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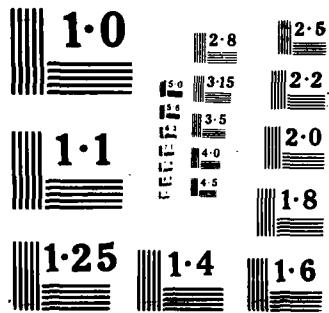
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FINAL FOUNDATION REPORT

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SPILLWAY MODIFICATION GRAPEVINE LAKE, TEXAS

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CORPS OF ENGINEERS
FORT WORTH DISTRICT, TEXAS

FINAL
FOUNDATION REPORT

GRAPEVINE LAKE
SPILLWAY MODIFICATION

BY

ALAN J. MARR
ENGINEERING GEOLOGY SECTION

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JUNE, 1986

PREFACE

This report was prepared by Fort Worth District Staff Geologist, Alan J. Marr, under the supervision of the Chief of the Engineering Geology Section, Robert C. Behm, and the Chief of the Geotechnical Branch, Melvin G. Green.

District Engineers for the Fort Worth District during construction of the Grapevine Spillway were Colonel Theodore Stroupe and Colonel A. J. Genetti, Jr. Mr. Shigeru Fujiwara was Chief of the Engineering Division and Mr. William Niese, Jr. served as Resident Engineer during construction.

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I - INTRODUCTION

1. Project Location and Description. Grapevine Dam is located in Tarrant County, Texas, about 20 miles northwest of Dallas, Texas, on Denton Creek about 11.7 river miles above its confluence with the Elm Fork of the Trinity River. The location of the project is shown on Plate 1.

The Grapevine Lake project consists of a compacted earth-fill embankment, an uncontrolled, off-channel, chute-type concrete spillway, and a cut-and-cover conduit outlet. The embankment is 12,850 feet long and has a maximum crest width of 28 feet. Top of dam elevation is 588 NGVD which is 137 feet above the streambed. The 500-foot wide spillway has a crest elevation of 560 NGVD and is located in a natural saddle near the right abutment of the dam. The 13-foot diameter outlet conduit, located near the left end of the dam, is controlled by two 6.5- by 13-foot electrically operated sluice gates. A site plan of the project is shown on Plate 2.

2. Construction Authority. Congressional authority for the construction of Grapevine Lake and subsequent spillway modification is contained in the River and Harbor Act approved March 2, 1945 (Public Law 14, 79th Congress 1st Session), in accordance with the recommendations of the Chief of Engineers contained in House Document No. 403 (77th Congress, 1st Session). Public Law 79-14 authorizes the U.S. Army Corps of Engineers to construct, repair, and preserve certain water resources projects in the Trinity River Basin, including Grapevine Dam and Lake.

3. Purpose of Report. This report has been prepared in accordance with requirements as set forth by the Office, Chief of Engineers, in ER 1110-1-1801. This report provides a complete record of foundation conditions encountered during construction of spillway modifications at Grapevine Lake. Information contained in this report will be valuable when evaluating: (1) necessary remedial action required to prevent or repair any failures resulting from foundation deficiencies; (2) Contractor claims related to foundation conditions or alleged change of conditions; and (3) planning and design of future comparable construction project.

A copy of this report will be included in the permanent records maintained at the project office.

4. Project History. Construction of Grapevine Dam began in January 1948 and was completed in June 1952. During heavy rains in May 1957 the reservoir level reached conservation pool, elevation 535, for the first time and eventually peaked at elevation 560.8 which was 0.8 feet above the spillway crest. Flow through the spillway washed out FM 2499 and caused minor erosion damage in the spillway channel, all of which was repaired.

Again during October and November 1981, the spillway went into service for 21 days. The reservoir elevation peaked at elevation 563.29, or 3.29 feet above the spillway crest. Discharge through the spillway, shown in Figure 1, peaked at 9100 cfs flowing at a velocity of 30-40 feet per second. The heavy discharge caused severe erosion

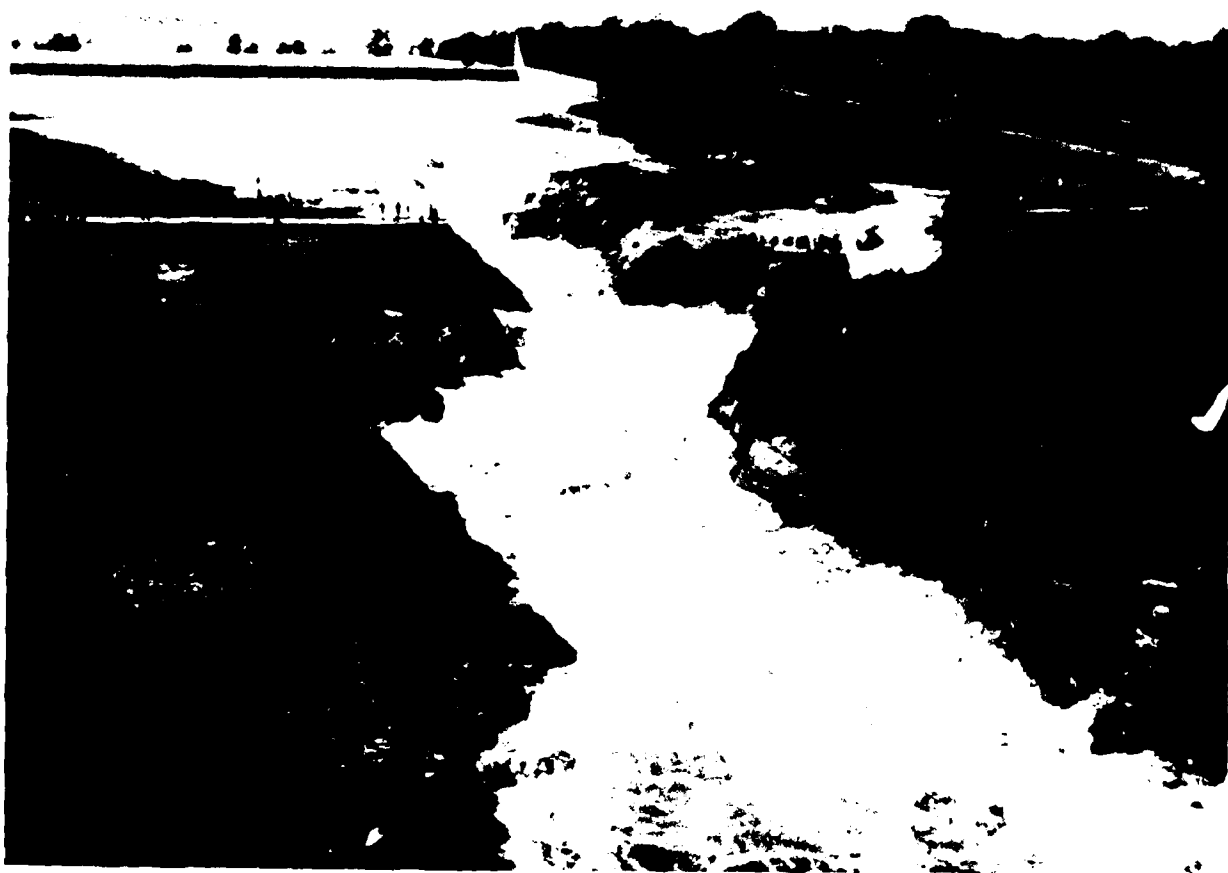


Fig. 1 - Flow through the Grapevine Spillway in November 1981

in the unprotected discharge channel, as seen in Figure 2. The erosion cut reached a maximum depth of about 30 feet below the original channel floor at a point about 600 feet downstream from the end of the existing concrete spillway apron slab.

The severity of the erosion damage created concern that another overflow event could undermine the concrete spillway chute and weir and ultimately endanger the integrity of the entire structure. As a result the Fort Worth District conducted a study of the project which resulted in the following recommendations:

(a) The spillway should be modified to include an elongated concrete chute that terminated into a stilling basin.

(b) The downstream face of the embankment which has been periodically subjected to erosion and sloughing, would be stabilized by constructing a berm using soils excavated for the spillway modification.

(c) FM 2499 would be relocated to cross the existing spillway apron.

The Southwestern Division Office and the Office of the Chief of Engineers approved the recommendations and requested that a design memorandum detailing the proposed work be prepared. Design Memorandum No. 3 - Modification of Embankment and Spillway was published in June 1983 followed by the project plans and specifications in August 1983. The contract was awarded and construction began in November 1983 with a scheduled completion date of June 1985.



Fig. 2 - Damage resulting from the November 1981 flood

5. Modification of the Spillway. The existing spillway was cut in a relatively narrow saddle about 1500 feet left (northwest) of the left abutment of the dam. It consists of a 500-foot wide by 400-foot long approach channel cut in natural ground to approximate elevation 550, a 500-foot wide concrete ogee weir with a crest elevation of 560.0 connected to a 200-foot long concrete apron sloping at a 5 percent grade, and a 500-foot wide discharge channel cut in natural ground and terminating in a natural ravine about 900 feet from the end of the apron. A plan of the existing spillway is shown on Plate 4.

The spillway modification consisted of constructing a reinforced concrete chute and stilling basin immediately downstream of the existing spillway apron. The chute is 500 feet wide by 301 feet long and provides a transition from elevation 540.0 to the new stilling basin elevation 462.0. The stilling basin is 130 feet long and bordered on each side by 33-foot high vertical concrete walls. For a distance of 265 feet from the end of the stilling basin the 510-foot wide downstream channel is graded to elevation 465 and protected by rip-rap. The channel then slopes upward on a 1 vertical on 10 horizontal grade to intersection with natural ground.

6. The Contract. Pertinent information related to the contract is listed below:

Modification of Embankment and Spillway - Grapevine Lake

Contractor: Granite Construction Company, Watsonville, CA

Contract No.: DACW63-83-C-0160

Bid: \$9,561,342.50

Contract Award Date: 30 Sep 83

Notice to Proceed: 26 Oct 83

Work Completed: November 1985

Contractor Superintendent at Site: Edouard (Skip) Izac

7. Quality Control. Quality control for all phases of the contract was furnished by the Contractor. Mr. John Moran performed all quality control functions from the beginning of the work until 3 Jan 85. During the remainder of the contract quality control functions were performed by Mr. Ron Milan.

8. Contract Supervision. Work under this contract was performed under the immediate supervision of the District Engineer, U.S. Army Engineer District, Fort Worth, Texas. The Contracting Officer's representative for administration of the contract was Mr. James D. Leslie, Area Engineer, North Texas Area Office. Mr. Bill Niese served as Resident Engineer during construction.

II FOUNDATION EXPLORATIONS

1. Investigations Prior to Construction of the Existing Spillway.

Geological investigations were conducted at the Grapevine Dam site as early as 1924. Much of the data collected during design and construction of the project, including original core boring logs and laboratory test results, are no longer available. A summary of some of this early data is found in the Definite Project Report, dated July 1947, which is available in SWFED-F.

2. Investigations Prior to Modification of the Spillway. Investigations for rehabilitation of the Grapevine Spillway began in December 1981, 2 months after the overtopping event. A total of 10 combination auger, fishtail, rock-bit and core borings were drilled to develop subsurface information. The borings included 302 linear feet of 4- and 6-inch core samples and 688 linear feet of auger, fish-tail and rock-bit borings. Electric logs were run in all but one of the borings to aid in stratigraphic correlation. Three bail-down/recovery tests were performed in selected borings in order to determine general ground-water conditions at the site. Locations of the borings and sections are shown on Plate 4. A centerline profile is shown on Plate 5, and Section B-B, C-C, and D-D are presented on Plates 6, 7, and 8 respectively. Results of all investigations were presented in Design Memorandum No. 3 - Modification of Embankment and Spillway - Grapevine Lake, published in June 1983.

3. Investigations During Construction. No unanticipated foundation conditions or problems were encountered during construction that required additional subsurface investigations.

III GEOLOGY

1. Physiography and Regional Geology. Grapevine Dam and spillway are located within the Eastern Cross Timbers Section of the West Gulf Coastal Plain physiographic province. The Eastern Cross Timbers Section occurs as a relatively narrow belt of moderately rugged topography which trends north-south through the area generally reflecting the outcrop of the basal member of the Woodbine Formation of Upper Cretaceous Age. Regional dip of the strata is toward the southeast at a steeper slope than that of the land surface resulting in older strata being encountered as one travels northwest upstream from the dam. In the project area the Woodbine Formation reaches an estimated thickness of 320 feet and consists of an alternating series of sands, clays, shales, and weakly indurated sandstones. The areal geology map is presented on Plate 3.

2. Geology of the Spillway.

(a) Description of the Overburden. Overburden in the vicinity of the Grapevine spillway consists of a thin mantle of residual soils resulting from the weathering of the sands and shales of the upper portion of the Woodbine Formation. Overburden exposed in the excavation slopes consists of fine-to-medium grained, loose to medium dense sand with varying amounts of silt, clay and gravel.

(b) Bedrock Stratigraphy and Lithology. The Grapevine Spillway is founded within strata of the Woodbine Formation. Borings within

the limits of the existing spillway encountered a 5-foot thick layer of reddish-brown, massive, fine-grained, weakly cemented sandstone which served as the spillway floor immediately downstream from the concrete apron. Underlying the sandstone layer was approximately 40 feet of soft, often carbonaceous, dark gray to brown, massive-bedded, sandy shale with occasional thin interbeds of glauconitic sandstone. Lignitic seams were noted along some of the bedding planes. Below the shale section is a sequence of alternating soft to moderately hard, fine-grained, weakly to moderately cemented, thin-bedded sandstones and soft, sandy shales which continue down to and below the base of the excavation. An increasing percentage of sandy material and the occasional occurrence of thin, moderately hard to very hard, very fine-grained sandstone and siltstone layers were observed as the excavation deepened.

Gradational changes in the lithologic composition of the Woodbine strata are typically pronounced, often changing from sandy shale to shaly sand or sandstone within a few feet. The lithology shown on the geologic map (Plate 9), generally classifies the materials according to their dominant composition. See Plates 5 through 8 for geologic profile and sections.

(c) Bedrock Structure. The Woodbine strata in the spillway area dip toward the southeast at a rate of about 100 feet per mile. No major faulting or folding was observed within the spillway excavation limits. Some minor jointing and fracturing was observed during the course of the excavation down to elevation 495; below this elevation

the strata was essentially free of structural discontinuities. Individual layers of competent material were sometimes separated by bedding planes of weaker material, often resulting in some minor overexcavation in areas where finished grade occurred within the more competent layers.

(d) Weathering. Weathering of strata within the Woodbine Formation is generally recognized by the change in color of the materials from gray when unweathered to light brown or yellow when weathered. This weathering reaction is caused by oxidation of the iron within the highly ferruginous formation. Shales are generally altered to the consistency of stiff clay, while sandstones tend to become indurated, as was the case with the 5-foot thick sandstone layer exposed on the spillway floor. Since the sandstone on the floor of the spillway had only been exposed to the weathering processes for the period since original construction in 1952, weathering was apparent only within 3 to 5 feet of the surface. In the slopes of the spillway excavation, the thickness of the weathered zone was generally from 10 to 15 feet. The spillway was founded entirely within unweathered strata.

(e) Ground Water. Ground water encountered during the course of the spillway excavation was minor and was adequately controlled using collector ditches and sump pumps. Minor amounts of ground water leaked out of the overburden on the upper slopes of the excavation. The amount of seepage and number of seepage areas varied according to the amount of rainfall. During dry periods there were only 3 seepage areas which continued to produce water. The 3 areas are shown on Plate 9.

Individual seepage points in the Woodbine Formation strata beneath the spillway structure were rarely detected during the course of the excavation because of the small amount of flow and the short time period that the surface was exposed. However, as the excavation progressed downward through the increasingly sandy Woodbine strata, reaching the base of the 1 vertical on 3.5 horizontal slope, water exiting from the sand filter blanket gave evidence of the collective seepage emitting from the foundation strata. The amount of seepage from any one area along the filter blanket generally amounted to only a few gallons per minute, only slightly hindering the cleaning of the freshly excavated surfaces downslope from the filter blanket.

After the excavation reached the stilling basin level the Contractor installed a collector well with collector ditches to care for both surface water and ground water entering the excavation. The location of the collector well is shown on Plate 9. Details of the collector well are described in Dewatering Provisions, Section V-2 of this report.

3. Engineering Characteristics of the Overburden Materials. All foundation investigation borings were located within the limits of the existing spillway where the overburden had been removed during original construction. As a result, no overburden samples were collected during the investigations for laboratory testing. Based on original project design values, the following design parameters were adopted by the Geotechnical Branch, Soils Design and Dam Safety Sections for the overburden materials:

Unit Weight

moist - 125 pcf

saturated - 130 pcf

Q - strength

c - 1.0 tsf

0 - 5 degrees

R - strength

c - 0.5 tsf

0 - 16 degrees

S - strength

c - 0.1 tsf

0 - 20 degrees

Overburden materials located outside the limits of the existing spillway, but within the limits of the new spillway excavation were used as select fill in constructing a berm on the downstream face of the main embankment under this contract.

4. Engineering Characteristics of the Primary Materials. Laboratory testing of primary materials was performed on core samples obtained from borings 8A6C-602 and 8A6C-603. A summary of the test results is presented on Plates 15 thru 17.

The results of laboratory testing indicate a slight variation in the strength and character of the Woodbine materials with depth. Therefore, the following design parameters were adopted for the primary materials:

Upper Primary Materials**Unit Weight**

moist - 135 pcf

saturated - 140 pcf

Q - strength

c - 0.7 tsf

0 - 25 degrees

R - strength

c - 0.2 tsf

0 - 30 degrees

S - strength

c - 0 tsf

0 - 30 degrees

Lower Primary Materials

Unit Weight		R - strength	
moist	- 140 pcf	c	- 0.2 tsf
saturated	- 145 pcf	0	- 30 degrees
Q - strength		S - strength	
c	- 0.7 tsf	c	- 0.2 tsf
0	- 25 degrees	0	- 30 degrees

5. Unusual or Unanticipated Conditions. There were no unusual or unanticipated conditions encountered that adversely affected the construction of the Grapevine Spillway.

The discovery of an isolated ± 1-foot thick limestone layer approximately 220 feet left of centerline station 14 + 20 was unexpected. (limestone was not observed in any of the samples retrieved during subsurface investigations). The presence of limestone is unusual, though not unprecedented within the Woodbine Formation. The occurrence of the limestone did not affect the excavation phase of the project, but it was the basis of a claim by the Contractor citing the extra time required to drill rock anchor holes.

IV SPECIAL DESIGN CONSIDERATIONS

1. During design of the spillway special consideration was given to the fact that the spillway is an active spillway for an existing reservoir with the possibility of engagement during the period of construction. Operation of the spillway during construction could have results ranging from lost construction time to catastrophic loss of the entire spillway. Although this fact did not alter the design of the spillway, special precautions were undertaken during construction to reduce the risk of spillway engagement and resulting damage. These precautions include the following:

(a) Sandbags were placed on the existing spillway weir raising the spillway crest from 560.0 to 562.5, thus increasing the computed spillway operation frequency from 100 years to approximately 270 years.

(b) A lower reservoir elevation was maintained during construction through the cooperation of local water supply users who responded to a letter request by CE to increase their water usage from Grapevine Lake when the reservoir elevation was above elevation 528 NGVD (about 75 percent of normal conservation pool).

(c) And finally, the amount of unprotected excavated surface was kept to a minimum by requiring the excavation and concrete placement to be staged into coordinated phases of work so that concrete placement would closely follow the deepening excavated surface.

2. Due to the proximity of the existing reservoir to the proposed spillway excavation, special consideration was given to ground water

during design of the project. There was early concern that the Woodbine Formation, which often has the capability of transporting and producing significant amounts of ground water, could transmit water to the excavation directly from the reservoir. However, the results of investigations in the spillway area indicated that the permeabilities of the Woodbine Formation sands were very low and that any ground water entering into the excavation could be controlled by a system of ditches and sump pumps.

V EXCAVATION PROCEDURES

1. Excavation Grades. Actual foundation conditions encountered during excavation for the rehabilitation of the Grapevine Spillway were essentially as described in the subsurface data presented in the contract plans and specifications. The design slopes in the overburden and primary materials were achieved and maintained generally without difficulty. Minor concerns which developed in the excavation slopes during construction were the low resistance of the material in the overburden slopes to erosion, and one minor slide which occurred in a vertically excavated shale face. Some minor variations (over-excavation) from the designed grade lines occurred. Final cross-sections on the excavation slopes were taken by the Contractor's survey team. The CE geologist, assisted by the Contractor's survey team, made all measurements of final excavation grade and recorded the foundation conditions below the new spillway structure. Final excavation grades below the spillway structure are shown on Plate 10. As-built centerline geologic profile and geologic section are presented on Plate 11 and Plate 12 respectively.

2. Dewatering Provisions. No serious ground-water problems were encountered in the spillway excavation. Perched water flow from the overburden slopes was the primary source of ground water within the excavation. Seepage from the exposed Woodbine strata in the excavation slopes was very minor, usually drying up before reaching the base of the slope. Ground water flowing from the excavation slopes was

controlled using collector ditches and sump pumps. The locations of ground water exit points are shown on the As-Built Geologic Maps on Plates 9 and 10.

For the most part the excavation of materials and the subsequent backfill of filter sand beneath the structure took place in the dry. Only an occasional small seep of water was observed in the Woodbine strata underlying the spillway structure during the brief periods between excavation and backfill that the surface was exposed. As the excavation approached the base of the 1V on 3.5H slope beneath the structure the accumulative water produced by the seeps became noticeable. Seepage water draining from the sand filter blanket trickled downslope and hindered the cleaning of the exposed sections of the foundation.

Surface water, i.e. run-off from rain, was a more difficult problem. The relatively large drainage area of the excavation combined with the highly erosive character of the excavation slopes caused heavy siltation in the work area even after moderate rains. Considerable construction time was lost while the work area, which normally was near the lower part of the excavation, was unwatered and cleaned of silt.

The Contractor installed a collector well in the base of the excavation as it neared final grade. A system of collector ditches intercepted the surface run-off and channeled it to the collector well for removal. The location of the collector well is shown on Plate 9. The well was equipped with a 6-inch 58 hp Flyght pump capable of pumping

800 gallons of water per minute from the well location to the edge of the excavation (approximately 60 ft head). However, it was estimated that, with the heavy silt load, the actual pumping rate was about 400 to 500 gallons per minute. During dry periods the pump was operated intermittently - once every two to three days - to handle "nuisance water" exiting from the sand blanket. A 6-inch diesel pump supplemented pumping after rain storms.

3. Overburden Excavation. Overburden materials in the spillway excavation consist of tan to reddish-brown fine-grained sand mixed with varying amounts of clay, silt, and gravel as previously described. Within the limits of the old spillway the overburden had been removed during construction leaving only primary strata exposed on the spillway floor. Excavation for the new spillway began in April 1984. Overburden materials, where present, were excavated using Caterpillar scrapers pushed by Caterpillar D6 and D8 bulldozers. Suitable overburden materials removed from the spillway excavation were used as fill in a berm being constructed on the downstream face of the main embankment as part of the same construction contract.

4. Rock Excavation. Primary material removed from the spillway excavation ranged from weathered sand and clay, to unweathered, sandy, soft shale, and soft to hard fine-grained sandstone. The methods used to excavated the primary material changed as the excavation neared final grade. The following methods were employed:

(a) Bulk excavation of the primary materials was accomplished in the same manner as the excavation of the overburden materials, i.e.,

Caterpillar scrapers pushed by D6 and D8 bulldozers (See Figure 3). Ripper equipped dozers plowed and loosened the material prior to removal. Most of this material was suitable for use as fill material in embankment berm. That material which was not suitable, either due to the presence of large pieces of sandstone or too much sand, was spoiled in on-site waste areas.

(b) Bulk excavations were halted a minimum of 2 feet above final grade. Final grade surfaces were required to be covered within 4 hours of excavation. Excavation of the final 2+ feet of primary material in the areas beneath the spillway structure was accomplished with a Warner Swassey Model G-1000 Gradall (track-mounted), and a Caterpillar Model 235 backhoe. As shown on Figure 4, the Gradall, with its wide, smooth-edged bucket was used to cut the flat surfaces to final grade, whereas the backhoe, with a deeper bucket equipped with 6-inch teeth, was more efficient at cutting ditches and at breaking through the moderately hard sandstone layers that were occasionally encountered. No blasting was required for any of the excavation or handling of materials during this project.

5. Overexcavation. A significant amount of overexcavation occurred during this project. The amount of overexcavation can be estimated by the amount of overrun in the sand required to construct the filter blanket between the excavated surface and the protective concrete slab beneath the structure. Using the designed thickness of the filter blanket, 6 inches, the estimated amount of sand required was 5465 cubic yards. Records show that 9134 cubic yards of sand were delivered to

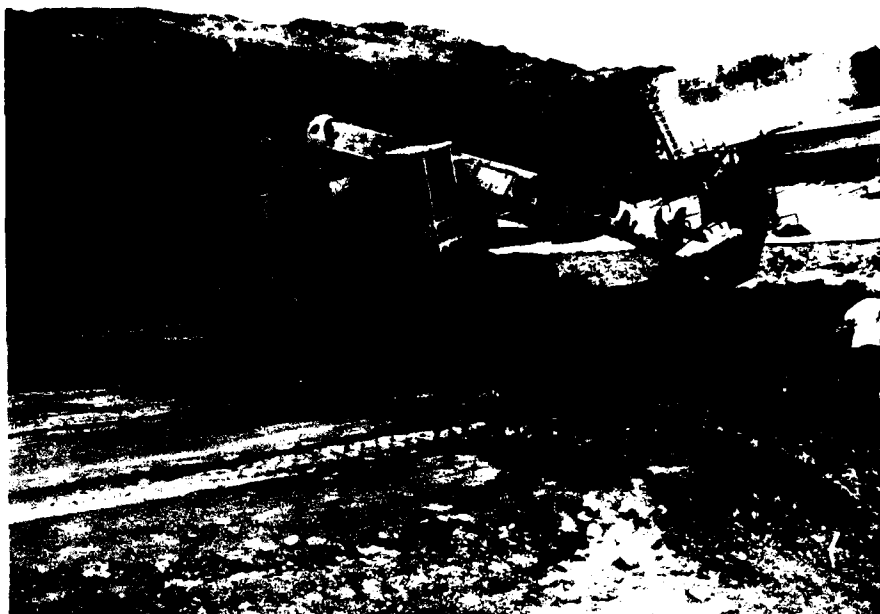


Fig. 3 - Bulk excavation down to grade plus a minimum of 2 feet is accomplished with scrapers pushed by bulldozers



Fig. 4 - Neat-line excavation is accomplished with Gradall equipped with straight-edged bucket

the site. Although it is estimated that as much as 20 percent of the overrun was due to waste, there were also numerous occasions when the excavation surface was measured in excess of a foot below grade. The following factors resulted in overexcavation:

(a) One factor was the angle or slope of the excavation. Past experience has shown that excavating through horizontally layered strata at an angle is very difficult to master even with experienced equipment operators. The horizontal layers usually break unevenly, leaving a stair-step appearance, especially if their hardness is inconsistent, as was the case in this excavation.

(b) Another factor contributing to overexcavation was the tendency of the Contractor to attempt to excavate to grade and backfill very large areas each day. Contract specifications required that when excavating in primary material, the exposed surface was to be cleaned and covered with backfill (either filter sand or protective concrete) within 4 hours of achieving final grade. In order to excavate, clean and cover larger areas within the required time frame the accuracy of excavating was sometimes sacrificed, resulting in overexcavation.

(c) A minor amount of overexcavation was caused by the presence of bedrock weaknesses such as jointing, fracturing, or soft pockets. The locations of these areas are shown on the Structure Foundation Map, Plate 10. Excavation in these areas typically resulted in the material breaking out irregularly, leaving a depression or a vertical face. Another example was the rock breaking out along a softer,

weaker horizontal bedding plane which could be up to several inches below the desired grade.

In areas where overexcavation was the direct result of naturally occurring weaknesses in the foundation bedrock, the Contractor was paid for the extra amount of excavation and backfill. The quantities were measured and agreed upon by representatives of the Government and the Contractor immediately after excavation and before placement of backfill. Under this agreement the Government paid for a total of 354 cubic yards of extra sand, and 61 cubic yards of extra concrete.

6. Foundation Preparation. Preliminary test results indicated the need to minimize the exposure time of the primary material in order to retard change in moisture content and subsequent deterioration. A minimum of 2 feet of undisturbed primary protective cover was left on all rock foundation surfaces for subsequent removal immediately prior to backfill with filter sand or protective concrete.

(a) Foundations Beneath the Structure. Each day the final 2 + feet of primary material was excavated from an area using the Gradall or the backhoe. Upon achieving final grade, all loose, drummy, or otherwise unsatisfactory rock was removed and the surface was cleaned using compressed air. Figures 14 thru 32 show typical foundation surfaces. While the surface was being cleaned the Contractor's survey team assisted the CE geologist in taking final grade cross-sections and mapping any geologic features in the foundation. Immediately after the cleaning and mapping were completed, and the foundation was

approved by the inspecting geologist, Aerospray 70, a resin-type sealer manufactured by the American Cynamid Company, Wayne, New Jersey, was mechanically sprayed onto the foundation surface. The surface was then covered with either filter sand in the area beneath the spillway floor, or protective concrete in the area beneath the spillway training walls. A complete record of foundation approval is presented on Plate 13.

The use of Aerospray 70 was ineffective in areas of predominantly sand or sandy material. It was observed that in sandy material, the Aerospray mixture actually penetrated and softened or loosened the top ± 1-inch of material, making the surface soft and slippery. The Aerospray was effective in the shaly zones of the foundation. Therefore, the decision whether or not to use the Aerospray was made on a daily basis by the CE geologist, depending on the type of material exposed on the excavation surface.

(b) Foundations Adjacent to the Structure. Foundations adjacent to the structure include unweathered strata of the Woodbine Formation. The excavation slopes beyond the limits of the spillway structure foundation were essentially excavated to final grade during the initial spillway excavation. Primary material immediately adjacent to the outside toe of the training walls was excavated to a 1 vertical on 1 horizontal slope and allowed to stand during the period of construction. Adjacent to each wall the 1 vertical on 1 horizontal slope came up to a specified height, then changed to a 1 vertical on 3.5 horizontal slope to the top of the excavation. After the training walls were

completed, non-expansive material was placed between the training walls and the 1 vertical on 1 horizontal slope. Before placement of fill, the slope was hand-cleaned of loose, deteriorated, or otherwise unsatisfactory materials. Figure 33 shows an area of the 1 vertical on 1 horizontal slope being backfilled with non-expansive material.

(c) Overburden. Overburden materials exposed in the excavation slopes are shown on Plate 9. Horizontal and vertical limits of the overburden are shown on the cross-section on Plate 12. No backfill occurred adjacent to overburden materials. Overburden materials exposed in the slopes were covered with topsoil and turf to protect against erosion.

7. Safety. The slopes of the excavation were designed so that there would be no requirement for protection against slides and rock falls within the excavation. However, one minor slide did occur in a nearly vertical shale face about 300 feet left of centerline at station 14 + 50. (See Figure 6) After a significant weekend rain it was discovered that about 20 cubic yards of material had fallen down the slope, possibly the result of water entering an isolated zone of jointing behind the shale mass. Fortunately there were no workmen or equipment immediately below the slide area at the time of occurrence. To preclude future slope stability problems the Contractor was directed to lower the top of the slope as the excavation deepened, thereby maintaining a decreased standing height. The remainder of the excavation slopes remained stable throughout the construction period.



Fig.5 - Parabolic-shaped slab at top of spillway slope -
note collars placed at rock anchor locations



Fig.6 - Slide area shown in upper center portion
of photo - note nearly vertical slopes

VI FOUNDATION ANCHORS

1. General. Permanent foundation anchors were installed in the existing spillway apron at Grapevine Dam and in the newly constructed chute and stilling basin. A total of 3549 foundation anchors were installed to a minimum depth of 16 feet below the surface of the apron slab in the existing section and the protective concrete slab in the new section. A plan of rock-anchor installation is presented on Plate 14.

2. Equipment. The 6-inch diameter holes for the foundation anchors were drilled using a Gardner-Denver RDC-16B track-mounted pneumatic drill, shown on Figure 7. Two types of bits were used for drilling: The majority of drilling was done using a 5½-inch drag bit in the soft shales, clays and sandstones; and, a 6-inch Varel Tri-cone rock-bit was used to penetrate the moderately hard to hard sandstone layers which were encountered. The anchors consisted of No. 11 rebar bent in an L-shape. The grout mixture placed around the anchors was mixed at a commercial off-site batch plant and delivered in ready-mix trucks. (See Figure 9) The grout was dumped into a hopper attached to a side-winder pump and subsequently pumped into the holes through a 1¼-inch ID flexible hose.

3. Grout Mix Design. One cubic yard of grout contained the following ingredients:



Fig. 7 - Anchor holes being drilled with track-mounted pneumatic drill



Fig. 8 - Anchor bars in place and ready for grouting



Fig.9 - Grout arrives at site and is dumped into hopper and pumped to hole locations



Fig.10 - Grout being placed in bottom of hole through 1½-inch ID flexible rubber hose

Cement (Normal Portland Type I)	2.630 cf (5.5 sacks)
Fine Aggregate (0 - #4 Trinity Newark Sand).	19.189 cf
Water	4.776 cf (35.75 gal.)
Admixture (MB-322N-Water Reducing Admixture)	<u>.405 cf</u>
	27.000 cf

4. Procedure. Work on the Grapevine Spillway was scheduled so that the drilling and installation of foundation anchors could be accomplished simultaneously with other phases of construction. All of the anchors were installed perpendicular to the spillway structural concrete slab. Holes for installing the anchors were drilled through 6-inch diameter collars installed through the protective concrete slab and filter blanket. The anchor holes were drilled 15 feet into the foundation bedrock. Upon reaching the required depth the holes were blown clean using compressed air and tightly plugged until the subsequent insertion of anchor bars and grout. The normal procedure was to drill and plug approximately 50 anchor holes, insert the anchor bars, and place grout, all within 2 to 3 consecutive days. After the anchor bars were fixed in the holes at the correct elevation the grout mixture was pumped through a 1 1/4-inch ID flexible rubber hose extending to the bottom of the hole (Figure 10). Pumping continued until pure grout returned to the surface, indicating the hole was filled. The hose was then withdrawn from the hole while pumping continued. The grout in the hole was then vibrated from the bottom of the hole up (Figure 11). Finally, after vibrating was completed, the hole was topped off with more grout, completing the installation.

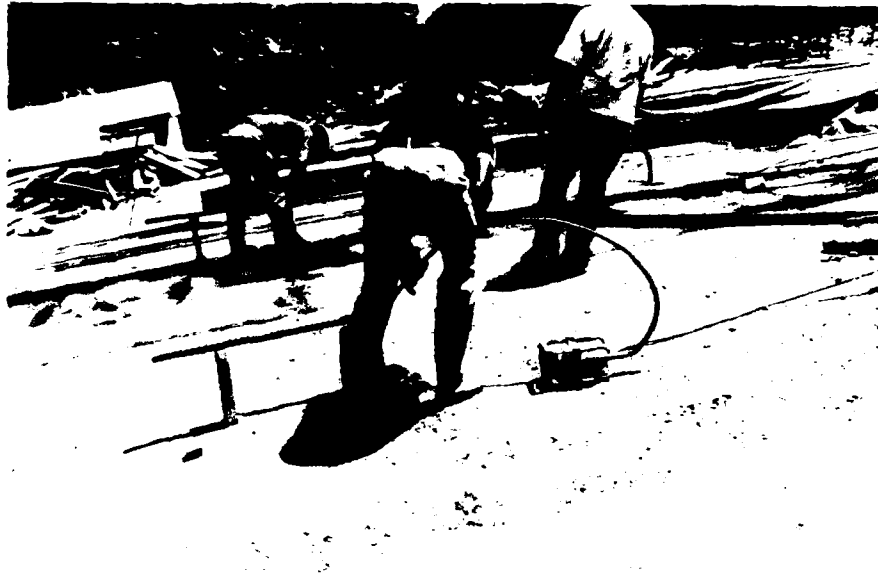


Fig.11 - Grout being vibrated in the hole

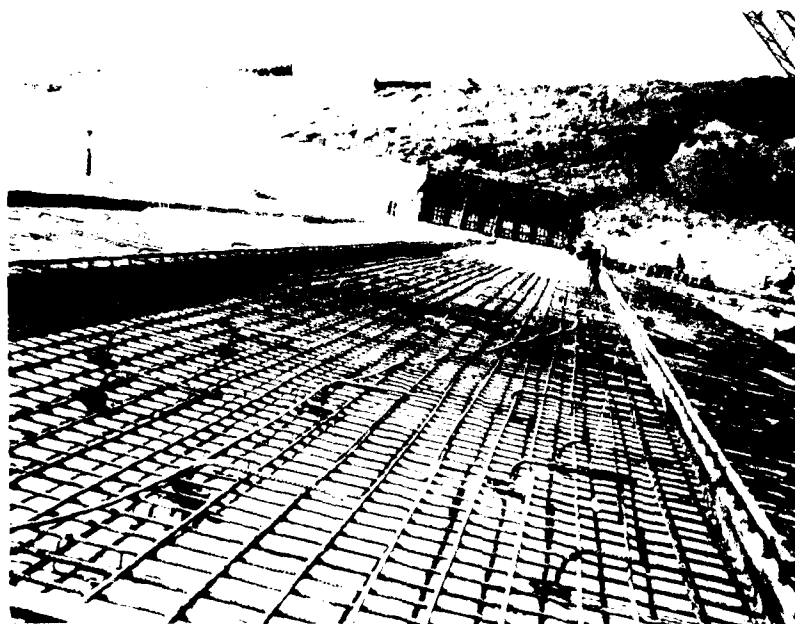


Fig.12 - Anchor bars and steel in place ready for concrete

5. Modification. In accordance with the Value Engineering Incentive Clause of the contract, the Contractor submitted two proposals to modify the rock anchor design and installation. The first proposal was to eliminate the 1/2-inch grout tube attached parallel to each anchor through which grout would be pumped causing the hole to be filled with grout from the bottom up. Instead, grout would be pumped to the bottom of the hole through a 1/2-inch steel pipe which would be retracted as the hole filled with grout. The second proposal was to reduce the number of spacers fixed to each anchor from four to two.

Both of the proposals were accepted by the SWF Value Engineering Officer, resulting in Modification No. P00005, D0-C0612 being issued on September 30, 1983. The net savings to the Government was \$7,296.

After installation of the rock anchors began, the Contractor requested and was granted approval to fill the grout holes through a flexible hose, as described above, rather than through a steel pipe.

6. Pull-Out Tests. Two rock anchors were installed on February 8, 1984, for the purpose of conducting pull-out tests. Both were installed at design grade near the centerline of the spillway at approximate station 12 + 80, about 50 feet downstream from the end of the existing spillway apron. The pull-out tests were performed by Southwestern Laboratories' personnel. The initial tests conducted on Feb 23-24, 1984, were unsuccessful because of problems with the jack and jack support. The same anchor bars were retested on March 8, 1984, with successful results. The anchors were stressed to 45 tons during which



Fig. 13 - Pull-out test in progress

the maximum deformation observed was 0.551 inch. Figure 13 shows the pull-out tests in progress.

As a result of this test it was concluded that the design for the spillway slab anchors was satisfactory, and the Contractor was given authorization to proceed with the fabrication and installation of the rock anchors based on the design given in the contract plans and specifications. A complete record of the pull-out test data is on file in the SWF Design Branch, Structural Section.

VII POSSIBLE FUTURE PROBLEMS

1. Observations. There were no unanticipated foundation conditions discovered during construction of the Grapevine Spillway Modification which would pose a threat to the stability of the structure. All foundation surfaces were stable and sufficiently competent as anticipated in the design, and remained so until covered by filter sand or protective concrete.

The materials exposed in the upper portion of the excavation are highly erodible in nature. The establishment and maintenance of a good turf zone will be required in this area in order to prevent severe erosional damage and subsequent heavy siltation over the spillway floor.

The channel downstream from the new spillway is founded in materials varying from loose clayey sand to soft to moderately hard, very fine-grained, weakly to moderately cemented sandstone. The channel will suffer severe erosional damage in the event of a major flow event. Measures to control erosion in the spillway discharge channel should be considered.

2. Future Considerations. The excavation of a 1 horizontal on 4 vertical slope, as required in the excavation for the spillway end sill, is very difficult to achieve. Normally, when excavating in soft materials where line drilling would not be required, a Contractor will use a backhoe, which will result in a rectangular-shaped ditch, as

was the case in this project (see Figure 32). Consideration should be given to designing a rectangular-shaped end sill excavation with a typical bottom width conforming to the width of a typical backhoe bucket.



Fig. 14 - Exposed foundation surface - 25 April 1984

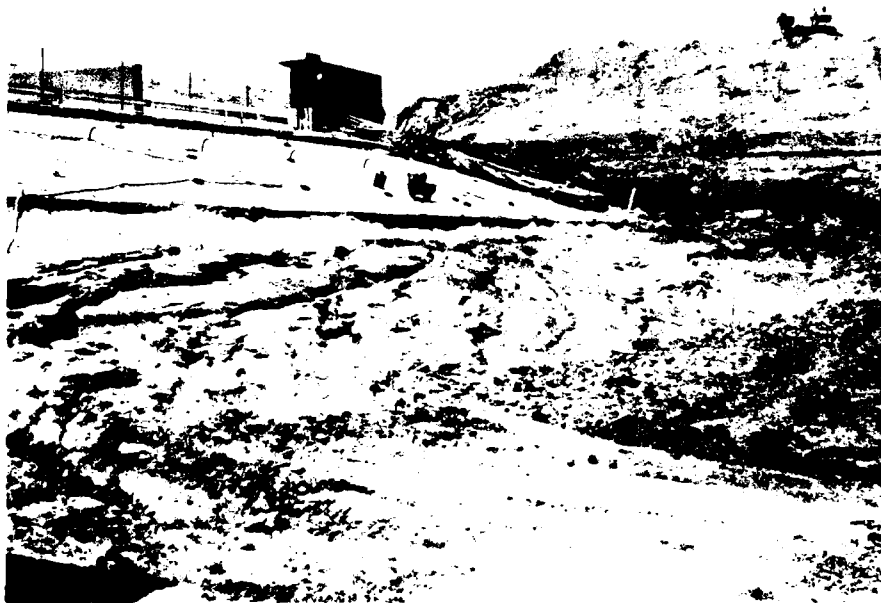


Fig. 15 - Exposed foundation surface - 9 May 1984

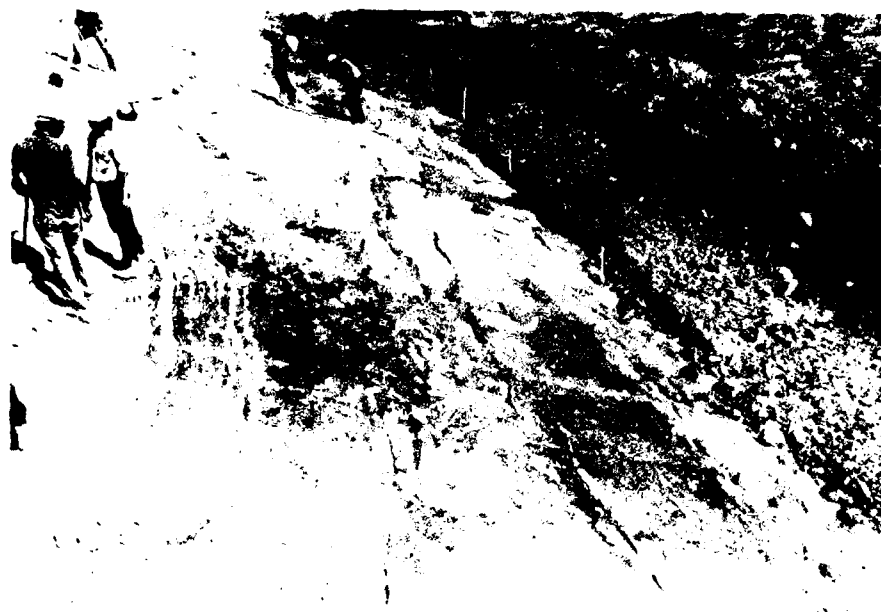


Fig. 16 - Exposed foundation surface - 9 May 1984



Fig. 17 - Exposed foundation surface - 25 June 1984



Fig. 18 - Exposed foundation surface - 10 July 1984



Fig. 19 - Exposed foundation surface - 10 July 1984



Fig. 20 - Exposed foundation surface - 18 July 1984

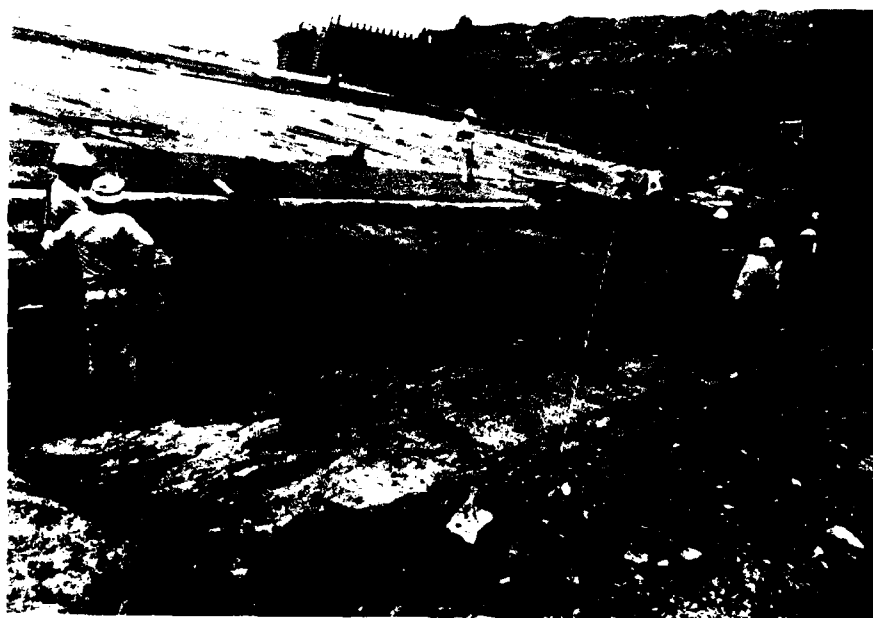


Fig. 21 - Exposed foundation surface - 25 July 1984



Fig. 22 - Excavation for cut off wall -
28 June 1984

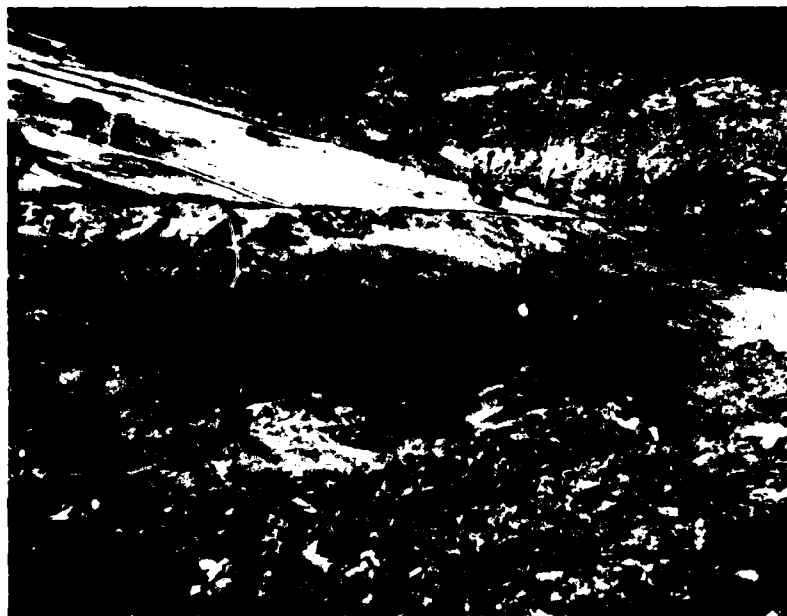


Fig. 23 - Exposed foundation surface - 10 September 1984



Fig. 24 - Exposed foundation surface - 10 September 1984



Fig. 25 - Exposed foundation surface - 17 September 1984



Fig. 26 - Exposed foundation surface - 9 October 1984

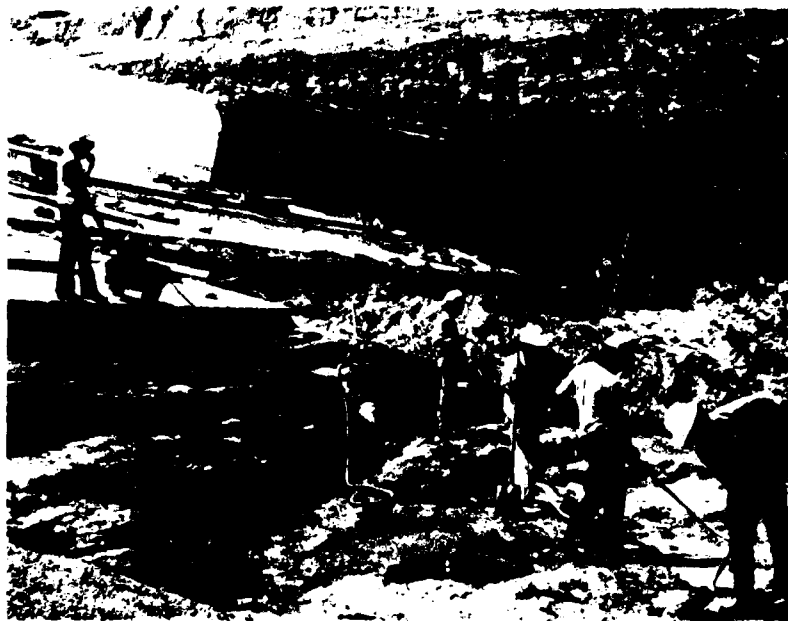


Fig. 27 - Exposed foundation surface - 9 October 1984



Fig. 28 - Exposed foundation surface - 20 November 1984



Fig. 29 - Exposed foundation surface - 6 March 1985



Fig. 30 - Exposed foundation surface - 6 March 1985



Fig. 31 - Exposed foundation surface - 7 March 1985



Fig. 32 - End sill excavation - 5 April 1985

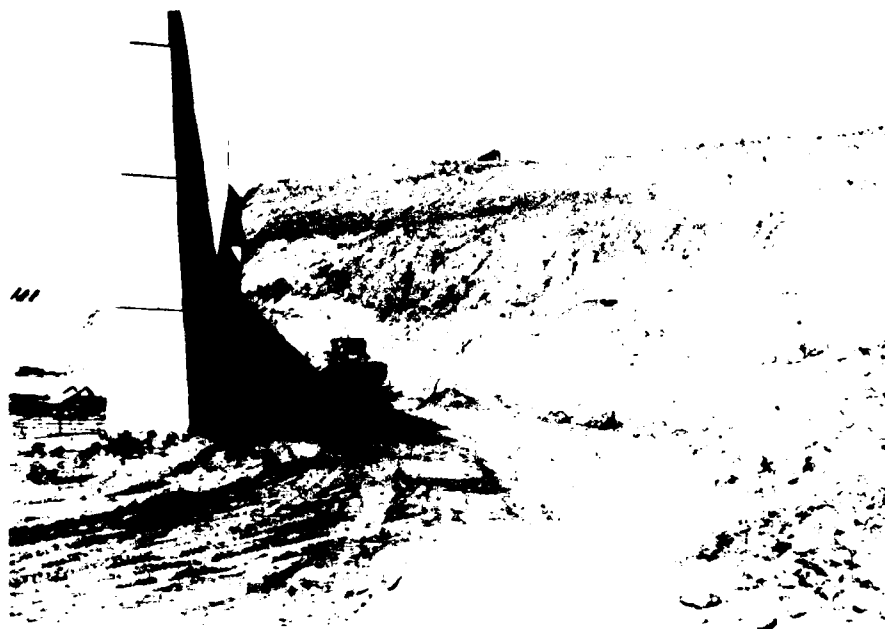
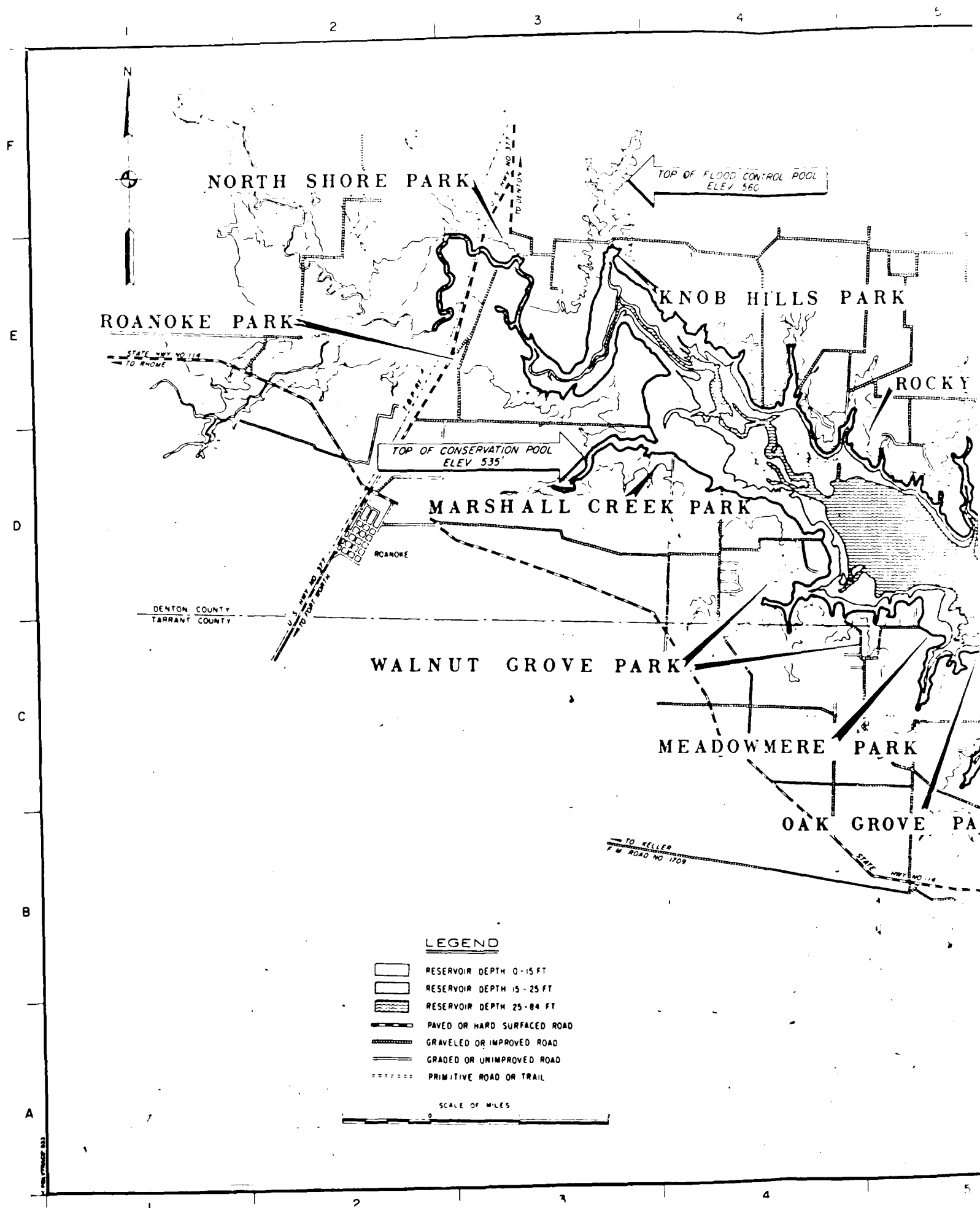


Fig. 33 - Placement of nonexpansive backfill between training wall and excavation slope

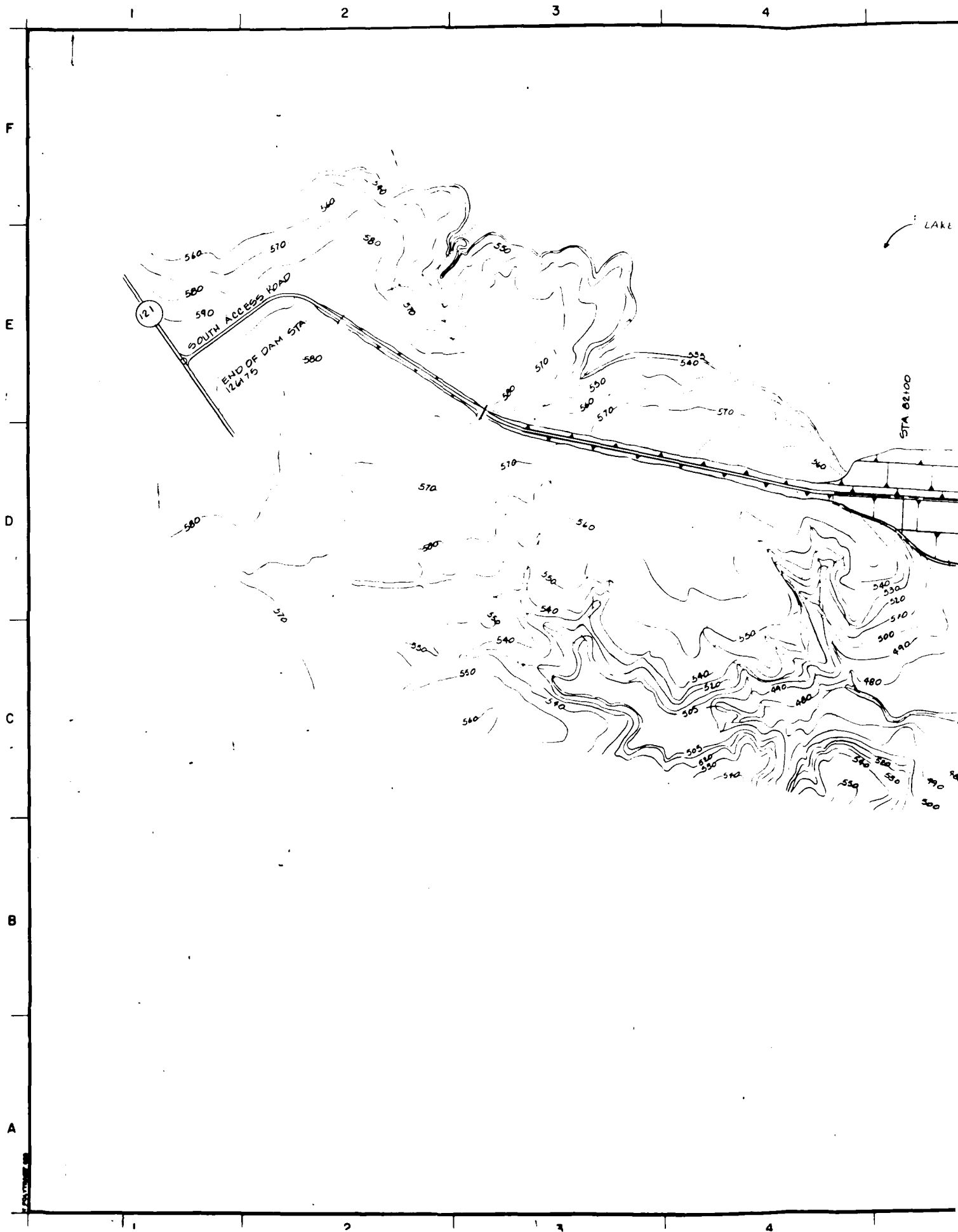




VICINITY MAP
NOT TO SCALE

S - AREA
RK

CONTRACT NO. JACW63 03-C-0160

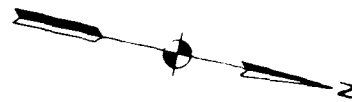


6

7

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9



APPROXIMATE LOCATION
WATER LINE IN THE
GROUND THE CONTRACTOR
TO THIS LINE TO PROVE
GOVERNMENT FIELD

CONSERVATION POOL EL. 5350

STA 60+00

STA 49+34

EMBANKMENT MODIFICATION
BETWEEN STA. 57+00 AND
STA. 65+00

DENTON CREEK

OUTLET
WORKS

WASTE AREA II

LIMITS OF CONSTRUCTION
R.O.W. A

STOCKPILE AREA
FOR 2 DRAP

OUTLET CHANNEL

BRIDGE 30' EASING DR

BRIDGE 45' DETOUR

BRIDGE 30' EASING DR

WASTE AREA III

AM #0001	23 AUG 83	ADDED LIMITS OF
SYM NO.	ACTION	DATE
DESIGNED BY M. GREEN		
DRAWN BY D. SMITH		
CHECKED BY A. MARR		
SUBMITTED BY MEL GREEN ENGINEER		
SITE P		
CONTRACT NO. 124761-1		
DRAWING NUMBER		

SCALE 1" = 100 FEET

TO ACCOMPANY FINAL FOUNDATION REPORT

8

9

10



APPROXIMATE LOCATION OF EXISTING 24" WATER LINE IN THE CITY OF FLOWER MOUND. THE CONTRACTOR SHALL CONNECT TO THIS LINE TO PROVIDE WATER TO THE GOVERNMENT FIELD OFFICE

BRATON POOL EL 5350

PROPOSED CANAL OR

LIMITS OF CONSTRUCTION R.O.W.

WASTE AREA I

CONTRACTOR/GOVERNMENT FIELD OFFICE LOCATION

WASTE AREA II

STOCKPILE AREA FOR REEF

CHANNEL

WASTE AREA III

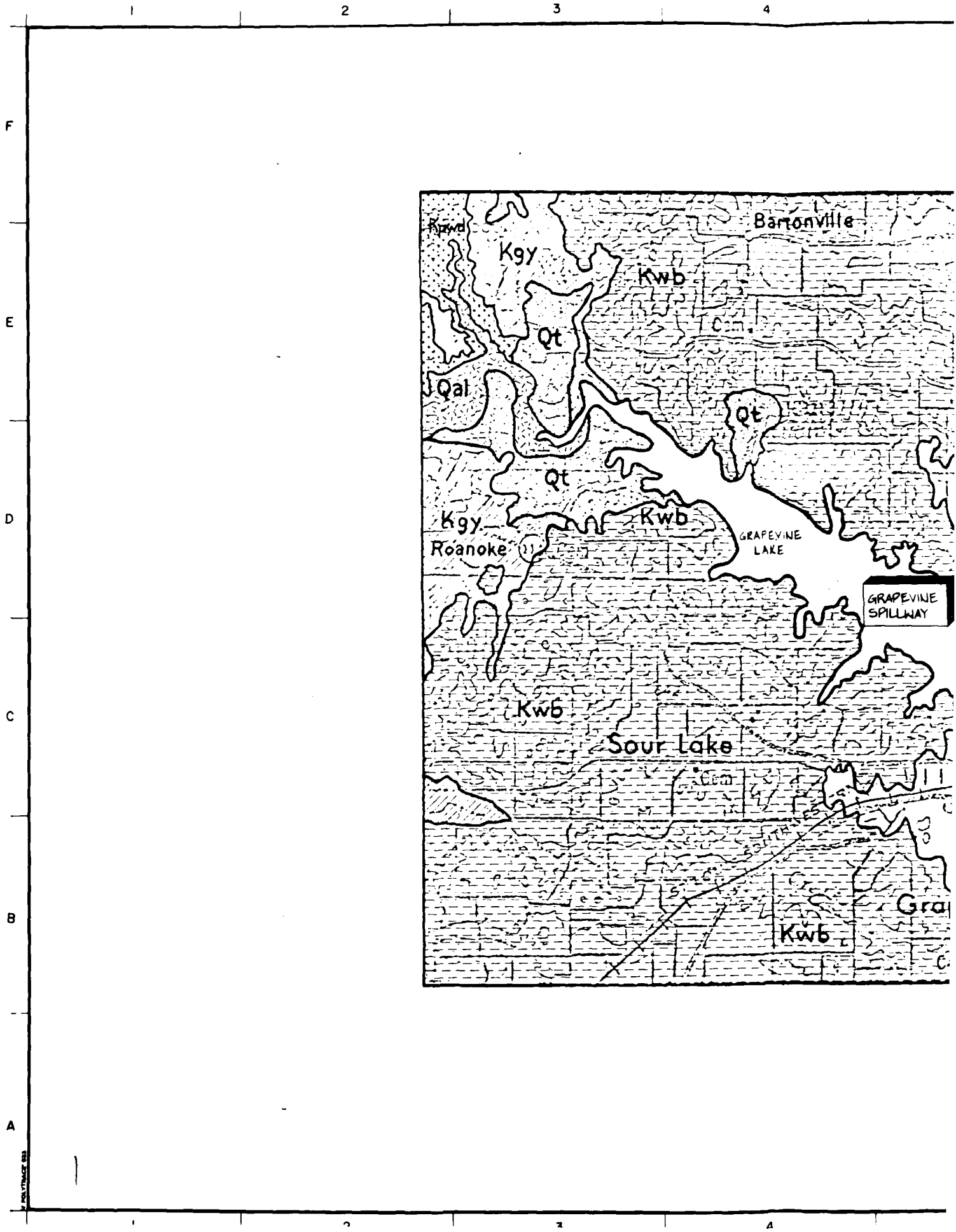
AM #0001				23 AUG 83	ADDED LIMITS OF CONSTRUCTION R.O.W.
DESIGNED BY	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS				
DRAWN BY	GRAPEVINE LAKE DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS				
REVIEWED BY	MODIFICATION OF EMBANKMENT AND SPILLWAY				
SUBMITTED BY	SITE PLAN				
MEL GREEN	INVITATION NO.	DAW63 83 B-0052	DATE	AUG 1983	
ENGINEER	CONTRACT NO.	DAW63 83 C-0160	SHEET NO.	2	
	DRAWING NUMBER		OF		

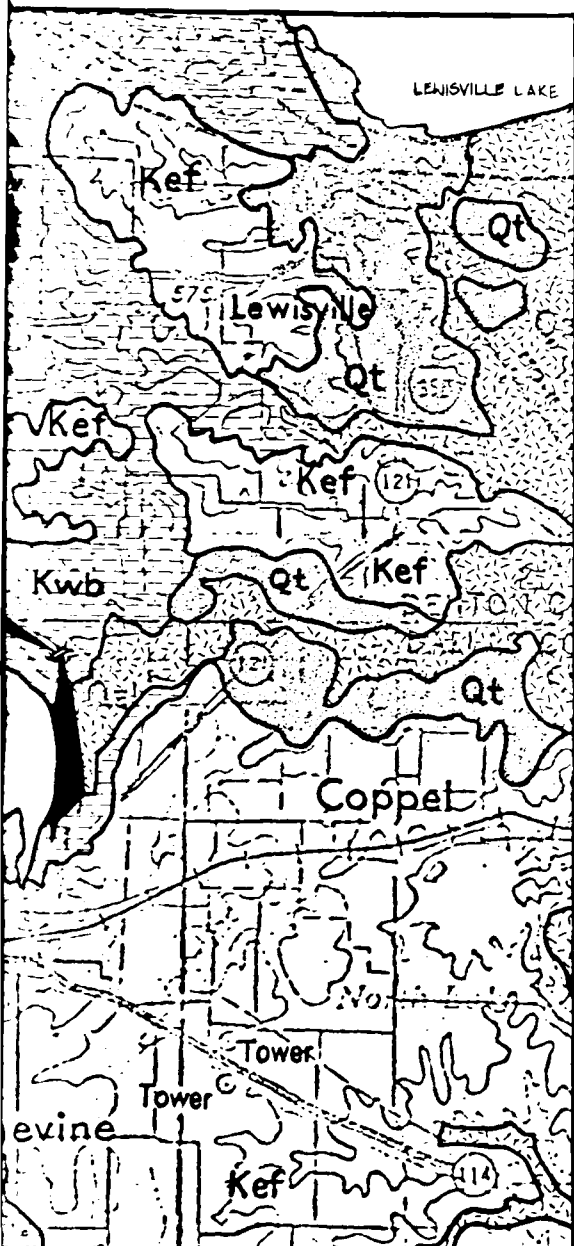
SCALE 1" = 100 FEET

8

TO ACCOMPANY FINAL FOUNDATION REPORT

CONTRACT NO. DAW63-83-C-0160





LEGEND

RECENT



(Qal) ALLUVIUM

PLEISTOCENE



(Qt) FLUVIAL TERRACE DEPOSITS

UPPER
CRETACEOUS



(Kef) EAGLE FORD GROUP UNDIVIDED



(Kwb) WOODBINE FORMATION

LOWER
CRETACEOUS



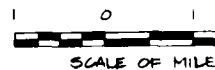
(Kgy) GRAYSON MARL & MAIN STREET



(Kpaw) PAW PAW FORMATION

NOTES:

1. MAP REFERENCE UNIVERSITY OF TEXAS BUREAU OF ECONOMIC GEOLOGY, DALLAS SHEET, 1972, AND SHERMAN SHEET, 1967.



DESIGNED BY A. MARK	GRAPEVINE DINTON CREEK, ELM FORK
DRAWN BY L. GOSS	MODIFICATION EMBANKMENT AND
REVIEWED BY A. MARK	AREAL (
SUBMITTED BY LA. GREEN	INVITATION NO.
ENGINEER	CONTRACT NO.
	DRAWING NUMBER



LEGEND

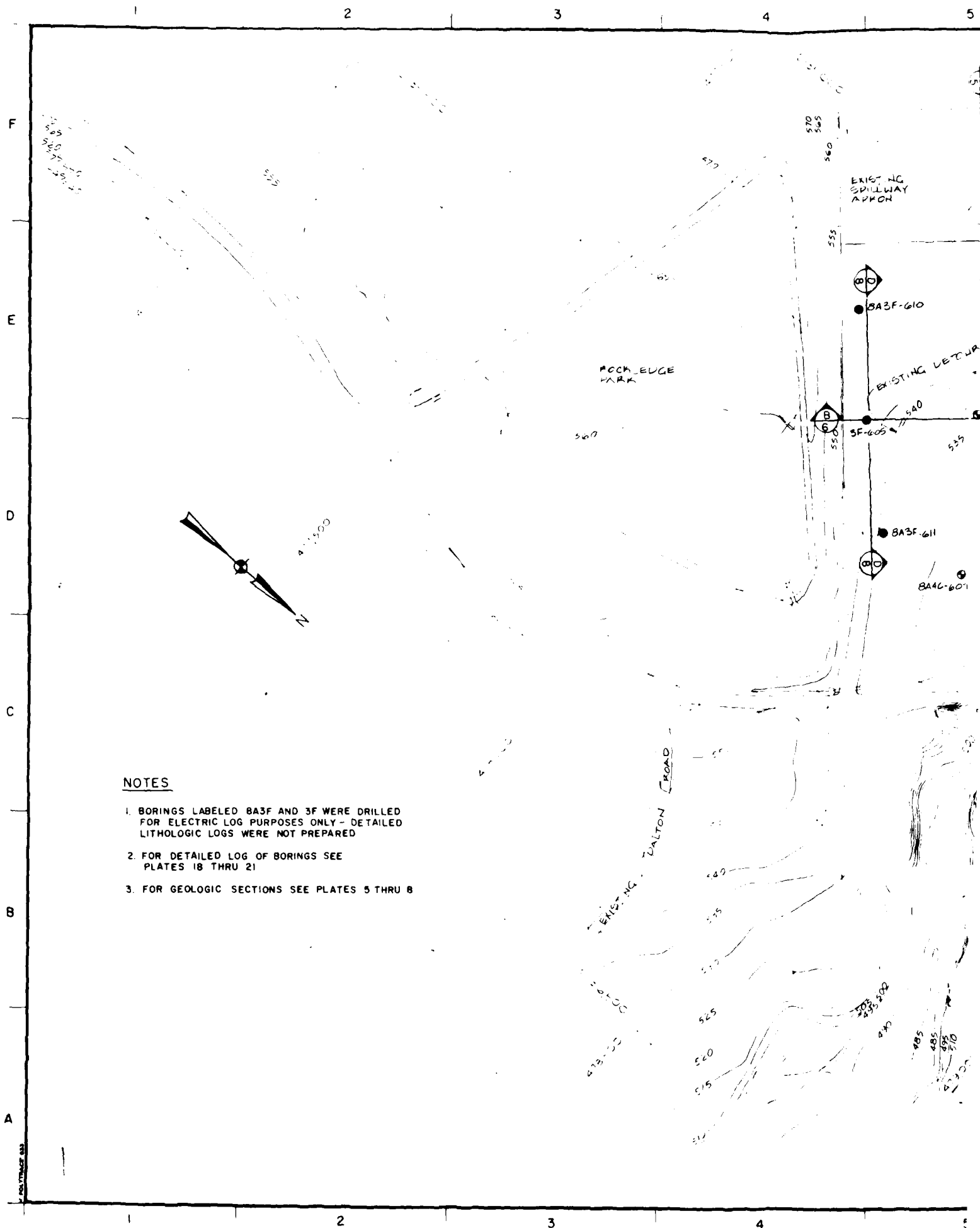
RECENT	[Symbol: Stippled pattern]	(Qal) ALLUVIUM
PLEISTOCENE	[Symbol: Horizontal lines]	(Qt) FLUVIATILE TERRACE DEPOSITS
UPPER CRETACEOUS	[Symbol: Diagonal lines]	(Kof) EAGLE FORD GROUP UNDIVIDED
	[Symbol: Horizontal lines with dots]	(Kwb) WOODBINE FORMATION
LOWER CRETACEOUS	[Symbol: Diagonal lines with dots]	(Kgy) GRAYSON MARL & MAIN STREET
	[Symbol: Stippled pattern with dots]	(Kpwb) PANPAW FORMATION

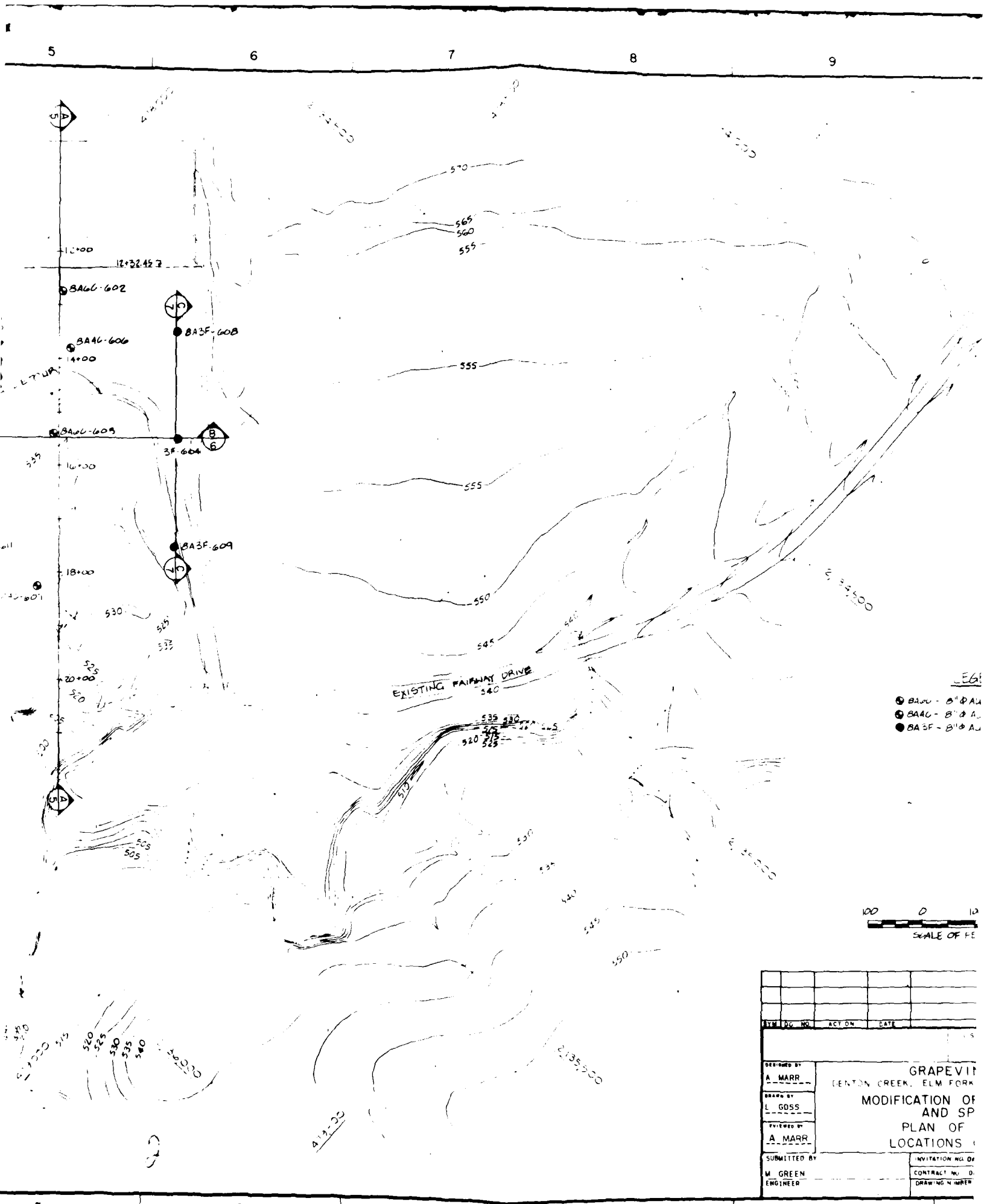
NOTES:

1. MAP REFERENCE UNIVERSITY OF TEXAS BUREAU OF ECONOMIC GEOLOGY, DALLAS SHEET, 1972, AND SHERMAN SHEET, 1967.



DESIGNED BY A. MARR		DRAWN BY L. GOSS		REVIEWED BY A. MARR		SUBMITTED BY M. GREEN ENGINEER	
INVESTIGATION NO.		ACTION		DATE		DESCRIPTION OF REVISION	
U.S. ARMY ENGINEER DISTRICT, FORT WORTH		CORPS OF ENGINEERS		FORT WORTH, TEXAS			
GRAPEVINE LAKE DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS MODIFICATION OF EMBANKMENT AND SPILLWAY AREAL GEOLOGY							
INVESTIGATION NO.		DATE		CONTRACT NO.		DRAWING NUMBER	
SHEET NO.		OF		PLATE 3		CONTRACT NO.	





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NG PARKWAY DRIVE

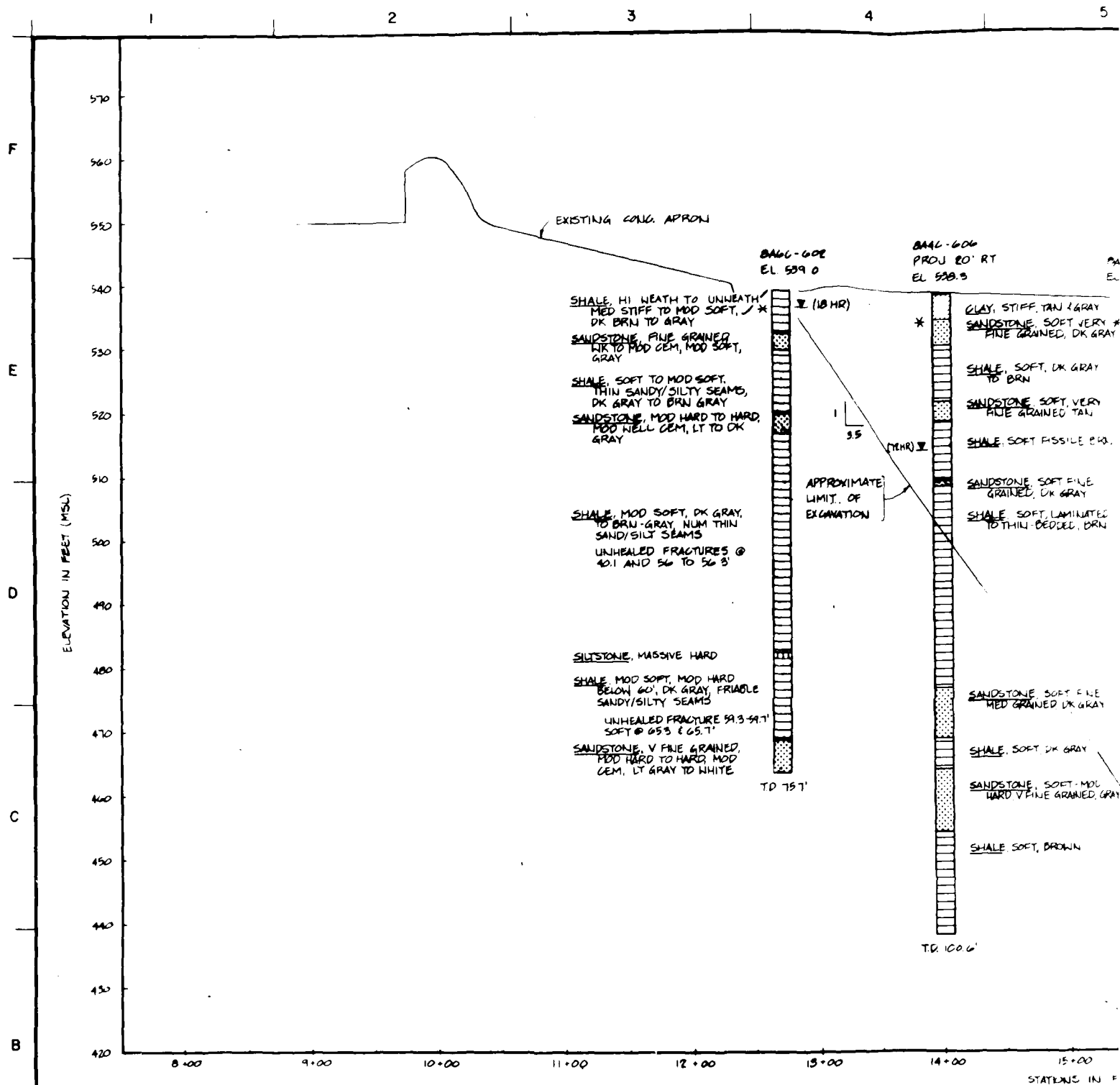
LEGEND

- BA 20 - 8" Ø AUGER, 6" Ø CORE
- BA 40 - 8" Ø AUGER, 4" Ø CORE
- BA 3F - 8" Ø AUGER, 3" FISHTAIL

100 0 100 200
SCALE OF FEET

DESIGNED BY A. MARR		DRAWN BY L. GOSS		CHECKED BY A. MARR		SUBMITTED BY M. GREEN ENGINEER	
PROJECT NO. 83 B 0052		DATE AUG 1983		CONTRACT NO. DACW83 B3 C 0180		DRAWING NUMBER	
DESCRIPTION OF REVISION		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS		GRAPEVINE LAKE CENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS MODIFICATION OF EMBANKMENT AND SPILLWAY PLAN OF BORINGS & LOCATIONS OF SECTIONS		3	
SHEET NO. 4		OF		PLATE		4	

CONTRACT NO. DACW83 B3 C 0180



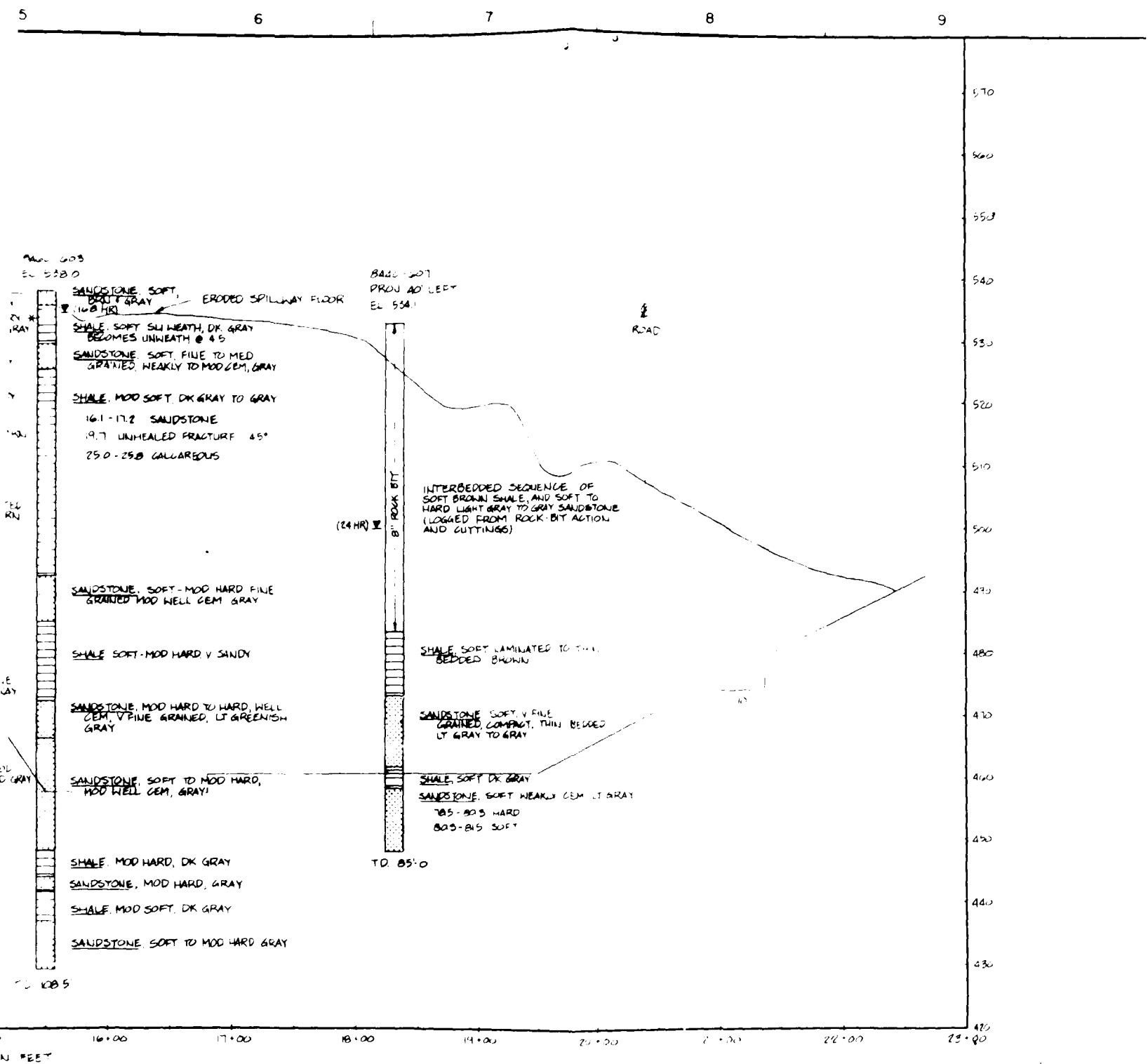
LEGEND

WOODBINE FORMATION
(CRETACEOUS AGE)

- PREDOMINANTLY SANDSTONE W/ SHALE & SHALY SANDSTONE INTERBEDS
- PREDOMINANTLY SHALE W/ SANDSTONE & SANDY SHALE INTERBEDS

SPILLWAY CENTERLINE

SCALE: VERT - 1" = 10'
HORIZ - 1" = 5'



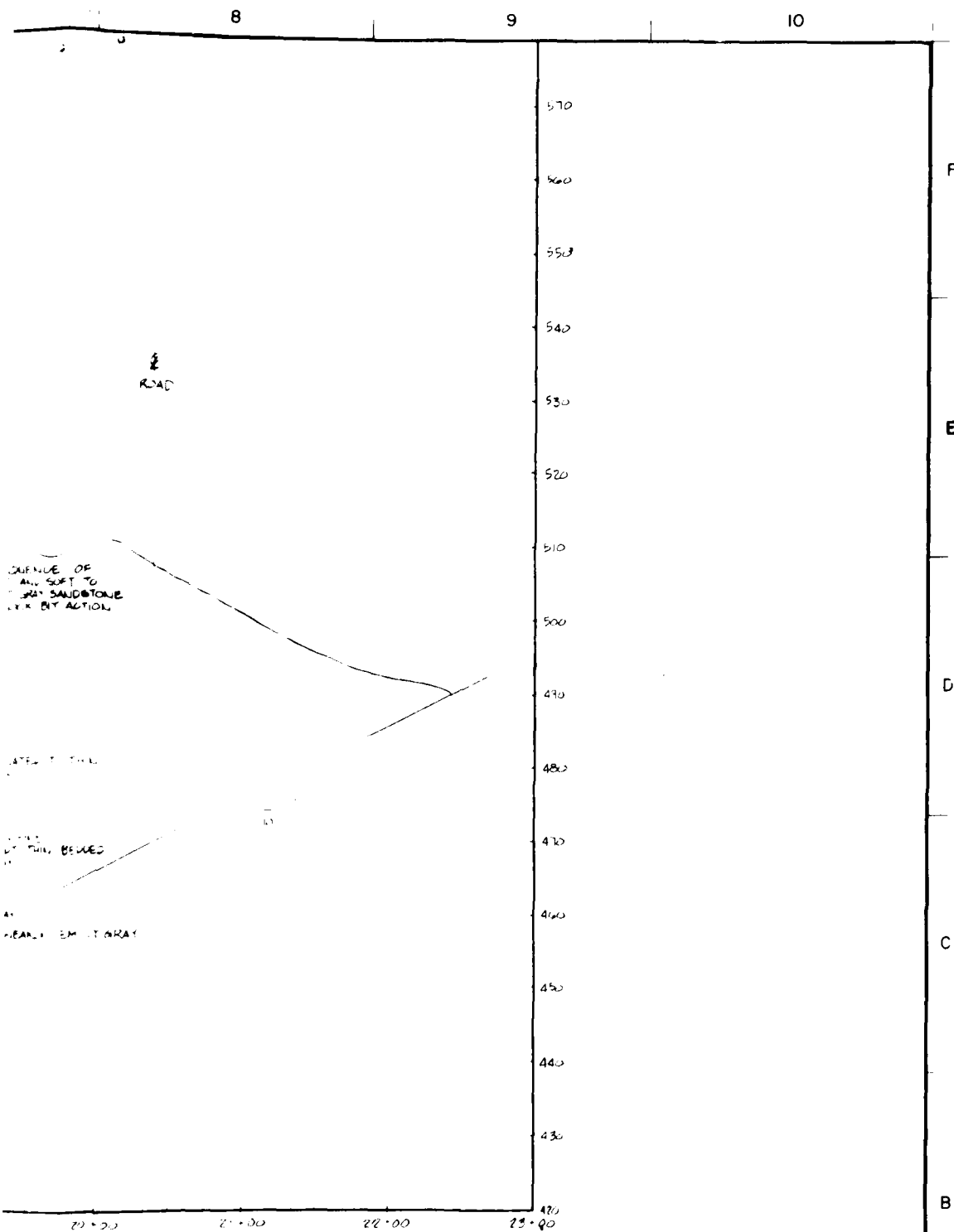
NE PROFILE

NOTES

1. DETAILED LOGS OF BORINGS ARE SHOWN ON PLATES 12 THROUGH 14
2. (12 HR) - WATER LEVEL 72 HOURS AFTER COMPLETION OF DRILLING
3. * - BASE OF WEATHERING

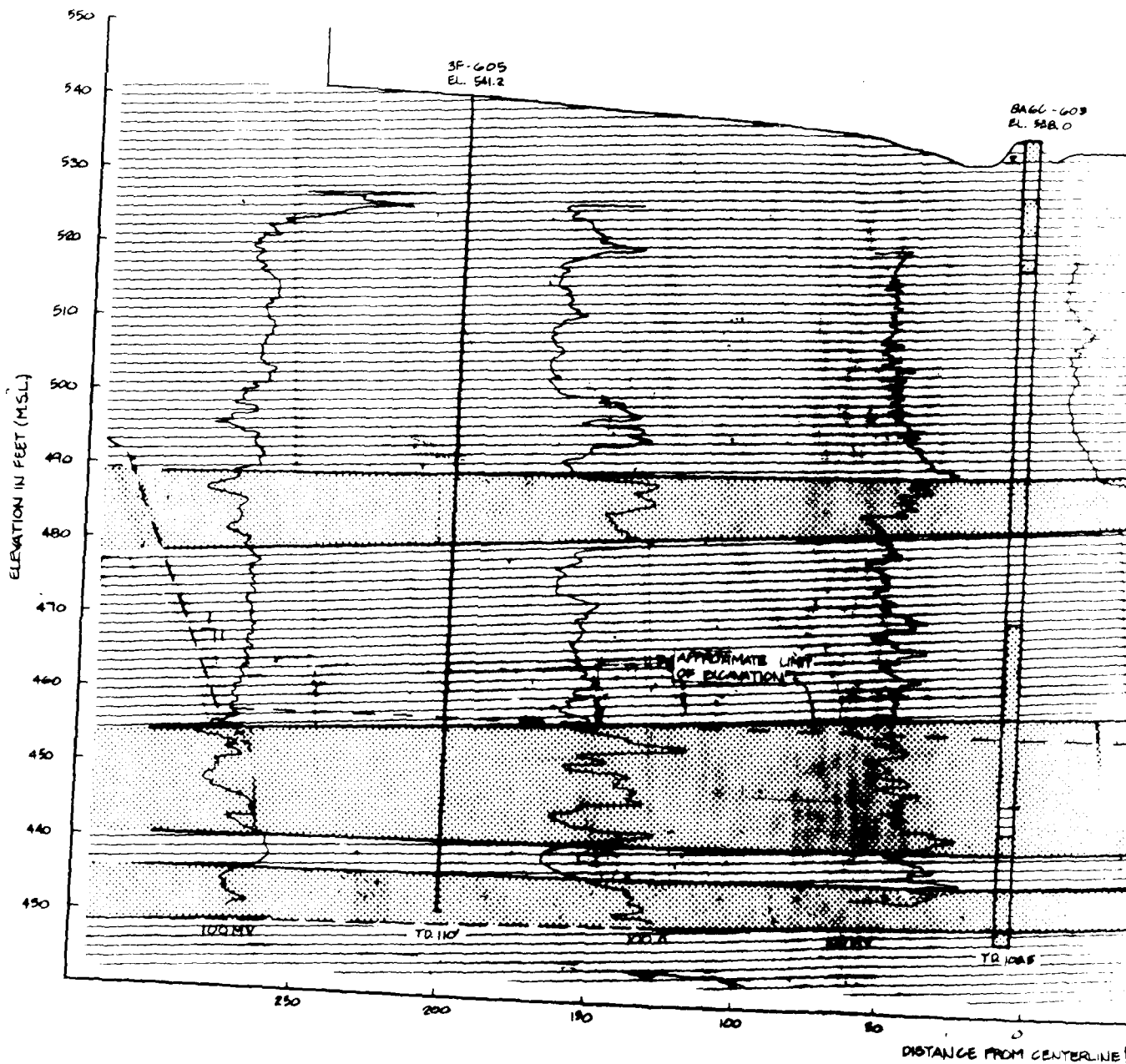
ITEM	DATE	NO.	ACTION	DATE

DESIGNED BY A. HARR	GRAPEVINE MODIFICATION EMBANKMENT AND CENTERLINE
DRAWN BY L. GROSS	
REVIEWED BY M. GREENE	
APPROVED BY M. GREENE	
DATE 10/1/77	INVITATION NO. CONTRACT NO. DRAWING NO.

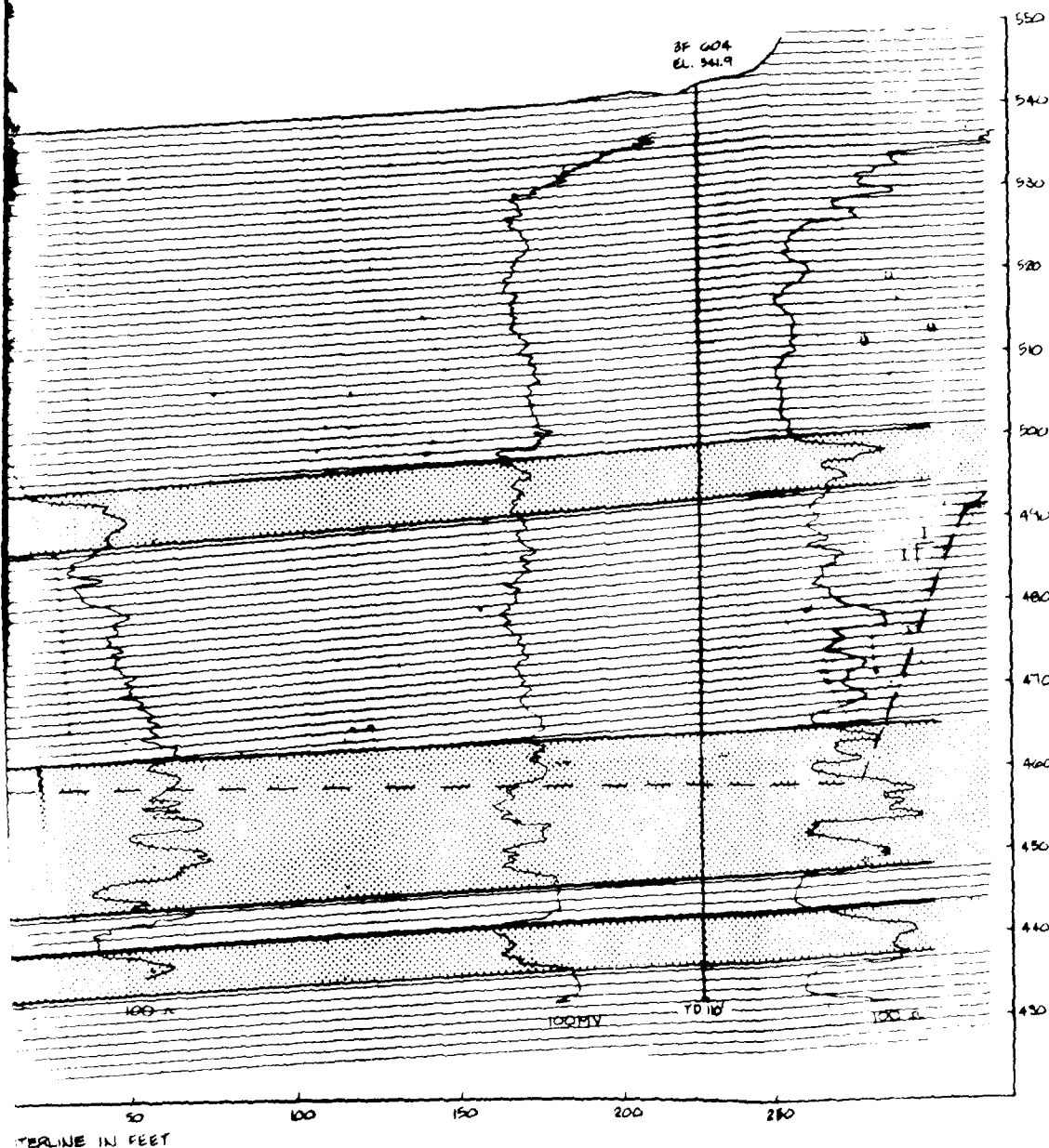


3. SLOPES ARE SHOWN
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 - 1:99
 - 1:100

SYN. NO.	ACTION	DATE	PERFORMED BY	REVISION
U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS				
DESIGNED BY A. MARR	GRAPEVINE LAKE MODIFICATION OF EMBANKMENT AND SPILLWAY			
DRAWN BY L. GROSS	3			
REVIEWED BY M. GREENE	CENTERLINE PROFILE			
SUBMITTED BY M. GREENE	INVITATION NO.	DATE	PLATE 5	
ENGINEER	CONTRACT NO.	DRAWING NUMBER		



SPILLWAY SECTION B
STATION 15+50
SCALE: VERT. 1" = 10'
HORIZ. 1" = 25'



TERLINE IN FEET

B - B

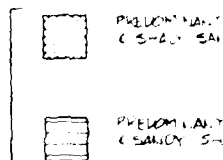
• W.O.
• 25-0

25-0

NOTES

- 1 FOR DETAILED LITHOLOGIC DESCRIPTIONS
SEE LOGS OF BORINGS.
- 2 E-LOGGER SETTINGS ARE NOTED AT BOTTOM
OF E-LOGS.
- 3 LOCATION OF SECTION 8-8 IS SHOWN ON
PLATE 4

LEGEND



8.3.2.1.2. *Explanatory*



SHUNTAGE IS POTENTIAL RESISTANCE

[illegible]

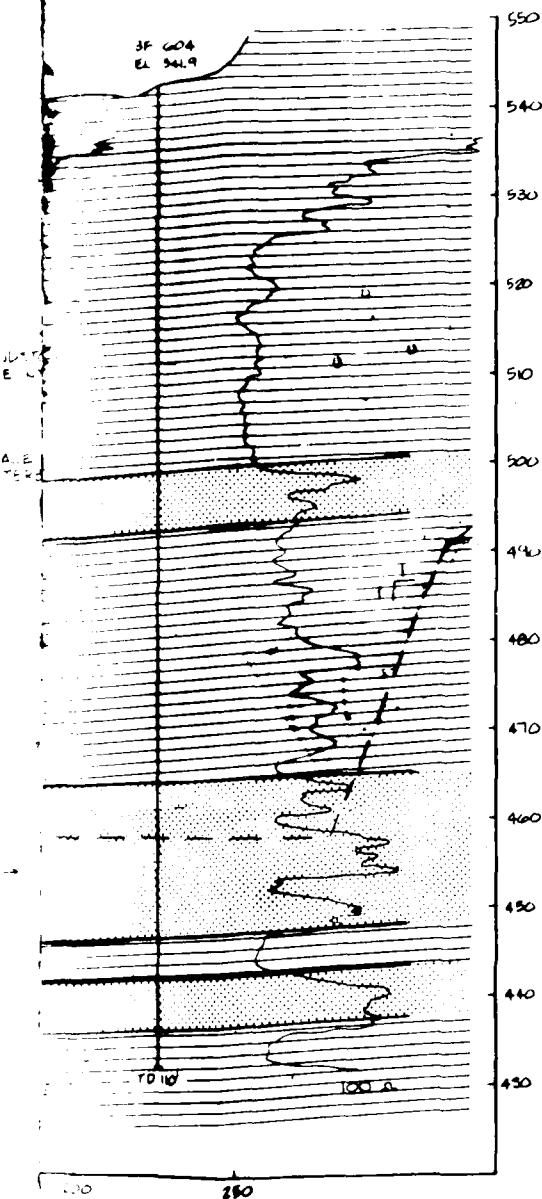
F

E

D

C

B



LEGEND

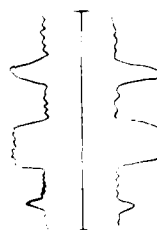


PREDOMINANTLY SANDSTONE w/ SHALE
& SHALY SANDSTONE INTERBEDS.



PREDOMINANTLY SHALE w/ SANDSTONE
& SANDY SHALE INTERBEDS.

ELECTRIC LOG



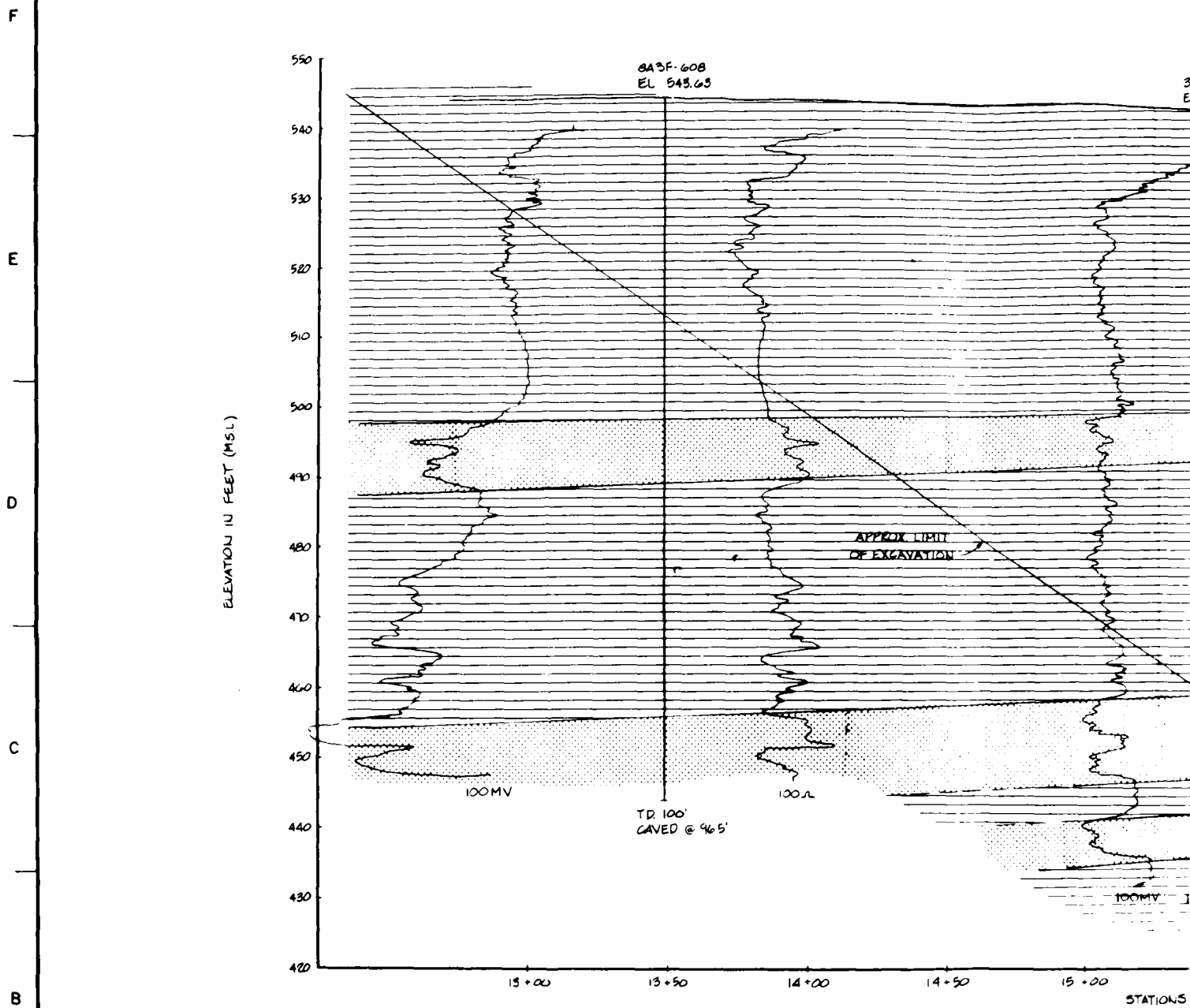
SP. INTAKE & POTENTIAL RESISTIVITY
INCREASES INCREASES

A. DESCRIPTIONS

B. NOTED AT BOTTOM

C. S SHOWN ON

DESIGNED BY A. MARR	GRAPEVINE LAKE SECTION, WITH FLOW FOR TRINITY RIVER, TEXAS	
DRAWN BY L. GOSS	MODIFICATION OF EMBANKMENT AND SPILLWAY	
REVIEWED BY M. GREEN	SECTION B-B	
SUBMITTED BY MEL GREEN ENGINEER	INVITATION NO. CONTRACT NO. DRAWING NUMBER	DATE SHEET NO. PLATE 6



SPILLWAY SE
SCALE: VERT.
HORIZ.

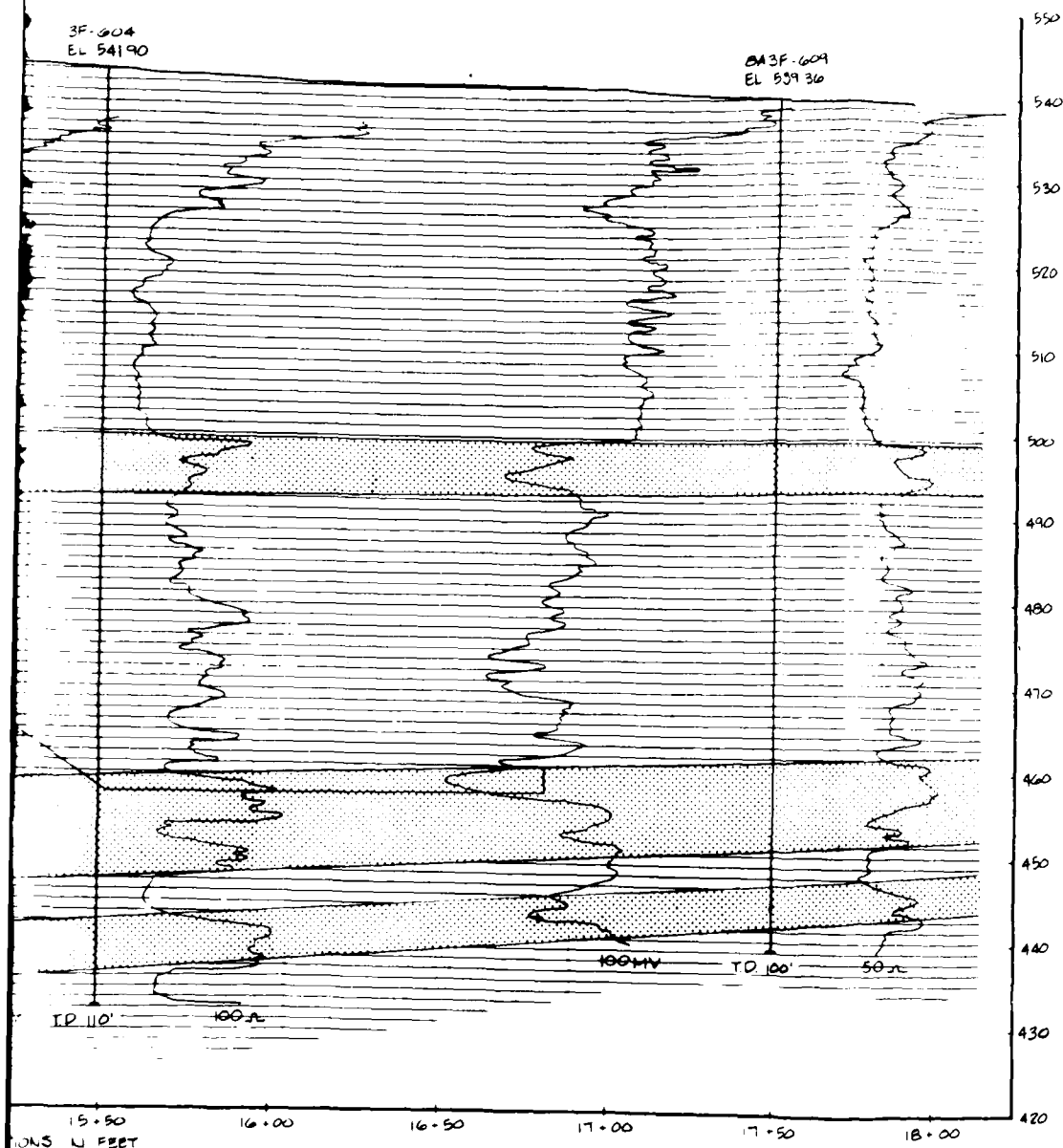
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7

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9

3F-604
EL 541903F-604
EL 53936

1 FOR LOCATION OF SECTION C-C SE
2 FOR LEGEND AND GENERAL NOTES

SECTION C-C

1" = 10'-0"
1" = 25'-0"

DESIGNED BY A. MARR	GRAPE DENTON CREEK MODIF EMBANKMEN SECTION C-C
DRAWN BY L. GOSS	
REVIEWED BY M. GREEN	
SUBMITTED BY M. GREEN ENGINEER	
INVITATION CONTRACT DRAWING NO.	

TO ACCOMPANY FINAL FOUNDATION RE

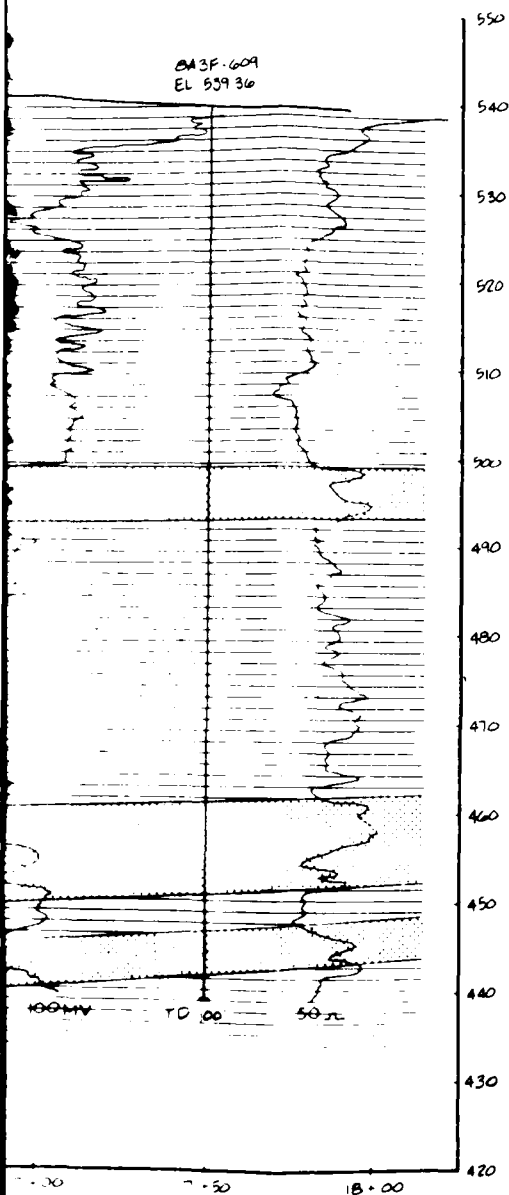
F

E

D

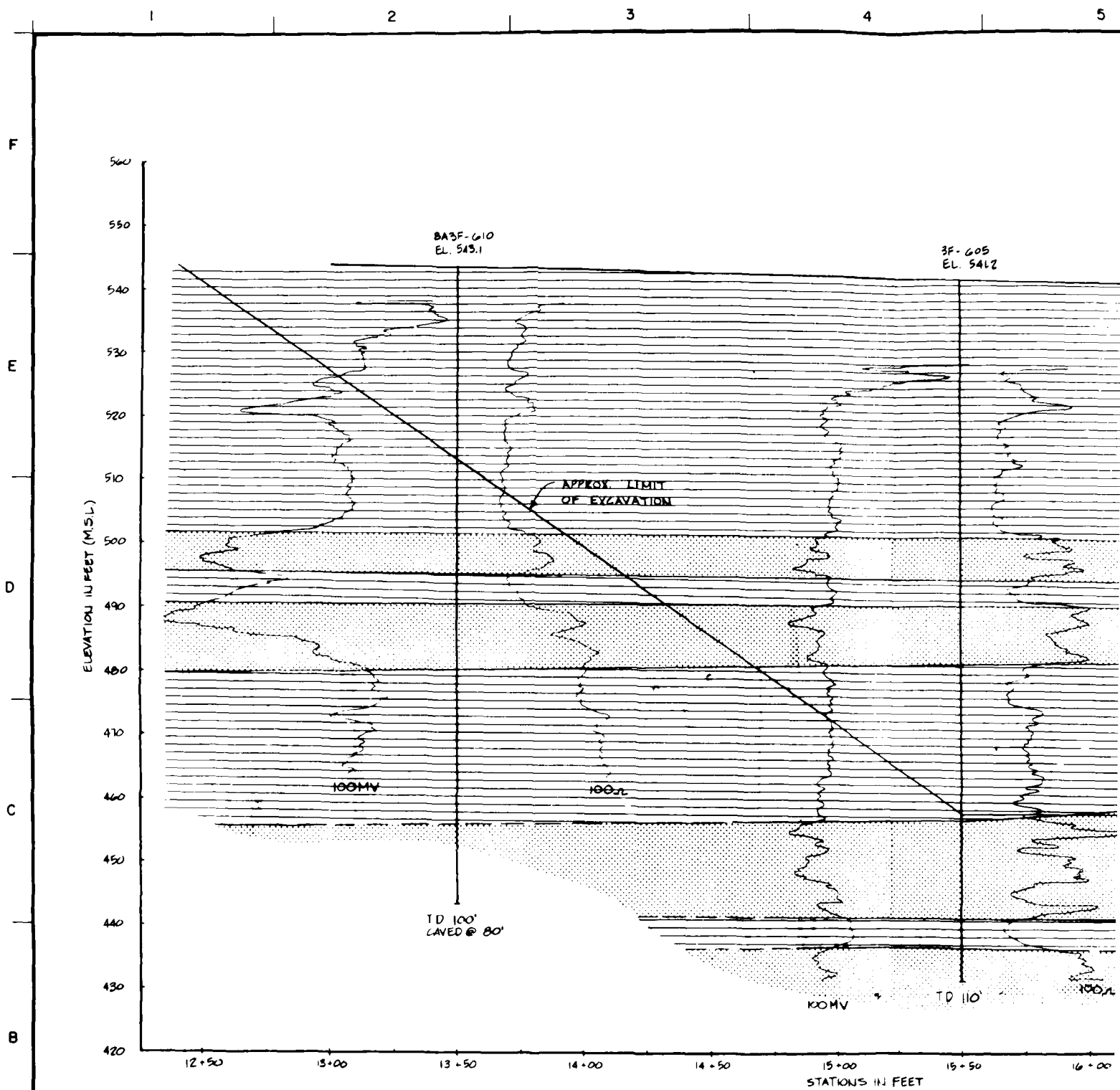
C

B

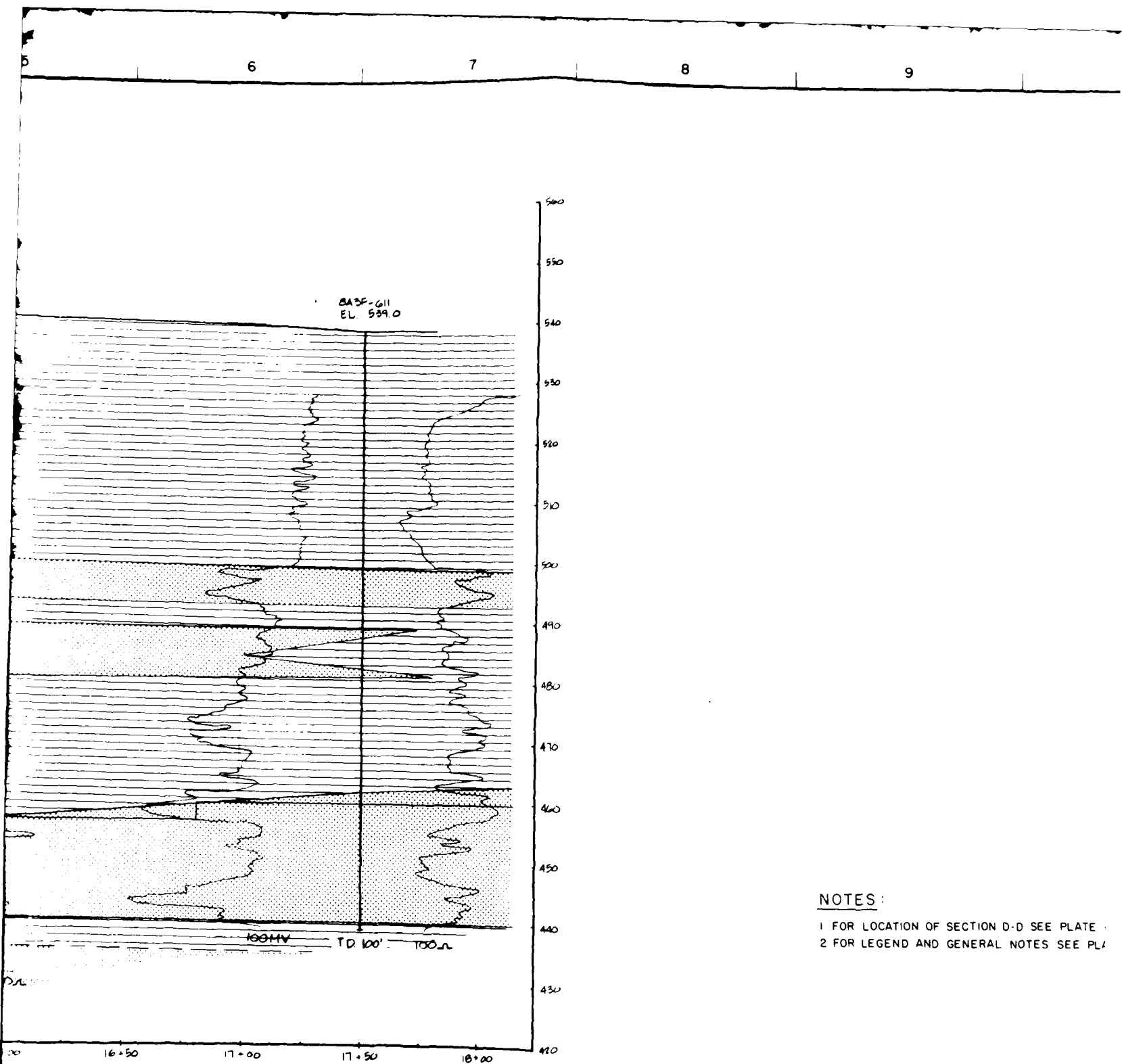


- 1 FOR LOCATION OF SECTION C-C SEE PLATE 4
2 FOR LEGEND AND GENERAL NOTES SEE PLATE 6

DESIGNED BY A. MARR		DRAWN BY L. GOSS		REVIEWED BY M. GREEN		SUBMITTED BY M. GREEN ENGINEER	
INVT. NO.		ACTION		DATE		DESCRIPTION OF REVISION	
U.S. ARMY ENGINEER DISTRICT, FORT WORTH		CORPS OF ENGINEERS		FORT WORTH, TEXAS			
GRAPEVINE LAKE GENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS MODIFICATION OF EMBANKMENT AND SPILLWAY 3 SECTION C-C							
INVITATION NO.		DATE		CONTRACT NO.		DRAWING NUMBER	
SHEET NO.		PLATE 7		CONTRACT NO.			



SPILLWAY SECTION D-D
 SCALE VERT 1" = 10'-0"
 HORIZ 1" = 25'-0"



NOTES:

- 1 FOR LOCATION OF SECTION D-D SEE PLATE
- 2 FOR LEGEND AND GENERAL NOTES SEE PL

DESIGNED BY A MARR	GRAPEVINE L DENTON CREEK ELM FORK TRI MODIFICATIO EMBANKMENT AND SECTION C
DRAWN BY L GOSS	
REVIEWED BY M GREEN	
SUBMITTED BY M GREEN ENGINEER	INVITATION NO. CONTRACT NO. DRAWING NUMBER

TO ACCOMPANY FINAL FOUNDATION REPORT

F

E

D

C

B

NOTES :

- 1 FOR LOCATION OF SECTION D-D SEE PLATE 4
2 FOR LEGEND AND GENERAL NOTES SEE PLATE 6

ATTENDING NO.	ACTION	DATE	DESCRIPTION OF REVISION

DESIGNED BY
A MARR

DRAWN BY
L GOSS

REVIEWED BY
M GREEN

SUBMITTED BY
M GREEL
ENGINEER

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

GRAPEVINE LAKE

CENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

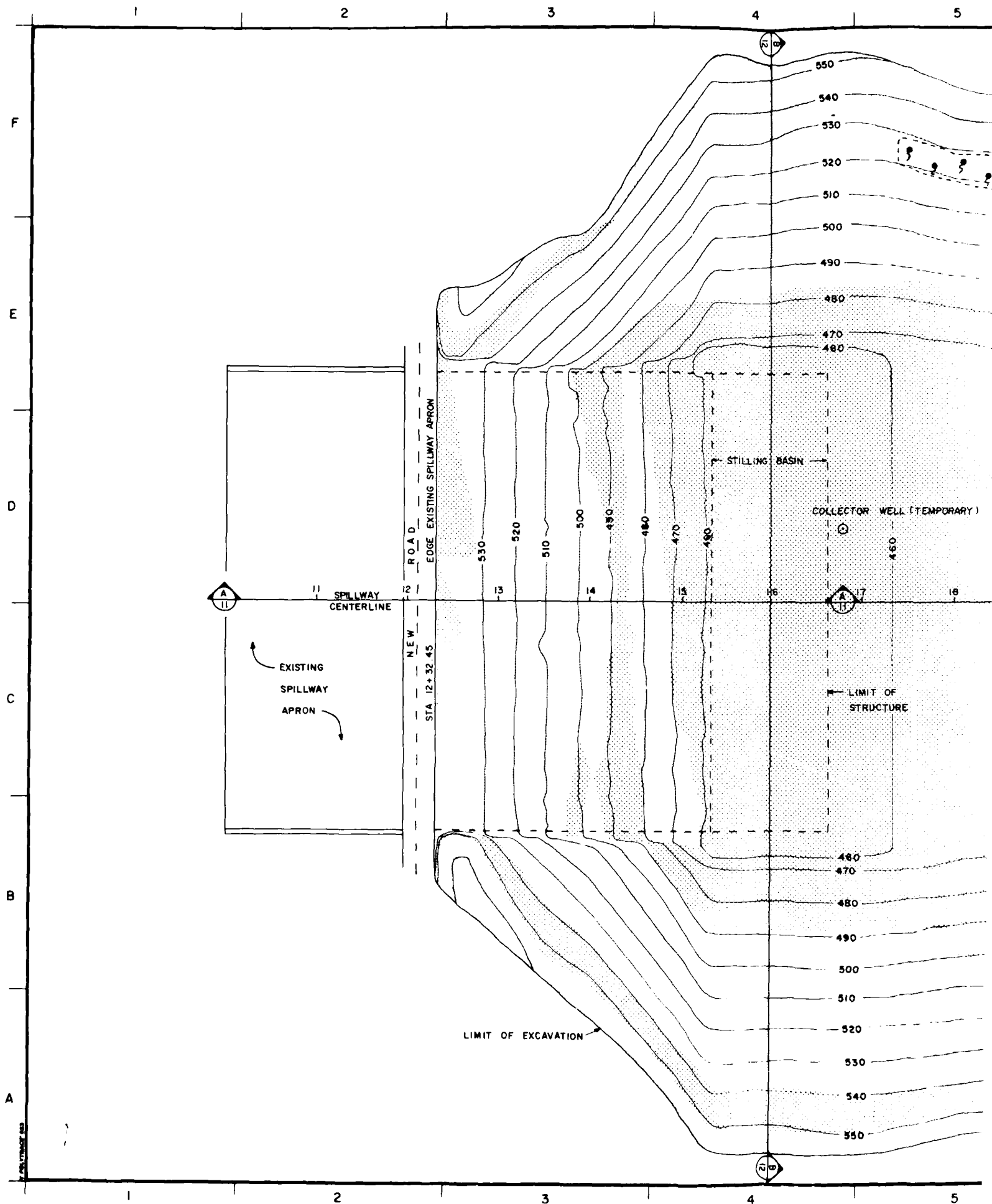
MODIFICATION OF EMBANKMENT AND SPILLWAY

SECTION D-D

3

INVITATION NO.	DATE
CONTRACT NO.	
DRAWING NUMBER	SHEET NO.

PLATE
8



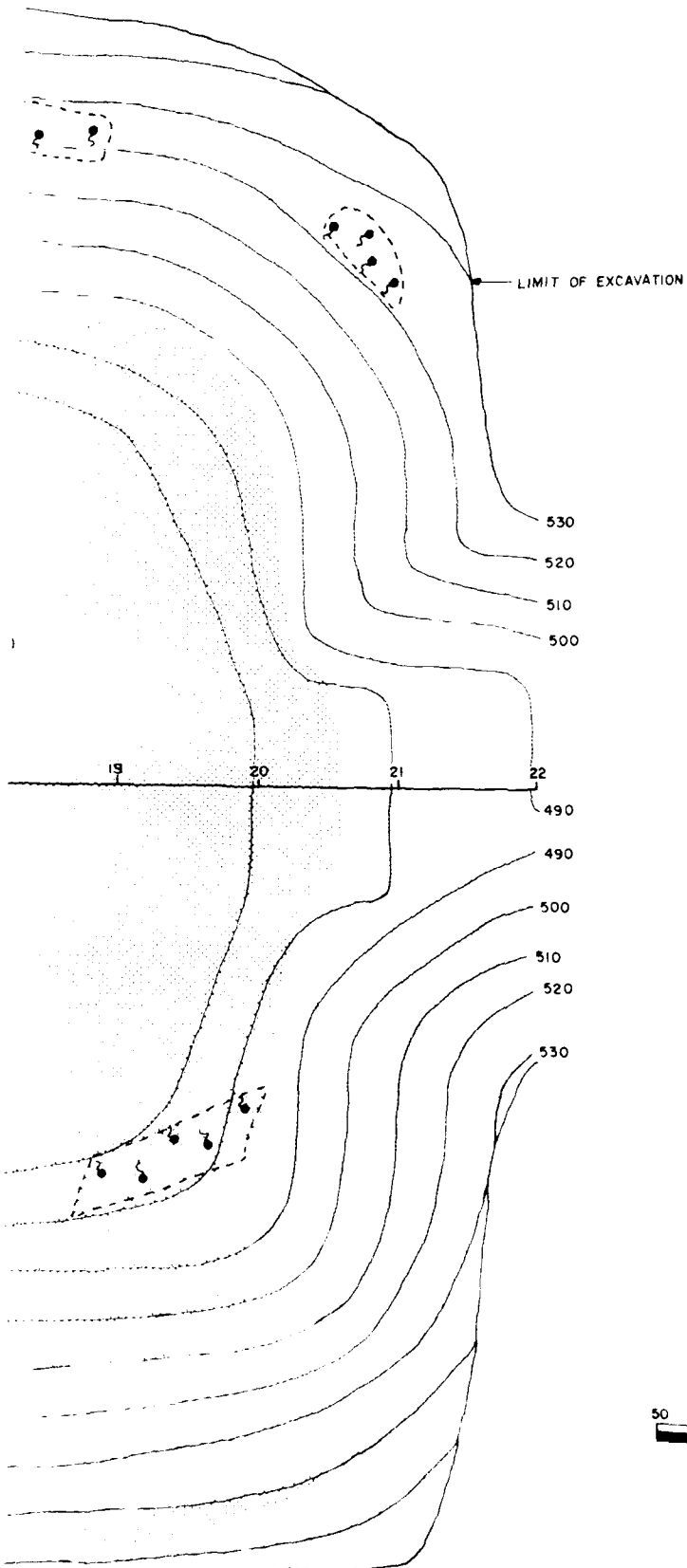
6

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9

10



LEGEND

OVERBURDEN		SAND, CLAYEY
PRIMARY WOODBINE FORMATION (CRETACEOUS AGE)		PREDOMINANTLY SANDSTONE W/SHALE AND SHALY SANDSTONE INTERBEDS
		PREDOMINANTLY SHALE W/SANDSTONE AND SANDY SHALE INTERBEDS
		CLAY
		GROUND WATER SEEPAGE AREA

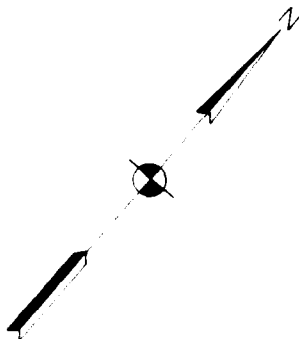
NOTES

- 1 SECTIONS A-A AND B-B ARE PRESENTED ON PLATES 11 AND 12 RESPECTIVELY
- 2 CONTOUR INTERVAL = 10 FT

50 0 50 100
SCALE IN FEET

TYPE		NO.	ACTION	DATE	DESCRIPTION
DESIGNED BY		GRAPEVINE LAKE			
DRAWN BY		DENTON CREEK, ELM FORK, TRINITY RIVE			
REVIEWED BY		MODIFICATION OF EMBANKMEN			
SUBMITTED BY		AND SPILLWAY			
MEL GREEN		GEOLOGIC MAP OF THE E			
INVITATION NO.		(AS-BUILT)			
CONTRACT NO.					
DRAWING NUMBER					

TO ACCOMPANY FINAL FOUNDATION REPORT



LEGEND

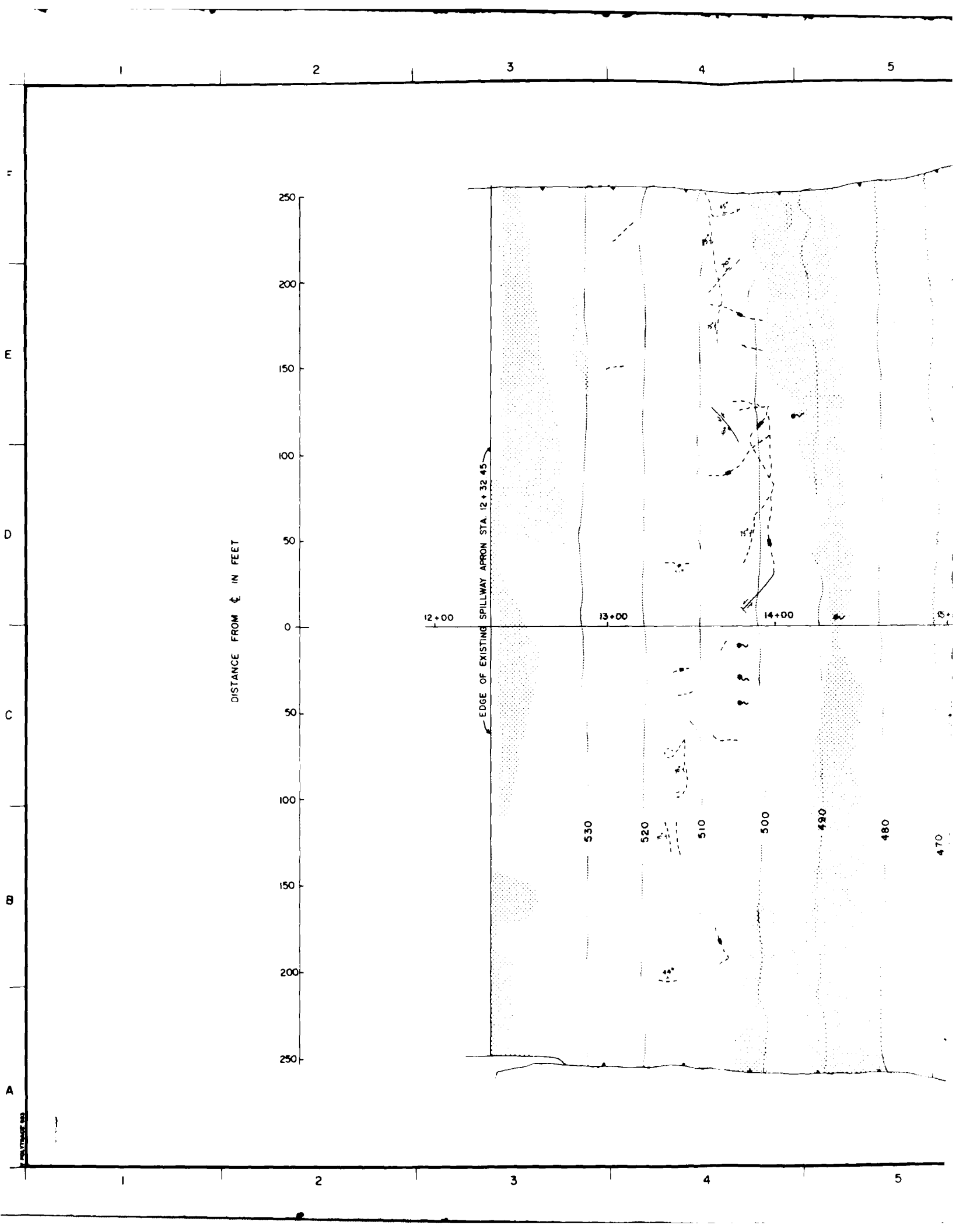
OVERBURDEN		SAND, CLAYEY
PRIMARY WOODBINE FORMATION (CRETACEOUS AGE)		PREDOMINANTLY SANDSTONE W/SHALE AND SHALY SANDSTONE INTERBEDS
		PREDOMINANTLY SHALE W/SANDSTONE AND SANDY SHALE INTERBEDS
		CLAY
		GROUND WATER SEEPAGE AREA

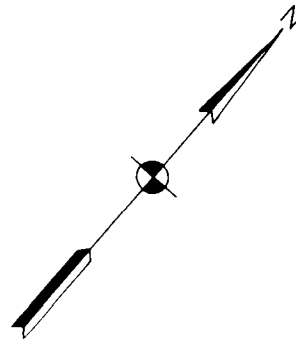
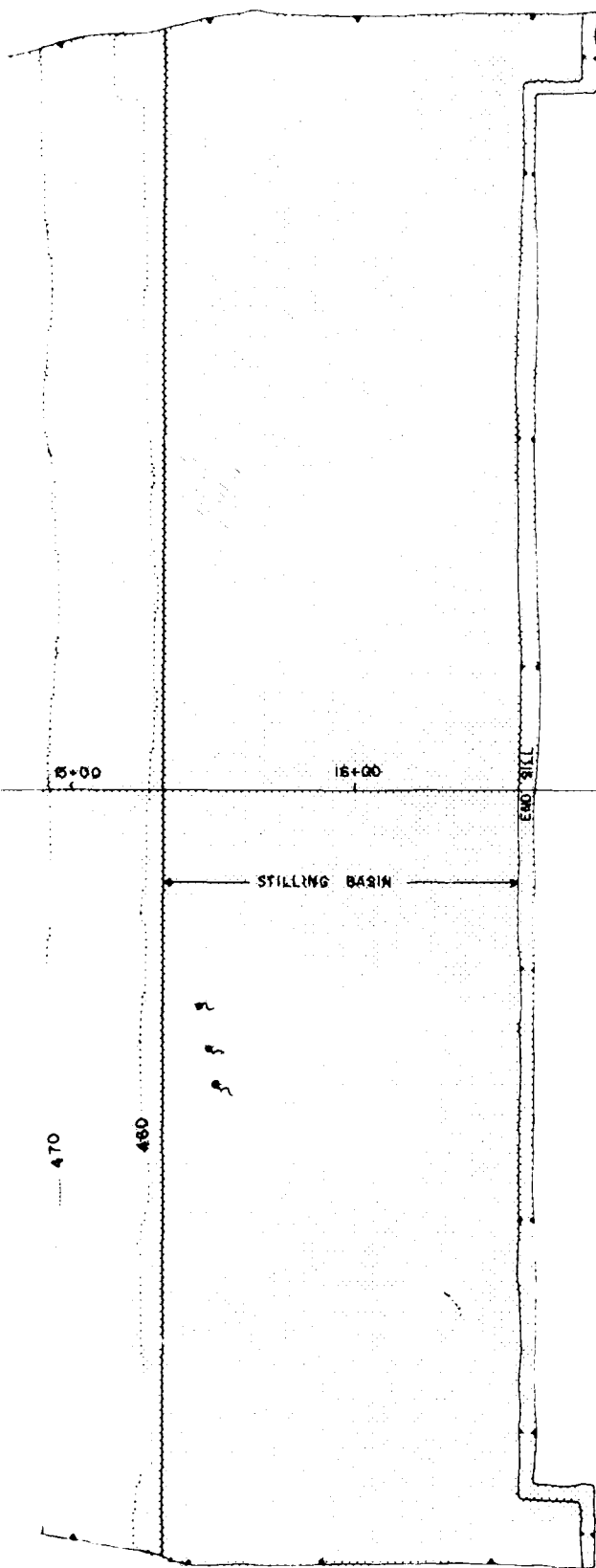
NOTES

- 1 SECTIONS A-A AND B-B ARE PRESENTED
ON PLATES 11 AND 12 RESPECTIVELY
- 2 CONTOUR INTERVAL = 10 FT

50 100
E IN FEET

DESIGNED BY MARR/BOOS		GRAPEVINE LAKE DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS	
DRAWN BY A MARR		MODIFICATION OF EMBANKMENT AND SPILLWAY	
CHECKED BY M. GREEN		GEOLOGIC MAP OF THE EXCAVATION (AS-BUILT)	
SUBMITTED BY MEL GREEN ENGINEER		INVITATION NO.	DATE
CONTRACT NO.		SHEET NO.	PLATE
DRAWING NUMBER		OF	9





LEGEND

WOODBINE FORMATION

CRETACEOUS AGE



CLAY



SAND

PREDOMINANTLY SANDSTONE
SHALY SANDSTONE INTERBEDPREDOMINANTLY SHALE W
SANDY SHALE INTERBEDS

VERTICAL JOINT - NO DISPLACEMENT



FAULT - DISPLACEMENT OBSERVED



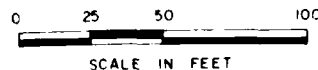
JOINT DIPPING 50° TO THE RIGHT



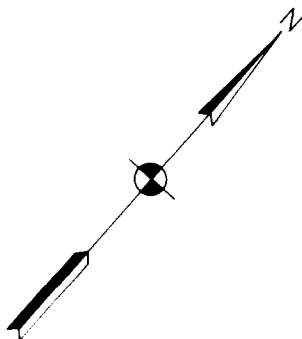
GROUND WATER SEEPAGE



VERTICAL CUT SLOPE



ITEM NO.	ACTION	DATE	DESCRIPTION
DESIGNED BY	GRAPEVINE LAKE		
DRAWN BY	DENTON CREEK, ELM FORK, TRINITY RIVER		
REVIEWED BY	MODIFICATION OF EMBANKMENT		
SUBMITTED BY	AND SPILLWAY		
ENGINEER	STRUCTURE FOUNDATION		
	(AS-BUILT)		
	INVITATION NO.		
	CONTRACT NO.		
	DRAWING NUMBER		



LEGEND

WOODBINE FORMATION

CRETACEOUS AGE

STATIONS IN FEET



CLAY



SAND



PREDOMINANTLY SANDSTONE W/SHALE AND SHALY SANDSTONE INTERBEDS



PREDOMINANTLY SHALE W/SANDSTONE AND SANDY SHALE INTERBEDS



VERTICAL JOINT - NO DISPLACEMENT



FAULT - DISPLACEMENT OBSERVED



JOINT DIPPING 50° TO THE SOUTHWEST



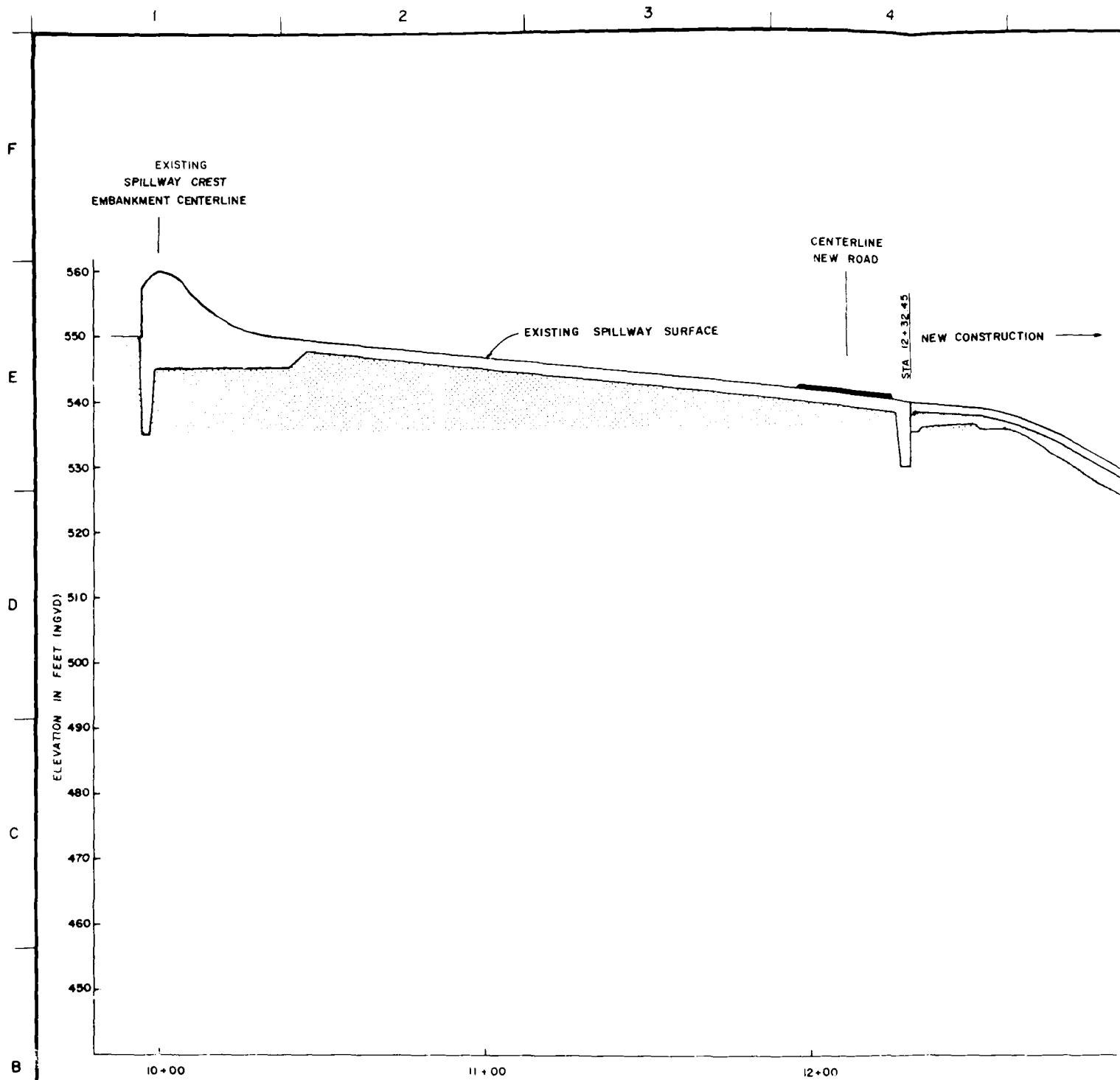
GROUND WATER SEEPAGE POINT



VERTICAL CUT SLOPE

0 25 50 100
SCALE IN FEET

DESIGNED BY A MARR		DRAWN BY A MARR		REVIEWED BY M GREEN		SUBMITTED BY MEL GREEN		INVITATION NO.		DATE	
CONTRACT NO.		DRAWING NUMBER		SHEET NO.		OF		CONTRACT NO.		DATE	
DESCRIPTION OF REVISION		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS		GRAPEVINE LAKE DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS MODIFICATION OF EMBANKMENT AND SPILLWAY STRUCTURE FOUNDATION MAP (AS - BUILT)		3		PLATE 10			



NOTES

1. FOR LOCATION OF CENTERLINE PROFILE A-A SEE PLATE 9
2. FOR LEGEND SEE PLATE 9

5

6

7

8

9

CENTERLINE PROFILE A-A

DRAINAGE BLANKET

STRUCTURAL CONCRETE

13+00

14+00

15+00

16+00

SPILLWAY STATIONS IN FEET

SYM.	NO.	ACTION	DATE
DESIGNED BY	A. MARR		
DRAWN BY	A. MARR		
REVIEWED BY	M. GREEN		
SUBMITTED BY	MEL GREEN		
ENGINEER			
GRAPE DENTON CREEK, EL		INVITATI	
MODIFICATION (		CONTRAC	
AND SI		DRAWING	
CENTERLIN			
(AS			

TO ACCOMPANY FINAL FOUNDATION REPORT

8

9

10

F

A - A

E

D

C

B

STRUCTURAL CONCRETE

48" RIPRAP

15+00

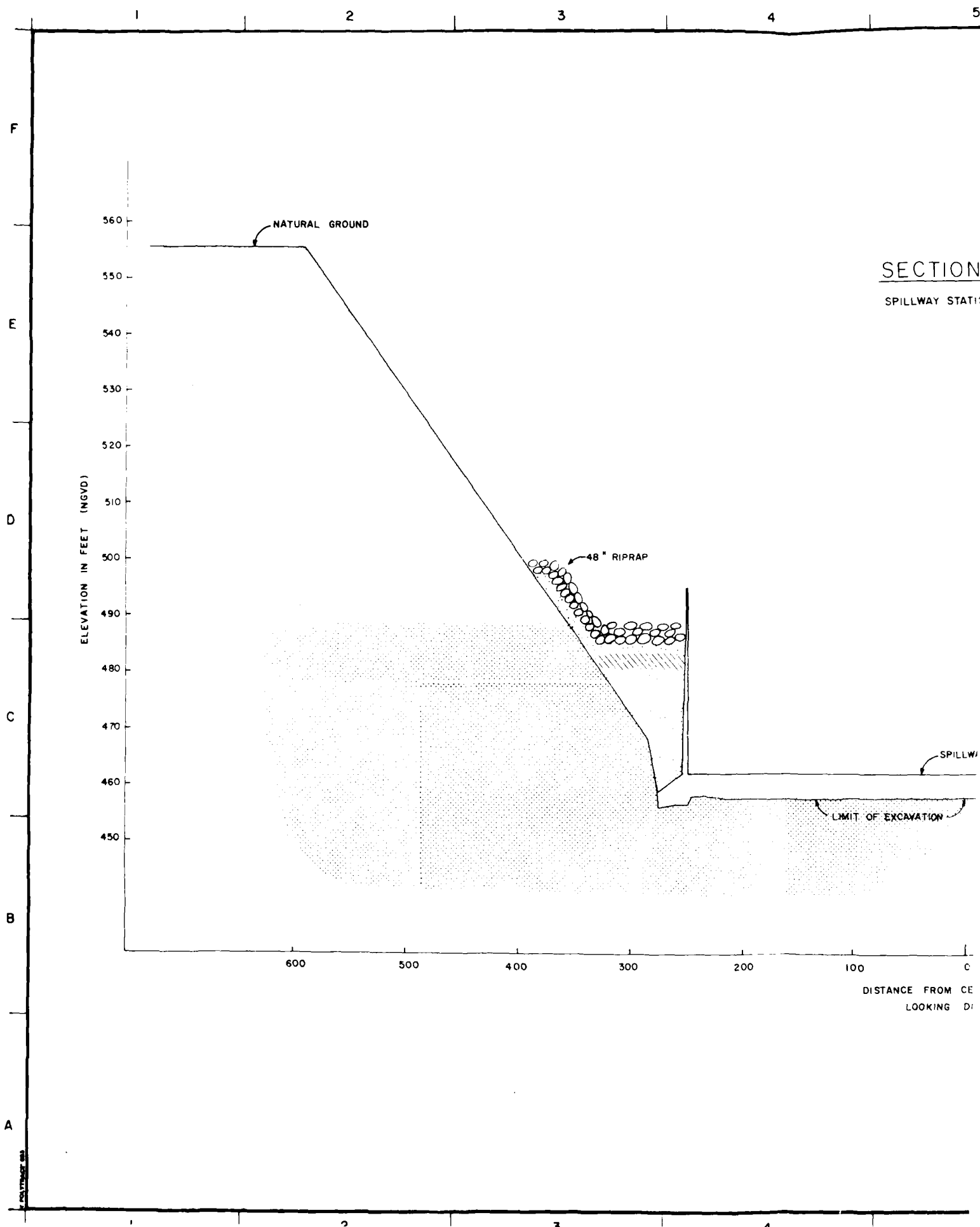
16+00

17+00

DESIGNED BY A. MARR	GRAPEVINE LAKE DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS MODIFICATION OF EMBANKMENT AND SPILLWAY		
DRAWN BY A. MARR	CENTERLINE PROFILE A - A (AS - BUILT)		
REVIEWED BY M. GREEN	3		
SUBMITTED BY MEL GREEN ENGINEER	INVITATION NO.	DATE	CONTRACT NO.
	CONTRACT NO.	DRAWING NUMBER	SHEET NO. OF
			PLATE 11

8

TO ACCOMPANY FINAL FOUNDATION REPORT



SECTION

SPILLWAY STATI

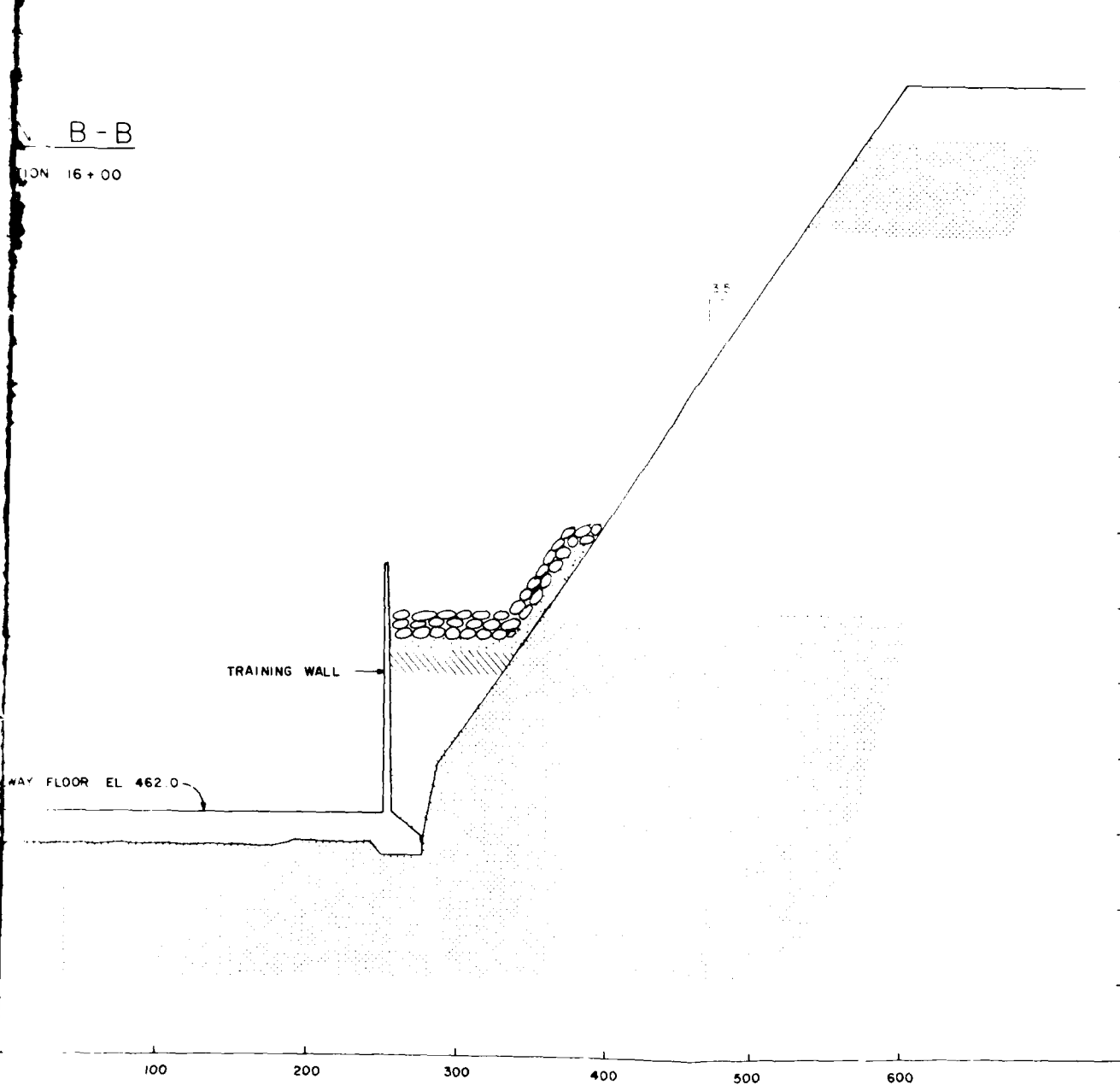
ELEVATION IN FEET (NGVD)

DISTANCE FROM CE
LOOKING DI

5 6 7 8 9

B-B

STATION 16+00



LEGEND

- OVERBURDEN ☐ SAND, CLAYE
- PRIMARY WOODBINE FORMATION (CRETACEOUS AGE) ☐ PREDOMINANT AND SHALY S.
- ☐ PREDOMINANT AND SANDY !
- ☐ STRUCTURAL
- ☐ NON-EXPANS
- ☐ FILTER SAND
- ☐ IMPERVIOUS
- ☐ DRAINAGE B

NOTES

1. FOR LOCATION OF SECTION B-B SEE PLATE 9

DESIGNED BY	GRAPEVINE LAK		
DRAWN BY	DENTON CREEK, ELM FORK, TRN		
REVIEWED BY	MODIFICATION OF EMBAN AND SPILLWAY		
SUBMITTED BY	SECTION B- (AS-BUILT)		
ENGINEER	INVESTIGATION NO.	CONTRACT NO.	DRAWING NUMBER

TO ACCOMPANY FINAL FOUNDATION REPORT

5 6 7 8

7

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F

E

D

C

B

LEGEND

OVERBURDEN		SAND, CLAYEY
PRIMARY WOODBINE FORMATION (CRETACEOUS AGE)		PREDOMINANTLY SANDSTONE W/SHALE AND SHALY SANDSTONE INTERBEDS
		PREDOMINANTLY SHALE W/SANDSTONE AND SANDY SHALE INTERBEDS
		STRUCTURAL CONCRETE
		NON-EXPANSIVE BACKFILL
		FILTER SAND
		IMPERVIOUS CLAY BACKFILL
		DRAINAGE BLANKET

400 500 600

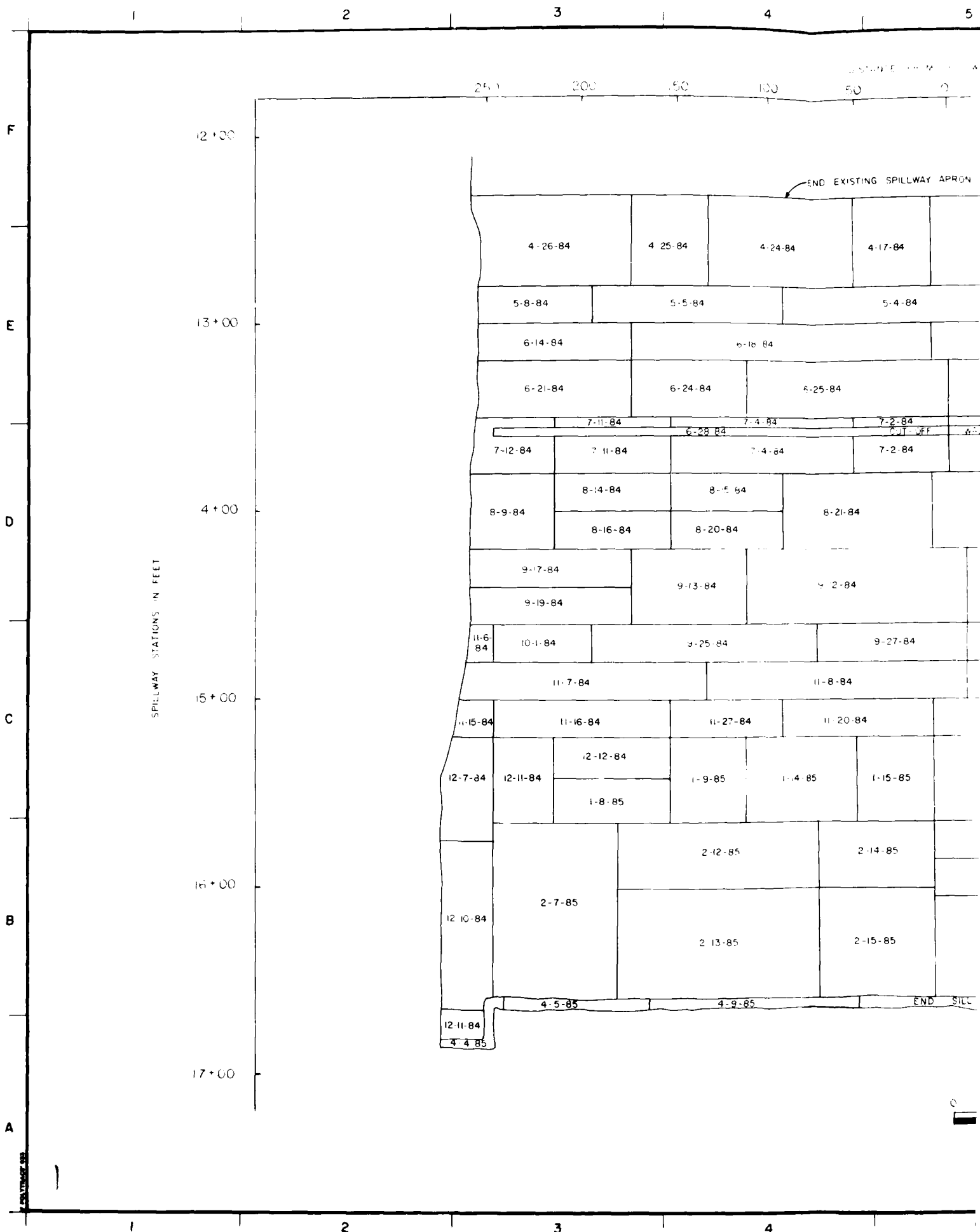
N. OF SECTION B-B SEE PLATE 9

REV. NO.	ACTION	DATE	DESCRIPTION OF REVISION
DESIGNED BY	GRAPEVINE LAKE DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS		
DRAWN BY	MODIFICATION OF EMBANKMENT AND SPILLWAY		
REVIEWED BY	SECTION B-B (AS-BUILT)		
SUBMITTED BY	INVITATION NO.	DATE	
MEL GREEN ENGINEER	CONTRACT NO.	SHEET NO. 12	
	DRAWING NUMBER		

7

8

TO ACCOMPANY FINAL FOUNDATION REPORT



5

6

7

8

9

WATER APRON

0 50 100 150 200 250

WATER APRON STATION 12+32.45

4-8-84

4-19-84

4-20-84

5-1-84

5-9-84

7-1-84

7-9-84

7-10-84

7-18-84

7-16-84

7-19-84

7-16-84

7-16-84

7-24-84

7-24-84

7-24-84

7-24-84

7-25-84

7-19-84

7-23-84

7-23-84

7-25-84

8-23-84

8-27-84

8-28-84

8-30-84

9-6-84

9-5-84

9-11-84

9-10-84

10-8-84

10-9-84

10-10-84

11-13-84

11-28-84

11-29-84

11-30-84

1-17-85

1-23-85

1-24-85

3-5-85

3-6-85

2-11-85

2-8-85

1-28-85

3-7-85

3-11-85

6-3-85

5-28-85

4-11-85

NOTES:

FOR GEOLOGIC MAP OF PLAIN AT
2 EXCAVATION, APPROVAL, AND
OCCURRED ON THE DATE SHOWN

0 25 50 100
SCALE IN FEET

SYM	NO.	ACTION	DATE
DESIGNED BY	A. MARR		
DRAWN BY	A. MARR		
REVIEWED BY	M. GREEN		
SUBMITTED BY	MEL GREEN		
ENGINEER			
GRAPEN DENTON CREEK, ELM MODIFICATION C AND SP RECORD OF F			INVITATION CONTRACT DRAWING

10

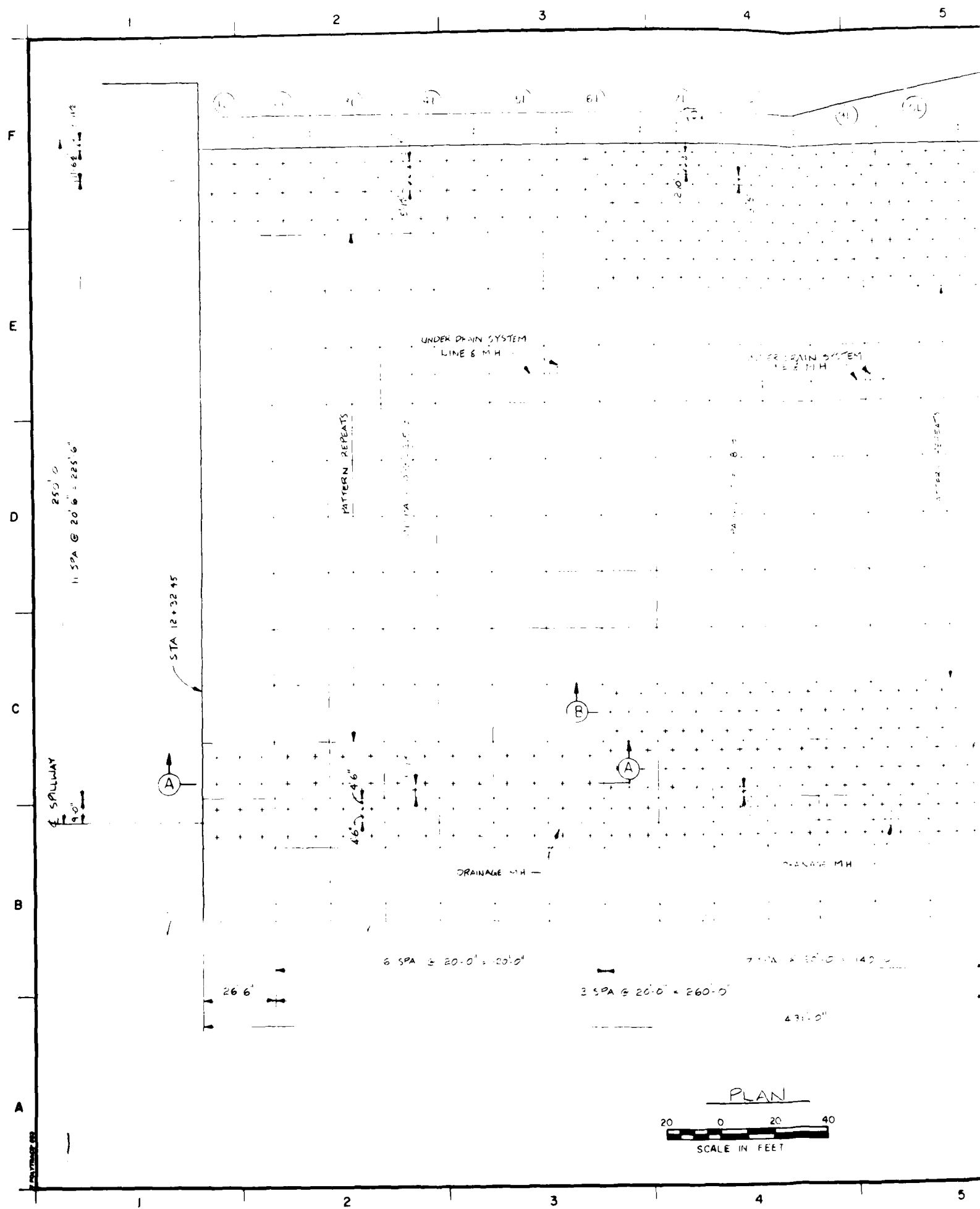
A

FOR GEOLOGIC MAP OF FOUNDATION SEE PLATE 10
 EXCAVATION, APPROVAL, AND BACKFILL ALL
 OCCURRED ON THE DATE SHOWN IN EACH AREA

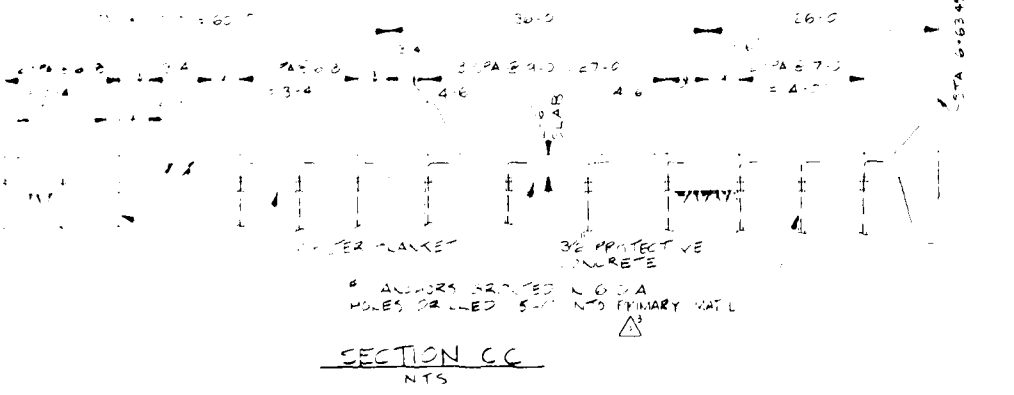
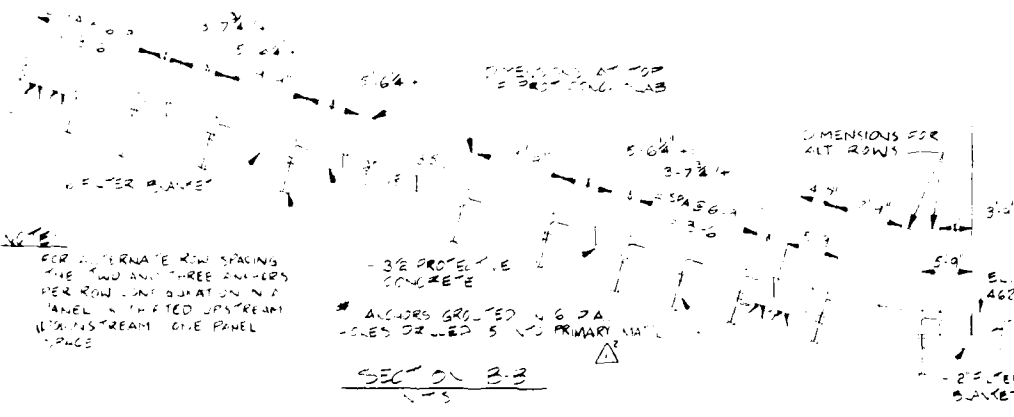
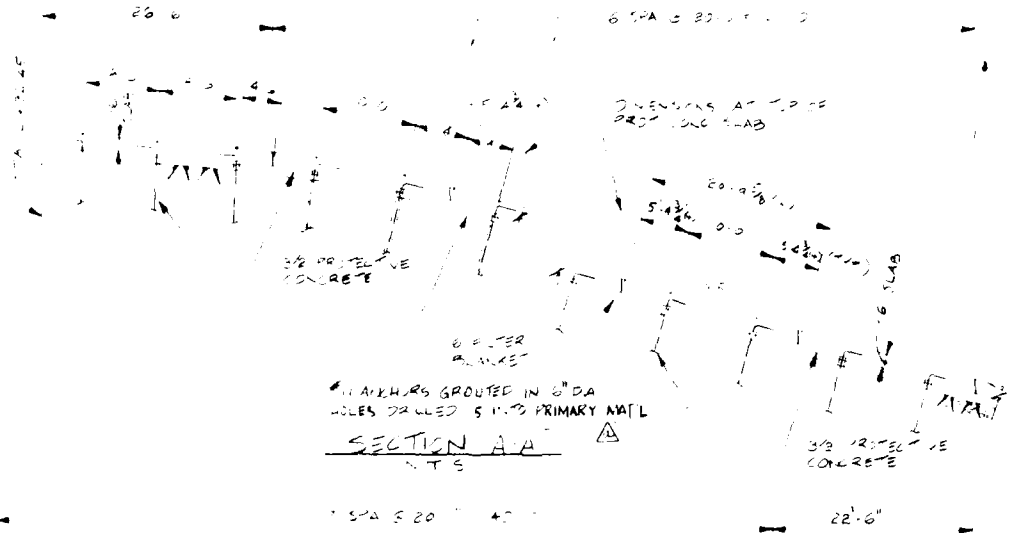
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TO ACCOMPANY FINAL FOUNDATION REPORT



 $\Delta^1, 2, 3$



REVISION NO.	ACTION	DATE	DESCRIPTION OF REVISION
1	AS NOTED	25/11/82	REVISED TO REFLECT WRITE IN CHANGES
U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS			
DESIGNED BY BA-11	GRAPEVINE LAKE DETENTION CREEK, ELM FORK, TRINITY RIVER TEXAS		
DRAWN BY BA-11	MODIFICATION OF EMBANKMENT AND SPILLWAY CHUTE SLAB ANCHOR		
REVIEWED BY A. MARR	PLAN AND SECTIONS		
SUBMITTED BY MEL GREEN ENGINEER	INVITATION NO. DACW63 83 8 0052	DATE AUG 1983	SHEET NO. OF 14
	CONTRACT NO. DACW63 83 8 0160	DRAWING NUMBER	

DATA SUMMARY

ST

ECT GRAPEVINE SPILLWAY

SHEAR DATA											PERMEABILITY		CONSOLIDATION DATA			
Y DENSITY BS/CU FT	W ₁ %	W _F %	S ₁ %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	σ_m T/SQ FT	σ_1 T/SQ FT	c T/SQ FT	ϕ DEGREES	e	K FT/MIN.	P _O T/SQ FT	P _C T/SQ FT	C _C	t ₅
<u>ED COMPRESSION TESTS</u>																
115	16.7		100		5.5 X 10.7		0	15.7								
119	14.5		100		5.7 X 9.0		0	47.6								
122	14.2		100		5.2 X 9.4		0	2.2								
137	8.3		95		5.3 X 10.0		0	54.5								
<u>COMPRESSION TEST (1-Pt Q)</u>																
118	15.2		100		5.4 X 10.4		0.25	16.5								
125	12.4		100		5.5 X 10.3		0.25	12.5								
134	8.6				5.6 X 8.9		2.3	43.2								

T - TRIAXIAL COMPRESSION
UC - UNCONFINED COMPRESSION

DS - DIRECT SHEAR
Q - UNCONSOLIDATED UNDRAINED

S
R

TO ACCOMPANY FINAL FOUNDATION REPORT

F

AD-A173 777

SPILLWAY MODIFICATION GRAPEVINE LAKE TEXAS(U) ARMY
ENGINEER DISTRICT FORT WORTH TX A J MARK JUN 86

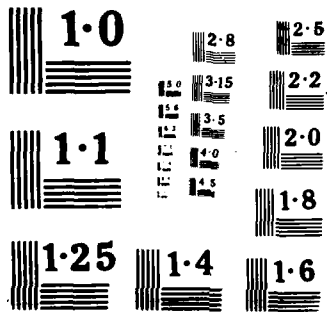
2/2

UNCLASSIFIED

F/G 13/2

NL

END
1-87



[illegible]

T - TRIAXIAL COMPRESSION
UC- UNCONFINED COMPRESSION

DS - DIRECT SHEAR
Q - UNCONSOLIDATED UNDRAINED

S - CONSOLIDATED DRAINED
R - CONSOLIDATED UNDRAINED

TEST DATA SUMMARY

PROJECT GRAPEVINE SAILWAY

SHEAR DATA										PERMEABILITY		CONSOLIDATION			
TIAL e	DRY DENSITY LBS/CU FT	W ₁ %	W _F %	S ₁ %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	G _m T/SQ FT	Q ₁ T/SQ FT	C T/SQ FT	φ DEGREES	e	K FT/MIN.	P ₀ T/SQ FT	P _C T/SQ FT
<u>2- TRIAXIAL COMPRESSION TEST</u>															
13	111	17.0		90		1.4 X 2.9		0.5	14.80	3.5	33.7				
13	111	17.5		91		1.3 X 2.9		1.5	19.0						
14	112	16.8		92		1.4 X 3.0		3.0	24.1						
14	113	16.7		95		1.3 X 3.0		6.0	27.84						
15	128	10.7		99		1.4 X 3.0		0.5	9.11	2.4	25.0				
15	128	10.8		99		1.4 X 3.0		1.5	11.53						
15	128	10.9		98		1.4 X 3.0		3.0	15.21						
15	128	11.2		101		1.4 X 3.0		4.0	16.45						
16	128	10.1		88		1.3 X 2.9		0.5	8.94	3.7	28.0				
16	128	9.7		85		1.3 X 2.9		1.5	10.50						
16	128	10.4		87		1.4 X 3.0		3.0	12.23						
16	128	10.0		83		1.4 X 3.0		5.0	14.41						

T - TRIAXIAL COMPRESSION
UC - UNCONFINED COMPRESSION

DS - DIRECT SHEAR
O - UNCONSOLIDATED UNDRAINED

TO ACCOMPANY FINAL FOUNDATION REPORT

2

SHEET _____ OF _____

[illegible]

TRIAXIAL COMPRESSION
UNIFORMED COMPRESSION

DS - DIRECT SHEAR
O UNCONSOLIDATED UNDRAINED

S CONSOLIDATED DRAINED
D CONSOLIDATED UNDRAINED

[illegible]

TEST DATA SUMMARY

PROJECT GRAPEVINE SPILLWAY

SHEAR DATA												PERMEABILITY		CONSOLIDATION	
NO.	DRY DENSITY LBS/CU FT	W ₁ %	W _F %	S ₁ %	TYPE TEST	SPECIMEN SIZE INCHES	TEST	U _{ni} T/SQ FT	Q ₁ T/SQ FT	C T/SQ FT	φ DEGREES	e	K FT/MIN	P _C T/SQ FT	P _L T/SQ FT
DIRECT SHEAR TEST															
95	113	17.0	22.5	93		3.0 X 3.0		1.5							
96	110	17.2	21.5	89				3.0		0	35.0				
97	113	16.8	22.3	92				6.0							
98	131	9.6	11.7	92		3.0 X 3.0		1.5							
99	129	9.4	13.0	84				5.0		1.2	29.0				
100	131	10.2	11.6	97				5.0							
101	135	7.6	9.7	92		3.0 X 3.0		1.5		0	31.5				
102	136	8.6	10.7	103				3.0							
103	136	8.1	9.6	96				6.0							
104	142	6.1	10.1	91		3.0 X 3.0		1.5		0.5	25.0				
105	141	6.3	9.8	92				3.0							
106	142	6.1	8.0	92				6.0							
DIRECT SHEAR TEST															
107	125	11.1	11.9	97				1.5		0	10.4				
108	128	10.7	13.8	97				3.0							
109	128	10.9	11.9	98				6.0							

T - TRIAXIAL COMPRESSION
UC - UNCONSOLIDATED COMPRESSION

DS - DIRECT SHEAR
U - UNCONSOLIDATED UNDRAINED

2
TO ACCOMPANY FINAL FOUNDATION REPORT

[illegible]

TRIAXIAL COMPRESSION
UNCONFINED COMPRESSION

DS - DIRECT SHEAR
Q - UNCONSOLIDATED UNDRAINED

S - CONSOLIDATED DRAINED
R - CONSOLIDATED UNDRAINED

DRILLING LOG		DIVISION	INSTALLATION	Note No.	Sheet
PROJECT		SVD	PT. VORT	RAIC-402	1
1. PROJECT					OF 2 SHEETS
2. LOCATION					
3. DRILLING AGENCY					
4. HOLE NO. (SEE INSTRUCTIONS)		RAIC-402			
5. NAME OF DRILLER					
6. DIRECTION OF HOLE					
7. THICKNESS OF OVERBURDEN		0.0			
8. DEPTH DRILLED INTO ROCK		75.7			
9. TOTAL DEPTH OF HOLE		75.7			
10. MANUFACTURER'S DESIGNATION					
11. TOTAL NO. OF 3/4" BUREN SAMPLES TAKEN					
12. TOTAL NUMBER CORES					
13. ELEVATION (GROUND SURFACE)					
14. DATE HOLE					
15. ELEVATION TOP OF HOLE					
16. TOTAL CORE RECOVERED					
17. SIGNATURE OF					
ELEVATION		DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	REMARKS
0.0 to 6.8				SHALE	
0.0 to 3.0 - highly weathered to a med stiff clay consistency, moist, dark brn to yellow brn, silty.					
3.0 to 6.8 - no apparent weathering, dark gray, dry, massive, mod soft (rx class).					
6.8 to 9.3				SANDSTONE - fine grained, dark gray, weakly to mod. cemented, massive, silty, mod soft (rx class).	
9.3 to 19.1				SHALE - non weathered, dark gray to brn gray, soft to mod soft (rx class), silty, non calc, few scattered brn and hard concretions, thin (less than 0.05" thick) sandy/silty seams, very thin lignite seams scattered, hard black tar seams, fossils.	
19.1 to 22.4				SILTSTONE - shaley, sl sandy, massive, mod hard to hard, mod to well cemented, non calc, lt gray to dark gray.	
22.4 to 56.4				SHALE - non weathered, non calc, mod soft, dark gray to brownish gray, silty, gray to lt gray from 55.3 to 56.4, numerous very thin silt/sand seams scattered throughout, hard, well cemented calc seams (0.1" thick) @ 33.4', few hard brn concretions.	
Unhealed fractures at 40.1' (45') and 56 to 56.3'.					

DRILLING LOG		DIVISION	INSTALLATION	Hole No.
Grangevine Lake		SUD	Ft. Worth	1012
Spillway				
1. NO. OF TESTS			10. SIZE AND TYPE OF BIT	
2. DRILLING AGENCY			11. DATUM FOR ELEVATION MEASUREMENT	
3. NO. OF TESTS			12. NO. OF TESTS	
4. NAME OF OPERATOR		BA6C-402	13. TOTAL NO. OF TESTS	
5. DIRECTION OF HOLE			14. TOTAL NUMBER OF TESTS	
6. THICKNESS OF OVERBURDEN			15. ELEVATION OF HOLE	
7. DEPTH OF HOLE INTO ROCK			16. DATE HOLE STARTED	
8. TOTAL DEPTH OF HOLE			17. ELEVATION TOP OF HOLE	
			18. TOTAL CORRECTION FOR HOLE	
			19. SIGNATURE OF OPERATOR	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	SCORING
			56.4 to 57.4	7
			SILTSTONE - hard, massive, mod to well cemented, white and lt gray, shaley.	8
			57.4 to 70.1	9
			SHALE - as shale shown except numerous sections of very sandy/silty, friable, thin seams, mod hard after 60'.	10
			unhealed fracture @ 59.3 to 59.7' (30'), soft at 65.3' and 65.7' (each less than 0.1' thick)	11
			70.1 to 75.7	12
			SILTSTONE - mod hard/hard, mod cemented, massive, lt. gray to white, some olive gray, shaley, a gray and clean silt section from 70.9 to 71.2, sl. sandy after 74'.	13

FOR LOCATION OF BORING SEE PLATE 4

NAME OF	GRANGEVINE
A. MARR	MODIFICATION
A. MARR	EMBANKMENT AND
M. GREEN	LOG OF BORING
MEL GREEN	

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FOR LOCATION OF BORING SEE PLATE 4

DESIGN BY A. MARR CHECKED BY A. MARR PREPARED BY M. GREEN DATE MEL GREEN		GRAPEVINE LAKE MODIFICATION OF EMBANKMENT AND SPILLWAY LOG OF BORING 8A6C-602 DRAWN BY 83 B 0052 DATE AUG 1983 CHECKED BY 83 B 0052 DATE 18	
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DRILLING LOG		SWD		FWD		Hole No. SWD - 603	
GRAPEVINE LAKE				FALLING 1500		SHEET 1	
USCE		BACC-603		TOTAL NUMBER CORE BOXES 19		SHEET 2	
BREWER				TOTAL NUMBER CORE BOXES 19		SHEET 3	
0				TOTAL NUMBER CORE BOXES 19		SHEET 4	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 5	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 6	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 7	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 8	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 9	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 10	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 11	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 12	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 13	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 14	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 15	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 16	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 17	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 18	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 19	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 20	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 21	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 22	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 23	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 24	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 25	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 26	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 27	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 28	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 29	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 30	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 31	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 32	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 33	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 34	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 35	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 36	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 37	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 38	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 39	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 40	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 41	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 42	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 43	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 44	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 45	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 46	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 47	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 48	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 49	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 50	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 51	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 52	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 53	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 54	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 55	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 56	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 57	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 58	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 59	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 60	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 61	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 62	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 63	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 64	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 65	
108.5				TOTAL NUMBER CORE BOXES 19		SHEET 66	
108.5				TOTAL NUMBER CORE BOXES 19			

DRILLING LOG		DATE	SIGN.
PROJECT JEEPEVINE A-6		NO. OF CORES 11	CORE NO. 11
LOCATION COLUMBIANA COUNTY, MISSISSIPPI		DATE 10/17/89	TIME 10:00 AM
DRILLING AGENCY MISSISSIPPI GEOLOGICAL SURVEY		DEPTH 110 FT	DIAMETER 4 IN
APPROVED BY JAMES H. HARRIS		REMARKS BA6C-603	
CORRECTION OF HOLE (VERTICAL) (DIP) (INCLINATION)		DETAILED DESCRIPTION OF STRATA	
THICKNESS OF OVERBURDEN			
DEPTH CALLED INTO ROCK			
TOTAL DEPTH OF HOLE			
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIAL (Description)
	40		
	50		45.6 TO 52.9 SANDSTONE, SOFT TO MOD HARD, FINE GRAINED, MOD TO WELL GRM, MASSIVE, GRAY
	60		52.9 TO 65.6 SHALE, VERY SANDY, VERY SILTY, SOFT TO MOD HARD, NON-CALC, MOD WELL GRM, NUM SANDSTONE/SILTSTONE LENSES SCAT THROUGHOUT, INCREASINGLY SILTY W/ DEPTH
	70		65.6 TO 71.2 SANDSTONE, MOD HARD TO HARD, WELL GRM, MASSIVE, LT GREENISH GRAY, VERY FINE GRAINED
	80		71.2 TO 89.5 SANDSTONE, VERY SILTY, SOFT TO MOD HARD, VERY FINE GRAINED, MOD WELL GRM, GRAY
	90		89.5 - 93.9 SOFT, POORLY LGD, LT GRAY
	93.9 - 100.0		HARD, LT GRAY

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SOIL LOG	
8A6C-603	15
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22-23	19
24-25	20
26-27	21
28-29	22
30-31	23
32-33	24
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36-37	26
38-39	27
40-41	28
42-43	29
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72-73	44
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744-745	380
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864-865	440
866-867	441
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904-905	460
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912-913	464
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920-921	468
922-923	469
924-925	470
926-927	471
928-929	472
930-931	473
932-933	474
934-935	475
936-937	476
938-939	477
940-941	478
942-943	479
944-945	480
946-947	481
948-949	482
950-951	483

Drilling Log Form for **GRAPEVINE DAM**, **SOUTHWESTERN** Division, **FORT WORTH** Installation. Project: **SPILLWAY REPAIR**. Drilling Agency: **USCE**. Hole No: **844C-606**. Driller: **WYATT**. Date: **4/22/83**. Completed: **4/22/83**. Signature: **R.P. A. L. H.**

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SCORE	REMARKS
0.0	0.0		0.0 TO 2.0 CLAY, MEDIUM PLASTICITY, STIFF, MOIST, SANDY, TAN	A	1 IMMEDIATELY AFTER RAINING WATER LEVEL TAPED AT -85.0 FT
	2.0		2.0 TO 3.0 CLAY, MEDIUM TO HIGH PLASTICITY, STIFF, MOIST, SANDY, GRAY.	B	- 72 HOURS LATER WATER LEVEL TAPED AT -24.70 FT
	3.0		3.0 TO 4.0 CLAY, LOW TO MEDIUM PLASTICITY, STIFF, MOIST, TAN TO GRAY.	C	
	4.0		4.0 TO 8.0 SANDSTONE, DARK GRAY, VERY FINE GRAINED, COMPACT, MASSIVE, THINLY BEDDED, UNFRACTURED, SLIGHTLY WEATHERED TO UNWEATHERED, SOFT.	1	2 TAPS A: 60-70 B: 20-30 C: 30-40
	8.0		8.0 TO 16.8 SHALE, DARK GRAY TO BROWN, SANDY, LAMINATED TO THINLY BEDDED, VERY LIGNITIC FROM 8.0'-12.4', AND FROM 16.2'-16.8' FISSILE, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	2	3 CARTONS NO CARTON SAMPLES (CORE WAVED TO DEPTH)
	16.8		16.8 TO 19.1 SANDSTONE, LIGHT GRAY, VERY FINE GRAINED, COMPACT, THINLY BEDDED WITH SHALE STRIPERS DISSEMINATED THROUGHOUT, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	3	4 DRILLING 0.0-40.0" 8" AUGER 40-100.6" 4" CORE
	19.1		19.1 TO 19.5 SHALE, BROWN, VERY FINE GRAINED, SANDY, LAMINATED TO THINLY BEDDED, FISSILE, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	4	
	19.5		19.5 TO 19.8 SANDSTONE, TAN, FINE GRAINED, MASSIVE, WELL INDURATED, UNJOINTED, UNFRACTURED, UNWEATHERED, HARD.	5	
	19.8		19.8 TO 29.3 SHALE, BROWN, VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, FISSILE, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	6	
	29.3		29.3 TO 29.6 SANDSTONE, DARK GRAY, FINE GRAINED, COMPACT, MASSIVE, THINLY BEDDED WITH FLUVIAL CROSS BEDDING, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	7	
	29.6		29.6 TO 30.0 SANDSTONE, LIGHT GRAY, FINE GRAINED, MASSIVE, WELL INDURATED, UNJOINTED, UNFRACTURED, UNWEATHERED, HARD.	8	
	30.0			9	

Drilling Log Form for **GRAPEVINE DAM**, **SOUTHWESTERN** Division, **FORT WORTH** Installation. Project: **SPILLWAY REPAIR**. Drilling Agency: **USCE**. Hole No: **844C-606**. Driller: **WYATT**. Date: **4/22/83**. Completed: **4/22/83**. Signature: **R.P. A. L. H.**

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SCORE	REMARKS
0.0	0.0		0.0 TO 2.0 CLAY, MEDIUM PLASTICITY, STIFF, MOIST, SANDY, TAN	A	1 IMMEDIATELY AFTER RAINING WATER LEVEL TAPED AT -85.0 FT
	2.0		2.0 TO 3.0 CLAY, MEDIUM TO HIGH PLASTICITY, STIFF, MOIST, SANDY, GRAY.	B	- 72 HOURS LATER WATER LEVEL TAPED AT -24.70 FT
	3.0		3.0 TO 4.0 CLAY, LOW TO MEDIUM PLASTICITY, STIFF, MOIST, TAN TO GRAY.	C	
	4.0		4.0 TO 8.0 SANDSTONE, DARK GRAY, VERY FINE GRAINED, COMPACT, MASSIVE, THINLY BEDDED, UNFRACTURED, SLIGHTLY WEATHERED TO UNWEATHERED, SOFT.	1	2 TAPS A: 60-70 B: 20-30 C: 30-40
	8.0		8.0 TO 16.8 SHALE, DARK GRAY TO BROWN, SANDY, LAMINATED TO THINLY BEDDED, VERY LIGNITIC FROM 8.0'-12.4', AND FROM 16.2'-16.8' FISSILE, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	2	3 CARTONS NO CARTON SAMPLES (CORE WAVED TO DEPTH)
	16.8		16.8 TO 19.1 SANDSTONE, LIGHT GRAY, VERY FINE GRAINED, COMPACT, THINLY BEDDED WITH SHALE STRIPERS DISSEMINATED THROUGHOUT, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	3	4 DRILLING 0.0-40.0" 8" AUGER 40-100.6" 4" CORE
	19.1		19.1 TO 19.5 SHALE, BROWN, VERY FINE GRAINED, SANDY, LAMINATED TO THINLY BEDDED, FISSILE, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	4	
	19.5		19.5 TO 19.8 SANDSTONE, TAN, FINE GRAINED, MASSIVE, WELL INDURATED, UNJOINTED, UNFRACTURED, UNWEATHERED, HARD.	5	
	19.8		19.8 TO 29.3 SHALE, BROWN, VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, FISSILE, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	6	
	29.3		29.3 TO 29.6 SANDSTONE, DARK GRAY, FINE GRAINED, COMPACT, MASSIVE, THINLY BEDDED WITH FLUVIAL CROSS BEDDING, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	7	
	29.6		29.6 TO 30.0 SANDSTONE, LIGHT GRAY, FINE GRAINED, MASSIVE, WELL INDURATED, UNJOINTED, UNFRACTURED, UNWEATHERED, HARD.	8	
	30.0			9	

Hole No. BAAC-606

SHEET 2	OF 4 SHEETS
DATE	4/29/83
TIME	9:24 AM
REMARKS	

DRILLING LOG		SOUTHWESTERN		FORT WORTH	
PROJECT: GRAPEVINE DAM		LOCATION: SOUTHWESTERN		INSTALLATION: FORT WORTH	
LOCATION: SOUTHWESTERN		INSTALLATION: FORT WORTH		DATE: 4/29/83	
USCE		USCE		DATE: 4/29/83	
NAME OF DRILLER: WYATT		NAME OF DRILLER: WYATT		DATE: 4/29/83	
THICKNESS OF OVERBURDEN: 4.0		THICKNESS OF OVERBURDEN: 4.0		DATE: 4/29/83	
DEPTH DRILLED INTO ROCK: 96.6		DEPTH DRILLED INTO ROCK: 96.6		DATE: 4/29/83	
TOTAL DEPTH OF HOLE: 100.6		TOTAL DEPTH OF HOLE: 100.6		DATE: 4/29/83	
ELEVATION	DEPTH	LOG	CLASSIFICATION OF MATERIALS	REMARKS	REMARKS
800.0	30.0 TO 61.3	SHALE BROWN VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, FISSILE, UNJOINTED, VISIBLE SLICKEN-SIDE (P. 34)	22.2	19	
900.0	61.3 TO 67.2	SANDSTONE, LIGHT GRAY, VERY FINE GRAINED, COMPACT, THINLY BEDDED WITH SHALE STRINGERS THROUGHOUT, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT TO MODERATELY HARD IN SECTION	6.9	20	
1000.0	67.2 TO 69.6	SANDSTONE, DARK GRAY, FINE GRAINED TO MEDIUM GRAINED, COMPACT, THINLY BEDDED, UNWEATHERED, UNJOINTED, UNFRACTURED, SOFT.	2.4	21	
1100.0	69.6 TO 74.2	SHALE, DARK GRAY, VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, SANDY, FISSILE, UNWEATHERED, UNJOINTED, UNFRACTURED, SOFT.	4.6	22	
1200.0					

DRILLING LOG		SOUTHWESTERN		FORT WORTH	
PROJECT: GRAPEVINE DAM		LOCATION: SOUTHWESTERN		INSTALLATION: FORT WORTH	
LOCATION: SOUTHWESTERN		INSTALLATION: FORT WORTH		DATE: 4/29/83	
USCE		USCE		DATE: 4/29/83	
NAME OF DRILLER: WYATT		NAME OF DRILLER: WYATT		DATE: 4/29/83	
THICKNESS OF OVERBURDEN: 4.0		THICKNESS OF OVERBURDEN: 4.0		DATE: 4/29/83	
DEPTH DRILLED INTO ROCK: 96.6		DEPTH DRILLED INTO ROCK: 96.6		DATE: 4/29/83	
TOTAL DEPTH OF HOLE: 100.6		TOTAL DEPTH OF HOLE: 100.6		DATE: 4/29/83	
ELEVATION	DEPTH	LOG	CLASSIFICATION OF MATERIALS	REMARKS	REMARKS
1200.0	74.2 TO 84.2	SANDSTONE, GRAY VERY FINE GRAINED, COMPACT, THINLY BEDDED, UNFRACTURED, UNJOINTED, ARGILLACEOUS WITH PROMINENT SHALE SLAMS TO 4-76.6', 12' TO 14' TO 179', SOFT TO MODERATELY HARD			
1300.0	84.2 TO 100.6 (100)	SHALE, BROWN, VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, FISSILE, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.			
1400.0					
1500.0					
1600.0					

STRUCTURAL FEATURES

THE SHALE, SANDSTONE CONTACTS APPEAR TO BE RELATIVELY HORIZONTAL BEDDING PLANES IN BOTH THE SHALE AND SANDSTONE HORIZONS APPEAR TO BE FLAT WITH SOME FLUVIAL CROSS BEDDING WITHIN THE SANDSTONES THE ENTIRE SEQUENCE IS UNJOINTED

100.6'

FOR LOCATION OF BORING SEE PLATE 4

2

DESIGNED BY: A. MARR	DESIGNED BY: A. MARR	DESIGNED BY: A. MARR	DESIGNED BY: A. MARR
DRAWN BY: A. MARR	DRAWN BY: A. MARR	DRAWN BY: A. MARR	DRAWN BY: A. MARR
CHECKED BY: M. GREEN	CHECKED BY: M. GREEN	CHECKED BY: M. GREEN	CHECKED BY: M. GREEN
INVESTIGATOR: MEL GREEN	INVESTIGATOR: MEL GREEN	INVESTIGATOR: MEL GREEN	INVESTIGATOR: MEL GREEN

LOG OF BORING

F

E

D

C

B

DRILLING LOG		SOUTHWESTERN		FORT WORTH	
GRAPEVINE DAM		B' H' 4' CORE		B' H' 4' CORE	
SPILLWAY REPAIR		FAILING 1500		FAILING 1500	
USCE		3		3	
WYATT		21		21	
4/29/83		4/22/83		4/29/83	
97.4%		97.4%		97.4%	
P. R. Andetta		P. R. Andetta		P. R. Andetta	
1200	74.2 TO 84.2	SANDSTONE, GRAY VERY FINE GRAINED COMPACT THINLY BEDDED, LATERAL UNWEATHERED, UNJOINTED, AREALIZED WITH PROMINENT SHALE SEAMS TO 4" TO 6", 1" TO 4" TO 6" TO 9" SOFT TO MODERATELY HARD			
1300	84.2 TO 100.6 (100)	SHALE, BROWN, VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, LATERAL UNJOINTED, UNWEATHERED, SOFT			
1400	STRUCTURAL FEATURES				
1500	THE SHALE / SANDSTONE CONTACTS APPEAR TO BE RELATIVELY HORIZONTAL BEDDING PLANES IN BOTH THE SHALE AND SANDSTONE HORIZONS APPEAR TO BE FLAT WITH SOME FLUVIAL CROSS BEDDING WITHIN THE SANDSTONES THE ENTIRE SEQUENCE IS UNJOINTED				
1600	TD 100.6'				

DESIGNED BY: A. MARR		DRAWN BY: A. MARR		CHECKED BY: M. GREEN	
GRAPEVINE LAKE DENISON CREEK, ELM FORK, TRINITY RIVER, TEXAS MODIFICATION OF EMBANKMENT AND SPILLWAY LOG OF BORING 8A4C-606					
APPROVED BY: MEL GREEN		INVESTIGATION NO. DACW83-83-B-0052		DATE AUG 1983	
CONTRACT NO. DACW83-83-C-0180		SHEET NO. 20		PLATE 20	

ATION OF BORING SEE PLATE 4

Hole No. **BAHC-607**

DRILLING LOG		DIVISION	INSTALLATION	SHEET
PROJECT		SOUTHWESTERN	FOOT MOUNT	OF 2 SHEETS
1. PROJECT		2. SITE AND TYPE OF BIT STANDARD 2 1/2" DIA. 1 1/2" DIA.		
3. LOCATION (elevation at top of hole)		11. DEPTH FOR ELEVATED LOCATION (ft.)		
4. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL		
5. DRILLING AGENCY		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		
6. NAME OF DRILLER		14. TOTAL NUMBER CORE BITES		
7. DIRECTION OF HOLE		15. ELEVATION GROUND WATER		
8. THICKNESS OF OVERBURDEN		16. DATE HOLE		
9. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE		
10. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BITES		
		19. SIGNATURE OF INSPECTOR		
		20. SIGNATURE OF DRILLER		
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	REMARKS
0.0			0.0 TO 4.0	1. IMMEDIATELY AFTER BAILING WATER LEVEL TAPPED AT - 89.5 FT.
			SAND FINE GRAINED, LOOSE, MOIST, CLAYEY, BROWN	
			4.0 TO 49.6	2. 24 HOURS LATER WATER LEVEL TAPPED AT - 33.5 FT.
			SHALE/SANDSTONE INTERBEDDED SEQUENCES OF SOFT BROWN SHALE AND SOFT TO MILD LIGHT GRAY TO GRAY SANDSTONE (SECTION LIFTED FROM ROCK BIT ACTION AND CUTTINGS).	
			49.6 TO 59.9	3. JARS
			SHALE, BROWN VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, FISSILE, LIGNITIC, UNWEATHERED WITH EUPRIC PRESERVED THROUGHOUT, UNJOINTED, UNFRACTURED, SOFT.	A: 0.0 - 4.0
			59.9 TO 71.2	4. CARTONS
			SANDSTONE, LIGHT GRAY TO GRAY, VERY FINE GRAINED, COMPACT, THINLY BEDDED, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	NO CARTON SAMPLES (CORE WALKED TO DEPTH)
			71.2 TO 74.9	5. DRILLING
			SHALE, DARK GRAY, VERY FINE GRAINED, LAMINATED TO THINLY BEDDED, COMPACT, VERY SANDY, UNWEATHERED, UNJOINTED, UNFRACTURED, SOFT.	0.0 - 4.0, AUGER REFUSAL
				4.0 - 49.6, 6 1/4" ROCK BIT
				49.6 - 85.0, 4" CORE

DRILLING LOG		DIVISION	INSTALLATION	SHEET
PROJECT		SOUTHWESTERN	FOOT MOUNT	OF 2 SHEETS
1. PROJECT		2. SITE AND TYPE OF BIT STANDARD 2 1/2" DIA. 1 1/2" DIA.		
3. LOCATION (elevation at top of hole)		11. DEPTH FOR ELEVATED LOCATION (ft.)		
4. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL		
5. DRILLING AGENCY		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		
6. NAME OF DRILLER		14. TOTAL NUMBER CORE BITES		
7. DIRECTION OF HOLE		15. ELEVATION GROUND WATER		
8. THICKNESS OF OVERBURDEN		16. DATE HOLE		
9. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE		
10. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BITES		
		19. SIGNATURE OF INSPECTOR		
		20. SIGNATURE OF DRILLER		
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	REMARKS
0.0			0.0 TO 74.9	1. IMMEDIATELY AFTER BAILING WATER LEVEL TAPPED AT - 89.5 FT.
			SANDSTONE, LIGHT GRAY, VERY FINE GRAINED, COMPACT, HEAVILY CEMENTED THINLY BEDDED WITH SHALE SEAMS 1/2" TO 1" AND FROM 74.9 TO 79.6' UNJOINTED, UNFRACTURED, SOFT.	
			74.9 TO 79.6	2. 24 HOURS LATER WATER LEVEL TAPPED AT - 33.5 FT.
			SANDSTONE, BROWN, FINE GRAINED, WELL INDURATED, THINLY BEDDED WITH THIN SHALE SEAMS THROUGHOUT, THIN VERY SOFT GRAY SANDSTONE SEAMS FROM 79.6' - 80.3' UNJOINTED, UNFRACTURED, UNWEATHERED, HARD.	
			80.3 TO 81.5	3. JARS
			SANDSTONE, LIGHT GRAY, VERY FINE GRAINED, MASSIVE, HEAVILY CEMENTED THINLY BEDDED WITH SHALE LAMINAE THROUGHOUT, UNJOINTED, UNFRACTURED, UNWEATHERED, SOFT.	A: 0.0 - 4.0
			81.5 TO 82.7	4. CARTONS
			SANDSTONE, BROWN, FINE GRAINED, WELL INDURATED, THINLY BEDDED WITH NUMEROUS SHALE SEAMS THROUGHOUT, UNJOINTED, UNFRACTURED, UNWEATHERED, HARD.	NO CARTON SAMPLES (CORE WALKED TO DEPTH)
				5. DRILLING
				0.0 - 4.0, AUGER REFUSAL
				4.0 - 49.6, 6 1/4" ROCK BIT
				49.6 - 85.0, 4" CORE

[illegible]

FOR LOCATION OF BORING SEE

A MARR
A MARR
M GREEN
MEL GREEN

MO. No. 8A4C-607

RT. NORTH

FAILING 1500

4/21/93 4/25/93

P. R. Rudette

9-9

FOR LOCATION OF BORING SEE PLATE 4

A MARR

GRAPEVINE LAKE
DENTON CREEK, ELM FORK, TRINITY RIVER, TEXAS

A MARR

MODIFICATION OF
EMBANKMENT AND SPILLWAY

3

M. GREEN

LOG OF BORING 8A4C-607

MEL GREEN

DACW63-83-B-0052

AUG 1983

DACW63-83-C-0160

PLATE

21

ND
-87