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Engineers and Geoscientists



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GEOTECHNICAL INVESTIGATION  
PROPOSED DANT BOULEVARD DETENTION DAM  
RENO, NEVADA

HLA Job No. 0843,149.05

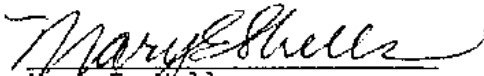
A Report Prepared for

Kennedy/Jenks/Chilton  
160 Hubbard Way, #2  
Reno, Nevada 89502

GEOTECHNICAL INVESTIGATION  
PROPOSED DANT BOULEVARD DETENTION DAM  
RENO, NEVADA

HLA Job No. 0843,149.05

by



Mary E. Wells  
Staff Engineer



Scott S. Smith  
Civil Engineer - 6853 (NV)

Harding Lawson Associates  
940 Matley Lane  
Reno, Nevada 89502  
(702) 329-6123

October 27, 1988

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PLATES

DISTRIBUTION

## I. INTRODUCTION

This report presents the results of our soil investigation at the site of the proposed Dant Boulevard Detention Dam. The embankment will serve a dual purpose. It will extend the existing Dant Boulevard to the south into the Lakeridge Development and serve as a flood and debris detention structure. It will be an approximately 50 feet high and 500 feet long earthfill structure. The borrow for the embankment will come from an area immediately east and southeast. The location of the embankment and borrow areas are shown on Plate 1.

The outlet pipe will be a 42-inch diameter reinforced concrete pipe (RCP). It will be constructed as a positive projection pipe and bedded in Type II base material.

The emergency spillway will be constructed over the embankment. It will pass under the road as a double box culvert. The box culvert will discharge into a lined concrete U-channel spillway. Spillway walls will be backfilled and will vary in height from 4 feet near the road to 15 feet at the concrete stilling basin.

The scope of our services included:

- Excavation, logging, and sampling seven (7) test pits within the proposed embankment area.
- Excavation, logging, and sampling six (6) test pits within the proposed borrow area.
- Surface geologic mapping within the embankment area.
- Laboratory classification testing of potential borrow soils.

- Analysis of field and laboratory data.
- Preparation of a written report including:
  1. Summary logs of test pits.
  2. Geology map of embankment area.
  3. Summary of laboratory test results.
  4. Conclusions and recommendations with regard to:
    - Site Preparation
    - Embankment Construction and Stability
    - Outlet Works
    - Emergency Spillway

## II. FIELD AND LABORATORY INVESTIGATION

A total of seven test pits (Pits 1 through 7) were excavated within the embankment area, at locations approximately shown on Plate 2. Six additional test pits (Pits 8 through 13) were excavated within the proposed borrow area, at locations shown on Plate 1. The test pits were excavated to depths varying from 8 to 12 feet below existing grade. The subsurface materials exposed in the pits were logged by our engineering geologist who also mapped the surface geology in the embankment area. Selected bulk (disturbed) samples of the subsurface materials were obtained and returned to our laboratory for testing.

The geologic map is shown on Plate 3. Summary logs of the subsurface materials encountered in the test pits are presented on Plates 4 through 10. The soils were classified in accordance with the ASTM D2487-85 Soil Classification System described on Plate 11.

Representative samples of the soils were tested for plastic limit, liquid limit, and grain size. The results of these tests are summarized on Plates 12 through 15 and on the test pit logs.

### III. SURFACE AND SUBSURFACE CONDITIONS

#### A. Embankment Area

The slopes forming the abutments on the north and south side are both approximately 30 feet high. The right abutment is sloped at approximately 2:1 (horizontal:vertical). The left abutment slope varies but has an average slope of approximately 3:1. The drainage area in the center is approximately 150 feet wide. The area is covered with sparse vegetation consisting of sagebrush and grass. Isolated large brush is located along the current drainage courses.

Our engineering geologist mapped the surface exposures at the site of the embankment. As shown on the geologic map, the site is mainly underlain by alluvial fan soils of the Peavine Mountain. These soils were encountered at the surface in Test Pits 1 through 4. The soils encountered were generally very dense, dry to moist, brown, well-graded gravel with sand, overlying a stiff to hard, moist, brown sandy silt containing gravel. A thin veneer of loose to medium dense, silty sand and soft, sandy silt capped the subsurface soils at Test Pits 1 and 2, respectively.

Artificial fill soils were encountered to a depth of approximately 2-1/2 feet in Test Pit 5 and to the full depth in Test Pits 6 and 7. The fill soils are generally loose and soft and not suitable to support the proposed embankment in their current state. The fill was

most likely placed as part of the housing and street construction north of the embankment area.

B. Borrow Area

The borrow area slopes gently to the northeast at approximately 10 percent. It is covered with sparse sagebrush and grass.

The subsurface materials encountered in the test pits consisted mainly of a very dense, dry, well-graded gravel with sand, silt and cobbles. Cemented layers of this formation were encountered below a depth of approximately 2 feet in Test Pits 8, 9, 10, and 11. Refusal was encountered at approximately 8 feet in Test Pits 8, 12, and 13. An approximately 2-foot thick upper layer of a very stiff, dry, sandy lean clay with gravel was encountered in Test Pits 8 and 12. An approximately 2-foot thick upper layer of dense, dry, clayey sand with gravel was encountered in Test Pit 13.

#### IV. CONCLUSIONS AND RECOMMENDATIONS

##### A. Site Preparation

The existing fill soils located on the left abutment are not suitable to support the proposed embankment. These soils should be removed to expose native, natural, dense soils. The removal of fill should extend horizontally beyond the embankment a distance equal to the depth of fill at the toe of the embankment.

The area upon which embankment or structures are to be placed should be cleared, grubbed, and stripped to remove brush, roots, organic soils, and any existing improvements. It is estimated that the stripping depth required will vary between 3 to 6 inches. Areas to receive fill should then be scarified to a depth of 6 inches, conditioned to a moisture content near optimum, and compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557-78. If the scarification turns up a significant amount of boulders, the subgrade can be prepared by proof rolling to a non-yielding surface. Abutment areas steeper than 5:1 (horizontal:vertical) should be benched into competent natural soils a minimum horizontal distance of 5 feet before embankment is placed.

B. Embankment Construction

The soils encountered in the test pits within the proposed borrow area are suitable as embankment fill. The fill soils encountered in the left abutment area may be reused as embankment fill. The sandy clay and clayey sand soils encountered in the borrow area should not be allowed within 2 feet of the proposed Dant Boulevard roadbed. The borrow area should be stripped of all vegetation before excavation commences. We estimate this excavation depth may vary from 3 to 6 inches.

The embankment fill should be placed in approximately horizontal lifts with a maximum loose thickness of 8 inches. Rocks greater than 8 inches in least dimension should either be screened before placement or raked and disposed of over embankment slopes. No deleterious material should be allowed in the fill. The fill should be compacted to a minimum of 90 percent relative compaction near optimum moisture content as determined by the ASTM D1557-78 method.

C. Outlet Pipe and Spillway

The natural soils at the proposed embankment location will provide adequate support for the RCP outlet pipe. We recommend cut-off collars be constructed around the outlet pipe. The collars should penetrate a minimum of 12 inches into the native soils.

The concrete spillway can be founded on either the compacted embankment soils or native, stiff or dense soil. We recommended the spillway walls be backfilled with a well graded soil meeting the following specification:

Maximum Size	Less than 1 inch
Liquid Limit	Less than 40
Plastic Limit	Less than 10
Passing No. 200 Sieve	Less than 40%
	Greater than 15%

If backfilled with this material, the cantilevered walls can be designed for an equivalent fluid density of 35 pounds per cubic foot, if the backfill surface is level and adequate drainage is provided so that hydrostatic pressures are not developed.

## V. EMBANKMENT DESIGN

It is proposed to construct the embankment with upstream and downstream slopes of 3:1. This is a very conservative slope with respect to slope stability. As an example, if it is conservatively assumed the compacted embankment materials have shear strength parameters consisting of an internal friction angle of 32 degrees and an apparent cohesion of 100 pounds per square foot, published charts predict a factor of safety of approximately 2.0. This factor of safety assumes a line of seepage is not formed within the embankment. We believe however that this assumption is valid since the embankment will impound water for a period of 1 or 2 days, at the most. This is not sufficient time for significant seepage to develop within the embankment because of the well graded nature of the proposed embankment materials. For this same reason, we do not see the need to incorporate internal seepage controls within the embankment structure.

A twelve inch thick layer of rip-rap will be placed on the upstream and downstream slopes. Given the small size of the rip-rap and the proposed 3:1 slopes, it is our opinion the rip-rap can be placed directly on the embankment face after the face has been proof rolled.

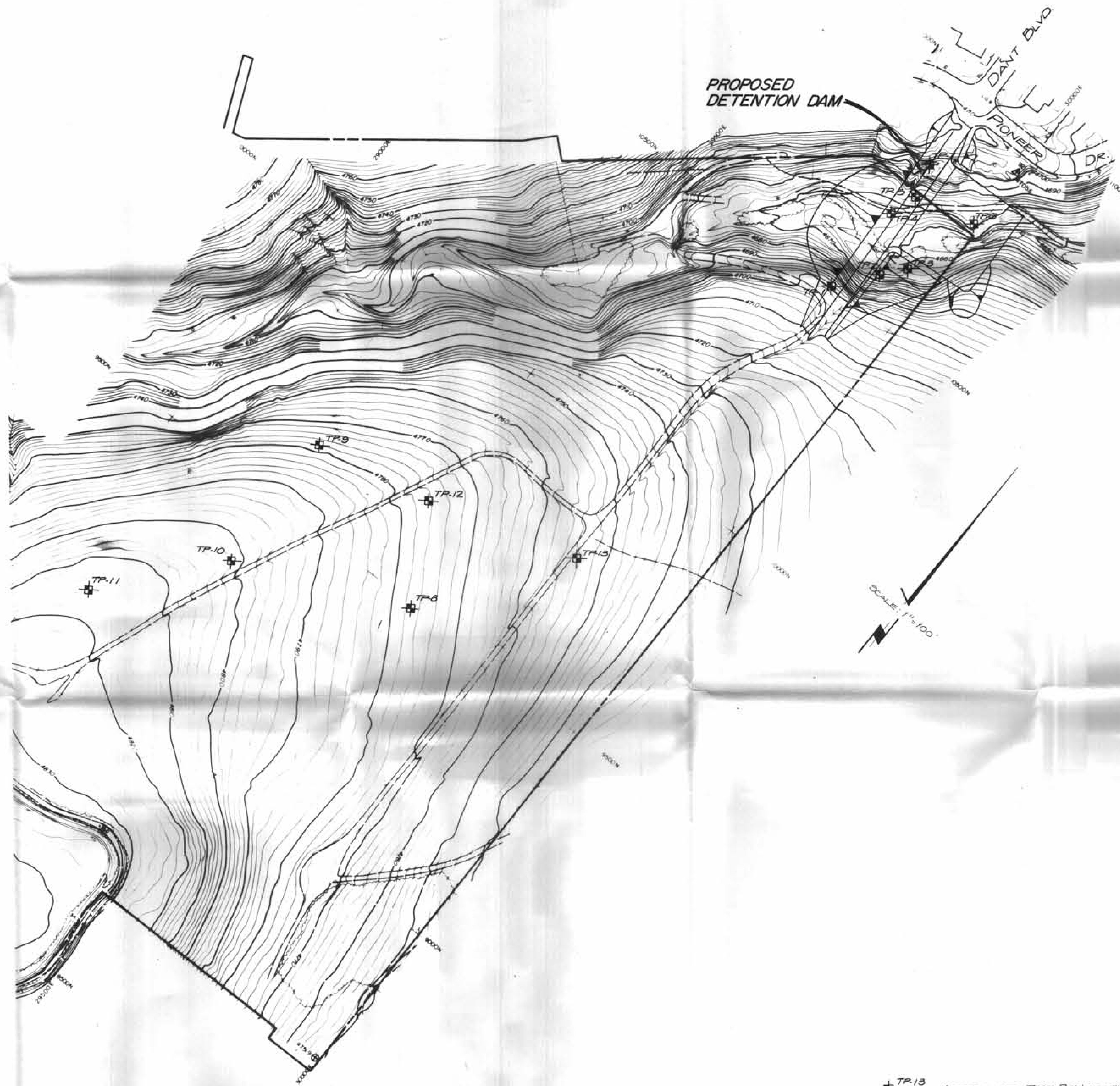
## VI. CONSTRUCTION AND TESTING

We should review the project plans and specifications for conformance with the intent of our recommendations. Site preparation and grading should be performed under our observation and testing to permit us to check that soil conditions are consistent with our findings. We should evaluate variations of soil conditions which require special consideration or modification of our recommendations.



PLATES

Plate	1	Site Plan
Plate	2	Approximate Test Pit Locations
Plate	3	Geologic Map
Plates through	4 10	Logs of Test Pits
Plate	11	Soil Classification and Key to Test Data
Plates through	12 15	Particle Size Analysis



+ TP-13 APPROXIMATE TEST PIT LOCATION.  
 TEST PITS 8 THROUGH 13 IN PROPOSED BORROW AREA.

JOB NO. 00845, 149 03

DESIGNED BY: MEW  
 DRAWN BY: ABE  
 CHECKED BY: SSS  
 DATE: 03-88  
 APPROVED BY:  
 DATE:

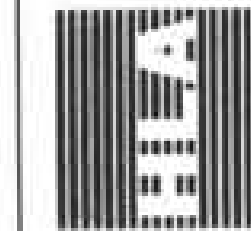
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REVISIONS  
 BY

**SITE PLAN**  
**DANT BOULEVARD DETENTION DAM**  
**RENO, NEVADA**

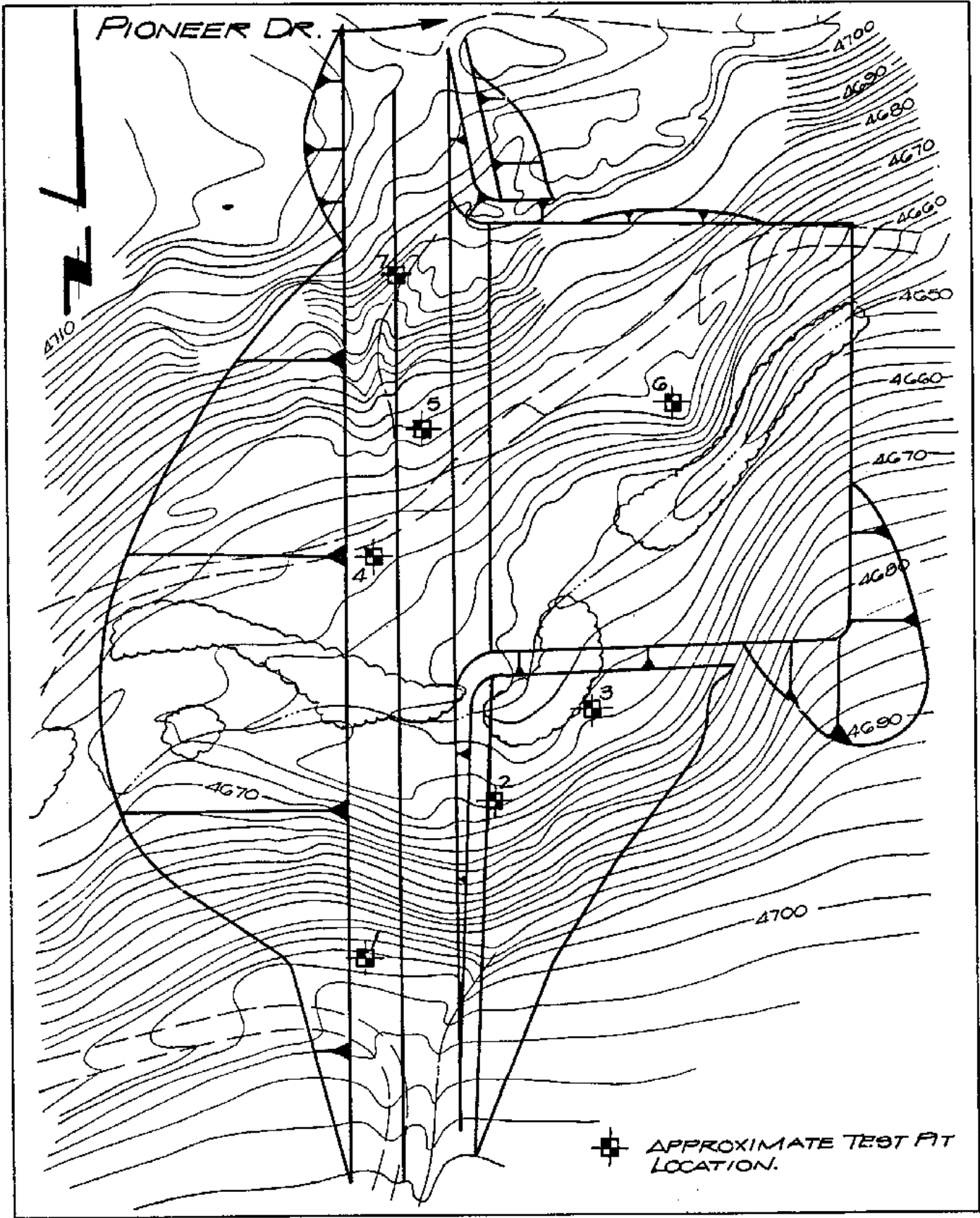
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 RENO, NEVADA 89502  
 TEL: 725-6175



PLATE

1



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**APPROXIMATE TEST PIT LOCATIONS  
DANT BOULEVARD DETENTION DAM  
RENO, NEVADA**

PLATE

**2**

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MAE

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00843.149.05

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*SBJ*

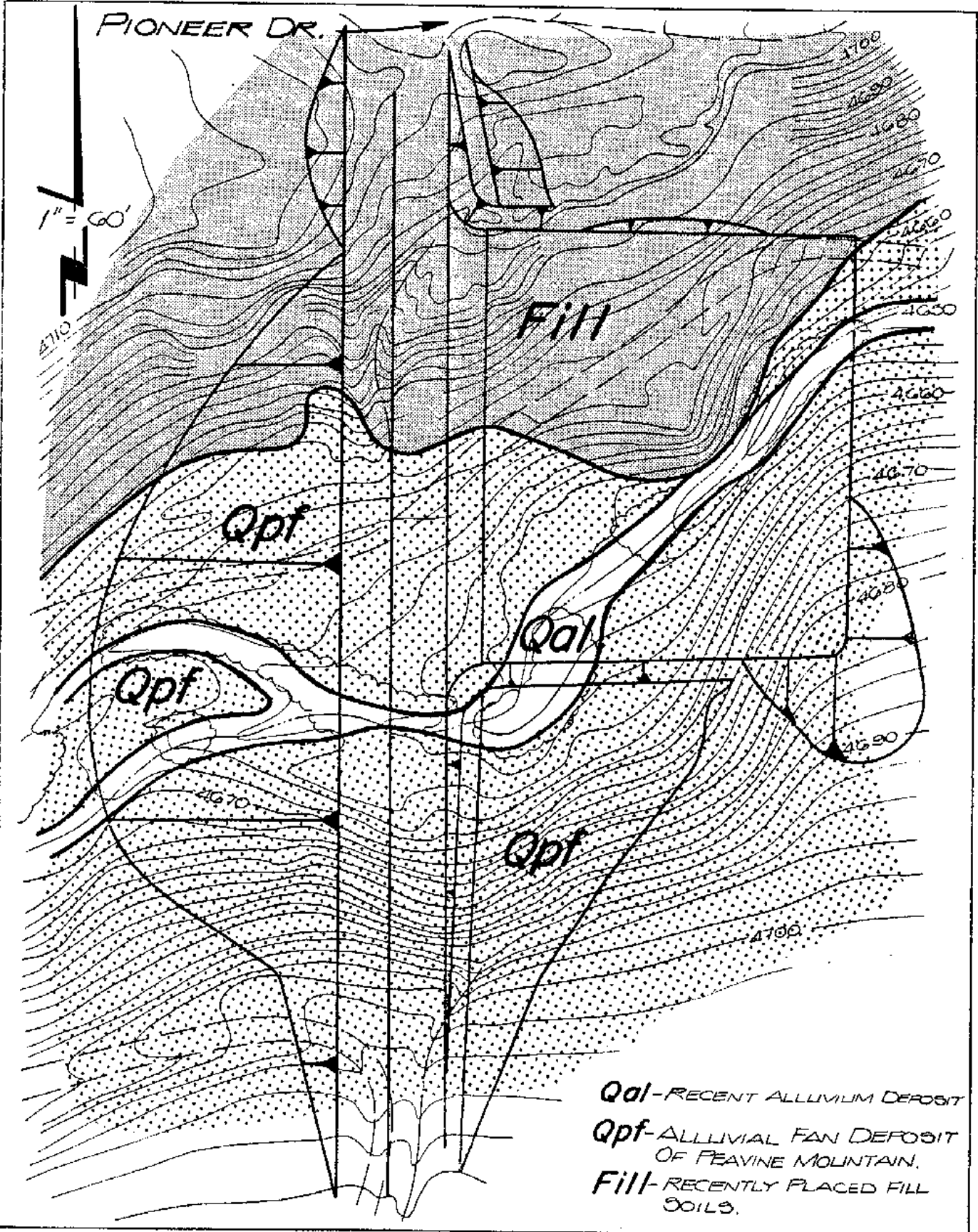
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10-3-88

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DATE

PIONEER DR.

1" = 60'



Qal-RECENT ALLUVIUM DEPOSIT  
 Qpf-ALLUVIAL FAN DEPOSIT  
 OF PEAVINE MOUNTAIN,  
 Fill-RECENTLY PLACED FILL  
 SOILS.



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GEOLOGIC MAP  
 DANT BOULEVARD DETENTION DAM  
 RENO, NEVADA

PLATE

3

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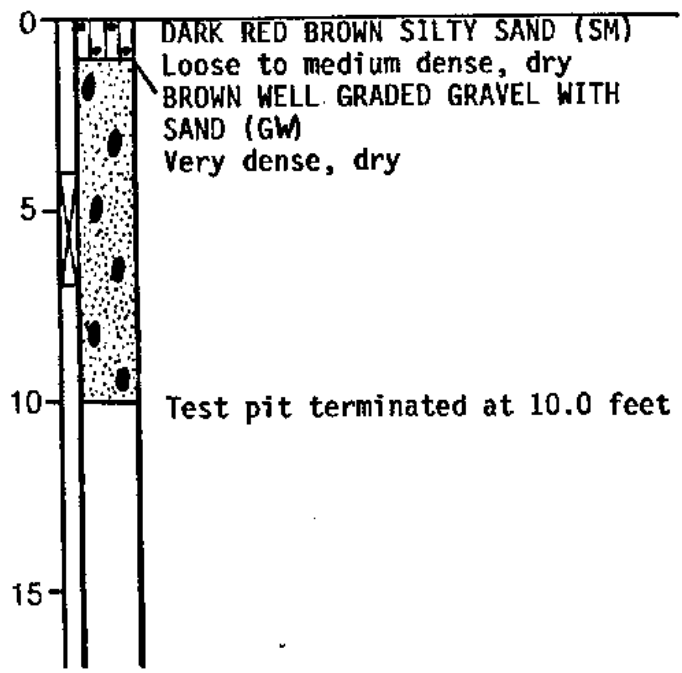
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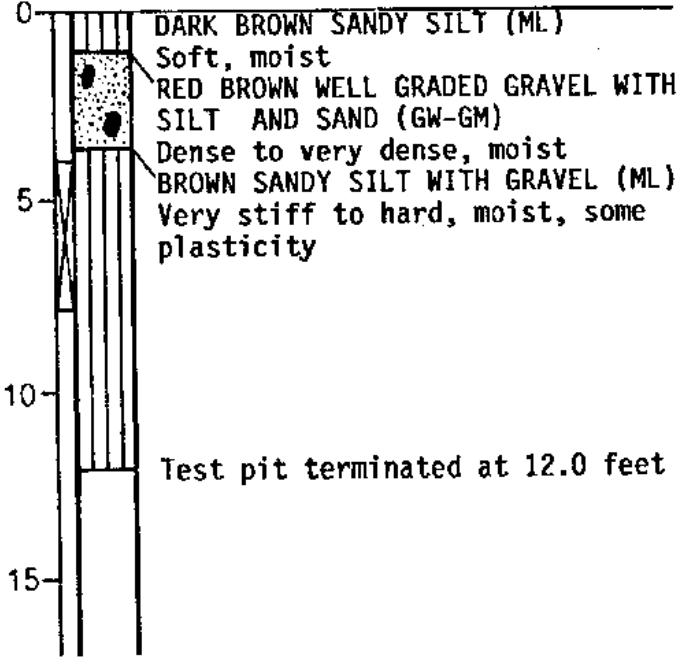
DATE

Laboratory Tests    Blows/foot  
 Moisture Content (%)  
 Dry Density (pcf)

LOG OF TEST PIT 1  
 Equipment Ford Backhoe  
 Elevation  $\pm$  4699 Ft.<sup>1</sup>    Date 9/14/88



LOG OF TEST PIT 2  
 Equipment Ford Backhoe  
 Elevation  $\pm$  4666 Ft.    Date 9/14/88



<sup>1</sup>Elevations interpolated from site topographic map, Plate 1.



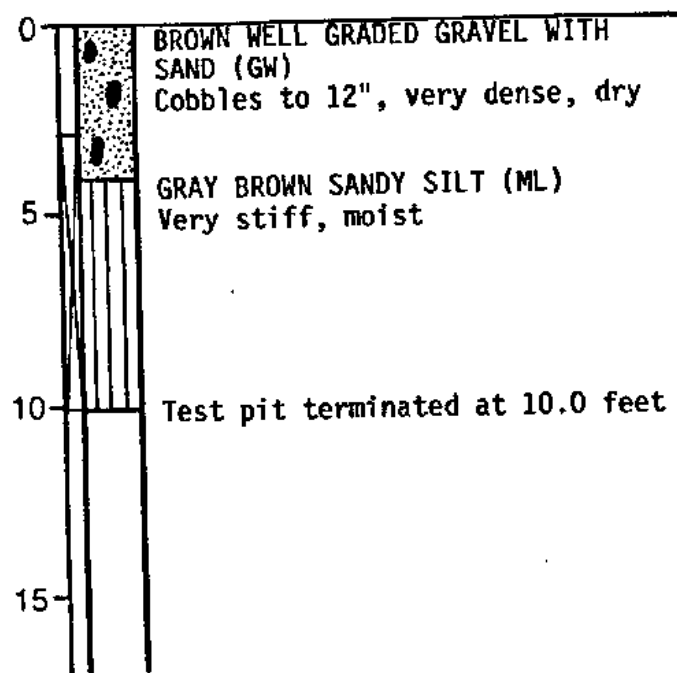
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LOGS OF TEST PITS 1 AND 2  
 DANT BOULEVARD DETENTION DAM  
 RENO, NEVADA

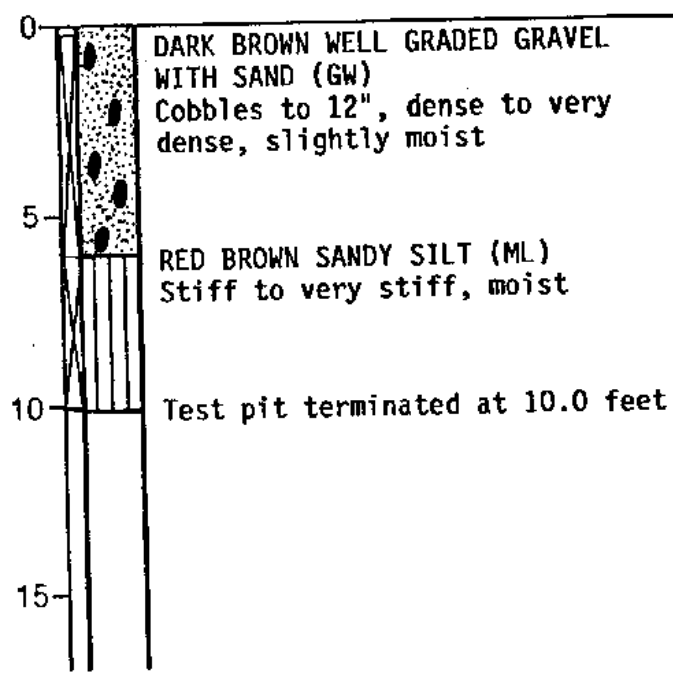
PLATE  
**4**

Laboratory Tests    Blows/foot  
 Moisture Content (%)  
 Dry Density (pcf)

LOG OF TEST PIT 3  
 Equipment Ford Backhoe  
 Elevation ± 4663 Ft. Date 9/14/88



LOG OF TEST PIT 4  
 Equipment Ford Backhoe  
 Elevation ± 4667 Ft. Date 9/14/88

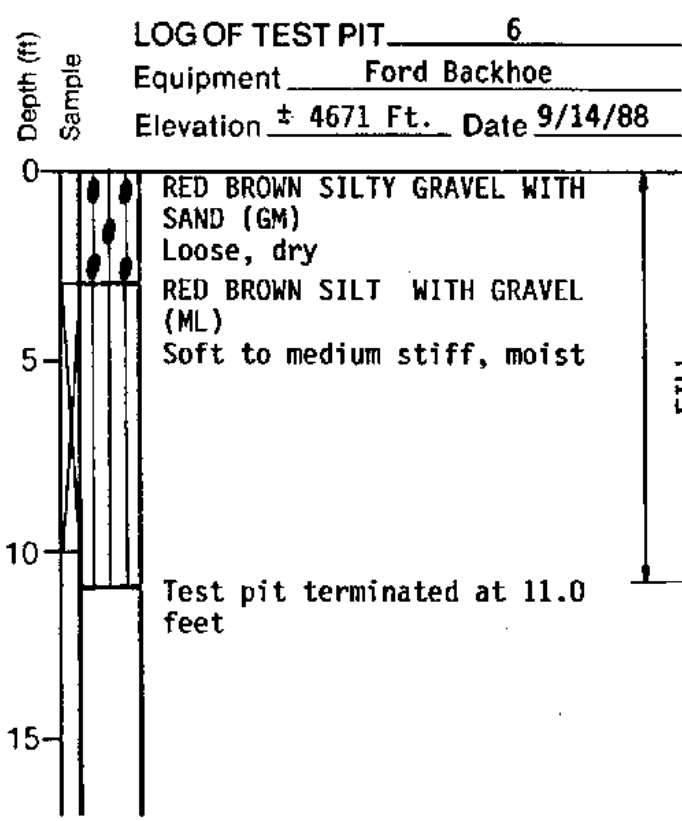
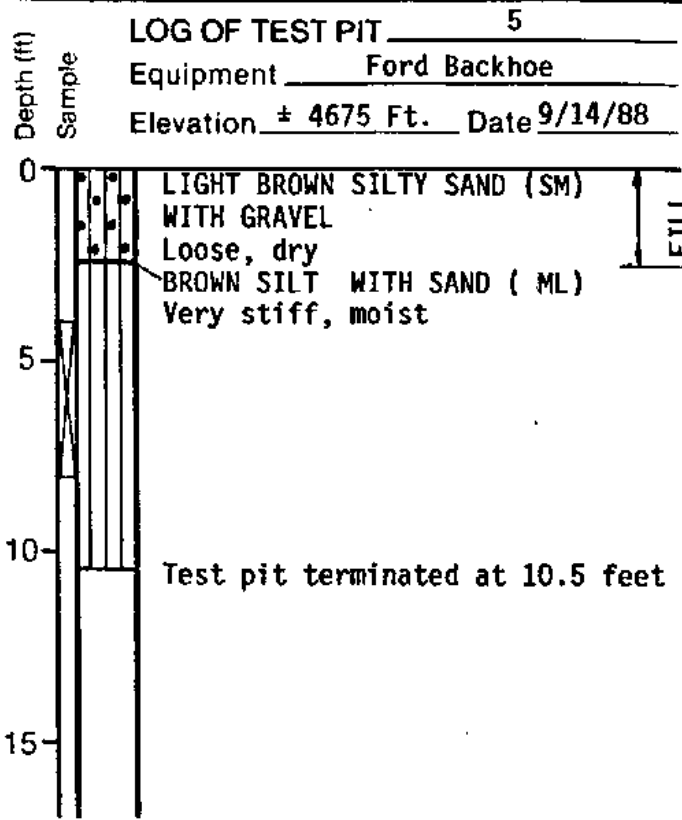


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LOGS OF TEST PITS 3 AND 4  
 DANT BOULEVARD DETENTION DAM  
 RENO, NEVADA

PLATE  
**5**

Laboratory Tests    Blows/foot  
 Moisture Content (%)  
 Dry Density (pcf)



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**LOGS OF TEST PITS 5 AND 6**  
**DANT BOULEVARD DETENTION DAM**  
**RENO, NEVADA**

PLATE

**6**

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JOB NUMBER  
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DATE  
 10/4/88

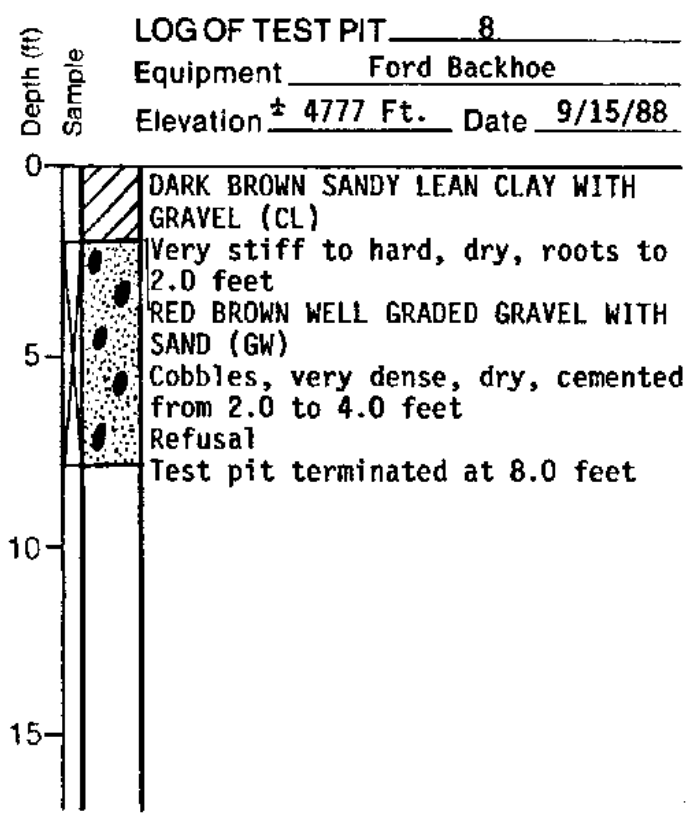
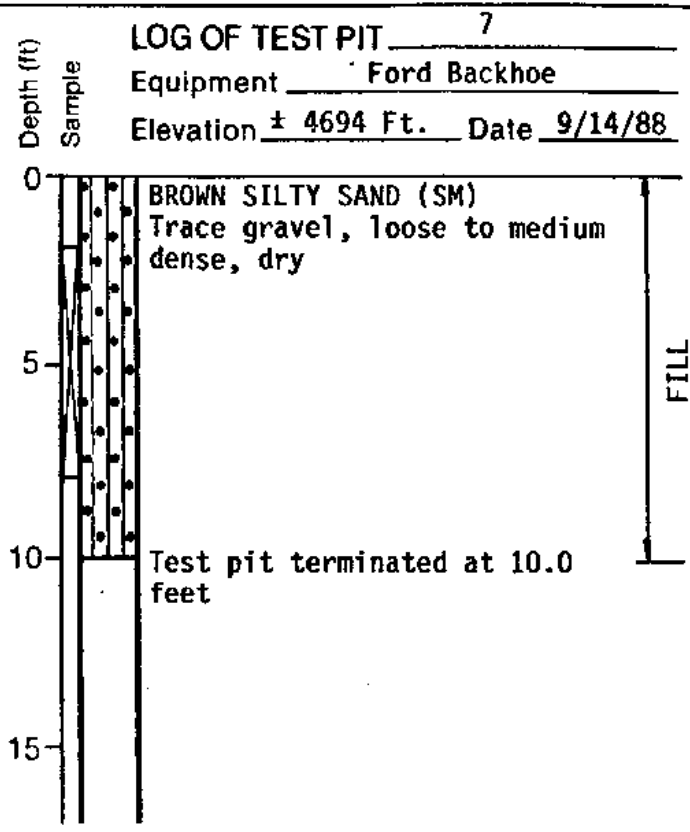
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DATE

Laboratory Tests

Blows/foot	Moisture Content (%)	Dry Density (pcf)
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% Passing No. 200  
Sieve = 26.4  
LL=36, PI=6



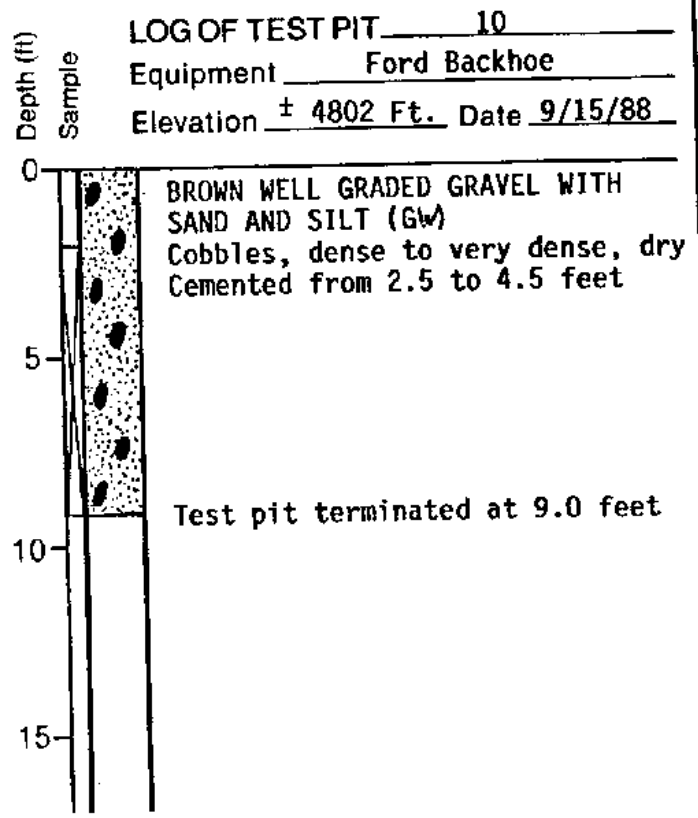
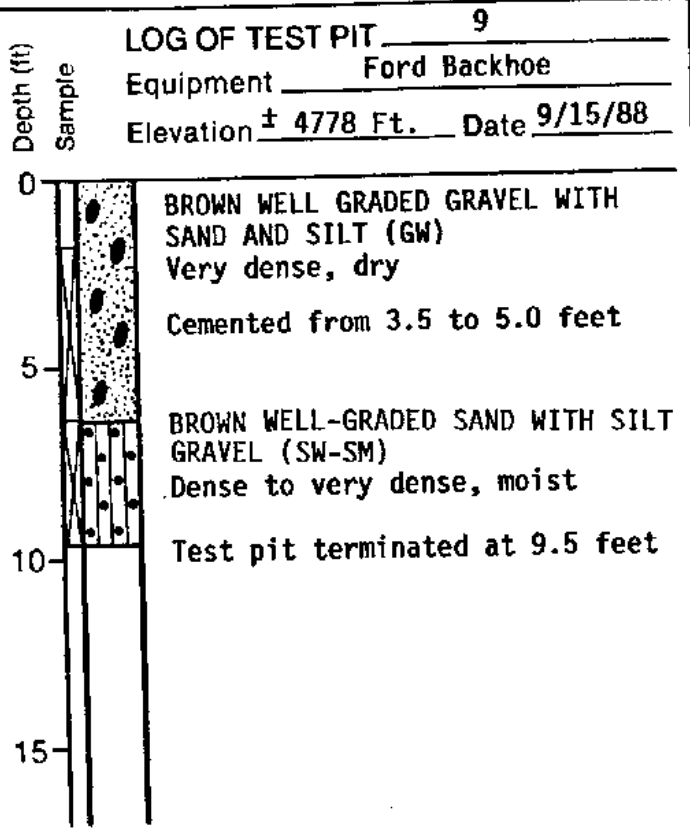
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LOGS OF TEST PITS 7 AND 8  
DANT BOULEVARD DETENTION DAM  
RENO, NEVADA

P. ATE  
**7**

Laboratory Tests    Blows/foot  
 Moisture Content (%)  
 Dry Density (pcf)

% Passing No. 200  
 Sieve = 11.7  
 LL=38, PI=14

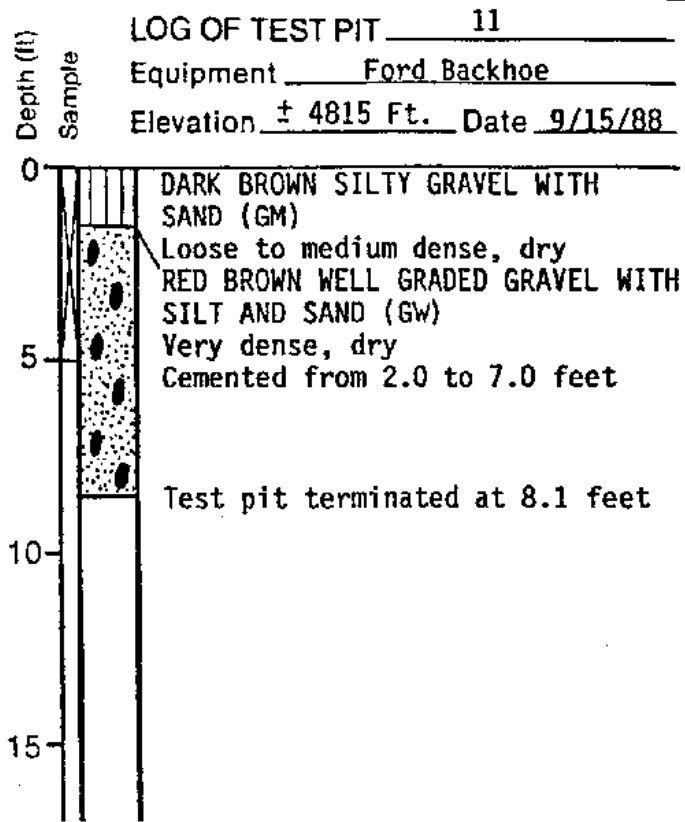


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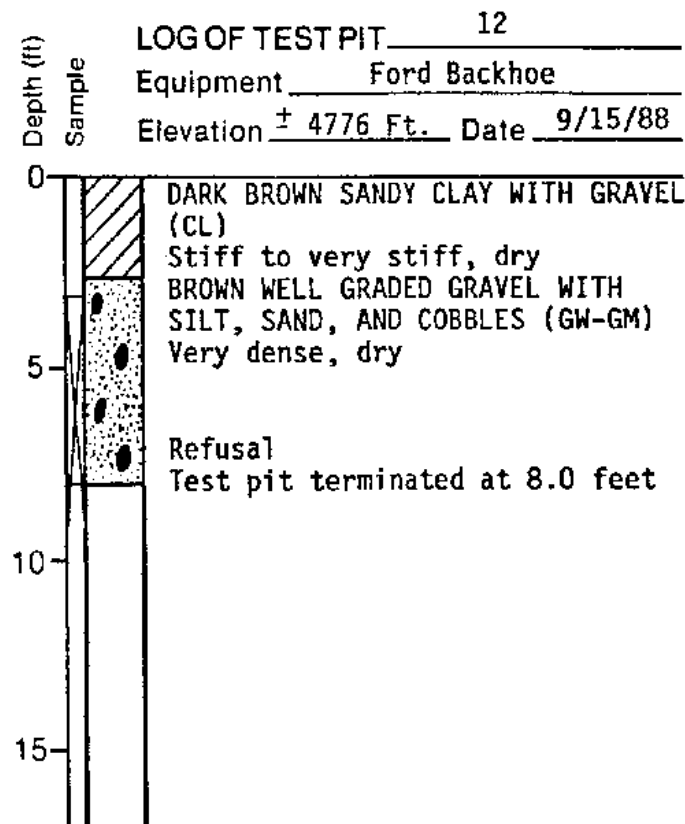
LOGS OF TEST PITS 9 AND 10  
 DANT BOULEVARD DETENTION DAM  
 RENO, NEVADA

PLATE  
**8**

Laboratory Tests  
 Blows/foot  
 Moisture Content (%)  
 Dry Density (pcf)



% Passing No. 200  
 Sieve = 7.6  
 Non-Plastic



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LOGS OF TEST PITS 11 AND 12  
 DANT BOULEVARD DETENTION DAM  
 RENO, NEVADA

PLATE

9

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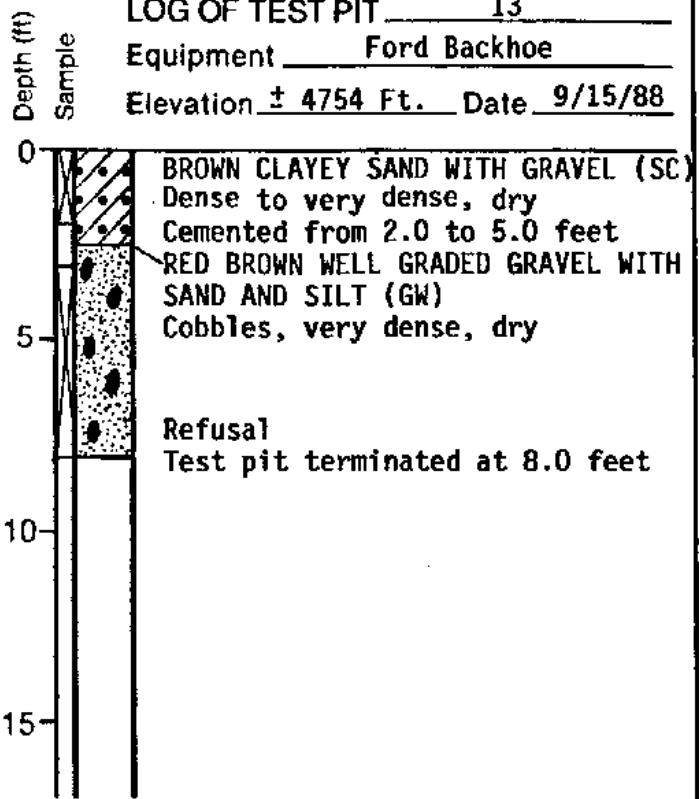
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**Laboratory Tests**

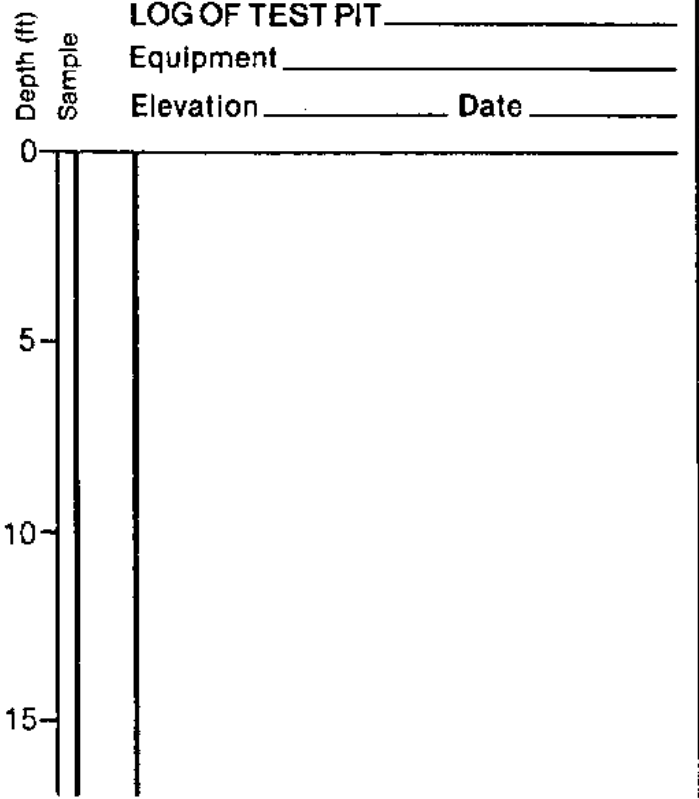
LL=38, PI=19  
 % Passing No. 200  
 Sieve = 36.6

Blows/foot  
 Moisture Content (%)  
 Dry Density (pcf)

LOG OF TEST PIT 13  
 Equipment Ford Backhoe  
 Elevation  $\pm$  4754 Ft. Date 9/15/88



LOG OF TEST PIT \_\_\_\_\_  
 Equipment \_\_\_\_\_  
 Elevation \_\_\_\_\_ Date \_\_\_\_\_



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LOG OF TEST PIT 13  
 DANT BOULEVARD DETENTION DAM  
 RENO, NEVADA

PLAT

**10**

MAJOR DIVISIONS					TYPICAL NAMES
COARSE-GRAINED SOILS MORE THAN HALF IS COARSER THAN NO. 200 SIEVE	GRAVELS	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GP		POORLY GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
			GM		SILTY GRAVELS, SILTY GRAVELS WITH SAND
			GC		CLAYEY GRAVELS, CLAYEY GRAVELS WITH SAND
	SANDS	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SP		POORLY GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
			SM		SILTY SANDS WITH OR WITHOUT GRAVEL
			SC		CLAYEY SANDS WITH OR WITHOUT GRAVEL
FINE-GRAINED SOILS MORE THAN HALF IS FINER THAN NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS	ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTS WITH SANDS AND GRAVELS	
		CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, CLAYS WITH SANDS AND GRAVELS, LEAN CLAYS	
		OL		ORGANIC SILTS OR CLAYS OF LOW PLASTICITY	
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
		CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
		OH		ORGANIC SILTS OR CLAYS OF MEDIUM TO HIGH PLASTICITY	
HIGHLY ORGANIC SOILS		PT		PEAT AND OTHER HIGHLY ORGANIC SOILS	

**UNIFIED SOIL CLASSIFICATION - ASTM D2487-85**

Perm	Permeability	Shear Strength (psi)	Confining Pressure
Consol	Consolidation	TxU) 3200 (2600) (FM) or (S)	Unconsolidated Undrained Triaxial Shear (field moisture or saturated)
LL	Liquid Limit (%)	TxCU 3200 (P)	Consolidated Undrained Triaxial Shear (with or without pore pressure measurement)
PI	Plastic Index (%)	TxCD 3200 (2600)	Consolidated Drained Triaxial Shear
G <sub>s</sub>	Specific Gravity	SSCU 3200 (P)	Simple Shear Consolidated Undrained (with or without pore pressure measurement)
MA	Particle Size Analysis	SSCD 3200 (2600)	Simple Shear Consolidated Drained
	"Undisturbed" Sample	DSCD 2700 (2000)	Consolidated Drained Direct Shear
	Bulk or Classification Sample	UC 470	Unconfined Compression
		LVS 700	Laboratory Vane Shear

**KEY TO TEST DATA**



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**SOIL CLASSIFICATION AND KEY TO TEST DATA**  
**DANT BOULEVARD DETENTION DAM**  
**RENO, NEVADA**

PLATE

**11**

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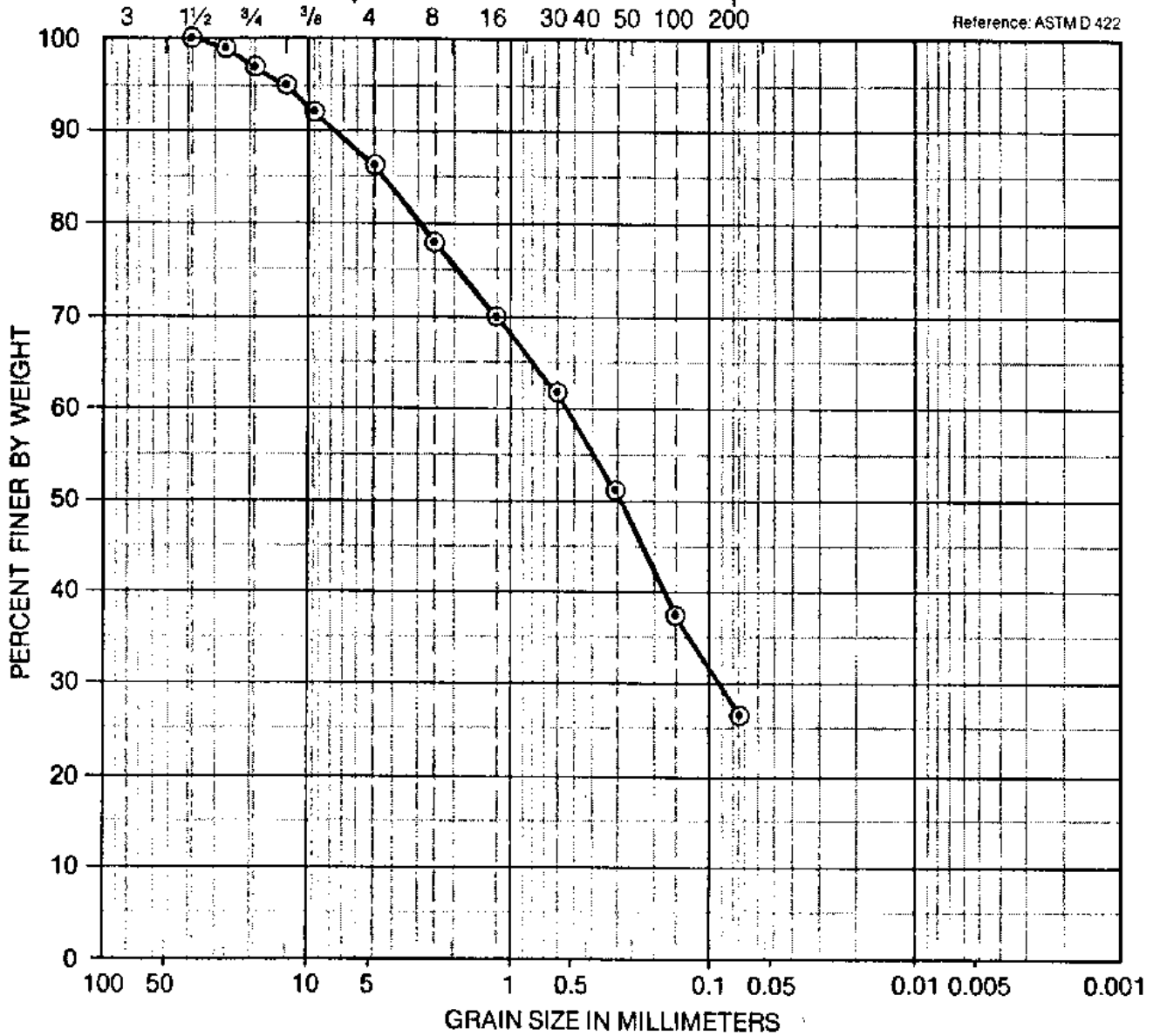
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DATE

U.S. Standard Sieve Size (in.)      U.S. Standard Sieve Numbers      Hydrometer



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
⊙	Trench 7 @ 2' to 8'	BROWN SILTY SAND (SM)



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**Particle Size Analysis**  
DANT BOULEVARD DETENTION DAM  
RENO, NEVADA

PLATE

**12**

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RLH

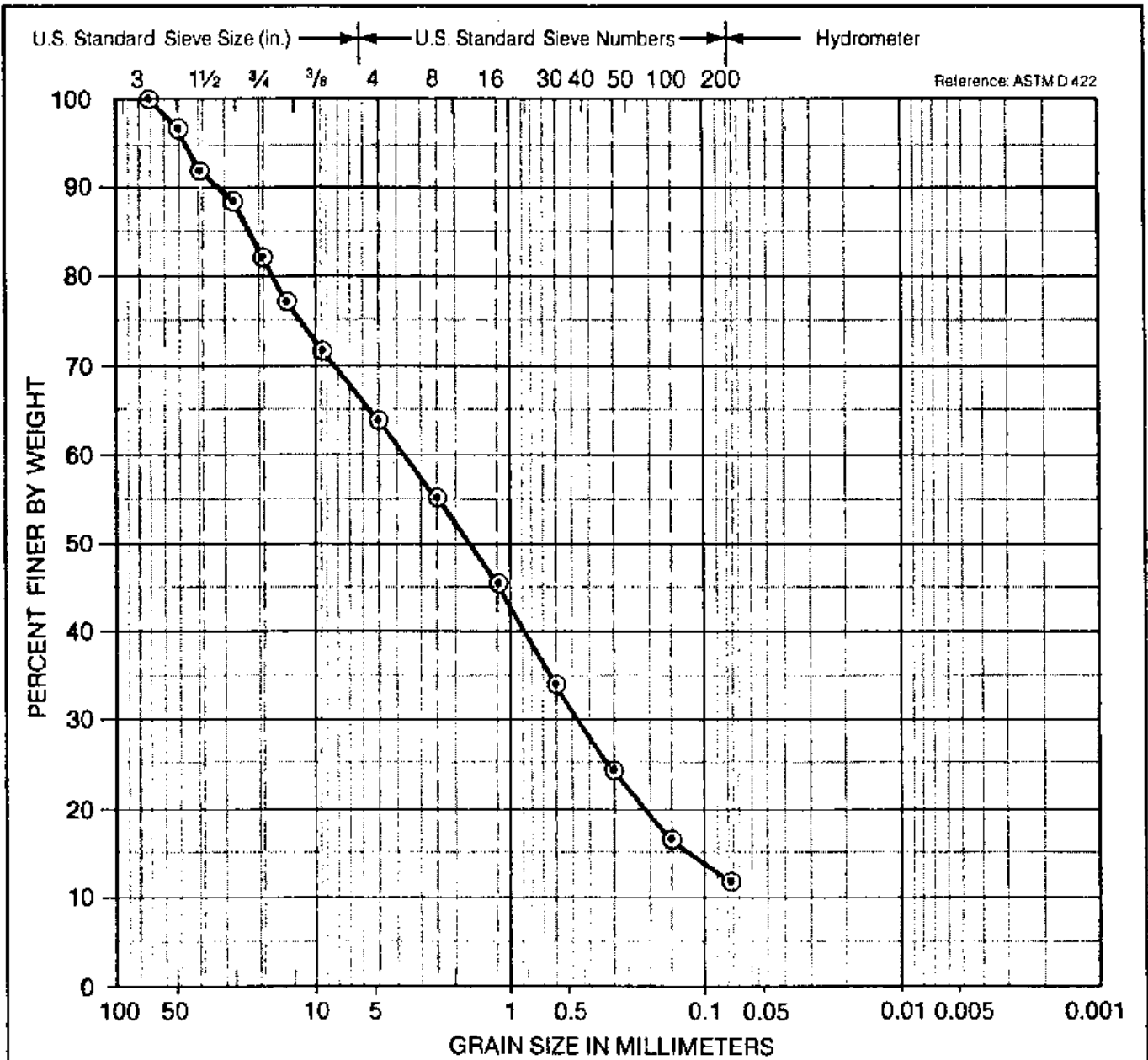
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DATE



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
⊙	Trench 9 @ 6-1/2' to 9-1/2'	BROWN WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM)



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**Particle Size Analysis**  
DANT BOULEVARD DETENTION DAM  
RENO, NEVADA

PLATE

**13**

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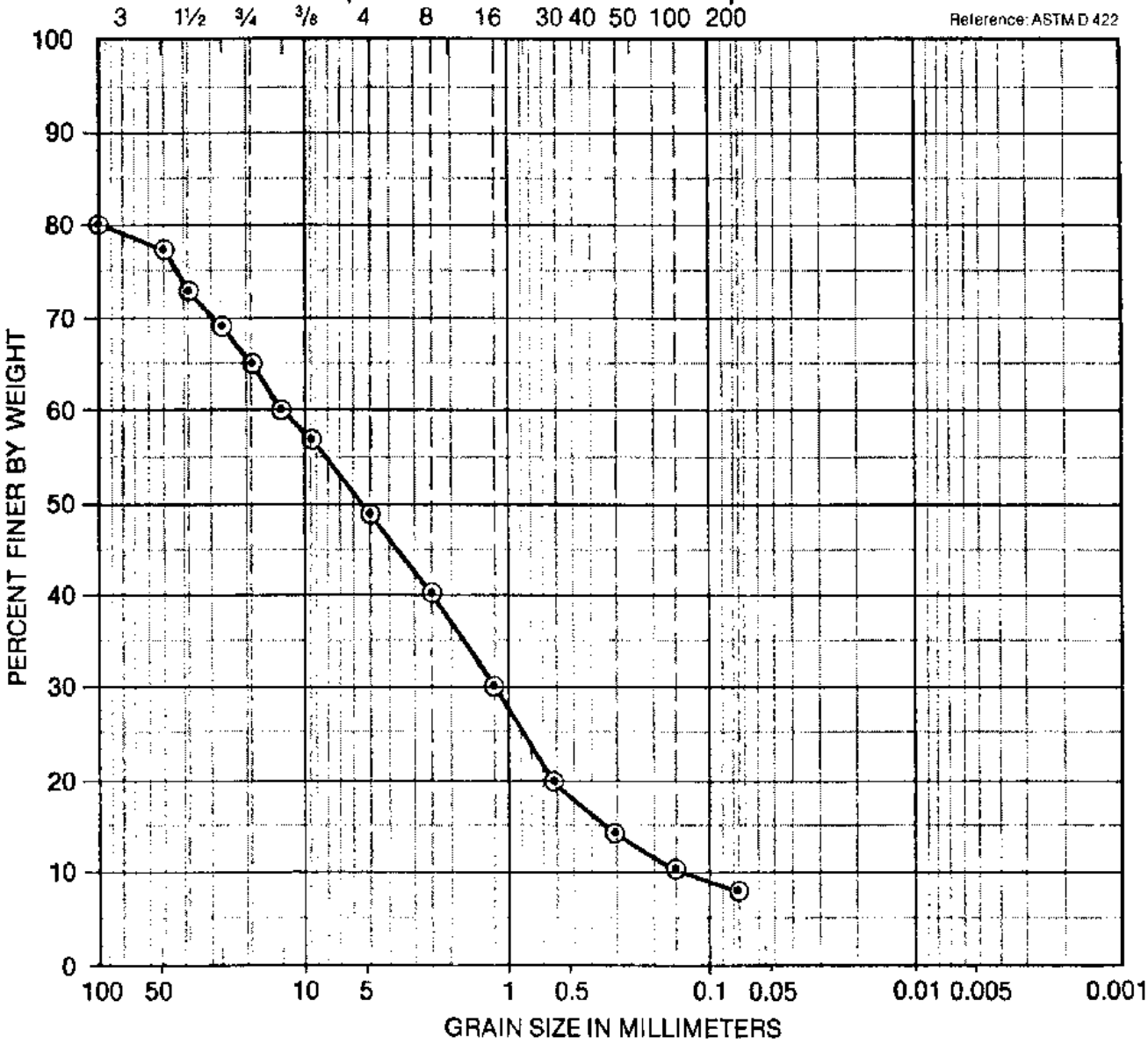
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U.S. Standard Sieve Size (in.)      U.S. Standard Sieve Numbers      Hydrometer



Reference: ASTM D 422

COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
⊙	Trench 12 @ 3' to 8'	BROWN WELL GRADED GRAVEL WITH SILT, SAND AND COBBLES (GW-GM)



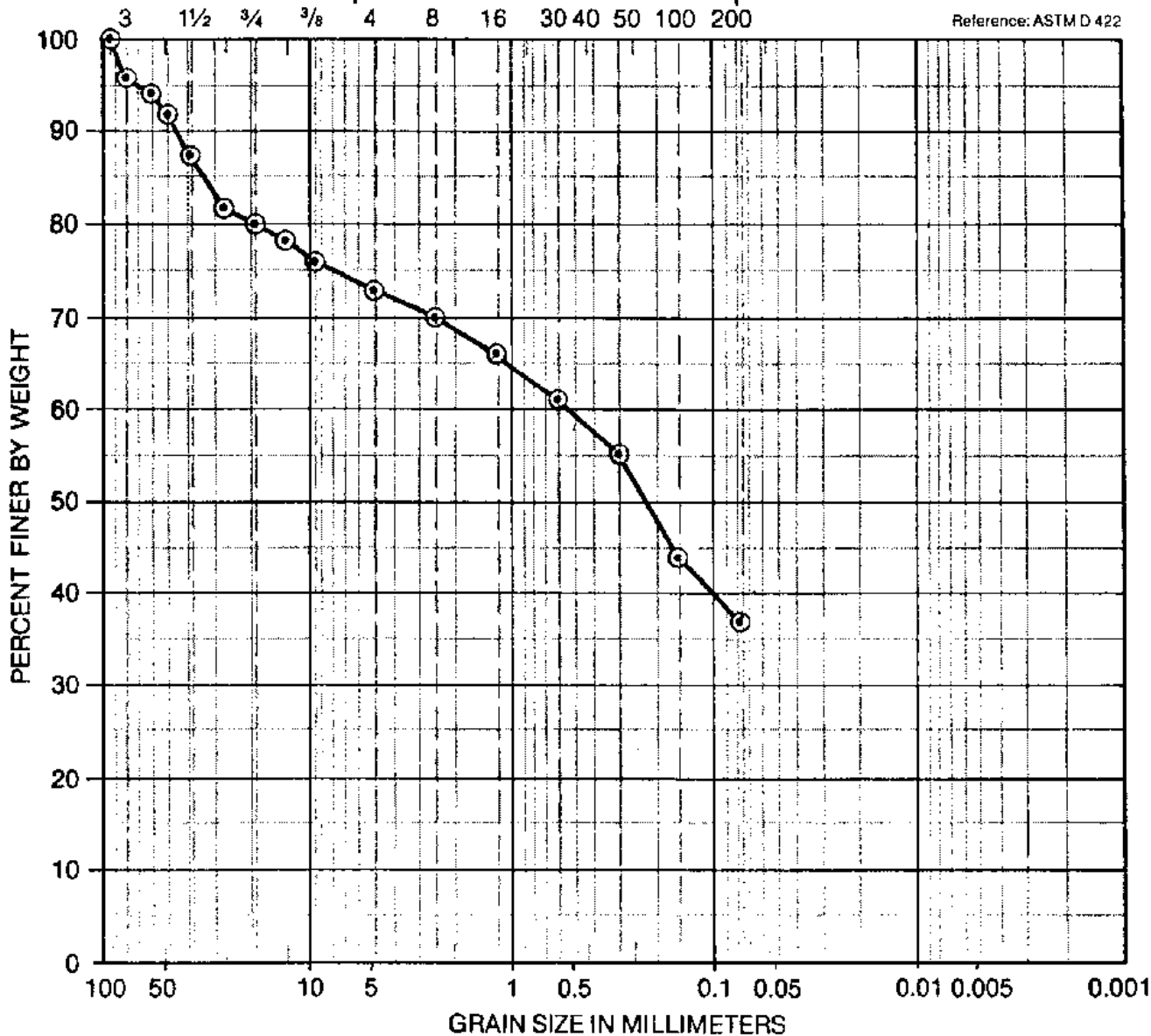
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**Particle Size Analysis**  
DANT BOULEVARD DETENTION DAM  
RENO, NEVADA

PLATE

**14**

U.S. Standard Sieve Size (in.) ← | ← U.S. Standard Sieve Numbers → | ← Hydrometer



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL			SAND		

Symbol	Sample Source	Classification
⊙	Trench 13 @ 0' to 2'	BROWN CLAYEY SAND WITH GRAVEL (SC)



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**Particle Size Analysis**  
DANT BOULEVARD DETENTION DAM  
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PLATE

**15**

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QUALITY CONTROL REVIEWER

Albert Joseph

Albert A. Joseph  
Civil Engineer - 5146 (NV)