S U L T S - SHEAR

AT START SUPPORT - Vu= 0.01 KIP Vc= 188.65 KIP Vs= 0.04 KIP
STIRRUPS ARE NOT REQUIRED.
AT END SUPPORT - Vu= 0.01 KIP Vc= 188.65 KIP Vs= 0.04 KIP
STIRRUPS ARE NOT REQUIRED.





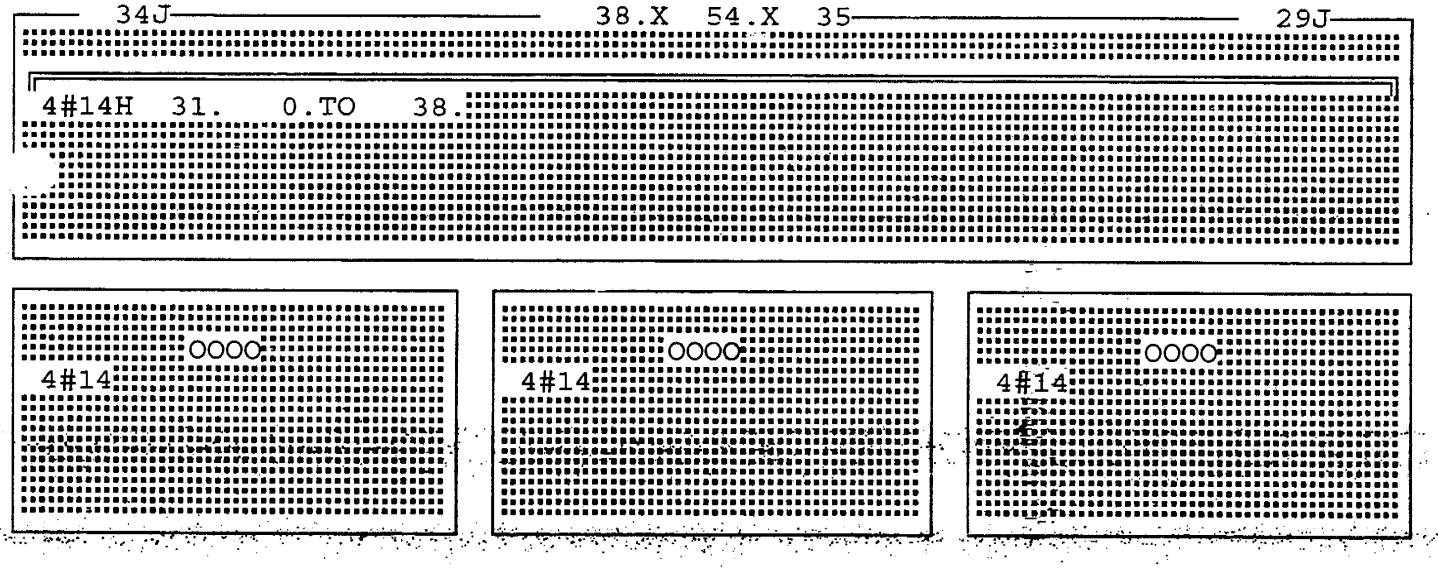
B E A M N O. 33 D E S I G N R E S U L T S - FLEXURE

LEN - 3.17FT. FY - 40000. FC - 3000. SIZE - 54.36 X 34.68 INCHES

LEVEL	HEIGHT FT.	IN.	BAR INFO	FROM FT.	IN.	TO FT.	IN.	ANCHOR STA	END
1	2 +	7-1/8	4-NUM.14	0 +	0-0/0	3 +	2-1/8	YES	YES

B E A M N O. 33 D E S I G N R E S U L T S - SHEAR

AT START SUPPORT - Vu= 0.01 KIP Vc= 188.65 KIP Vs= 0.04 KIP
STIRRUPS ARE NOT REQUIRED.
AT END SUPPORT - Vu= 0.01 KIP Vc= 188.65 KIP Vs= 0.04 KIP
STIRRUPS ARE NOT REQUIRED.



**********END OF BEAM DESIGN**********

346. END CONCRETE DESIGN
347. FINISH

********** END OF STAAD-III **********

**** DATE= NOV 14,1996 TIME= 13:46:13 ****

****
* For questions on STAAD-III, contact: *
* Research Engineers, Inc at *
* Ph: (714) 974-2500 Fax: (714) 921-2543 *
****

FILENAME: PNFOM2

```
INPUT DATA          ANALYSIS PROCEDURES
FCJ =7000.          IN ACCORDANCE WITH
EPS =210.           ACI 318 ULTIMATE STRENGTH
FSU =270.           METHODS
DD1 =36.
DD2 =26.
RRS =15.3
ZMM =8.
ASS =.347
ACC =487.
TYPE =1.            BASIC DATA SUMMARY
CODE =1.            DATA PREPARED BY  ERICH REICHLE
SAFETY FACTOR =1.11
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EQUIVALENT TO $\phi = 0.9$

ULT COMP LOAD AT ZERO MOMENT/SF P0/SF= 2295.382 KIPS

ULT TENS LOAD AT ZERO MOMENT/SF PT/SF= 550.198 KIPS

ULTIMATE MOMENT AT ZERO AXIAL LOAD/SF MO/SF= 9146.337 IN-KIPS

ULTIMATE AXIAL LOAD AT BALANCED CONDITIONS/SF PB/SF= 1011.184 KIPS

ULTIMATE MOMENT AT BALANCED CONDITIONS/SF MB/SF= 13592.850 IN-KIPS

INTERACTION DIAGRAM FOR PRESTRESSED CONCRETE PILES

PT	ULT AXIAL LOAD/SF KIPS	ULTIMATE MOMENT/SF IN-KIPS	f.k
1	2222.671	447.206	37.3
2	2191.624	938.359	78.2
3	1968.763	4425.708	368.8
4	1666.814	8463.494	705.3
5	1454.913	10765.290	897.1
6	1283.307	12197.750	1016.4
7	1126.626	13135.040	1094.5
8	976.077	13691.830	1163.4
9	826.181	13915.840	1159.5
10	663.556	13779.480	1148
11	504.323	13250.780	1104
12	331.643	12263.730	1021.9
13	136.810	10649.520	887.4
14	-120.946	7796.993	650
15	-459.692	3233.632	269.4

With $\phi = .9$

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DE DIEGO BRIDGE MOD. @ MAIN CHANNEL			

MEMBER #	P_u (kips)	M_{uy} (k.ft)	M_{uz} (k.ft)	M_u (k.ft)	LOAD CASE
10	706	0	-23	23	21
25	243	-375	-227	438	70
29	318	-712	-283	766	76

FROM STAAD 3 OUTPUT, THE ABOVE LOADS GOVERN

USE THE MOMENT MAGNIFIER METHOD TO ACCOUNT FOR SLENDERNESS EFFECTS, AND CHECK AGAINST THE INTERACTION DIAGRAM.

RE-RUN STAAD 3 FOR CASE 70 USING $\phi = 0.75$ TO CHECK FOR MIN. AXIAL AND MAX. MOMENT.

MEMBER #	P_u (kips)	M_{uy} (k.ft)	M_{uz} (k.ft)	M_u (k.ft)	LOAD CASE
25	163	-375	-227	438	70

ALL CASES ARE WITHIN THE ACCEPTABLE REGION OF THE INTERACTION DIAGRAM

SAJ Form 1000
14 Mar 78

Moment Magnification for Reinforced Concrete Circular Columns

14-Nov-96

Project: De Diego @ Main Channel
Des. Engr:

Reference: AASHTO 8.16.5.2.7

Magnified Moment Mc = delta * M2

FILENAME: MAGMOM.XLS

Delta = Cm / (1-Pu/(Phi*Pc)) <= 1.0

Pc = (PI^2)*(EI)/(Klu)^2

EI = (EcIg/2.5)/(1+Bd)

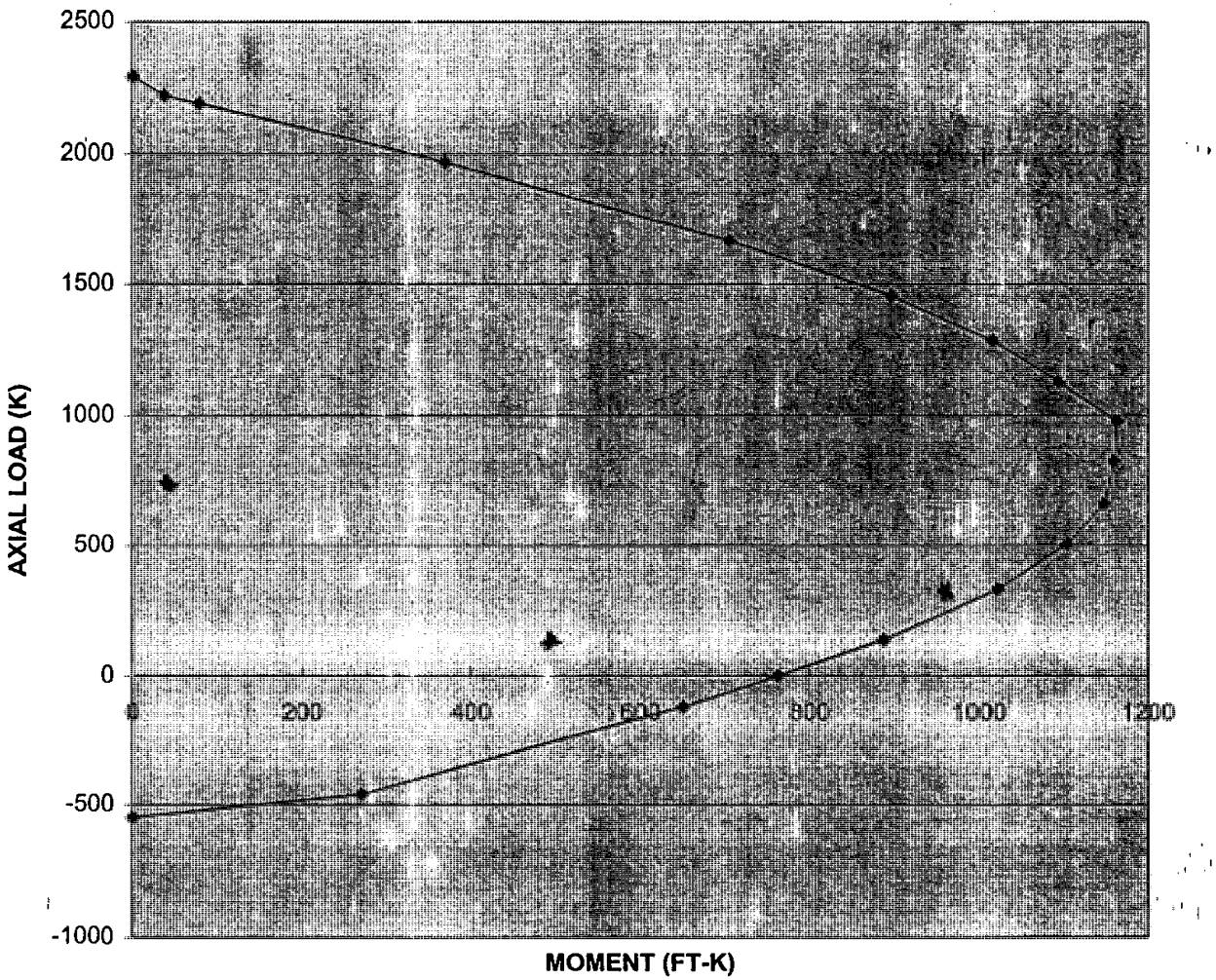
Bd = Max DL moment / Max TL moment

Cm = 1.0

Pier No.:

Load case No.:	1	2	3	4
Input column data				
Diam of col(in):	36.00	36.00	36.00	36.00
Ec of col(ksi):	4700.00	4700.00	4700.00	4700.00
Lu of col (ft):	29.38	29.38	29.38	29.38
K of col:	2.10	2.10	2.10	2.10
Input forces				
Pu (k) :	706.00	163	318	0
Mu (f-k):	23.00	438	766	0
Max DL moment(f-k):	0.00	0	0	0
Max TL moment(f-k):	1.00	1	1	1
Output values				
"r"rad of gyr(in) =	10.92	10.92	10.92	10.92
Igross(in^4) =	59098.00	59098.00	59098.00	59098.00
Bd = DLmom/TLmom =	0.0000	0.0000	0.0000	0.0000
EI (ksi) =	111104240	111104240	111104240	111104240
Pc (k) =	2000.44	2000.44	2000.44	2000.44
Delta =	1.8888	1.1219	1.2690	1.0000
Delta*Mu =	43.44	491.39	972.02	0.00

NOMINAL CAPACITY 36" DIA. PRESTRESSED CYLINDER PILE



C-5-5

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DE DIEGO BRIDGE MOD @ MAIN CHANNEL				

THE ORIGINAL PLANS CALL FOR AN ALLOWABLE VERTICAL LOAD ON THE PILES TO NOT EXCEED 160 TONS (320^k)

RE-RUN LOAD CASE 21 REMOVING ALL THE LOAD FACTORS* TO DETERMINE THE ACTUAL WORST CASE AXIAL LOAD *(AND IMPACT)

$P = 390^k$ MEMBER NO. 10

ASSUMING A F.S. = 2.0 WAS ORIGINALLY USED, THE NEW F.S. IS:

$$\frac{285\,(2)}{390} = 1.46$$

THE FUTURE CHANNEL INVERT ELEVATION SHOWN ON THE PLANS IS @ EL. -10.83. IT IS LOGICAL TO ASSUME THE PILINGS WERE DESIGNED NEGLECTING ANY SKIN FRICTION ABOVE THIS ELEV. OUR NEW INVERT IS @ EL. -15.64 WHICH IS 4.81 FT LOWER. ASSUMING THE PILE CAPACITY IS BASED SOLELY ON SKIN FRICTION; ITS NEW CAPACITY IS APPROX:

$$\frac{320}{(55-10.83)} = \frac{P}{(55-15.64)} \qquad P = 285\ k_{ips}$$

SEE EXISTING PILE ANALYSIS

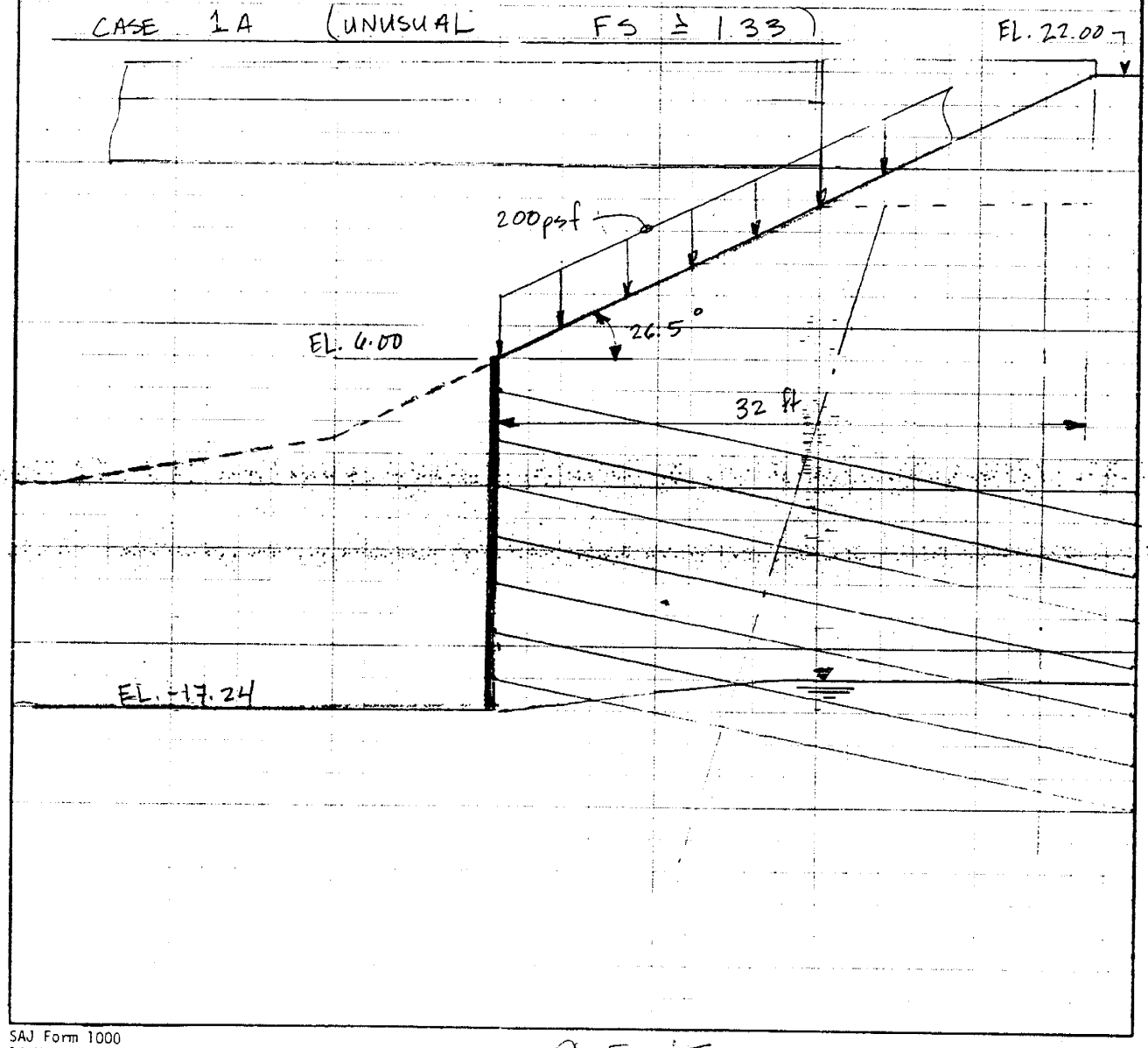
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SUBJECT		CHECKED BY	DATE
DE DIEGO EXP. BRIDGE MOD. @ MAIN CHANNEL			

SOIL NAILED WALL DESIGN

CASES 2A & 2B WILL NOT GOVERN DESIGN. CASE 1B IS NOT APPLICABLE, AND ONLY SURCHARGE EFFECTS WILL BE CONSIDERED FOR CASE 1A. THERE WILL BE NO COMPACTION.

CALTRANS PROGRAM SNAIL IS USED TO DETERMINE WALL PRESSURES, NAIL FORCES AND FACTORS OF SAFETY.

CASE 1A (UNUSUAL FS ≥ 1.33)



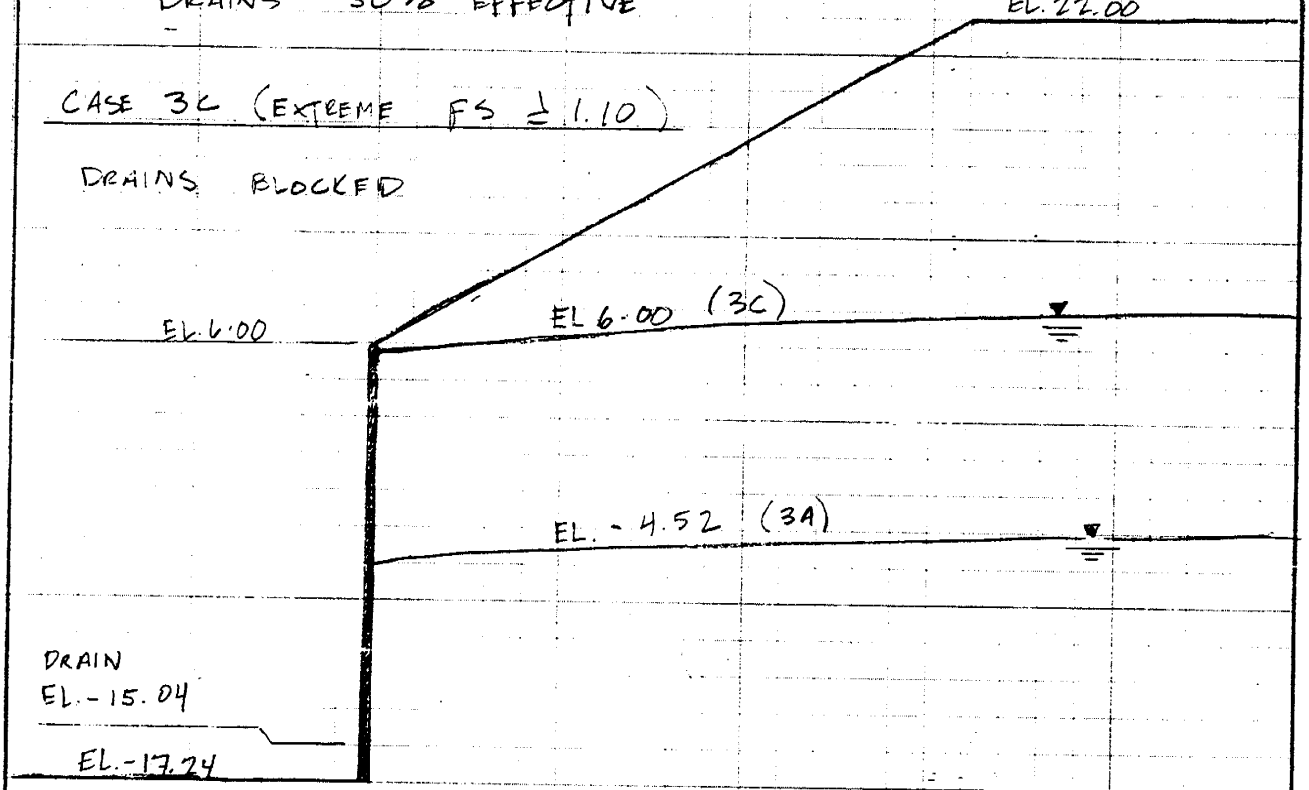
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DE DIEGO EXP. BRIDGE MOP. @ MAIN CHANNEL				

CASE 3A (USUAL FS ≥ 1.50)

DRAINS 50% EFFECTIVE

CASE 3C (EXTREME FS ≥ 1.10)

DRAINS BLOCKED



CASE 4A (EXTREME FS ≥ 1.10)

SAME AS CASE 3A WITH
A HORIZONTAL EARTHQUAKE COEFFICENT = 0.15

SAJ Form 1000
14 Mar 78

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**************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION     *
* DIVISION OF NEW TECHNOLOGY, MATERIALS& RESEARCH *
*       OFFICE OF GEOTECHNICAL ENGINEERING       *
* Reinforced Soil Systems & Earthquake Engineering*
*    Date: 06-30-1997          Time: 14:36:59     *
**************************************************
```

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	23.24 ft
Wall Batter	=	0.0 degrees
First Slope Angle-above the wall	=	26.6 degrees
First Slope Length from Wallcrest	=	32.10 ft
Second Slope Angle	=	0.0 degrees
Second Slope Length from 1st Slope	=	50.00 ft
Third Slope Angle	=	0.0 degrees
Third Slope Length from 2nd Slope	=	100.00 ft
Fourth Slope Angle	=	0.0 degrees

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

Allowable bond Stress, SIG2 = 6.90 psi

Coordinates of Two points Defining Boundary for soil 2

POINT	X-Direction	Y-Direction
1	XS1= 0.0 ft	YS1= 8.5 ft
2	XS2= 100.0 ft	YS2= 8.5 ft

C-5.29

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.15 (a/g)
Vertical Earthquake Coefficient = 0.00
Horiz. Force applied to the Wall = 0.0 Kips

--------- WATER SURFACE ---------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = 0.00 ft Y(1)-Coordinate = 12.72 ft
X(2)-Coordinate = 20.00 ft Y(2)-Coordinate = 13.00 ft
X(3)-Coordinate = 150.00 ft Y(3)-Coordinate = 14.00 ft

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 150.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 8
Horizontal Spacing = 5.00 ft
Diameter of Reinforcement Element = 0.00 in
Yield Stress of Reinforcement = 60.00 ksi
Diameter of Grouted Hole = 6.00 in
Punching Shear Capacity = 43.00 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (Inch)	Ultimate Bond Stress (psi)
1	50.0	15.0	2.0	1.00	20.8
2	50.0	15.0	3.0	1.00	20.8
3	50.0	15.0	3.0	1.00	20.8
4	50.0	15.0	3.0	1.00	2.8
5	50.0	15.0	3.0	1.00	2.8
6	50.0	15.0	3.0	1.00	6.9
7	50.0	15.0	3.0	1.00	6.9
8	50.0	15.0	3.0	1.00	6.9

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)

C-5-50

Toe	1.530	15.0	49.5	16.2	76.3	19.0

Reinf. Stress at Level
1 = 39.225 Ksi (Yield Stress controls.)
2 = 39.225 Ksi (Yield Stress controls.)
3 = 39.225 Ksi (Yield Stress controls.)
4 = 21.718 Ksi (Pullout controls...)
5 = 22.855 Ksi (Pullout controls...)
6 = 39.225 Ksi (Yield Stress controls.)
7 = 38.819 Ksi (Punching Shear controls..)
8 = 36.016 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	1.363	30.0	26.6	16.8	63.5	33.6

Reinf. Stress at Level
1 = 44.018 Ksi (Yield Stress controls.)
2 = 44.018 Ksi (Yield Stress controls.)
3 = 44.018 Ksi (Yield Stress controls.)
4 = 20.205 Ksi (Pullout controls...)
5 = 22.225 Ksi (Pullout controls...)
6 = 44.018 Ksi (Yield Stress controls.)
7 = 44.018 Ksi (Yield Stress controls.)
8 = 40.636 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.276	45.0	18.5	23.7	53.2	37.6

Reinf. Stress at Level
1 = 47.027 Ksi (Yield Stress controls.)
2 = 47.027 Ksi (Yield Stress controls.)
3 = 47.027 Ksi (Yield Stress controls.)
4 = 18.304 Ksi (Pullout controls...)
5 = 21.563 Ksi (Pullout controls...)
6 = 47.027 Ksi (Yield Stress controls.)
7 = 47.027 Ksi (Yield Stress controls.)
8 = 43.554 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.255	60.0	0.0	12.0	38.1	61.0

Reinf. Stress at Level
1 = 47.791 Ksi (Yield Stress controls.)
2 = 47.791 Ksi (Yield Stress controls.)
3 = 47.791 Ksi (Yield Stress controls.)
4 = 18.429 Ksi (Pullout controls...)
5 = 20.326 Ksi (Pullout controls...)
6 = 47.791 Ksi (Yield Stress controls.)
7 = 47.791 Ksi (Yield Stress controls.)
8 = 45.077 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.253	75.0	4.8	45.2	48.5	45.2

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 7.735 Ksi (Pullout controls...)
3 = 24.472 Ksi (Pullout controls...)
4 = 8.981 Ksi (Pullout controls...)
5 = 14.669 Ksi (Pullout controls...)
6 = 47.894 Ksi (Yield Stress controls.)
7 = 47.894 Ksi (Yield Stress controls.)
8 = 44.824 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.201	90.0	0.0	45.0	39.9	58.6

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 2.134 Ksi (Pullout controls...)
4 = 2.176 Ksi (Pullout controls...)
5 = 9.600 Ksi (Pullout controls...)
6 = 42.832 Ksi (Pullout controls...)
7 = 49.950 Ksi (Yield Stress controls.)
8 = 47.113 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 7	1.185	105.0	0.0	42.0	30.8	73.4

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 8.836 Ksi (Pullout controls...)
4 = 3.634 Ksi (Pullout controls...)
5 = 9.734 Ksi (Pullout controls...)
6 = 43.429 Ksi (Pullout controls...)
7 = 50.647 Ksi (Yield Stress controls.)
8 = 47.770 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 8	1.192	120.0	0.0	36.0	24.1	92.0

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 1.504 Ksi (Pullout controls...)
3 = 23.306 Ksi (Pullout controls...)
4 = 6.072 Ksi (Pullout controls...)
5 = 9.671 Ksi (Pullout controls...)
6 = 43.152 Ksi (Pullout controls...)
7 = 50.323 Ksi (Yield Stress controls.)
8 = 47.465 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 9	1.199	135.0	0.0	40.5	21.7	101.7

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 6.244 Ksi (Pullout controls...)
4 = 3.977 Ksi (Pullout controls...)
5 = 9.616 Ksi (Pullout controls...)
6 = 42.905 Ksi (Pullout controls...)
7 = 50.036 Ksi (Yield Stress controls.)
8 = 47.194 Ksi (Punching Shear controls..)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE10	1.231	150.0	0.0	45.0	19.7	111.5

Reinf. Stress at Level
1 = 0.000 Ksi
2 = 0.000 Ksi
3 = 0.000 Ksi
4 = 2.038 Ksi (Pullout controls...)
5 = 9.365 Ksi (Pullout controls...)
6 = 41.785 Ksi (Pullout controls...)
7 = 48.729 Ksi (Yield Stress controls.)
8 = 45.961 Ksi (Punching Shear controls..)

* FOLLOWING IS LOCATION WHERE MAX. REINFORCEMENT FORCE OCCURS *

LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)	DISTANCE BEHIND THE WALL TOE (ft)	FACTOR OF SAFETY F.S.
22.7	9.8	43.2	49.4	45.0	1.283

Maximum Average Reinforcement Working Force = 27.074 kips/level

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SEISMIC ANALYSIS

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CE DIEGO BRIDGE @ MAIN CHANNEL			

EQ. SPRING CONSTANT FOR NEOPRENE BEARING PAD

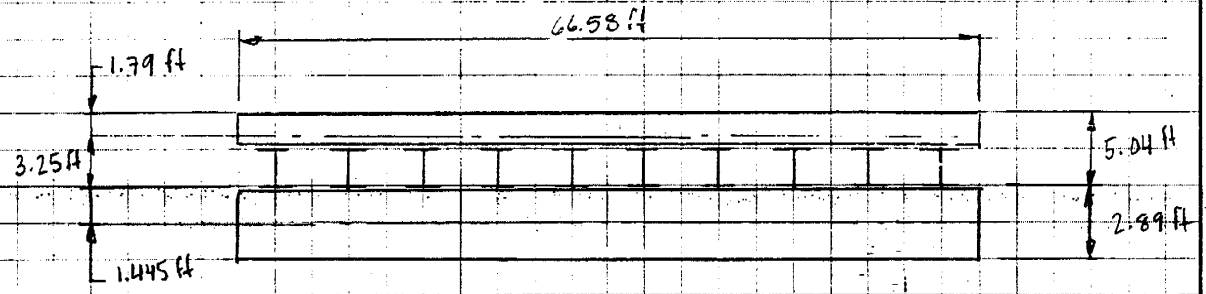
$$R = \frac{MLT\Delta}{E.R.T.} \quad \text{or} \quad F = k\Delta \quad \therefore \quad k = \frac{MLT}{E.R.T.}$$

M = SHEAR MODULUS = 110 psi
L = BEARING LENGTH = .26 in
T = BEARING WIDTH = 8 in
E.R.T. = EFF. RUBBER THK. = 1.125 in

$$k = \frac{(110)(.26)(8)}{1.125} = 20.338\ \#/in.$$

$$= 244\ k/ft$$

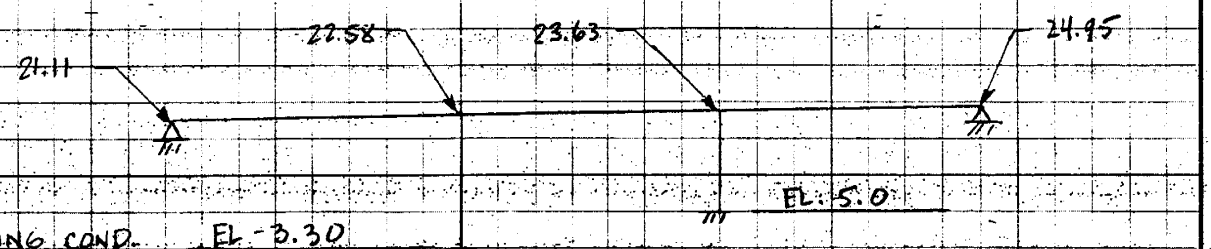
GEOMETRY OF PIER



$$\bar{y} = \frac{(66.58)(6.5/12)(4.77) + 10(5.47)(2.25)}{(66.58)(6.5/12) + 10(5.47)}$$

$$= 3.25\ ft$$

APPROX. TOP OF SLAB ELEV.



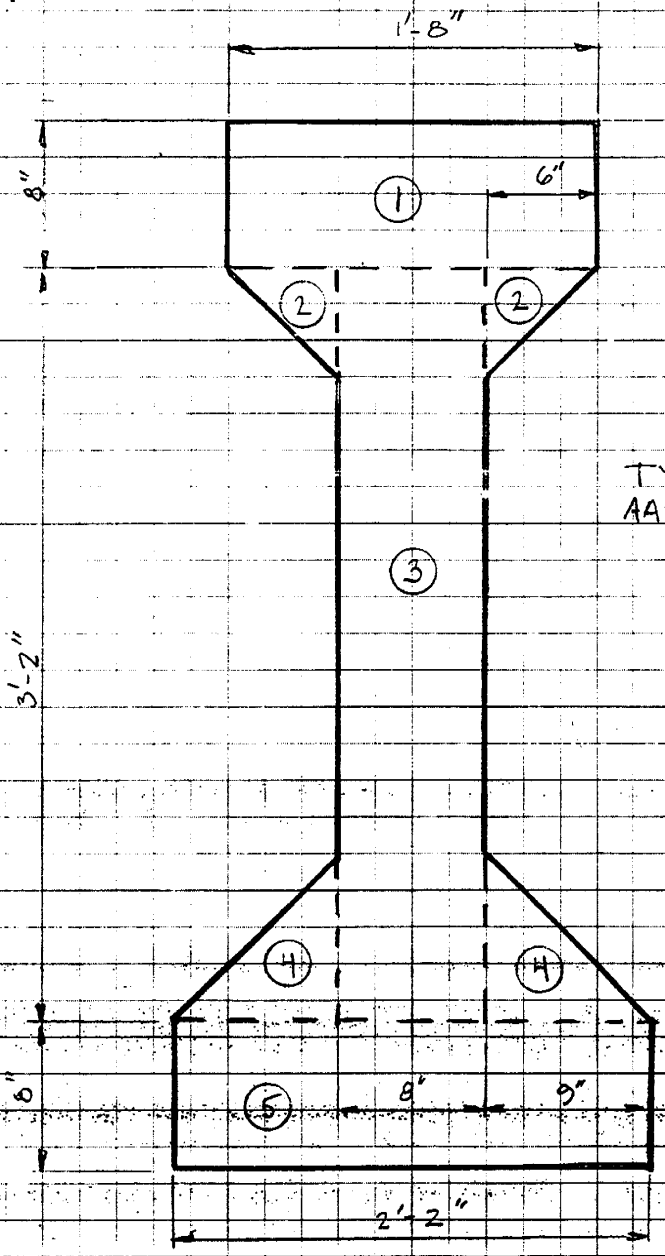
EXISTING COND. EL - 3.30

TOP	19.32	20.79	21.84	22.36
BEARING	-	17.54	18.59	-
CAP	-	16.10	17.15	-

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C-5-56

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DE DIEGO BRIDGE @ MAIN CHANNEL			



TYPE IV
AASHTO BEAM

TORSIONAL PROPERTIES (Ref. Salmon & Johnson, pp. 393-394)

(1) $b/t = 20/8 = 2.5$; $k_2 = 0.249$; $J = k_2 bt^3$

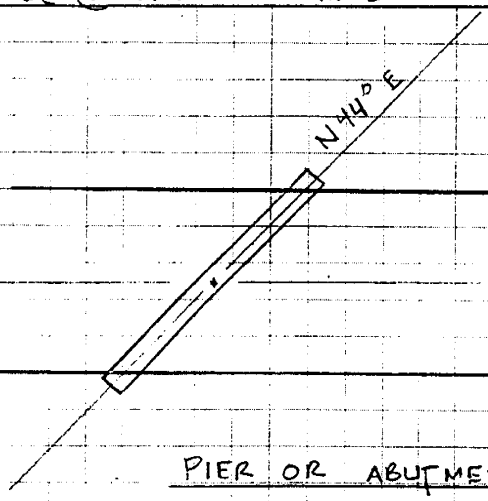
(2) $J = \sqrt{3}/80\ s^4$ (Ref Roark & Young, p. 291)

(3) $b/t = 38/8 = 4.75$; $k_2 = 0.2885$; $J = k_2 bt^3$

(4) $J = \sqrt{3}/80\ s^4$

(5) $b/t = 26/8 = 3.25$; $k_2 = 0.2675$; $J = k_2 bt^3$

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DE DIEGO BRIDGE @ MAIN CHANNEL			



N 90° E (PROGRAM DEFAULT)

PIER OR ABUTMENT CENTERLINE BEARING

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SUBJECT: PUE DIEGO BRIDGE @ MAIN CHANNEL | CHECKED BY: | DATE:

SUPERSTRUCTURE PARAMETERS

AREA = $10(5.47\ ft^2) + (66.58\ ft)(6.5''/12''/ft) = 90.76\ ft^2$

$I_{11} = (1/3)(66.58\ ft)(6.5/12)^3 + 10[(0.249)(1.67)(0.67)^3$
$+ (2)(0.0261)(0.5)^4 + (0.2885)(3.167)(0.67)^3$
$+ (2)(0.0261)(0.75)^4 + (0.2675)(2.167)(0.67)^3]$
$= 9.38\ ft^4$

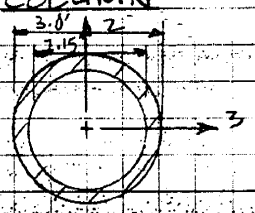
$I_{22} = (1/12)(6.5/12)(66.58)^3 + 10(0.876)$
$+ (5.47)(2)(1.75^2 + 5.25^2 + 8.83^2 + 12.33^2 + 15.83^2)$
$= 18,924\ ft^4$

$I_{33} = (1/12)(66.58)(6.5/12)^3 + (66.58)(6.5/12)(1.52)^2$
$+ 10\left(\frac{260,730}{12^4}\right) + 5.47(10)(1)^2$
$= 265\ ft^4$

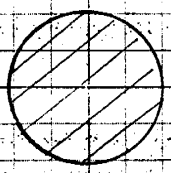
DENSITY (P) = 0.150 k/f

SUBSTRUCTURE PARAMETERS

COLUMN

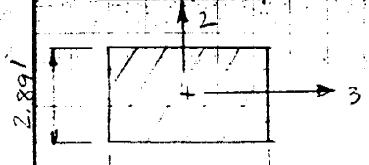


AREA = $3.44\ ft^2$
$I_{11} = 5.70\ ft^4$
$I_{22} = I_{33} = 2.85\ ft^4$



AREA = $7.07\ ft^2$
$I_{11} = 7.95\ ft^4$
$I_{22} = I_{33} = 3.98\ ft^4$

BENT CAP



$I_{33} = 9.11\ ft^4$

WEIGHT = $(4.53)(2.89)(94.75)(0.15) = 186.07^k$

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14 Mar 78

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**********************************
* CORPS PROGRAM  #  X0080       *  CPGA - CASE PILE GROUP ANALYSIS PROGRAM
* VERSION NUMBER # 1992/07/01   *  RUN DATE 20-AUG-1996   RUN TIME 14.44.15
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```

essentially same

DE DIEGO EXPRESSWAY BRIDGE ABUTMENT STIFFNESS
SEVENTEEN 12 INCH DIAMETER CONCRETE PILES
TOP ELEVATION = 4.04 WITH LENGTH OF 65 FT
PHI=1.0 14.00"OD PILE PCR=279K 05/25/94

K_x = 226.1 k/in Transv.

K_y = 503.28 k/in. Clong

THERE ARE 34 PILES AND
           5 LOAD CASES IN THIS RUN.

ALL PILE COORDINATES ARE CONTAINED WITHIN A BOX

	X	Y	Z
WITH DIAGONAL COORDINATES = (	-47.17 ,	-19.55 ,	.00)
(	54.88 ,	7.53 ,	4.00)

****

PILE PROPERTIES AS INPUT

E	I1	I2	A	C33	B66
KSI	IN**4	IN**4	IN**2		
.30000E+04	.10180E+04	.10180E+04	.11310E+03	.10000E+01	.00000E+00

THESE PILE PROPERTIES APPLY TO THE FOLLOWING PILES -

ALL

****

SOIL DESCRIPTIONS AS INPUT

ES	ESOIL	LENGTH	L	LU
	K/IN**2		FT	FT
	.55000E-01	L	.65000E+02	.00000E+00

THIS SOIL DESCRIPTION APPLIES TO THE FOLLOWING PILES -

ALL

****

PILE GEOMETRY AS INPUT AND/OR GENERATED

NUM	X	Y	Z	BATTER	ANGLE	LENGTH	FIXITY

	FT	FT	FT			FT	
1	-47.17	-1.15	4.00	V	.00	65.00	F
2	-42.25	-1.14	4.00	3.00	90.00	65.00	F
3	-37.55	.00	4.00	V	.00	65.00	F
4	-32.86	-1.15	4.00	3.00	90.00	65.00	F
5	-28.16	.00	4.00	V	.00	65.00	F
6	-23.47	-1.15	4.00	3.00	90.00	65.00	F
7	-18.77	.00	4.00	V	.00	65.00	F
8	-14.82	-1.15	4.00	3.00	90.00	65.00	F
9	-9.39	.00	4.00	V	.00	65.00	F
10	-4.78	-1.15	4.00	3.00	90.00	65.00	F
11	.00	.00	4.00	V	.00	65.00	F
12	4.69	-1.15	4.00	3.00	90.00	65.00	F
13	9.39	.00	4.00	V	.00	65.00	F
14	14.82	-1.15	.00	3.00	90.00	65.00	F
15	18.76	.00	4.00	V	.00	65.00	F
16	23.47	-1.15	4.00	3.00	90.00	65.00	F
17	28.16	.00	4.00	V	.00	65.00	F
18	32.86	-1.15	4.00	3.00	90.00	65.00	F
19	37.42	.00	4.00	V	.00	65.00	F
20	38.80	-7.97	4.00	V	.00	65.00	F
21	-37.50	-7.54	4.00	V	.00	65.00	F
22	-28.16	~~-7.53~~ chgd	4.00	V	.00	65.00	F
23	-18.78	7.53 to	4.00	V	.00	65.00	F
24	-9.39	~~-7.53~~ -7.53	4.00	V	.00	65.00	F
25	.00	~~-7.53~~	4.00	V	.00	65.00	F
26	9.39	7.53	4.00	V	.00	65.00	F
27	18.78	~~-7.53~~	4.00	V	.00	65.00	F
28	28.16	-7.53	4.00	V	.00	65.00	F
29	37.42	-7.53	4.00	V	.00	65.00	F
30	43.89	-5.17	4.00	V	.00	65.00	F
31	44.50	-12.94	4.00	V	.00	65.00	F
32	48.99	-10.34	4.00	V	.00	65.00	F
33	50.49	-19.55	4.00	V	.00	65.00	F
34	54.88	-15.51	.00	V	.00	65.00	F
						2210.00	

****

APPLIED LOADS

LOAD CASE	PX K	PY K	PZ K	MX FT-K	MY FT-K	MZ FT-K	OVERSTRESS COM	OVERSTRESS TEN
1	100.0	.0	.0	.0	.0	.0	1.25	1.25
2	.0	100.0	.0	.0	.0	.0	1.25	1.25
3	.0	.0	100.0	.0	.0	.0	1.25	1.25
4	.0	.0	.0	100.0	.0	.0	1.25	1.25
5	.0	.0	.0	.0	100.0	.0	1.25	1.25

****

ORIGINAL PILE GROUP STIFFNESS MATRIX

.22829E+03	-.16849E-04	-.50547E-04	.14158E-02	.24059E+05	.85530E+04
-.16849E-04	.61375E+03	.11564E+04	-.56447E+05	.65281E+05	-.63050E+04
-.50547E-04	.11564E+04	.14405E+05	-.67255E+06	-.10231E+07	-.65281E+05
.14158E-02	-.56447E+05	-.67255E+06	.10013E+09	.21504E+09	.87679E+06
.24059E+05	.65281E+05	-.10231E+07	.21504E+09	.19537E+10	-.10152E+09
.85530E+04	-.63050E+04	-.65281E+05	.87679E+06	-.10152E+09	.66212E+08

LOAD CASE 1. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 15.

LOAD CASE 2. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 25.

LOAD CASE 3. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 2.

LOAD CASE 4. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 16.

LOAD CASE 5. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 21.

****

PILE CAP DISPLACEMENTS

LOAD CASE	DX IN	DY IN	DZ IN	RX RAD	RY RAD	RZ RAD
1	.4423E+00	.3622E-02	-.1994E-03	.2902E-04	-.1287E-04	-.7711E-04
2	.3622E-02	.1987E+00	-.1483E-01	.6191E-04	-.2294E-04	-.3216E-04
3	-.1994E-03	-.1483E-01	.1136E-01	.6964E-04	-.8212E-06	.7633E-05
4	.3483E-03	.7429E-03	.8357E-03	.2290E-04	-.2265E-05	-.2926E-05
5	-.1545E-03	-.2752E-03	-.9854E-05	-.2265E-05	.9455E-06	.1464E-05

****

PILE FORCES IN LOCAL GEOMETRY

M1 & M2 NOT AT PILE HEAD FOR PINNED PILES
* INDICATES PILE FAILURE
# INDICATES CBF BASED ON MOMENTS DUE TO (F3*EMIN) FOR CONCRETE PILES
B INDICATES BUCKLING CONTROLS

$K_x = 100\ k/.4423''$
$= 226.1\ k/in$

$K_y = 100\ k/.1987$
$= 503.28\ k/in$

LOAD CASE - 1

PILE	F1 K	F2 K	F3 K	M1 IN-K	M2 IN-K	M3 IN-K	ALF	CBF		
1	3.0	.3	-3.4	-17.3	179.9	.0	.02	.84	.00	.00

PROJECT	Page — of —	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

Pile #	X	Y	Z
1	-47.17	-1.148	4.04
2	-42.296	-1.148	4.04
3	-37.552	0.0	4.04
4	-32.858	-1.148	4.04
5	-28.164	0.0	4.04
	-23.470	-1.148	4.04
6			
7	-18.776	0.0	4.04
8	-14.82	-1.148	4.04
9	-9.388	0.0	4.04
10	-4.694	-1.148	4.04
11	0.0	0.0	4.04
12	4.694	-1.148	4.04
13	9.388	0.0	4.04
14	14.82	-1.148	4.04
15	18.776	0.0	4.04
16	23.470	-1.148	4.04
17	28.164	0.0	4.04
18	32.858	-1.148	4.04
19	37.416	0.0	4.04
20	38.796	-7.967	4.04
21	-37.552	-7.53	
22	-28.164	-7.53	
23	-18.776	-7.53	
24	-9.388	-7.53	
25	0.0	-7.53	
26	9.388	-7.53	
27	18.776	-7.53	
28	28.164	-7.53	
29	37.416	-7.53	
30	43.842	-5.17	
31	44.50	-12.98	
32	48.99	-10.34	
33	50.491	-12.55	
34	54.88	-15.51	

PROJECT	Page __ of __	COMPUTED BY	DATE
SUBJECT		CHECKED BY	DATE

E_s Soil $\cong$ 48 q_u

$= 48\ (3520)$

$= 168960$

$C = 1760$ psf

$\frac{1760}{1000}$ 55.55 pci

$q_u = 2C$

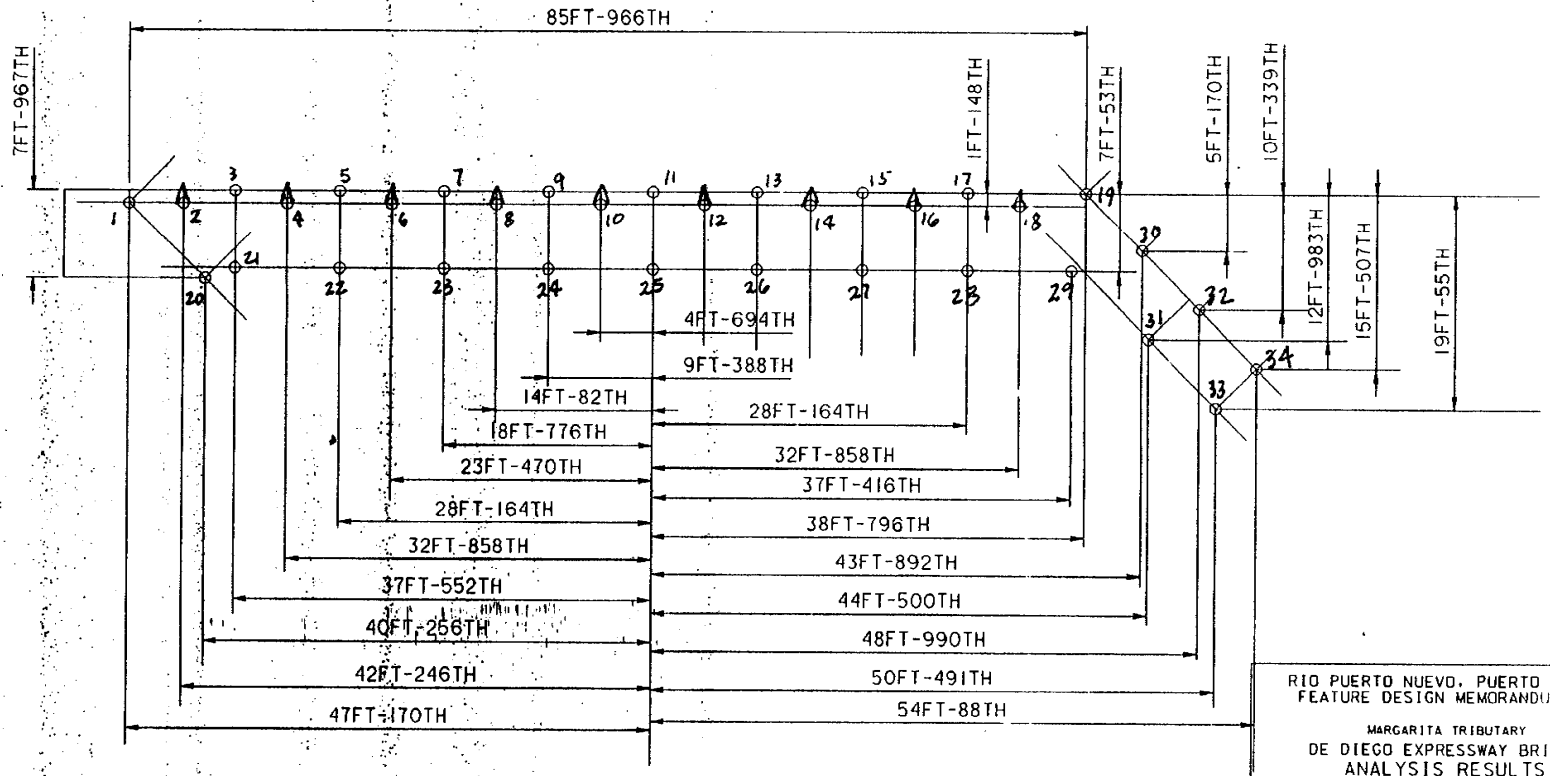
$2(1760) = 3520$ psf

$E_s = \frac{48\ (2000)}{1728} = 55.6$ pci

$C = 1000$

$q_u = 2000$

○ 0.0 55.6



ABUTMENT PILE LAYOUT

12" DIA PILE LAYOUT

DESIGN ENG.: HEW	
DWN. BY: HEW	CKD. BY: XXX

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

MARGARITA TRIBUTARY
DE DIEGO EXPRESSWAY BRIDGE
ANALYSIS RESULTS

STRUCTURAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
D.O. FILE NO. 102-36.XXX NOVEMBER 1997

PLATE S-X

DGOFDN.DGN

SSDDMC.IN

```
C       ****************************************

        SEISAB BLOCK
C
C       ****************************************
C
        SEISAB "DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION"  W/ CHANNEL IMPROV.
        RESPONSE SPECTRUM ANALYSIS
        SUPERSTRUCTURE JOINTS 3
        COLUMN JOINTS 2
C       ****************************************
C
C       ALIGNMENT BLOCK
C
C       ****************************************
C
        ALIGNMENT
        COORDINATES  N 0 E 0.
        STATION   0 + 00.00
        BEARING N 90 0 0 E
C       ****************************************
C
C       SPAN BLOCK
C
C       ****************************************
C
        SPANS
        LENGTHS  98.0 98.0 98.0
        AREAS   90.76
        I11     9.38
        I22     18924
        I33     265
        DENSITY  0.150
        WEIGHT   0.950  $ 15 psf future wearing
        E       519120. $ f'c = 4000 psi
        ****************************************

C       DESCRIBE BLOCK
C
C       ****************************************
C
        DESCRIBE
        COLUMN 'ROUND'
        LENGTHS 0.00  2.64
        AREAS   3.44  7.07
        I11     5.70  7.95
        I22     2.85  3.98
        I33     2.85  3.98
        DENSITY 0.15  0.15
        E       686731.   686731. $ f'c = 7000 psi
C
        SPECIAL CAP 'DROPCAP'
        I33     9.11
        DENSITY 0.15
        E      449571.  $ f'c = 3000 psi C
C
        BEARING ELEMENT 'EXP'
        KF1F1   244.05
        KF2F2   1.0E10
        KF3F3   1.0E10

        BEARING ELEMENT 'FIX'
        KF1F1   1.0E10
        KF2F2   1.0E10
        KF3F3   1.0E10

C
C       ****************************************
C
        ABUTMENT BLOCK
```

```
C       ******************************************

        ABUTMENT STATION  0 + 00.00
        BEARING  N 44 0 0 E
        ELEVATION TOP 19.32 AT ABUTMENT 1
        ELEVATION TOP 23.16 AT ABUTMENT 4
CONN BEAR ELEM SKEW LAYOUT 'FIX' 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 -
'FIX' AT ABUT 1 4
C ******************************************
C
C       BENT  BLOCK
C
C ******************************************
        BENT
        BEARING N 44 0 0 E
        ELEV TOP         20.79 21.84 $ ELEV AT C.G. SUPERSTRUC
        ELEV BEARING     17.54 18.59 $ ELEV AT TOP OF CAP (BEARING)
        ELEV CAP    16.10 17.15 $ ELEV AT C.G. BENT CAP
        ELEV BOT   -31.28 -31.28 $ ELEV AT POINT OF FIXITY
        WEIGHT  186.07
        COLUMN SKEWED LAYOUT 'ROUND' 12.63 12.63 12.63 12.63 12.63 12.63 -
        12.63 'ROUND' AT BENT 2 3
        SPECIAL CAP 'DROPCAP' AT BENT 2 3
CONN JOINT BEAR ELEM BACK SKEW LAYOUT 'EXP' 10.0 10.0 10.0 10.0 10.0 10.0 -
10.0 10.0 10.0 'EXP' AT BENT 2
CONN JOINT BEAR ELEM FORE SKEW LAYOUT 'EXP' 10.0 10.0 10.0 10.0 10.0 10.0 -
10.0 10.0 10.0 'EXP' AT BENT 2
CONN JOINT BEAR ELEM BACK SKEW LAYOUT 'FIX' 10.0 10.0 10.0 10.0 10.0 10.0 -
10.0 10.0 10.0 'FIX' AT BENT 3
CONN JOINT BEAR ELEM FORE SKEW LAYOUT 'EXP' 10.0 10.0 10.0 10.0 10.0 10.0 -
10.0 10.0 10.0 'EXP' AT BENT 3
COLUMN TOP END JOINT SIZE 1.45  AT BENT 2 3 $ TOP OF COL TO C.G. BENT CAP
C ******************************************
C
C       FOUNDATION  BLOCK

  ******************************************
C
        FOUNDATION
        AT ABUTMENT 1 4
        SPRING CONSTANTS
        KF1F1    6039
        KF3F3    2713

C ****************************************** C
C       LOAD BLOCK
C
C ******************************************
        LOAD
        RESPONSE SPECTRUM
        MODE SHAPES 9
        ATC6 CURVE
        SOIL TYPE III
        ACC COE 0.2
C
 FINISH
```

SSDDMC.OUT

- - - - S E I S A B - - - - (Version 4.1.12) 11-JUL-97
Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION W/ CHANNEL IMPROV.

RESPONSE SPECTRUM RESULTS

ABUTMENT CQC DISPLACEMENTS

ITEM		LC	....LEFT FACE.... LNGTUDNL	TRNSVRSE	....RGHT FACE.... LNGTUDNL	TRNSVRSE	...OPNNG/CLSNG... LNGTUDNL	TRNSVRSE
ABU	1	1	0.124	0.061	0.124	0.061	0.000	0.000
		2	0.071	0.185	0.071	0.185	0.000	0.000
		3	0.145	0.117	0.145	0.117	0.000	0.000
		4	0.108	0.204	0.108	0.204	0.000	0.000
ABU	4	1	0.177	0.066	0.177	0.066	0.000	0.000
		2	0.073	0.185	0.073	0.185	0.000	0.000
		3	0.199	0.121	0.199	0.121	0.000	0.000
		4	0.126	0.205	0.126	0.205	0.000	0.000

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

- - - - S E I S A B - - - - (Version 4.1.12) 11-JUL-97
Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

RESPONSE SPECTRUM RESULTS

BENT CQC DISPLACEMENTS

ITEM	LC	....LEFT FACE.... LNGTUDNL	TRNSVRSE	....RGHT FACE.... LNGTUDNL	TRNSVRSE	...OPNNG/CLSNG... LNGTUDNL	TRNSVRSE
B 2 J1	1	0.125	0.061	0.167	0.061	0.067	0.000
	2	0.070	0.192	0.063	0.192	0.087	0.000
	3	0.146	0.119	0.186	0.119	0.093	0.000
	4	0.108	0.211	0.113	0.211	0.107	0.000
B 2 J2	1	0.167	0.061	0.279	0.061	0.117	0.000
	2	0.063	0.192	0.112	0.192	0.054	0.000
	3	0.186	0.119	0.312	0.119	0.133	0.000
	4	0.113	0.211	0.196	0.211	0.089	0.000
B 3 J1	1	0.278	0.063	0.278	0.063	0.000	0.000
	2	0.112	0.193	0.112	0.193	0.000	0.000
	3	0.311	0.121	0.311	0.121	0.000	0.000
	4	0.195	0.211	0.195	0.211	0.000	0.000
B 3 J2	1	0.278	0.063	0.179	0.063	0.117	0.000
	2	0.112	0.193	0.072	0.193	0.108	0.000
	3	0.311	0.121	0.201	0.121	0.149	0.000
	4	0.195	0.211	0.126	0.211	0.143	0.000

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

C-5-70

- - - - S E I S A B - - - - (Version 4.1.12) 11-JUL-97
Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

RESPONSE SPECTRUM RESULTS

CQC COLUMN FORCES

CL	LOC	LC	....LNGITUDNL.... SHEAR	MOMENT	....TRANSVRSE.... SHEAR	MOMENT	AXIAL	TORSION
BNT	2							
	1 BOT	1	6.3	270.	33.0	769.	91.9	2.3
		2	10.1	424.	28.9	673.	80.3	2.7
		3	9.3	397.	41.7	971.	116.0	3.1
		4	12.0	505.	38.8	904.	107.9	3.4
	1 TOP	1	5.2	17.	31.0	708.	91.9	2.3
		2	8.5	12.	27.1	618.	80.3	2.7
		3	7.8	20.	39.1	894.	116.0	3.1
		4	10.0	17.	36.4	831.	107.9	3.4
	2 BOT	1	6.2	268.	36.4	822.	23.2	2.3
		2	9.9	419.	31.8	719.	21.1	2.7
		3	9.2	394.	45.9	1038.	29.6	3.1
		4	11.7	500.	42.7	966.	28.1	3.4
	2 TOP	1	5.2	13.	34.3	809.	23.2	2.3
		2	8.2	7.	29.9	706.	21.1	2.7
		3	7.7	15.	43.3	1021.	29.6	3.1
		4	9.8	11.	40.2	949.	28.1	3.4
	3 BOT	1	6.1	267.	36.7	828.	8.2	2.3
		2	9.6	414.	32.2	725.	7.9	2.7
		3	9.0	391.	46.4	1045.	10.5	3.1
		4	11.5	494.	43.2	974.	10.3	3.4
	3 TOP	1	5.1	9.	34.7	819.	8.2	2.3
		2	8.0	4.	30.3	718.	7.9	2.7
		3	7.5	11.	43.8	1035.	10.5	3.1
		4	9.6	7.	40.7	963.	10.3	3.4
	4 BOT	1	6.1	266.	36.1	818.	44.3	2.3
		2	9.4	409.	31.9	720.	59.5	2.7
		3	8.9	388.	45.7	1034.	62.2	3.1
		4	11.2	489.	42.8	966.	72.8	3.4

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

- - - - S E I S A B - - - - (Version 4.1.12) 11-JUL-97
Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

RESPONSE SPECTRUM RESULTS

CQC COLUMN FORCES (CONTINUED)

CL	LOC	LC	....LNGITUDNL.... SHEAR	MOMENT	....TRANSVRSE.... SHEAR	MOMENT	AXIAL	TORSION
BNT	2	(CONTINUED)						
COLUMN	4	(CONTINUED)						
4	TOP	1	5.1	7.	34.1	801.	44.3	2.3
		2	7.8	7.	30.0	709.	59.5	2.7
		3	7.4	9.	43.1	1014.	62.2	3.1
		4	9.3	9.	40.2	949.	72.8	3.4
5	BOT	1	6.0	264.	36.5	823.	64.0	2.3
		2	9.2	404.	31.6	716.	40.6	2.7
		3	8.8	385.	45.9	1038.	76.1	3.1
		4	11.0	483.	42.5	963.	59.7	3.4
5	TOP	1	5.0	7.	34.4	811.	64.0	2.3
		2	7.6	12.	29.7	699.	40.5	2.7
		3	7.3	11.	43.3	1021.	76.1	3.1
		4	9.1	14.	40.0	943.	59.7	3.4
6	BOT	1	6.0	263.	36.8	829.	8.4	2.3
		2	8.9	399.	32.2	724.	7.7	2.7
		3	8.6	383.	46.4	1046.	10.7	3.1
		4	10.7	478.	43.2	973.	10.2	3.4
6	TOP	1	5.0	10.	34.7	821.	8.4	2.3
		2	7.4	17.	30.2	716.	7.7	2.7
		3	7.2	15.	43.8	1036.	10.7	3.1
		4	8.9	20.	40.7	962.	10.2	3.4
7	BOT	1	5.9	262.	36.4	822.	24.0	2.3
		2	8.7	394.	31.8	719.	20.4	2.7
		3	8.5	380.	45.9	1038.	30.1	3.1
		4	10.5	472.	42.8	966.	27.6	3.4
7	TOP	1	4.9	14.	34.3	808.	24.0	2.3
		2	7.2	23.	29.9	706.	20.4	2.7
		3	7.1	21.	43.3	1020.	30.1	3.1
		4	8.7	27.	40.2	949.	27.6	3.4

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

- - - - S E I S A B - - - - (Version 4.1.12) 11-JUL-97
Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

RESPONSE SPECTRUM RESULTS

CQC COLUMN FORCES (CONTINUED)

CL	LOC	LC	....LNGITUDNL.... SHEAR	MOMENT	....TRANSVRSE.... SHEAR	MOMENT	AXIAL	TORSION
BNT	2	(CONTINUED)						
	8 BOT	1	5.9	261.	33.0	769.	92.0	2.3
		2	8.5	389.	28.9	673.	80.3	2.7
		3	8.4	377.	41.6	971.	116.1	3.1
		4	10.3	467.	38.8	904.	107.9	3.4
	8 TOP	1	4.9	18.	31.0	708.	92.0	2.3
		2	7.0	28.	27.1	618.	80.3	2.7
		3	7.0	26.	39.1	893.	116.0	3.1
		4	8.4	34.	36.4	831.	107.8	3.4
BNT	3							
	1 BOT	1	9.5	431.	47.3	1125.	133.9	2.3
		2	9.6	444.	26.0	618.	73.4	3.0
		3	12.4	564.	55.0	1311.	155.9	3.2
		4	12.5	573.	40.1	956.	113.5	3.7
	1 TOP	1	7.8	23.	44.2	1034.	133.8	2.3
		2	7.8	30.	24.2	567.	73.4	3.0
		3	10.2	32.	51.4	1204.	155.8	3.2
		4	10.1	37.	37.5	877.	113.5	3.7
	2 BOT	1	9.6	433.	52.0	1201.	34.8	2.3
		2	9.9	449.	28.6	660.	18.0	3.0
		3	12.5	568.	60.6	1399.	40.2	3.2
		4	12.7	579.	44.2	1020.	28.5	3.7
	2 TOP	1	7.9	19.	48.8	1178.	34.8	2.3
		2	8.0	24.	26.7	646.	18.0	3.0
		3	10.3	26.	56.8	1372.	40.2	3.2
		4	10.3	30.	41.4	1000.	28.5	3.7
	3 BOT	1	9.7	435.	52.6	1211.	12.2	2.3
		2	10.1	455.	28.8	663.	5.4	3.0
		3	12.7	572.	61.3	1410.	13.8	3.2
		4	13.0	585.	44.6	1027.	9.1	3.7

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

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Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

RESPONSE SPECTRUM RESULTS

CQC COLUMN FORCES (CONTINUED)

CL	LOC	LC	....LNGITUDNL.... SHEAR	MOMENT	....TRANSVRSE.... SHEAR	MOMENT	AXIAL	TORSION
BNT	3	(CONTINUED)						
COLUMN	3	(CONTINUED)						
3	TOP	1	8.0	15.	49.4	1197.	12.2	2.3
		2	8.2	18.	27.0	653.	5.4	3.0
		3	10.5	21.	57.5	1393.	13.8	3.2
		4	10.6	23.	41.8	1012.	9.1	3.7
4	BOT	1	9.7	438.	52.2	1204.	94.7	2.3
		2	10.3	460.	28.3	655.	32.4	3.0
		3	12.8	576.	60.7	1400.	104.4	3.2
		4	13.2	591.	43.9	1016.	60.8	3.7
4	TOP	1	8.1	12.	49.0	1183.	94.6	2.3
		2	8.4	12.	26.5	638.	32.3	3.0
		3	10.6	16.	56.9	1375.	104.3	3.2
		4	10.8	16.	41.1	993.	60.7	3.7
5	BOT	1	9.8	440.	51.6	1195.	60.0	2.3
		2	10.6	465.	28.7	662.	52.5	3.0
		3	13.0	579.	60.2	1394.	75.7	3.2
		4	13.5	597.	44.2	1020.	70.5	3.7
5	TOP	1	8.2	9.	48.4	1167.	60.0	2.3
		2	8.6	7.	26.9	651.	52.5	3.0
		3	10.8	11.	56.5	1362.	75.7	3.2
		4	11.1	10.	41.4	1001.	70.5	3.7
6	BOT	1	9.9	442.	52.5	1210.	11.7	2.3
		2	10.8	471.	28.9	665.	5.7	3.0
		3	13.2	583.	61.2	1409.	13.4	3.2
		4	13.8	603.	44.6	1027.	9.2	3.7
6	TOP	1	8.3	9.	49.3	1194.	11.7	2.3
		2	8.8	4.	27.0	656.	5.7	3.0
		3	10.9	10.	57.4	1391.	13.4	3.2
		4	11.3	6.	41.8	1014.	9.2	3.7

M = 1525 (GOVERNS)
V = 63

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

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Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

RESPONSE SPECTRUM RESULTS

CQC COLUMN FORCES (CONTINUED)

CL	LOC	LC	....LNGITUDNL.... SHEAR	MOMENT	....TRANSVRSE.... SHEAR	MOMENT	AXIAL	TORSION
BNT	3	(CONTINUED)						
7	BOT	1	10.0	444.	52.0	1202.	33.4	2.3
		2	11.0	476.	28.6	659.	19.1	3.0
		3	13.3	587.	60.6	1399.	39.2	3.2
		4	14.0	609.	44.2	1020.	29.1	3.7
7	TOP	1	8.4	10.	48.8	1179.	33.4	2.3
		2	9.1	7.	26.7	646.	19.1	3.0
		3	11.1	12.	56.8	1373.	39.2	3.2
		4	11.6	10.	41.4	1000.	29.1	3.7
8	BOT	1	10.1	446.	47.3	1126.	133.8	2.3
		2	11.3	482.	26.0	618.	73.4	3.0
		3	13.5	591.	55.1	1311.	155.8	3.2
		4	14.3	616.	40.1	955.	113.6	3.7
8	TOP	1	8.5	13.	44.2	1034.	133.8	2.3
		2	9.3	13.	24.2	567.	73.4	3.0
		3	11.3	17.	51.5	1205.	155.8	3.2
		4	11.8	17.	37.5	877.	113.5	3.7

M = 1517

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

C-5-75

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Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

RESPONSE SPECTRUM RESULTS

ABUTMENT CQC FORCES

ITEM	LC	VERT SHEAR	W/R TO BRIDGE C.L. LONGITUDNL	W/R TO BRIDGE C.L. TRANSVERSE	W/R TO ITEM C.L. NORMAL	W/R TO ITEM C.L. PARALLEL
ABU 1	1	9.4	488.6	205.3	420.3	322.8
	2	13.5	196.8	709.5	561.2	476.6
	3	13.5	547.6	418.2	588.7	465.8
	4	16.4	343.3	771.1	687.3	573.4
ABU 4	1	30.9	711.1	215.6	601.5	436.2
	2	30.9	302.2	739.8	660.9	449.3
	3	40.1	801.7	437.6	799.8	571.0
	4	40.1	515.5	804.5	841.3	580.2

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

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Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

RESPONSE SPECTRUM RESULTS

ABUTMENT BEARING CQC FORCES

BRNG	LC	KF1F1	KF2F2	KF3F3	KM1M1	KM2M2	KM3M3
ABT	1						
1	1	84.1	1.5	66.9	0.0	0.0	0.0
	2	137.2	2.8	194.5	0.0	0.0	0.0
	3	125.2	2.4	125.2	0.0	0.0	0.0
	4	162.4	3.2	214.5	0.0	0.0	0.0
2	1	74.8	1.3	56.3	0.0	0.0	0.0
	2	109.0	2.0	167.0	0.0	0.0	0.0
	3	107.5	1.9	106.4	0.0	0.0	0.0
	4	131.4	2.4	183.9	0.0	0.0	0.0
3	1	66.2	1.1	45.9	0.0	0.0	0.0
	2	81.0	1.3	139.5	0.0	0.0	0.0
	3	90.5	1.5	87.7	0.0	0.0	0.0
	4	100.9	1.7	153.3	0.0	0.0	0.0
4	1	58.3	1.0	35.5	0.0	0.0	0.0
	2	53.7	0.9	112.1	0.0	0.0	0.0
	3	74.4	1.2	69.1	0.0	0.0	0.0
	4	71.1	1.2	122.7	0.0	0.0	0.0
5	1	51.6	0.9	25.4	0.0	0.0	0.0
	2	28.5	1.1	84.6	0.0	0.0	0.0
	3	60.2	1.2	50.8	0.0	0.0	0.0
	4	44.0	1.4	92.2	0.0	0.0	0.0
6	1	46.6	1.0	16.0	0.0	0.0	0.0
	2	19.2	1.7	57.3	0.0	0.0	0.0
	3	52.4	1.5	33.2	0.0	0.0	0.0
	4	33.1	2.0	62.1	0.0	0.0	0.0
7	1	43.9	1.1	10.0	0.0	0.0	0.0
	2	39.3	2.4	30.2	0.0	0.0	0.0
	3	55.7	1.9	19.0	0.0	0.0	0.0
	4	52.5	2.8	33.2	0.0	0.0	0.0

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

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Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

ABUTMENT BEARING CQC FORCES (CONTINUED)

BRNG	LC	KF1F1	KF2F2	KF3F3	KM1M1	KM2M2	KM3M3
ABT 1	(CONTINUED)						
8	1	43.9	1.3	13.1	0.0	0.0	0.0
	2	65.9	3.2	7.4	0.0	0.0	0.0
	3	63.7	2.3	15.3	0.0	0.0	0.0
	4	79.1	3.6	11.4	0.0	0.0	0.0
9	1	46.7	1.6	21.7	0.0	0.0	0.0
	2	93.6	4.0	26.7	0.0	0.0	0.0
	3	74.8	2.8	29.7	0.0	0.0	0.0
	4	107.6	4.5	33.2	0.0	0.0	0.0
10	1	51.7	1.9	31.6	0.0	0.0	0.0
	2	121.7	4.8	53.7	0.0	0.0	0.0
	3	88.2	3.3	47.7	0.0	0.0	0.0
	4	137.2	5.4	63.1	0.0	0.0	0.0
ABT 4							
1	1	43.6	2.4	41.7	0.0	0.0	0.0
	2	124.1	1.9	62.9	0.0	0.0	0.0
	3	80.8	3.0	60.6	0.0	0.0	0.0
	4	137.2	2.6	75.4	0.0	0.0	0.0
2	1	44.3	2.5	29.4	0.0	0.0	0.0
	2	93.6	1.6	33.2	0.0	0.0	0.0
	3	72.4	3.0	39.3	0.0	0.0	0.0
	4	106.9	2.3	42.0	0.0	0.0	0.0
3	1	48.9	2.6	18.1	0.0	0.0	0.0
	2	63.8	1.7	8.1	0.0	0.0	0.0
	3	68.1	3.1	20.5	0.0	0.0	0.0
	4	78.5	2.5	13.5	0.0	0.0	0.0
4	1	56.5	2.8	11.3	0.0	0.0	0.0
	2	36.6	2.1	29.3	0.0	0.0	0.0
	3	67.4	3.4	20.1	0.0	0.0	0.0
	4	53.5	2.9	32.7	0.0	0.0	0.0

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

ABUTMENT BEARING CQC FORCES (CONTINUED)

BRNG	LC	KF1F1	KF2F2	KF3F3	KM1M1	KM2M2	KM3M3
ABT	4	(CONTINUED)					
5	1	65.9	3.0	16.4	0.0	0.0	0.0
	2	23.8	2.7	59.0	0.0	0.0	0.0
	3	73.0	3.8	34.1	0.0	0.0	0.0
	4	43.5	3.6	63.9	0.0	0.0	0.0
6	1	76.5	3.2	27.3	0.0	0.0	0.0
	2	41.8	3.4	89.0	0.0	0.0	0.0
	3	89.1	4.2	54.0	0.0	0.0	0.0
	4	64.8	4.4	97.2	0.0	0.0	0.0
7	1	88.0	3.5	39.5	0.0	0.0	0.0
	2	70.0	4.2	119.2	0.0	0.0	0.0
	3	109.0	4.7	75.3	0.0	0.0	0.0
	4	96.4	5.2	131.0	0.0	0.0	0.0
8	1	99.9	3.7	52.1	0.0	0.0	0.0
	2	100.0	5.0	149.3	0.0	0.0	0.0
	3	129.9	5.2	96.9	0.0	0.0	0.0
	4	130.0	6.1	165.0	0.0	0.0	0.0
9	1	112.2	4.0	64.9	0.0	0.0	0.0
	2	130.6	5.8	179.5	0.0	0.0	0.0
	3	151.4	5.8	118.7	0.0	0.0	0.0
	4	164.3	7.0	199.0	0.0	0.0	0.0
10	1	124.7	4.3	77.7	0.0	0.0	0.0
	2	161.5	6.6	209.7	0.0	0.0	0.0
	3	173.2	6.3	140.6	0.0	0.0	0.0
	4	198.9	7.9	233.0	0.0	0.0	0.0

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

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Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

RESPONSE SPECTRUM RESULTS

BENT CQC FORCES

ITEM	LC	VERT SHEAR	W/R TO BRIDGE C.L. LONGITUDNL	TRANSVERSE	W/R TO ITEM C.L. NORMAL	PARALLEL
B 2 J1	1	6.6	164.3	131.2	177.0	113.5
	2	7.7	211.7	174.7	268.0	59.5
	3	8.9	227.8	183.6	257.3	131.4
	4	9.7	261.0	214.1	321.0	93.6
B 2 J2	1	23.8	286.0	110.3	173.8	252.4
	2	27.4	131.3	282.1	258.2	173.7
	3	32.0	325.4	194.9	251.3	304.5
	4	34.5	217.1	315.2	310.4	249.5
B 3 J1	1	18.8	460.8	94.5	311.8	352.2
	2	23.8	219.3	281.4	306.2	183.2
	3	25.9	526.6	178.9	403.6	407.1
	4	29.5	357.5	309.8	399.7	288.8
B 3 J2	1	21.2	284.8	198.8	321.9	130.4
	2	20.6	262.8	213.2	324.5	96.1
	3	27.3	363.7	262.8	419.3	159.2
	4	26.9	348.3	272.9	421.1	135.3

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

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Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

RESPONSE SPECTRUM RESULTS

BENT BEARING CQC FORCES

BRNG	LC	KF1F1	KF2F2	KF3F3	KM1M1	KM2M2	KM3M3
BNT	2 - JNT 1						
1	1	16.4	3.3	40.2	0.0	0.0	0.0
	2	21.2	3.6	70.2	0.0	0.0	0.0
	3	22.8	4.4	61.3	0.0	0.0	0.0
	4	26.1	4.6	82.3	0.0	0.0	0.0
2	1	16.4	2.7	30.6	0.0	0.0	0.0
	2	21.2	2.9	51.1	0.0	0.0	0.0
	3	22.8	3.6	45.9	0.0	0.0	0.0
	4	26.1	3.7	60.3	0.0	0.0	0.0
3	1	16.4	2.1	21.5	0.0	0.0	0.0
	2	21.2	2.2	32.1	0.0	0.0	0.0
	3	22.8	2.8	31.1	0.0	0.0	0.0
	4	26.1	2.8	38.5	0.0	0.0	0.0
4	1	16.4	1.5	13.9	0.0	0.0	0.0
	2	21.2	1.6	13.6	0.0	0.0	0.0
	3	22.8	2.0	18.0	0.0	0.0	0.0
	4	26.1	2.0	17.8	0.0	0.0	0.0
5	1	16.4	0.9	11.3	0.0	0.0	0.0
	2	21.2	1.0	9.0	0.0	0.0	0.0
	3	22.8	1.2	14.0	0.0	0.0	0.0
	4	26.1	1.3	12.4	0.0	0.0	0.0
6	1	16.4	0.5	16.4	0.0	0.0	0.0
	2	21.2	0.7	26.7	0.0	0.0	0.0
	3	22.8	0.7	24.4	0.0	0.0	0.0
	4	26.1	0.8	31.6	0.0	0.0	0.0
7	1	16.4	0.7	24.8	0.0	0.0	0.0
	2	21.2	0.9	45.7	0.0	0.0	0.0
	3	22.8	0.9	38.5	0.0	0.0	0.0
	4	26.1	1.1	53.1	0.0	0.0	0.0

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

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Imbsen and Associates, Inc.

DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

BENT BEARING CQC FORCES (CONTINUED)

BRNG	LC	KF1F1	KF2F2	KF3F3	KM1M1	KM2M2	KM3M3
BNT 2 - JNT 1 (CONTINUED)							
8	1	16.4	1.2	34.1	0.0	0.0	0.0
	2	21.2	1.5	64.8	0.0	0.0	0.0
	3	22.8	1.7	53.5	0.0	0.0	0.0
	4	26.1	1.9	75.0	0.0	0.0	0.0
9	1	16.4	1.8	43.8	0.0	0.0	0.0
	2	21.2	2.1	84.0	0.0	0.0	0.0
	3	22.8	2.4	69.0	0.0	0.0	0.0
	4	26.1	2.7	97.1	0.0	0.0	0.0
10	1	16.4	2.4	53.6	0.0	0.0	0.0
	2	21.2	2.8	103.1	0.0	0.0	0.0
	3	22.8	3.3	84.6	0.0	0.0	0.0
	4	26.1	3.5	119.2	0.0	0.0	0.0
BNT 2 - JNT 2							
1	1	28.6	2.9	49.5	0.0	0.0	0.0
	2	13.1	8.7	59.6	0.0	0.0	0.0
	3	32.5	5.5	67.4	0.0	0.0	0.0
	4	21.7	9.6	74.5	0.0	0.0	0.0
2	1	28.6	2.5	39.6	0.0	0.0	0.0
	2	13.1	7.3	40.9	0.0	0.0	0.0
	3	32.5	4.7	51.9	0.0	0.0	0.0
	4	21.7	8.1	52.8	0.0	0.0	0.0
3	1	28.6	2.3	30.0	0.0	0.0	0.0
	2	13.1	6.0	22.8	0.0	0.0	0.0
	3	32.5	4.1	36.8	0.0	0.0	0.0
	4	21.7	6.7	31.8	0.0	0.0	0.0
4	1	28.6	2.2	20.8	0.0	0.0	0.0
	2	13.1	4.7	9.2	0.0	0.0	0.0
	3	32.5	3.6	23.6	0.0	0.0	0.0
	4	21.7	5.3	15.5	0.0	0.0	0.0

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

C-5-82

- - - - S E I S A B - - - - (Version 4.1.12) 11-JUL-97
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DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

BENT BEARING CQC FORCES (CONTINUED)

BRNG	LC	KF1F1	KF2F2	KF3F3	KM1M1	KM2M2	KM3M3
BNT 2 - JNT 2 (CONTINUED)							
5	1	28.6	2.3	13.2	0.0	0.0	0.0
	2	13.1	3.4	19.4	0.0	0.0	0.0
	3	32.5	3.3	19.0	0.0	0.0	0.0
	4	21.7	4.0	23.4	0.0	0.0	0.0
6	1	28.6	2.5	11.0	0.0	0.0	0.0
	2	13.1	2.1	37.4	0.0	0.0	0.0
	3	32.5	3.2	22.2	0.0	0.0	0.0
	4	21.7	2.9	40.6	0.0	0.0	0.0
7	1	28.6	2.9	16.5	0.0	0.0	0.0
	2	13.1	1.2	56.0	0.0	0.0	0.0
	3	32.5	3.3	33.3	0.0	0.0	0.0
	4	21.7	2.1	61.0	0.0	0.0	0.0
8	1	28.6	3.3	25.1	0.0	0.0	0.0
	2	13.1	1.5	74.9	0.0	0.0	0.0
	3	32.5	3.8	47.5	0.0	0.0	0.0
	4	21.7	2.5	82.4	0.0	0.0	0.0
9	1	28.6	3.9	34.5	0.0	0.0	0.0
	2	13.1	2.5	93.8	0.0	0.0	0.0
	3	32.5	4.6	62.7	0.0	0.0	0.0
	4	21.7	3.7	104.2	0.0	0.0	0.0
10	1	28.6	4.4	44.3	0.0	0.0	0.0
	2	13.1	3.8	112.8	0.0	0.0	0.0
	3	32.5	5.5	78.1	0.0	0.0	0.0
	4	21.7	5.1	126.0	0.0	0.0	0.0
BNT 3 - JNT 1							
1	1	61.3	3.0	22.0	0.0	0.0	0.0
	2	59.3	5.6	68.6	0.0	0.0	0.0
	3	79.1	4.7	42.5	0.0	0.0	0.0
	4	77.7	6.5	75.2	0.0	0.0	0.0

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

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DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

BENT BEARING CQC FORCES (CONTINUED)

BRNG	LC	KF1F1	KF2F2	KF3F3	KM1M1	KM2M2	KM3M3
BNT	3 - JNT 1 (CONTINUED)						
2	1	57.6	2.6	18.0	0.0	0.0	0.0
	2	50.3	3.9	59.5	0.0	0.0	0.0
	3	72.7	3.8	35.9	0.0	0.0	0.0
	4	67.6	4.7	64.9	0.0	0.0	0.0
3	1	54.1	2.3	14.3	0.0	0.0	0.0
	2	41.5	2.3	50.5	0.0	0.0	0.0
	3	66.5	2.9	29.5	0.0	0.0	0.0
	4	57.7	2.9	54.8	0.0	0.0	0.0
4	1	50.7	2.0	11.3	0.0	0.0	0.0
	2	33.0	0.9	41.5	0.0	0.0	0.0
	3	60.6	2.3	23.8	0.0	0.0	0.0
	4	48.2	1.5	44.9	0.0	0.0	0.0
5	1	47.6	1.9	9.6	0.0	0.0	0.0
	2	25.3	1.6	32.6	0.0	0.0	0.0
	3	55.1	2.4	19.4	0.0	0.0	0.0
	4	39.5	2.2	35.4	0.0	0.0	0.0
6	1	44.7	1.9	9.8	0.0	0.0	0.0
	2	19.2	3.2	23.8	0.0	0.0	0.0
	3	50.4	2.9	17.0	0.0	0.0	0.0
	4	32.6	3.8	26.7	0.0	0.0	0.0
7	1	42.1	2.0	11.9	0.0	0.0	0.0
	2	16.6	4.9	15.5	0.0	0.0	0.0
	3	47.1	3.5	16.5	0.0	0.0	0.0
	4	29.3	5.5	19.0	0.0	0.0	0.0
8	1	40.0	2.3	15.1	0.0	0.0	0.0
	2	19.1	6.6	8.9	0.0	0.0	0.0
	3	45.7	4.3	17.7	0.0	0.0	0.0
	4	31.1	7.3	13.4	0.0	0.0	0.0
9	1	38.2	2.6	18.8	0.0	0.0	0.0
	2	25.1	8.3	9.4	0.0	0.0	0.0
	3	45.8	5.1	21.6	0.0	0.0	0.0
	4	36.6	9.1	15.0	0.0	0.0	0.0

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

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DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

BENT BEARING CQC FORCES (CONTINUED)

BRNG	LC	KF1F1	KF2F2	KF3F3	KM1M1	KM2M2	KM3M3
BNT 3 - JNT 1 (CONTINUED)							
10	1	37.0	3.0	22.8	0.0	0.0	0.0
	2	32.8	10.1	16.2	0.0	0.0	0.0
	3	46.9	6.1	27.7	0.0	0.0	0.0
	4	43.9	11.0	23.0	0.0	0.0	0.0
BNT 3 - JNT 2							
1	1	28.5	7.1	55.1	0.0	0.0	0.0
	2	26.3	8.2	106.4	0.0	0.0	0.0
	3	36.4	9.5	87.1	0.0	0.0	0.0
	4	34.8	10.4	123.0	0.0	0.0	0.0
2	1	28.5	6.0	46.3	0.0	0.0	0.0
	2	26.3	6.9	87.3	0.0	0.0	0.0
	3	36.4	8.0	72.5	0.0	0.0	0.0
	4	34.8	8.6	101.2	0.0	0.0	0.0
3	1	28.5	4.8	37.8	0.0	0.0	0.0
	2	26.3	5.5	68.3	0.0	0.0	0.0
	3	36.4	6.5	58.3	0.0	0.0	0.0
	4	34.8	6.9	79.6	0.0	0.0	0.0
4	1	28.5	3.7	29.7	0.0	0.0	0.0
	2	26.3	4.1	49.3	0.0	0.0	0.0
	3	36.4	5.0	44.5	0.0	0.0	0.0
	4	34.8	5.2	58.2	0.0	0.0	0.0
5	1	28.5	2.6	22.7	0.0	0.0	0.0
	2	26.3	2.7	30.5	0.0	0.0	0.0
	3	36.4	3.5	31.8	0.0	0.0	0.0
	4	34.8	3.5	37.3	0.0	0.0	0.0
6	1	28.5	1.6	17.9	0.0	0.0	0.0
	2	26.3	1.4	12.8	0.0	0.0	0.0
	3	36.4	2.0	21.7	0.0	0.0	0.0
	4	34.8	1.9	18.1	0.0	0.0	0.0

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

- - - - S E I S A B - - - - (Version 4.1.12) 11-JUL-97
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DE DIEGO BRIDGE @ MAIN CHANNEL - EXISTING CONDITION

BENT BEARING CQC FORCES (CONTINUED)

BRNG	LC	KF1F1	KF2F2	KF3F3	KM1M1	KM2M2	KM3M3
BNT 3 - JNT 2 (CONTINUED)							
7	1	28.5	0.8	17.3	0.0	0.0	0.0
	2	26.3	0.7	11.4	0.0	0.0	0.0
	3	36.4	1.0	20.8	0.0	0.0	0.0
	4	34.8	0.9	16.6	0.0	0.0	0.0
8	1	28.5	1.1	21.4	0.0	0.0	0.0
	2	26.3	1.7	28.8	0.0	0.0	0.0
	3	36.4	1.6	30.0	0.0	0.0	0.0
	4	34.8	2.0	35.2	0.0	0.0	0.0
9	1	28.5	2.1	28.1	0.0	0.0	0.0
	2	26.3	3.0	47.6	0.0	0.0	0.0
	3	36.4	3.0	42.3	0.0	0.0	0.0
	4	34.8	3.6	56.0	0.0	0.0	0.0
10	1	28.5	3.2	36.0	0.0	0.0	0.0
	2	26.3	4.4	66.5	0.0	0.0	0.0
	3	36.4	4.5	55.9	0.0	0.0	0.0
	4	34.8	5.3	77.3	0.0	0.0	0.0

*** LOAD CASE/COMB	DESCRIPTION
1	Longitudinal
2	Transverse
3	1.0*Long + 0.3*Trans
4	0.3*Long + 1.0*Trans

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DE DIEGO BRIDGE MOD.			

CALCULATE THE CAPACITY-DEMAND RATIOS OF BRIDGE COMPONENTS FOR SEISMIC @ EXISTING CONDITION

REFERENCE APPENDIX A OF FHA SEISMIC RETROFITTING MANUAL FOR HIGHWAY BRIDGES, MAY 1995

MINIMUM BEARING FORCE DEMANDS

MIN. OF 20% SUPERSTRUCTURE DEAD LOAD

TOTAL S.S. DEAD LOAD @ A BENT IS 1450 k

$(0.2)(1450) = 290\ ^{k}/_{BENT} \times {}^{BENT}/_{20\ GIRDERS} \times {}^{GIRDER}/_{=BOLTS} = 7.25\ ^{k}/_{BOLT}$

MINIMUM SUPPORT LENGTHS

SEISMIC PERF. CAT. "C"

$N(d) = 12 + 0.03L + 0.12H$

$= 12 + 0.03(98\text{ ft}) + 0.12(40\text{ ft}) = 19.74\text{ in.}$

DISPLACEMENT CAPACITY/DEMAND RATIOS

METHOD 1

$$r_{BD} = \frac{N(c)}{N(d)} = \frac{\text{SUPPORT LENGTH PROVIDED}}{\text{MIN. SUPPORT LENGTH}}$$

$$= \frac{24.6\text{ in}}{19.74\text{ in}} = \boxed{1.25}$$

OR

METHOD 2

$$r_{BD} = \frac{\Delta_s(c) - \Delta_i(d)}{\Delta_{eq}(d)} = \frac{24.6\text{ in} - 0.235\text{ in}}{3.744\text{ in}}$$

FROM STAND TEMP MODEL

from SEISAB W/ CHANNEL IMPROV. MODEL (SSDOMC)

$$= 6.50$$

SAJ Form 1000
14 Mar 78

2-5-87

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DE DIEGO BRIDGE MOD.				

FORCE CAPACITY/DEMAND RATIOS FOR BEARINGS

$$r_{bf} = \frac{V_b(c)}{V_b(d)}$$

STRENGTH OF BOLTED CONNECTIONS IS GOVERNED BY SHEAR STRENGTH OF CONCRETE

(REF. UBC P. 2-255) $V_b(c) = 2\pi d_e^2 \lambda \sqrt{f'_c}$

$= 2\pi (5.33\,in)^2 (1.0) \sqrt{3000\,psi} = \underline{9,777\,\#}$

$V_b(d)_{min} = 7.25^k/Bolt$ $\quad 9.78\,k/_{bolt} \times \frac{2\,bolts}{girder} \times 10\,girders = \underline{196^k}$

FOR ABUTMENTS $V_b(d) = 1.25\left(\sqrt{(841.3)^2+(580.2)^2}\right) = \underline{1277^k}$

FOR PILE BENTS $V_b(d) = 1.25\left(\sqrt{(403.6)^2+(407.1)^2}\right) = \underline{717^k}$

r_{bf} (ABUTMENTS) $= \frac{196}{1277} = \boxed{0.15}$

r_{bf} (PILE BENTS) $= \frac{196}{717} = \boxed{0.27}$

CAPACITY/DEMAND RATIOS FOR 36" Ø PRESTRESSED CYLINDER PILES

FROM INTERACTION DIAGRAM, MOMENT CAPACITY IS APPROX.:

$M(c) = 1050$ k·ft @ $P = 250^k$

AND FROM SEISAB, MOMENT DEMAND IS:

$M(d) = 1525$ k·ft

$r_{cp} = \frac{M(c)}{M(d)} = \frac{1050\ k\cdot ft}{1525\ k\cdot ft} = \boxed{0.69}$

SHEAR STRENGTH PROVIDED BY CONCRETE FOR PRESTRESSED MEMB.

$$V_c = 2\sqrt{f'_c}\, b_w d$$

$$= 2\sqrt{7000\,psi}\,\frac{\pi}{4}\left[(33\,in)^2 - (26\,in)^2\right] = 54.3^{k}$$

SHEAR STRENGTH PROVIDED BY STEEL SPIRAL #4

$$V_s = \frac{A_v f_y d}{s} = \frac{2(0.2)(40{,}000\,psi)(33)}{2.25\,in} = 235^{k}$$

$$V_u = V_c + V_s = 289^{k}$$

FROM SEISAB, $V_{max} = 63^{k}$

$$r_{cs} = \frac{V(c)}{V(d)} = \frac{289^{k}}{63^{k}} = \boxed{4.59}$$

CAPACITY / DEMAND RATIOS FOR ABUTMENTS

BY EXPERIENCE, $D(c)$ = 3 in (TRANSVERSE)
6 in (LONGITUDINAL)

FROM SEISAB $D(d)$ = 2.46 in (TRANSVERSE)
2.39 in (LONGITUDINAL)

$$r_{ad} = \frac{D(c)}{D(d)} = \frac{3\,in}{2.46\,in} = \boxed{1.22}$$

OR

$$= \frac{6\,in}{2.39\,in} = 2.51$$

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DE DIEGO BRIDGE MOD.			

ANCHORAGE OF LONGITUDINAL REINFORCEMENT

FOR STRAIGHT ANCHORAGE

$$l_a(d) = \frac{k_s d_b}{(1 + 2.5c/d_b + k_{tr})\sqrt{f'_c}} \geq 30 d_b$$

$k_s = (f_y - 11,000)/4.8 = (40,000 - 11,000)/4.8 = 6042$

$d_b = 1.27$ in (#10 bar)

$f'_c = 40,000$ psi

$c = 5$ in

$k_{tr} = (A_{tr(c)} f_{yt})/(600 s d_b) = \{(0.10)(40,000)\}/\{(600)(2.25)(1.27)\} = 2.33$

$A_{tr(c)} = 0.10$ in^2 (#4 spiral / 8 bars)

$f_{yt} = 40,000$ psi

$s = 2.25$ in

$$l_a(d) = \frac{(6042)(1.27)}{\{[1+(2.5)(5)/1.27] + 2.33\}\sqrt{3000}} = 10.63 \text{ in}$$

$\geq 30 d_b = 30(1.27) = 38.1$ in.

$l_a(c)$ from AS-BUILTS = 32.7 in

$$r_{ca} = \frac{l_a(c)}{l_a(d)} = \frac{32.7}{38.1} = \boxed{0.86}$$

→ MULTIPLY BY r_{CB} TO GET ACTUAL COLUMN MOMENT C/D RATIO

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DE DIEGO BRIDGE MOD.				

SUMMARY

BRIDGE ELEMENT	C/D RATIO
BEARING DISPLACEMENT, r_{BD}	1.25
BEARING FORCE, r_{BF}	
@ ABUTMENTS	0.15
@ PILE BENTS	0.27
36" Ø PILE MOMENT, r_{CB}	0.59
36" Ø PILE SHEAR, r_{CS}	4.59
ABUTMENTS, r_{AD}	1.22

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

APPENDIX D

COORDINATION

AGENCY	NAME OFFICE	TELEPHONE NUMBER	AUTHORIZED SIGNATURE
FROM: ED BROWN	232-3647		
TO: Ing. Ortiz	AAA		DATE:
NO. PAGES	REMARKS: FAX 787-763-5440		

REMARKS: Enclosed are meeting minutes.

Ed.

U.S. Army Corps of Engineers
Jacksonville District

Engineering Division
Design Branch

400 West Bay Street
Mail: P.O. Box 4970
Jacksonville, FL 32232-0019

Phone: (904) 232-2473
FAX: (904) 232-2131

Please call us if you have had any problems receiving or if there are any pages missing.

Commonwealth of Puerto Rico
PUERTO RICO AQUEDUCT & SEWER AUTHORITY

June 3, 1996

Eng. Yamil Castillo
Department of the Army
400 Fernandez Juncos Ave.
San Juan, Puerto Rico 00901-3299

Re:- San Juan - Relocation Sewer Facilities for Puerto Nuevo

Sir:-

Adjoined is a copy of the As Built Plans of the Puerto Nuevo Trunk Sewer as requested by Eng. Ed Brown in his fax to my office on May 30, 1996.

The plans designate their manholes with a different identification to those indicated by Eng. Brown. I think his manholes will be found on sheets 3 and 4 of the plans. I would appreciate if you could deliver these plans to Eng. Brown as soon as possible.

Cordially yours,

Dennis Ortiz - Assist. Chief,
Region II Sewer Design Department

DOM/1pm

c Eng. D. Ortiz
Eng. Montenegro
Eng. B. Colón - 8

(39S-IUAN.WP)(17)

D-2

Commonwealth of Puerto Rico
PUERTO RICO AQUEDUCT & SEWER AUTHORITY

May 15, 1997

Meeting:-

Re:- San Juan - Relocation of Water & Sewer Facilities

Location:- COE Offices

Date:- May 13, 1997

Presents: Eng. Pedro J. Acosta - COE-SJ
Eng. Ed Brown - COE-JAX
Eng. Dennis Ortiz - PRASA

San José Siphon

- 95% Design Drawings are presented of Siphon Design.
- I Presented Eng. Jaime Tous comments relative to the design of 4-90º Bends substituting the existing straight line alignment. The bends will cause turbulence and creation of objectionable odors.
- Eng. Brown indicates that the transitions for flow will be smooth to decrease turbulence and as for an odor problem in area the suggestion of sealing manholes will be considered. Protective coating or lining will be used for corrosion protection.
- The manner in which the bottom configuration of dog house (upstream) manhole will be placed was discussed. Template of pipe sections in fiberglass will be lowered into manhole but water and sediments under template must be taken into consideration. Use of weepholes and exterior grout ventilation pipes can be used.
- I suggest they consider a preform by-pass around pipe before cutting pipe and then when pipe is cut, a preformed concrete plug be installed to conform to pipe and direct sewage flow which can later be grouted. Interior coating protection will be required and can be placed before siphon is by-passed. Existing pipe will be cut and taken to 3/4 diameter height. Eng. Acosta suggests use of liner to cover inconsistencies at cuts in pipe.
- For now doghouse manhole will be built and existing pipe supported. Details of by-pass will be included later.

Miramar Siphon Trunk Sewer

- Eng. Acosta presents problem in siphon wherein the upstream manhole has on overflow discharge which is allowing sewage to divert to channel and water from channel to siphon. This must be corrected. I indicated that the Metro Region has been informed by Eng. Jaime Tous and we are providing Eng. José Prados, Operations AAA, phone number 755-8000 for reference and coordination.

Feature Design Memorandum 2 (FDM2)

a. Reviewed 30"ϕ S/S to Puerto Nuevo T/S crossing Puerto Nuevo Channel to Nemesio Canales Residential area

- Our comments on the other siphons relative barscreens, transitional flows, access hatches, access for operation & maintenance, placed above graded ground, fencing, hoist equipment, etc. will also be taken into here and other siphon crossings.

- At site no siphon manholes were found. COE needs PRASA to discover in the field influent & effluent siphon manholes & manhole "B" in order to complete their design relocation (see plate M-2, M-3). I will inform Eng. Jaime Tous for the necessary coordination.

- Suggested that proposed inlet siphon be placed outside DRN Pump Station nearer canal for construction purpose. Operational access must be studied.

- From observation of local manhole before the existing inlet siphon the water was stagnant and manhole flooded.

b. Reviewed Sewer Relocation of water and sewer at Calle 10 & 25 N.E.

- Some houses will be eliminated. Existing system may suffer from sheet pile and the tieback installation. Proposed sewerline M.H. 227A to M.H. 228A may not be required and can be eliminated for existing line. Soil anchors may be H-Piles.

c. Existing 48"ϕ waterline crossing Puerto Nuevo channel from Calle 25

- Waterline will be replaced with HDPE pipe. with surge safety factor of 2.5. Design pressure will range about 128 psi. Three 30"ϕ pipe will substitute the 48"ϕ pipe.

- I will suggest to Eng. Jaime Tous that the Aqueduct Design Division provide comments for this replacement of waterline.

d. 10"ϕ & 30"ϕ waterlines crossing South of Roosevelt Bridge

- This project entails relocation of existing waterlines in relation to new bridge to be built near Police Headquarters on Roosevelt Avenue.

e. 36"ϕ T/S crossing under Margarita Channel

- No flow information from PRASA has been forth coming for flow design. Estimated low flows are approx. 6 MGD, maximum flows are 23 MGD and average flow of 15.1 MGD Consideration of construction of new siphon in close proximity to existing siphon must be noted. Relocation is due to concrete channel to be constructed by COE under which siphon need not be 6' below channel. At present siphon is in channel bed.

- COE requests PRASA to locate existing manhole north of Margarita Channel (see plate M-9) opposite INESCO Company parking lot. I will inform Eng. Jaime Tous for the necessary coordination.

DOM/1pm

c Eng. D. Ortiz
Eng. J. Tous - Sub-Dir. Exec. Eng. & Oper.
Eng. B. Pomales - Executive Director
Eng. P. Acosta - COE-SJ
Eng. E. Brown - COE-JAX

(432MINUT.WP)(18)

CESAJ-EN-DM (1110-2-1150b) May 29, 1997
MEMORANDUM FOR THE RECORD

Subject: Rio Puerto Nuevo FDM 2, minutes of May 13, 1997 Review Meeting and Plan in Hand review of 50 % FDM

1. Purpose: The purpose of the meeting was two fold;

a. To study the relocation methodology and respond to PRASA's comments and discuss design features

b. obtain a consensus from PRASA on both the desired and economical methods for relocation.

c. Perform a site visit to familiarize PRASA and Antilles Office of any special site problems.

2. Participants:

Ing. Dennis Ortiz	PRASA	756-2297
Ing. Jimmy Acosta	COE	729-6833
Ing. Ed Brown	COE	232-3647

3. Mr. Brown discussed the 5 relocation's during the course of the morning portion of the meeting. Ing Ortiz recommended the following features for incorporation in the final plans and specifications for siphons and other crossings.

a. hydraulic transitions from diversions and to siphon will be smooth to minimize turbulence and headloss.

b. Bar screens will be installed on the siphon and sloped at a 70 angle to facilitate cleaning. Screen openings will be 3 inches to catch large items such as block corrugated metal sheets, etc.

c. The siphon will include a maintenance hoist for removal of large objects.

d. All hatches and ingress's will be lockable .

e. The site will be fenced to control access and separate access will be provided for AAA personnel.. All structures in the ROW will have graded ramps and be rated for traffic .

MEMORANDUM FOR THE RECORD

Subject: Rio Puerto Nuevo FDM 2, minutes of May 13, 1997 Review Meeting and Plan in Hand review of 50 % FDM

4. The plan in hand review comprised a site visit to the crossing at Rio Puerto Nuevo channel (Crossing # 1 , station 99+04) and the Margaret channel (Crossing # 5 Station 66+29).

a. Access to Crossing # 1 is constrained and limited. It requires approach from the De Diego Expressway and Nemsio Canales. The site is heavily vegetated. The siphon is covered by fill from the construction of the Storm-water pump station, De Diego Expressway and junk disposal. The field surveyor had been unable to adequately locate the structure for the Contract Surveys. The approximate location of the structure and configuration had been reconstructed from existing record drawings and a site visit performed by Luis Ayala and Ed Brown in February 1996. Mr. Ortiz and Mr. Acosta recognize that this is the information that the relocation is based upon and that additional surveys will be required for plans and specifications. Mr. Ortiz will attempt (in his capacity) to see if PRASA remove some of the debris for a final field survey. Additionally, flow monitoring information will be required for optimal design of the siphon.

b. Again access to crossing # 5 is constrained and limited. The existing 36 inch pipe was relocated and covered upon by about 20 feet of fill during the construction of the confluencia of the De Diego Expressway. The existing 36 inch pipe and manholes are pile supported. The existing 36 inch pipe is encased in concrete and dams the Margaret channel. The proposed relocation design was based upon hydraulic heads being observed during a February 1996 site visit. Flow monitoring will be required to optimize the design and some survey will be required to verify pipe elevations at the plans and specifications stage.

5. This is offered as record of my observations at the meeting.

Edwin Brown III, PE
Environmental Engineer

Author: Edwin Brown at EN
Date: 2/6/97 9:52 AM
Priority: Normal
TO: Yamil Castillo at ANTILLES
CC: Jana K Tanner
CC: Shashi Makker
CC: Bart D Shivers
Subject: Puerto Nuevo FDM for Prasa

---------- Message Contents ----------

Yamil,

I have sent two copies (via office mail) of the FDM plates and description of the water and sewer utility relocations for pick-up by Ing. Dennis Ortiz(AAA). I would be much obliged if you would retain these until Ing. Ortiz can make arrangements to pick them up. My plans are once they have sufficient time to thoroughly review the documents, we can schedule a conference and site visit review.

Thanks,

Ed Brown 3647

D-8

Wednesday, February 05, 1997

Dear Ing. Collazo ,

I have sent two copies of the 50 % Feature Design Memorandum to Engineer Castillo. He will retain these in the Antilles Office for pick-up as we have done in the past. I have prepared designs for 5 water and sewer crossings for your department's review. These designs involve crossings and relocations in congested areas that must occur during channel construction therefore, the options for relocation are limited. This is reflected in the design. These books are offered for your review and valuable comment.

I would like to schedule a meeting with you in the later part of April to perform a plan in hand site visit and discuss the the relocations. This information will be used for preparation of the final submittal. I thank you and look forward to hearing from you.

Ed Brown
904-232-3647

Estimado Ing. Collazo,

Mandare dos (2) copias de 50 % FDM a Inginero Castillo. El reteenera' en la Oficina Antilles por su conseguir para Ing. Ortiz (el mismo pra'ctica a pasada). Yo prepare' estos designios por 5 cruzamientos de agua y alcantrarillados por revista para su departamento. Esta designio's envolven cruzamientos en areas congestas durante el constuccion de canales por esa razo'n, los opcio'ns son limitados. Esta libros son ofrecido por su repuesto y comentario valioso.

Me gusta planar conferencia y visito sitio en ultimo Avril . Es necessario discutir los relocacions. Esta informacion usara' por la ultma preparacion de la sumisio'n ultima . Gracias y me gusta por su repuesta.

Ed Brown
904-232-3747

Friday, July 12, 1996

Operations Division
A.A.A
Re: Flow Monitoring of Margarita Manhole C-16D and
Puerto Nuevo Trunk Sewer, Manhole C-236 B

Dear Ing. Vega

As a follow-up to my letter of May 8, 1996, and subsequent phone call. I am requesting flow information for Manholes C-16D and C-236B. This data is vitally needed and required so we can design a siphon crossing/ relocation for the Margerita and Puerto Nuevo Channels.

I would be much obliged for any part of this information that you can provide to me so that we may proceed with this very important project for the Commonwealth of Puerto Rico. Do not hesitate to call me at 904-232-3647 or 904-232-2131(FAX) if you have any questions.

Sincerely,

Edwin Brown III, P.E.
Environmental Engineer
US Army Corps of Engineers

D-10

Ing. Anil Vega
Operations Division
A.A.A
Re: Flow Monitoring of Margarita Manhole C-16D and
Puerto Nuevo Trunk Sewer, Manhole C-236 B

Dear Ing. Vega

The district is working on a design to channelize Puerto Nuevo and Margarita channels. It will impact utilities in The Margarita Channel and Puerto Nuevo Channels. -. This impacts a . 36" Sewer line under Margaret Channel .approximately (item 1 on vicinity map) and the Puerto Nuevo Trunk sewer (item 2 on the vicinity map). It will require constructing siphon sunder both channels Flow data will be required to adequately size the siphon for future and current conditions. We, the Corps respectfully request your assistance in the monitoring of the flow at these locations (manhole C-16D and manhole C-236b) . The flow data should be of sufficient duration to ascertain average, minimum, and maximum conditions. Any historical flow data would be welcomed in place of this.

I thank you in advance for your cooperation and certainly enjoyed meeting yourself and other representative of Operations Division at Corps Offices this past February. If you have any questions or would like to discuss this further , do not hesitate to call me at 904-232-3647 or via fax at 904-232-2131.

Sincerely,

Edwin Brown III, P.E.
Environmental Engineer
US Army Corps of Engineers

D-11

Ing. Hector de Jesus
Chief Operations Division
A.A.A

Dear Ing. de Jesus,

The district is working on a design to channelize Puerto Nuevo and Margarita channels. It will impact utilities in 5 areas . The Corps is dedicated to minimizing impact to these utilities by providing relocation and design in accordance with Aqueductos Standards. In order to minimize this impact, I request some assistance from . your deptartment . This will be to collect sufficient data so we can relocate these crossings. It involves 5 areas. The Corps surveyors found much information but were unable to obtain all of the necessary information due to the system complexity. Perhaps you can help us. The 5 areas that I request information from are as follows.

Operations Division
A.A.A
Re: Flow Monitoring of Margarita Manhole C-16D and
Puerto Nuevo Trunk Sewer, Manhole C-236 B

Dear Ing. Vega

The district is working on a design to channelize Puerto Nuevo and Margarita channels. It will impact utilities in The Margarita Channel and Puerto Nuevo Channels. -. This impacts a . 36" Sewer line under Margaret Channel .approximately (item 1 on vicinity map) and the Puerto Nuevo Trunk sewer (item 2 on the vicinity map). It will require constructing siphon sunder both channels Flow data will be required to adequately size the siphon for future and current conditions. We, the Corps respectfully request your assistance in the monitoring of the flow at these locations (manhole C-16D and manhole C-236b) . The flow data should be of sufficient duration to ascertain average, minimum, and maximum conditions. Any historical flow data would be welcomed in place of this.

I thank you in advance for your cooperation and certainly enjoyed meeting yourself and other representative of Operations Division at Corps Offices this past February. If you have any questions or would like to discuss this further , do not hesitate to call me at 904-232-3647 or via fax at 904-232-2131.

Sincerely,

Edwin Brown III, P.E.
Environmental Engineer
US Army Corps of Engineers

D13

AGENCY	NAME OFFICE	TELEPHONE NUMBER	AUTHORIZED SIGNATURE
FROM: ED BROWN		904-232-3647	
TO: Dennis Ortiz	A.A.A		DATE:
NO. PAGES	REMARKS: FAX 787-763-5446		

REMARKS: FAX: 904-232-2131

I am in need of the sheets for The Puerto Nuevo Trunk Sewer that shows the profile of Manholes C-236B, C-236C C-360, C-361, & C-362. Any drawings for information on These I would be much obliged.

Thanks again,

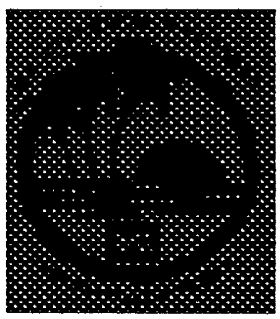
Ed Brown

U.S. Army Corps of Engineers
Jacksonville District

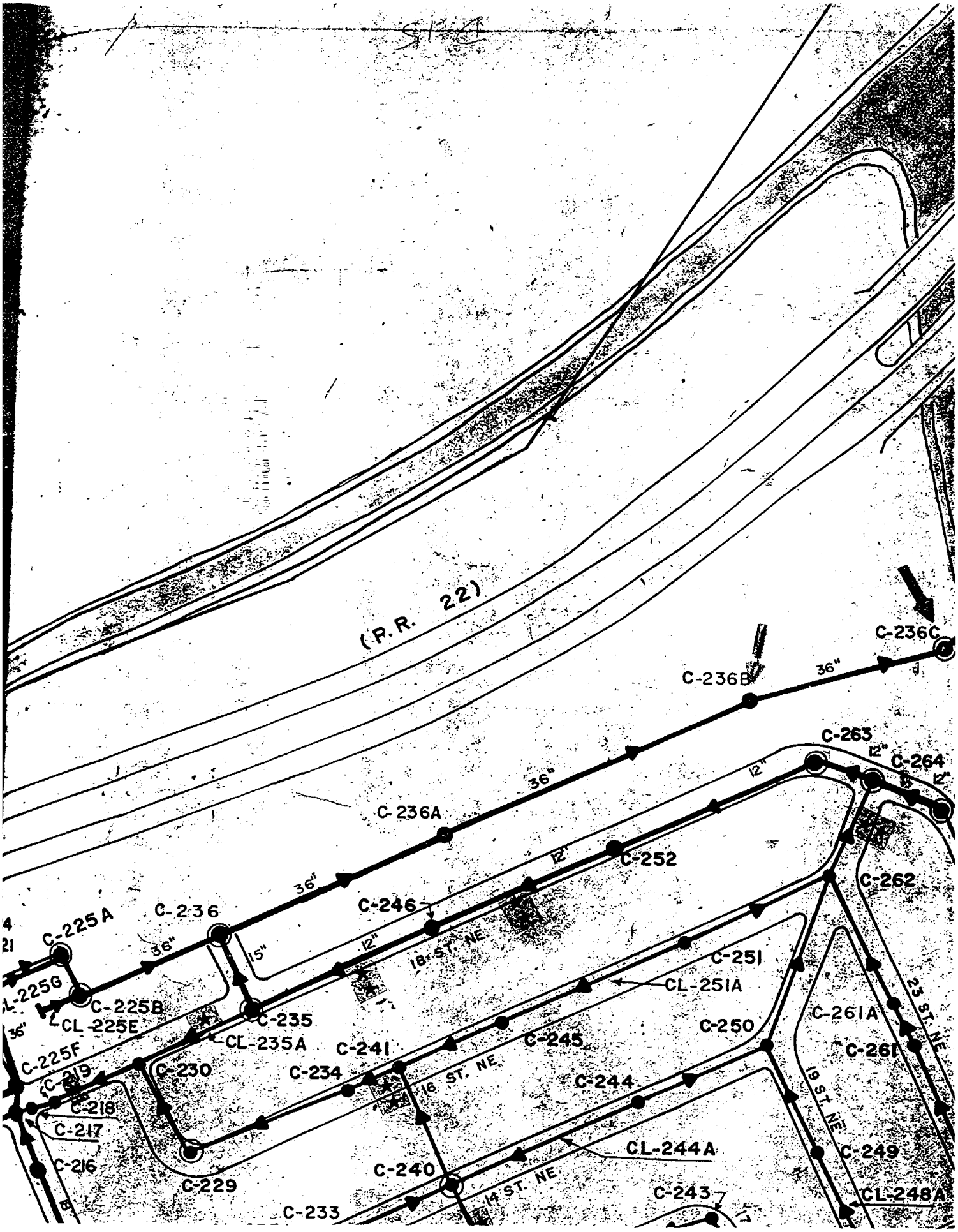
Engineering Division
Design Branch

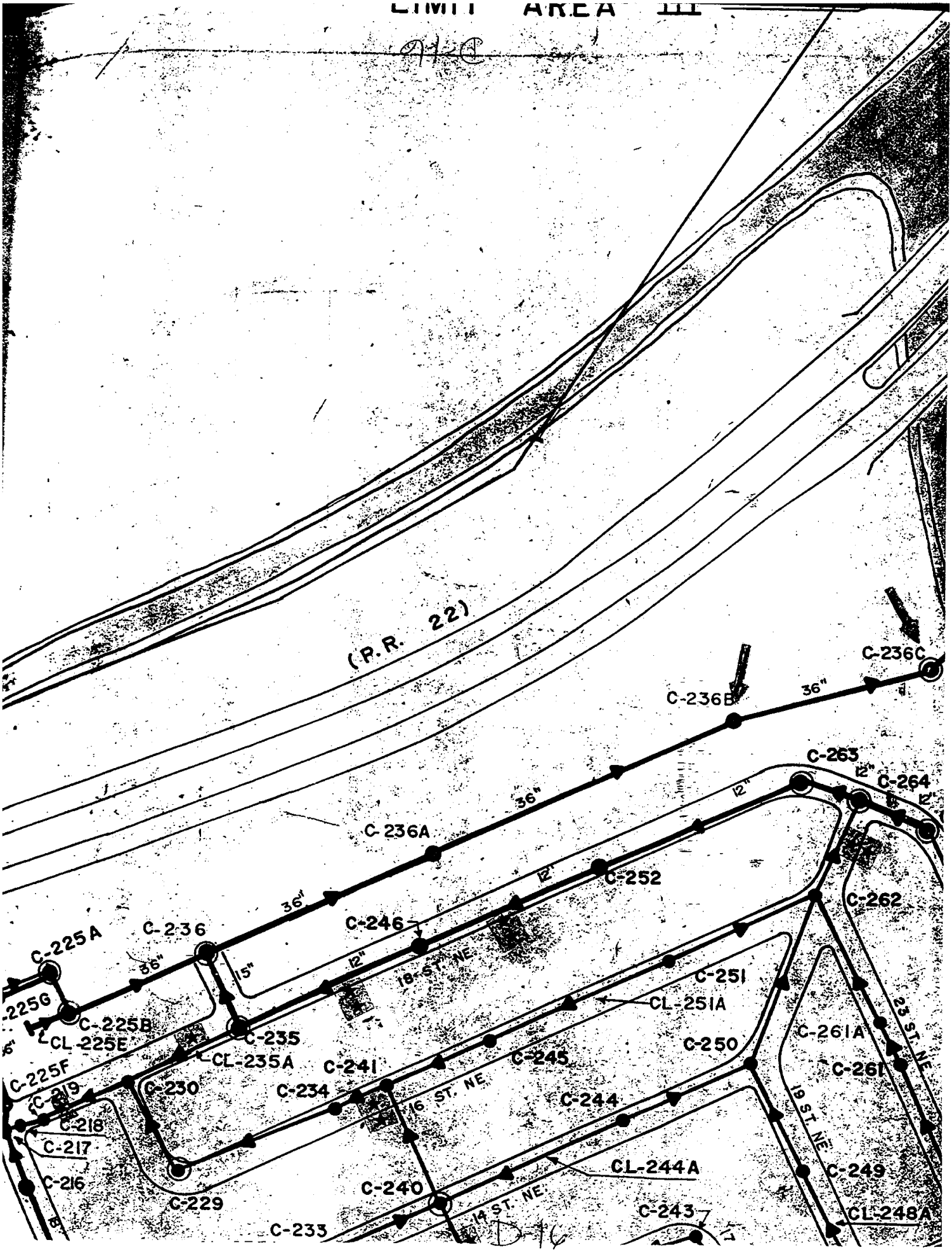
400 West Bay Street
Mail: P.O. Box 4970
Jacksonville, FL 32232-0019

Phone: (904) 232-2473
FAX: (904) 232-2131



Please call us if you have had any problems receiving or if there are any pages missing.


(P.R. 22)
C-236C
C-236B
36"
C-263
12"
C-264
12"
C-236A
36"
12"
C-252
C-262
C-225A
C-236
36"
C-246
36"
15"
12"
18 ST. NE
C-251
CL-251A
C-225G
C-225B
CL-225E
C-235
CL-235A
C-250
C-261A
23 ST. NE
C-225F
C-219
C-230
C-241
C-234
C-245
16 ST. NE
C-261
C-244
C-218
C-217
C-216
C-229
C-240
CL-244A
19 ST. NE
C-249
14 ST. NE
C-243
CL-248A
C-233


LIMIT AREA III
(P.R. 22)
C-236C
C-236B
36"
C-263
12"
C-264
12"
C-236A
36"
12"
C-252
C-262
C-225A
C-236
36"
C-246
36"
15"
12"
18 ST. NE.
C-251
CL-251A
C-225G
C-225B
CL-225E
C-235
C-261A
23 ST. NE.
C-250
C-225F
CL-235A
C-241
C-245
C-219
C-230
C-234
16 ST. NE.
C-261
C-244
C-218
C-217
19 ST. NE.
CL-244A
C-216
C-229
C-240
C-249
14 ST. NE.
C-243
CL-248A
C-233
D-16

CESAJ-EN-DM

MEMORANDUM FOR THE RECORD:

Subject: Minutes of Meeting between DNR, PRASA, and Corps at PRASA Offices, 26 February 1996, relative to the Utilities encountered by Channelization of Puerto Nuevo Contract 2.

1. Purpose: The purpose of the meeting was two fold;

a. To respond to PRASA's comments and discuss design features

b. obtain a consensus from PRASA and DNR personnel on both the desired and economical methods for relocation.

2. Participants:

Ing. Jose Arroyo	DRN	724-3422
Ing. Ing. Dennis Ortiz	PRASA	756-2297
Ing. Jose Collazo	PRASA	756-2309
Ing. Antonio Rivera-Seijo	COE	729-6833
Ing. Jimmy Acosta	COE	729-6833
Ing. Bart Shivers	COE	232-1177
Ing. Ed Brown	COE	232-3647

3. The meeting was initiated by the presentation of the 5 utility crossings that would impact the project. They are as follows:

a. 48" Water line (in vicinity of Calle 10 & 25 NE

b. Street water and sewer lines of 10 houses in vicinity of Calle 10 NE (south) Calle 25 NE (east boundary), and Calle 14 on the North.

c. 36" Sewer crossing under Margaret Channel . 400 feet upstream of De Diego Overpass

d. 30 "water line crossing (south of Roosevelt Bridge)

e. 36" Puerto Nuevo Trunk Sewer crossing under Puert Nuevo channel.

4. 48" Water line (in vicinity of Calle 10 & 25 NE)): we discussed several routing options i.e. routing North down Calle 25 to the De Diego bridge, routing it exterior on the channel wall. The most economical method would be to route it under the channel using Ball and socket pipe They would require 2 barrels in the event one had to be taken out of service. Ing. Collazo (

PRASA Water Design Department) stated it would be acceptable to PRASA.

5. Street water and sewer lines of 10 houses in vicinity of Calle 10-NE (south) Calle 25 NE (east boundary), and Calle 14 on the North. Frank Grant and I had developed a method run a collection sewer on the concrete channel wall (deep enough so it would operate by gravity) and support the 2- inch water service on the channel wall. This was acceptable to all parties.
Note: The channel alignment will be changed to minimize the number of houses taken . The exact configuration will be developed in response to this however this approach will be used.

6. - 36" Sewer crossing under Margaret Channel . 400 feet upstream of De Diego Overpass. We talked at length on this. I presented 2 options :

a. a rather shallow siphon using HDPE pipe and
b. Ductile Iron encased in concrete option that would require very deep burial as the shallow strata would not support the pipe.

Dennis Ortiz preferred the shallow option using HDPE pipe. He further requested a bar screen for the siphon (3-6 inch openings) and that I investigate the ability of HDPE pipe to resist abrasion of fine sand present in sewage. (My opinion is if the abrasion is a problem we can increase the SDR to compensate for lost pipe thickness). He further requested that siphons be designed for a minimum of 3 fps flow through velocity and preferably 6 fps (at higher flows for flushing)

Epilogue: subsequent to this our detailed showed that that sewer was laid across the channel effectively damming the channel (It was much higher than we realized). The site is behind a building(Inesco Inc.) and between the Express way in a very constrained site. so the easiest method would be to use a shallow siphon and collect the sewage on manhole upstream and tap into the pipe across the channel. The deeper pipe placement will require extensive dewatering encasement and impact the Expressway embankment. The relocation would be prohibitively expensive for this method.

7. 30 "water line (south of Roosevelt Bridge): This pipeline is approximately 100 feet south of the Roosevelt Bridge. The FDM addressed relocating this pipeline North to the Roosevelt Bridge and supporting it upon the new Replacement Bridge. The Consensus was to use this approach.

8. - 36" Puerto Nuevo Trunk Sewer line crossing under the Puerto Nuevo Channel at the intersection of the De Diego Expressway. The FDM proposes using a siphon to cross the channel at this

location however insufficient survey data was available to determine if this was hydraulically feasible. Ing. Ortiz was in agreement with the concept and initiated several phone calls to arrange an afternoon meeting with PRASA Operations Personnel that afternoon.

9. Tony Rivera, Jimmy Acosta, myself met with PRASA personnel, PRASA Operations personnel present were Juan Calderan, Ing. Vega, Jose Diaz, and several other Operations Personnel.

After some orientation, Ing. Rivera recommended that we perform a brief "recon"of the site to pin point water line crossings and locate manhole locations. This allowed Luis Ayala (DS-RE) to perform a more detailed survey on Thursday.

10. Epilogue: During the detailed survey of item 8 the Puerto Nuevo Trunk sewer we located the crossing. The manholes in vicinity of the river were covered with fill however we located the upstream manhole and located the entrance of the sewer to the Nemesio Canales Pump station on the opposite side. We collected elevations at both these locations. This allows the detailed design of the siphon crossing.

11. This is offered as record of my observations at the meeting.

Edwin Brown III, PE
Environmental Engineer

Itinerary: Antilles Office TDY 29 Jan to 2 Feb 96

Personnel From CESAJ-EN-DM, Mechanical & Electrical Section:

- Frank Grant, Environmental Engineer, (904) 232-1050
- Bart Shivers, Electrical Engineer, (904) 232-1177

Projects

- Rio Puerto Nuevo Contracts 2 and 2A (Primary)
- Rio Grande de Loiza Contract 1 (Secondary)

Problems and Issues

- Several sewer pipes, water pipes, power lines, telephone lines, and television cable cross under and over the Rio Puerto Nuevo, Margarita, and Caguitas Channels and must be relocated as part of the channel projects; however, the Corps' survey contractor has not been able to supply sufficient information on those lines to allow adequate relocation design.

- Review of design options would be speeded by meeting directly with utility people and DS.

Purposes of TDY

- Become familiar with the project sites and utilities involved

- Meet with representatives of PRASA, PREPA, and DS to verify the locations and technical details of utilities; obtain as-built drawings of utilities.

- Discuss relocation design options with utilities and DS.

- Walk the project sites with PRASA, PREPA, and an Antilles Office surveyor to inspect for utility features; measure and locate as necessary.

Proposed Schedule

- Monday, 29 Jan: Travel; Jax to San Juan, PR. Arr. 2:01 p.m.

- Tuesday, 30 Jan: Puerto Nuevo and Loiza Projects. Parallel water/sewer and electrical meetings at COE Antilles office

    - 9:00 a.m. - 2:30 p.m.; **Water & Sewer/Puerto Nuevo** - Meeting between Frank Grant of COE, Engs. Dennis Ortiz (sewer systems) and José Collazo (water systems) of PRASA and José Arroyo of DNER. Discuss locations and details of existing pipes and pump stations for the Rio Puerto Nuevo project. Discuss relocation design options, including pipe materials and construction costs.

    - 9:00 a.m. - 5:30 p.m.; **Electrical/Puerto Nuevo** - Meeting between Bart Shivers of COE, a representative of PREPA , a representative of the Puerto Rico Telephone Company, and Guillermo Schwars or Jorge Ilarraza of Cable Television of Greater San Juan to discuss locations and details of existing lines, poles, and towers.

Discuss relocation design options. This meeting may adjourn early for a field inspection of electrical features.

- 2:30 p.m. - 5:30 p.m.; **Water & Sewer/Loiza** - Meeting between Frank Grant of COE, Engs. Dennis Ortiz and Antonio Avila (sewer systems) and a water systems engineer from PRASA and José Arroyo of DNER. Discuss locations and details of existing pipes and pump stations for the Rio Grande de Loiza project. Discuss relocation design options. If this meeting finishes early, go on a familiarization field trip of the Puerto Nuevo site.

- Wednesday, 31 Jan: Puerto Nuevo Project Field Trip

  - 9:00 a.m. - 5:30 p.m. **Water & Sewer/Puerto Nuevo** - Puerto Nuevo project site inspection: Frank Grant of COE, Engs. Ortiz, Collazo, Arroyo, PRASA Operations personnel, and a DS surveyor to check for sewer and water features, e.g., manholes, buried lines, pump stations. Photograph, note, and measure as necessary. Metal detection equipment for locating buried manhole covers and magnetic tracing tape above underground pipes would be helpful, as would shovels.

  - 9:00 a.m. - 5:30 p.m. **Electrical/Puerto Nuevo** - Walk the Puerto Nuevo project site with representatives of PREPA and the Puerto Rico Telephone Company, Guillermo Schwars or Jorge Ilarraza of Cable Television of Greater San Juan, and José Arroyo of DNER, and a DS surveyor to check for power, telephone, and television cable. Photograph, note, and measure as necessary.

- Thursday, 1 Feb: Loiza/Caguitas Project Field Trip

  - 9:00 p.m. - 5:30 p.m. **Water, Sewer, and Electrical/Loiza** - Loiza/Caguitas project site inspection: Frank Grant & Bart Shivers of COE, Engs. Ortiz, a PRASA water systems engineer, Arroyo, Schwars or Ilarraza, a PREPA representative, a representative of Puerto Rico Telephone Company, and a DS surveyor to check for sewer, water, and electrical features. Photograph, note, and measure as necessary. Metal detection equipment for locating buried manhole covers and magnetic tracing tape above underground pipes would be helpful, as would shovels.

- Friday, 2 Feb 10:59 a.m. Return travel to Jax.

Cognizant PRASA Personnel

- Eng. Dennis Ortiz, sewer systems: we want to meet with Eng. Ortiz to discuss both projects.
- Eng. Antonio Avila, sewer systems: we want to meet with Eng. Avila to discuss Loiza/Caguitas.
- Eng. José Collazo, water systems: we want to meet with Eng. Collazo to discuss the Puerto Nuevo project.
- A PRASA water systems engineer responsible for water lines affected by the Loiza project.

Cognizant PREPA Personnel

- Eng. Thomas Velez - Primary PREPA POC
- Cognizant working level people who can discuss both projects

Puerto Rico Telephone Company

- Cognizant working level people who can discuss both projects

Cable Television of Greater San Juan

- Mr. Guillermo Schwars, (809) 766-0909 x 4600 and/or Mr. Jorge Ilarraza, (809) 766-0909 x 4606

Note: Areas of concern for telephone and cable television lines are along Andalucia down to Adelina Substation and the Roosevelt Bridge.

Cable Television/Caguas

- Cognizant working level people who can discuss the Rio Grande de Loiza project

DNER

- José Arroyo - (809) 724-3422: we want to meet with Mr.Arroyo to discuss both projects.

Author: Edwin Brown at EN
Date: 1/11/96 1:38 PM
Priority: Normal
TO: Shashi Makker
CC: Frank J Grant
CC: Edwin Brown
Subject: Reply to Newman's CCmail on outstanding issues for PN utilit

---------- Message Contents ----------

Enclsoed is a list of information that you, Frank and I discussed yesterday. This is offered so it can be easily consolidated with Barts list and sent to Newman and Jose Arroyo. The Faxes to PRASA are offered as attachment.
PRASA Information

1. Survey Information: This was requested of Survey Contractor. They have been unable to obtain this.
Mr. Ayalla (DS-RE) has helped obtain this in the past and might be able to assist us.

Locations:

a. 48" Water line (in vicinity of Calle 10 & 25 NE)

(1) Find crossing and pin point it on survey drawings. Determine burial depth if possible.
(2) This will require looking for appurtenances ie valves air releases etc. then using a. metal detector for final verification

b. Street water and sewer lines of 10 houses in vicinity of Calle 10 NE (south) Calle 25 NE (east boundary), and Calle 14 on the North. Require site visit to determine good engineering solution for installing water and collection sewers.

c. 36" Sewer line under De Diego Expressway. (also Known as Puerto Nuevo Trunk Sewer)

(1) Sewer terminates at Pump Station on West Side of River.

(2) Survey shows it going across river (by gravity) to a second pump station on east. Side. This does not make sense.

(3) Require depth of crossing and inverts of pump stations so we can determine a way to get it across the rive by gravity.

d. 36" Sewer line under Margaret Channel . 400 feet upstream of De Diego Overpass

(1) Manholes on opposite side of channel could not be located.
(2) These manholes need to be found as

well as inverts so we can design a siphon crossings

e. 30 "water line (south of Roosevelt Bridge)

(1) Surveyor did not find this. The location and depth needs to be found so we can design a relocation and support upon the Roosevelt Bridge.

2. Answer to Technical Questions of November 17, 1995 FAX

a. Capacity and heads of pumpstations refereed to in par. 1. c. (1) & (2).

b. Confirmation on Puerto Nuevo Trunk Sewer Crossing at this location.

c. Comments on plan street sewer relocation for houses between Calle 10 & 25 par. 1 b above .

d. Margarita 36 " crossing Comments on crossing plan submitted and capacity of sewer for design purposes.

3. Discussions with Eng. Collazo on Waterline Plates.

further discussion on the use of HDPE pipe for water lines where concrete encasement and piles are very expensive. We would like to get some approval for using this pipe just at crossings as it can tolerate pressure and does not have the complicated support requirements. I would like to perform a cost comparison between to the three piping systems (Concrete, Ductile Iron, & HDPE) to see the if there is significant cost savings . If there is a huge cost difference s (like the Miramar and San Jose Siphons) than I would like to explore further discussions with Collazo to see if this pipe can be approved and economically benefit the project.

Author: Robert J Newman at DP
Date: 12/19/95 3:20 PM
Priority: Normal
TO: Frank J Grant at EN
TO: Shashi Makker at EN
Subject: POC, Cable TV of San Juan
---------- Message Contents ----------

FYI

---------- Forward Header ----------
Subject: POC, Cable TV of San Juan
Author: Yamil Castillo at ANTILLES
Date: 12/19/95 3:33 PM

Bob:

The POC at Cable TV of San Juan are:

1. Mr. Guillermo Schwars 766-0909 x-4600

2. Mr. Jorge Ilarraza 766-0909 x-4606

I told I would be contacting them for a meeting during the week of 22 January to discuss the Puerto Nuevo project.

Still no contact with PR Telephone Co.

D-25

December 12, 1995

Engineering Division
Design Branch

SUBJECT: As-Built Plans for the Relocation of Potable Water and Sewer Lines to be Affected by Contract 2 of the Rio Puerto Nuevo Project

Eng. Alex Melendez
Puerto Rico Aqueduct and Sewer Authority
Engineering Director
P.O. Box 7066
Bo. Obrero Station
Santurce, Puerto Rico 00916

Dear Eng. Melendez:

As we discussed in our letter of October 27, we are continuing work on Feature Design Memorandum No. 2 for the Rio Puerto Nuevo flood control project.

At the current stage of utility relocation design, the need for additional detailed information on the existing water and sewer lines has become apparent. However, a surveyor retained by the Corps of Engineers has not been able to locate all of the features necessary to complete the relocation design. The data that we are specifically seeking are the following:

Sewers:

Manhole locations, top elevations, materials
Pipe inverts, diameters, materials
Flow capacity requirements
Pump station hardware and specifications

Water Lines:

Pipe locations, elevations, diameters, materials

As the point of contact for PRASA, we request that you send us copies of as-built drawings for each of the water and sewer lines shown on the attached drawings. If information more current than as-builts is available, we would prefer the most recent data.

D-26

Attached are copies of portions of PRASA's Water System Maps and 1982 San Juan Sewer System Evaluation Survey showing the lines for which data is needed. These lines are the same ones addressed in the relocation plates attached to our October 27 letter. Please let us know if your maps show utility crossings other than the ones we have identified.

We have been in discussions with Eng. Dennis Ortiz about the sewer relocations, but have yet to receive a response to the water line relocation plates sent in October. We will need these water line comments for the proper completion of the utility portions of this project.

As-built drawings are needed by January 19, 1996. The project sponsor, The Department of Natural and Environmental Resources (DNER), has requested that you provide these drawings to them so that they may review them prior to forwarding to us. You may send the drawings directly to Mr. Ramon Alonso Harris, Asst. Administrator for Natural Resources, DNER, P.O. Box 5887, Puerta de Tierra, Puerto Rico 00906, or by calling him directly for pickup at 725-3852. Any special concerns regarding these plans will be discussed at our next oversight committee meeting, currently set for early February. Your continued support on this vital project is appreciated.

The technical point of contact for discussion of these relocations is Frank Grant at 904-232-1050; fax 904-232-2131.

Sincerely,

Edward E. Middleton, Ph.D., P.E.
Chief, Engineering Division

Enclosures

Copies Furnished:

Mr. Carmello Caes, Director of Strategic Planning, Puerto Rico Aqueduct & Sewer Authority
Mr. Ramon Alonso Harris, Assistant Administrator for Natural Resources, Puerto Rico Department of Natural and Environmental Resources

bcc (w/encl):
CESAJ-DP-I (R. Newman)
CESAJ-DS-CO
CESAJ-DS-PD
CESAJ-EN-DS (J. Tanner)

Grant/CESAJ-EN-DM/1050/bs
Makker/CESAJ-EN-DM
Newman/CESAJ-DP-I
Jaeger/CESAJ-EN-DA
Lockhart/CESAJ-EN-D
Sanders/CESAJ-EN-A

Confirmation of Preliminary PRASA

Waterline Comments; Puerto Nuevo Project

1. **Collazo**: Of the two relocation options for the 48-inch water pipe crossing under the channel, the preferred option is to run the pipe under the channel in its current location rather than to take it on a 3400-foot run, some of which would be through city streets, that would allow it to cross the De Diego bridge.

Grant: We will pursue this option. It appears that it may be much less expensive than the other.

2. **Collazo**: On the relocation of the 48-inch water pipe crossing the channel, the replacement pipe may be a single 48-inch line if the construction is heavy. If there is any question about joint leakage, pipe cracking, or clogging, dual 36-inch lines should be considered so that one line can handle most of the demand while the other undergoes maintenance.

Grant: We will consider the advantages of the dual-pipe option, since maintenance access will be limited.

3. **Collazo**: Water pipes must be installed a minimum of 6 feet below the bottom of the channel.

Grant: Concur; we understand that this is PRASA standard practice.

4. **Collazo**: Water line under the channel should be either prestressed concrete or ductile iron pipe. The pipe should be encased in concrete. Plastic pipe materials are not favored by PRASA.

Grant: We understand that these requirements are part of the PRASA design manual. (However, we are evaluating some newer pipe materials and installation methods that could dramatically reduce construction costs. We would like to discuss them when we meet to see whether they would meet your service needs.)

5. **Collazo**: Ball-and-socket pipe joints should be used.

Grant: (same as in #4 above)

6. **Collazo**: In reference to the Roosevelt Avenue Bridge water line crossing: If a water pipeline is hung from an existing bridge, a DOT permit is required to allow review of the added load on the structure. If the pipeline is to be hung from a new bridge, the bridge should be designed to accept the pipeline load.

Grant: Concur. (This bridge will be replaced. A sketch of the proposed relocation will be forwarded to the bridge designers)

November 17, 1995

Eng. Ortiz:

Thank you for your comments on our recent submittal of utility relocation plans for Puerto Nuevo Contract 2. I'd like to further clarify the points covered:

1. **Relocate 36" Sewer Crossing; De Diego E'Way Bridge:**

   After seeing the system map you sent to Ed Brown, I see that this sewer, highlighted in green, is the Puerto Nuevo Trunk Sewer, which crosses under the channel as shown and then flows into the San Jose Trunk Sewer just southeast of the siphon under the Rio Puerto Nuevo. Is this the same sewer that your comments refer to as a storm sewer? Please note that the existing Puerto Nuevo Trunk Sewer is highlighted in green on the drawing, while a possible relocation of this line onto the bridge is highlighted in yellow.

   Would you please confirm whether the Puerto Nuevo Trunk Sewer is part of the sanitary or storm systems. If it is part of the sanitary system, is it pumped by the pumphouse on the channel's west bank as shown, or is it strictly a gravity-flow sewer? What is its flow capacity?

   Your comments on the pump stations are noted. What is the required flow capacity of the pump stations on the east bank? We will request as-built plans for these and other features in order to complete the design.

2. **Calle 25 Water & Sewer Location Conflict:**

   As shown on the drawing, the intent of the project designers is to remove a section of Calle 25. Structural piles will be driven in this area, requiring relocation of the sewer and water utilities. Some possible options under consideration at this point are:

   - Reroute the sewer and water lines behind the houses along Calle 25. The line routing would be difficult, as would the house connections. This solution could require additional house demolitions and be very difficult to install and maintain. Some of the work might involve replumbing inside or beneath each house.

   - Relocate all connections for houses along Calle 25 back to Calle 23. Upgrade the lines along Calle 23 to handle the additional loads. The difficulty with this approach is the narrow space between buildings in which to place the house connections. This approach would also require running house connections on the property of other property owners. Again, some of the work might involve replumbing inside or beneath each house.

   - Relocate the sewer and water pipes from under Calle 25 to the top of the new channel wall in protective trenches or chases. This approach would require installing a sanitary pump station in the sewer line where manhole SMH-228 is marked on my drawing, pumping the flow up into the new line on top of the new channel wall, and letting it gravity flow into the existing manhole at the intersection of Calle 25 and Calle 14. Each of the six houses affected would require a sanitary sump and pumps to push its discharge into the main line through similar trenches or pipe chases in the concrete in front of the houses. Drinking water distribution could be similarly routed. The concerns with this approach are the cost of the pump station and sumps, finding the space to

install the individual sumps, determining who will own and maintain the individual sumps, avoiding complications in the design of the channel wall design, and adding complexity to the sewer system.

I'm open to all suggestions on relocation of this conflict, and would also appreciate your comments on the above options.

3. **Margarita 36" Sewer Crossing**

One of the plates submitted showed an existing 36" gravity sewer crossing under the Margarita Channel roughly 140 meters (400 feet) upstream of the De Diego Expressway overpass. The plate also shows a proposed siphon (highlighted in yellow) that could be used to accommodate construction of the channel improvements. I noted that your letter did not include comments on this crossing - did you receive this third sewer plate and have an opportunity to review it? I'm including a copy of it.

What is the rated capacity of this sewer crossing?

4. **San Juan System Map**

The system map that Ed Brown received appears to show a 72" diameter sewer running next to the 90" diameter San Jose sewer into the wastewater plant. The map's legend indicates that this line is proposed. Has this line been constructed? If it is still proposed, its design can be adjusted for the proposed channel width.

October 27, 1995

Engineering Division
Design Branch

SUBJECT: Relocation of Potable Water and Sewer Lines to be Affected by Contract 2 of the Rio Puerto Nuevo Project

Eng. Alex Melendez
Puerto Rico Aqueduct and Sewer Authority
Engineering Director
P.O. Box 7066
Bo. Obrero Station
Santurce, Puerto Rico 00916

Dear Eng. Melendez:

We have initiated work on Feature Design Memorandum No. 2 for the Rio Puerto Nuevo flood control project. As Mr. Bob Newman briefed you at the last meeting of the Puerto Nuevo Oversight Committee, this will include Quebrada Margarita and the Rio Piedras channel improvements from the Diego Expressway Bridge to about 1000 feet downstream of the Las Americas Expressway. Work will include replacement of the Roosevelt Avenue Bridge as well as modifications to the De Diego Expressway Bridges over Rio Piedras and Quebrada Margarita.

As the point of contact for PRASA, we are sending you two copies of drawings for coordination within your agency showing conflicts between the channel project and existing water and sewer utilities. Drawings dealing with the relocation of the San Jose Sewer siphon are not included in this package; this issue will be dealt with separately at a later date. Options for utility relocation are shown in some cases. We request that members of your staff review these drawings, comment on them, and discuss suggestions and concerns with us in order to arrive at a suitable design approach.

For your information, we are providing a list of PRASA staff that in the past have been contacted or involved in discussions of this project: Engrs. Benedicto Colón, Dennis Ortiz, and Antonio Avila.

Your comments and information are needed by November 20, 1995. Details will be discussed at our next oversight committee meeting, currently set for January. Your continued support on this vital project is appreciated.

The technical point of contact for discussion of these relocations is Frank Grant at 904-232-1050; fax 904-232-2131.

Sincerely,

for Edward E. Middleton, Ph.D., P.E.
Chief, Engineering Division

Enclosures

Copy Furnished:

Mr. Carmello Caes, Director of Strategic Planning, Puerto Rico Aqueduct & Sewer Authority

Ms. Lizbeth Hyman, Assistant Secretary for Water and Mineral Resources, Puerto Rico Department of Natural and Environmental Resources

bcc:
CESAJ-DS-CO
CESAJ-DS-PD
CESAJ-EN-DS/J. Tanner
CESAJ-DP-I/R. Newman (wo/encl)

FGrant/CESAJ-EN-DM/1050/bs
Makker/CESAJ-EN-DM
Newman/CESAJ-DP-I
Jaeger/CESAJ-EN-DA
Lockhart/CESAJ-EN-D
Sanders/CESAJ-EN-A

RIO PUERTO NUEVO, PUERTO RICO
FEATURE DESIGN MEMORANDUM 2

APPENDIX E

UTILITY RELOCATION DESIGN NOTES

PROJECT	Page 1 of —	COMPUTED BY	DATE
PUERTO NUEVO FDM-2		PK	2/16/96
SUBJECT		CHECKED BY	DATE
MARGARITA 36" SEWER CROSSING			

PROBLEM: THE EXISTING SEWER LINE NEEDS TO BE REMOVED AND A NEW SIPHON NEEDS TO BE INSTALLED DUE TO THE CONSTRUCTION DREDGING OF THE MARGARITA CHANNEL.

DESIGN NOTES:

ASSUMPTIONS:

Q = 18 MGD ref. PRASA planning map

Headable = 1' from practical experience

Criteria

* Surface Elevations from Server file
* Layout from server file
* Influent MH invert elevation from Server
* Effluent MH unknown

Hazen Williams Calc,

$$V = 1.318\, C R^{.63} \left(\frac{H}{l}\right)^{.54}$$

$Q = VA$ ft & S

also cfs → MGD mult. by 0.65

PROJECT		Page 2 of —	COMPUTED BY	DATE
PUERTO NUEVO FDM-2			PK	2/15/96
SUBJECT			CHECKED BY	DATE
MARGARITA 36" SEWER CROSSING				

Equivalent Length, l was calculated by adding the total length of pipe used in design plus friction loss due to fittings. Results are tabulated as follows: Ref. "Resistance of Values and Fittings to Flow of Fluids"

EQUIVALENT LENGTH

Dia (in)	Sudden Contraction	Sudden Enlargement	45°	90° STD ELBOW Tee ½	Length of pipe	Total Length (ft)
14	8	8	17	37	91	① 175
					110	② 244
16	11	11	19	[redacted]	91	① 189
					110	② —
18	12	12	22	[redacted]47	91	① 203
					110	② 320
20	13	13	24	53	91	① 213
					110	② 348
24	14	14	30	63	91	① 239
					110	② 390
30	16	16	37	80	91	① 271
					110	② 462
36	20	20	42	100	91	① 299
					110	② 550

NOTE:
1) Plastic Pipe
2) Cast Iron

Calculation of 30" RCP-

flowing full Q $n = .0016$ $n = .013$

$$Q = \frac{.276}{n} D^{8/3} \sqrt{S} \qquad V = \frac{1.127}{N} D^{2/3} S^{1/2}$$

$$Q = \frac{.276}{.013} \left(\frac{30}{12}\right)^{8/3} \sqrt{.0016}$$

$$= (21.2308)\left(\frac{30}{12}\right)^{8/3} \sqrt{}$$

$$= 9.77 \text{ cfs} \quad 7387 \text{ gpm} = 10.6 \text{ MGD}$$

$$\frac{25}{30} = \frac{y}{d_w} = .8333$$

$$\frac{A}{D^2} = .70 \qquad A = (.70)\left(\frac{30}{12}\right)^2 = 4.37 \text{ ft}^2$$

$$\frac{AR^{2/3}}{d_w^{8/3}} = .3165 \qquad AR^{2/3} = (.3165)\left(\frac{2.5}{12}\right)^{2.667} = 3.6448$$

$$Q = AV = A\left(\frac{1.486}{n}\right) R^{2/3} S^{1/2}$$

$$q = AV = \left(\frac{A(1.486)}{n}\right) R^{2/3} S^{1/2} =$$

$$= \left(\frac{1.486}{.013}\right) 3.6448 \sqrt{.0016}$$

$$= 416.63 \sqrt{.0016} = 16.66 \text{ CFS} = 10.82 \text{ MGD}$$

=

APPENDIX A. GEOMETRIC ELEMENTS FOR CIRCULAR CHANNEL SECTIONS (*continued*)

$\frac{y}{d_0}$	$\frac{A}{d_0^2}$	$\frac{P}{d_0}$	$\frac{R}{d_0}$	$\frac{T}{d_0}$	$\frac{D}{d_0}$	$\frac{Z}{d_0^{2.5}}$	$\frac{AR^{2/3}}{d_0^{8/3}}$
0.31	0.2074	1.1810	0.1755	0.9250	0.2242	0.0981	0.0650
0.32	0.2167	1.2025	0.1801	0.9330	0.2322	0.1044	0.0690
0.33	0.2260	1.2239	0.1848	0.9404	0.2404	0.1107	0.0736
0.34	0.2355	1.2451	0.1891	0.9474	0.2486	0.1172	0.0776
0.35	0.2450	1.2661	0.1935	0.9539	0.2568	0.1241	0.0820
0.36	0.2546	1.2870	0.1978	0.9600	0.2652	0.1310	0.0864
0.37	0.2642	1.3078	0.2020	0.9656	0.2736	0.1381	0.0909
0.38	0.2739	1.3284	0.2061	0.9708	0.2822	0.1453	0.0955
0.39	0.2836	1.3490	0.2102	0.9755	0.2908	0.1528	0.1020
0.40	0.2934	1.3694	0.2142	0.9798	0.2994	0.1603	0.1050
0.41	0.3032	1.3898	0.2181	0.9837	0.3082	0.1682	0.1100
0.42	0.3132	1.4101	0.2220	0.9871	0.3172	0.1761	0.1147
0.43	0.3229	1.4303	0.2257	0.9902	0.3262	0.1844	0.1196
0.44	0.3328	1.4505	0.2294	0.9928	0.3352	0.1927	0.1245
0.45	0.3428	1.4706	0.2331	0.9950	0.3446	0.2011	0.1298
0.46	0.3527	1.4907	0.2366	0.9968	0.3538	0.2098	0.1348
0.47	0.3627	1.5108	0.2400	0.9982	0.3634	0.2186	0.1401
0.48	0.3727	1.5308	0.2434	0.9992	0.3730	0.2275	0.1452
0.49	0.3827	1.5508	0.2467	0.9998	0.3828	0.2366	0.1505
0.50	0.3927	1.5708	0.2500	1.0000	0.3928	0.2459	0.1558
0.51	0.4027	1.5908	0.2531	0.9998	0.4028	0.2553	0.1610
0.52	0.4127	1.6108	0.2561	0.9992	0.4130	0.2650	0.1664
0.53	0.4227	1.6308	0.2591	0.9982	0.4234	0.2748	0.1715
0.54	0.4327	1.6509	0.2620	0.9968	0.4340	0.2848	0.1772
0.55	0.4426	1.6710	0.2649	0.9950	0.4448	0.2949	0.1825
0.56	0.4526	1.6911	0.2676	0.9928	0.4558	0.3051	0.1878
0.57	0.4625	1.7113	0.2703	0.9902	0.4670	0.3158	0.1933
0.58	0.4723	1.7315	0.2728	0.9871	0.4786	0.3263	0.1987
0.59	0.4822	1.7518	0.2753	0.9837	0.4902	0.3373	0.2041
0.60	0.4920	1.7722	0.2776	0.9798	0.5022	0.3484	0.2092
0.61	0.5018	1.7926	0.2797	0.9755	0.5144	0.3560	0.2146
0.62	0.5115	1.8132	0.2818	0.9708	0.5270	0.3710	0.2199
0.63	0.5212	1.8338	0.2839	0.9656	0.5398	0.3830	0.2252
0.64	0.5308	1.8546	0.2860	0.9600	0.5530	0.3945	0.2302
0.65	0.5404	1.8755	0.2881	0.9539	0.5666	0.4066	0.2358

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APPENDIX A. GEOMETRIC ELEMENTS FOR CIRCULAR CHANNEL SECTIONS (*continued*)

$\frac{y}{d_0}$	$\frac{A}{d_0^2}$	$\frac{P}{d_0}$	$\frac{R}{d_0}$	$\frac{T}{d_0}$	$\frac{D}{d_0}$	$\frac{Z}{d_0^{2.5}}$	$\frac{AR^{2/3}}{d_0^{8/3}}$
0.66	0.5499	1.8965	0.2899	0.9474	0.5804	0.4188	0.2407
0.67	0.5594	1.9177	0.2917	0.9404	0.5948	0.4309	0.2460
0.68	0.5687	1.9391	0.2935	0.9330	0.6096	0.4437	0.2510
0.69	0.5780	1.9606	0.2950	0.9250	0.6250	0.4566	0.2560
0.70	0.5872	1.9823	0.2962	0.9165	0.6408	0.4694	0.2608
0.71	0.5964	2.0042	0.2973	0.9075	0.6572	0.4831	0.2653
0.72	0.6054	2.0264	0.2984	0.8980	0.6742	0.4964	0.2702
0.73	0.6143	2.0488	0.2995	0.8879	0.6918	0.5100	0.2751
0.74	0.6231	2.0714	0.3006	0.8773	0.7104	0.5248	0.2794
0.75	0.6318	2.0944	0.3017	0.8660	0.7296	0.5392	0.2840
0.76	0.6404	2.1176	0.3025	0.8542	0.7498	0.5540	0.2888
0.77	0.6489	2.1412	0.3032	0.8417	0.7710	0.5695	0.2930
0.78	0.6573	2.1652	0.3037	0.8285	0.7934	0.5850	0.2969
0.79	0.6655	2.1895	0.3040	0.8146	0.8170	0.6011	0.3008
0.80	0.6736	2.2143	0.3042	0.8000	0.8420	0.6177	0.3045
0.81	0.6815	2.2395	0.3044	0.7846	0.8686	0.6347	0.3082
0.82	0.6893	2.2653	0.3043	0.7684	0.8970	0.6524	0.3118
0.83	0.6969	2.2916	0.3041	0.7513	0.9276	0.6707	0.3151 ←
0.84	0.7043	2.3186	0.3038	0.7332	0.9606	0.6897	0.3182
0.85	0.7115	2.3462	0.3033	0.7141	0.9964	0.7098	0.3212
0.86	0.7186	2.3746	0.3026	0.6940	1.0354	0.7307	0.3240
0.87	0.7254	2.4038	0.3017	0.6726	1.0784	0.7528	0.3264
0.88	0.7320	2.4341	0.3008	0.6499	1.1264	0.7754	0.3286
0.89	0.7380	2.4655	0.2996	0.6258	1.1800	0.8016	0.3307
0.90	0.7445	2.4981	0.2980	0.6000	1.2408	0.8285	0.3324
0.91	0.7504	2.5322	0.2963	0.5724	1.3110	0.8586	0.3336
0.92	0.7560	2.5681	0.2944	0.5426	1.3932	0.8917	0.3345
0.93	0.7612	2.6061	0.2922	0.5103	1.4918	0.9292	0.3350
0.94	0.7662	2.6467	0.2896	0.4750	1.6130	0.9725	0.3353
0.95	0.7707	2.6906	0.2864	0.4359	1.7682	1.0242	0.3349
0.96	0.7749	2.7389	0.2830	0.3919	1.9770	1.0888	0.3340
0.97	0.7785	2.7934	0.2787	0.3412	2.2820	1.1752	0.3322
0.98	0.7816	2.8578	0.2735	0.2800	2.7916	1.3050	0.3291
0.99	0.7841	2.9412	0.2665	0.1990	3.9406	1.5554	0.3248
1.00	0.7854	3.1416	0.2500	0.0000	∞	∞	0.3117

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PE 3408 Industrial Piping System
Pipe Data and Pressure Ratings — Bulletin No. 301

PLEXCO

(Pipe weights are calculated in accordance with PPI TR-7)
Average inside diameter calculated on minimum wall plus 6%.

Pressure Ratings are for water at 73°F. For other fluids and service temperatures ratings may differ, refer to Application Note No. 6 Chemical and Environmental Considerations.

[illegible] Rating																	
IPS* Pipe Size	Nominal OD (in.)	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT	IPS* Pipe Size
1¼"	1.660	0.227	1.179	0.44	0.184	1.270	0.37	0.151	1.340	0.31	0.123	1.399	0.26	0.107	1.433	0.23	1¼"
1½"	1.900	0.260	1.349	0.58	0.211	1.453	0.49	0.173	1.533	0.41	0.141	1.601	0.34	0.123	1.639	0.30	1½"
2"	2.375	0.325	1.686	0.91	0.264	1.815	0.76	0.216	1.917	0.64	0.176	2.002	0.53	0.153	2.051	0.47	2"
3"	3.500	0.479	2.485	1.98	0.389	2.675	1.65	0.318	2.826	1.39	0.259	2.951	1.15	0.226	3.021	1.02	3"
4"	4.500	0.616	3.194	3.27	0.500	3.440	2.74	0.409	3.633	2.30	0.333	3.794	1.90	0.290	3.885	1.67	4"
5⅜"	5.375	0.736	3.815	4.66	0.597	4.109	3.90	0.489	4.338	3.27	0.398	4.531	2.72	0.347	4.639	2.40	5⅜"
5"	5.563	0.762	3.948	5.00	0.618	4.253	4.18	0.506	4.490	3.50	0.412	4.690	2.91	0.359	4.802	2.57	5"
6"	6.625	0.908	4.700	7.09	0.736	5.065	5.93	0.602	5.349	4.97	0.491	5.584	4.13	0.427	5.720	3.64	6"
7⅛"	7.125	0.976	5.056	8.20	0.792	5.446	6.87	0.648	5.751	5.75	0.528	6.006	4.78	0.460	6.150	4.21	7⅛"
8"	8.625	1.182	6.119	12.01	0.958	6.594	10.05	0.784	6.963	8.42	0.639	7.270	7.00	0.556	7.446	6.16	8"
10"	10.750	1.473	7.627	18.66	1.194	8.219	15.62	0.977	8.679	13.09	0.796	9.062	10.87	0.694	9.279	9.59	10"
12"	12.750	1.747	9.046	26.25	1.417	9.746	21.97	1.159	10.293	18.42	0.944	10.749	15.30	0.823	11.005	13.47	12"
13¾"	13.375	1.832	9.491	28.88	1.486	10.225	24.17	1.216	10.797	20.26	0.991	11.274	16.83	0.863	11.545	14.83	13¾"
14"	14.000	1.918	9.934	31.64	1.556	10.701	26.49	1.273	11.301	22.20	1.037	11.802	18.44	0.903	12.086	16.24	14"
16"	16.000	2.192	11.353	41.34	1.778	12.231	34.61	1.455	12.915	29.00	1.185	13.488	24.09	1.032	13.812	21.21	16"
18"	18.000	2.466	12.772	52.31	2.000	13.760	43.79	1.636	14.532	36.69	1.333	15.174	30.48	1.161	15.539	26.85	18"
20"	20.000	2.740	14.191	64.57	2.222	15.289	54.05	1.818	16.146	45.30	1.481	16.860	37.64	1.290	17.265	33.13	20"
22"	22.000	3.014	15.610	78.15	2.444	16.819	65.41	2.000	17.760	54.82	1.630	18.544	45.56	1.419	18.992	40.09	22"
24"	24.000	3.288	17.029	92.99	2.667	18.346	77.85	2.182	19.374	65.24	1.778	20.231	54.22	1.548	20.718	47.72	24"
†26"	26.000	3.562	18.449	109.15	2.889	19.875	91.35	2.364	20.988	76.58	1.926	21.917	63.63	1.677	22.445	56.02	†26"
†28"	28.000				3.111	21.405	105.96	2.545	22.605	88.79	2.074	23.603	73.76	1.806	24.171	64.94	†28"
†30"	30.000				3.333	22.934	121.62	2.727	24.219	101.94	2.222	25.289	84.68	1.935	25.898	74.56	†30"
†32"	32.000							2.909	25.833	115.99	2.370	26.976	96.35	2.065	27.622	84.88	†32"
†34"	34.000							3.091	27.447	130.92	2.519	28.660	108.80	2.194	29.349	95.83	†34"
†36"	36.000													2.323	31.075	107.40	†36"
†42"	42.000																†42"
†48"	48.000																†48"
†54"	54.000																†54"

* Industrial PE (polyethylene) pipe sizes are identified by IPS (iron pipe size) diameters which designate the nominal diameter for 12" IPS AND SMALLER PIPE, AND O.D. (outside diameter) for 14" IPS and larger pipe.

PLEXCO can produce to specialized pipe dimensions. Check with your PLEXCO sales office for availability of dimensions not listed

† **SUBJECT TO MINIMUM ORDER QUANTITIES, AND AVAILABILITY OF TOOLING.**

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Rev. 3/93

PE 3408 Industrial Piping System
Pipe Data and Pressure Ratings

Bulletin No. 301

Chevron Plexco

(Pipe weights are calculated in accordance with PPI TR-7)
Average inside diameter calculated on minimum wall plus 6%.

Pressure Ratings are for water at 73°F. For other fluids and service temperatures ratings may differ, refer to Application Note No. 6 Chemical and Environmental Considerations.

IPS* Pipe Size	Nominal OD (in.)	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT	IPS* Pipe Size
1¼"																	1¼"
1½"																	1½"
2"	2.375	0.140	2.078	0.43													2"
3"	3.500	0.206	3.063	0.93													3"
4"	4.500	0.265	3.938	1.54	0.214	4.046	1.26										4"
5⅜"	5.375	0.316	4.705	2.20	0.256	4.832	1.80	0.207	4.936	1.47							5⅜"
5"	5.563	0.327	4.870	2.35	0.265	5.001	1.93	0.214	5.109	1.58							5"
6"	6.625	0.390	5.798	3.34	0.315	5.957	2.73	0.255	6.084	2.23	0.204	6.193	1.80				6"
7⅛"	7.125	0.419	6.237	3.86	0.339	6.406	3.16	0.274	6.544	2.58	0.219	6.661	2.08				7⅛"
8"	8.625	0.507	7.550	5.65	0.411	7.754	4.64	0.332	7.921	3.79	0.265	8.063	3.05				8"
10"	10.750	0.632	9.410	8.78	0.512	9.665	7.21	0.413	9.874	5.87	0.331	10.048	4.75				10"
12"	12.750	0.750	11.160	12.36	0.607	11.463	10.13	0.490	11.711	8.26	0.392	11.919	6.67				12"
13⅜"	13.375	0.787	11.707	13.60	0.637	12.025	11.15	0.514	12.285	9.09	0.412	12.502	7.35				13⅜"
14"	14.000	0.824	12.253	14.91	0.667	12.586	12.22	0.538	12.859	9.96	0.431	13.086	8.05				14"
16"	16.000	0.941	14.005	19.46	0.762	14.385	15.97	0.615	14.696	13.02	0.492	14.957	10.51				16"
18"	18.000	1.059	15.755	24.65	0.857	16.183	20.19	0.692	16.533	16.48	0.554	16.826	13.29				18"
20"	20.000	1.176	17.507	30.42	0.952	17.982	24.92	0.769	18.370	20.34	0.615	18.696	16.41				20"
22"	22.000	1.294	19.257	36.81	1.048	19.778	30.19	0.846	20.206	24.62	0.677	20.565	19.87				22"
24"	24.000	1.412	21.007	43.82	1.143	21.577	35.92	0.923	22.043	29.29	0.738	22.435	23.62				24"
†26"	26.000	1.529	22.759	51.40	1.238	23.375	42.13	1.000	23.880	34.39	0.800	24.304	27.74				†26"
†28"	28.000	1.647	24.508	59.62	1.333	25.174	48.86	1.077	25.717	39.89	0.862	26.173	32.20				†28"
†30"	30.000	1.765	26.258	68.45	1.429	26.971	56.13	1.154	27.554	45.78	0.923	28.043	36.92	0.732	28.448	29.50	†30"
†32"	32.000	1.882	28.010	77.86	1.524	28.769	63.83	1.231	29.390	52.10	0.985	29.912	42.04	0.780	30.346	33.53	†32"
†34"	34.000	2.000	29.760	87.91	1.619	30.568	72.06	1.308	31.227	58.79	1.046	31.782	47.44	0.829	32.243	37.87	†34"
†36"	36.000	2.118	31.510	98.56	1.714	32.366	80.79	1.385	33.064	65.93	1.108	33.651	53.18	0.878	34.139	42.47	†36"
†42"	42.000				2.000	37.760	109.97	1.615	38.576	89.71	1.292	39.261	72.40	1.024	39.829	57.74	†42"
†48"	48.000				2.286	43.154	143.64	1.846	44.086	117.20	1.477	44.869	94.58	1.171	45.517	75.48	†48"
†54"	54.000				2.571	48.549	181.74	2.077	49.597	148.35	1.662	50.477	119.72	1.317	51.208	95.52	†54"

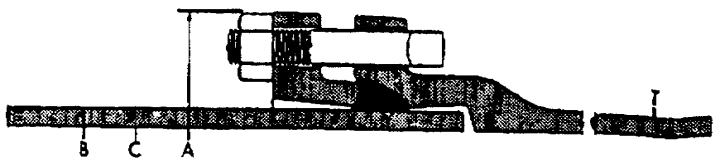
* Industrial PE (polyethylene) pipe sizes are identified by IPS (iron pipe size) diameters which designate the nominal diameter for 12" IPS AND SMALLER PIPE, AND O.D. (outside diameter) for 14" IPS and larger pipe

PLEXCO can produce to specialized pipe dimensions. Check with your PLEXCO sales office for availability of dimensions not listed

† SUBJECT TO MINIMUM ORDER QUANTITIES, AND AVAILABILITY OF TOOLING.

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DIMENSIONS AND WEIGHTS

Nominal Inside Diameter Inches	Wall Thickness		Dimensions—Inches			Approximate Weight—Pounds			
	ANSI Thick. Class	T In Inches	A Gland O.D.	B Pipe O.D.	C Av. Pipe I.D.	Bell Metal Only	Pipe Barrel Per Ft.	Per* Length	Per* Foot
3	51	.25	7.69	3.96	3.46	11	8.9	190	9.4
	52	.28	7.69	3.96	3.40	11	9.9	210	10.4
	53	.31	7.69	3.96	3.34	11	10.9	230	11.4
	54	.34	7.69	3.96	3.28	11	11.8	245	12.4
	55	.37	7.69	3.96	3.22	11	12.8	265	13.4
	56	.40	7.69	3.96	3.16	11	13.7	285	14.2
4	51	.26	9.12	4.80	4.28	16	11.3	240	12.1
	52	.29	9.12	4.80	4.22	16	12.6	270	13.4
	53	.32	9.12	4.80	4.16	16	13.8	290	14.6
	54	.35	9.12	4.80	4.10	16	15.0	315	15.8
	55	.38	9.12	4.80	4.04	16	16.1	340	16.9
	56	.41	9.12	4.80	3.98	16	17.3	360	18.1
6	50	.25	11.12	6.90	6.40	18	16.0	305	17.0
	51	.28	11.12	6.90	6.34	18	17.8	340	18.8
	52	.31	11.12	6.90	6.28	18	19.6	370	20.6
	53	.34	11.12	6.90	6.22	18	21.4	405	22.4
	54	.37	11.12	6.90	6.16	18	23.2	435	24.2
	55	.40	11.12	6.90	6.10	18	25.0	470	26.0
	56	.43	11.12	6.90	6.04	18	26.7	500	27.7
8	50	.27	13.37	9.05	8.51	24	22.8	435	24.1
	51	.30	13.37	9.05	8.45	24	25.2	480	26.5
	52	.33	13.37	9.05	8.39	24	27.7	525	29.0
	53	.36	13.37	9.05	8.33	24	30.1	565	31.4
	54	.39	13.37	9.05	8.27	24	32.5	610	33.8
	55	.42	13.37	9.05	8.21	24	34.8	650	36.1
	56	.45	13.37	9.05	8.15	24	37.2	695	38.5
10	50	.29	15.62	11.10	10.52	31	30.1	575	31.8
	51	.32	15.62	11.10	10.46	31	33.2	630	34.9
	52	.35	15.62	11.10	10.40	31	36.2	685	37.9
	53	.38	15.62	11.10	10.34	31	39.2	735	40.9
	54	.41	15.62	11.10	10.28	31	42.1	790	43.8
	55	.44	15.62	11.10	10.22	31	45.1	845	46.8
	56	.47	15.62	11.10	10.16	31	48.0	895	49.7
12	50	.31	17.88	13.20	12.58	37	38.4	730	40.5
	51	.34	17.88	13.20	12.52	37	42.0	795	44.1
	52	.37	17.88	13.20	12.46	37	45.6	860	47.7
	53	.40	17.88	13.20	12.40	37	49.2	925	51.3
	54	.43	17.88	13.20	12.34	37	52.8	985	54.9
	55	.46	17.88	13.20	12.28	37	56.3	1050	58.4
	56	.49	17.88	13.20	12.22	37	59.9	1115	62.0

Depth of Bells: 3" thru 12" - 2.50"; 14" thru 24" - 3.50"
Nominal laying lengths: 3" & 4" - 20'-0"; 6" thru 24" - 18'-0"
*Including bell. Calculated weight rounded off the nearest 5 pounds

Nominal Inside Diameter Inches	Wall Thickness		Dimensions—Inches			Approximate Weight—Pounds			
	ANSI Thick. Class	T In Inches	A Gland O.D.	B Pipe O.D.	C Av. Pipe I.D.	Bell Metal Only	Pipe Barrel Per Ft.	Per* Length	Per* Foot
14	50	.33	20.25	15.30	14.64	61	47.5	915	50.9
	51	.36	20.25	15.30	14.58	61	51.7	990	55.1
	52	.39	20.25	15.30	14.52	61	55.9	1065	59.3
	53	.42	20.25	15.30	14.46	61	60.1	1145	63.5
	54	.45	20.25	15.30	14.40	61	64.2	1215	67.6
	55	.48	20.25	15.30	14.34	61	68.4	1290	71.8
	56	.51	20.25	15.30	14.28	61	72.5	1365	75.9
16	50	.34	22.50	17.40	16.72	74	55.8	1080	59.9
	51	.37	22.50	17.40	16.66	74	60.6	1165	64.7
	52	.40	22.50	17.40	16.60	74	65.4	1250	69.5
	53	.43	22.50	17.40	16.54	74	70.1	1335	74.2
	54	.46	22.50	17.40	16.48	74	74.9	1420	79.0
	55	.49	22.50	17.40	16.42	74	79.7	1510	83.8
	56	.52	22.50	17.40	16.36	74	84.4	1595	88.5
18	50	.35	24.75	19.50	18.80	85	64.4	1245	69.1
	51	.38	24.75	19.50	18.74	85	69.8	1340	74.5
	52	.41	24.75	19.50	18.68	85	75.2	1440	79.9
	53	.44	24.75	19.50	18.62	85	80.6	1535	85.3
	54	.47	24.75	19.50	18.56	85	86.0	1635	90.7
	55	.50	24.75	19.50	18.50	85	91.3	1730	96.0
	56	.53	24.75	19.50	18.44	85	96.7	1825	101.4
20	50	.36	27.00	21.60	20.88	98	73.5	1420	78.9
	51	.39	27.00	21.60	20.82	98	79.5	1530	84.9
	52	.42	27.00	21.60	20.76	98	85.5	1635	90.9
	53	.45	27.00	21.60	20.70	98	91.5	1745	96.9
	54	.48	27.00	21.60	20.64	98	97.5	1855	102.9
	55	.51	27.00	21.60	20.58	98	103.4	1960	108.8
	56	.54	27.00	21.60	20.52	98	109.3	2065	114.7
24	50	.38	31.50	25.80	25.04	123	92.9	1795	99.7
	51	.41	31.50	25.80	24.98	123	100.1	1925	106.9
	52	.44	31.50	25.80	24.92	123	107.3	2055	114.1
	53	.47	31.50	25.80	24.86	123	114.4	2180	121.2
	54	.50	31.50	25.80	24.80	123	121.6	2310	128.4
	55	.53	31.50	25.80	24.74	123	128.8	2440	136.6
	56	.56	31.50	25.80	24.68	123	135.9	2570	142.7

Depth of Bells: 3" thru 12" - 2.50"; 14" thru 24" - 3.50"
Nominal laying lengths: 3" & 4" - 20'-0"; 6" thru 24" - 18'-0"
*Including bell. Calculated weight rounded off to nearest 5 pounds

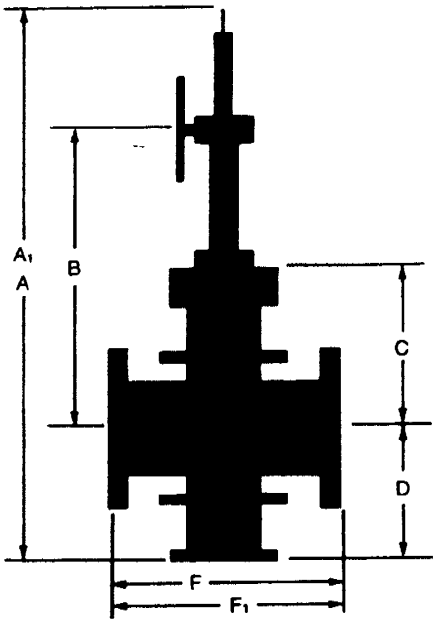
MAXIMUM DEFLECTIONS OF MECHANICAL JOINT PIPE

Size of Pipe Inches	Based on 18-Ft. Length		Approx. Radius in Feet of Curve Produced By Succession of Joints	Approx. Number of 18-Foot Pipe Required for a 90° Bend
	Angle Degrees	Deflection Inches		
3	8°-18'	35.0†	140	11†
4	8°-18'	35.0†	140	11†
6	7°-7'	27.0	145	13
8	5°-21'	20.0	195	17
10	5°-21'	20.0	195	17
12	5°-21'	20.0	195	17
14	3°-35'	13.5	285	25
16	3°-35'	13.5	285	25
18	3°-0'	11.0	340	30
20	3°-0'	11.0	340	30
24	2°-23'	9.0	450	39

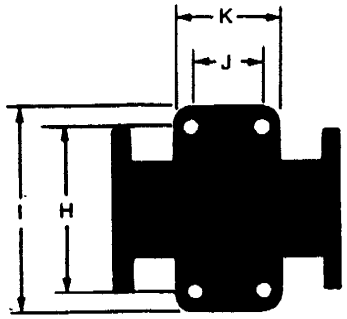
†20 Ft. length

ANSI PIPELINE GATE VALVES —Through Conduit

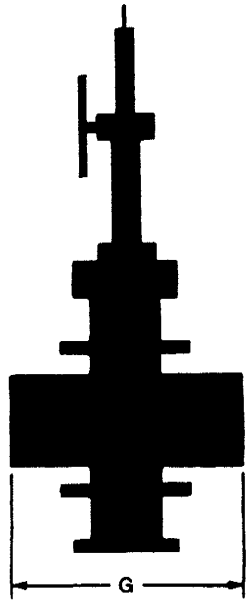
Walworth Sure-Seal® Valves 6" through 48"



FLANGED ENDS



LOCATION OF ANCHOR BOLT HOLES



WELDED ENDS

Walworth Sure-Seal ANSI Valves Dimensional Table

Dimensions in Inches

Nom. Size	ANSI Series	Operation	Bore	General Dimensions A	A1	B	C	D	End to End Flange Dimensions RF F	F1	RTJ W x W G	Dimensions between Anchor Bolt Holes H	I	J	K	L	Approx. Wt. Lbs/Kg F x F	W x W
6	300	HWO	6	61 7/8	68 3/4	30 5/16	14 9/16	12 3/4	15 7/8	16 1/2	15 7/8	18	22	8	12	2	557/253	425/193
	600	BGO	6	61 7/8	68 3/4	30 5/16	15 15/16	12 3/4	22	22 1/8	22	18	22	8	12	2	805/366	652/295
	600	HWO	6	61 7/8	68 3/4	31 1/16	14 9/16	12 3/4	22	22 1/8	22	18	22	10	14	2	647/294	494/224
8	150	HWO	8	65 3/4	74 1/8	36 5/16	18 1/4	15 3/4	11 1/2	12	16 1/2	17 1/4	21 1/4	7 1/4	11 1/4	2	293/133	223/102
	300	HWO	8	65 3/8	74 1/8	36 5/16	18 3/4	15 3/8	16 1/2	17 1/8	16 1/2	17 1/4	21 1/4	7 1/4	11 1/4	2	787/357	690/313
	300	BGO	8	66 1/2	74 1/4	36 21/32	18 3/4	15 3/8	16 1/2	17 1/8	16 1/2	17 1/4	21 1/4	7 1/4	11 1/4	2	1043/473	842/382
	600	HWO	8	65 3/4	74 1/8	36 3/4	17 1/8	15 3/8	26	26 1/8	26	17 1/4	21 1/4	7 1/4	11 1/4	2	970/440	737/335
	600	BGO	8	66 1/16	74 13/16	36 7/32	18 1/4	15 3/8	26	26 1/8	26	17 1/4	21 1/4	7 1/4	11 1/4	2	1210/550	977/443
10	150	HWO	10	67 13/16	79 7/16	38 11/16	21 11/16	18 9/16	13	13 1/2	18	19	23	7	11	2	506/229	456/207
	150	BGO	10	60 13/16	72	44 3/8	21 1/4	18 3/8	13	13 1/2	18	19	23	7	11	2	594/269	510/231
	300	HWO	10	79 3/8	90 1/8	33 3/8	19 11/16	18 3/8	18	18 3/8	18	19	23	7	11	2	1210/550	1060/480
	300	BGO	10	79 3/8	90 3/8	38 1/4	21 11/16	18 3/8	18	18 3/8	18	19	23	7	11	2	1440/654	1299/590
	600	HWO	10	82 9/16	93 7/16	44 11/16	23 5/16	19 7/16	31	31 1/8	31	18 1/2	21	10 1/4	12 3/4	1 1/2	1670/757	1508/684
	600	BGO	10	82 3/8	94 1/4	45 3/8	21 5/16	19 1/2	31	31 1/8	31	18 1/2	21	10 1/4	12 3/4	1 1/2	1963/891	1684/765
12	150	HWO	12	89 3/8	103 1/4	43	25 1/4	22	14	14 1/2	19 3/4	23	27	6 1/4	10 3/4	2	920/417	818/371
	300	BGO	12	90 3/4	104 3/8	44 1/16	25 1/8	21 1/4	19 3/4	20 3/8	19 3/4	23	27	11 1/2	15 1/2	2	2208/1002	1834/833
	400	BGO	12	94 1/8	107 3/8	51 1/16	25 1/8	22 1/4	30	30 1/8	30	24	28	10	14	2	2263/1026	1896/860
	600	HWO	12	95 7/32	108 7/32	51 1/8	27 1/2	22 1/4	33	33 1/8	33	24	28	10	14	2	2625/1192	2199/998
	600	BGO	12	94 1/8	107 3/8	51 1/8	25 1/8	22 1/4	33	33 1/8	33	24	28	10	14	2	3036/1380	2702/1226
14	150	BGO	13 1/4	98 11/16	112 7/8	48 1/16	26 15/32	24 7/8	15	15 1/2	22 1/2	24	28	9	13	2	1139/517	1135/514
	300	BGO	13 1/4	103 5/16	117 7/8	49 1/8	26 1/8	23 11/16	30	30 3/8	30	26	30	13 3/8	17 3/8	2	2261/1026	1967/893
	400	BGO	13 1/4	99 7/8	114 9/16	47 15/16	28 5/16	24 1/16	32 1/2	32 3/8	32 1/2	26	30	13 3/8	17 3/8	2	2640/1200	2315/1050
	600	BGO	13 1/4	105 5/16	120 1/4	52	26 1/8	23 11/16	35	35 1/8	35	26	30	13 3/8	17 3/8	2	3373/1531	2923/1327
16	150	BGO	15 1/4	113	129 1/4	45 1/2	28 1/4	31 13/16	16	16 1/2	24	28	32	13 3/8	17 3/8	2	1404/637	1400/635
	300	BGO	15 1/4	113	129 3/4	45 1/2	28 1/4	31 13/16	33	33 3/8	33	28	32	13 3/8	17 3/8	2	2000/907	1654/750
	600	BGO	15 1/4	113	129 1/4	58 1/4	29 1/8	26 11/16	39	39 1/8	39	28	32	14	18	2	4012/1821	3508/1593
18	300	BGO	17 1/4	116 11/16	135 3/8	63		35 11/16	30 7/8	36	36 3/8	36	31 1/4	35 1/4	18 1/2	22 1/2	2	2636/1196	2187/992
	600	BGO	17 1/4	116 11/16	135 3/8	63		35 11/16	30 7/8	43	43 1/8	43	31 1/4	35 1/4	18 1/2	22 1/2	2	4620/2100	3865/1753
20	150	BGO	19 1/4	125 9/16	146 9/16	116 9/16	34 9/16	33 7/8	18	18 1/2	28	17 1/4	34 1/2	11	15	2	3466/1574	3038/1379
	300	BGO	19 1/4	133 1/4	159 1/2	67 1/8	36 1/16	33	39	39 3/4	39	30 1/4	34 1/4	13 1/4	12 1/4	2	4373/1985	3882/1762
	600	BGO	19 1/4	137 1/8	157 3/8	71 1/2	37 1/2	33 1/4	47	47 1/8	47	31 1/4	35 1/4	16 1/4	20 1/8	2	7260/3296	6278/2850
24	150	BGO	23 1/4	148 1/16	180 1/16	79 29/32	45 1/8	39 1/2	20	20 1/2	32	42	46	21	25	2	3418/1550	3356/1522
	300	BGO	23 1/4	156 1/8	180 3/4	79 1/2	43 1/8	39 1/4	45	45 7/8	45	42	46	21	25	2	6678/3009	5944/2699
	600	BGO	23 1/4	163 1/4	187 7/8	84 1/8	44 9/16	40	55	55 3/8	55	42	46	21	25	2	11410/5180	9840/4467
30	150	BGO	29	184	215 1/4	97 17/32	56 1/16	49 1/8	26		36	50 1/2	46 1/2	24	28	2	6053/2745	6107/2770
	300	BGO	29	189	220 1/4	97 1/4	53 1/16	49 1/8	55	56	55	46 1/2	50 1/2	24	28	2	13882/6302	12824/5822
	600	BGO	29	197 7/16	228 9/16	103 1/8	55 1/2	49 1/8	65 9/16	65 1/2	65	47	51	24	28	2	21659/9833	19712/8949
36	150	BGO	34 1/2	239 1/4	277	117 1/8	65 1/8	59 1/4	32		40	36 1/8	41 5/8	17 1/4	23 1/4	2	9467/4299	9332/4228
	300	BGO	34 1/2	239 1/4	277	117 1/8	65 1/8	59 1/4	68	69 1/8	68	36 1/8	41 5/8	17 1/4	23 1/4	2	15441/7003	13607/6172
	600	BGO	34 1/2	255 5/16	291 7/8	136 1/8	70 7/16	63 1/8	82	82 5/8	82	39 1/4	46 1/4	22	29 3/4	2	31800/14440	28500/12940
42	150	BGO	40 1/4	246 7/16	289 1/16	130 1/8	68 1/4	74				56	60	17 1/2	21 1/2	2	14848/6734	12727/5572
	600	BGO	40 1/4	272 1/16	316 5/16	150 1/4	80 1/8	74	87	87 1/8	87	45 1/2	52 1/2	24 1/4	31 1/4	2	49000/22245	42000/19070
48	150	BGO	46	304	356 1/4	163 1/2	92 1/16	83 1/8				67 1/2	79 1/4	22 1/2	32	1 7/8	24520/11122	21133/9586
	300	BGO	46	304	356 1/4	163 1/8	92 9/16	83 1/8	105	105 5/8	105	67 1/2	79 1/4	22 1/2	32	1 7/8	58388/26540	50334/22831
	600	BGO	46	310 1/16	363 1/2	168 1/8	93 1/8	83 1/2	114	114 5/8	114	52 1/4	59 1/4	17	20	2	80919/36740	69740/31700

All Dimensions are approx. except the basic ones in accordance with specs.
HWO = Handwheel Operated, BGO = Bevel Gear Operated

A_1 = Total height including Indicator Rod in open position.
L = Diameter of Anchor Bolt Holes.

E-9

HEAD	LOSS	THROUG	Puerto	Nuevo	SIPHON								
PIPE I.D.													
DIA	AREA	FLOW	FLOW	.HWC	.285d2.63	.Q/.285	LENGTH	HEAD		VELOCITY		7/7/97	
(in)	(FT^2)	mgd	gpm			(FT)		LOSS					
			0										
15	1.226563	2.88	2000	100	35315.46	0.004934	330	1.628113		3.615959	barrel 1		
21	2.404063	7.2	5000	100	85562.13	0.005228	341	1.782904		4.612193	barrel 2		
15	1.226563	2.82	1958.332	100	35315.46	0.004745	330	1.565917		3.540627	barrel 1		
21	2.404063	6.71	4659.692	100	85562.13	0.004589	341	1.564928		4.298308	barrel2		
14.77	1.189236	2.88	1999.99	140	47472.66	0.002854	536	1.529839		3.729452	HDPE	barrel 1	
20.31	2.248677	7.27	5048.579	140	109711	0.00336	547	1.838179		4.978839	HDPE	barrel 2	
16.616	1.505082	3.88	2694.427	140	64707.94	0.002793	536	1.497119		3.970017	HDPE	barrel 1	
22.154	2.67554	8.64	5999.962	140	137883.4	0.00303	547	1.657543		4.973052	HDPE	barrel 2	
16.616	1.505082	4.33	3006.925	140	64707.94	0.003422	536	1.834088		4.430457	HDPE	barrel 1	closure
22.154	2.67554	9.14	6347.218	140	137883.4	0.003363	547	1.839371		5.260844	HDPE	barrel 2	closure
	0	0	0										

HEAD	LOSS	THROUG	MARGAR	ITA	SIPHON						7/7/97		
PIPE I.D.													
DIA	AREA	FLOW	FLOW	.HWC	.285d2.63	Q/.285	LENGTH	HEAD		VELOCITY			
(IN)	(FT^2)	mgd	gpm			(FT)		LOSS					
			0										
20.31	2.248677	6	2000	140	109711	0.000606	217	0.131493		4.109083	HDPE	22" OD	SDR 26
20.31	2.248677	6.71	4660	140	109711	0.002898	217	0.628798		4.595325			
20.31	2.248677	8	5555.552	140	109711	0.004011	217	0.870448		5.478778			
20.31	2.248677	9	6249.96	140	109711	0.004988	217	1.082356		6.163625			
22.154	2.67554	10	6944.4	140	137883.4	0.003971	217	0.861761		5.755847			
22.524	2.765656	11	7638.84	140	144022.6	0.00437	217	0.948339		6.125128		24" OD	SDR 32.5
22.524	2.765656	12	8333.28	140	144022.6	0.005133	217	1.113968		6.681958		24" OD	SDR 32.5
22.524	2.765656	6	4166.64	140	144022.6	0.001424	217	0.309006		3.340979		24" OD	SDR 32.5
23.264	2.950366	14	9722.16	140	156802.4	0.005834	217	1.265954		1.54		26" OD	SDR 19
23.264	2.950366	6	4166.664	140	156802.4	0.001217	217	0.264038		3.131814		26" OD	SDR 19

10" (10.750 OD)

SDR 7	267 psi	19.32 lbs./ft.	7.678 ID	1.536 wall
SDR 9	200 psi	15.61	8.362	1.194
SDR 11 ●	**160 psi**	**13.09**	**8.796**	**.977**
SDR 13.5	128 psi	10.87	9.158	.796
SDR 15.5	110 psi	9.58	9.362	.694
SDR 17 ●	**100 psi**	**8.78**	**9.486**	**.632**
SDR 19	89 psi	7.92	9.618	.566
SDR 21 ●	**80 psi**	**7.21**	**9.726**	**.512**
SDR 26 ●	**64 psi**	**5.87**	**9.924**	**.413**
SDR 32.5 ●	**51 psi**	**4.75**	**10.088**	**.331**

12" (12.750 OD)

SDR 7	267 psi	27.16 lbs./ft.	9.108 ID	1.821 wall
SDR 9	200 psi	21.97	9.916	1.417
SDR 11 ●	**160 psi**	**18.41**	**10.432**	**1.159**
SDR 13.5	128 psi	15.29	10.862	.944
SDR 15.5 ●	**110 psi**	**13.48**	**11.104**	**.823**
SDR 17 ●	**100 psi**	**12.36**	**11.250**	**.750**
SDR 19	89 psi	11.14	11.408	.671
SDR 21 ●	**80 psi**	**10.13**	**11.536**	**.607**
SDR 26 ●	**64 psi**	**8.26**	**11.770**	**.490**
SDR 32.5 ●	**51 psi**	**6.67**	**11.966**	**.392**

13" (13.386 OD)

SDR 7	267 psi	29.24 lbs./ft.	9.562 ID	1.912 wall
SDR 9	200 psi	23.62	10.412	1.487
SDR 11	160 psi	20.30	10.952	1.217
SDR 13.5	128 psi	16.87	11.402	.992
SDR 15.5	110 psi	14.85	11.658	.864
SDR 17	100 psi	13.62	11.812	.787
SDR 19	89 psi	12.28	11.976	.705
SDR 21	80 psi	11.16	12.112	.637
SDR 26	64 psi	9.12	12.356	.515
SDR 32.5	51 psi	7.36	12.562	.412

14.000 OD

SDR 7	267 psi	32.76 lbs./ft.	10.00 ID	2.000 wall
SDR 9	200 psi	26.50	10.888	1.556
SDR 11 ●	**160 psi**	**22.20**	**11.454**	**1.273**
SDR 13.5	128 psi	18.44	11.926	1.037
SDR 15.5	110 psi	16.24	12.194	.903
SDR 17 ●	**100 psi**	**14.91**	**12.352**	**.824**
SDR 19	89 psi	13.43	12.526	.737
SDR 21	80 psi	12.22	12.666	.667
SDR 26 ●	**64 psi**	**9.96**	**12.924**	**.538**
SDR 32.5	51 psi	8.05	13.138	.431

16.000 OD

SDR 9	200 psi	34.60 lbs./ft.	12.444 ID	1.778 wall
SDR 11 ●	**160 psi**	**29.00**	**13.090**	**1.455**
SDR 13.5	129 psi	24.09	13.630	1.185
SDR 15.5	110 psi	21.21	13.936	1.032
SDR 17 ●	**100 psi**	**19.46**	**14.118**	**.941**
SDR 19	89 psi	17.54	14.316	.842
SDR 21 ●	**80 psi**	**15.96**	**14.476**	**.762**
SDR 26 ●	**64 psi**	**13.01**	**14.770**	**.615**
SDR 32.5	51 psi	10.50	15.016	.492

18.000 OD

SDR 9	200 psi	43.79 lbs./ft.	14.000 ID	2.000 wall
SDR 11 ●	**160 psi**	**36.69**	**14.728**	**1.636**
SDR 13.5	128 psi	30.48	15.334	1.333
SDR 15.5 ●	**110 psi**	**26.84**	**15.678**	**1.161**
SDR 17 ●	**100 psi**	**24.64**	**15.882**	**1.059**
SDR 19	89 psi	22.19	16.106	.947
SDR 21	80 psi	20.19	16.286	.857
SDR 26 ●	**64 psi**	**16.47**	**16.616**	**.692**
SDR 32.5	51 psi	13.30	16.892	.554

20.000 OD

SDR 9	200 psi	54.05 lbs./ft.	15.556 ID	2.222 wall
SDR 11 ●	**160 psi**	**45.30**	**16.364**	**1.818**
SDR 13.5	128 psi	37.63	17.038	1.481
SDR 15.5	110 psi	33.14	17.420	1.290
SDR 17 ●	**100 psi**	**30.41**	**17.648**	**1.176**
SDR 19	89 psi	27.42	17.894	1.053
SDR 21	80 psi	24.93	18.096	.952
SDR 26 ●	**64 psi**	**20.34**	**18.462**	**.769**
SDR 32.5 ●	**51 psi**	**16.41**	**18.770**	**.615**

21.500 OD

SDR 9	200 psi	62.47 lbs./ft.	16.722 ID	2.389 wall
SDR 11	160 psi	52.37	17.590	1.955
SDR 13.5	128 psi	43.51	18.314	1.593
SDR 15.5	110 psi	38.30	18.726	1.387
SDR 17	100 psi	35.16	18.970	1.265
SDR 19	89 psi	31.68	19.236	1.132
SDR 21	80 psi	28.82	19.452	1.024
SDR 26	64 psi	23.51	19.846	.827
SDR 32.5	51 psi	18.98	20.176	.662

● denotes standard sizes

22.000 OD

SDR 9	200 psi	65.40 lbs./ft.	17.112 ID	2.444 wall
SDR 11 ●	**160 psi**	**54.82**	**18.000**	**2.000**
SDR 13.5	128 psi	45.56	18.740	1.630
SDR 15.5	110 psi	40.10	19.162	1.419
SDR 17	100 psi	36.80	19.412	1.294
SDR 19	89 psi	33.16	19.684	1.158
SDR 21	80 psi	30.18	19.904	1.048
SDR 26 ●	**64 psi**	**24.61**	**20.308**	**.846**
SDR 32.5 ●	**51 psi**	**19.86**	**20.646**	**.677**

24.000 OD

SDR 9	200 psi	77.85 lbs./ft.	18.666 ID	2.667 wall
SDR 11 ●	**160 psi**	**65.24**	**19.636**	**2.182**
SDR 13.5	128 psi	54.21	20.444	1.778
SDR 15.5	110 psi	47.72	20.904	1.548
SDR 17 ●	**100 psi**	**43.81**	**21.176**	**1.412**
SDR 19	89 psi	39.46	21.474	1.263
SDR 21 ●	**80 psi**	**35.91**	**21.714**	**1.143**
SDR 26 ●	**64 psi**	**29.30**	**22.154**	**.923**
SDR 32.5 ●	**51 psi**	**23.62**	**22.524**	**.738**

26.000 OD

SDR 11	160 psi	76.57 lbs./ft.	21.272 ID	2.364 wall
SDR 13.5	128 psi	63.62	22.148	1.926
SDR 15.5	110 psi	56.00	22.646	1.677
SDR 17	100 psi	51.39	22.942	1.529
SDR 19	89 psi	46.30	23.264	1.368
SDR 21	80 psi	42.14	23.524	1.238
SDR 26	64 psi	34.39	24.000	1.000
SDR 32.5 ●	**51 psi**	**27.74**	**24.400**	**.800**

28.000 OD

SDR 11	160 psi	88.78 lbs./ft.	22.910 ID	2.545 wall
SDR 13.5	128 psi	73.78	23.852	2.074
SDR 15.5	110 psi	64.95	24.388	1.806
SDR 17 ●	**100 psi**	**59.62**	**24.706**	**1.647**
SDR 19	89 psi	53.73	25.052	1.474
SDR 21	80 psi	48.86	25.334	1.333
SDR 26	64 psi	39.88	25.846	1.077
SDR 32.5 ●	**51 psi**	**32.19**	**26.276**	**.862**

30.000 OD

SDR 11	160 psi	101.92 lbs./ft	24.546 ID	2.727 wall
SDR 13.5	128 psi	84.69	25.556	2.222
SDR 15.5	110 psi	74.56	26.130	1.935
SDR 17	100 psi	68.45	26.470	1.765
SDR 19	89 psi	61.67	26.842	1.579
SDR 21 ●	**80 psi**	**56.12**	**27.142**	**1.429**
SDR 26	64 psi	45.78	27.692	1.154
SDR 32.5 ●	**51 psi**	**36.93**	**28.154**	**.923**

800 mm (31.496 OD)

SDR 13.5	128 psi	93.35 lbs./ft.	26.830 ID	2.333 wall
SDR 15.5	110 psi	82.20	27.432	2.032
SDR 17	100 psi	75.45	27.790	1.853
SDR 19	89 psi	67.98	28.180	1.658
SDR 21	80 psi	61.85	28.496	1.500
SDR 26	64 psi	50.44	29.074	1.211
SDR 32.5	51 psi	40.71	29.558	.969

32.000 OD

SDR 13.5	128 psi	96.35 lbs./ft.	27.260 ID	2.370 wall
SDR 15.5	110 psi	84.87	27.870	2.065
SDR 17	100 psi	77.86	28.236	1.882
SDR 19	89 psi	70.15	28.632	1.684
SDR 21	80 psi	63.84	28.952	1.524
SDR 26	64 psi	52.10	29.538	1.231
SDR 32.5 ●	**51 psi**	**42.04**	**30.030**	**.985**

34.000 OD

SDR 13.5	128 psi	108.81 lbs./ft.	28.962 ID	2.519 wall
SDR 15.5	110 psi	95.81	29.612	2.194
SDR 17	100 psi	87.91	30.000	2.000
SDR 19	89 psi	79.17	30.422	1.789
SDR 21	80 psi	72.06	30.762	1.619
SDR 26	64 psi	58.81	31.384	1.308
SDR 32.5	51 psi	47.43	31.908	1.046

36.000 OD

SDR 13.5	128 psi	121.98 lbs./ft.	30.666 ID	2.667 wall
SDR 15.5	110 psi	107.41	31.354	2.323
SDR 17	100 psi	98.57	31.764	2.118
SDR 19	89 psi	88.81	32.210	1.895
SDR 21 ●	**80 psi**	**80.78**	**32.572**	**1.714**
SDR 26 ●	**64 psi**	**65.94**	**33.230**	**1.385**
SDR 32.5 ●	**51 psi**	**53.20**	**33.784**	**1.108**

● denotes standard sizes