CAVE BUTTES DAM

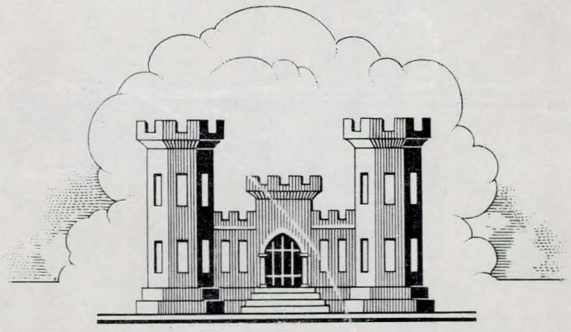
GILA RIVER BASIN

NEW RIVER AND PHOENIX CITY STREAMS
ARIZONA

DAM, OUTLET WORKS AND SPILLWAY

PERIODIC INSPECTION REPORT NO. 1

FEBRUARY 1980



U S ARMY ENGINEERS DISTRICT, LOS ANGELES
CORPS OF ENGINEERS

COPY #4

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2711
LOS ANGELES, CALIFORNIA 90053

SPLED-DA

6 August 1980

Mr. William D. Matthews
Chief Engineer and General Manager
Flood Control District of Maricopa County
3335 West Durango Street
Phoenix, Arizona 85009

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Dear Mr. Matthews:

Inclosed are four copies of Periodic Inspection Report No. 1 for Cave Buttes Dam.

We wish to call your attention to the required action, Para. 6, Page 4 and future inspections, Para. 7, Page 4. Please notify the Los Angeles District by letter when the required action is complete.

Sincerely yours,

for Walter Rakitsch
NORMAN ARNO
Chief, Engineering Division

1 Incl
As stated

TEAM INSPECTION OF CAVE BUTTES DAM

Periodic Inspection Report No. 1
Dated February 1980

CONTENTS

TEAM INSPECTION OF CAVE BUTTES DAM

1. INSPECTION TEAM. On 14 February 1980, a periodic team inspection of Cave Buttes Dam was made as required by ER 1110-2-100. The inspection team consisted of the following personnel:

OCE	Arizona Water Commission
R. Beene	B. Scott
SPD	Maricopa County Flood Control District
F. McLean W. Strid	H. Fuller
Area Engineer, Arizona - Nevada	LAD
MAJ C. Rust	R. Gray R. Gutschow
Project Resident Engineer	G. Harski V. Minor
V. Cox	B. Tracy H. Tatsugawa

2. PROJECT CONDITIONS.

a. This was the first periodic inspection of the dam facilities since the completion of the project. The following visual inspection comments are pertinent regarding this report.

b. The weather was cloudy and overcast with intermittent showers and a high temperature of 70 degrees F and a low of about 50 degrees F.

c. The reservoir between Cave Creek Dam (old dam) and Cave Buttes Dam (located downstream of old dam) contained a small amount of impoundment from rains which occurred during the inspection. The reservoir appeared to be clean and free of weeds.

d. The gates at Cave Creek Dam are permanently welded to remain open, therefore allowing low flow to collect between the two dams.

3. MAXIMUM WATER SURFACE ELEVATION. Since the completion of the dam and before the dam inspection no appreciable water level had been recorded. However, shortly after the inspection, the water level reached an elevation of 1601.4 feet on 20 February 1980.

4. INSPECTION RESULTS.

a. Embankment.

(1) Crest. The crest was clean and free of weeds and brush. The roadway surface was in good condition and showed no signs of deterioration. The shoulders of the road along the crest were generally free of erosion, however, there were some soft spots.

(2) Abutment contacts. No slides, signs of instability or erosion of the abutment surfaces was observed.

(3) Upstream and downstream slopes. The upstream slope was generally clean with the exception of some small weeds growing on the fill. Bike tracks were noticed, below the access ramp to the outlet, about midway up the embankment. The stone facing on the slopes appeared sound and durable with no sign of deterioration or displacement. The gutters at the upstream and downstream abutment contacts were clean and in good condition. There was some evidence of run-off along the gutter, causing erosion along the contact. The grouted access ramp to the outlet works was in good condition. The broomed grout surface of the ramp has numerous shrinkage cracks which do not present any immediate problem.

(4) Upstream and downstream toes. There was no evidence of erosion, seepage, undermining, settlement or sloughing at the downstream or upstream toes of the embankment.

b. Dikes.

(1) Dike No. 1. The crest and slopes were generally in good condition and free of weeds. At the edge of the crest, where the combination of fill and rock join each other, may cause material to be washed down the slope. Some minor sloughing of natural material was noted in the upstream and downstream right abutment gutters.

(2) Dike No. 2. The crest showed occasional areas of the dike, especially on the downstream side, to be uneven. The crest material may have migrated into the stone facing. This may have been the result of difficulty in getting proper compaction, resulting in local settlement.

(3) Dike No. 3. The crest and slopes showed no erosion.

c. Spillway.

(1) The spillway, located 1,700 feet northwest of the right abutment, was excavated in rock. A concrete sill was placed the full width of the spillway and found to be in good condition. Presently it was noted that the sill has approximately 1/4 tight shrinkage cracks at various spacings. Bullet holes were noticed on the vertical end sill wall. Considerable sloughing was noticed in the spillway channel due to the highly weathered and closely fractured rock exposed in the cut slope. This rock will continue to fall until the slope stabilizes.

d. Flood Control Outlet Works.

(1) Approach channel. The approach channel and grouted stone was in good condition and free of any obstruction. Concrete in the tower and retaining wall structure showed no signs of structural distress. Two construction joints in the retaining wall on the (west) side have a slight offset at the top. The joint nearest the tower and the next joint westerly have separated horizontally and vertically approximately 1/4 of an inch.

(2) Control Tower.

(a) Concrete in the rectangular conduit control section was in good condition. Since the project had just been completed, a few transverse hairline cracks were noted. Experience has shown this to be normal; however, all hairline cracks will be observed during future inspections.

(b) Trash rack structure. The trash rack was inundated with debris and was inaccessible due to water around the tower.

(3) Outlet channel. The outlet channel was clear and free of debris. The grouted stone and concrete in the downstream channel appeared to be in good condition. There was some erosion between the grouted stone and the unlined slope portion of the channel. Evidence also showed several minor erosion gulleys along the slopes of the unlined channel.

5. CONCLUSIONS.

a. The erosion on the crest of the dam is insignificant. Inasmuch as the dam and dikes are newly constructed, it is anticipated that a certain amount of erosion will occur. This erosion should be repaired under normal maintenance proceedures to prevent further erosion.

b. The amount of erosion on the side slopes of the channel (noted during the inspection) was minor. However, the storms of February 1980 have now eroded the slopes significant enough to require repair during maintenance.

c. Various low spots, near the downstream face of the main embankment, should be filled to prevent ponding of water in the area.

d. The main access road to Cave Buttes Dam has deposition in the dip crossing. (MAIN ACCESS IS CAVE CREEK DAM ROAD SOUTH & EAST OF THE MAIN STRUCTURE.)

e. Areas, where cuts were made in rock, will require maintenance until the slopes become stabilized.

f. In general, the dam and appurtenances appear to be in excellent condition and are functioning as designed. There were no unusual conditions noted which would affect the safety of the structures.

6. REQUIRED ACTION.

a. Continuing observation should be made of the above mentioned items.

b. For safety, at least three wall steps should be installed at the end of conduit within the outlet works. (STA 48+44).

c. Minor erosion should be repaired and the access road to the dam, at the dip crossing, should be cleaned.

d. All the required action above will be accomplished by the Maricopa County Flood Control District (MCFCD).

7. FUTURE INSPECTIONS. The next team inspection is scheduled for February 1981. Future inspections will be conducted by the Maricopa County Flood Control District (MCFCD) according to ER 1110-2-100, 30 March 1977, with the Corps of Engineers to participate. The inspections are to be conducted at one-year intervals for the next four years, at two-year intervals for the following four years, and then may be extended to each five years if warranted by the results of previous inspections.

Photo 1- Upstream face near left abutment at start of accesss ramp to outlet work, slope protection and gutter

Photo 2- Upstream east (left) abutment, outlet works and grouted inlet wall

Photo 3- Outlet works tower; note debris/trash (prior to the days of storm)

Photo 4- Outlet works downstream channel, note erosion at end of grouted stone on west side of channel. Erosion on east - left side similar.

Photo 5- Outlet works inlet retaining wall slight separation (horizontal) at 1st construction joint right (west) of tower, slightly less than 1/4 inch

Photo 6- Outlet works retaining wall. Slight vertical off-set on 2nd joint right (west) of tower, down slightly less than 1/4inch on west (pencil) side

Photo 7-Cave Creek Dam and by-pass channel in background, 1st water from storm run-off C.B. Intake tower & outlet works lower left.

Photo 8-Outlet works looking downstream from top of dam embankment.

Photo 9- Outlet works, outlet channel downstream of bridge, note erosion along low flow and laterally along side alope.

Photo 10- Dike No. 1 upstream face and gutter, view east from right abutment.

Photo 11- By pass channel for Cave Creek Dam, upstream portion of right (west) wall.

Photo 12- Dike No. 1, view downstream of main dam embankment.

Photo 13- Upstream face, esthetic treatment. Sand (bottom), rock (top), access ramp to outlet works view west.

Photo 14- S/W west wall (right), sill and channel bottom.

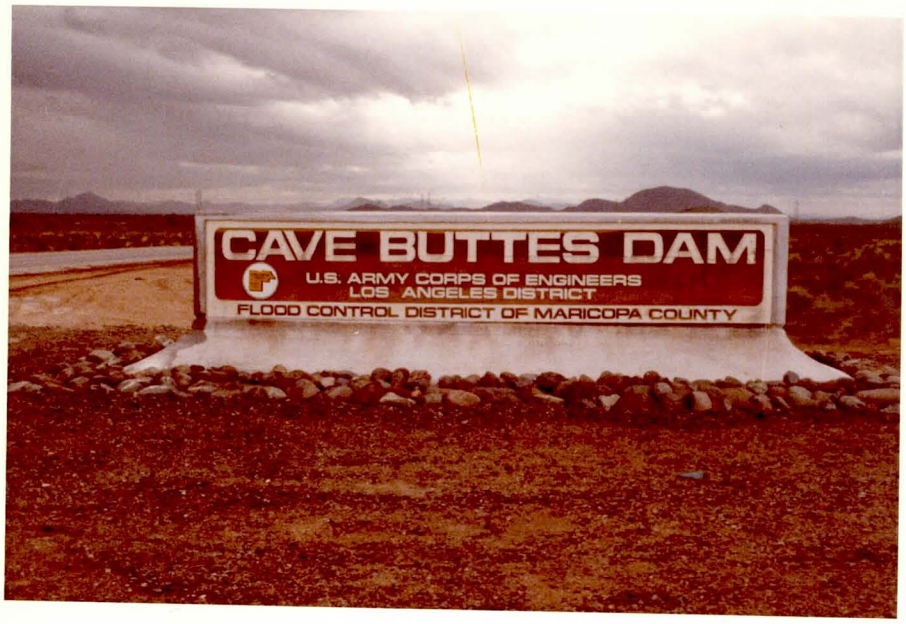


Photo 15- Marker at entrance to project.

Photo 16- Downstream side of Cave Buttes Dam embankment, looking ~~west~~ EAST towards outlet structure.

Photo 17- Dike No. 2, upstream slope looking west at Cave Creek Road.

Photo 18- Looking SE at access road.

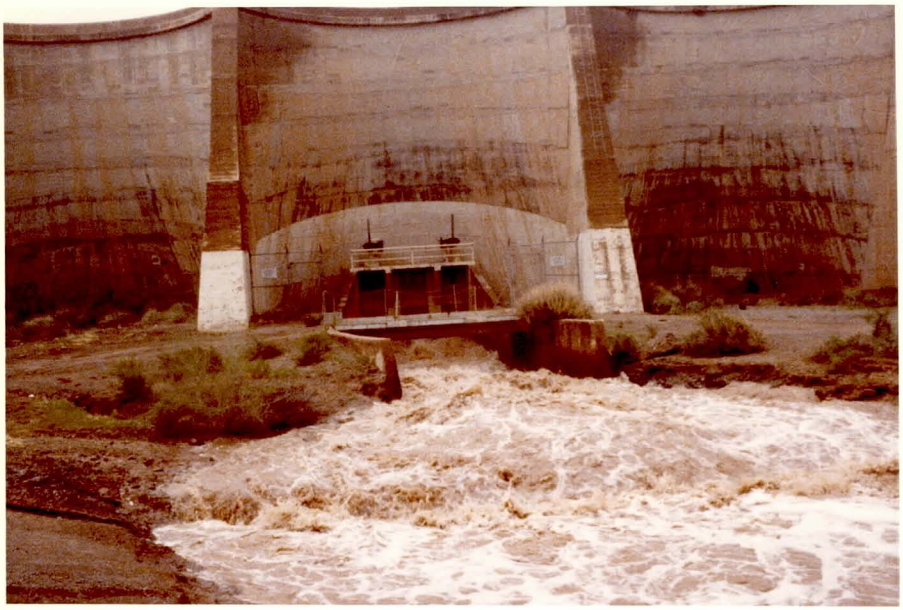


Photo 19- Cave Creek Dam, water outflow during inspection from main gates. Gates were welded permanently.

Photo 20- Upstream face, view east along access road to outlet works, taken from the right abutment.

Photo 21- Downstream of Cave Buttes Dam embankment.

Photo 22- S/E east wall (left) sill

Photo 23- N/W west wall (right) sill.

Photo 24- Dike No. 1, west (right) abutment side view east along downstream gutter.

Photo 25- Diversion channel from Dike No. II view SE.

Photo 26- Looking NW at access road.

Photo 27- Looking west from Cave Creek Road Dike No. 2.

Photo 28- East end of Dike No.2, downstream slope.

Photo 29- Diversion Channel from Dike No. 2. View looking NW from access road.

Photo 30- Dip crossing on access road to outlet works

Photo 31- Dike No. 2 west end looking east at both slopes

APPENDIX I
AGENDA FOR INSPECTION OF

CAVE BUTTES DAM

Members will arrive at Phoenix, Arizona on Wednesday, February 13, 1980. Arrangements for transportation will be made by each individual. Our rendezvous will be at the following motel:

RAMADA INN
3801 E. Van Buren
Phoenix, Arizona
(602) 275-7878

Thursday, 14 February 1980

0800 - Depart from Motel
0900 - Inspection of Dam
1300 - Assemble for Discussion of Inspection
1330 - Depart for Phoenix

APPENDIX II

CAVE BUTTES DAM

GENERAL PROJECT DESCRIPTION

CONTENTS

CAVE BUTTES DAM

PERTINENT DATA

Drainage area	sq mi	191
Dam (rolled earthfill)		
Crest elevation	ft msl	1,679.1
Max. height above streambed	ft	109
Crest length	ft	2,260
Freeboard	ft	5
Spillway (detached)		
Crest elevation	ft msl	1,657.1
Crest length	ft	510
Elevation of max. water surface	ft msl	1,674.1
Outlet works (ungated conduit)		
Diameter of conduit	ft	3.75
Length	ft	528.75
Intake elevation	ft msl	1,560.7
Saddle dike No. 1		
Crest length	ft	930
Max. Height above existing ground	ft	39
Saddle dike No. 2 or east dike		
Crest length	ft	9,035
Max. height above existing ground	ft	55
Saddle dike No. 3 or west dike		
Crest length	ft	3,245
Max. height above existing ground	ft	10

PERTINENT DATA (CONT'D)

Reservoir area at spillway crest	acres	1,820
Capacity (gross) at spillway crest	acre-ft	46,600
Storage allocation below spillway crest		
Flood Control (net)	acre-ft	40,900
Sedimentation	acre-ft	5,700
Standard Project flood		
Total volume	acre-ft	42,900
Peak inflow	cfs	54,000
Peak outflow	cfs	486
Drawdown time	days	48
Maximum probable flood		
Total volume	acre-ft	122,000
Peak inflow	cfs	172,000
Peak outflow	cfs	100,600
Drawdown time	days	61

CAVE BUTTES DAM
GENERAL PROJECT DESCRIPTION

1. PURPOSE AND SCOPE. This report is prepared in accordance with ER 1110-2-100, entitled "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures" and dated 30 March 1977, which defines objectives, assigns functions, and establishes procedures by which the Corps of Engineers carries out its responsibilities for assuring the continuing structural integrity and operational adequacy of its major civil works structures in service. Periodic evaluation of constructed structures is accomplished by periodic inspection for the purpose of detecting conditions of significant structural distress and to provide a basis for timely initiation of corrective measures to be taken when necessary.

Cave Buttes Dam was designed and constructed by the Corps of Engineers who has transferred the responsibility for operation and maintenance of the project to the Maricopa County Flood Control District (M.C.F.C.D.). In accordance with ER 1110-2-100, the operating entity is also responsible for the periodic inspections and observations necessary for assuring the continuing structural integrity and operational adequacy of the structure. The M.C.F.C.D. should conduct the inspections and prepare the inspection reports. The Corps of Engineers should be invited to participate in the inspections. The initial inspection was conducted by the Los Angeles District and the report was prepared by the Los Angeles District. Subsequent inspections should be made at one-year intervals for the next four years, at two-year intervals for the following four years, and then may be extended to each five years if warranted by the results of the previous inspections.

2. GENERAL. Cave Buttes Dam is located in Maricopa County, Arizona, approximately 19 miles north of downtown Phoenix. The dam is on Cave Creek about 0.7 miles downstream (south) of the existing Cave Creek Dam (see pls. 1 and 2). It provides flood protection to the City of Phoenix from floodwaters emanating from the 191-square-mile drainage area upstream of the dam. The northern half of the drainage area is characterized by rugged terrain where ground elevations vary from 2,000 feet mean sea level (MSL) at the base of the mountains to elevations of greater than 4,900 feet MSL at the mountain peaks. The southern half is primarily composed of flatlands with scattered hills and mountains. Desert plants of various species are scattered throughout the drainage area with more concentrations of desert riparian trees and shrubs occurring along the streambed. The wildlife found in the project area includes snakes, lizards, small desert rodents and various birds.

The principal features of the project (shown on pl. 2) include the main embankment, three dikes, the outlet works, an unlined spillway, a drainage channel, access roads and unlined bypass channel for Cave Creek Dam.

a. The embankment is a compacted three-zone earthfill structure with a crest width of 20 feet. The crest has a 12 foot wide paved service road. An access ramp is provided on the upstream slope of the embankment to allow access to the intake structure. The upstream slope of the dam is 1V on 2.25 H between the top of the dam and elevation 1,619.0 and 1V on 2.75 H below elevation 1,619.0. The downstream slope is 1V on 2 H (see pls. 3 and 4).

b. Dike No. 1 is located about 90 feet east of the dam embankment and is 930 feet in length with the crest at elevation 1,679.1. The top of the dike is 20 feet wide, and is used as a service road. The embankment cross section is similar to that of the dam embankment (see pl. 5).

c. Dike No. 2 is 9,035 feet in length. The western 5,345 feet is designed as a saddle dike, while the eastern 3,690 feet is designed for diversion of floodwaters from the drainage area northeast of Cave Creek Road. The western end of this dike is located approximately 6,000 feet northeast of the dam embankment. The top of the western portion of the dike is at elevation 1,679.1, forming an embankment with a maximum height of 55 feet above the existing ground. The eastern 3,690 feet is a variable height ranging from 10 feet to 6 feet above the existing ground. The entire length of the embankment has a top width of 20 feet, an upstream slope of 1V on 2.25H, and downstream slope of 1V on 2H. There are two cross sections for this dike embankment: the first has a core with exterior zones of pervious material, and the second consists of a homogenous section of transition material. The first section covers the highest portion of the embankment, west of station 88+00, and the latter covers the remainder of the dike above the standard project flood pool. The upstream slope of the dual zoned section is protected by 1.5 feet of riprap overlying 8 inches of filter material. The upstream slope of the homogenous section is faced with 1.5 feet of riprap. The downstream slope of the dike between stations 50+15 and 88+00 is protected with 12 inches of stone covered with 6 inches of topsoil. The remainder of the dike (stations 88+00 and 140+50), which is less than 30 feet in height, is protected by a layer of topsoil with landscaping.

d. Dike No. 3 is located approximately 2.5 miles northwest of the main dam. The dike is 3,245 feet in length and its top is at elevation 1,679.1. The maximum height is 10 feet above the existing ground. The crest width of the dike is 20 feet and the upstream and downstream slopes are 1V on 2.25H and 1V on 2H, respectively. The embankment is composed of transition material with 1.5 feet of riprap for upstream slope protection. There is no stone protection on the downstream slope. For details see plate 5.

e. The outlet works is founded on bedrock at the left abutment of the dam. The outlet works consist of an approach channel, intake tower, conduit, energy dissipator and outlet channel (see pl. 11). The outlet is designed to release approximately 500 cfs with the water surface at the spillway crest.

(1) Due to the location of the outlet works, an approach channel was excavated between the borrow area and the intake structure. The approach channel (see pl. 12) is trapezoidal in cross section with a base width of 30 feet. The left bank is excavated approximately along the bedrock surface with a side slope of 1V on 1.5H. The right bank is excavated in alluvium with a side slope of 1V on 2H. A concrete retaining wall is provided just downstream of the intake structure to retain the fill forming the service ramp for inspection and maintenance of the intake structure.

(2) The intake structure is located in the center of the approach channel, and is 10 feet upstream of the retaining wall. The reinforced concrete structure is 13 feet in height and 10.75 feet square in cross

section. The interior of the structure forms a chamber 7.25 by 7.25 feet in cross section and 13.0 feet in height. A total of eight 2-square-foot openings are provided at various elevations for the intake of floodwaters. Two openings, one 7 by 6 feet and the other 7.25 foot-square, are provided at the base and the top of the structure, respectively, for cleaning purposes. Steel grating is provided in these large openings to prevent debris from entering the intake structure.

(3) The total length of the 3.75-foot-diameter circular conduit is 528.75 feet. Precast reinforced concrete pipes form the interior surface of the conduit and a reinforced concrete casing on the outside of the concrete pipe supports the embankment fill. A bellmouth structure is provided at the upstream end of the conduit to improve the entrance flow conditions (see pl. 12).

(4) An energy dissipator is located at the end of the conduit (see pl. 13). It is rectangular in cross section, having a 71.55 foot long transition section with base width increasing from 3.75 to 18 feet. Wall heights increase from 7.59 to 12 feet. The total length of the structure is 102.55 feet. At the downstream end of the dissipator in the rectangular section, there is one row of 6 dentates, each one 18 inches wide and 18 inches high.

(5) An unlined trapezoidal outlet channel (see pl. 11) is constructed at the downstream end of the energy dissipator. The channel has a base width varying from 8 to 24 feet, side slopes of 1V on 2H and a length of 1,380 feet.

18-inches of grouted stone riprap protects the sideslope of the energy dissipator and the sideslopes and bottom of the channel from station 47+68 to the bridge. Grouted stone is provided downstream of the bridge for approximately 20 feet to protect the base of the bridge structure from erosion.

f. The spillway is located in a natural saddle approximately 1,600 feet northwest of the main embankment and is alined to fit the natural terrain (see pl. 10). Based on the 3.75-foot diameter conduit, the minimum crest elevation that will control the standard project flood is 1,657.1 feet. The spillway has a 510-foot crest length. The spillway is excavated in rock and is unlined, except at the crest where a concrete sill is provided which extends up the sideslope to the maximum water surface elevation. This detached, broad-crested spillway is trapezoidal in cross section with side slopes of 2V on 1H. A 12-foot wide bench is provided at elevation 1,680.0 for control of erosion on the excavated slopes.

g. The drainage channel is located north of dike No. 2 near its west abutment. This channel (see pl. 14) is designed to drain a dead pool of 230 acre-feet which is created by the construction of dike No. 2. The channel is 2,800 feet in length, unlined and trapezoidal in cross section. Base width of the channel is 12 feet and side slopes are 1V on 2H.

h. Access to the dikes, dam embankment, and unlined spillway is from the junction of dike No. 2 and the existing Cave Creek Road. The tops of embankments are utilized as service roads (see pl. 2). Dike No. 2 and dike

No. 1 are connected by an access road, 5,530 feet in length, around the north side of a hill. The minimum elevation on the top of the bituminous-treated road is above the maximum water surface behind the dam so that the road can be used under the most adverse weather conditions. Dike No. 1 and the dam embankment are connected with a 100-foot-long access road excavated through the hill between the dike and dam. The right abutment of the dam and the spillway are connected by an access road 4,366-foot-long around the south side of a hill between the embankment and the spillway.

i. To preserve Cave Creek Dam as is, a bypass channel (see pl. 15) is excavated through the saddle about 500 feet west of the right abutment of the dam. The channel is unlined and has a 400-foot base width, 2V on 1H sideslopes and a crest elevation of 1628 feet.

3. GEOLOGY. The damsite at streambed elevation (1,570 feet) spans Cave Creek between two rock ridges that parallel the valley. A thin veneer of older alluvium (talus material) covers the upper slopes of the ridges and becomes much thicker on the east side of the valley near the base of the slope. The alluvial materials in the valley consist of various combinations of sand, gravel, cobbles and some boulders extending to a depth of approximately 35 feet. Bedrock forming the ridges and underlying the stream bottom is a metaigneous rock, consisting of moderately hard schist and greenstone. There is evidence of ancient folding and some faulting in the rock formations in the vicinity of the Cave Buttes Dam.

The rock types encountered in the mountainous areas of the surrounding region are very similar. The basement complex is composed predominantly of Precambrian schistose and massive metaigneous rocks with lesser amounts of gneiss and quartzite. These are covered and intruded by Tertiary igneous rocks. The igneous rocks consist of granite, rhyolite, andesite, vesicular basalt flows, tuff and tuffaceous agglomerate. The trend of foliation in the rock formations is in a southwest-northeast direction, and generally is steeply dipping. Older alluvium, which consists of moderately to well consolidated residual soil and talus debris, is generally found along the side slopes of the valleys and underlies the Recent alluvium. In the valleys, the older alluvium is mostly sand and silty sand containing varying amounts of caliche. Recent alluvium, which consists of unconsolidated silt, sand, gravel, cobbles and boulders, is found in the valley areas in the streambed channels and the flood plain washes. The deep dissection of the mountains, and the great extent and depth of alluvial fans suggest that the Phoenix area has undergone a long, stable geologic history.

4. EMBANKMENT. The dam embankment consists of impervious core, transition zones on either side of the core, outer zones of pervious material, and exterior zones of slope protection (see pl. 4). The core is founded on bedrock within the cutoff trench. The upstream stone slope protection is 1.5 feet thick. Downstream protection consists of 6 inches of topsoil for landscaping over 12 inches of stone. Erosion control gutters are provided at the juncture of the embankment and the abutments.

a. Materials for the impervious (zone I) of the embankment were obtained from the basin of the existing dam. The materials in the designated area were predominantly sandy clays and sandy silts. The depth of suitable material after clearing and grubbing, varied in thickness from 19 feet near the existing dam to about 7 feet at the far end of the designated area.

b. Materials for the transition (zone II) of the main embankment were obtained from the borrow area located approximately 6,000 feet upstream from the site. The materials in the designated area were predominantly clayey sands and silty sands with varying amounts of gravel and some cobbles. The depth of suitable material, after clearing and grubbing, varied in thickness from 4 to 15 feet. The materials were loose to very dense, having a standard penetration test blow count range from 6 to 60+ blows per foot.

c. Materials for the pervious (zone III) of the main embankment were obtained from the borrow area located between the existing Cave Creek Dam and Cave Buttes Dam embankment.

d. Material to construct dike No. 1 was obtained from the same source as the transition borrow (zone II) for the main embankment.

e. Material to construct dike No. 2 was obtained from the borrow area just north of dike No. 2 area. The materials are predominantly gravelly, silty sands.

f. Material to construct dike No. 3 was obtained from the borrow area just south of dike No. 2 area. The material is sandy clays and silts.

g. Embankment design values of materials are shown on plate No. 25. The construction control data and record tests are presently being evaluated and will be presented in the Foundation and/or Embankment Reports.

5. FOUNDATION CONDITIONS

a. Dam. The foundation exposed by the cutoff trench excavation below streambed at the embankment site disclosed adequate conditions for the construction of an earth embankment. The rock exposed in the cutoff trench and the abutments is greenstone, gray to brownish gray, weathered near the surface, fractured moderately hard to hard, platy and micaceous. Occasional granite dikes intrude the greenstone on the right abutment and a few on the left abutment.

b. Dikes. The following is a brief description of the condition of the foundation and abutments for the three dikes.

Dike No. 1 is founded on moderately hard to hard greenstone bedrock.

Dike No. 2's right abutment is founded on rock similar to that at Dike No. 1. The embankment foundation and left abutment, station 53+50 to 115+00, consists of older alluvium of the valley bottom. The alluvial materials in the foundation east of station 54+00 are predominantly silty sand and clayey sand. The soils are finer east of Cave Creek Road. The materials to a depth

of approximately 5 feet have an average dry density of 102 pcf or 81 percent relative compaction. Beyond this depth, the materials are progressively harder due to caliche cementation and cobbles become more numerous. At a depth of approximately 10 feet the average dry density is 110 pcf or 87 percent relative compaction. At station 97+00 Cave Creek Road crosses the alinement of dike No. 2. The existing road embankment was removed to permit construction of the dike and the new road embankment was ramped to the top of dike.

Dike No. 3 has a maximum fill of about 10 feet above the existing ground surface near station 177+00. The near surface foundation materials are sandy clay or clay underlain by sandy silt and clay sand highly cemented and containing a small percentage of gravel size material. The in-place density of the top 12 inches of material is in the order of 80 percent of maximum density. The material becomes harder from 1 to 3 feet. At depths greater than 4 feet the materials have blow counts greater than 50.

c. Outlet Works. The outlet works are located near the toe of the left abutment. The 3.75-foot diameter reinforced concrete conduit is founded mainly on greenstone bedrock. Between station 50+58 and 48+00 the rock surface was deeper than anticipated and the area was overexcavated to a depth of as much as 13 feet near station 50+00. The excavation was backfilled with concrete to provide a foundation for the conduit. Grouting was conducted along the outlet works contact of the rock and concrete under the impervious core. The foundation rock for the ungated intake structure is also greenstone.

d. Spillway. The spillway, located 1,700 feet northwest of the top of the right abutment is excavated in rock. The rock is predominantly a moderate to highly fractured and foliated schist with occasional moderately fractured greenstone intervals, weathered to approximately 8 feet with foliation dipping 60 to 90 degrees to the northwest.

During the excavation minor slumping occurred on the west wall between station 19+00 and station 22+50. To remedy this situation the cut slope of the wall was flattened. At the east wall of the spillway sill a slight overbreak occurred. This overbreak was formed and filled with concrete. At the elevation and location of the concrete sill, the rock is adequate to resist scour during the infrequent spillway flows. The alinement of the sill is located near the highest point in the saddle.

6. FOUNDATION TREATMENT.

a. Main Embankment.

(1) The cutoff trench for the core and 12 feet of the transition material across the streambed was excavated to sound bedrock. The core material was placed on sound rock. All blocks, slabs and boulders were removed from the bottom of the trench to provide a uniform bedrock surface for placement of fill. The exposed bedrock for the core and 12 feet on either side of the transition zones was throughly cleaned by air blasting. Grouting consisted of a single line of holes along the center of the cutoff trench.

The grout holes were spaced approximately 20 feet apart, forming a grout curtain ranging from 25 to 75 feet in depth. Dental concrete was used to fill scour pockets and channels not accessible to roller equipment. Foundation preparation of the streambed outside of the cutoff trench consisted of removing all loose and dumped material from the recent excavations by aggregate producers. To provide a uniform, dense surface the foundation was excavated to a depth of approximately 15 feet from the original ground surface. Cobbles larger than 6 inches were removed. The area was leveled, moistened and proof-rolled.

(2) Right and Left Abutment, Dam. Loose and unsound rock was removed from the abutment. The core contact was cleaned by air blasting. Dental concrete was used to fill the depressions. The fractured rock was generously treated with a fine sand cement slurry to mortar the joints in order to seal off surface fractures at the core contact. A minimum pressure grouting program consisted of drilling and grouting along the centerline of the core zone with holes spaced approximately 40 feet apart and 40 feet deep.

b. Dike No. 1. The foundation under the Zone II material was stripped of all overburden to firm rock. The central third of the foundation was cleaned by air blasting. Dental concrete was used to fill depressions. A grouting program consisting of a single line of grout holes spaced 40 feet apart, drilled to 25 foot depth was used. The foundation treatment for the areas under the pervious Zone III material consisted of removing all loose rock, clearing, grubbing, moistening and proof-rolling.

c. Dike No. 2. The entire foundation was stripped to a depth of 24 inches. An exploration trench was then excavated along the embankment centerline to a depth of 10 feet from the toe of the right abutment to station 88+00. From station 88+00 to 90+00 the depth of the excavation trench was reduced uniformly from 10 to 5 feet. From station 90+00 to 103+00 the depth of the trench was 5 feet. The entire foundation, including the bottom of the exploration trench was scarified, moistened and proof-rolled.

The right abutment, under Zone II material, was stripped of all overburden to firm rock. A grouting program consisting of a single line of grout holes spaced 40 feet apart, drilled to 25 foot depth was used. The central third of the foundation was cleaned by air blasting. Dental concrete was used to fill depressions. Open fractures were filled with a fine sand-cement grout slurry. Within the abutment area of the contact with Zone III materials, the treatment consisted of removing all loose rock, clearing, grubbing, shaping and moistening.

d. Dike No. 3. The entire foundation was stripped to a depth of 18 inches before dike construction. The grade was then scarified, moistened and proof rolled.

7. SPILLWAY AND DETENTION BASIN. The unlined spillway, excavated in rock, located about 1,600 feet west of the west (right) abutment of the main embankment, has a concrete sill with a length of 510 feet at elevation 1,657.1 feet. The spillway, in conjunction with the outlet works, will pass a peak discharge of 100,600 cfs with 5 feet of freeboard.

The detention basin has a capacity of 46,600 acre-feet at the spillway crest, of which 5,700 acre-feet is for the accumulation of sediment over a 100-year period, and 40,900 acre-feet is for flood control. The detention basin reduces a standard project flood with a peak inflow of 54,000 cfs to an outflow of about 500 cfs.

8. CONSTRUCTION HISTORY.

a. Contractor.

Washington Construction Co.
Missoula, Montana
Contract No. DACW09-77-C-0058

b. Schedule.

Started: September 1977
Completed: December 1979

c. Cement.

Type II
Arizona Portland, Rillito, Arizona

d. Concrete Data.

Designed Compressive Strength	Government Assurance Testing Actual Field Values			Contractor Control Testing Actual Field Values		
fc psi 28 day	fc psi 28 day	W/C gal/sack	CF sacks/cy	fc psi 28 day	W/C gal/sack	CF sacks/cy
3000	4120	5.2	5.0	4110	5.2	5.0
*4000	4370	5.0	6.0			

*4000 psi concrete was used in the conduit for the outlet works only.

e. Aggregates.

Tanner Industries
Phoenix, Arizona
Along Cave Creek

f. Construction Problems.

Concrete was placed during a nationwide cement shortage. There was a cement allocation problem. Wet weather and flooding during the 1978 and 1979 wet seasons, caused 3 months delay in construction.

9. ENGINEERING DATA. Engineering data to be stored in the recorder house at the project.

a. General Design Memorandum No. 3, July 1976.

b. Operation and Maintenance Manual.

c. Periodic Inspection Reports.

d. Foundation Report.

e. Embankment Report.

f. As Built Drawings and Specifications.

10. INSTRUMENTATION. Settlement monuments were installed on the embankments for determining post construction settlement and lateral displacements. Hydrographic instrumentation has been installed to record water flows through the outlet works.

a. Settlement Monuments. A total of forty-seven settlement monuments were installed on the upstream crest edges of the dam (14), Dike No. 1(5), and Dike No. 2(28). Four settlement monuments were also installed at the upstream and downstream toes of Dike No. 3. The locations of the settlement monuments are shown on plates 25 through 28. The monuments were surveyed following embankment construction and their installation. Initial elevations are shown on plates 30 and 31. Subsequent readings will be made at intervals consistent with periodic inspections.

b. Water depth recorders. Water depth recorders have been provided for measuring depths at both ends of the outlet works. The recorders are located in the recorder house.

c. A rain gage will be installed in the recorder house.

d. Twenty-four staff gages have been installed on the upstream face of the dam. Each staff gage faces the recorder house.

11. INSPECTION CHECKLIST.

a. Embankment, Dike No. 1, Dike No. 2 and Dike No. 3

(1) Crest
(2) Abutment contacts
(3) Upstream and downstream slopes
(4) Upstream and downstream toes

b. Spillway

(1) Approach Channel
(2) Control Section
(3) Outlet Channel

c. Flood Control Outlet Works

(1) Approach channel
(2) Intake tower
(3) Conduit
(4) Energy dissipator
(5) Outlet channel
(6) Bridge

d. Drainage Channel

e. Existing Cave Creek Dam

(1) Multi-Arches

f. Instrumentation

(1) Staff gages
(2) Gaging stations
(3) Reservoir water surface recorders
(4) Rain gage

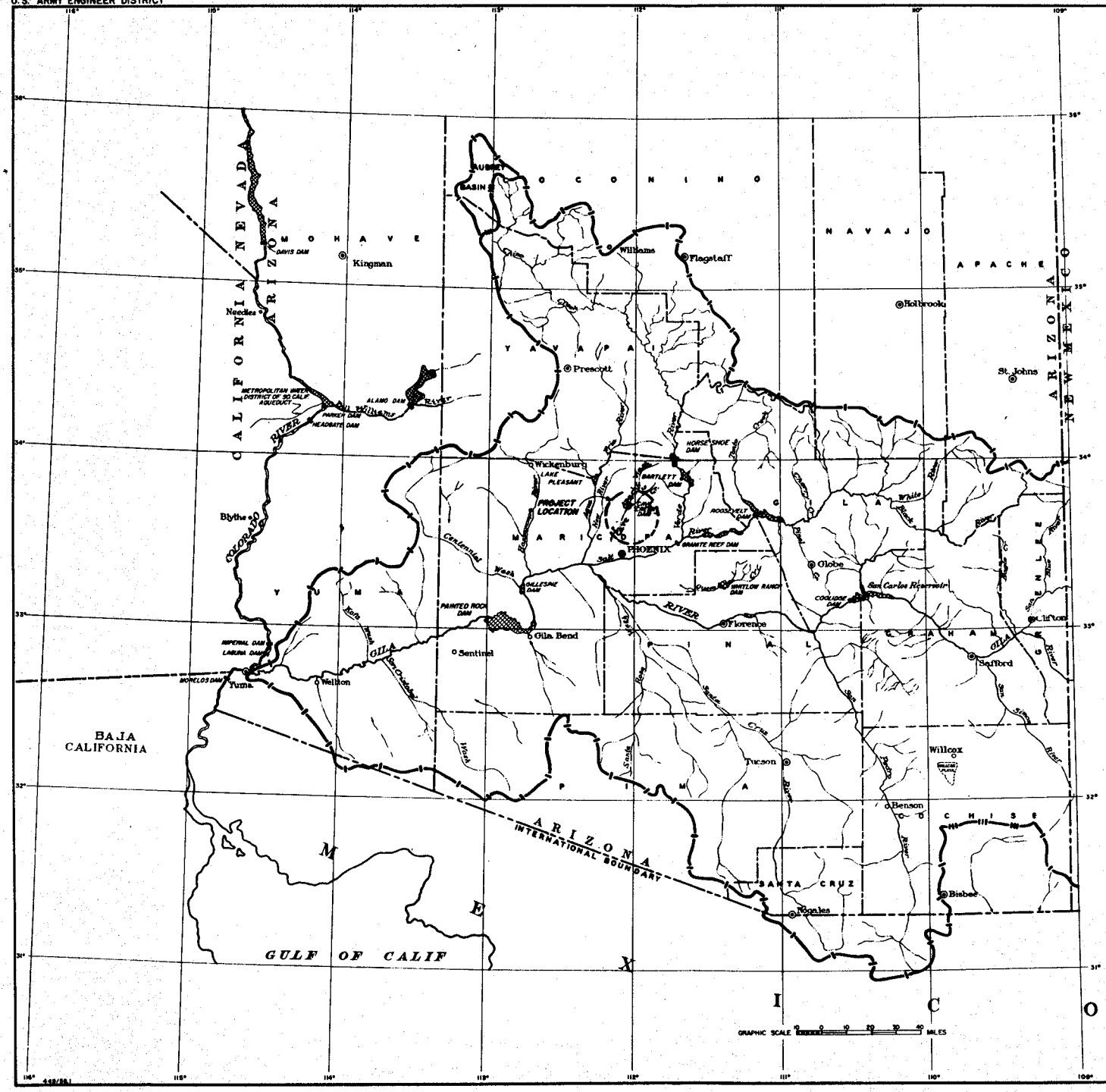
12. PLATES.

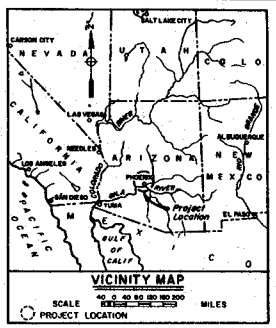
1. Project location.
2. General Plan.
3. Embankment Plan and Profile.
4. Embankment Cross Sections.
5. Dikes No. 1 and No. 3 - Plan, Profile and Typical Sections.
6. Dike No. 2 - Plan and Profile Part I.
7. Dike No. 2 - Plan and Profile Part II.
8. Dike No. 2 - Plan and Profile Part III.
9. Dike No. 2 - Cross Sections.
10. Spillway Plan, Profile and Sections.
11. Outlet Works Plan and Profile.
12. Approach Channel and Intake Structure.
13. Recorder House, Outlet Conduit and Energy Dissipator.
14. Drainage Channel Plan, Profile and Typical Section.
15. Bypass Channel Location Map
16. General Site Geology and Plan of Geologic Exploration
17. Geology and Foundation Exploration-Geologic Logs (Sheet 1 of 2)
18. Geology and Foundation Exploration-Geologic Logs (Sheet 2 of 2)
19. Dam Foundation Plan of Soils Exploration.
20. Dikes No. 1, No. 3 and Spillway Foundation Plan of Exploration.
21. Dike No. 2 Foundation and Borrow Area Plan of Exploration.

22. Dam, Dike No. 1, No. 3, and Spillway Foundation Exploration, Soils Log.
23. Dike No. 2 Foundation and Borrow Area Exploration Soil Logs.
24. Dike No. 2 Foundation and Borrow Area Exploration Soil Logs.
25. Embankment and Dike No. 1 Instrumentation.
26. Dike No. 2 Instrumentation Sheet 1.
27. Dike No. 2 Instrumentation Sheet 2.
28. Dike No. 2 Instrumentation Sheet 3.
29. Summary of Design Values.
30. Settlement Data - Sheet 1
31. Settlement Data - Sheet 2

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS





N

LEGEND

BOUNDARY OF GILA RIVER DRAINAGE AREA.

BOUNDARY OF INEFFECTIVE AREA.

EXISTING DAM AND RESERVOIR.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

PROJECT LOCATION

DESIGNED BY:

DRAWN BY:

CHECKED BY:

SUBMITTED BY:

APPROVED:

APPROVAL RECOMMENDED:

SPEC. NO. DACW09-____-B-____

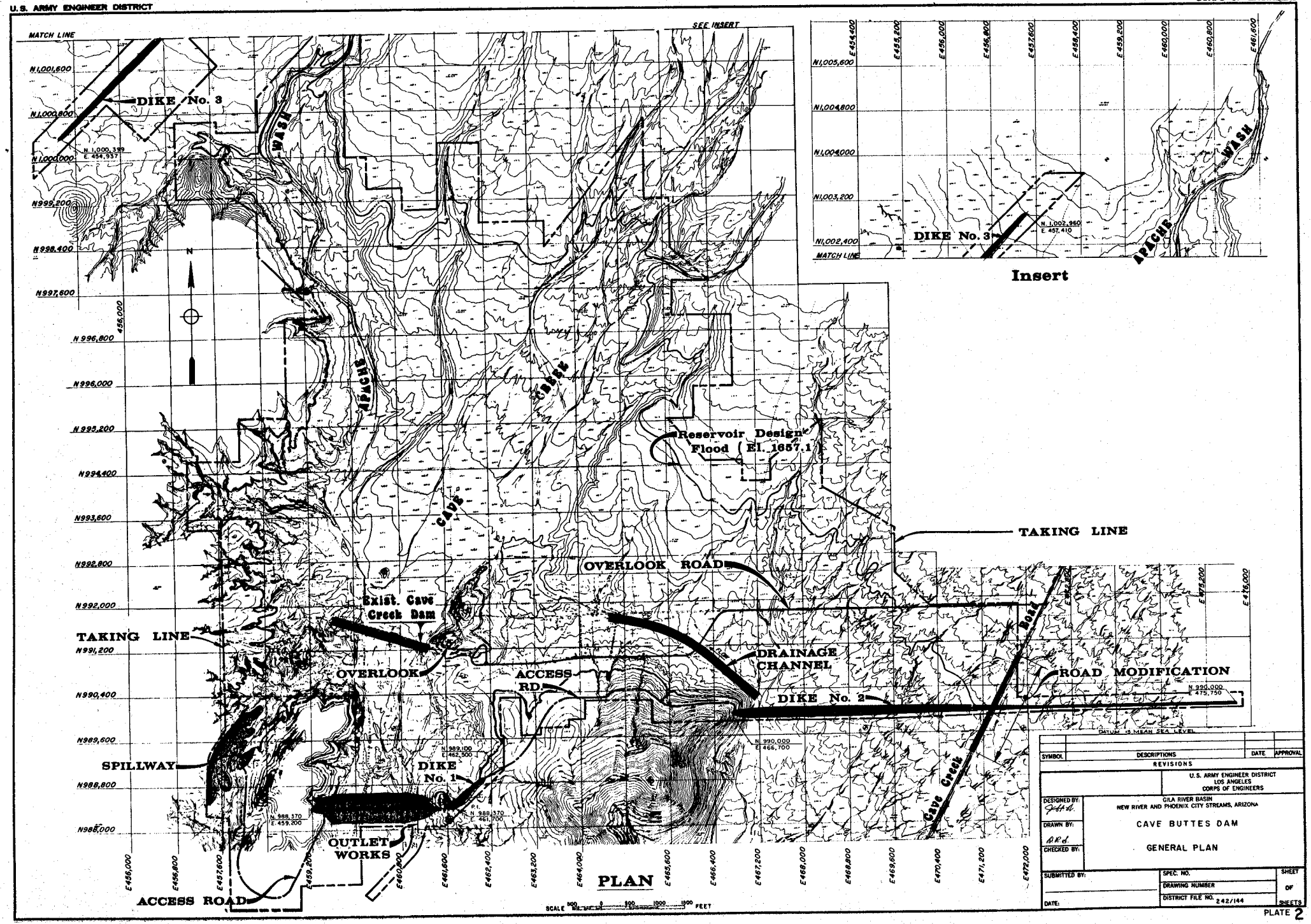
DISTRICT FILE NO. 242/142

SHEET ____ OF ____ SHEETS

PLATE 1

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS



PLAN

Insert

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: Jeff H.
DRAWN BY: A.R.d.
CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

GENERAL PLAN

SUBMITTED BY:
DATE:

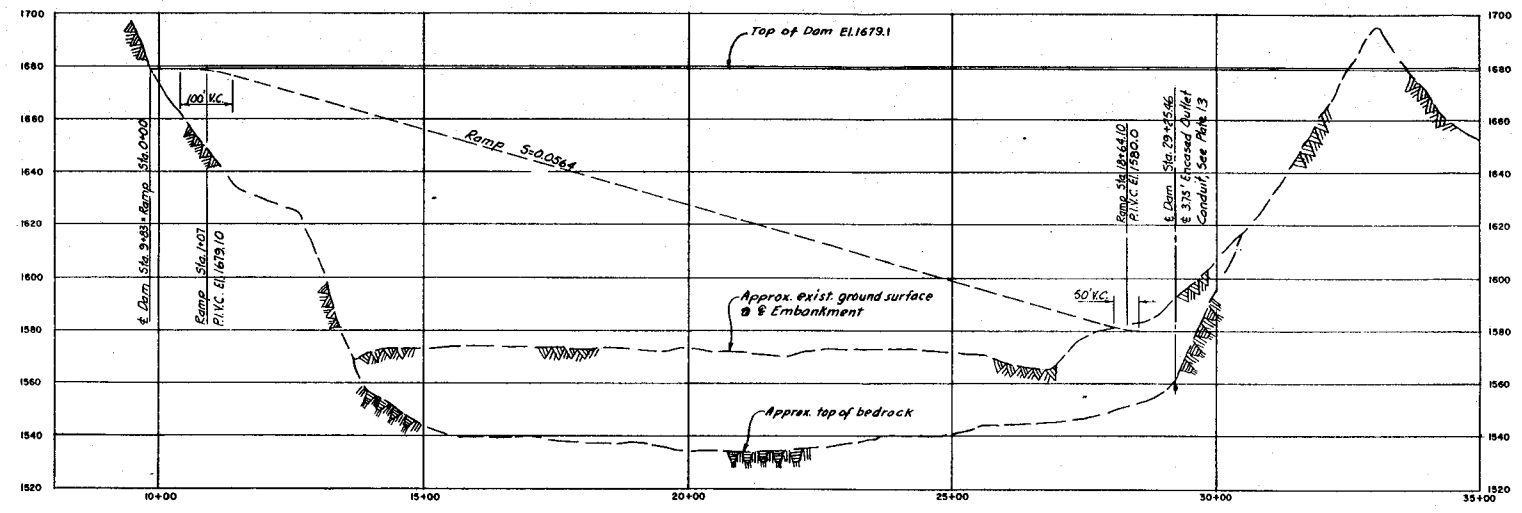
SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO. 242/144

SHEET
OF
SHEETS

PLATE 2

U.S. ARMY ENGINEER DISTRICT

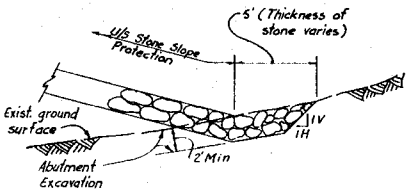
CORPS OF ENGINEERS



℄ PROFILE OF EMBANKMENT

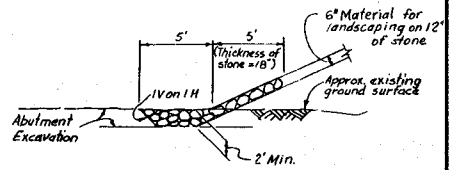
HORIZ. SCALE 100 0 100 200 300 FEET

VERT. SCALE 10 0 10 20 30 40 50 60 70 FEET



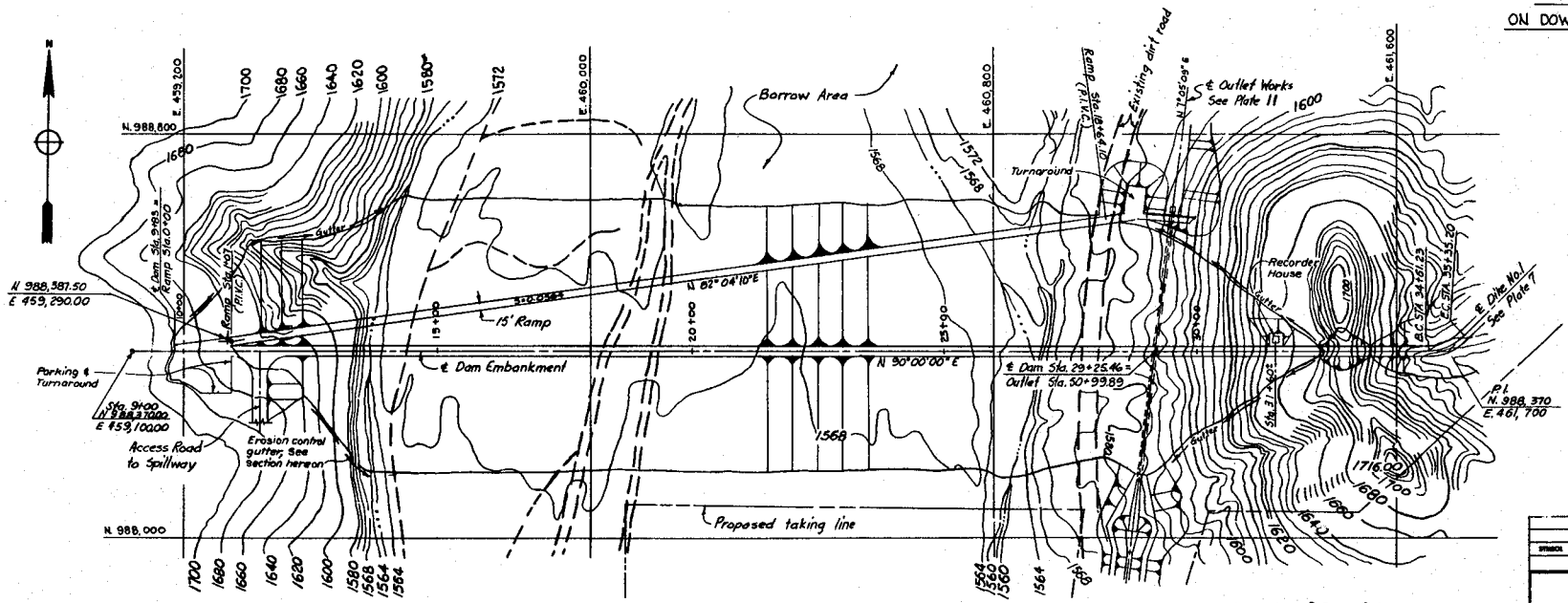
DETAIL OF EROSION CONTROL GUTTER ON UPSTREAM SLOPE OF EMBANKMENT

NOT TO SCALE



DETAIL OF EROSION CONTROL GUTTER ON DOWNSTREAM SLOPE OF EMBANKMENT

NOT TO SCALE



PLAN

SCALE: 1 IN = 100 FT.

℄ Curve Data
Δ = 42° 22' 50"
R = 100'
T = 38.77'
L = 73.97'

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

EMBANKMENT

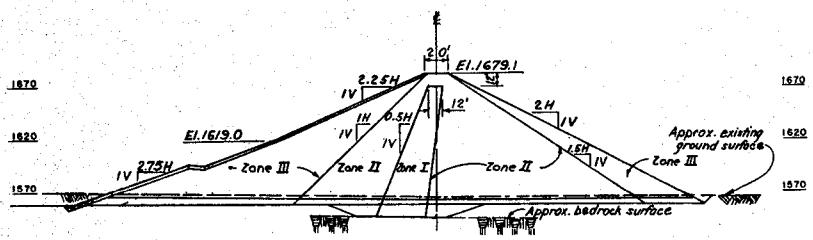
PLAN AND PROFILE

DESIGNED BY: [signature]
DRAWN BY: R. J. A.
CHECKED BY:
SUBMITTED BY: CHIEF, ENGR. DIV.
APPROVED: CHIEF, CA. BRANCH ENGINEER
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION
SPEC. NO. DACW09-__-__-__
DISTRICT FILE NO. 242/146
SHEET OF SHEETS

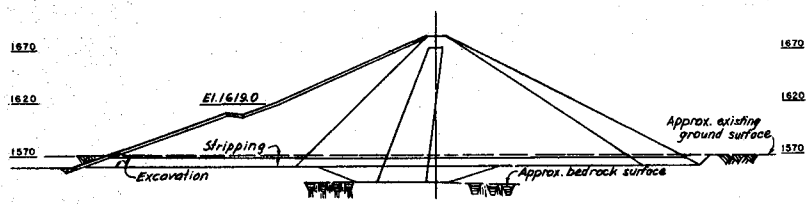
PLATE 3

U.S. ARMY ENGINEER DISTRICT

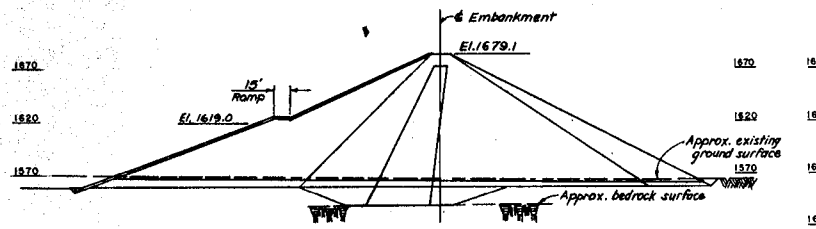
CORPS OF ENGINEERS



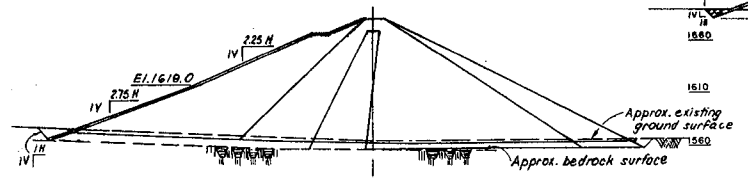
STA. 27+00



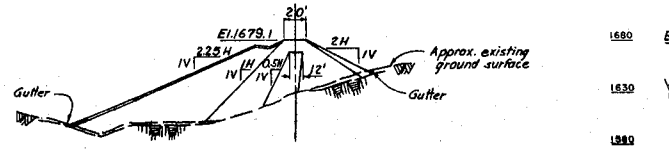
STA. 25+00



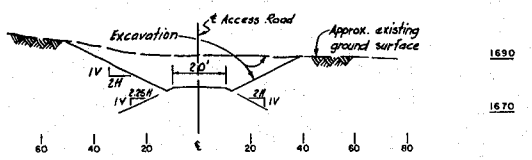
STA. 20+00



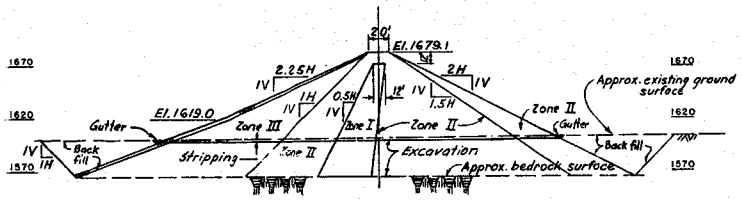
STA. 14+00



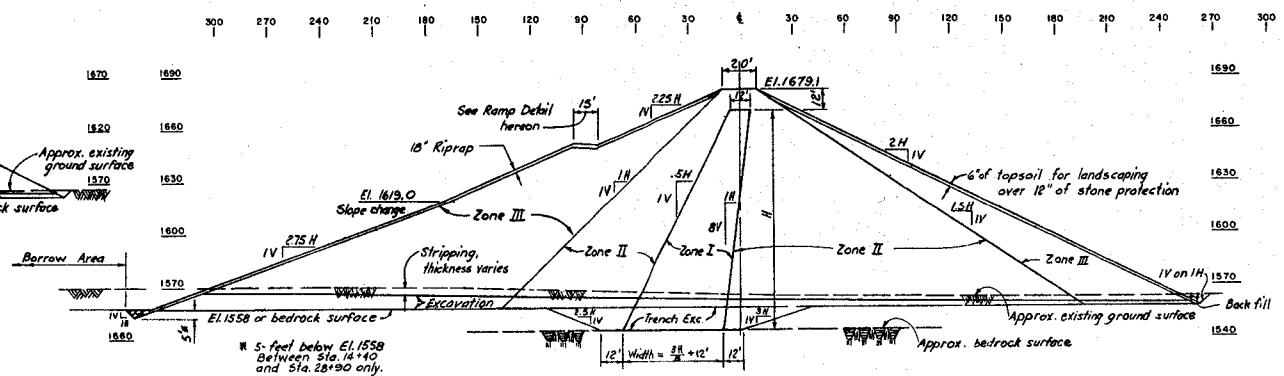
STA. 12+00



STA. 33+00



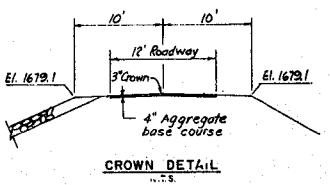
STA. 30+00



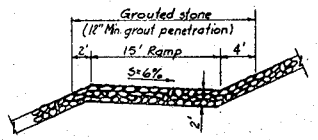
* 5 feet below El. 1558 between Sta. 14+40 and Sta. 28+90 only.

Notes:
1. For plan and profile of embankment, see plate 3.

TYPICAL EMBANKMENT SECTION



CROWN DETAIL
N.T.S.



RAMP DETAIL
N.T.S.

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: Drafted
DRAWN BY: J.J.
CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

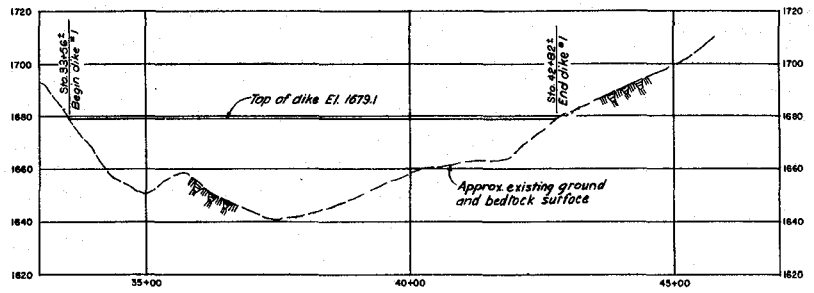
CAVE BUTTES DAM
EMBANKMENT CROSS SECTIONS

SUBMITTED BY: CHIEF, ENGINEERING DIVISION
APPROVED: COLONEL, CE, DISTRICT ENGINEER
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION
SPEC. NO. DACW09-___-___
DISTRICT FILE NO. 242/147
SHEET ___ OF ___ SHEETS

PLATE 4

U.S. ARMY ENGINEER DISTRICT

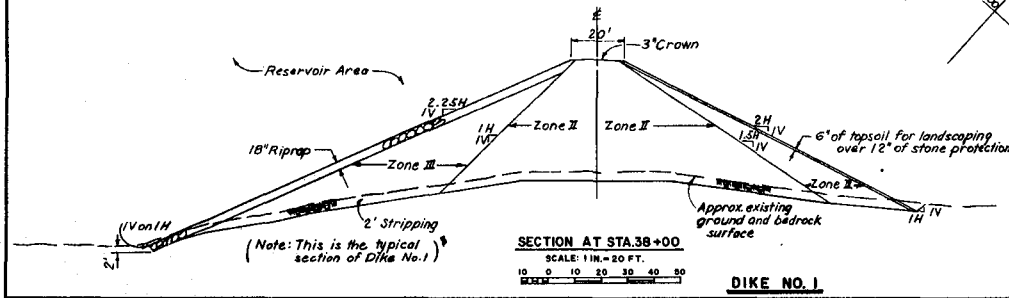
CORPS OF ENGINEERS



℄ PROFILE

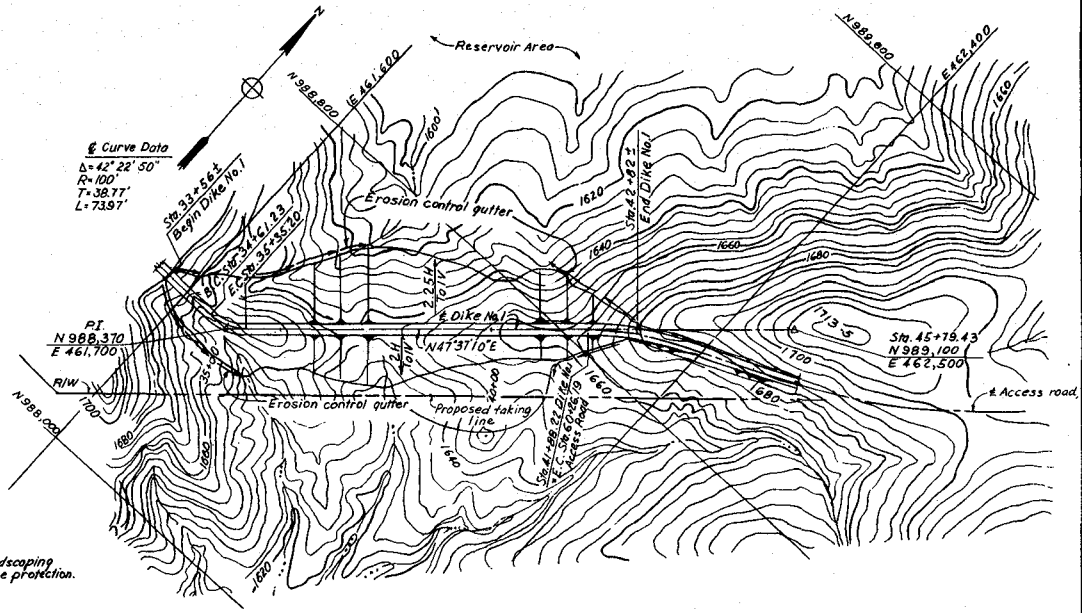
HORT. SCALE: 1 IN. = 100 FT.

VERT. SCALE: 1 IN. = 20 FT.



SECTION AT STA. 38+00

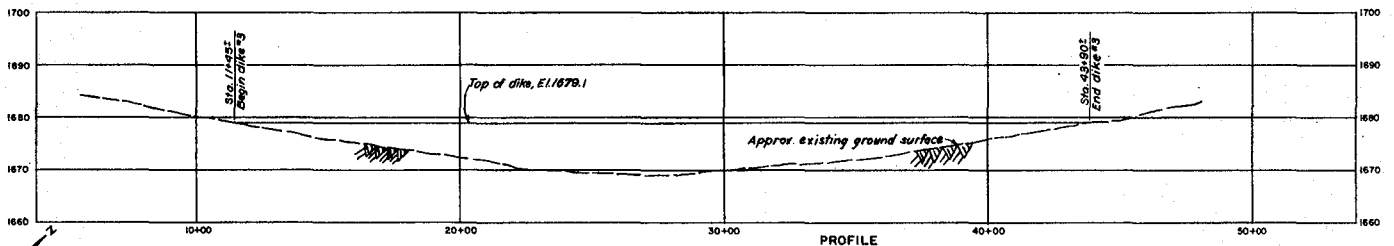
SCALE: 1 IN. = 20 FT.



PLAN

SCALE: 1 IN. = 100 FT.

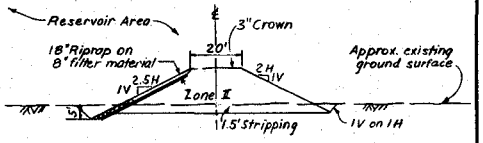
DIKE NO. 1



PROFILE

HORIZ. SCALE: 1 IN. = 200 FT.

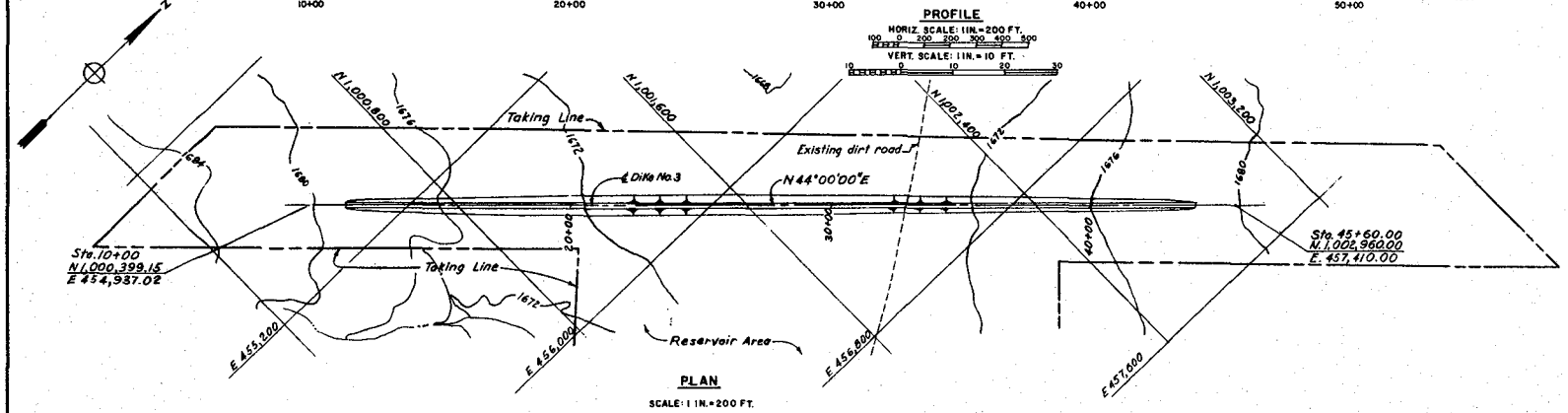
VERT. SCALE: 1 IN. = 10 FT.



SECTION AT STA. 27+50

SCALE: 1 IN. = 20 FT.

(Note: This is the typical section of Dike No. 3)



PLAN

SCALE: 1 IN. = 200 FT.

DIKE NO. 3

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

DIKES NO. 1 AND NO. 3 – PLAN, PROFILE AND TYPICAL SECTIONS

DESIGNED BY: Griffith
DRAWN BY: J.H.
CHECKED BY:

SUBMITTED BY: CHIEF, BRANCH

APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION

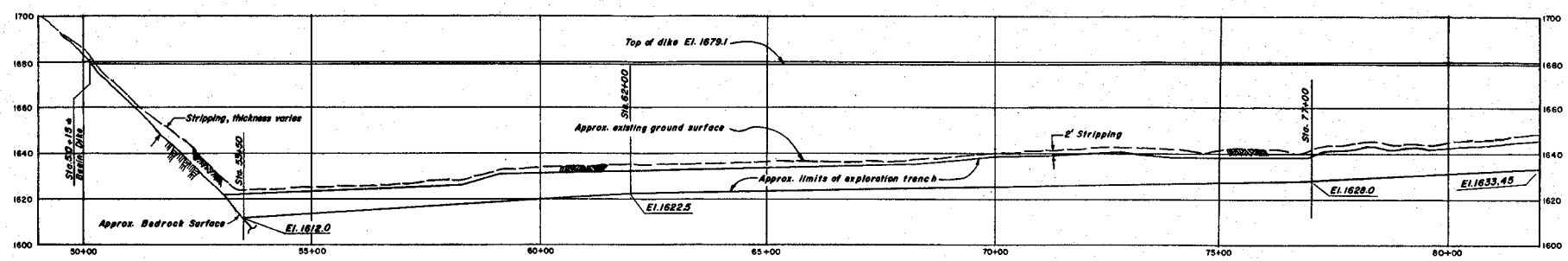
APPROVED: CORPS OF ENGINEERS, DISTRICT ENGINEER

SPEC. NO. DACW09-____-B-____

DISTRICT FILE NO. 242/146

SHEET ____ OF ____ SHEETS

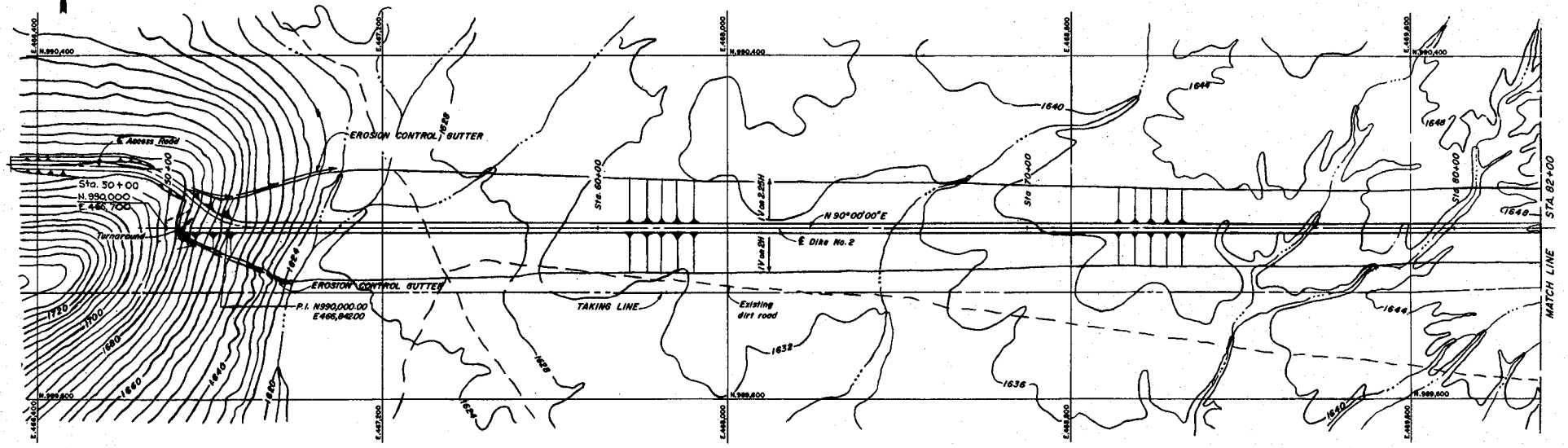
PLATE 5



PROFILE

HORIZONTAL SCALE: 1 IN. = 100 FT.

VERTICAL SCALE: 1 IN. = 20 FT.



PLAN

SCALE: 1 IN. = 100 FT.

NOTE
For cross sections, see plate 9.

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: Staff
DRAWN BY: DRV. IV.
CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

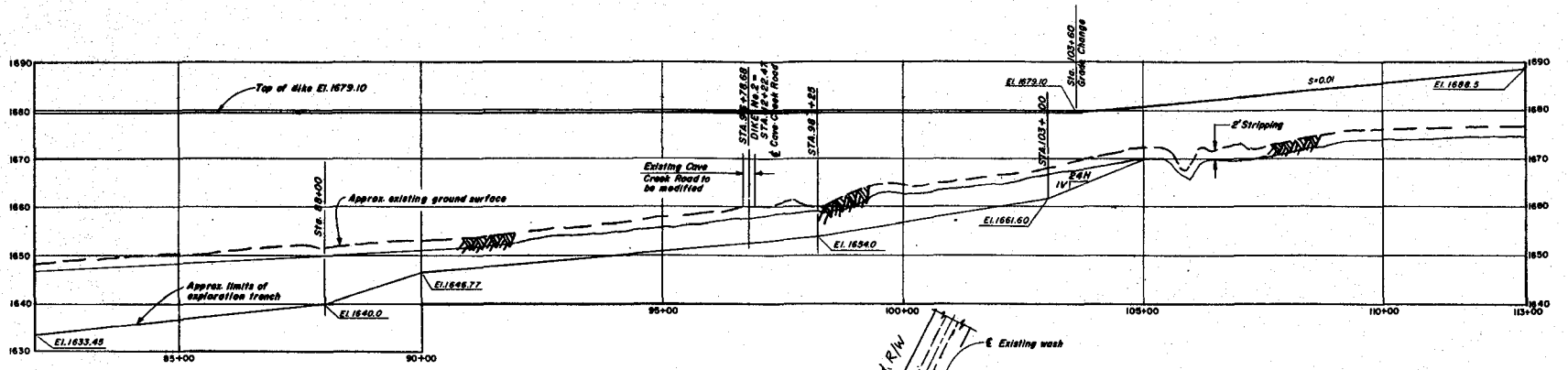
DIKE NO. 2 - PLAN AND PROFILE
PART I

SUBMITTED BY: CHIEF, ENGINEERING DIVISION
APPROVED: COLONEL, CE, DISTRICT ENGINEER
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION
SPEC. NO. DACW09- -B-
DISTRICT FILE NO. 242/149
SHEET OF SHEETS

PLATE 6

U.S. ARMY ENGINEER DISTRICT

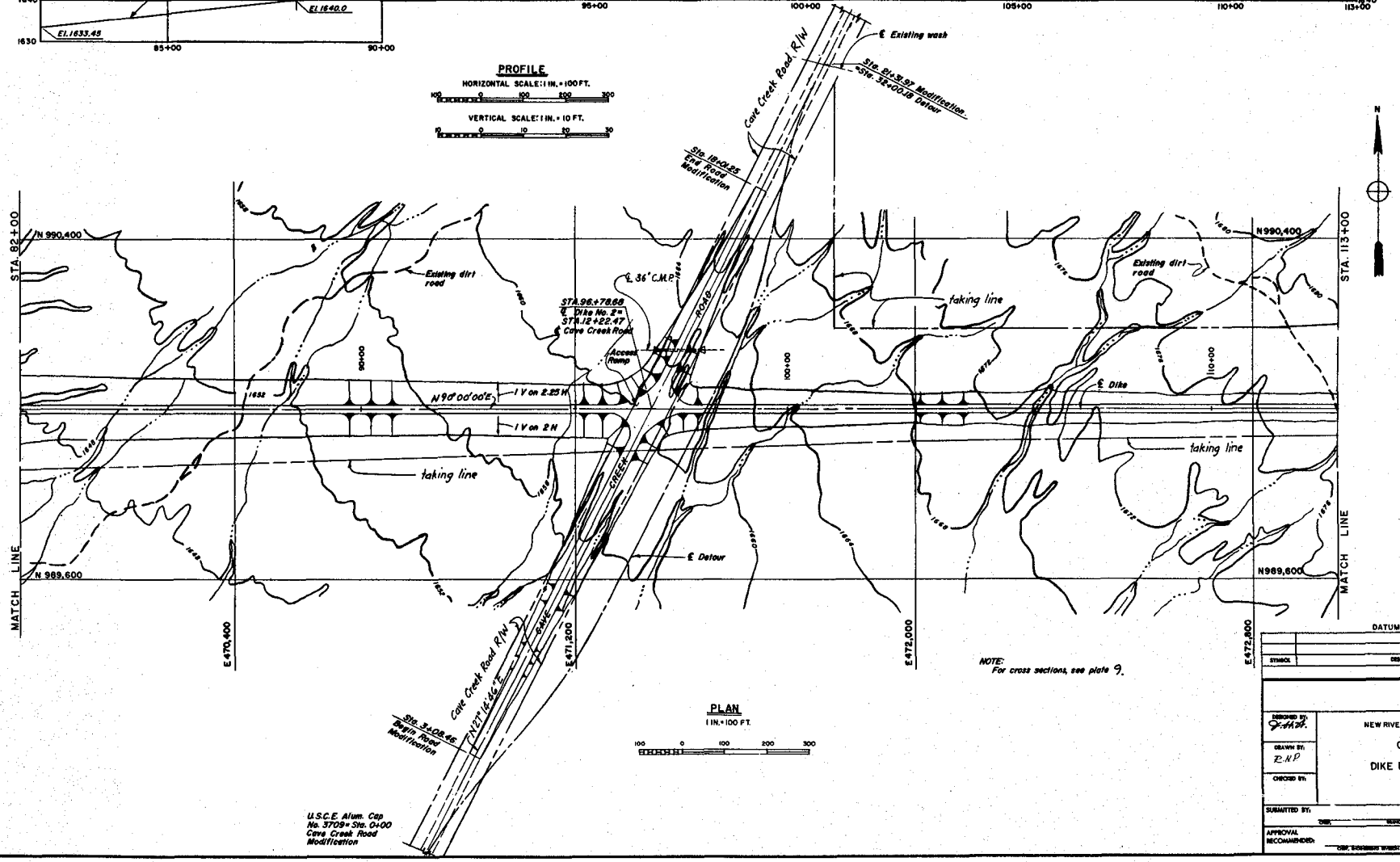
CORPS OF ENGINEERS



PROFILE

HORIZONTAL SCALE: 1 IN. = 100 FT.

VERTICAL SCALE: 1 IN. = 10 FT.



PLAN

1 IN. = 100 FT.

NOTE: For cross sections, see plate 9.

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

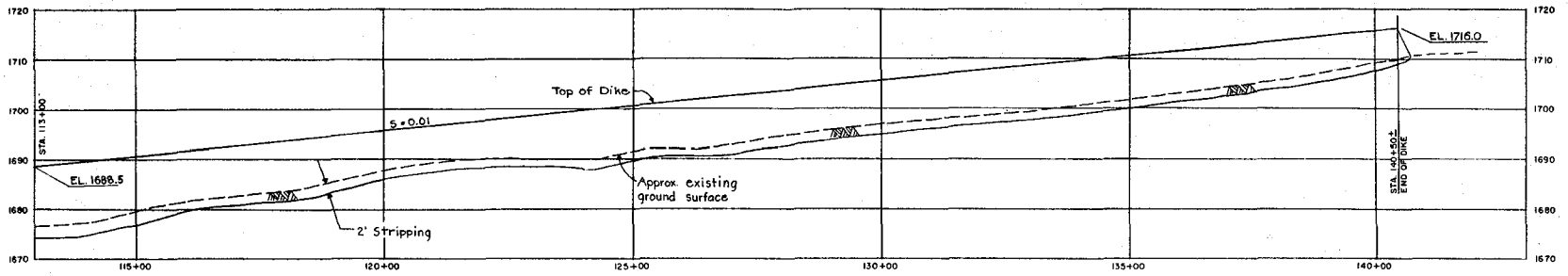
CAVE BUTTES DAM

DIKE NO. 2 - PLAN AND PROFILE

PART II

DESIGNED BY: G.A.D.		
DRAWN BY: R.N.P.		
CHECKED BY:		
SUBMITTED BY: CHIEF, HYDROLOGY	APPROVED: COLONEL, C.E. DISTRICT ENGINEER	SHEET OF SHEETS
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION	SPEC. NO. DACW09-___-___ DISTRICT FILE NO. 242/150	

PLATE 7



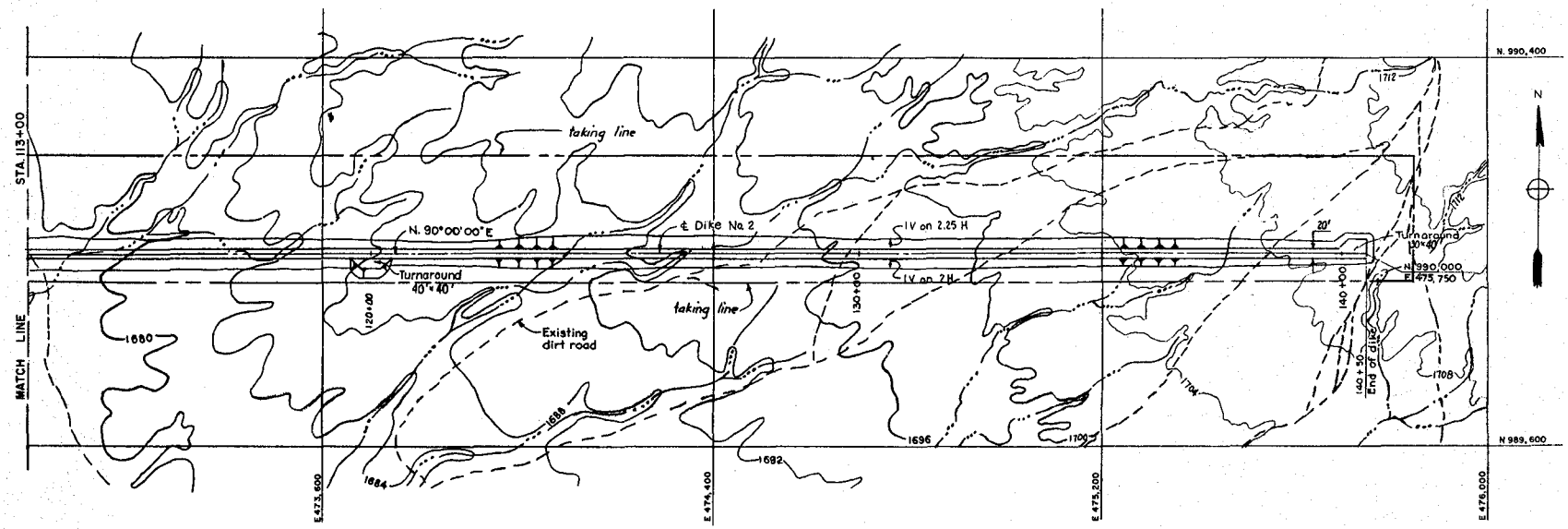
PROFILE

HORIZ. SCALE: 1 IN. = 100 FT.

100 0 100 200 300

VERT. SCALE: 1 IN. = 10 FT.

10 0 10 20 30



PLAN

SCALE: 1 IN. = 100 FT.

Note:
For cross sections, see plate 9.

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

DIKE NO. 2 – PLAN AND PROFILE

PART III

DESIGNED BY: Gatton
DRAWN BY: R. L. A.
CHECKED BY:

SUBMITTED BY: _____ CHIEF, _____ BRANCH

APPROVED: _____ COLONEL, C.E. DISTRICT ENGINEER

APPROVAL RECOMMENDED: _____ CHIEF, ENGINEERING DIVISION

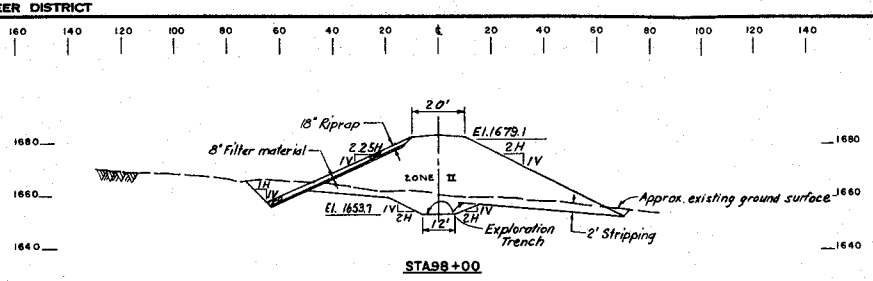
SPEC. NO. DACW09-_____-_____

DISTRICT FILE NO. 242/1151

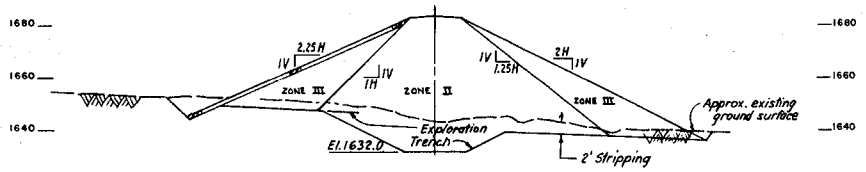
SHEET _____ OF _____ SHEETS

U.S. ARMY ENGINEER DISTRICT

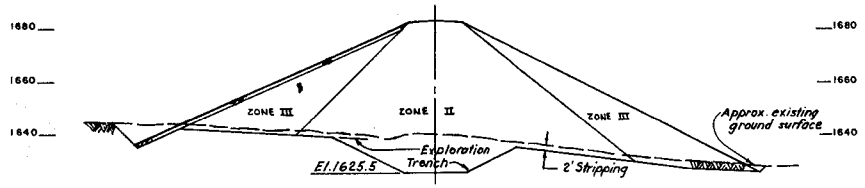
CORPS OF ENGINEERS



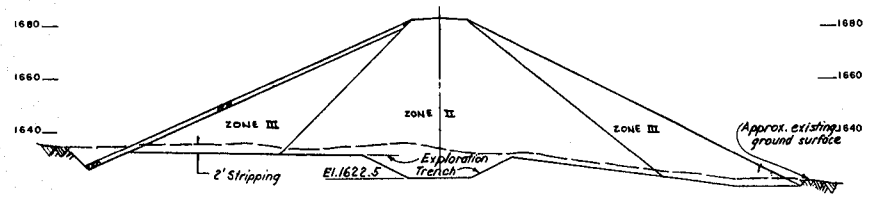
STA 98+00



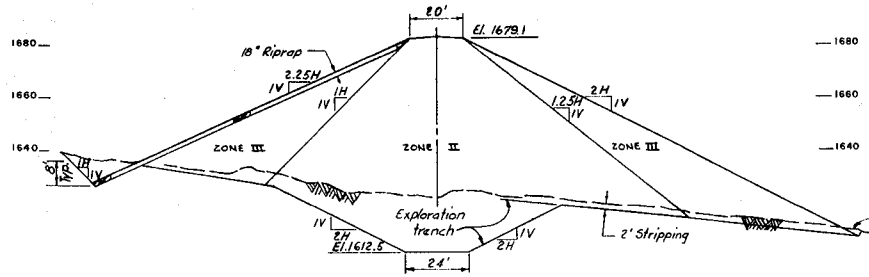
STA. 80+00



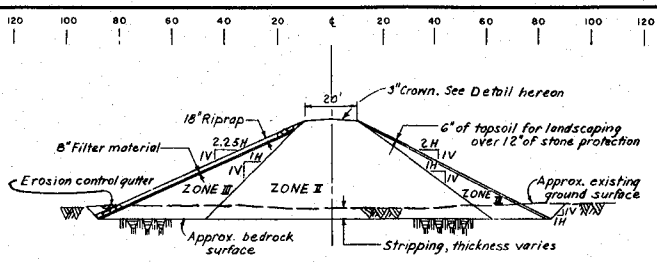
STA. 70+00



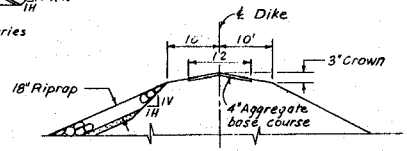
STA. 62+00



STA. 54+00

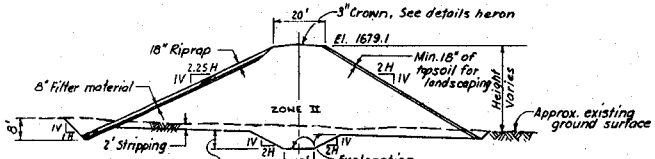


TYPICAL SECTION (STA. 50+15 THRU. STA. 53+00)



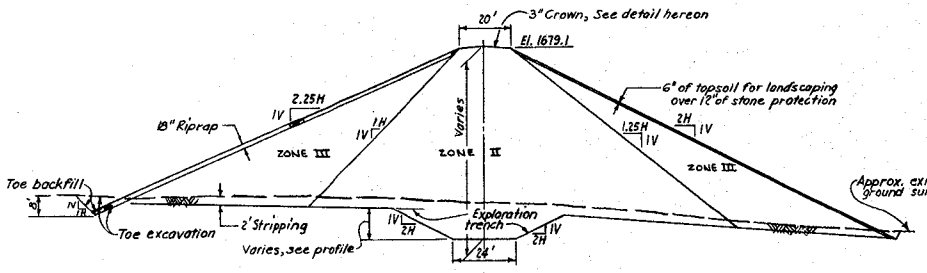
CROWN DETAIL

NOT TO SCALE



* Width of exploration trench varies uniformly from 24' at Sta. 88+00 to 12' @ Sta. 90+00

TYPICAL SECTION (STA. 88+00 THRU STA. 140+50)



TYPICAL SECTION (STA. 53+00 THRU. STA. 88+00)

NOTES: For plan and profile of Dike No. 2, see Plates 6, 7, and 8.

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:

DRAWN BY: J.T.

CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
DIKE No. 2 — CROSS SECTIONS

SUBMITTED BY: CHIEF, [illegible] BRANCH

APPROVED: COLONEL, C.E. DISTRICT ENGINEER

APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION

SPEC. NO. DACW09-____-B-____

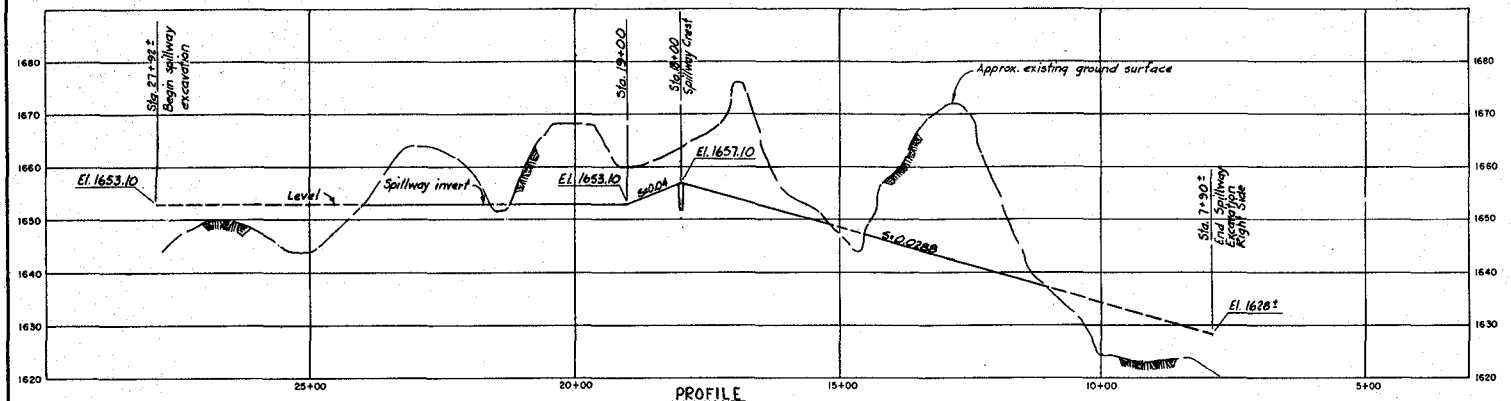
DISTRICT FILE NO. 242/152

SHEET ____ OF ____ SHEETS

PLATE 9

U.S. ARMY ENGINEER DISTRICT

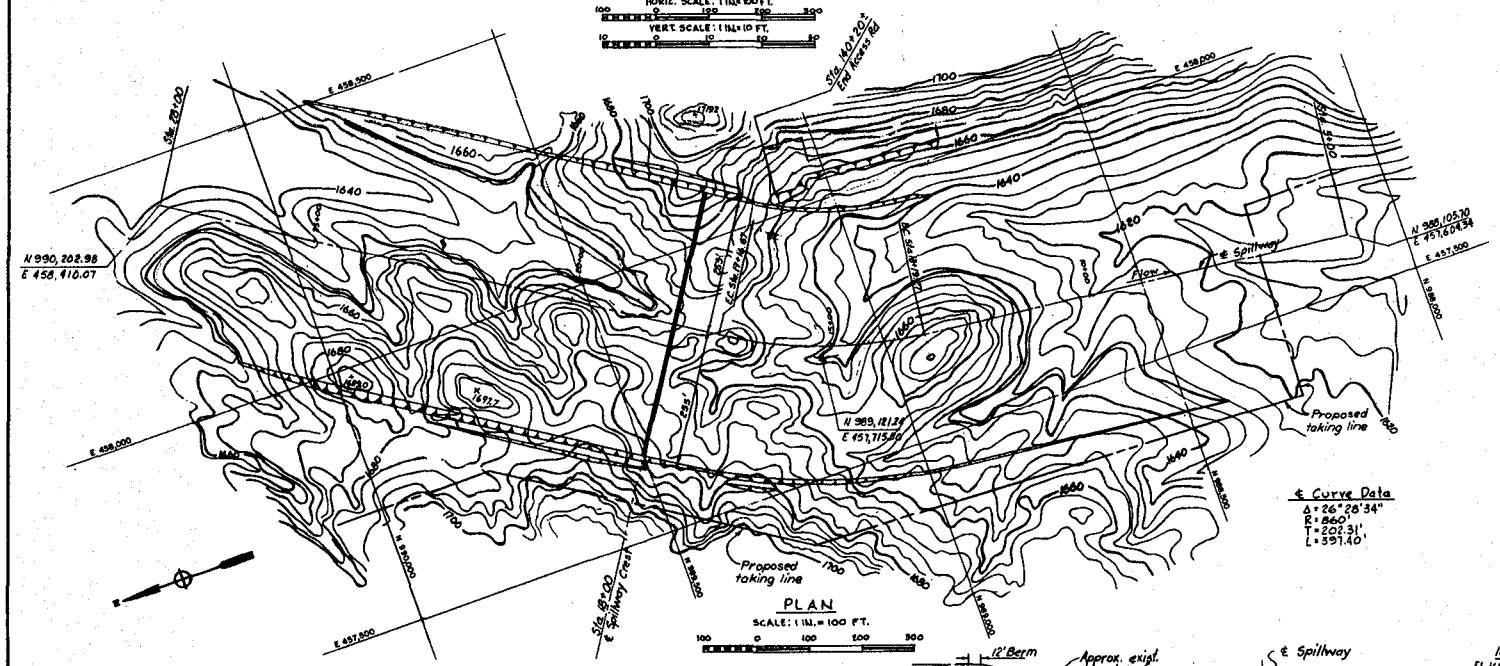
CORPS OF ENGINEERS



PROFILE

HORIZ. SCALE: 1 IN. = 100 FT.

VERT. SCALE: 1 IN. = 10 FT.



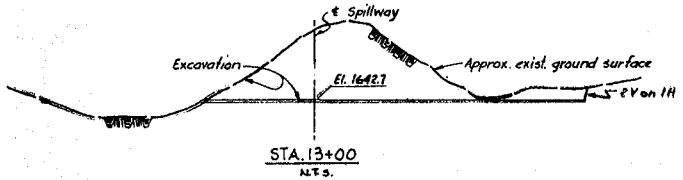
PLAN

SCALE: 1 IN. = 100 FT.

℄ Curve Data
Δ = 26°28'34"
R = 860'
T = 202.31'
L = 397.40'

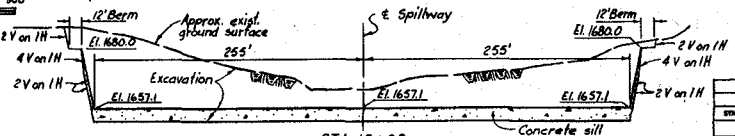
CONCRETE SILL @ STA. 18+00

N.T.S.



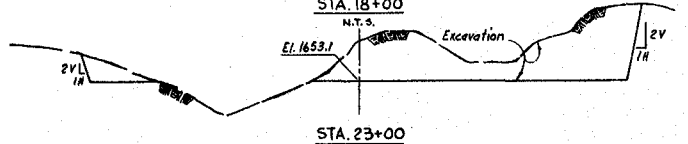
STA. 13+00

N.T.S.



STA. 18+00

N.T.S.



STA. 23+00

N.T.S.

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

SPILLWAY

PLAN, PROFILE AND SECTIONS

DESIGNED BY:

DRAWN BY: YWS

CHECKED BY:

SUBMITTED BY: CHIEF, BRANCH

APPROVED: COLONEL, CE, DISTRICT ENGINEER

APPROVAL RECOMMENDED: CHIEF, ENGINEERING BRANCH

SPEC. NO. DACW09- -B- -

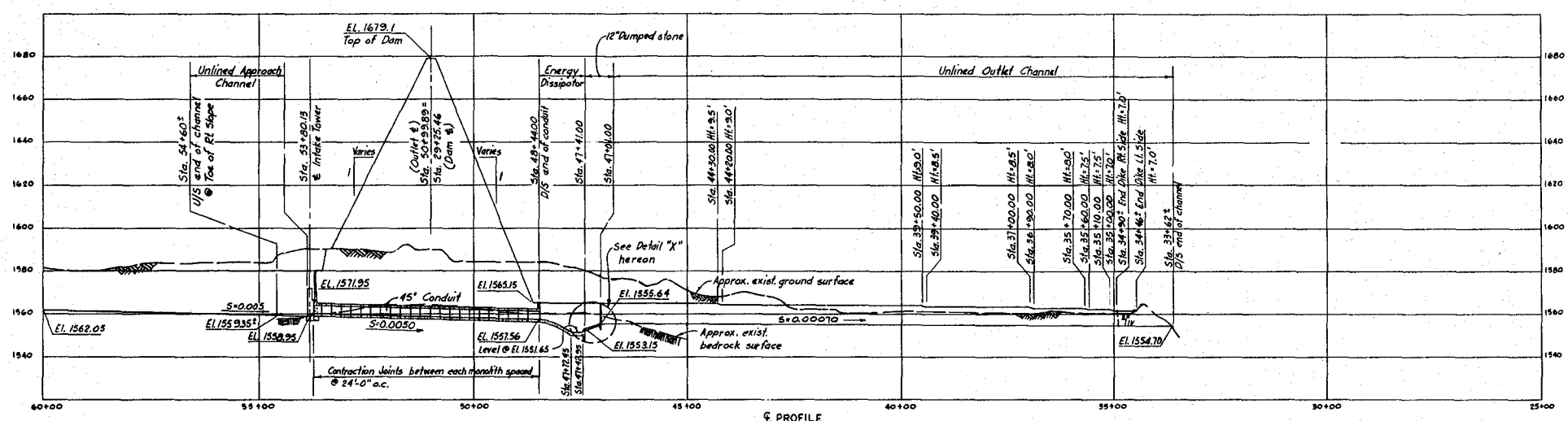
DISTRICT FILE NO. 242/153

SHEET OF SHEETS

PLATE 10

U.S. ARMY ENGINEER DISTRICT

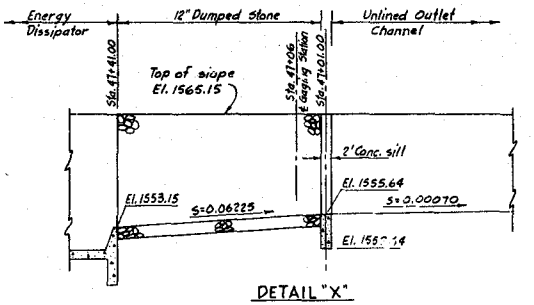
CORPS OF ENGINEERS



℄ PROFILE

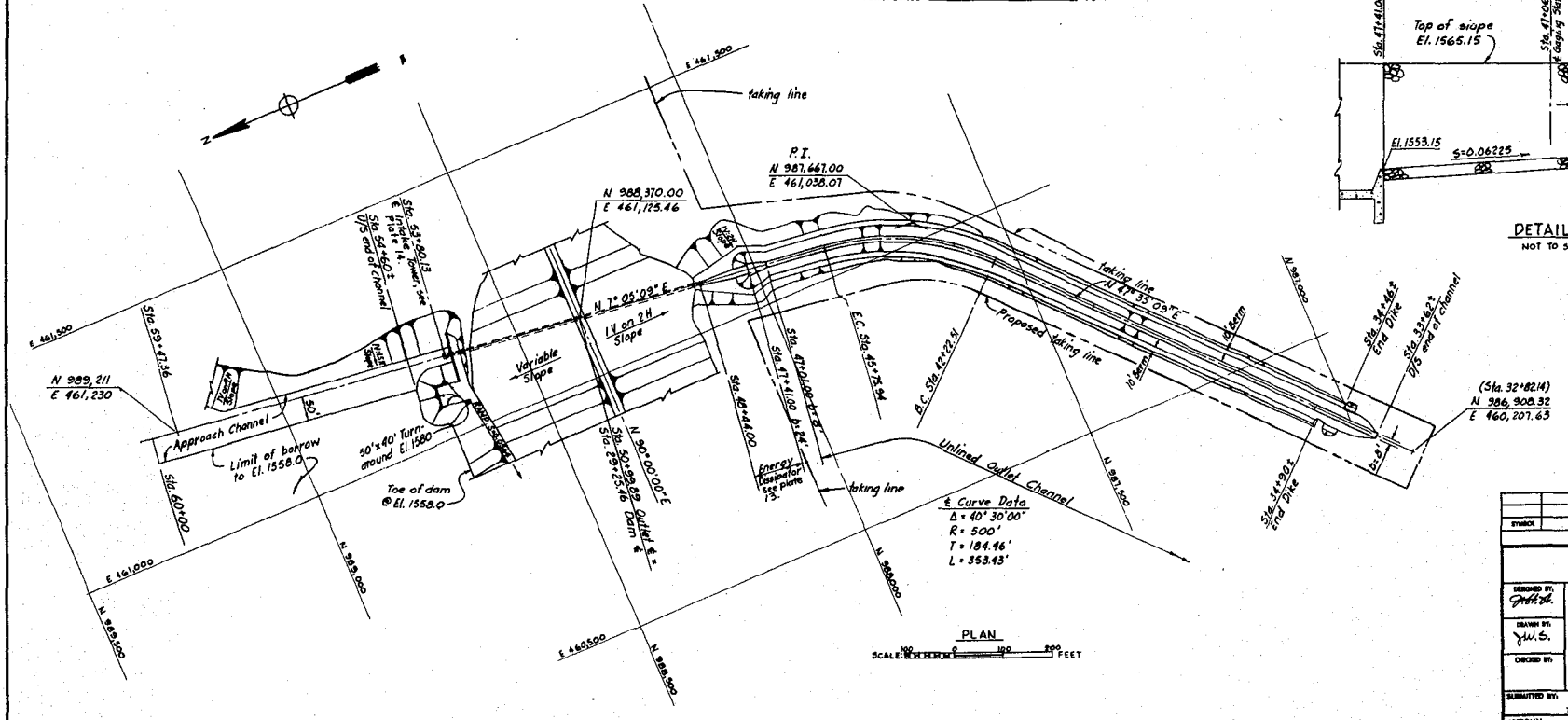
HORIZ. SCALE: 100 0 100 200 FEET

VERT. SCALE: 10 0 10 20 30 40 50 FEET



DETAIL "X"

NOT TO SCALE



PLAN

SCALE: 100 0 100 200 FEET

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

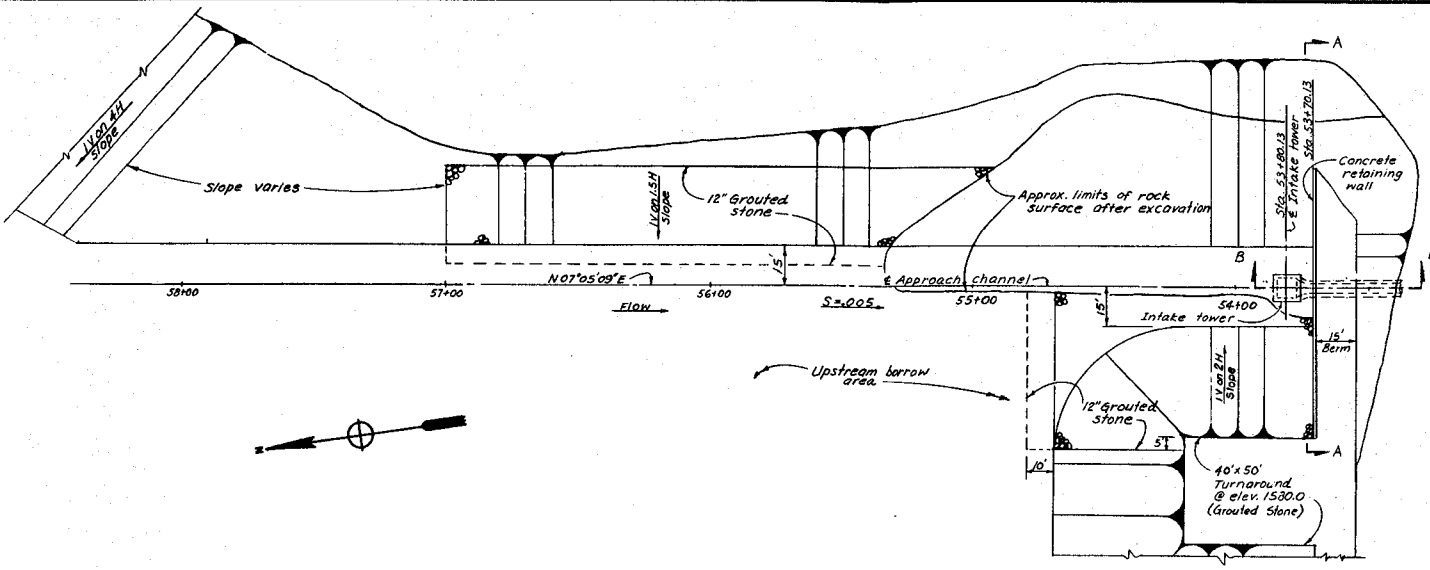
CAVE BUTTES DAM
OUTLET WORKS
PLAN AND PROFILE

DESIGNED BY: [illegible]
DRAWN BY: J.W.S.
CHECKED BY:
SUBMITTED BY:
APPROVED:
APPROVAL RECOMMENDED:
SPEC. NO. DACW09-___-S-____
DISTRICT FILE NO. 242/154
SHEET ___ OF ___ SHEETS

PLATE 11

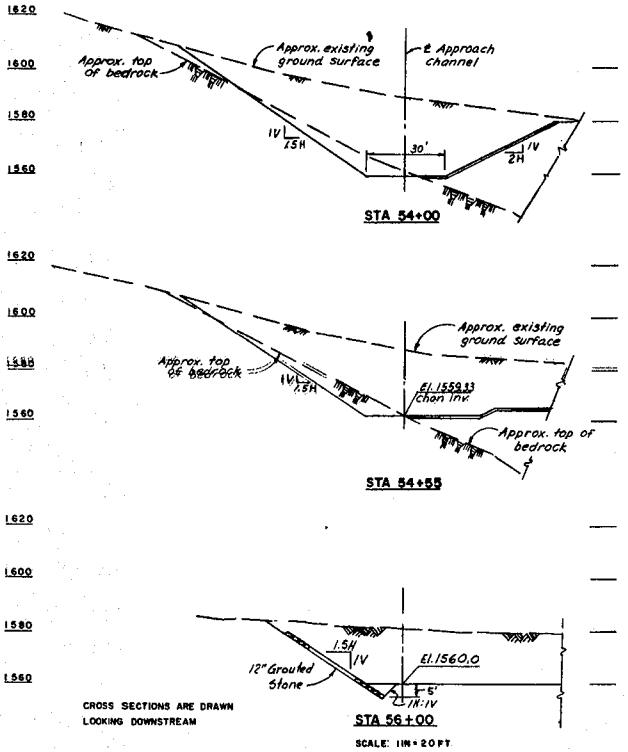
U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS



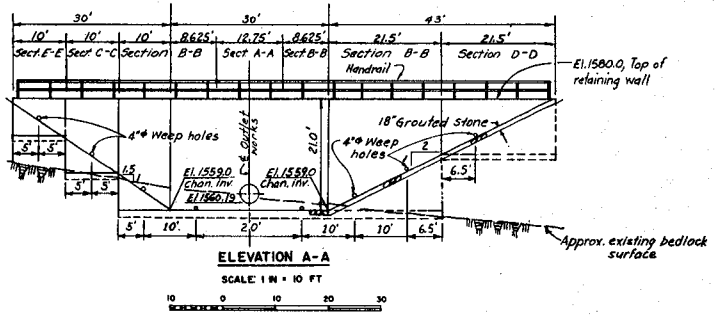
PLAN

SCALE: 1 IN = 20 FT



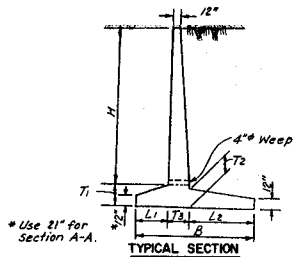
CROSS SECTIONS ARE DRAWN LOOKING DOWNSTREAM

SCALE: 1 IN = 20 FT



ELEVATION A-A

SCALE: 1 IN = 10 FT



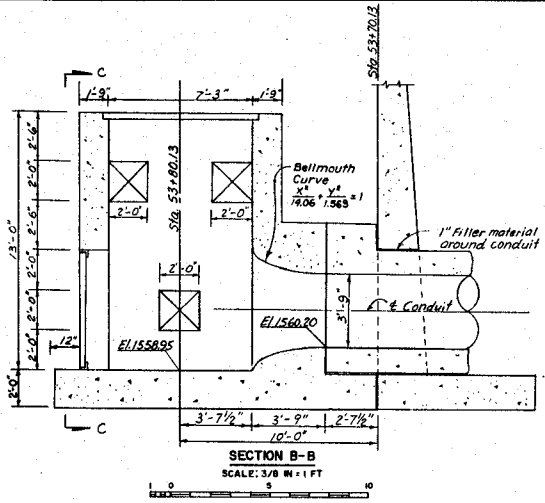
* Use 21" for Section A-A.

TYPICAL SECTION

NOT TO SCALE

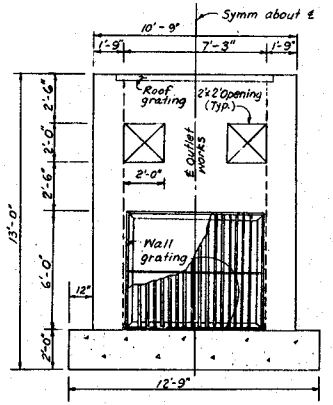
RETAINING WALL SCHEDULE

SECTION	H	T_1	T_2	T_3	B	L_1	L_2
A-A	21.0'	21"	22"	26"	13'-0½"	2'-7½"	8'-3"
B-B	21.0'	21"	19"	26"	12'-0"	3'-7"	6'-3"
C-C	14.0'	14"	13"	16"	8'-5"	2'-5"	4'-8"
D-D	10.5'	12"	12"	12"	6'-9"	2'-0"	3'-9"
E-E	7.0'	12"	12"	12"	5'-0"	1'-10"	2'-2"



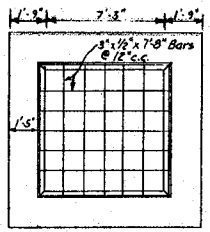
SECTION B-B

SCALE: 3/8 IN = 1 FT



SECTION C-C

SCALE: 3/8 IN = 1 FT



TOP GRATING PLAN

NOT TO SCALE

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: Draft'd.
DRAWN BY: J.W.
CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
APPROACH CHANNEL AND INTAKE STRUCTURE

SUBMITTED BY: AP. JOVEN, CHIEF, DESIGN BRANCH; TERRENCE M. HENRY, DIVISION ENGINEER

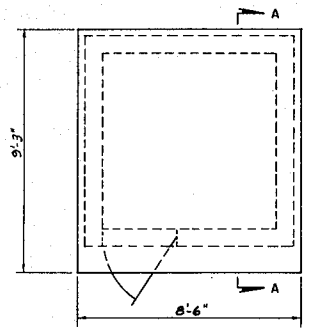
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION

SPEC. NO. DACW09-

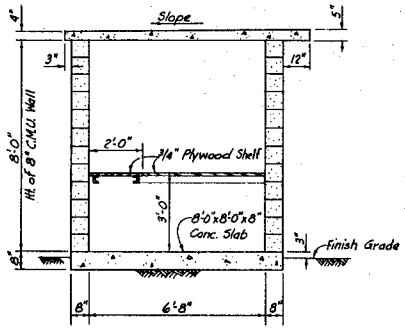
DISTRICT FILE NO. 242/155

SHEET OF SHEETS

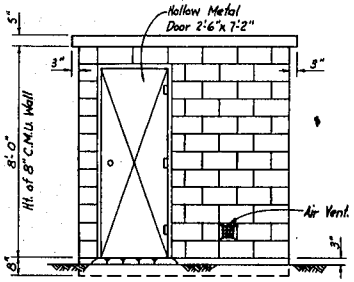
PLATE 12



PLAN



SECTION A-A

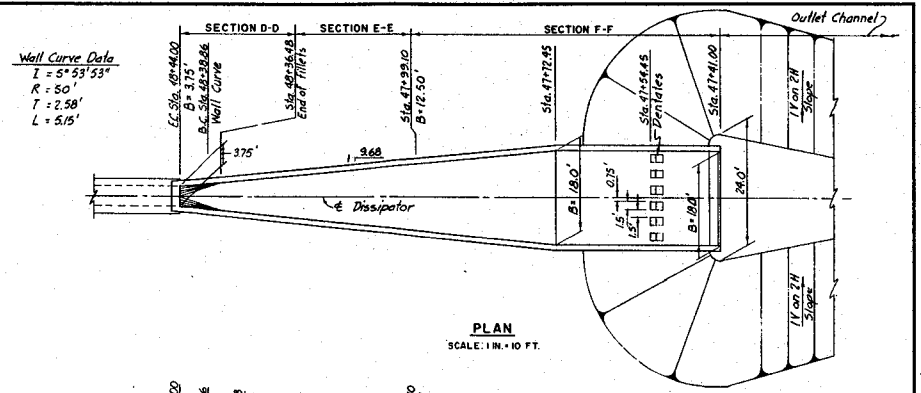


ELEVATION

RECORDER HOUSE

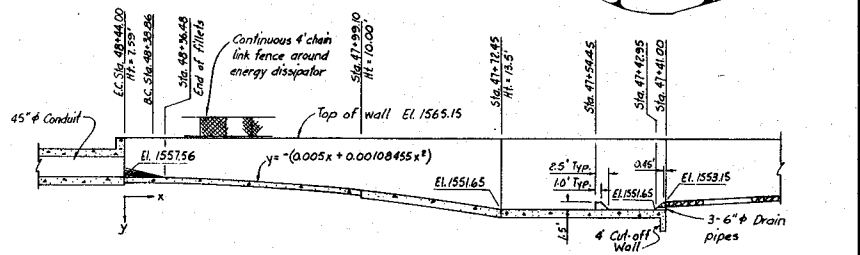
SCALE: 1/2 IN.= 1 FT.

Note:
For location of recorder house, see Plate 3.



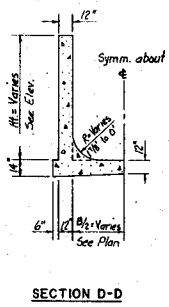
PLAN

SCALE: 1 IN. = 10 FT.



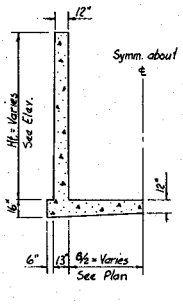
ELEVATION

SCALE: 1 IN. = 10 FT.



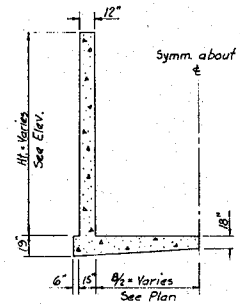
SECTION D-D

N.T.S.



SECTION E-E

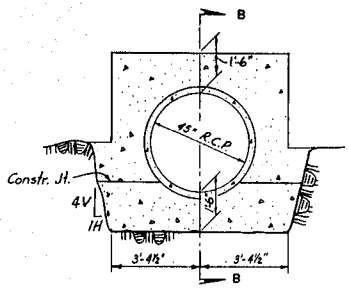
N.T.S.



SECTION F-F

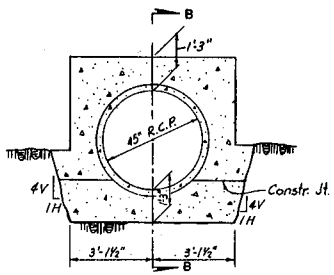
N.T.S.

ENERGY DISSIPATOR



SECTION I

(STA. 50+09.23 TO STA. 52+43.23)

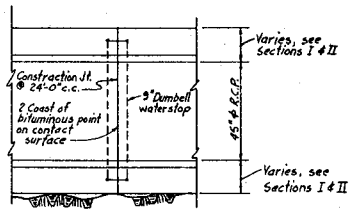


SECTION II

(STA. 48+44.23 TO STA. 50+09.23
AND
STA. 52+43.23 TO STA 53+72.75)

OUTLET CONDUIT

SCALE: 1/2 IN.= 1 FT.



SECTION B-B

CONTRACTION JOINT DETAIL

Note: R.C.P. shall be tied down to prevent its movement during construction.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: amd
DRAWN BY: J.W.S.
CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

RECORDER HOUSE, OUTLET CONDUIT AND ENERGY DISSIPATOR

SUBMITTED BY: _____ CHIEF, ENGINEERING DIVISION

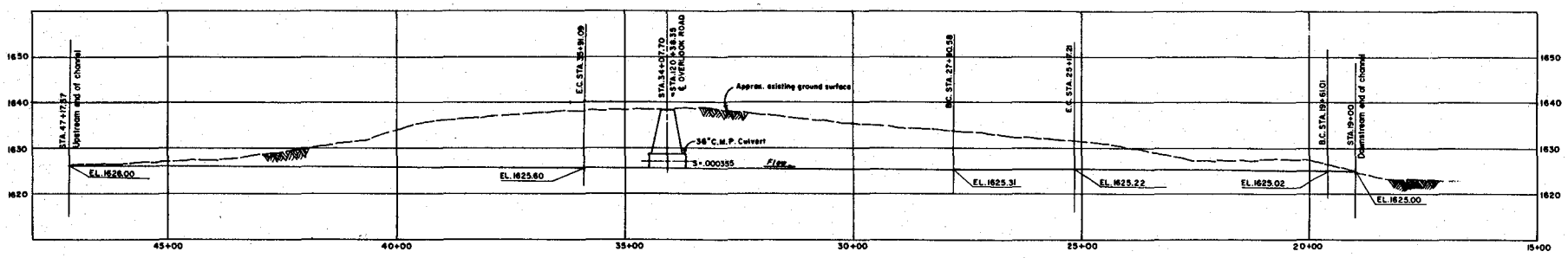
APPROVED: _____ COLONEL, C.E. DISTRICT ENGINEER

APPROVAL RECOMMENDED: _____ CHIEF, ENGINEERING DIVISION

SPEC. NO. DACW09- ____ -B- _____

DISTRICT FILE NO. 242/156

SHEET ____ OF ____ SHEETS



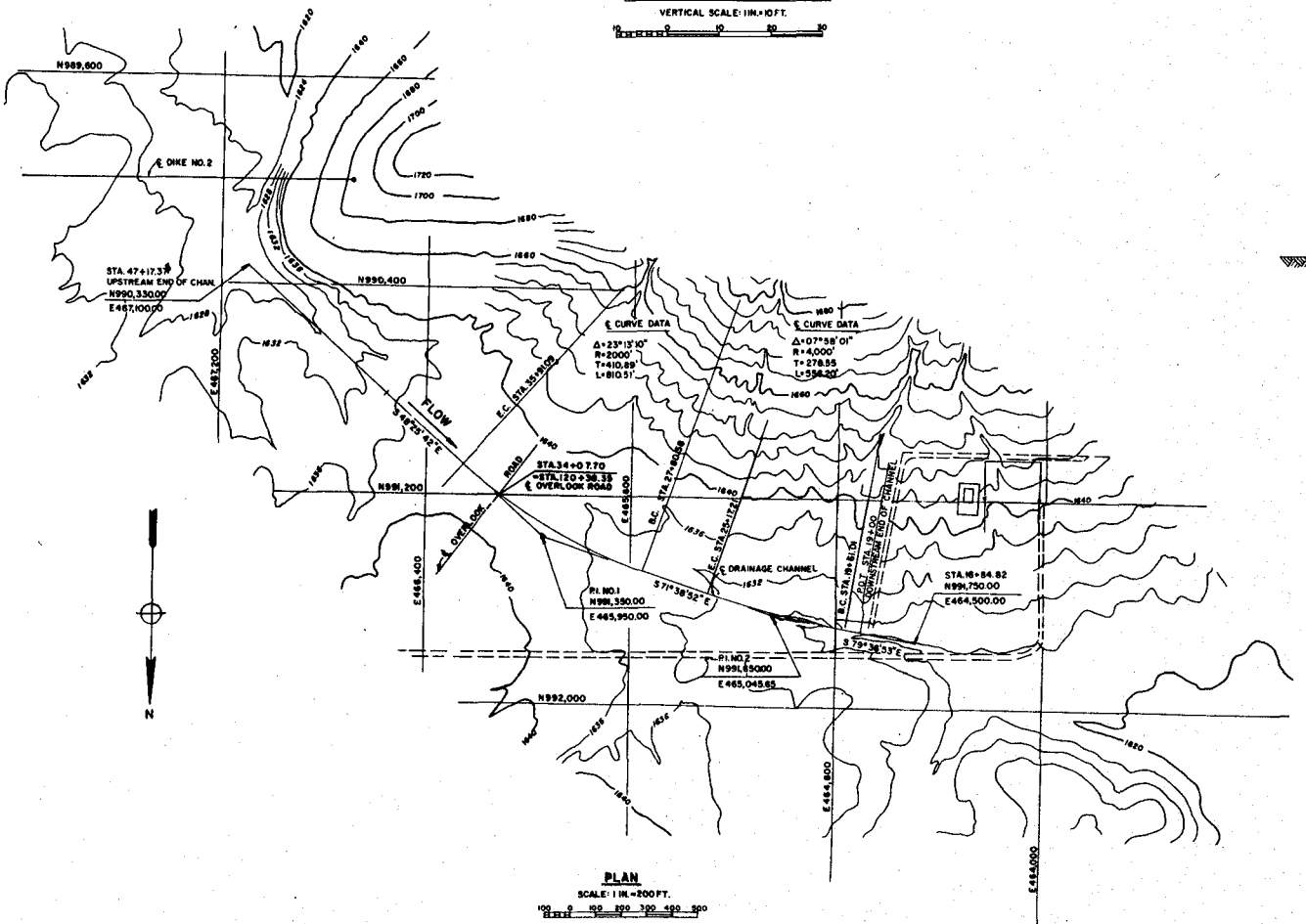
PROFILE

HORIZONTAL SCALE: 1 IN. = 100 FT.

100 0 100 200 300

VERTICAL SCALE: 1 IN. = 10 FT.

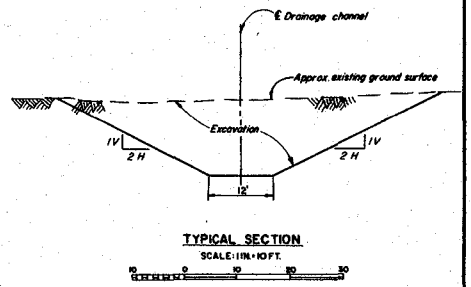
10 0 10 20 30



PLAN

SCALE: 1 IN. = 200 FT.

100 0 100 200 300 400 500



TYPICAL SECTION

SCALE: 1 IN. = 10 FT.

10 0 10 20 30

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: Draft
DRAWN BY: R.N.P.
CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

DRAINAGE CHANNEL

PLAN, PROFILE AND TYPICAL SECTION

SUBMITTED BY: CHIEF, ENGINEERING DIVISION

APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION

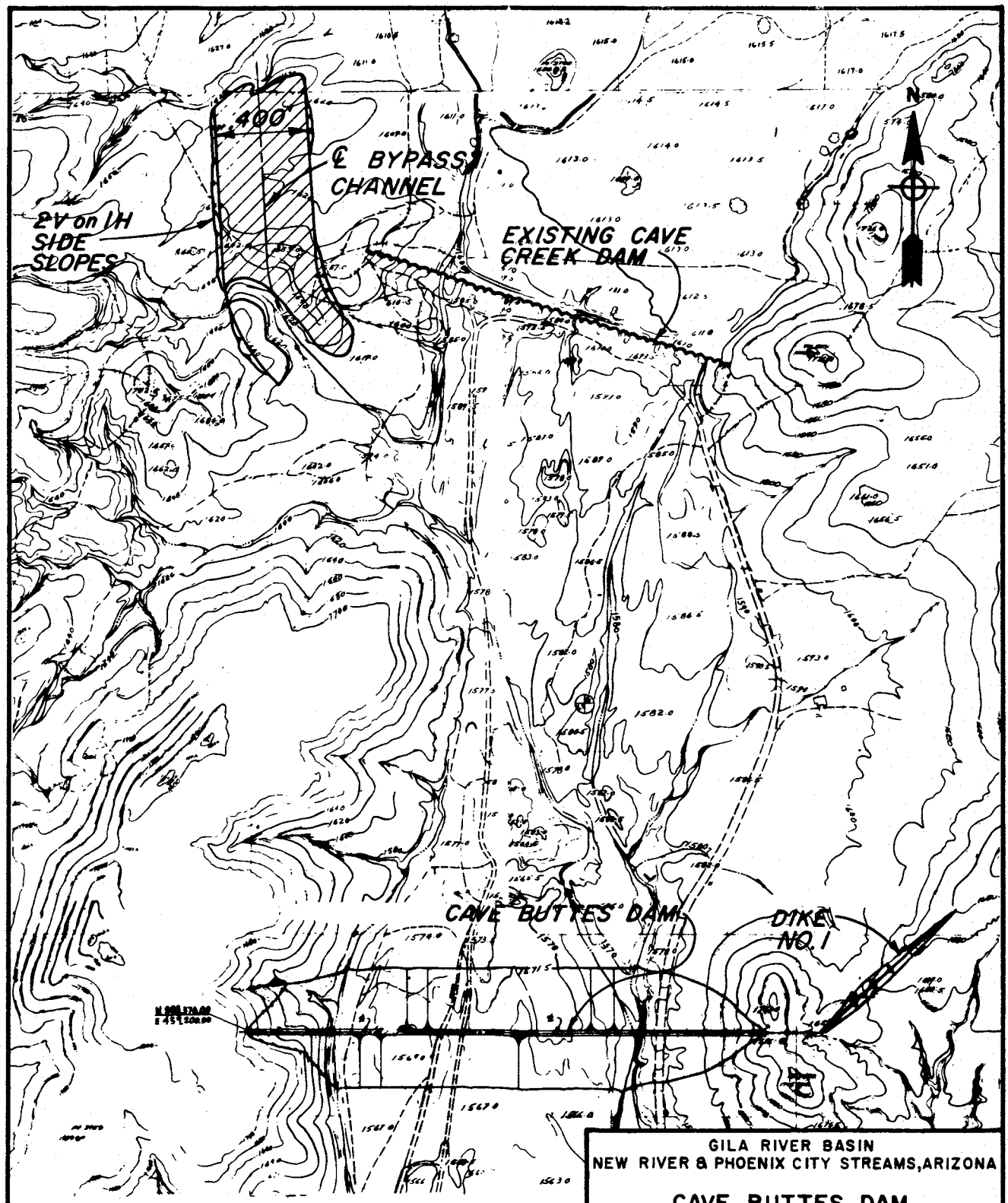
APPROVED: COLONEL, CE, DISTRICT ENGINEER

SPEC. NO. DACW09-___-___

DISTRICT FILE NO. 242/157

SHEET OF SHEETS

PLATE 14



GILA RIVER BASIN
NEW RIVER & PHOENIX CITY STREAMS, ARIZONA

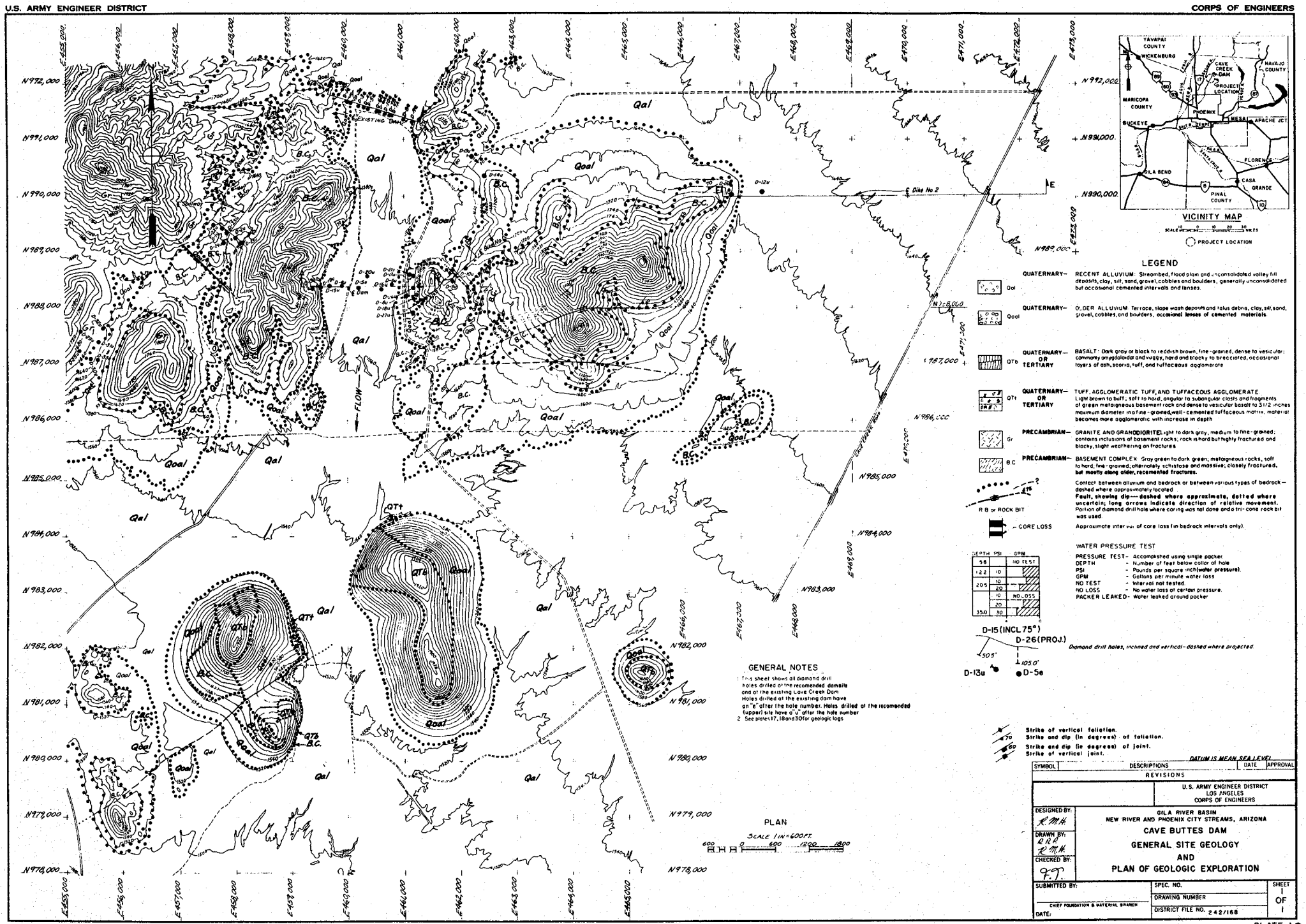
CAVE BUTTES DAM
BYPASS CHANNEL
LOCATION MAP

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS

PLATE 15

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS



VICINITY MAP

SCALE 0 10 20 30 MILES

PROJECT LOCATION

LEGEND

QUATERNARY— RECENT ALLUVIUM: Streambed, flood plain and unconsolidated valley fill deposits, clay, silt, sand, gravel, cobbles and boulders, generally unconsolidated but occasional cemented intervals and lenses. (Qal)

QUATERNARY— OLDER ALLUVIUM: Terrace, slope wash deposits and talus debris, clay, silt, sand, gravel, cobbles, and boulders, occasional lenses of cemented materials. (Qoal)

QUATERNARY— OR TERTIARY BASALT: Dark gray or black to reddish brown, fine-grained, dense to vesicular; commonly amygdaloidal and vuggy, hard and blocky to brecciated, occasional layers of ash, scoria, tuff, and tuffaceous agglomerate (QTb)

QUATERNARY— OR TERTIARY TUFF, AGGLOMERATIC TUFF, AND TUFFACEOUS AGGLOMERATE Light brown to buff, soft to hard, angular to subangular clasts and fragments of green metaigneous basement rock and dense to vesicular basalt to 3 1/2 inches maximum diameter in a fine-grained, well-cemented tuffaceous matrix, material becomes more agglomeratic with increase in depth (QTs)

PRECAMBRIAN— GRANITE AND GRANODIORITE Light to dark gray, medium to fine-grained; contains inclusions of basement rocks; rock is hard but highly fractured and blocky, slight weathering on fractures (Gr)

PRECAMBRIAN— BASEMENT COMPLEX Gray green to dark green; metaigneous rocks, soft to hard, fine-grained, alternately schistose and massive; closely fractured, but mostly along older, recemented fractures. (B.C.)

Contact between alluvium and bedrock or between various types of bedrock—dashed where approximately located

Fault, showing dip— dashed where approximate, dotted where uncertain; long arrows indicate direction of relative movement.

Portion of diamond drill hole where coring was not done and a tri-cone rock bit was used — R B or ROCK BIT

— CORE LOSS Approximate interval of core loss (in bedrock intervals only).

WATER PRESSURE TEST

PRESSURE TEST- Accomplished using single packer.
DEPTH - Number of feet below collar of hole
PSI - Pounds per square inch(water pressure).
GPM - Gallons per minute water loss
NO TEST - Interval not tested
NO LOSS - No water loss at certain pressure.
PACKER LEAKED - Water leaked around packer

DEPTH	PSI	GPM
58		NO TEST
122	10	
205	10	
	20	
	10	NO LOSS
	20	
350	30	

Diamond drill holes, inclined and vertical- dashed where projected.

Strike of vertical foliation.
Strike and dip (in degrees) of foliation.
Strike and dip (in degrees) of joint.
Strike of vertical joint.

DATUM IS MEAN SEA LEVEL

GENERAL NOTES

1. This sheet shows all diamond drill holes drilled at the recomended damsite and at the existing Cave Creek Dam. Holes drilled at the existing dam have an "e" after the hole number. Holes drilled at the recomended (upper) site have a "u" after the hole number
2. See plates 17, 18 and 30 for geologic logs

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: R.M.H.
DRAWN BY: D.R.L. R.M.H.
CHECKED BY: F.P.

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

GENERAL SITE GEOLOGY AND PLAN OF GEOLOGIC EXPLORATION

SUBMITTED BY: CHIEF FOUNDATION & MATERIAL BRANCH
DATE:

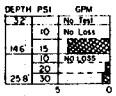
SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO. 242/168

SHEET 1 OF 1

PLATE 16

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS

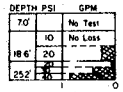


D-1U

Elev 1671.0'

BASEMENT COMPLEX: Schist; light to dark grayish green; metaigneous rock; slightly weathered to 5.1' (clay-coated open fractures); chlorite and quartz-rich; more massive interval from 1.4 to 6.4'; highly foliated, with dips mostly 45 to 50°; slightly to moderately fractured; fractures tight below 5.1'; talc and clay gouge 21.6 to 25.1'.

87.2% Core Recovery
October 1970

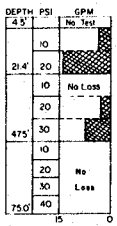


D-2U

Elev 1677.1'

BASEMENT COMPLEX: Schist; mostly dark green chlorite-rich; metaigneous; weathered and altered to 9'; quartz filling in tight, recemented fractures below 9'; hard; highly fractured 0 to 7' and 18.4 to 20.2'; remainder of hole moderately fractured along older, recemented fractures; occasional slickensides and shearing 6.5 to 9.9' and 19 to 20.2'; foliations mostly dip 10 to 40°.

99.0% Core Recovery
November 1970

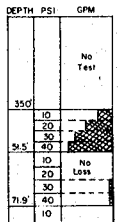


D-3U (INCL. 45°)

Elev 1639.2'

BASEMENT COMPLEX: Schist; green, foliated metaigneous rock; weathered to 16.2'; hard, with quartz veins and occasional more massive intervals from 5 to 29.5'; occasional altered zones; chlorite-rich schist with altered zones from 29.5 to 55° and 60 to 75°; occasionally to moderately fractured; breaks along older, recemented fractures; fractures tight below 14'; most of water loss from 13 to 14' in open fractures; foliations dip 30 to 40°, relative to core.

94.0% Core Recovery
October 1970



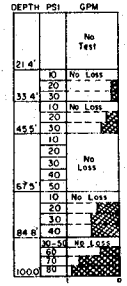
D-4U

Elev 1570.3'

RECENT ALLUVIUM: Sandy gravel with occasional cobbles; unconsolidated; streambed deposits.

BASEMENT COMPLEX: Green; fine-grained, foliated metaigneous rock; hard to moderately hard; moderate fracturing from 31.9 to 41.7' (most of water loss here); many recemented fractures from 41.7 to 100'; iron oxide from 61.2 to 67.9'; some quartz seams and iron-stained fractures from 31.9 to 87'; 70° dipping 1/8" thick fracture 69.4 to 69.3'; foliations generally indistinct, but dip 45° from 62 to 64'; slickensides occur at several intervals from 56.9 to 89.3'; only slightly altered or weathered entire depth.

100.0% Core Recovery
October 1970



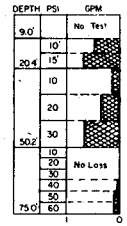
D-6U

Elev 1564.4'

RECENT ALLUVIUM: Sandy gravel with numerous cobbles and occasional boulders; poorly consolidated.

BASEMENT COMPLEX: Green; foliated metaigneous rock; fine-grained; highly fractured 29.3 to 31.2' and 33.4 to 39'; weathered and altered, but hard to 39'; moderately hard to moderately soft below 39'; fault zone 27 to 29'--slickensided, gouge material, and crushed shear zone; slickensides 79.6 to 80.4'; brecciated 84 to 84.8'; alternating intervals of schistose and massive material from 83 to 92.5'; many tight, recemented irregular fractures breaking up into small pieces ranging from less than 1" to 9" long; foliations mostly indistinct.

95.9% Core Recovery
November 1970



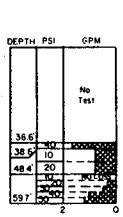
D-7U (INCL. 45°)

Elev 1616.4'

OLDER ALLUVIUM: Talus debris and slope wash; some residual material; silt, sand, and angular gravel and cobbles; poorly consolidated.

BASEMENT COMPLEX: Light to dark green; foliated metaigneous rock; fine-grained; moderately hard to hard with occasional soft gouge/brecciated intervals (especially 50.2 to 52'); highly fractured (iron-stained) to occasionally fractured; fractures mostly along older, recemented fractures; weathered and highly fractured down to 11.5'; numerous slickensides from 29.2' to bottom of hole (abundant 52.5 to 56.7'); calcite-rich vuggy interval 36.2 to 39'; foliation dips mostly 45°, relative to core.

[illegible] Core Recovery
October 1970



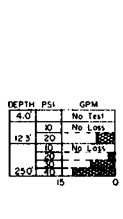
D-8U

Elev 1579.7'

OLDER ALLUVIUM: Talus debris, slope wash, and residual material; silt, sand, and angular gravel and cobbles; poorly consolidated.

BASEMENT COMPLEX: Light to dark green; foliated, fine-grained metaigneous rock; highly altered, weathered, and fractured schist to 35.2'; highly fractured, slightly weathered, and moderately hard 35.2 to 51'; moderately fractured and hard 51' to bottom of hole; fractures below 35.2' occur mostly along older, recemented fractures; schistose 30.5 to 35.2'; foliations generally indistinct, dipping 15° from 43 to 44°; slickensides on fracture dipping 5° at 40.9° depth.

94.3% Core Recovery
October 1970

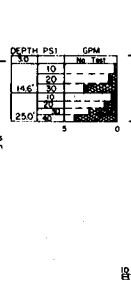


D-9U

Elev 1647.4'

BASEMENT COMPLEX: Light brownish green to dark green; foliated metaigneous rock; fine-grained; moderately hard to hard; weathered to 9.5' (much oxidation on fractures); slightly weathered to unweathered below 9.5'; occasionally to highly fractured (tends to be blocky), but mostly moderately fractured--breaks along older, recemented fractures; foliation dips 45° where distinct; occasional slickensides; some shear zone and brecciation 11.3 to 12.3', 21 to 21.5', and 23.4 to 24.7'.

95.2% Core Recovery
October 1970



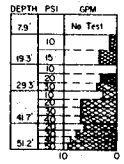
D-10U

Elev 1657.6'

BASEMENT COMPLEX: Light brownish green to dark green; metaigneous rock; fine-grained; moderately hard to hard; weathered down to 3.5'; moderately fractured 0 to 6.3' and 14.3 to 15.3'; occasionally fractured 6.3 to 14.3' and 15.3 to 25'; slightly open fracture 3.5 to 4', remainder are fairly tight; fractures occur mostly along older, recemented fractures, which have iron oxide and calcite cement; foliations indistinct; slickensides at 22.1', 22.5', and from 23.9 to 24.4'.

94.6% Core Recovery
October 1970

SCALE: 1 IN = 20 FT



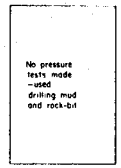
D-11U (INCL. 45°)

Elev 1657.7'

OLDER ALLUVIUM: Talus debris, slope wash, and residual material.

BASEMENT COMPLEX: Green, foliated metaigneous rock; fine-grained; weathered to 8.5' (highly to moderately fractured, with iron oxide coatings); occasionally to moderately fractured below 8.5'; fractures occur along older, recemented fractures; foliation generally indistinct, but dips from 45 to 60° relative to core; many open, calcite crystal-lined fractures (especially from 37.5 to 45°); brecciated 28.6 to 29.3'.

96.8% Core Recovery
October 1970



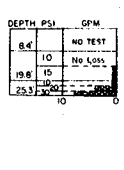
D-12U

Elev 1625.1'

RECENT ALLUVIUM: Streambed deposits; decomposed granitic sand; clay, sand, gravel, and cobbles; unconsolidated.

OLDER ALLUVIUM: Sandy gravel with occasional cobbles; loose, rounded grains; some clay from 30 to 55'; moderately compacted from 42.5 to 50'; mostly greenstone and basalt gravel and cobbles.

49.2% Core Recovery
November 1970



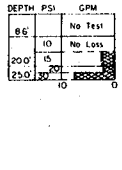
D-13U (INCL. 45°)

Elev 1649.7'

OLDER ALLUVIUM: Talus debris, slope wash, and residual material; caliche fragments.

BASEMENT COMPLEX: Green, slightly foliated metaigneous rock; fine-grained; carbonate (caliche)-cemented breccia from 7 to 11.3' and 20.8 to 22'; iron oxide and calcite-rich interval from 21 to 21.4'; foliation dips 60° relative to core at 23'; some joint 14 to 14.9'; moderately hard to hard; occasionally to moderately fractured--occasional 7 to 16'.

71.1% Core Recovery
October 1970

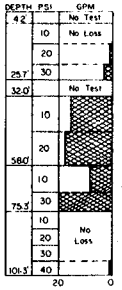


D-14U

Elev 1651.9'

BASEMENT COMPLEX: Green, foliated metaigneous rock; fine-grained; moderately hard to hard; foliations dip 45° from 7 to 11'; weathered and altered down to 7.2'; moderately fractured 3 to 7'; highly fractured 11 to 14'; occasionally fractured remainder of hole; gouge interval 2.2' to 4.9'; joint and brecciated interval 12 to 14'.

84.4% Core Recovery
October 1970

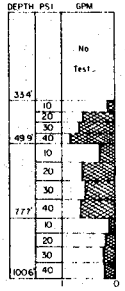


D-19U (INCL. 45°)

Elev 1568'

BASEMENT COMPLEX: Green; fine-grained, highly foliated metaigneous rock; moderately weathered to 9'; very little weathering below 9'; occasionally to moderately fractured, with iron oxide and calcite lining fractures; moderately hard to soft (soft in shear zones from 52.5 to 53.5' and 54 to 60'); most of water loss 52.5 to 53.5'; open fracture 59 to 63'; foliations dip 30 to 50°, relative to core.

98.3% Core Recovery
April 1970



D-20U

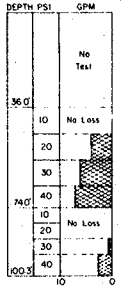
Elev 1569.6'

RECENT ALLUVIUM: Streambed deposits; silt, sand, gravel, cobbles, and boulders; unconsolidated.

OLDER ALLUVIUM: Silt, sand, gravel, cobbles and boulders; occasional stringers of clay; poorly consolidated.

BASEMENT COMPLEX: Green; fine-grained, foliated metaigneous rock; highly fractured/sheared entire depth; iron oxide and calcite coatings on fracture surfaces; moderately soft to moderately hard; breccia, slickensides, and clay gouge abundant--hole drilled through a steeply dipping shear zone; foliations generally indistinct, but dip 45° at 34.4'; fracturing tight and along older, recemented fractures.

51.8% Core Recovery
March 1970



D-21U (INCL. 50°)

Elev 1580.6'

OLDER ALLUVIUM: Slope wash and residual materials; silt, sand, gravel, cobbles, and occasional boulders; gravel, cobbles, and boulders are mostly greenstone and basalt; some carbonate (caliche) material; poorly consolidated.

BASEMENT COMPLEX: Green; fine-grained, foliated metaigneous rock; moderately soft to hard; moderately to highly fractured; highly weathered and altered to 54.3'; slightly weathered from 54.3' to bottom of hole; fractures are coated or filled with clay and calcite; fractures are tight below 55'; brecciated zone 87.2 to 92.2'; foliations generally dip 30 to 40°, relative to core.

55.8% Core Recovery
April 1970

GENERAL NOTES:

1. See Plate 16 for legend.
3. Drill hole inclinations are measured from horizontal.
4. Soil classifications on this sheet are visual.
5. Dip of foliations and joints, fractures, and faults measured from horizontal except in inclined holes, where measured relative to core.

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: R.M.H.
DRAWN BY: E.A.P.
CHECKED BY: C.J.P.

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
CAVE BUTTES DAM
GEOLOGY AND FOUNDATION EXPLORATION

GEOLOGIC LOGS

SUBMITTED BY: CHIEF, FOUND & MATLS. BRANCH
APPROVED: CHIEF, E.E. BRANCH
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION
SPEC. NO. DACW09-____-____
DISTRICT FILE NO. 242/182
SHEET 1 OF 2 SHEETS

PLATE 17

D-5U

DEPTH	PSI	GPM
31.8'		NO TEST
	10 / 20 / 30	NO LOSS
43.8'	20	NO LOSS
52.0'	30	0.4
	10	
	20	
75.5'	30	

Scale: 15 — 0

0.0' Elev. 1567.1 — ROCK BIT

RECENT ALLUVIUM: Streambed deposits; silt, sand, gravel, cobbles, and occasional boulders; unconsolidated.

31.5' *BASEMENT COMPLEX:* Green, fine-grained metaigneous rock; chlorite-rich; occasionally to highly fractured along older, recemented fractures; unweathered; fault gouge 32.5 to 32.7' and 43.5 to 43.8'; occasional slickensides from 43 to 70.5'; brecciated from 36.2 to 41.5' and 62.1 to 63.2'; occasional quartz-rich intervals; moderately hard to hard; large water loss from 31.5 to 31.8' to 31.8' (around casing); most of water loss 52 to 66'.

75.0'

70.6 % Core Recovery
September 1974

D-15U

DEPTH	PSI	GPM
33.0'		NO TEST
43.0'	10 TO 40	NO LOSS
72.9'	20 TO 60	NO LOSS

Scale: 1 — 0

0.0' El. 1569.2' — ROCK BIT

RECENT ALLUVIUM: Streambed deposits; silt, sand, gravel, cobbles, and occasional boulders; silt-rich 0 to 3'; slightly consolidated 8.5 to 26.1'.

26.1' *BASEMENT COMPLEX;* Green, fine-grained metaigneous rock and pink, medium-grained granitic rock; extensive breccia intervals; rock is moderately hard to hard with numerous, scattered soft gouge zones; weathered 26.1 to 31'; green rock (greenstone) to 39'; greenstone breccia and granitic rock in alternating intervals from 39' to bottom of hole; numerous gouge intervals associated with the granite/breccia contacts; these gouge intervals/small faults generally dip 40 to 50° and go to 1" thick; occasionally fractured 31 to 67' and 68 to 72.9'; moderately fractured 27 to 28'; highly fractured 26.1 to 31' and 67 to 68'; the reddish-brown, iron-oxide cemented breccia has many healed fractures; barely distinct 40° dip in breccia.

72.9'

98.2 % Core Recovery
October 1974

D-16U

DEPTH	PSI	GPM
43.0'		NO TEST
52.0'	10 TO 40	NO LOSS
60.0'	10 TO 50	NO LOSS

Scale: 1 — 0

0.0' Elev. 1563.6 — ROCK BIT

RECENT ALLUVIUM: Streambed deposits; sand, gravel, cobbles, and occasional boulders; uncemented, especially in top 2'; continuous cobbles 15 to 24.2'; caliche-cemented metaigneous rock fragments 25.7 to 27.4' (fragments are angular and go to 3" maximum diameter).

29.8' *BASEMENT COMPLEX:* Green, fine-grained metaigneous rock; highly fractured along older, recemented fractures; moderately hard to hard; slightly weathered 29.8 to 38'; schistose interval (25° dip on foliations) from 40 to 41.3'; occasional slickensides from 30 to 57.5'; thin gouge interval at 48.1'; gouge and clay-like material 49 to 52'.

60.0'

76.7 % Core Recovery
September 1974

D-17U

DEPTH	PSI	GPM
26.0'		NO TEST
	10	
	20	
	30	
45.0'	40	

Scale: 2 — 0

0.0' Elev. 1589.2' — ROCK BIT 7.4'; RB

OLDER ALLUVIUM: Slope wash, with residual soil and talus debris; slightly consolidated; angular to subrounded metaigneous rock fragments to 3" maximum diameter, well-cemented material from 7.4 to 10.7; less indurated from 10.7 to 25.7', with fragments of basalt, greenstone, and quartzite.

25.7' *BASEMENT COMPLEX:* Green metaigneous rock; quartz-rich; moderately fractured 25.7 to 29.3', 30.5 to 34.5', and 40 to 41.5'; highly fractured 29.3 to 30.5' and 41.5 to 45'; occasionally fractured 34.5 to 40'; relatively unweathered; secondary filling mostly calcite; rock is blocky and moderately hard to hard down to 43'; softer (chlorite-rich) below 43'; becomes mottled below 40' with more iron oxide and calcite coating the 60°-dipping fractures.

45.0'

68.4 % Core Recovery
October 1974

D-18U

DEPTH	PSI	GPM
26.0'		NO TEST
	20 TO 40	NO LOSS
45.0'	50	0.3

Scale: 1 — 0

0.0' Elev. 1589.4 — 6.0' RB

OLDER ALLUVIUM: Slope wash, with residual soil and talus debris; silt, sand, and gravel, cemented material from 6.0 to 18.4.

18.4' *BASEMENT COMPLEX:* Green metaigneous rock; soft and weathered down to 20.2', then becomes highly fractured and slightly platy (moderately hard to hard) to 26.7'; plates dip 35° at 24.5'; schistose interval 39.4 to 40.5' (foliations dip 60°); occasional slickensides from 26 to 43'; moderately to occasionally fractured 26.7 to 45'; brecciated interval 28.3 to 28.7' and 35.8 to 36.2'.

45.0'

65.6 % Core Recovery
October 1974

DEPTH	PSI	GPM
18.0'		NO TEST
	10	
	20	0.1
	30	0.1
30.0'	40	

Scale: 1 — 0

D-22U

DEPTH	PSI	GPM
34.8'		NO TEST
	10 TO 40	NO LOSS
58.8'	50	0.2

Scale: 1 — 0

0.0' Elev. 1681.6' — 5.3'

OLDER ALLUVIUM: Slope wash, with residual soil and talus debris; silt, sand, and gravel.

BASEMENT COMPLEX: Green metaigneous rock; chlorite-rich schist (soft to hard) from 5.3 to 33' and 42.4 to 58.8'; massive interval 33 to 42.4'; weathered down to 6.8'; foliation dips 45 to 90°, but mostly 45° down to 13', and 60 to 70° from 13' to bottom of hole; schist is soft to 29.5', rock gets harder with depth; occasional intervals of talc down to 20' depth; claystone 20 to 27.8'; the massive metaigneous rock (greenstone) is occasionally to highly fractured along older, recemented fractures; numerous slickensides occur along foliations, but not below 46.5'.

58.8'

66.8 % Core Recovery
October 1974

DEPTH	PSI	GPM
13.0'		NO TEST
	10	NO LOSS
	20	0.1
	30	0.3
40.0'	40	

Scale: 1 — 0

D-23U

DEPTH	PSI	GPM
11.3'		NO TEST
	5 TO 10	NO LOSS
	20	
	30	
43.3'	40	

Scale: 2 — 0

0.0' Elev. 1664.5'

BASEMENT COMPLEX: Green, foliated metaigneous rock (chlorite-rich schist); foliation dips 40 to 90°, but mostly 45 to 60°; the 70 to 90° dip occurs 30 to 43.3'; slickensides common along foliations; rock soft to moderately hard, getting harder with depth; highly weathered down to 6.7'; breccia from 11 to 13'— greenstone fragments in light reddish brown carbonate matrix; much iron oxide filling between foliations; talc schist interval from 23.4 to 25.8'; red claystone 30.6 to 31.3'; talc/limenite-rich schist 31.3 to 36.5'; hard, massive green metaigneous rock (greenstone) 37.5 to 38.2'.

43.3'

84.5 % Core Recovery
October 1974

D-24U

DEPTH	PSI	GPM
7.8'		NO TEST
	10	
	20	
	30	
36.8'	40	

Scale: 6 — 0

0.0' Elev. 1655.8 (INCL. 69.5°)

BASEMENT COMPLEX: Pale to dark green, foliated metaigneous rock (chlorite-rich schist); soft to hard; highly weathered to 6', then slightly weathered to 7'; occasional intervals of hard massive rock (greenstone) or quartzite; foliation dips mostly 45 to 55° relative to hole; alternating chlorite-rich and carbonate-rich layers; slickensides occur occasionally along the foliations; talc-schist interval 32.2 to 32.8'.

36.8'

87.8 % Core Recovery
October 1974

D-25U

DEPTH	PSI	GPM
9.0'		NO TEST
	10	0.1
	20	0.2
33.0'	30	0.2
	10	
	20	
43.0'	30	
	10	
	20	
	30	
60.3'	40	

Scale: 15 — 0

0.0' Elev. 1683.9 (INCL. 75°)

BASEMENT COMPLEX: Green, foliated metaigneous rock (chlorite-rich schist); fine-grained; moderately soft to moderately hard; hard where schist grades into massive interval (greenstone); fracturing occurs along older, recemented fractures; foliation dips mostly 70 to 80°; foliation at ground surface is vertically dipping; rock is occasionally to moderately fractured, slickensides common along foliations; most fractures are iron-stained and occur along foliations; occasional slickensides from 10 to 49'; highly fractured from 0 to 5' and 12.7 to 13.2'; moderately fractured from 9.4 to 10.2'; slightly weathered 0-5'; water loss mostly in slightly open fractures from 34 to 38', 45.5 to 46.5', and 50 to 51'.

60.3'

96.3 % Core Recovery
October 1974

D-26U

0.0' Elev. 1590.2'

OLDER ALLUVIUM: Slope wash, residual soil, and talus debris; cemented material from 5 to 8' depth; cobbles encountered 11 to 15.5'.

15.5' *BASEMENT COMPLEX:* Green, non-foliated metaigneous rock; occasionally to highly fractured along older, recemented fractures; very soft to hard; numerous slickensides from 21.5 to 27'; occasionally to moderately fractured from 15.5 to 20' and 26.8 to 30'; gouge interval 23.7 to 24'; coarser grained 27 to 30'; fractures coated with iron oxide; highly weathered 15.5 to 17.8'.

30.0'

84.1 % Core Recovery
October 1974

D-27U

0.0' Elev. 1580.9'

OLDER ALLUVIUM: Slope wash, residual soil, and talus debris. Cemented material from 5.5-7.0'.

7.0' *BASEMENT COMPLEX:* Green metaigneous rock; moderately soft to hard; occasionally to highly fractured along older, recemented fractures; slightly weathered 7 to 8.5'; epidote-rich and platy (moderately soft 12.8 to 14.8'; banded hard metaigneous rock (greenstone) 14.8 to 34'; foliated from 14 to 40'; foliations dip mostly 45°; occasional slickensides from 11 to 34'; usually along foliations; occasional gouge intervals; highly fractured 20.1 to 22.5', 25.7 to 27.6', and 35.2 to 36'; occasionally fractured from 22.5 to 25.7' and 36 to 40'; moderately fractured 7 to 20.1' and 27.6 to 35.2'; platy schistose intervals from 28.4 to 29.6' and 30.4 to 35.2.

40.0'

82.5 % Core Recovery
October 1974

T.T. 75-1

0.0' Elev. 1577.6'

OLDER ALLUVIUM: Slope wash and residual material; silt, sand and gravel; some caliche between 1.5-4.5'; thin lenses of cemented materials from 4.5-7.5' and below 7.5' coarse unconsolidated materials including some cobbles and occasional boulders 2.5' maximum diameter.

19.5' *BASEMENT COMPLEX:* Green, platy schist, cryptocrystalline; moderately hard to hard; foliations dip 60-85°.

July 1975

T.T. 75.-2

0.0' Elev. 1581.4

OLDER ALLUVIUM: Slope wash and residual material; silt, sand and gravel. unconsolidated; some lenses of well cemented material from 3.0 to 9.0'; loosely consolidated coarse material below 9.0'; some cobbles and occasional boulders 2' maximum diameter.

27.5' *BASEMENT COMPLEX:* Green, platy schist, cryptocrystalline; moderately hard to hard foliations dip 50 to 70°.

July 1975

T.T 75.19

0.0' Elev. 1587.6

OLDER ALLUVIUM: Slope wash and residual material: silt, sand and gravel, unconsolidated well cemented material from 5.0-13.0'; loosely consolidated coarse material below 13.0' including cobbles and occasional boulders 2' maximum diameter.

27.0' *BASEMENT COMPLEX:* Green, platy schist, cryptocrystalling; moderately hard to hard foliations dip 60-85°.

August 1975

GENERAL NOTES

1. SEE PLATE 16 FOR LEGEND.
3. DRILL HOLE INCLINATIONS ARE MEASURED FROM HORIZONTAL.
4. SOIL CLASSIFICATIONS ON THIS SHEET ARE VISUAL.
5. DIP OF FOLIATIONS AND JOINTS, FRACTURES, AND FAULTS MEASURED FROM HORIZONTAL (EXCEPT IN INCLINED HOLES, WHERE IT IS MEASURED RELATIVE TO CORE, OR HOLE).
6. TERM "GREENSTONE" REPRESENTS THE GREEN, MASSIVE METAIGNEOUS ROCK.

SCALE: 1 IN = 20 FT.
10 0 10 20 30 40 50

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

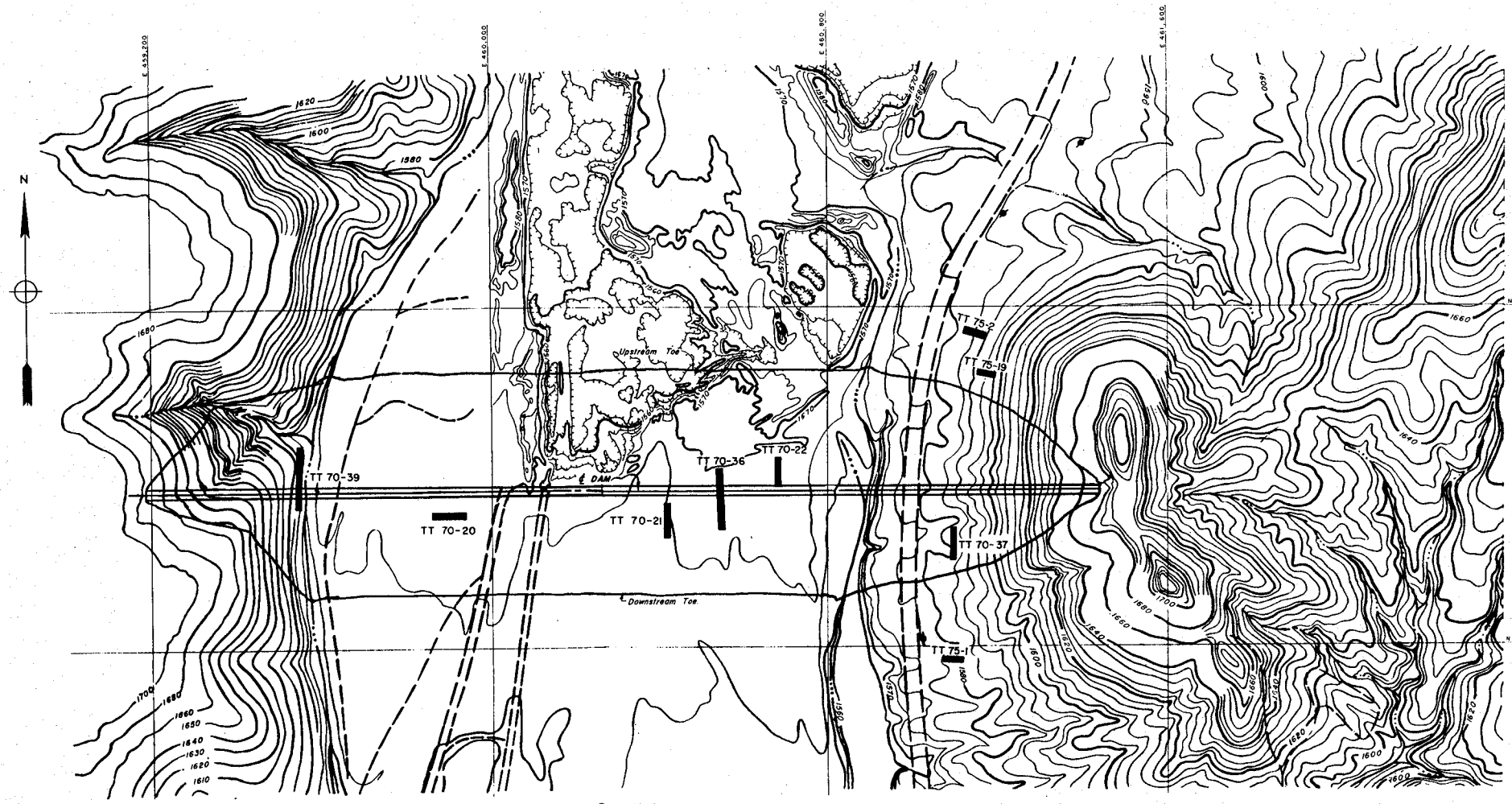
REVISIONS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: R. M. H.
DRAWN BY: J.Y.
CHECKED BY: [illegible]

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
CAVE BUTTES DAM
GEOLOGY AND FOUNDATION EXPLORATION
GEOLOGIC LOGS

SUBMITTED BY: CHIEF, FOUND. & MAT'LS. BRANCH
APPROVED: COLONEL, C.E. DISTRICT ENGINEER
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION
SPEC. NO. DACW09-____ B-____
DISTRICT FILE NO. 242/183
SHEET 2 OF 2 SHEETS



PLAN

SCALE 1 IN = 100 FT

100 0 100 200 300

LEGEND

TT 70-36 — Location & numbers of Test Trench

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: KAK
DRAWN BY:
CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
DAM FOUNDATION
PLAN OF SOILS EXPLORATION

SUBMITTED BY:
CHIEF FOUNDATION & MATERIALS BRANCH
DATE:

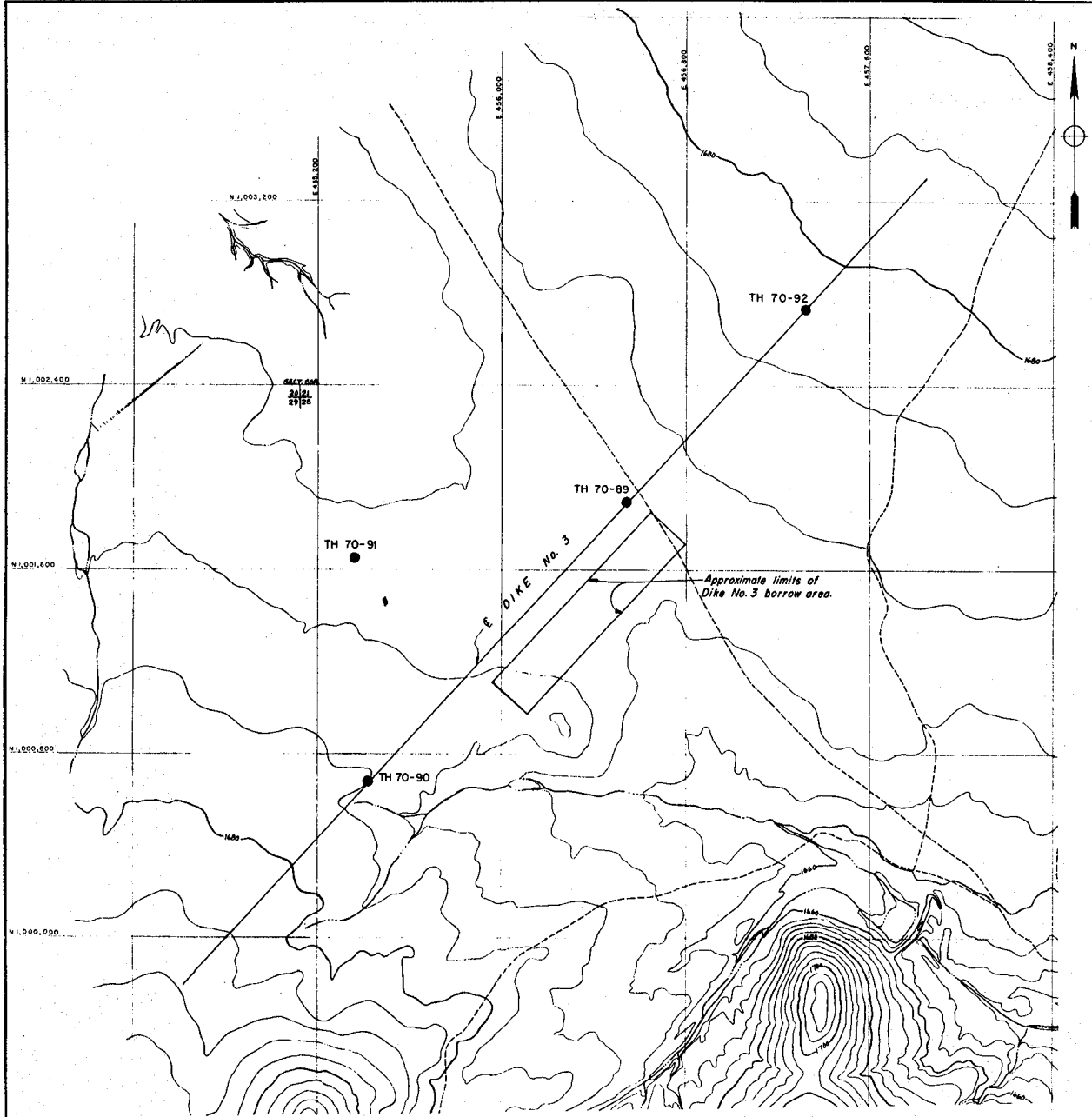
SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO. 242/170

SHEET OF

PLATE 19

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS

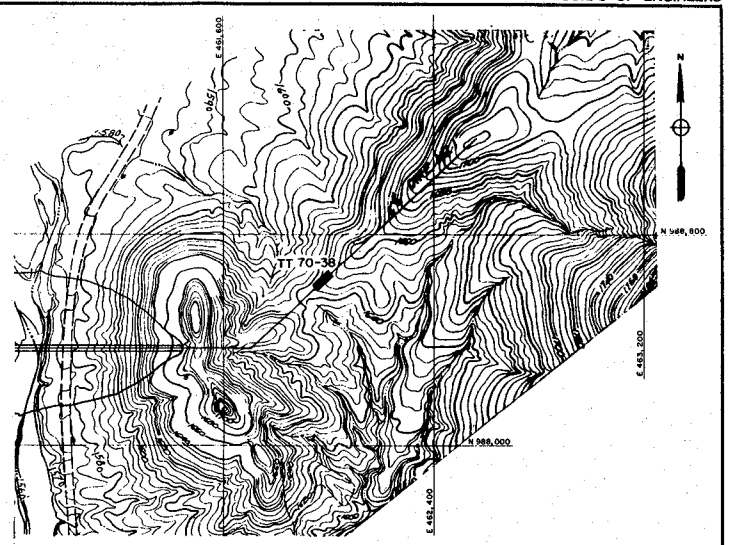


DIKE NO. 3 PLAN

200 100 0 200 400 600

SCALE: 1 IN = 200 FT

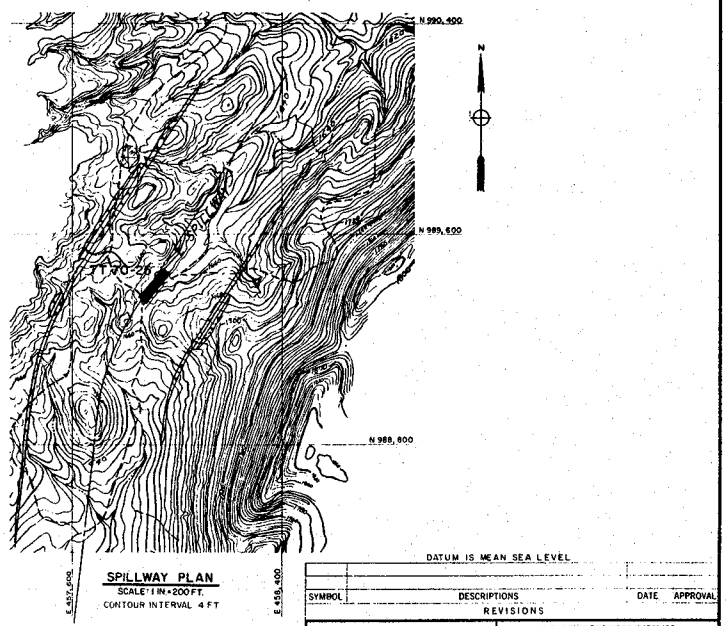
CONTOUR INTERVAL 4 FT



DIKE NO.1 PLAN

SCALE: 1 IN.=200FT.

CONTOUR INTERVAL 4 FT.



SPILLWAY PLAN

SCALE: 1 IN=200 FT.

CONTOUR INTERVAL 4 FT

LEGEND

TT 70-25 Location and number of Test Trenches.

TH 70-90 Location and number of Test Holes.

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: HDA
DRAWN BY: JY
CHECKED BY: LJL

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
DIKES NO. 1, NO. 3 AND SPILLWAY FOUNDATION
PLAN OF EXPLORATION

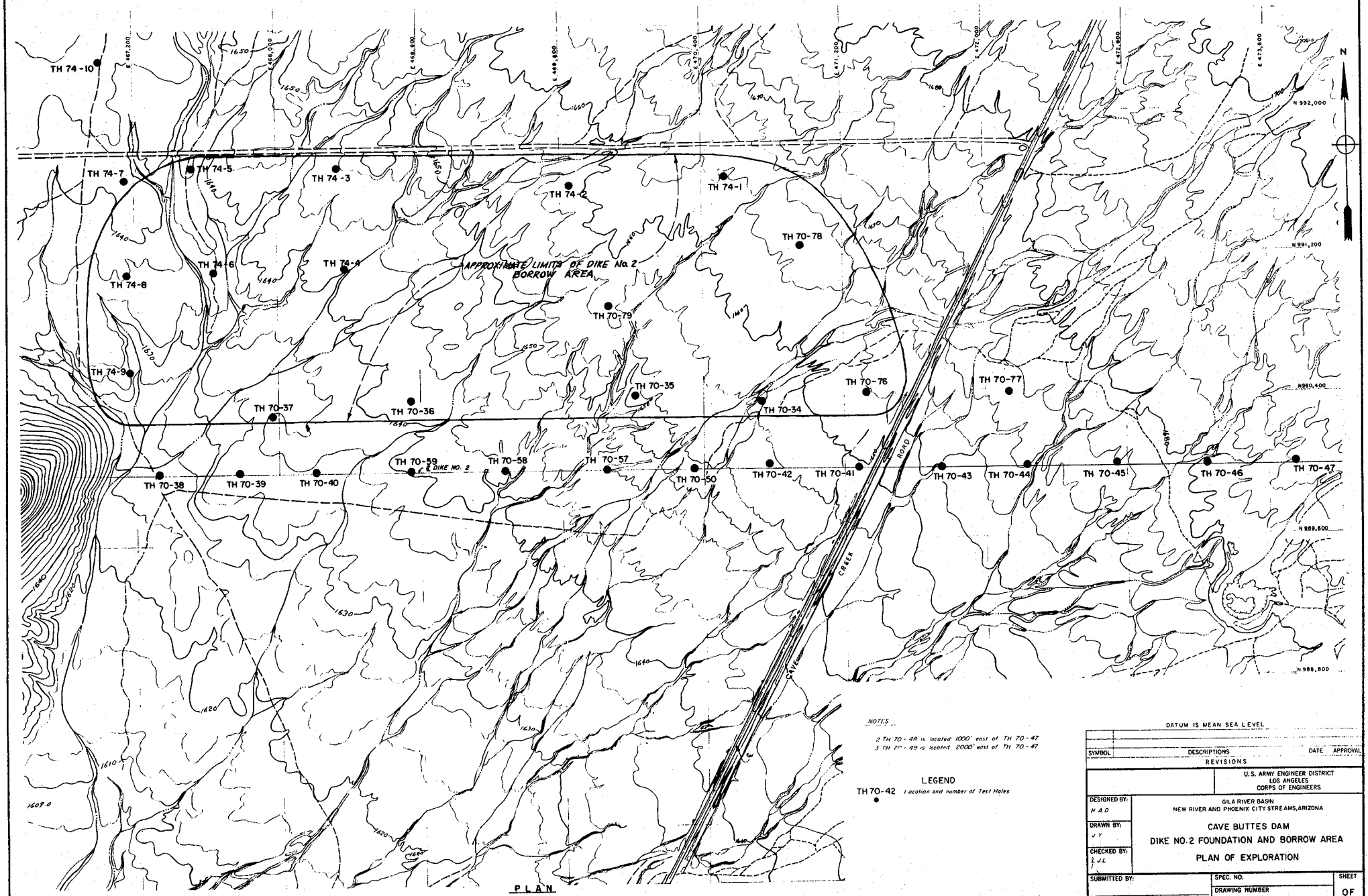
SUBMITTED BY:
CHIEF FOUNDATION & MATERIALS BRANCH
DATE:

SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO. 242/171
SHEET
OF

PLATE 20

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS



PLAN

SCALE : 1 IN. = 200 FT.

NOTES

2 TH 70 - 48 is located 1000' east of TH 70 - 47

3 TH 70 - 49 is located 2000' east of TH 70 - 47

LEGEND

TH 70-42 Location and number of Test Holes

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: H A D

DRAWN BY: J Y

CHECKED BY: J V L

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
DIKE NO. 2 FOUNDATION AND BORROW AREA
PLAN OF EXPLORATION

SUBMITTED BY:

CHIEF, FOUNDATION AND MATERIALS BRANCH

DATE:

SPEC. NO.

DRAWING NUMBER

DISTRICT FILE NO. 242/172

SHEET OF

PLATE 21

DAM FOUNDATION

TT 70-20

DEPTH		MC	LL	PI	-4	-200	
1.0	SM			NP	95	44	SILTY SAND, brown, loose, gravel to 1" max.
5.0	SP			NP	59	1	GRAVELLY SAND, gray, brown, medium dense, cobbles and boulders to 18" max.
6.0	ML		30	6	100	78	SANDY SILT, brown, medium dense.
11.0	SP			NP	53	2	GRAVELLY SAND, gray, medium dense, cobbles and boulders to 30" max.
16.0	GW			NP	43	3	SANDY GRAVEL, gray, medium dense, cobbles and boulders to 30" max.
20.0	SP SC		26	8	61	6	GRAVELLY SAND-CLAYEY GRAVELLY SAND, red-brown, medium dense, cemented, cobbles to 9" max.

April 1970

TT 70-21

DEPTH		MC	LL	PI	-4	-200	
5.0	SP	3		NP	52	2	GRAVELLY SAND, gray and brown, loose to medium dense cobbles and boulders to 18" max.
11.0	GP	3		NP	43	2	SANDY GRAVEL, gray and brown, loose to medium dense, cobbles and boulders to 24" max.
		2	27	10	46	4	
16.0	SW SM	1		NP	74	5	GRAVELLY SAND-SILTY GRAVELLY SAND, red-brown, medium dense, cemented, cobbles and boulders to 24" max.
19.0	GP	1	32	12	52	4	SANDY GRAVEL, brown, medium dense, cobbles and boulders to 24" max.

April 1970

TT 70-22

DEPTH		MC	LL	PI	-4	-200	
3.0	SP	3		NP	63	2	GRAVELLY SAND, gray and brown, loose, cobbles to 18" max. (boulders on surface)
7.0	GP	4		NP	44	3	SANDY GRAVEL, gray and brown, loose, cobbles and boulders to 24" max.
12.0	SW	3	27	9	72	4	GRAVELLY SAND, brown, dense, cobbles and boulders to 18" max.
16.0	GW GC	3	49	27	52	7	SANDY GRAVEL-CLAYEY SANDY GRAVEL, red-brown, dense, cemented, cobbles, and boulders to 24" max.

April 1970

TT 70-36

DEPTH		MC	LL	PI	-4	-100	UW	
2.0	SP SM	1			61	10	118.5	GRAVELLY SAND-SILTY GRAVELLY SAND, gray-brown, loose, cobbles and boulders to 18" max.
3.0	SM	1			87	14		2.0
5.0	GP	2			40	4	112.0	SILTY SAND, brown and gray, gravel to 1½" max.
7.0	SW SM	1			85	7	114.5	3.0
10.0	GP	1			58	2		SANDY GRAVEL, gray, cobbles and boulders to 15" max. 5.0
12.0	SW SM	2		NP	59	5	115.6	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, cemented, cobbles and boulders to 18" max. 7.0
14.0	GP	2	29	12	31	2		SANDY GRAVEL, brown, dense, cobbles and boulders to 30" max. 10.0
15.0	SW-SC	2	26	10	87	8	119.5	
16.0	GP-GC	3	33	15	21	5		GRAVELLY SAND-SILTY GRAVELLY SAND, brown, slight cementation, cobbles and boulders to 20" max. 12.0
18.0	SW SC	2	34	15	58	6	138.2	
20.0	GP GC	2	50	31	24	5		SANDY GRAVEL, brown, open gravel, cobbles to 12" max. 14.0
23.0	GC	4	37	18	52	13		SAND - CLAYEY SAND, brown, dense. 15.0
26.0	GP GC	11	88	55	31	9		SANDY GRAVEL-CLAYEY SANDY GRAVEL, brown, dense. 18.0
								GRAVELLY SAND-CLAYEY GRAVELLY SAND, brown, cemented, gravel and cobbles to 7" max. 18.0
30.0	GC	7	81	49	33	19		SANDY GRAVEL-CLAYEY SANDY
		4	40	22	34	15		GRAVEL, red-brown, open gravel,
31.0	SC	5	41	17	74	22		cobbles to 9" max. 20.0
36.0	Bed-rock	5	32	7	-	-		CLAYEY SANDY GRAVEL, red-brown, dense, cobbles and boulders to 30" max. 23.0
								SANDY GRAVEL-CLAYEY SANDY GRAVEL, red-brown, open gravel, cobbles to 18" max. 26.0
								SANDY CLAYEY GRAVEL, brown, open gravel, cobbles and boulders to 15" max. 30.0
								CLAYEY GRAVELLY SAND, green and red contact zone. 31.0
								SCHIST, green, red and brown, highly fractured, easily ripped. 36.0

July 1970

TT 70-37

DEPTH		MC	LL	PI	-4	-200	
3.0	SC	2	45	21	72	32	GRAVELLY CLAYEY SAND, red, dense, angular fragments to 3" max.
6.0	GC	3	34	14	44	17	CLAYEY SANDY GRAVEL, brown, dense, angular fragments to 3" max.
8.0	GP	2		NP	22	4	SANDY GRAVEL, tan to white, highly caliche cemented.
11.0	SM	2	23	3	56	14	SILTY GRAVELLY SAND, tan, highly caliche cemented.

July 1970

TT 70-39

DEPTH		MC	LL	PI	-4	-200	
1.0	GM	1		NP	49	26	SILTY GRAVELLY SAND, light brown
4.0	Bed-rock	1					SCHIST, green, red and brown, fractured, hard at 4 ft.

July 1970

SPILLWAY

TT 70-25

DEPTH		LL	PI	
				SCHIST, gray and brown, very platey and easily ripped
	Bed-rock	24	4	red and green, easily ripped
25.0				gray, green and red, some soft zones, some blocky but breaks down easily.

April 1970

DIKE NO 1

TT 70-38

DEPTH		MC	LL	PI	-4	-200	
1.0	GC	3	28	9	43	20	CLAYEY SANDY GRAVEL, red-brown, dense.
4.0	Bed-rock	2					SCHIST, red to gray and green, fractured, hard at 3 ft

July 1970

DIKE NO. 3

TH 70-89

DEPTH		MC	LL	PI	-4	-200	N	UW	
2.0	CL	4	33	12	100	78	10	83+	SANDY CLAY, brown, stiff.
5.0	ML	8	41	8	96	71	36		SANDY SILT, brown and tan, cemented with caliche
							56		
8.0	MH	10	50	18	96	61	60+		
10.0	CH	8	50	22	97	68	60+	X	SANDY CLAY, tan, very hard drilling.
								X	

June 1970

TH 70-90

DEPTH		MC	LL	PI	-4	-200	N	UW	
4.0	CL	7	37	14	91	69	10	89.0	SANDY CLAY, brown, stiff to hard.
		7	40	16	89	63	50		SANDY SILT, tan, dense to very dense, cemented hard drilling
7.5	ML	7	49	17	94	67	55		
							57		
10.5	SM	5	45	17	85	46	50		GRAVELLY SILTY SAND, brown, very dense, gravel to 1" max.
							60+		
							60+		

June 1970

TH 70-91

DEPTH		MC	LL	PI	-4	-200	N	UW	
3.0	CL	9	35	15	95	78	10	81.8	SANDY CLAY, brown, stiff to hard
							33		
4.0	SC	7	44	18	79	41	X		GRAVELLY CLAYEY SAND, tan, cemented, hard drilling.
8.0	MH	11	52	21	94	60	X		SANDY SILT, tan, cemented, hard drilling
10.0	CH	9	50	22	100	76	X		SANDY CLAY, tan, cemented, hard drilling.
							X		

June 197

TH 70-92

DEPTH		MC	LL	PI	-4	-200	N	UW	
1.0	CH	15	59	33	86	72	13	83.9	SANDY CLAY, brown, stiff.
3.0	CH	11	63	36	100	86	—		CLAY, brown, cemented, hard drilling
4.0	SC	5	53	28	65	28	X		CLAYEY GRAVELLY SAND, tan, cemented, cobbles to 4" max
							X		
9.0	SC	5	34	13	73	24	X		GRAVELLY CLAYEY SAND, tan, hard drilling cobbles to 4" max.
							X		

June 1970

Notes:

4. All test trenches were excavated using a DB tractor type dozer equipped with a hydraulic blade and rippers.
5. All test holes were drilled using a bucket type power auger equipped with a 16" bucket.
6. No ground water was encountered.
7. Holes were drilled during the month: indicated at the bottom of the log.

VERT. SCALE 5 0 5 10 15 FEET

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: HDA
DRAWN BY: J.V.
CHECKED BY: LJL

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

DAM, DIKE NO. 1, NO. 3, AND SPILLWAY
FOUNDATION EXPLORATION
SOIL LOGS

SUBMITTED BY:
CHIEF, FOUND & MAT'LS BRANCH
DATE:

SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO. 242/184

SHEET OF

PLATE 22

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS

TH 70-38

		MC	LL	PI	-4	-200	N	
	SM	1	20	NP	83	17	8	GRAVELLY SILTY SAND, brown loose
3.0							7	
	SW SM	1	19	NP	89	8	17	SAND-SILTY SAND, brown, medium dense
5.0	SC	3	30	15	87	18	56	CLAYEY SAND, brown, hard.
7.5		9	25	18	88	37	52	
	SM SC	3	22	6	78	37	X	GRAVELLY SILTY SAND - GRAVELLY CLAYEY SAND, brown, cemented, cobbles at 9.5 ft.
9.5								
	SC	10	40	20	82	32	X	GRAVELLY CLAYEY SAND, tan, cemented, gravel to 3" max.
13.0								
	GC	11	38	16	48	20	X	CLAYEY SANDY GRAVEL, brown, cemented, gravel and cobbles to 5" max.
15.5								

May 1970

TH 70-39

		MC	LL	PI	-4	-200	N	
1.0	CL	11	45	19	97	71	35	SANDY CLAY, brown, medium dense.
	SC	6	37	14	65	27	-	CLAYEY GRAVELLY SAND, grayish-white, medium
4.0							X	dense, highly cemented, gravel and cobbles 5" max.
	SM	6	40	12	75	14	-	SILTY GRAVELLY SAND, grayish-white, medium
8.0							-	dense, caliche cemented.
9.0	SW	3		NP	81	4	-	GRAVELLY SAND, gray and brown, loose.
	GW GM	2	25	NP	41	6	60	SANDY GRAVEL-SILTY SANDY GRAVEL, whitish-gray, medium dense, highly
13.0								cemented, cobbles and boulders 18" max.
	GW GC	3	21	4	51	9		SANDY GRAVEL-CLAYEY SANDY GRAVEL, whitish-gray, medium dense, highly
16.0								cemented, cobbles and boulders 18" max.

May 1970

TH 70-40

		MC	LL	PI	-4	-200	N	U.W.	
	SC	5	51	25	79	30	57		GRAVELLY CLAYEY SAND, red-brown, hard, gravel to 3/4" max.
3.0							60+	99.0	
	SM	7	36	8	89	21	X		SILTY SAND, tan, cemented, gravel to 1/4" max.
6.5							X		CLAYEY GRAVELLY SAND, tan, cemented, cobbles and boulders to 18" max.
	SC	4	51	23	80	16	X		
8.0									
	SC	5	40	15	75	19			
13.5		3	36	14	74	22			cemented cobbles at 13.5'

May 1970

TH 70-41

		MC	LL	PI	-4	-200	N	U.W.	
	SM	3	21	NP	89	36	4		SILTY SAND, light brown, loose, gravel to 1/4" max.
3.0							9	97.8	
	SM	7	43	14	82	22	46		GRAVELLY SILTY SAND, tan, caliche cemented, gravel to 1/2" max.
6.0							44		
8.0	SC	4	44	19	86	21	18		CLAYEY SAND, tan medium dense, gravel to 3/4" max.
							45		
	ML	6	42	14	98	57	60+		SANDY SILT, tan, caliche cemented
12.0							60+		
14.5	SC	6	40	15	85	25	X		GRAVELLY CLAYEY SAND, tan, highly cemented, gravel to 1 1/2" max.
	SM	4	28	NP	95	35	X		SILTY SAND, tan, highly cemented, hard drilling.
18.0							X		
	ML	8	27	NP	99	64	X		SANDY SILT, tan, highly cemented, cobbles to 4" max.
21.0									
23.0	SM SC	4	28	6	80	27			GRAVELLY SILTY SAND, GRAVELLY CLAYEY SAND, tan, highly cemented, cobbles to 6" max.
24.5	SW SM	2	20	NP	71	11			GRAVELLY SAND-SILTY GRAVELLY SAND, gray, caving, cobblet to 5" max.

May 1970

A 16" boulder at 24.5 ft

TH 70-42

		MC	LL	PI	-4	-200	N	
	SM	1	21	NP	81	20	5	GRAVELLY SILTY SAND, brown, loose to medium dense.
4.0							14	
	SC	4	31	12	86	25	17	CLAYEY SAND, brown, medium dense
8.0							8	
							17	
	SM	6	44	14	92	23	60+	SILTY SAND, tan, medium dense, cemented
15.0							X	
		8	37	10	90	19	X	
17.0	SM	7	28	NP	77	15	X	SILTY GRAVELLY SAND, gray-white medium dense, highly cemented with caliche, gravel to 3" max.
	SW	2		NP	64	10		
	SM							GRAVELLY SAND-SILTY GRAVELLY SAND, gray, loose, gravel 3" max., extreme caving.
23.0		2	21	1	63	9		

May 1970

TH 70-43

		MC	LL	PI	-4	-200	N	
	SM	5	30	6	93	43	9	SILTY SAND, light tan, some small gravel.
		6	40	10	91	21	X	
5.0							X	
	SC	6	74	44	92	21	X	CLAYEY SAND, brown, highly cemented, gravel 1/2" max.
		5	50	27	86	24	60+	
10.0							60+	SILTY SAND, tan, very highly cemented, some small gravel
	SM	6	43	16	94	32	X	
14.0							X	CLAYEY SAND, tan, highly cemented, some small gravel
	SC	7	35	11	97	49	X	
18.0								SILTY SAND, tan, highly cemented with caliche, gravel 1/2" max.
	SM	3		NP	89	20	X	
23.5		7	30	NP	95	40	X	
26.0	CL	12	38	18	100	66		SANDY CLAY, brown, cemented, very hard.
	SC	3	26	8	81	16		CLAYEY GRAVELLY SAND, tan, dense, gravel and cobbles 5" max. caving
		2	28	12	74	14		
34.0		4	43	23	65	15		

May 1970

TH 70-44

		MC	LL	PI	-4	-200	N	
	SC	3	35	17	96	42	5	CLAYEY SAND, brown, loose, some small gravel
		3	32	16	90	25	25	
5.5							21	
		9	38	8	96	24	46	SILTY SAND, light tan, highly cemented with caliche, very hard
							X	
		8	39	9	97	31	X	
							X	
	SM	6	42	12	90	25	X	
		8	43	15	87	22		
		8	38	11	96	38	X	
		6	27	NP	89	38	X	
26.0		2		NP	86	17		
28.0	SM SC	3	27	6	90	24		SILTY SAND-CLAYEY SAND, brown, dense, gravel 1 1/4" max.
31.0	CL	10	42	20	99	73		SANDY CLAY, brown, very hard.

May 1970

TH 70-45

		MC	LL	PI	-4	-200	N	
	ML CL	4	27	7	96	53	10	SANDY SILT - SANDY CLAY, brown, firm, some small gravel
2.0							60+	
4.0	SM	4	36	10	84	33	X	GRAVELLY SILTY SAND, tan, cemented, gravel 1" max.
		7	46	18	97	40	X	SILTY SAND, light tan, highly cemented, some small gravel.
8.0	SM						X	
	SC	7	43	18	89	24	60+	CLAYEY SAND, light tan, highly cemented, gravel 1" max.
11.0							X	
	SM	6	44	16	93	34	X	SILTY SAND, light tan, very highly cemented and hard, some small gravel
15.0							X	
	SC	8	42	16	82	22	X	GRAVELLY CLAYEY SAND, light tan, highly cemented
19.0								
		5	30	6	86	33	X	SILTY SAND, light tan, highly cemented.
							X	
	SM	10	26	NP	92	38	X	
							X	
30.0		6		NP	97	48	X	

May 1970

TH 70-46

		MC	LL	PI	-4	-200	N	
	SC	3	31	9	93	50	28	CLAYEY SAND, brown, medium dense, small gravel
		4	42	20	86	24	60	
							X	
		5	50	30	90	26	42	
7.0							60+	
	SM	9	50	19	84	36	X	GRAVELLY SILTY SAND, light tan, highly cemented and hard.
10.0							X	
		7	45	16	87	26	X	SILTY SAND, light tan, highly cemented, hard gravel 1" max.
	SM						X	
		5	48	12	86	19	X	
16.0							X	
	SC	5	49	30	92	41	60+	CLAYEY SAND, brown, very hard, some small gravel
19.0							X	
	CL	8	43	25	100	73	-	SANDY CLAY, brown, dense, very hard.
23.0							X	
25.0	SM	6		NP	88	30	-	SILTY SAND, tan, very dense, some small gravel
							60+	
27.0	SM	3	24	NP	82	17		SILTY GRAVELLY SAND, tan, very dense, gravel 1/2" max.
30.0	CL	11	49	26	100	51		SANDY CLAY, brown, hard.

June 1970

TH 70-47

		MC	LL	PI	-4	-200	N	
	SM	2		NP	83	27	6	GRAVELLY SILTY SAND, brown, loose to medium dense, small gravel.
2.5							36	
5.0	SC	10	49	31	94	49	43	CLAYEY SAND, brown, hard, some small gravel
							60+	
	SM	6		NP	92	28	X	SILTY SAND, gray-white, highly cemented with caliche, gravel 1" max.
9.0							X	
12.0	SM	3	29	6	82	14	60	SILTY GRAVELLY SAND, gray-white, cemented, gravel to 1 1/2" max.
	SC	3	40	20	79	13	60+	
15.0							60+	CLAYEY GRAVELLY SAND, brown, cemented, gravel 1" max.
	SC	7	42	17	92	36	X	CLAYEY SAND, tan, highly cemented with caliche, very hard.
21.0		8	41	17	90	29	X	
	SC	9	39	14	78	31	X	GRAVELLY CLAYEY SAND, light brown, highly cemented very hard.
25.0							X	SILTY SAND, light tan, highly cemented, hard
28.0	SM	6	30	6	90	46	X	CLAYEY SAND, light tan, highly cemented, hard.
30.0	SC	6	25	9	90	44	60+	

June 1970

TH 70-50

		MC	LL	PI	-4	-200	N	U.W.	
	SM	3		NP	90	24	5	100.5	SILTY SAND, brown, loose to medium dence, gravel to 1/2" max.
3.0							12		
5.0	GM	4	42	14	80	17	24		SILTY GRAVELLY SAND, brown, medium dense, gravel to 1/2" max.
	SP SC	4	47	21	70	12	44		GRAVELLY SAND-CLAYEY GRAVELLY SAND, brown, dence, gravel to 1" max.
7.0							X		
	SM	9	52	18	84	22	X		
11.0							X		GRAVELLY SILTY SAND, gray, caliche cemented
		7	44	20	98	47	X		
	SC						X		CLAYEY SAND, tan, caliche cemented, hard drilling
		8	37	15	91	14	X		
17.0									
	SC	8	46	22	76	22			CLAYEY GRAVELLY SAND, tan, caliche cemented, cobbles to 8" max.
20.0		5	50	28	69	21			

June 1970

TH 70-57

		MC	LL	PI	-4	-200	N	
	SM	2		NP	79	22	7	GRAVELLY SILTY SAND, brown, loose, some small gravel
3.0							9	
	SP SC	2	30	14	75	10	9	GRAVELLY SAND-CLAYEY GRAVELLY SAND, brown, loose, gravel to 1" max.
5.0							25	
	CL	6	35	16	94	95	40	SANDY CLAY, brown, very stiff, slight cementation
8.0							60+	GRAVELLY CLAYEY SAND, red-brown, highly cemented, gravel to 1 1/2" max.
10.5	SC	4	48	27	83	20	60+	
12.0	SM	12	48	18	95	46	X	SILTY SAND, tan, highly cemented with caliche
	SM	8	41	11	71	22		SILTY GRAVELLY SAND, tan, cemented, gravel and cobbles to 8" max, 1-1/4" boulder
15.5								

June 1970

Boulders at 15.5'

Notes:

3. All test holes were drilled using a bucket-type power auger equipped with a 16" bucket.
4. No ground water was encountered.
5. Holes were drilled during the month indicated at the bottom of the log.

TH 70-58

		MC	LL	PI	-4	-200	N	U.W.	
	SM	2	32	7	90	28	5		SILTY SAND, tan, loose to dense, gravel to 1" max
3.5							34	94.0	CLAYEY SAND, red-brown, caliche cemented, gravel to 1/4" max
5.0	SC	3	64	33	90	30	41		
	GM	9	40	14	53	13	60+		SILTY SANDY GRAVEL, tan, highly cemented with caliche.
8.0							X		
	SM	8	56	20	87	26	X		SILTY SAND, tan, cemented, cobbles to 7" max.
11.0		6	54	19	86	26	-		CLAYEY GRAVELLY SAND, tan, cemented, cobbles to 6" max.
13.0	SC	4	35	18	82	22	-		GRAVELLY SAND-CLAYEY GRAVELLY SAND, tan, cemented, cobbles and boulders to 16" max. 1-24" boulder.
15.5	SP SC	3	28	7	58	12	-		
17.0	GM SC	2	23	6	72	14			
17.5	SW SM	2		NP	93	4			SILTY GRAVELLY SAND-CLAYEY GRAVELLY SAND, tan, cemented, gravel to 3" max.
19.0	GW SM	2	20	3	77	12			SAND, brown, loose, some cemented.
									GRAVELLY SAND-SILTY GRAVELLY SAND, tan, cemented, cobbles to 11" max.

June 1970

cemented cobbles at 19.0'

TH 70-59

		MC	LL	PI	-4	-200	N	
	SM	4	44	12	82	28	21	GRAVELLY SILTY SAND, tan, medium to very dense, cemented below 2', small gravel
3.0							60+	
		6	45	14	92	34	60+	SILTY SAND, tan, highly cemented, small gravel.
7.0							X	
	SP SC	3	51	27	74	11	29	GRAVELLY SAND-CLAYEY GRAVELLY SAND, brown, medium dense, gravel to 1/4" max.
9.0								
12.0	SC	5	51	29	75	18	60+	CLAYEY GRAVELLY SAND, brown, dense, gravel and cobbles to 5" max.

June 1970

VERT. SCALE 5 0 5 10 FEET

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: H.L.L.
DRAWN BY: J.V.
CHECKED BY: L.J.L.

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS ARIZONA

CAVE BUTTES DAM
DIKE NO. 2 FOUNDATION AND BORROW AREA EXPLORATION
SOIL LOGS

SUBMITTED BY:
CHIEF FOUND. AND MAT'LS BRANCH
DATE:

SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO. 242/185

SHEET OF

PLATE 23

TH 70-34

DEPTH		MC	LL	PI	-4	-200	N	U.W.	
2.0	SM	2		NP	90	25	8	105.9	SILTY SAND, brown, loose, gravel to ½" max.
	SW SM	1		NP	84	11	16		GRAVELLY SAND- SILTY GRAVELLY SAND, brown, medium dense, gravel to 1½" max.
6.0							18		
	SC	9	46	23	86	33	28		CLAYEY SAND, brown, caliche cemented.
8.0							38		
	SC	6	42	17	84	21	60+		GRAVELLY CLAYEY SAND, tan, caliche cemented, gravel to ½" max.
10.0	SW SM	4	35	7	85	11	60+		
12.0							X		
14.0	SC	10	40	15	89	32	60+		GRAVELLY SAND- SILTY GRAVELLY SAND, brown, cemented, gravel to 1" max.
							X		CLAYEY SAND, tan, caliche cemented, hard drilling.

Zone II

May 1970

TH 70-35

DEPTH		MC	LL	PI	-4	-200	N	
	SM SC	5	23	5	94	46	4	SILTY SAND- CLAYEY SAND, brown, loose to medium dense
4.0							19	
5.0	SC	4	35	15	85	34	46	GRAVELLY CLAYEY SAND, brown, loose to medium dense
	SM	4	41	14	86	17	X	
8.0							X	SILTY SAND, brown with gray, medium dense, hard
9.0	SC	6	54	25	75	17	60+	CLAYEY GRAVELLY SAND, brown and red brown, medium dense
	SM	7	42	11	77	23	X	
							X	
		6	32	7	83	29	X	GRAVELLY SILTY SAND, white, dense, caliche cemented.
15.0							X	

Zone II

May 1970

TH 70-36

DEPTH		MC	LL	PI	-4	-200	N	U.W.	
							9	85.0	CLAYEY SAND, brown loose
		4	35	11	91	43	60+		
	SC	7	44	18	93	29	X		caliche cemented
							X		
8.0		5	44	18	86	25	X		CLAYEY GRAVELLY SAND, brown, highly cemented, hard drilling cobbles to 6" max
10.0	SC	3	42	18	79	17	X		

Zone I

May 1970

TH 70-37

DEPTH		MC	LL	PI	-4	-200	N	
	ML	6	23	NP	95	57	4	SANDY SILT, brown, medium dense, one 4" cobble
3.0							16	
	SM	5	28	3	87	40	40	SILTY SAND, brown, medium dense, very hard.
5.5							60+	SILTY GRAVELLY SAND- CLAYEY GRAVELLY SAND, tan medium dense, hard, 5" cobbles
7.5	SM SC	6	24	7	66	25	X	

Zone II

May 1970

TH 70-48

DEPTH		MC	LL	PI	-4	-200	N	
	SM SC	2	24	5	91	34	11	SILTY SAND- CLAYEY SAND, brown, loose to medium dense, small gravel
3.0							8	
5.0	SC	2	31	11	85	25	19	GRAVELLY CLAYEY SAND, brown, medium dense, gravel 1" max.
	SC	6	38	15	92	44	54	CLAYEY SAND, tan, very dense, cemented,
8.0							X	
		6	41	13	88	28	X	SILTY SAND, tan, highly cemented with caliche, very hard
	SM						X	
		8	44	12	93	46	X	CLAYEY SAND, tan, highly cemented with caliche, very hard
14.0							X	
	SC	8	43	17	94	47	X	CLAYEY GRAVELLY SAND, brown, very dense cemented, small gravel, very hard
17.0								
19.0	SC	3	38	17	80	16	60+	
21.0	SC	4	44	23	89	32	60+	CLAYEY SAND, brown cemented, very dense.

June 1970

TH 70-49

DEPTH		MC	LL	PI	-4	-200	N	
2.0	SM	4	22	2	85	29	5	GRAVELLY SILTY SAND, brown, loose, small gravel
	SC	6	35	13	88	34	13	CLAYEY SAND, tan, medium dense, small gravel
5.0							30	
		5	36	9	90	29	60+	SILTY SAND, tan, dense, to very dense, cemented with caliche.
		8	44	13	92	47	14	
							X	SILTY SAND, brown, highly caliche cemented
	SM	8	49	90	86	28	X	
							60+	
							X	
		7	37	8	96	36	X	
							60+	
		7	46	13	90	23		
20.0								

June 1970

TH 70-76

DEPTH		MC	LL	PI	-4	-200	N	U.W.	
1.5	SM	1		NP	82	23	5	102.3	GRAVELLY SILTY SAND, brown, loose, gravel to 1" max.
	SC	4	28	8	90	50	10		CLAYEY SAND, brown, medium dense
5.0							11		
		6	39	13	84	45	60+		GRAVELLY SILTY SAND, brown, cemented with caliche, hard drilling.
							60+		
	SM	4	42	12	81	24	X		
							X		
		3	40	12	82	24			
15.0	SC	9	55	28	90	39			CLAYEY SAND, brown, cemented.
17.0	SC	6	36	12	74	34	X		GRAVELLY CLAYEY SAND, tan, cemented.
	ML	8	32	5	90	70			SANDY SILT, brown, cemented. hard drilling
20.0									

Zone II

June 1970

TH 70-77

DEPTH		MC	LL	PI	-4	200	N	U.W.	
	ML	3		NP	97	56	6	102.8	SANDY SILT, brown, loose
2.0							23		
	SW SC	3	35	18	84	12	60+		GRAVELLY SAND- CLAYEY GRAVELLY SAND, brown, cemented,
4.0							X		
	SC	7	60	34	92	44	60+		CLAYEY SAND, brown, cemented
7.0							X		
	SC	9	48	26	84	43	X		GRAVELLY CLAYEY SAND, brown, cemented, gravel to 1" max.
9.0							X		
	SM	11	45	14	87	34	X		SILTY SAND, tan, cemented,
13.0									
	SC	4	42	20	89	25	X		CLAYEY SAND, brown, cemented,
17.0									
	SC	7	30	10	84	47			GRAVELLY CLAYEY SAND, white, highly cemented
20.0									

June 1970

TH 70-78

DEPTH		MC	LL	PI	-4	-200	N	
2.0	SM	5	30	18	90	44	19	SILTY SAND, brown to tan, medium dense, small gravel
	SM	5	41	13	85	28	X	GRAVELLY SILTY SAND, tan cemented, some small gravel
4.0							60+	
	SM	5	59	26	86	38	X	SILTY SAND, brown, cemented. small gravel
6.0							X	
	SM	9	50	20	85	37	X	GRAVELLY SILTY SAND, white highly cemented white caliche, hard drilling, small gravel
10.0							X	
	SC	5	42	18	91	37		CLAYEY SAND, brown, highly cemented, hard drilling, small gravel
14.0							60+	
15.5	SC	5	68	36	84	19		GRAVELLY CLAYEY SAND, red-brown, dense, gravel to 1½" max.
	SC	10	55	26	94	34		
		11	55	30	90	40		CLAYEY SAND, tan, dense, very hard drilling, some small gravel
20.0								

Zone II

June 1970

TH 70-79

DEPTH		MC	LL	PI	-4	-200	N	
1.5	CL	6	32	10	92	61	60+	SANDY CLAY, brown, very dense gravel to 1" max.
	SM	5	38	10	89	32	X	SILTY SAND, white to tan, caliche cemented, hard drilling. gravel to 1" max
5.0							X	
	SM	4	35	8	82	20	X	GRAVELLY SILTY SAND, tan, very highly cemented. some small gravel
9.5							60+	CLAYEY SAND, brown, highly cemented, hard drilling, small gravel
13.0	SC	7	67	37	11	58	X	
	SC	5	51	24	69	95	60+	CLAYEY GRAVELLY SAND, brown, highly cemented hard drilling.
15.5	SC	7	52	28	89	91		CLAYEY SAND, brown, coarse gravel and cobbles to 6" max. cobbles all?
17.0								

June 1970

Notes

3. All test holes were drilled using a bucket type power auger equipped with a 16" bucket.
4. No ground water was encountered.
5. Holes were drilled during the month indicated at the bottom of the log.

VERT SCALE 5 0 5 10 FEET

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:

DRAWN BY: J V

CHECKED BY:

SUBMITTED BY:

CHIEF FOUND. AND MATLS. BRANCH

DATE:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS ARIZONA

CAVE BUTTES DAM

DIKE NO. 2 FOUNDATION AND BORROW AREA EXPLORATION

SOIL LOGS

SPEC. NO.

SHEET

DRAWING NUMBER

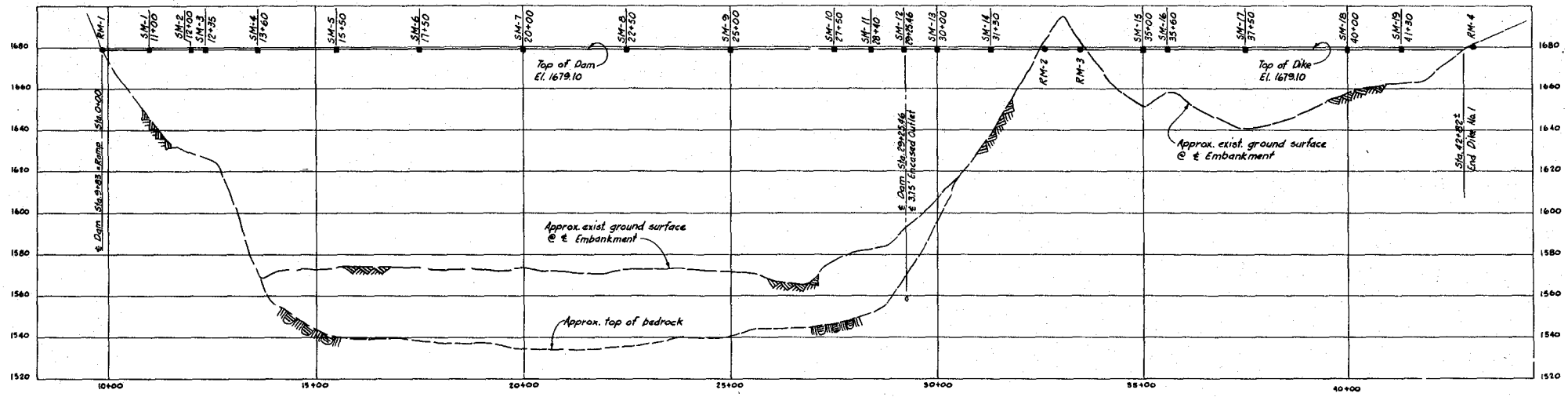
OF

DISTRICT FILE NO. 242/186

PLATE 24

U.S. ARMY ENGINEER DISTRICT

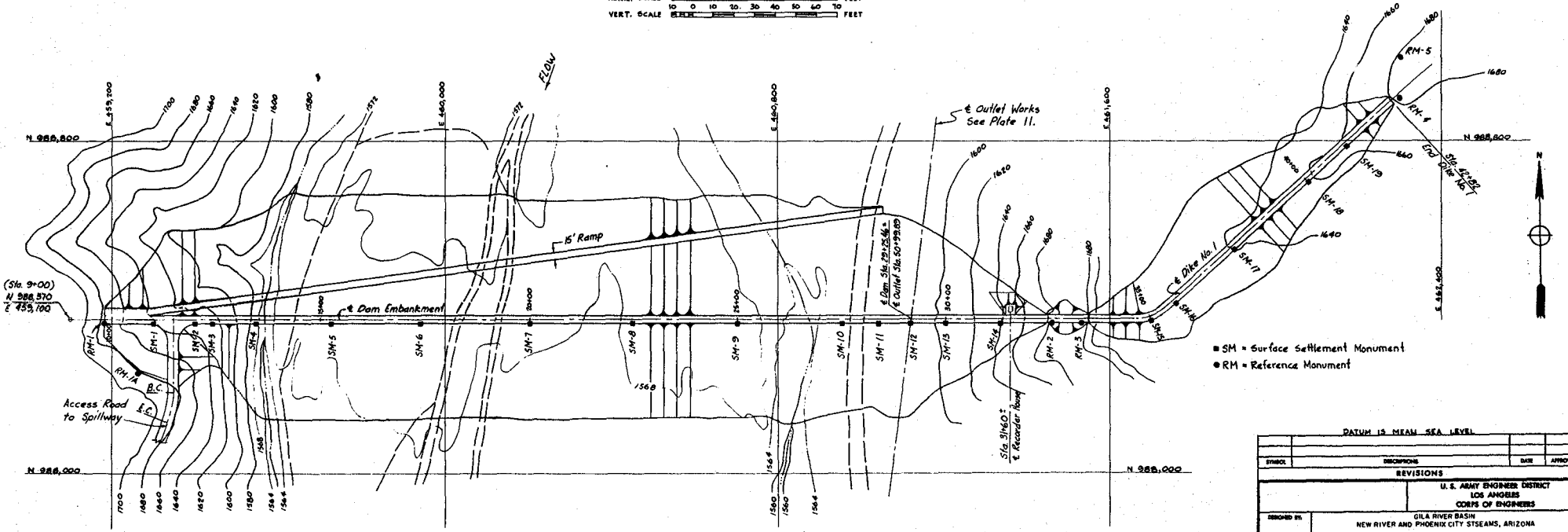
CORPS OF ENGINEERS



PROFILE

HORIZ. SCALE 100 0 100 200 300 FEET

VERT. SCALE 10 0 10 20 30 40 50 60 70 FEET



PLAN

SCALE: 1 IN.=100 FT.

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:

DRAWN BY: J.W.S.

CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STSEAMS, ARIZONA

CAVE BUTTES DAM

EMBANKMENT AND DIKE NO. 1
INSTRUMENTATION

SUBMITTED BY: CHIEF, POWER & WATER BRANCH

APPROVED: CHIEF, CA. BRANCH ENGINEER

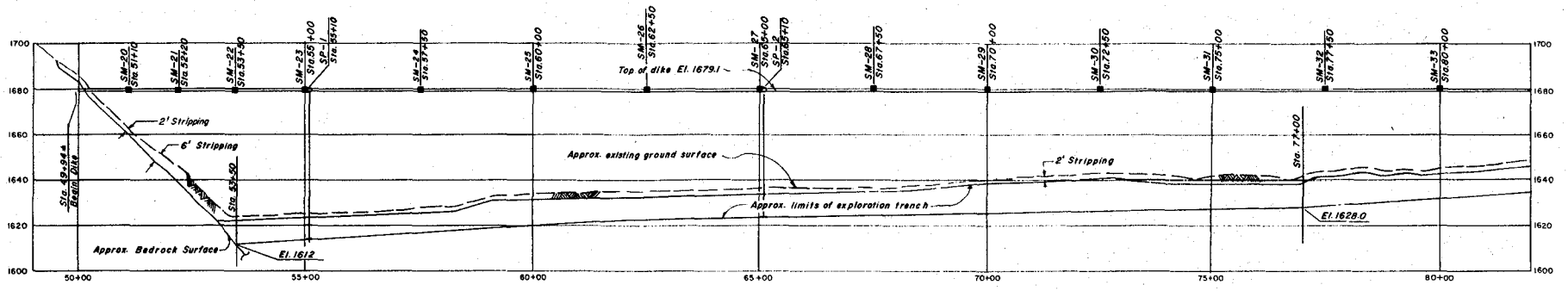
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION

SPEC. NO. DACW 09-___-b-____

DISTRICT FILE NO. 242/210

SHEET ___ OF ___ SHEETS

PLATE 25



PROFILE

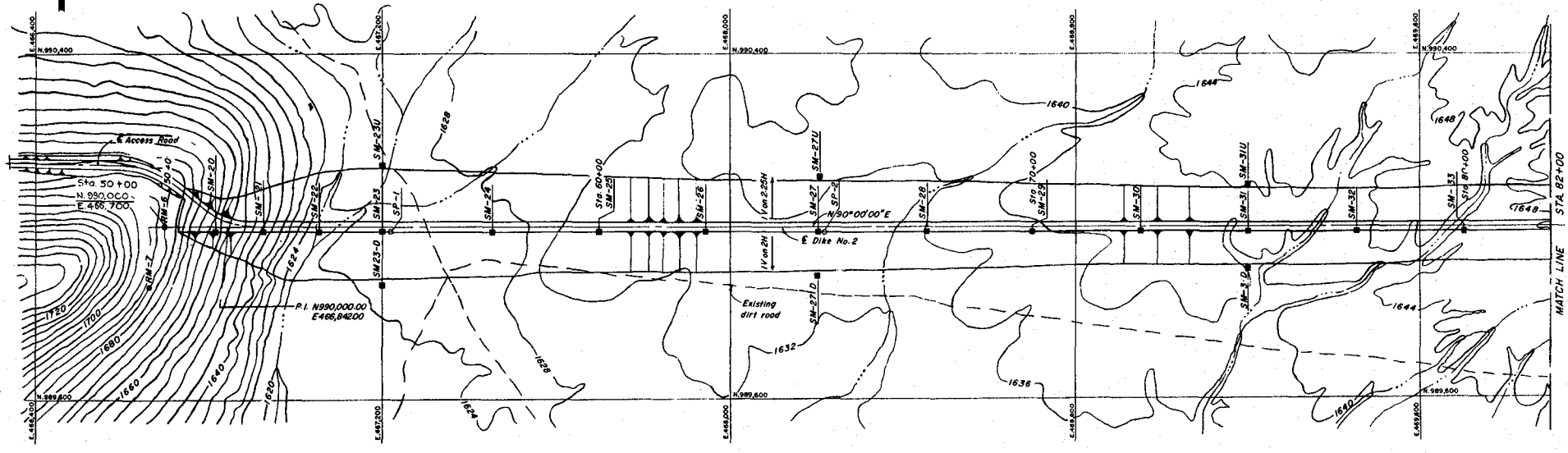
HORIZONTAL SCALE: 1 IN. = 100 FT.

100 0 100 200 300

VERTICAL SCALE: 1 IN. = 20 FT

10 0 10 20 30 40 50

NOTE:
Upstream and downstream toe settlement monuments not shown.



PLAN

SCALE: 1 IN. = 100 FT.

100 0 100 200

■ SURFACE SETTLEMENT MONUMENTS
● REFERENCE MONUMENTS
○ SETTLEMENT PLATES

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

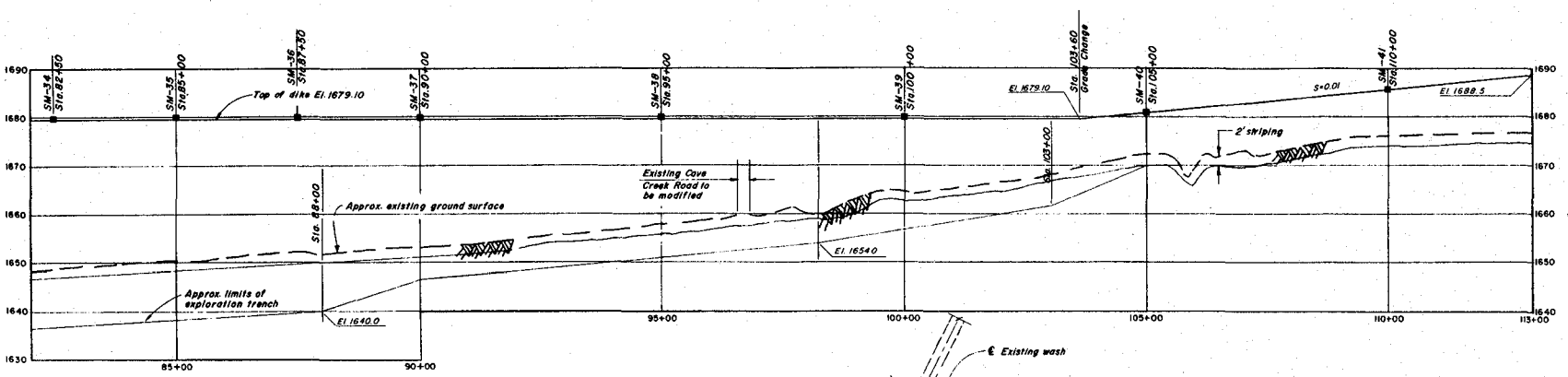
DESIGNED BY:
DRAWN BY: DRV
CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

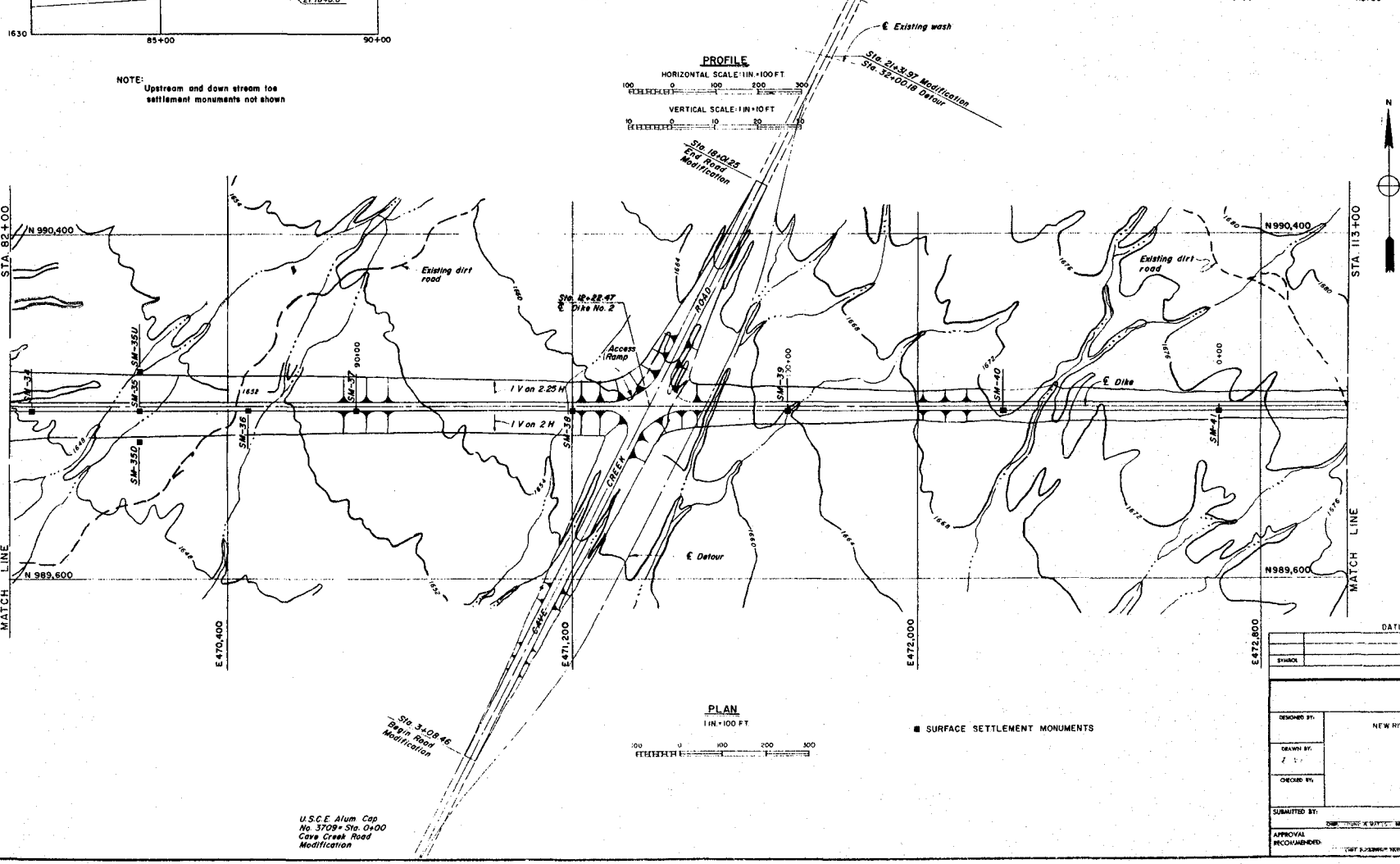
DIKE NO. 2
INSTRUMENTATION

SUBMITTED BY: CHIEF, FOUND. & MAT'LS. BRANCH
APPROVED: CHIEF, ENGINEERING DIVISION
APPROVAL RECOMMENDED: CHIEF, SOILS DESIGN SECTION
SPEC. NO. DACW09-____-____
DISTRICT FILE NO. 242/211
SHEET ____ OF ____ SHEETS



NOTE:
Upstream and down stream toe settlement monuments not shown

PROFILE
HORIZONTAL SCALE: 1 IN. = 100 FT.
100 0 100 200 300
VERTICAL SCALE: 1 IN. = 10 FT.
10 0 10 20 30



PLAN
1 IN. = 100 FT.
100 0 100 200 300

■ SURFACE SETTLEMENT MONUMENTS

Sta. 3+08.46 Begin Road Modification

U.S.C.E. Alum. Cap No. 3709+ Sta. 0+00 Cave Creek Road Modification

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

DIKE NO 2
INSTRUMENTATION

SUBMITTED BY:
CHIEF, ENGINEERING DIVISION

APPROVED:
DEPUTY FOR CONSTRUCTION

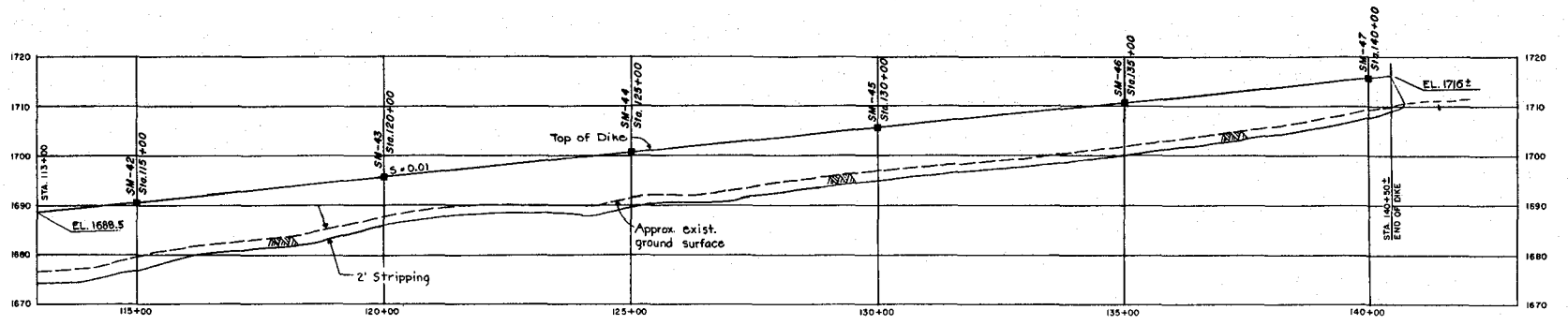
APPROVAL RECOMMENDED:
CHIEF, ENGINEERING DIVISION

SPEC. NO. DACW09-____-____

DISTRICT FILE NO. 242/212

SHEET ____ OF ____ SHEETS

PLATE 27



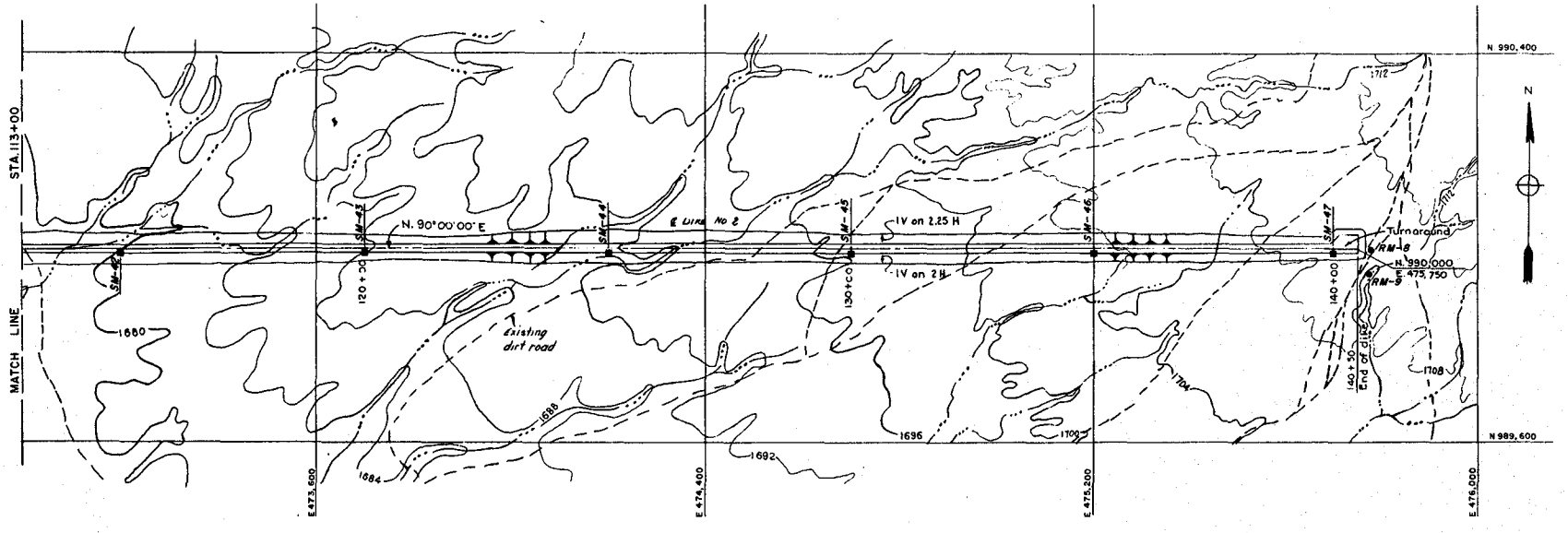
PROFILE

HORIZ. SCALE: 1 IN. = 100 FT

100 0 100 200 300

VERT SCALE: 1 IN. = 10 FT

10 0 10 20 30



PLAN

SCALE: 1 IN. = 100 FT.

■ SURFACE SETTLEMENT MONUMENTS
● REFERENCE MONUMENTS

DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:

DRAWN BY: E. L. A.

CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

DIKE NO. 2
INSTRUMENTATION

SUBMITTED BY: CHIEF, PLANS & SERVICES BRANCH

APPROVED: COLONEL, CE DISTRICT ENGINEER

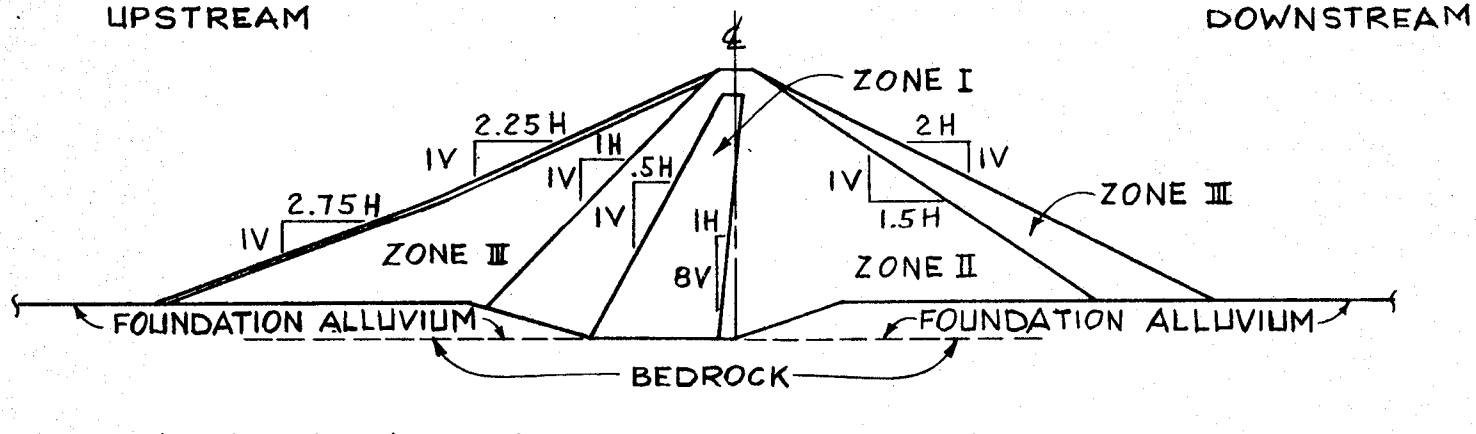
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION

SPEC. NO. DACW09-____-____

DISTRICT FILE NO. 242/213

SHEET OF SHEETS

PLATE 28



EMBANKMENT DESIGN VALUES

MATERIALS	UNIT WEIGHT*			SHEAR STRENGTH (Φ IN DEGREES & C IN T/SF)						PERM. COEFF. (K) FT./DAY	SPEC. GRAV. (G)
				"S"		"R"		"Q"			
	DRY P.C.F.	WET P.C.F.	SAT P.C.F.	Φ	C	Φ	C	Φ	C		
ZONE I	95	115	122	30	–	14	0.5	13	0.8	0.001	2.68
ZONE II	118	128	137	34	–	17	0.4	–	–	0.10	2.61
ZONE III	129	139	145	39	–	30	–	–	–	10.0	2.77
DAM FOUNDATION ALLUVIUM	129	139	145	39	–	30	–	–	–	10.0	2.77
DIKE 2 FOUNDATION (0'-8')	100	104	125	–	–	18	0.5	–	–	50.0	2.68
DIKE 2 FOUNDATION (8'-15')	110	112	130	–	–	18	1.5	–	–	3.0	2.68

* Unit Weights Shown Are Based On 95 Percent Of Maximum Dry Density.

GILA RIVER BASIN
NEW RIVER & PHOENIX CITY STREAMS, ARIZONA
CAVE BUTTES DAM

SUMMARY OF DESIGN VALUES

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

CONTROL BENCH MARKS		COORDINATES NORTHING	COORDINATES EASTING	DISTANCE	OFFSET	APRIL 1980 CARRILLO ELEVATION	DISTANCE	OFFSET	ELEVATION	DISTANCE	OFFSET	ELEVATION	DISTANCE	OFFSET	ELEVATION	DISTANCE	OFFSET	ELEVATION
TBM (1969)*	PK & LEAD					*1564.588												
TBM (1968)*	PK & LEAD					*1564.532												
RM-1A	USCE BRASS DISC.					1679.138												
RM-1	USCE BRASS DISC.					1679.859												
RM-2	USCE BRASS DISC.					1679.533												
RM-3	USCE BRASS DISC.					1679.412												
RM-5	USCE BRASS DISC.					1681.645												
#2159	USCE CONC. MON.					1590.981												
CB-20	USCE BRASS DISC.					1683.037												
RM-6	USCE BRASS DISC.					1679.806												
RM-7	USCE BRASS DISC.					1678.934												
CB-10	USCE ALUM. MON.					1678.943												
CB-11	USCE ALUM. MON.					1679.048												
RM-8	USCE BRASS DISC.					1710.888												
RM-9	USCE BRASS DISC.					1710.423												
#2153*	USCE COPPERWELD ROD	986,143.05	467,120.21															
#2154*	USCE COPPERWELD ROD	987,012.70	464,182.76															
#2155*	USCE COPPERWELD ROD	981,584.58	465,120.29															
SETTLEMENT MONUMENTS ON DAM																		
CB-1	USCE BRASS DISC.	986,377.33	459,086.79		0.00													
				96.53														
CB-2	USCE ALUM. MON.				0.00													
SM-1	USCE BRASS DISC.					1680.136												
SM-2	USCE BRASS DISC.			106.02	0.29N	1680.266												
SM-3	USCE BRASS DISC.			125.18	0.00	1680.733												
SM-4	USCE BRASS DISC.			190.01	0.04N	1681.187												
SM-5	USCE BRASS DISC.			199.62	0.05N	1681.236												
SM-6	USCE BRASS DISC.			250.95	0.05N	1681.121												
SM-7	USCE BRASS DISC.			249.37	0.04N	1681.114												
SM-8	USCE BRASS DISC.			250.12	0.02N	1681.246												
SM-9	USCE BRASS DISC.			249.67	0.03N	1681.329												
SM-10	USCE BRASS DISC.			89.91	0.07N	1681.317												
SM-11	USCE BRASS DISC.			85.49	0.04S	1681.012												
SM-12	USCE BRASS DISC.			75.28	0.02S	1680.918												
SM-13	USCE BRASS DISC.			129.31	0.02S	1680.678												
SM-14	USCE BRASS DISC.			121.71	0.00	1679.996												
CB-3	USCE ALUM. MON.				0.00													
CB-4	USCE BRASS DISC.	988,377.39	461,508.44	55.86	0.00													
SM-15	USCE BRASS DISC.			192.79	6.79S	1679.496												
CB-5	USCE ALUM. MON.	988,233.58	461,563.43		0.00													
CB-6	USCE ALUM. MON.			53.69	0.00													
SM-16	USCE BRASS DISC.			200.15	0.03N	1679.468												
SM-17	USCE BRASS DISC.			190.06	0.04N	1679.740												
SM-18	USCE BRASS DISC.			249.97	0.04N	1679.537												
SM-19	USCE BRASS DISC.			129.89	0.03N	1679.628												
RM-4	USCE BRASS DISC.			155.10	0.00	1679.859												
CB-7	USCE BRASS DISC.	989,109.20	462,523.34	320.48	0.00													
CB-8	USCE BRASS DISC.	988,891.34	466,521.22		0.00													
CB-9	USCE ALUM. MON.			129.82	0.04S													

*BASIS OF ELEVATIONS

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY: G.S.O.
CHECKED BY:

CAVE BUTTES DAM
SETTLEMENT STUDIES

SUBMITTED BY: CHIEF, BRANCH
DATE APPROVED:
SPEC. NO. DACW09-____-____
DISTRICT FILE NO. 362/175
SHEET 1 OF 2

PLATE 30

SETTLEMENT MONUMENTS ON DAM		COORDINATES NORTHING	COORDINATES EASTING	APRIL 1980 CARRILLO DISTANCE	APRIL 1980 CARRILLO OFFSET	APRIL 1980 CARRILLO ELEVATION	DISTANCE	OFFSET	ELEVATION	DISTANCE	OFFSET	ELEVATION	DISTANCE	OFFSET	ELEVATION	DISTANCE	OFFSET	ELEVATION
CB-9	USCE ALUM. MON.			160.08	0.04S													
SM-20	USCE BRASS DISC.			109.97	0.08S	1679.395												
SM-21	USCE BRASS DISC.			129.85	0.11S	1679.451												
SM-22	USCE BRASS DISC.			150.09	0.09S	1679.537												
SM-23	USCE BRASS DISC.			249.87	0.16S	1679.471												
SM-24	USCE BRASS DISC.			249.96	0.12S	1679.552												
SM-25	USCE BRASS DISC.			249.92	0.13S	1679.630												
SM-26	USCE BRASS DISC.			249.98	0.09S	1679.462												
SM-27	USCE BRASS DISC.			250.09	0.17S	1679.407												
SM-28	USCE BRASS DISC.			249.92	0.06S	1679.613												
SM-29	USCE BRASS DISC.			249.90	0.12S	1679.434												
SM-30	USCE BRASS DISC.			249.98	0.00	1679.565												
SM-31	USCE BRASS DISC.			249.95	0.02N	1679.574												
SM-32	USCE BRASS DISC.			249.93	0.04N	1679.472												
SM-33	USCE BRASS DISC.			250.07	0.13N	1679.520												
SM-34	USCE BRASS DISC.			249.89	0.03N	1679.629												
SM-35	USCE BRASS DISC.			250.06	0.08N	1679.755												
SM-36	USCE BRASS DISC.			249.87	0.06N	1679.498												
SM-37	USCE BRASS DISC.			499.96	0.06N	1679.593												
SM-38	USCE BRASS DISC.			114.66	0.03N	1679.625												
CB-10	USCE ALUM. MON.			97.87	0.03S	1679.943												
CB-11	USCE ALUM. MON.			288.23	0.00	1679.048												
SM-39	USCE BRASS DISC.			488.97	0.16S	1679.514												
SM-40	USCE BRASS DISC.			499.69	0.27S	1681.098												
SM-41	USCE BRASS DISC.			499.71	0.26N	1686.104												
SM-42	USCE BRASS DISC.			500.18	0.34N	1691.067												
SM-43	USCE BRASS DISC.			500.00	0.05N	1696.057												
SM-44	USCE BRASS DISC.			499.72	0.58N	1700.788												
SM-45	USCE BRASS DISC.			500.05	1.12N	1706.064												
SM-46	USCE BRASS DISC.			499.77	0.10N	1710.975												
SM-47	USCE BRASS DISC.			351.41	0.00	1715.990												
CB-12	USCE ALUM. MON.			114.94	0.00													
CB-13	USCE ALUM. MON.	989,989.32	476,165.52		0.00													
CB-14	USCE BRASS DISC.	989,875.31	466,650.14	105.52														
CB-15	USCE ALUM. MON.			447.04	0.00													
SM-23D	USCE BRASS DISC.			997.80	7.82S	1623.199												
SM-27D	USCE BRASS DISC.			1000.36	0.03N	1633.484												
SM-31D	USCE BRASS DISC.			999.69	1.29S	1639.472												
SM-35D	USCE BRASS DISC.			1107.51	0.00	1649.048												
CB-16	USCE ALUM. MON.			52.32	0.00													
CB-17	USCE ALUM. MON.	989,929.55	471,360.07															
CB-21	USCE ALUM. MON.	990,132.56	466,724.25	106.91	0.00													
CB-20	USCE BRASS DISC.			371.64	0.00	1663.037												
SM-23U	USCE BRASS DISC.			997.79	2.92N	1627.937												
SM-27U	USCE BRASS DISC.			1001.04	0.00	1636.260												
SM-31U	USCE BRASS DISC.			999.31	3.03N	1643.531												
SM-35U	USCE BRASS DISC.			1174.92	0.01S	1651.013												
CB-19	USCE ALUM. MON.			46.43	0.00													
CB-18	USCE BRASS DISC.	990,059.26	471,921.71		0.00													
CB-22	USCE BRASS DISC.	991,348.52	461,665.29															

*BASIS OF ELEVATIONS

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:

DRAWN BY: G.A.D.

CHECKED BY:

CAVE BUTTES DAM
SETTLEMENT STUDIES

SUBMITTED BY: CHIEF, BRANCH

DATE APPROVED:

SPEC. NO. DACW09-____-R-____

DISTRICT FILE NO. 362/176

SHEET 2 OF 2

PLATE 31