DRAFT REPORT OF PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED EL SEGUNDO SEGMENT

NORWALK - EL SEGUNDO RAIL TRANSIT PROJECT

Prepared for

TRANSIT CONSULTANTS OF SOUTHERN CALIFORNIA

LeROY CRANDALL AND ASSOCIATES

JOB NO. ADE-88044

August 1988

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August 31, 1988

Transit Consultants of Southern California
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Attention: Mr. Deepak Shah
Manager, Structural Design

Subject: Preliminary Geotechnical Investigation
Proposed El Segundo Segment
Norwalk-El Segundo Rail Transit Project
LC&A Job No. ADE-88044

Gentlemen:

This letter transmits our draft report covering the preliminary geotechnical investigation performed for the El Segundo Segment of the Norwalk-El Segundo Rail Transit Project. The report has been issued initially in draft form so that if you have any questions or desire to make any comments on it before it is prepared in final form, you will have the opportunity to do so.

We look forward to discussing this report with you.

Respectfully submitted,

LeROY CRANDALL AND ASSOCIATES

Marshall Lew, Ph.D.
Project Manager
Vice President

XS1/pa
(7 copies submitted)

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PROPOSED EL SEGUNDO SEGMENT
NORWALK-EL SEGUNDO RAIL TRANSIT PROJECT
FOR
TRANSIT CONSULTANTS OF SOUTHERN CALIFORNIA

1.0 EXECUTIVE SUMMARY

The proposed El Segundo Segment of the Norwalk-El Segundo Rail Transit Project will extend from the Century Freeway near Aviation Boulevard to Compton Boulevard. This section is referred to as the Baseline Route, which is elevated for a large portion of its total length. There are five stations planned along the segment: Aviation Boulevard Station, Mariposa Avenue Station, El Segundo Boulevard Station, Douglas Street Station, and the Compton Boulevard Station. A yard and shops area is planned at the south end of the alignment.

This preliminary geotechnical investigation of the Segment was conducted to evaluate the general geologic environment, to identify any geologic/seismic constraints, and to provide general soils and foundation information for preliminary use. The investigation included a field reconnaissance along the alignment, review of prior geotechnical investigations adjacent to and near the alignment, drilling of six borings, analytical testing of soil samples, and preparation of this report.

No geologic/seismic constraints were identified during this preliminary evaluation. A review of published literature indicates that no known active or potentially active fault cross the alignment. Accordingly, the possibility of surface rupture along the alignment due to faulting is considered remote. The possibility of liquefaction occurring within the underlying deposits is also considered remote. Although the area could be subject to severe ground shaking in the event of a major earthquake, this hazard is common to Southern California and the effects of the shaking can be minimized by proper structural design and proper construction.

Fill materials should be anticipated along the alignment; the fill should be generally shallow, but local deep deposits could occur. Native materials generally consist of moderately firm but expansive clay, underlain by dense and firm sands and silty sand with clay and silt. The sand deposits have very little cohesion. Ground water is relatively deep beneath the alignment.

Foundation support for the aerial structures (rail guideways and elevated stations) and the Rosecrans Avenue/ Aviation Boulevard Bridge may utilize drilled cast-in-place reinforced concrete piles. Some difficulties could be encountered in the construction of the piles due to caving. At-grade structures may be supported on spread footings established in either the natural soils or properly compacted fill. The on-site soils, except for debris, and clay, may be used as fill material.

Section 2.0
Scope of Work

2.0 SCOPE OF WORK

2.1 PURPOSE

This report presents the results of our preliminary investigation of the El Segundo Segment alignment between the western end of the Century Freeway Segment near Aviation Boulevard, and Maintenance Facilities at the south end of the alignment.

The scope of our services included the following tasks:

- o A review of existing geotechnical data from about 35 adjacent and nearby projects to characterize the nature of the soils along the El Segundo Segment.
- o A preliminary geologic evaluation to characterize the general geologic environment and identification of geologic/seismic constraints.
- o An environmental audit of prior and current land use in the project area to determine the potential for soil contamination. This task was addressed in our report dated August 25, 1988; our Job No. F-88044-4.
- o Limited resistivity testing to evaluate corrosion potential of the soils. This task has been deferred until the final geotechnical investigation is performed.
- o Drilling and sampling of six exploration borings, and limited sampling of soil samples, including direct shear, consolidation, expansion, compaction, and grain size tests.
- o Preparation of a report containing the results and conclusions of the preliminary investigation characterizing the project soils and evaluating the environmental and geotechnical constraints, if any.

2.2 LIMITATIONS OF INVESTIGATION

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has been prepared for Transit Consultants of Southern California their design consultants to be used solely in the preliminary evaluation of the proposed rail transit project and related facilities. The report has not been prepared for use by other parties, and may not contain sufficient information for purposes of other parties or other uses.

2.3 INSPECTION OF BORING SAMPLES

Soil samples recovered from the borings and remaining after laboratory testing are stored at the laboratory of LeRoy Crandall and Associates, 900 Grand Central Avenue, Glendale, California 91201.

Section 3.0
Project Description

3.0 PROJECT DESCRIPTION

3.1 GENERAL DESCRIPTION

The proposed El Segundo segment of the Norwalk-El Segundo Rail Transit Project will run from the Century Freeway near Aviation Boulevard to Compton Boulevard. The proposed alignment of the entire Norwalk-El Segundo Rail Transit Project is shown on Plate 3.1, System Map. The El Segundo Segment is shown in more detail on Plate 3.2, This section is referred to as the Baseline Route, which is elevated for a large portion of its total length.

There are five stations planned along this segment of the rail transit project: Aviation Boulevard Station, Mariposa Avenue Station, El Segundo Boulevard Station, Douglas Street Station, and Compton Boulevard Station. The stations will provide both pedestrian and handicapped access, fare collection, seating, shelter, and security. All stations will include shuttle bus stops and passenger drop-off areas. Two of the stations will provide small park-and-ride facilities. There is also a rail yard and shop area in Hawthorne.

3.2 CENTURY SEGMENT ALIGNMENT AND STATIONS

The rail transit alignment for this segment diverges from the Century Freeway segment about 1,800 feet east of Aviation Boulevard. The elevated aerial alignment continues westward from the Century Freeway to the Aviation Boulevard Station which is about 500 feet east of Aviation

Boulevard. The Aviation Boulevard Station is an aerial station platform. The alignment continues west past the station to the Aviation Wye which will connect to the future Coast Line to the north.

After leaving the Aviation Wye, the route runs westerly on an aerial structure and turns southwesterly upon crossing Douglas Street. The alignment turns south after crossing Nash Street and proceeds above grade on the west side of Nash Street as it enters the Mariposa Avenue Station.

The Mariposa Avenue Station is an above-grade station located south of the intersection of Mariposa Avenue and Nash Street. The line heads south after leaving the Mariposa Avenue Station and continues to run along the west side of Nash Street. After crossing Grand Avenue, the alignment diagonally crosses the intersection of El Segundo Boulevard and Nash Street to the El Segundo Boulevard Station.

The El Segundo Boulevard Station is an aerial station which overhangs both El Segundo Boulevard and the Hughes EDSG Facility parking lot. It includes an off-street shuttle van facility, a drop-off area, and a small operations building. As the line leaves the El Segundo Boulevard Station, there are two alternatives. The alignment can either descend to grade at a point near the eastern edge of the Hughes property for approximately 1,000 feet and rise to cross the Southern Pacific freight rail spur and a vacant building or it can remain elevated for the full distance from El Segundo Boulevard Station to the Douglas Street Station. With either option, it is aerial when crossing the Southern Pacific rail spur. It continues south on the aerial structure, running beneath the Southern California Edison's transmission towers. The alignment turns southeasterly to pass over and run parallel to the south side of the Atchison Topeka and Santa Fe (ATSF) Railroad Los Angeles Harbor tracks before entering the Douglas Street Station.

The Douglas Street Station is an aerial station located in an area interrupted by the ATSF mainline tracks. Access from the south is from a drop-off area at the end of the cul-de-sac using stairs and an elevator; access from the north is from a drop-off area under the Southern California Edison transmission tower right-of-way using stairs. A small parking lot is planned adjacent to the station. As the line leaves the aerial station, it continues southeasterly parallel to the ATSF mainline.

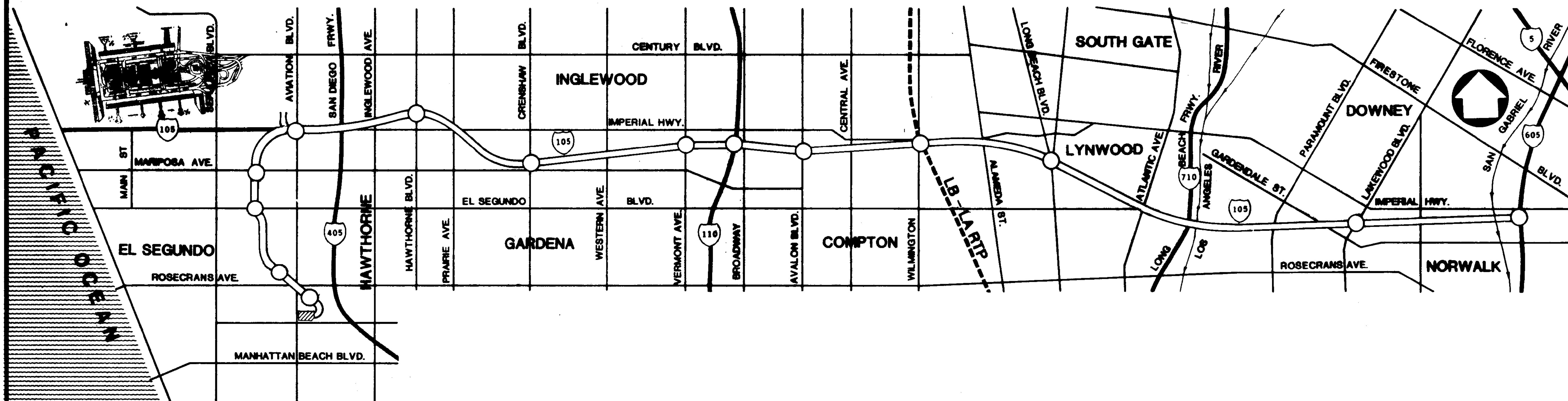
The alignment will diagonally cross the intersection of Rosecrans Avenue and Aviation Boulevard on a new bridge structure west of the existing ATSF railroad truss bridge. The span length may be as long as 270 feet to accommodate future widening of the Rosecrans/Aviation intersection. After crossing the intersection of Rosecrans Avenue and Aviation Boulevard, the alignment descends to grade and uses the ATSF right-of-way to the Compton Boulevard Station.

The Compton Boulevard Station will be at-grade with side platforms. A parking lot will be located either east of the railroad or on U.S. Air Force property east of the yard and shops site. South of the Compton Boulevard Station, the alignment turns west into the Hawthorne Yard and Shops area. The future Torrance mainline segment would continue to the south.

3.3 YARD AND SHOPS AREA

The Hawthorne Yard and Shops would serve the following operations: vehicle dispatch, storage, interior and exterior cleaning, running repair, daily and periodic inspection, testing, and blowdown. A vehicle maintenance building, operations building, and other facilities would be built to accommodate such operations.

The proposed Hawthorne Rail Yard would be on approximately 9.4 acres of land located at 14714 Aviation Boulevard that was owned by the State of California. The site is relatively level and bordered by Aviation Boulevard on the west, U. S. Air Force property on the south and east, and a Southern California Edison utility right-of-way on the north. It would permit direct access from the Compton Boulevard Station on the north with a possible future southern exit to the future Torrance mainline extension of the rail transit project.



SYSTEM MAP

NORWALK-EL SEGUNDO RAIL TRANSIT PROJECT

NO SCALE

LeROY CRANDALL AND ASSOCIATES

PLATE 3-1

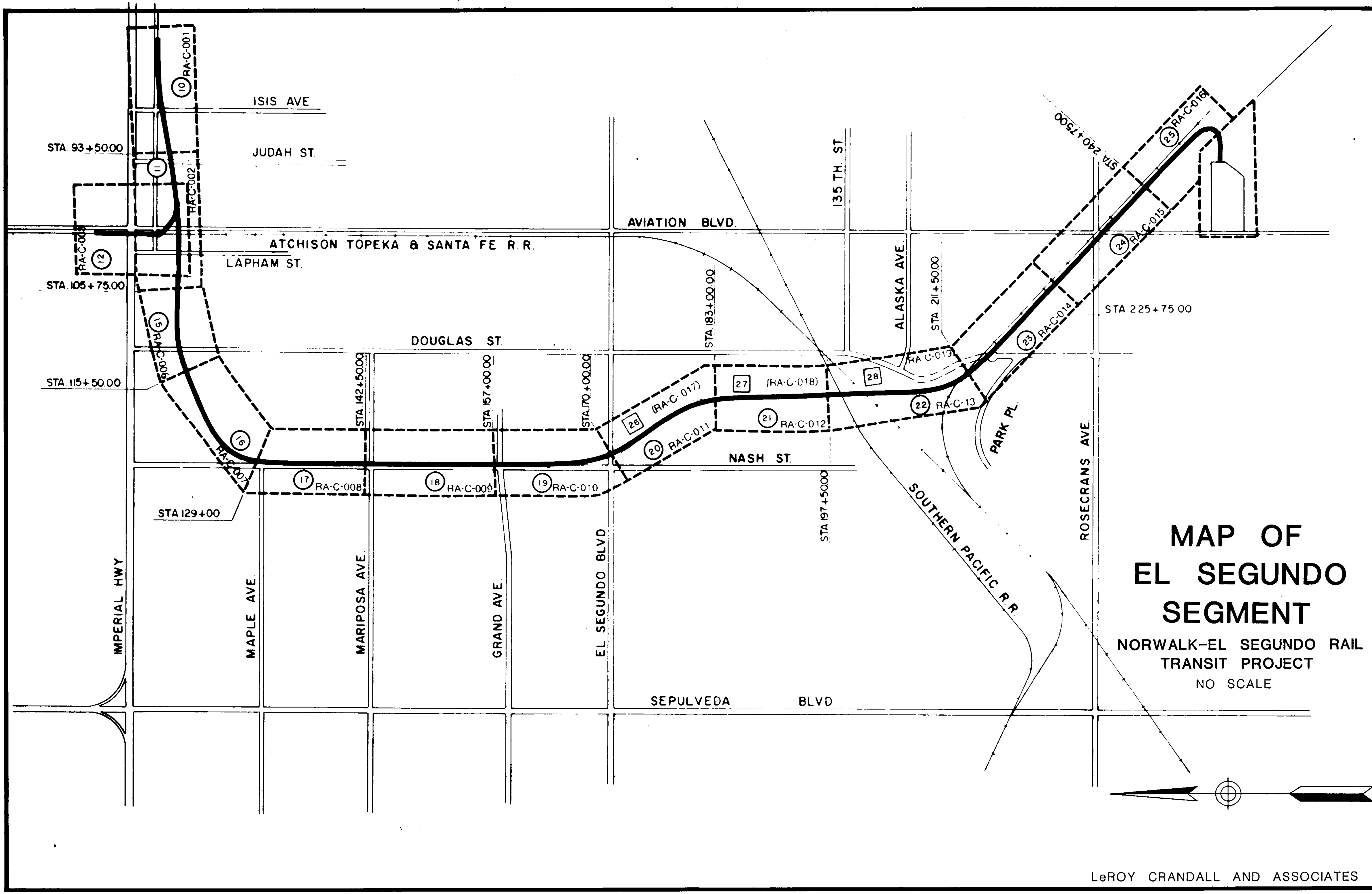

MAP OF
EL SEGUNDO
SEGMENT
NORWALK-EL SEGUNDO RAIL
TRANSIT PROJECT
NO SCALE
ISIS AVE
JUDAH ST
AVIATION BLVD.
ATCHISON TOPEKA & SANTA FE R.R.
LAPHAM ST.
DOUGLAS ST.
NASH ST.
SEPULVEDA BLVD
IMPERIAL HWY
MAPLE AVE
MARIPOSA AVE
GRAND AVE
EL SEGUNDO BLVD
135 TH. ST.
ALASKA AVE
ROSECRANS AVE
PARK PL.
SOUTHERN PACIFIC R.R.
STA. 93+50.00
STA. 105+75.00
STA. 115+50.00
STA. 129+00
STA. 142+50.00
STA. 157+00.00
STA. 170+00.00
STA. 183+00.00
STA. 197+50.00
STA. 211+50.00
STA. 225+75.00
STA. 240+75.00
RA-C-001
RA-C-002
RA-C-003
RA-C-006
RA-C-007
RA-C-008
RA-C-009
RA-C-010
RA-C-011
RA-C-012
RA-C-13
RA-C-014
RA-C-015
RA-C-016
(RA-C-017)
(RA-C-018)
RA-C-019
LeROY CRANDALL AND ASSOCIATES

PLATE 3-2

Section 4.0
Geology

4.0 GEOLOGY

4.1 PHYSICAL SETTING

The proposed El Segundo Segment of the Norwalk-El Segundo Rail Transit Project will be located within the Los Angeles Basin at the northerly end of the Peninsular Ranges geomorphic province. This geomorphic province trends northwest reflecting the dominant northwesterly trend of major fold belts and fault zones in the Southern California region.

The most prominent physiographic feature along the alignment is the El Segundo Sandhills which consist of a coastal belt of dunes and sandhills extending south from Ballona Gap to the Palos Verdes Hills (a distance of about 11½ miles) and inland, or eastward, from three to five miles (Poland et al., 1959). The sandhills are subdivided into two distinct elements. One element is adjacent to the coast and is comprised largely of active, or recent, dunes. The recent dunes are between one-third to one-half mile wide, with a maximum elevation of 185 feet above sea level.

The second element constitutes the main part of the sandhills, consisting of stabilized ancient, or older dunes. The older dune sand attains a maximum height of about 245 feet above sea level. Weathering and associated stabilizing processes have removed all but the gross features of dune topography in the older dune sand area (California Department of Water Resources, 1961).

The major geologic structural feature in the area is the Newport-Inglewood Fault Zone which is reflected at the surface by the nearby Baldwin Hills. At its closest point, the Newport-Inglewood Fault Zone is about 2.8 miles northeast of the alignment.

The relationship of the rail transit alignment to regional and local geologic features is shown on Plate 4.1, Regional Geology, and Plate 4.2, Local Geology, respectively. The alignment is shown in relation to major fault zones and earthquake epicenters on Plate 4.3, Regional Seismicity.

4.2 GEOLOGIC MATERIALS

The alignment will extend across areas partially mantled by late Pleistocene age (older) dune sands and by continental deposits of the late Pleistocene Lakewood Formation. Where present, the older dune sands directly overlie the Lakewood Formation. As observed in our exploratory borings, the older dune sand consists of fine to medium sand initially deposited as offshore bars and later reworked by wind and stream action (Poland et al., 1959). The older dune sand is estimated to attain a maximum depth of about 100 feet in the area.

The Lakewood Formation consists primarily of sand, with discontinuous lenses of silt and clay. These deposits extend to depths of about 200 feet beneath the alignment and unconformably overlie marine silt and clay of the early Pleistocene San Pedro Formation. The San Pedro Formation, attaining a maximum thickness of 200 feet, is underlain by approximately 26,000 feet of Tertiary marine and non-marine sedimentary rocks. The Tertiary units, in turn, are underlain by basement rocks believed to be primarily Catalina Schist.

A thin cover of artificial fill materials is present along some of the alignment.

4.3 GROUND WATER

The proposed transit alignment is located within Township 3 South, Range 14 West, Sections 7, 18, and 20 within the West Coast Hydrologic Subarea of the Coastal Plain of Los Angeles County Hydrologic Subunit. Water level measurements by the Los Angeles County Flood Control District indicate that the ground water elevation in the area has historically been at or below sea level (this would correspond to a water level depth generally about 100 feet beneath the alignment). The highest recorded water level in the area over the past 50 years was about 14 feet above sea level in 1973, obtained in a well situated about one-half mile west of the south end of the alignment (near the intersection of Sepulveda Boulevard and Rosecrans Avenue).

Data compiled by the Los Angeles County Flood Control District in the Fall of 1985 indicate the water level beneath the alignment as varying between 5 feet above sea level (at the northerly end) to about 5 feet below sea level (at the southerly end). Accordingly, the depth to ground water ranged at that time from 95 feet to 85 feet, respectively.

Perched ground water, at a depth of about 50 feet below ground surface, has been reported for the area near the intersection of Rosecrans Avenue and Aviation Boulevard. Water was measured at a depth of 73 feet in one of the borings drilled near this intersection; details of the boring are discussed in Section 6.0.

4.4 GEOLOGIC HAZARDS

4.4.1 General

The geologic hazards along the alignment are essentially limited to those caused by earthquakes. The major cause of damage from earthquakes is the result of shaking from earthquake waves. Damage due to actual displacement or fault movement beneath a structure is much less frequent.

4.4.2 Faults

The numerous faults in Southern California include active, potentially active, and inactive faults. The criteria for these major groups, as established by the Association of Engineering Geologists (1973), are presented in Table 4.1. Table 4.2 presents a listing of active faults in Southern California with the anticipated magnitude of a maximum credible earthquake of each fault. Table 4.3 provides a similar listing for potentially active faults. No faults or fault associated features were observed in the vicinity of the alignment during our reconnaissance of the area.

TABLE 4.1

CRITERIA FOR CLASSIFICATION OF FAULTS WITH
REGARD TO SEISMIC ACTIVITY

(Modified From Association of Engineering Geologists, Geology and Earthquake Hazards, 1973)

A. Active Faults: (See Table 4.2)

These faults have shown historical activity or have been included in the State of California's fault rupture studies zones as established by the California Division of Mines and Geology in accordance with the Alquist-Priolo Special Studies Zone Act of 1972. This category includes such faults as the San Andreas, San Jacinto, and Newport-Inglewood.

B. Potentially Active Faults: (See Table 4-3)

These faults are those, based on available data, along which no known historical ground surface ruptures or earthquakes have occurred. These faults, however, show strong indications of geologically recent activity. Potentially active faults can be placed in two subgroups that are based on the boldness or sharpness of their topographic features and the estimates related to recency of activity. These subgroups are:

1. Subgroup One - High Potential

   a. Offsets affecting the Holocene deposits (age less than 10 - 11,000 years).

   b. A ground water barrier or anomaly occurring along the fault within the Holocene deposits.

   c. Earthquake epicenters (generally from small earthquakes occurring close to the fault).

   d. Strong geomorphic expression of fault origin features (e.g. faceted spurs, offset ridges or stream valleys or similar features, especially where Holocene topography appears to have been modified).

2. Subgroup Two - Low Potential

   This subgroup is the same as 1-a, b, or d above, with the exception that the indications of fault movement can be only determined in Pleistocene deposits (less than 1,000,000 years ago).

C. Inactive Faults:

These faults are without recognized Holocene or Pleistocene offset or activity.

TABLE 4.2

MAJOR NAMED FAULTS CONSIDERED TO BE ACTIVE (a)

IN SOUTHERN CALIFORNIA

Fault (in alphabetical order)	Date of Latest Major Activity	Maximum Credible Earthquake	Known Fault Length (f) (Miles)
Big Pine	1852	7.5 (b)	47
Coyote Creek	1968	7.2 (c)	50
Elsinore	1910	7.5 (b)	120
Garlock	(d)	7.75(b)	170
Malibu Coast	1973	7.0 (c)	30
Manix	1947	6.25(b)	15
More Ranch	(d)	7.5 (b)	34
Newport-Inglewood	1933	7.0 (b)	39
Raymond	(e)	6.6 (c)	15
San Andreas Zone	1857	8.25(b)	200+
San Cayetano		6.75(c)	32
San Fernando Zone	1971	6.5 (b)	8
San Gabriel	(e)	7.5 (c)	80
San Jacinto Zone	1968	7.5 (b)	112
Superstition Hills	1987	7.0 (b)	22
White Wolf	1952	7.75(b)	60
Whittier	1987 (?)	7.1 (c)	30

(a) Historic movement (1769 present).
(b) Greensfelder, C.D.M.G. Map Sheet 23, 1974.
(c) Mark (1977) Length-Magnitude relationship.
(d) Intermittent creep.
(e) Zoned by the State Geologist for the Alquist-Priolo Program.
(f) Based on Division of Mines and Geology "Fault Map of California," Map No. 1 (1975).

TABLE 4.3

MAJOR NAMED FAULTS CONSIDERED TO BE POTENTIALLY ACTIVE (a)

IN SOUTHERN CALIFORNIA

Fault (in alphabetical order)	Maximum Credible Earthquake	Fault Length (d) (Miles)
Calico-Newberry	7.25(b)	60
Charnock	6.6 (c)	13
*Chino	6.7 (c)	18
Cucamonga	6.5 (b)	20
*Duarte	6.3 (c)	60
Northridge Hills	6.5 (b)	12
Norwalk	6.4 (c)	20
Oakridge	7.5 (b)	35
*Overland	6.2 (c)	6
Ozena	7.3 (c)	47
Palos Verdes	7.0 (b)	30
Pinto Mountain	7.5 (b)	42
*San Jose	6.5 (c)	17
Santa Cruz Island	7.2 (c)	50
Santa Monica-Hollywood	6.8 (c)	17
Santa Susana	6.5 (b)	10
Santa Ynez	7.5 (b)	100
Sierra Madre	7.5 (b)	55
Sierra Nevada	8.25(b)	118
*Verdugo	6.8 (c)	12

(a) Pleistocene deposits disrupted.
(b) Greensfelder, C.D.M.G. Map Sheet 23, 1974.
(c) Mark (1977) Length-Magnitude relationship.
(d) Based on Division of Mines and Geology "Fault Map of California," Map No. 1 (1975).
* Low Potential per A.E.G. definition.

No known active faults pass beneath the alignment nor does the alignment extend into or through an established Alquist-Priolo Special Studies Zone.

In our opinion, there is little probability of surface fault rupture occurring beneath the El Segundo Segment alignment.

Nearby faults include the active Newport-Inglewood Fault Zone and the potentially active Charnock, Overland, and Palos Verdes Faults. Other significant faults include the active San Andreas and Malibu Coast Fault Zones.

4.4.2.1 Newport-Inglewood Fault Zone

The closest known active fault is the Inglewood Fault of the Newport-Inglewood Fault Zone, located about 2.8 miles northeast of the alignment at its closest point. The fault zone, or uplift as it is sometimes called, is composed of a series of discontinuous northwest trending en echelon faults extending from the southern edge of the Santa Monica Mountains southeastward to the area offshore of Newport Beach.

The Newport-Inglewood uplift is reflected at the surface by a line of geomorphically young anticlinal hills and mesas formed by the folding and faulting of a thick sequence of sequence of Pleistocene and Tertiary sedimentary rocks (Barrows, 1974). The magnitude 6.3 1933 Long Beach earthquake occurred on the Newport-Inglewood Fault Zone. Other faults comprising the fault zone include the Potrero, Avalon-Compton, Cherry Hill, Pickler, Northeast Flank, and Reservoir Hill-Seal Beach Faults.

4.4.2.2 Malibu Coast Fault Zone

The Malibu Coast Fault Zone, located about 11 miles northwest of the rail transit project, is an east-west trending, north-dipping reverse fault extending westward from Santa Monica to offshore of Point Mugu. Although some seismologists and geologists attribute movement of the fault to the February 21, 1973 Point Mugu earthquake, Holocene activity on the fault had not been positively established until recently. Fault trenching conducted in 1985 and 1986 by Converse Consultants on South Winter Mesa in the Malibu area of Los Angeles County exposed several faults disrupting Tertiary and Pleistocene units, and one fault offsetting colluvial deposits estimated to be 6,000 years old (Fall et al., 1987). The observed fault, named the Winter Mesa Fault, are believed to be splays of the nearby Malibu Coast Fault; accordingly, the Holocene faulting on the Winter Mesa Faults is considered representative of active faulting along the Malibu Coast Fault Zone.

4.4.2.3 San Andreas Fault Zone

The active San Andreas Fault Zone is California's most prominent structural feature, trending in a general northwest direction for almost the entire length of the state. In Southern California, the San Andreas Fault Zone extends from the Mexican border to the Transverse Mountain Ranges west of Tejon Pass, for a length of approximately 280 miles. At its closest point, the San Andreas Fault Zone is approximately 45 miles north-northeast of the alignment. Along this segment of the fault zone there is no single traceable fault line, rather the fault is composed of several branches including the Banning Fault and the Mission Creek Fault. The July 8, 1986 North Palm Springs earthquake was believed to have occurred on the Banning Fault. Preliminary data indicate that this earthquake, occurring at 2:21 a.m., registered a magnitude 5.9 on the Richter scale with the epicenter located approximately 12 miles northwest of Palm Springs.

4.4.2.4 Charnock Fault

The potentially active Charnock Fault is located 0.9 miles northeast of the alignment at its closest point. The Charnock Fault trends northwest-southeast, subparallel to the trend of the Newport-Inglewood Fault Zone and the Overland Fault. Differential water levels occur in the San Pedro Formation across the fault and, therefore, it is concluded that the fault has experienced some movement during early Pleistocene time (approximately 500,000 to 2 million years ago).

4.4.2.5 Overland Fault

The Overland Fault is located 3.7 miles north of the alignment. The Overland Fault trends northwest and lies between the Charnock and Newport-Inglewood Fault Zones. The fault extends from the northwest flank of the Baldwin Hills to Santa Monica Boulevard in the vicinity of Overland Avenue. Displacement on the fault is believed to be vertical, with an offset of about 30 feet. Water levels in the Pleistocene age sediments indicate that the fault is an effective barrier to ground water movement and that Pleistocene materials have been offset.

4.4.2.6 Palos Verdes Fault

The potentially active Palos Verdes Fault is approximately 3.5 miles west-southwest, and offshore, of the alignment. This fault is traceable in the subsurface along the northern flank of the Palos Verdes Hills. Zielbauer et al. (1962) report that early Pleistocene age San Pedro Formation beds are sharply upwarped along the fault trace but, on land, the fault does not cut material younger than middle Pleistocene. Offshore data, consisting of acoustic and reflection profiles, show offsets in the base of Holocene material, suggesting very youthful movement along the Palos Verdes Fault.

4.4.3 Seismicity

The seismicity of the region surrounding the El Segundo segment of the rail transit project was determined from a computer search of a magnetic tape catalog of earthquakes. The catalog of earthquakes included those with a Richter magnitude greater than 4.0, within a radius of 100 kilometers from the center of the El Segundo Segment, compiled by the California Institute of Technology for the period 1932 to 1981, and those earthquakes for the period 1812 to 1931 compiled by Richter and the U.S. National Oceanic and Atmospheric Administration (NOAA). The computer printout of the earthquakes is presented in Appendix A. The earthquake recurrence curve based on that information is presented on Plate 4.4, Recurrence Curve. The search indicates that 309 earthquakes of Richter Magnitude 4.0 and greater have been recorded within 100 kilometers (62 miles) from the center of the alignment during the period from 1932 to 1981.

The information listed for each earthquake found in the computer scan in Appendix A includes date and time in Greenwich Civil Time (GCT), location of the epicenter in latitude and longitude, quality of epicentral determination (Q), depth in kilometers, and magnitude. Where a depth of 0.0 is given, the solution was based on an assumed 16-kilometer focal depth. The explanation of the letter code for the quality factor of the data is presented on the first page of the scan.

The epicenter of the 1920 Inglewood earthquake was located about 2.7 miles north of the alignment. This earthquake, which occurred at 6:47 p.m., had an estimated Richter magnitude of 4.9 and the intensity, described as a very strong shock, was estimated as 8½ on the Rossi-Forel intensity scale. No evidence of surface rupture was found. Damage to structures was sustained in the vicinity of the Inglewood City Hall along Commercial Street (now called La Brea Avenue). At least 36 aftershocks between June 21 and July 16, 1920 followed the main shock.

The epicenter of the March 11, 1933 Long Beach earthquake, magnitude 6.3, was located about 32 miles southeast of the south end of the alignment. This earthquake, although of only moderate magnitude, ranks as one of the major disasters in Southern California. The majority of damage was suffered by structures which are now considered substandard construction and/or were located on filled or saturated ground.

The epicenter of the February 9, 1971 San Fernando earthquake, with a magnitude of 6.5, was about 33 miles north of the alignment. Surface rupture occurred on the

Sylmar and Tujunga Faults which are segments of the larger San Fernando Fault Zone.

The epicenter of the October 1, 1987 Whittier Narrows earthquake was situated about 20 miles east-northeast of the alignment. This earthquake registered a magnitude of 5.9 and was followed by numerous aftershocks including a magnitude 5.3 quake on October 4, 1987.

The location of the alignment in relation to known active and potentially active faults indicates that the alignment is not exposed to greater than normal seismic risk than other areas within the Coastal Plain of Los Angeles County.

4.4.4 Liquefaction and Seismically Induced Settlement

The evaluation of the liquefaction potential of the soils along the alignment involved the estimation of the potential loss of shear strength of the saturated cohesionless soils during earthquakes that may affect the project. The significant factors that may affect liquefaction include the soil types, particle size and gradation, water level, relative density, confining pressure, intensity of shaking, and duration of shaking. Studies indicate that the liquefaction potential is the greatest where the ground water level is shallow and loose fine sands occur within a depth of 40 to 50 feet. The liquefaction potential increases as the ground acceleration and duration of shaking increase.

Based on the available published data and our previous and current borings, which indicates a great depth to ground water, we see little or no potential for liquefaction occurring along the alignment.

Seismically induced differential settlement is also not considered a potential problem.

4.4.5 Stability

The alignment extends across relatively flat-lying ground with no potential for either landsliding or lurching (movement at right angles to a slope during strong earthquake shaking). Additionally, the alignment is not known to be on or in the path of any existing or potential landslides.

4.4.6 Flooding

The alignment does not extend across a flood hazard area as designated by the Federal Emergency Management Agency.

4.4.7 Tsunamis and Seiches

The alignment is at elevations of about 100 feet to 80 feet above mean sea level and located about two miles east-northeast of the Pacific Ocean. The risk of damage from earthquake generated sea waves, called tsunamis, need not be considered.

The alignment is not located downslope of any large bodies of water that could adversely affect the alignment in the event of earthquake induced failures or seiches (oscillations due to earthquake shaking).

4.4.8 Subsidence

Most of the alignment is situated over the El Segundo Oil Field and several oil wells have been drilled in close proximity to the proposed alignment. Subsidence associated with petroleum production has been identified in some of the oil fields in the Los Angeles Basin, including the nearby Playa Del Rey Oil Field located about 3.6 miles northwest of the alignment (Castle and Yerkes, 1976); however, subsidence has not been recognized in the El Segundo Field. In recent years, oil field subsidence has been mitigated by the injection of fluids. Consequently, the potential for future subsidence within the El Segundo Oil Field is considered low.

4.4.9 Ground Shaking

Movements on any of the above described active and potentially active faults could cause ground shaking in the vicinity of the alignment. The relationship between the magnitude of an earthquake and the duration of strong shaking that results has been investigated by Bolt (1973). The relationship is presented in Table 4.4. The period of strong shaking is defined as that period of time when the acceleration of the ground due to seismic waves is in excess of 0.05g.

TABLE 4.4

BRACKETED DURATION AS A FUNCTION OF MAGNITUDE AND DISTANCE TO SOURCE (after Bolt, 1973)

Distance to Source (km)	Bracketed Duration (seconds) Magnitude 5.5	6.0	6.5	7.0	7.5	8.0	8.5
10	8	12	19	26	31	34	35
25	4	9	15	24	28	30	32
50	2	3	10	22	26	28	29
75	1	1	5	10	14	16	17
100	0	0	1	4	5	6	7
125	0	0	1	2	2	3	3
150	0	0	0	1	2	2	3
175	0	0	0	0	1	2	2
200	0	0	0	0	0	1	2

4.5 BIBLIOGRAPHY

Association of Engineering Geologists, 1973, "Geology, Seismicity, and Environmental Impact," Special Publication.

Barrows, A.G., 1974, "A Review of the Geology and Earthquake History of the Newport-Inglewood Structural Zone, Southern California," California Division of Mines and Geology Special Report 114.

Bolt, B.A., 1973, "Duration of Strong Ground Motion," in Proceedings, Fifth World Conference on Earthquake Engineering.

California Department of Water Resources, 1961, Bulletin 104, "Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County," App. A, Ground Water Geology.

California Division of Oil and Gas, 1974, "California Oil and Gas Fields, Vol. II - South Central Coastal and Offshore California," Report No. TR12.

California Division of Oil and Gas, 1975, "Regional Wildcat Map, Northern Los Angeles Basin," Map No. 121.

Castle, R.O., and Yerkes, R.F., 1976, "Recent Surface Movements in the Baldwin Hills, Los Angeles County, California," U. S. Geological Survey Professional Paper 882.

City of El Segundo, 1975, "Technical Report, Seismic Safety Element Comprehensive General Plan," Prepared by Envicom Corp.

Fall, E.W., Rzonca, G.F., and Spellman, H.A., 1987, "Late Quaternary Faulting, Malibu Coast Fault Zone, Malibu, California (abstract), "Association of Engineering Geologists Annual Meeting, October 8 - 13, 1987, Atlanta, Georgia, Abstracts and Program, p. 38.

Poland, J.F., Garrett & Sinnott, 1959, "Geology, Hydrology, and Chemical Character of Ground Waters in the Torrance-Santa Monica Area, California," U.S.G.S. Water Supply Paper 1461.

Yerkes, McCulloch, Schoellhamer & Vedder, 1965, "Geology of the Los Angeles Basin, California," U.S.G.S. Prof. Paper 420-A.

Zielbauer, E.J., Juez, H.A., Burnham, W.L., and Keene, A.G., 1962, "Coastal Basin Barrier and Replenishment Investigation, Dominguez Gap Barrier Project Geologic Investigation," Unpublished Report by the Los Angeles County Flood Control District.

LEGEND

SEDIMENTARY ROCKS

QUATERNARY

RECENT
- Qal — ALLUVIUM: GRAVEL, SAND, SILT, AND CLAY
- Qsr — ACTIVE DUNE SAND: WHITE OR GREYISH, WELL SORTED SAND

PLEISTOCENE
- UPPER — OLDER DUNE SAND: FINE TO MEDIUM SAND WITH SILT, AND GRAVEL LENSES
- UPPER — Qlw — LAKEWOOD FORMATION (INCLUDES "TERRACE DEPOSITS," "PALOS VERDES SAND," AND "UNNAMED UPPER PLEISTOCENE DEPOSITS"): MARINE AND CONTINENTAL GRAVEL, SAND, SANDY SILT, SILT, AND CLAY WITH SHALE PEBBLES
- LOWER — SAN PEDRO FORMATION (INCLUDES "LA HABRA CONGLOMERATE" AND PART OF "SAUGUS FORMATION"): MARINE AND CONTINENTAL GRAVEL, SAND, SANDY SILT, SILT, AND CLAY
- Qsp-Pp — UNDIFFERENTIATED SAN PEDRO FORMATION AND/OR PICO FORMATION: MARINE, PARTIALLY CONSOLIDATED GRAVEL, SAND, SILT, AND CLAY

TERTIARY

PLIOCENE
- Pp — PICO FORMATION: MARINE SAND, SILT, AND CLAY INTERBEDDED WITH GRAVEL
- Pr — REPETTO FORMATION: MARINE SILTSTONE WITH LAYERS OF SANDSTONE AND CONGLOMERATE

MIOCENE
- (SANTA MONICA MOUNTAINS) MODELO FORMATION: MARINE CONGLOMERATIC SANDSTONE, SANDSTONE, AND SHALE; TOPANGA FORMATION: MARINE CONGLOMERATE, SANDSTONE, AND SHALE
- (PALOS VERDES HILLS) MONTEREY FORMATION: MUDSTONE, DIATOMITE, AND SHALE
- (ELYSIAN HILLS, REPETTO HILLS, AND PUENTE HILLS) PUENTE FORMATION: MARINE SILTSTONE, SANDSTONE, SHALE, CONGLOMERATE, LIMESTONE, AND TUFF

OLIGOCENE(?)
- VAQUEROS AND SESPE FORMATIONS: CONTINENTAL RED CONGLOMERATE AND SANDSTONE

EOCENE
- MARTINEZ FORMATION: MARINE CONGLOMERATE, SANDSTONE, SANDY SHALE, AND SHALE

PALEOCENE(?)
- E-K — UNDIVIDED MARTINEZ AND CHICO FORMATIONS

CRETACEOUS — UPPER
- Ks — CHICO FORMATION: UPPER MARINE MEMBER–HARD CONGLOMERATE, SANDSTONE, AND SHALE; LOWER CONTINENTAL MEMBER–RED CONGLOMERATE AND SANDSTONE

IGNEOUS AND METAMORPHIC ROCKS

TERTIARY — MIOCENE
- MIDDLE MIOCENE VOLCANIC ROCKS: VOLCANIC FLOWS, BRECCIAS, TUFFS, AND INTRUSIVES CHIEFLY BASALTIC AND ANDESITIC WITH OCCASIONAL ACID ROCKS GENERALLY ASSOCIATED WITH TOPANGA, MODELO, OR PUENTE FORMATIONS

CRETACEOUS — UPPER
- (SANTA MONICA MOUNTAINS) INTRUSIVES OF GRANITE AND GRANODIORITE

JURASSIC
- (PALOS VERDES HILLS) CATALINA SCHIST COMPARED WITH FRANCISCAN FORMATION OF THE COAST RANGES. VARIED TYPES OF SCHISTOSE ROCKS

TRIASSIC
- SANTA MONICA SLATE: GREY TO BLACK SLATE, SPOTTED SLATE, MICA SCHIST WITH QUARTZ VEINS

REFERENCE:
CALIFORNIA D.W.R.
BULLETIN 104, PLATE 3B
(1961)

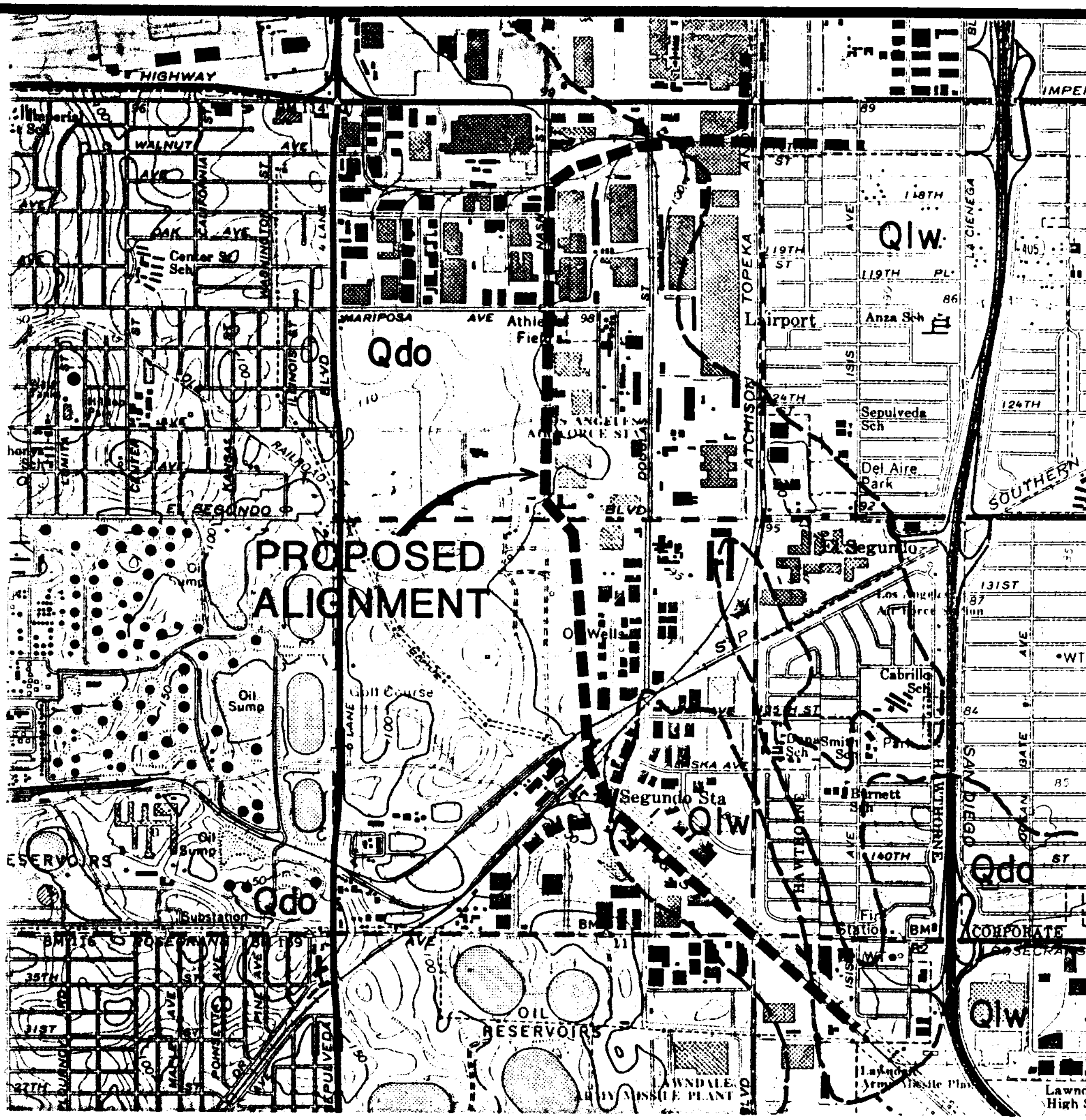
REGIONAL GEOLOGY

SCALE OF MILES 1 0 1 2 3

1961

JOB AE-88044-3 DATE 6-24-88 DR. Jlng. OF. CHKD /L

PLATE 4-1



EXPLANATION:

Qdo PLEISTOCENE OLDER DUNE SAND

Qlw LAKEWOOD FORMATION

GEOLOGIC CONTACT

REFERENCE:

BASE MAP FROM U.S.G.S. 7.5' VENICE QUADRANGLE 1964, (PHOTOREVISED 1981) AND INGLEWOOD QUADRANGLE 1964, (PHOTOREVISED 1981).

GEOLOGY MODIFIED FROM DWR BULLETIN 104.

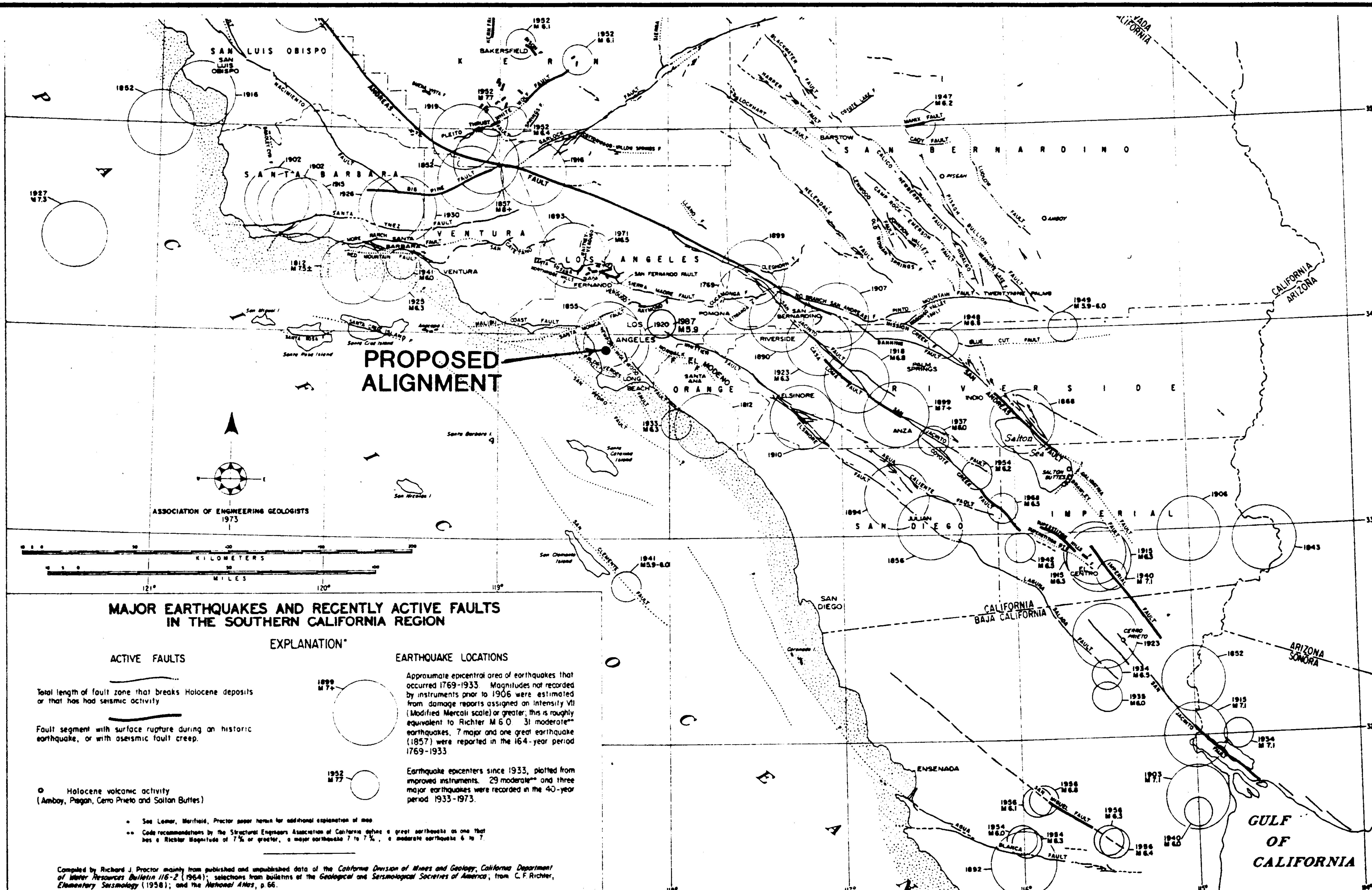
LOCAL GEOLOGY

SCALE 1"=2000'

LeROY CRANDALL AND ASSOCIATES

PLATE 4-2

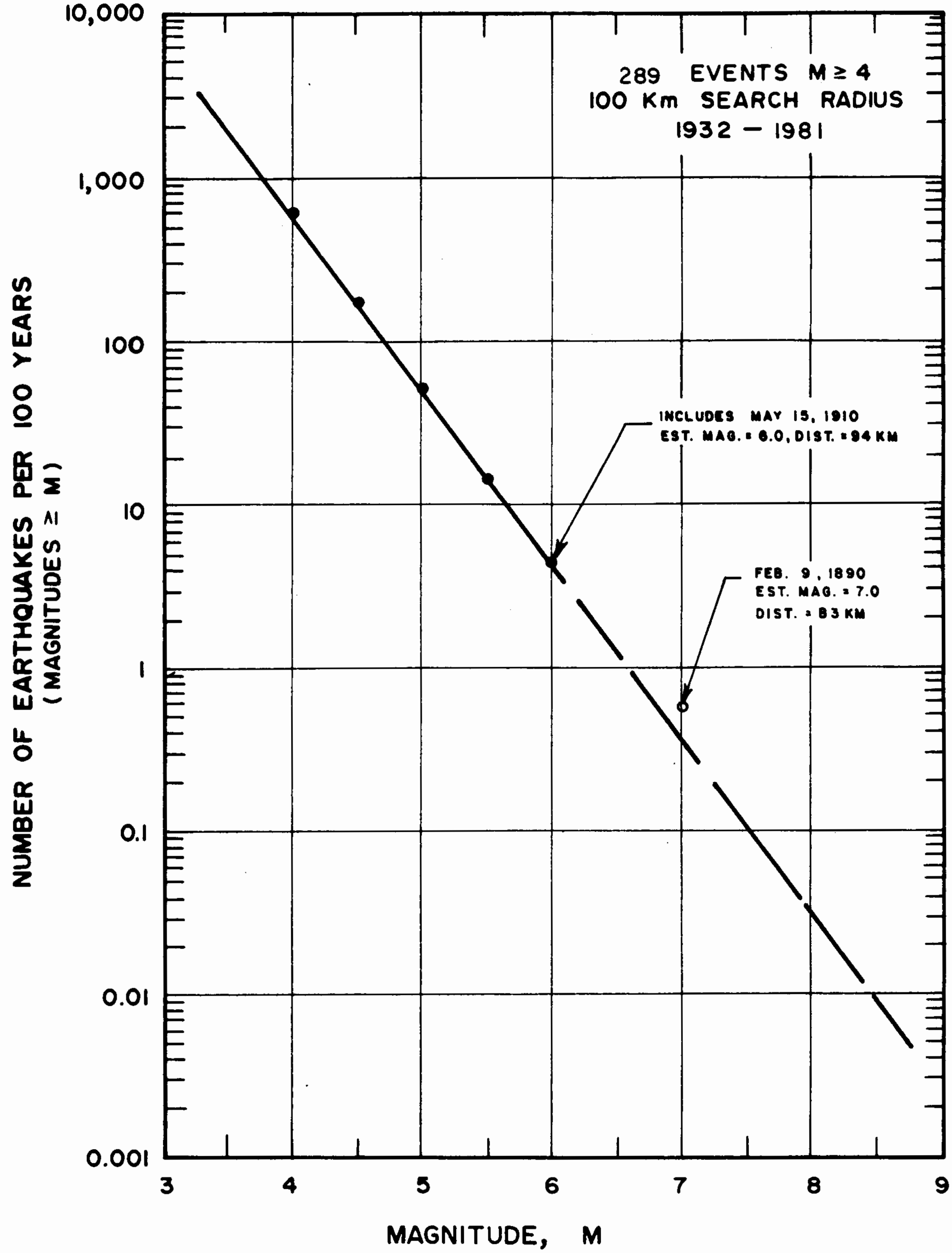
FORM 120



REGIONAL SEISMICITY

LeROY CRANDALL AND ASSOCIATES

PLATE 4-3



RECURRENCE CURVE

o REPRESENTS SINGLE EVENT, AND THEREFORE HAS BEEN DISCOUNTED IN PREDICTION.

LeROY CRANDALL AND ASSOCIATES

PLATE 4.4

FORM 138 JOB ADE F-88044-3 DATE 87/29/88 DR. JOHN O.E. MBH W.P. ___ CHKD ___

Section 5.0

Review of Available Geotechnical Data

5.0 REVIEW OF AVAILABLE GEOTECHNICAL DATA

5.1 PREVIOUS LC&A GEOTECHNICAL INVESTIGATIONS

The review of existing geotechnical data included identifying and researching nearby and adjacent projects along the El Segundo Segment. The locations of the 35 identified projects are shown on Plate 5.1, Locations of Prior Geotechnical Investigations. Pertinent information regarding the projects is presented in Table 5.1, Previous LC&A Investigations near the El Segundo Alignment. Table 5.1 follows the text of this section. For each prior investigation identified, the table presents the I.D. number, LC&A job number, street locations, city, depth of excavation (if any), foundation type recommended, number of borings, maximum boring depth, and water depth if encountered.

The I.D. numbering begins near the interface with the Century Segment and increases towards the south (Hawthorne Yard). Plates 5.2 through 5.16, Tentative Baseline Plan and Profile, show the tentative plan and profile of the project and the locations of those borings from the prior projects that are in the immediate proximity of the alignment. The borings are identified with the I.D. Number and the LC&A boring number.

Logs of selected prior borings are presented in Appendix B.

5.2 SUMMARY OF SOIL CONDITIONS

5.2.1 Fill Materials

At the prior boring locations, fill materials generally ranging from 0 to 7 feet were encountered. Some deeper fills (up to 22 feet) were encountered which may have been the result of previous oil drilling activities in the region.

5.2.2 Native Materials

Near surface natural clay soils were found in most of the projects. The clay soils were found to be expansive in nature and would swell and shrink with changes in the moisture content. The deeper natural soils consisted primarily of sand, silty sand, with some silt, clayey sand, and clay. These deeper natural soils were generally firm and dense.

Evidence of hydrocarbons was noted in a few borings. Such an occurrence would expected due to prior oil field activities. The potential for soil contamination was covered in our environmental audit report dated August 25, 1988 (our Job No. F-88044-4.)

5.2.3 Water

Water was encountered in borings drilled for four of the projects (Projects 1, 4, 30, and 33). For Project 1, water was encountered at a depth of 37 feet. The water appeared to be perched water on top of an impervious clay layer, and not part of the main ground water body.

For Project 4, water seepage was encountered in one boring at a depth of 36 feet. For Projects 30 and 33, minor water seepage was encountered at a depth of 7½ feet.

TABLE 5 - 1 **PREVIOUS L.C.& A. GEOTECHNICAL INVESTIGATIONS NEAR THE EL SEGUNDO ALIGNMENT**

ID	L.C.&A. JOB NO.	LOCATION	CITY	FOUNDATION TYPE	EXCA-VATION DEPTH	NO. OF BORINGS	MAXIMUM BORING DEPTH	WATER DEPTH
1	ADE-83078	Imperial Hwy. & Aviation Blvd.	El Segundo	Spread footings on natural	45	11	101	37 *
2	A-81025	Imperial Hwy. & Douglas Street	El Segundo	Spread footings on natural	25	8	57	–
3	A-73201	Imperial Hwy. & Nash Street	El Segundo	Spread footings or Caissons	–	9	35.5	–
4	A-72295	Imperial Hwy. & Nash Street	El Segundo	Spread footings on natural	–	5	59	36 **
5	61538	Imperial Hwy. & Nash Street	El Segundo	Spread footings or Caissons	–	8	35	–
6	AD-77040	2060 Imperial Highway	El Segundo	Spread footings on natural	15	4	74	–
7	A-76243	2060 Imperial Highway	El Segundo	Spread footings on natural	–	3	10	–
8	59293	Nash Street & Mariposa Avenue	El Segundo	Spread footings on natural	–	3	17	–
9	AE-83307	Grand Avenue & Continental Blvd.	El Segundo	Spread footings on natural	–	6	75.5	–
10	AD-83307-B	Grand Avenue & Continental Blvd.	El Segundo	Spread footings on natural	–	4	76	–
11	A-85019	Grand Avenue & Continental Blvd.	El Segundo	Spread footings on natural	–	1	50	–
12	ADE-81408	Imperial Hwy. & Aviation Blvd.	El Segundo	Driven Piles	–	12	101	–

* Perched Water ** Seepage in Boring

PREVIOUS L.C.& A. GEOTECHNICAL INVESTIGATIONS NEAR THE EL SEGUNDO ALIGNMENT

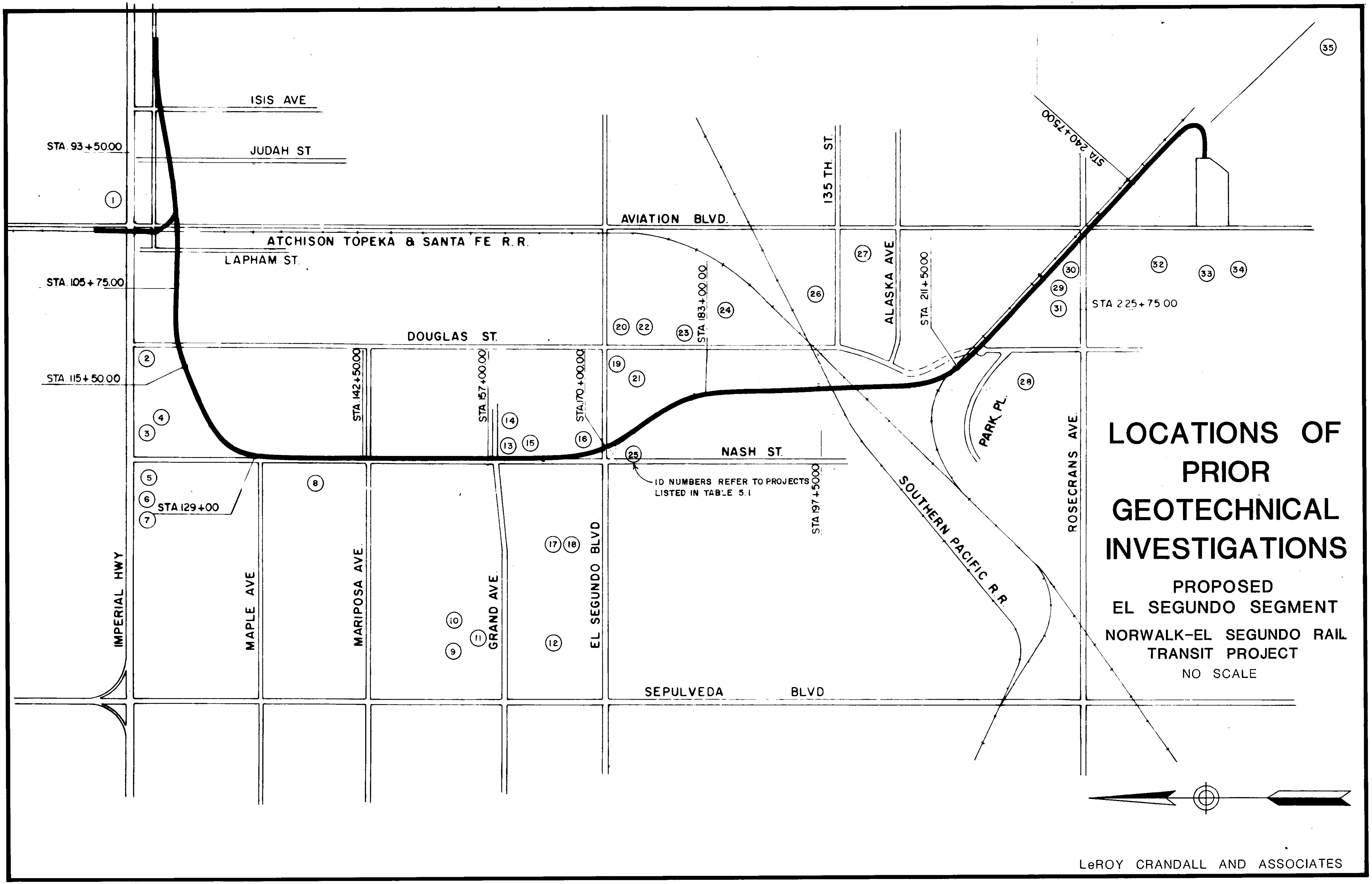
ID	L.C.& A. JOB NO.	LOCATION	CITY	FOUNDATION TYPE	EXCA-VATION DEPTH	NO. OF BORINGS	MAXIMUM BORING DEPTH	WATER DEPTH
13	A-71185	Grand Avenue & Nash Street	El Segundo	Spread footings on natural	–	5	40.5	–
14	A-74001	Nash Street & Grand Avenue	El Segundo	Spread footings on natural or compacted fill	–	6	15.5	–
15	A-75193	Nash Street & Grand Avenue	El Segundo	Spread footings on natural or compacted fill	–	14	35	–
16	A-81113	Nash Street & El Segundo Blvd.	El Segundo	Spread footings on natural	20	6	60	–
17	A-76121	Continental Blvd. & El Segundo Blvd.	El Segundo	Spread footings on natural	12	7	31	–
18	AD-78361	El Segundo Blvd. & Continental Blvd.	El Segundo	Spread footings on natural	–	6	75	–
19	A-86361	El Segundo Blvd. & Douglas St.	El Segundo	Spread footings on natural or compacted fill	–	5	35	–
20	A-85231	2332 E. El Segundo Blvd.	El Segundo	Spread footings on natural	16	7	41	–
21	A-81186	201 S. Douglas Street	El Segundo	Spread Footings or Caissons	–	5	45	–
22	A-81172	Douglas Street & El Segundo Blvd.	El Segundo	Spread Footings or Caissons	–	2	40.5	–
23	A-73101	Douglas Street & El Segundo Blvd.	El Segundo	Spread Footings or Caissons	6	4	27	–
24	A-82282	300 S. Douglas Street	El Segundo	Mat Foundation	–	2	40	–

TABLE 5 - 1

PREVIOUS L.C.& A. GEOTECHNICAL INVESTIGATIONS NEAR THE EL SEGUNDO ALIGNMENT

ID	L.C.& A. JOB NO.	LOCATION	CITY	FOUNDATION TYPE	EXCA-VATION DEPTH	NO. OF BORINGS	MAXIMUM BORING DEPTH	WATER DEPTH
25	ADE-78034-B	El Segundo Blvd. & Sepulveda Blvd.	El Segundo	Spread footings on natural	40	55	80	–
26	A-82177	2333 Utah Avenue	El Segundo	Drilled Piles	–	3	44.5	–
27	A-65382	Utah Avenue & Alaska Avenue	El Segundo	Drilled Piles	–	5	39	–
28	ADE-86172	2200 Park Place	El Segundo	Spread footings on natural	–	4	16	–
29	A-85123	2301 Rosecrans Avenue	El Segundo	Spread footings or Caissons	7	8	41	–
30	A-88225	Rosecrans Avenue & Aviation Blvd.	El Segundo	Spread footings on natural	9	4	40	7.5*
31	A-84344	2301 Rosecrans Avenue	El Segundo	Spread footings on natural or compacted fill	–	8	36	–
32	A-80222	33rd St., Aviation Blvd. & Redondo Avenue	Manhattan Beach	Spread footings on natural	10	8	50	–
33	A-80085	Aviation Blvd. & Marine Avenue	Manhattan Beach	Spread footings on natural	14	4	35	7.5*
34	A-82231	Aviation Blvd. & Marine Avenue	Manhattan Beach	Spread footings on natural	10	3	37	–
35	A-83313	Freeman Blvd. & Compton Blvd.	Redondo Beach	Spread footings on natural	–	1	20	–

* Slight Seepage in one Boring



LOCATIONS OF PRIOR GEOTECHNICAL INVESTIGATIONS

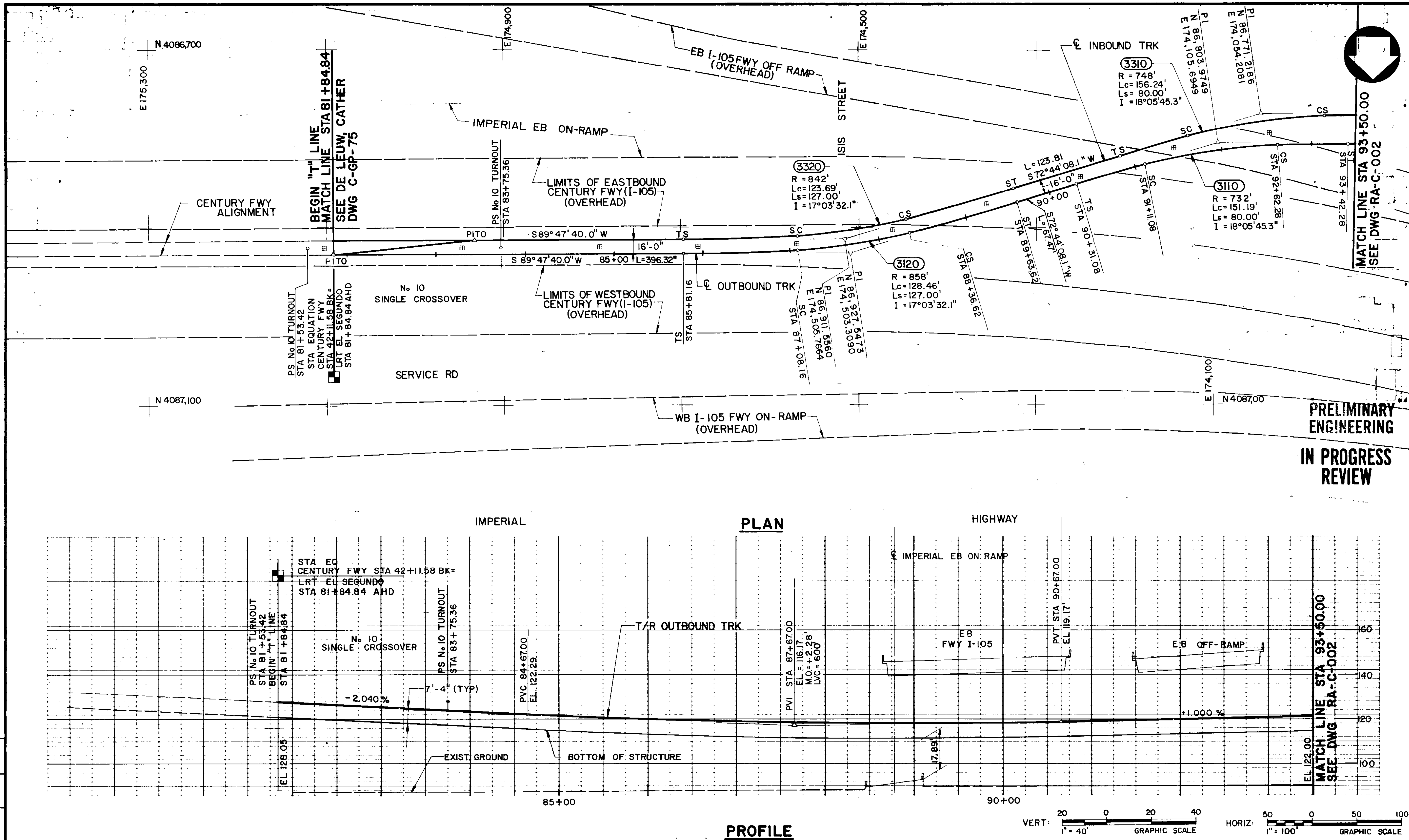
PROPOSED
EL SEGUNDO SEGMENT

NORWALK-EL SEGUNDO RAIL TRANSIT PROJECT

NO SCALE

LeROY CRANDALL AND ASSOCIATES

PLATE 5.1



JOB [redacted] F-8 [redacted] 4-6 [redacted] DATE [redacted] 8-[redacted] 88 CHKD. DM

REV.	DATE	DESCRIPTION	BY	APP.

Work Element | Physical Entity | Contract Designator | Line Item | Cost Element | Project Number

Information confidential: all plans, drawings, specifications, and/or information furnished herewith shall remain the property of the Los Angeles County Transportation Commission; shall be held confidential, and shall not be used for any purpose not provided for in agreements with the Los Angeles County Transportation Commission.

DESIGNED BY J. DVORAK
DRAWN BY
CHECKED BY
APPROVED BY
DATE 8/15/88

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Norwalk– El Segundo Rail Transit Project

LeROY CRANDALL AND ASSOCIATES
GEOTECHNICAL CONSULTANTS

TRANSCAL Transit Consultants of Southern California
A Joint Venture of: Parsons Brinckerhoff Quade & Douglas, Inc. – Daniel, Mann, Johnson & Mendenhall – Kaiser Engineers (California) Corp. – North Pacific Construction Management

APPROVED:

TENTATIVE BASELINE
PLAN AND PROFILE
STA 81+84.84 TO STA 93+50.00

CONTRACT NO.
DRAWING NO. RA-C-001
REV.
SHEET NO. 10
SCALE AS NOTED

PLATE 5.2

[redacted]OB-[redacted] ADEF-88044.6 [redacted]DA[redacted] 8-29-88 [redacted]CH[redacted]

Project Number	Cost Element	Line Item	Contract Designator	Physical Entity	Work Element

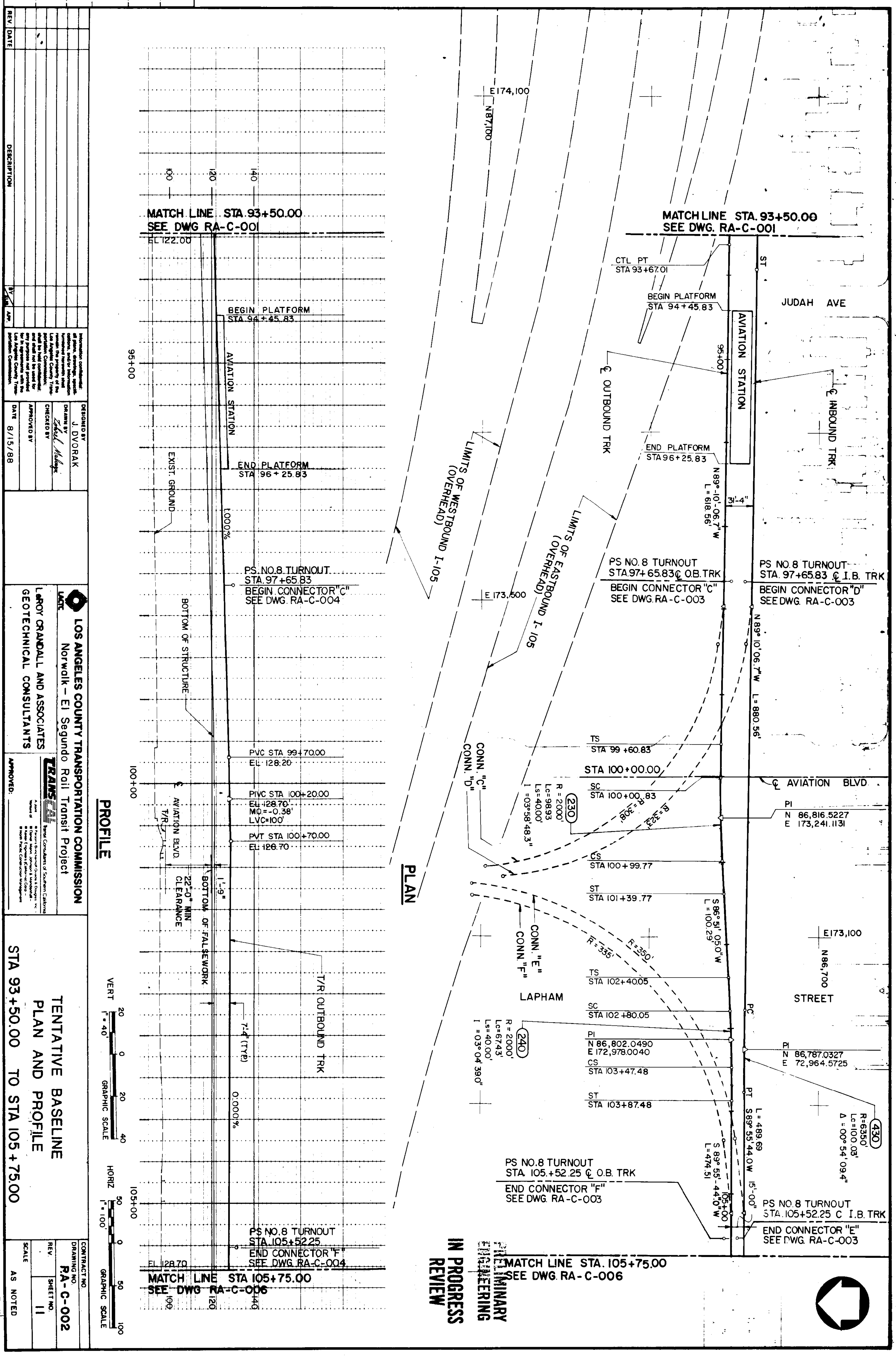
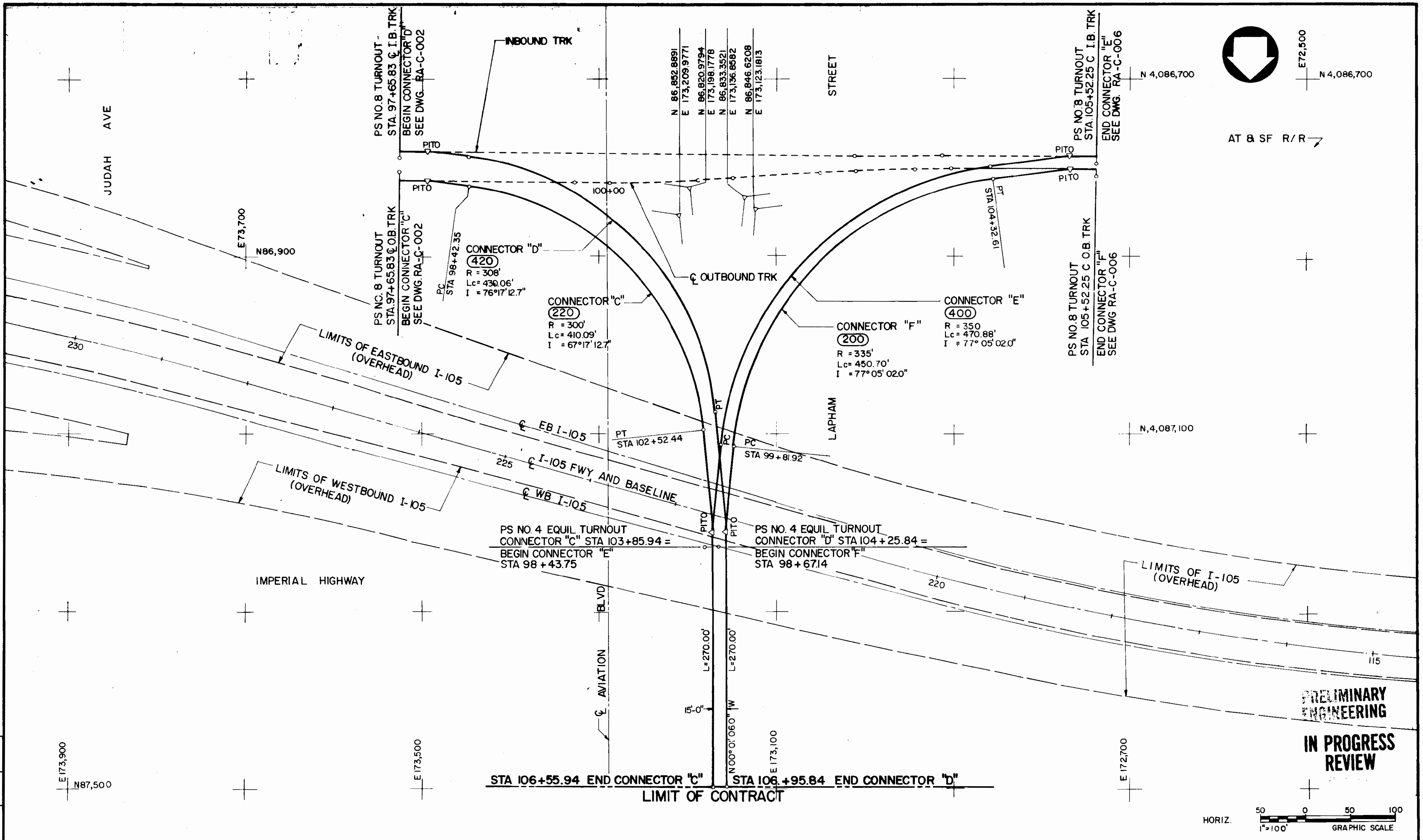


PLATE 5.3



REV.	DATE	DESCRIPTION	BY	SUB	APP.

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DRAWN BY [signature]
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APPROVED BY
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Norwalk - El Segundo Rail Transit Project

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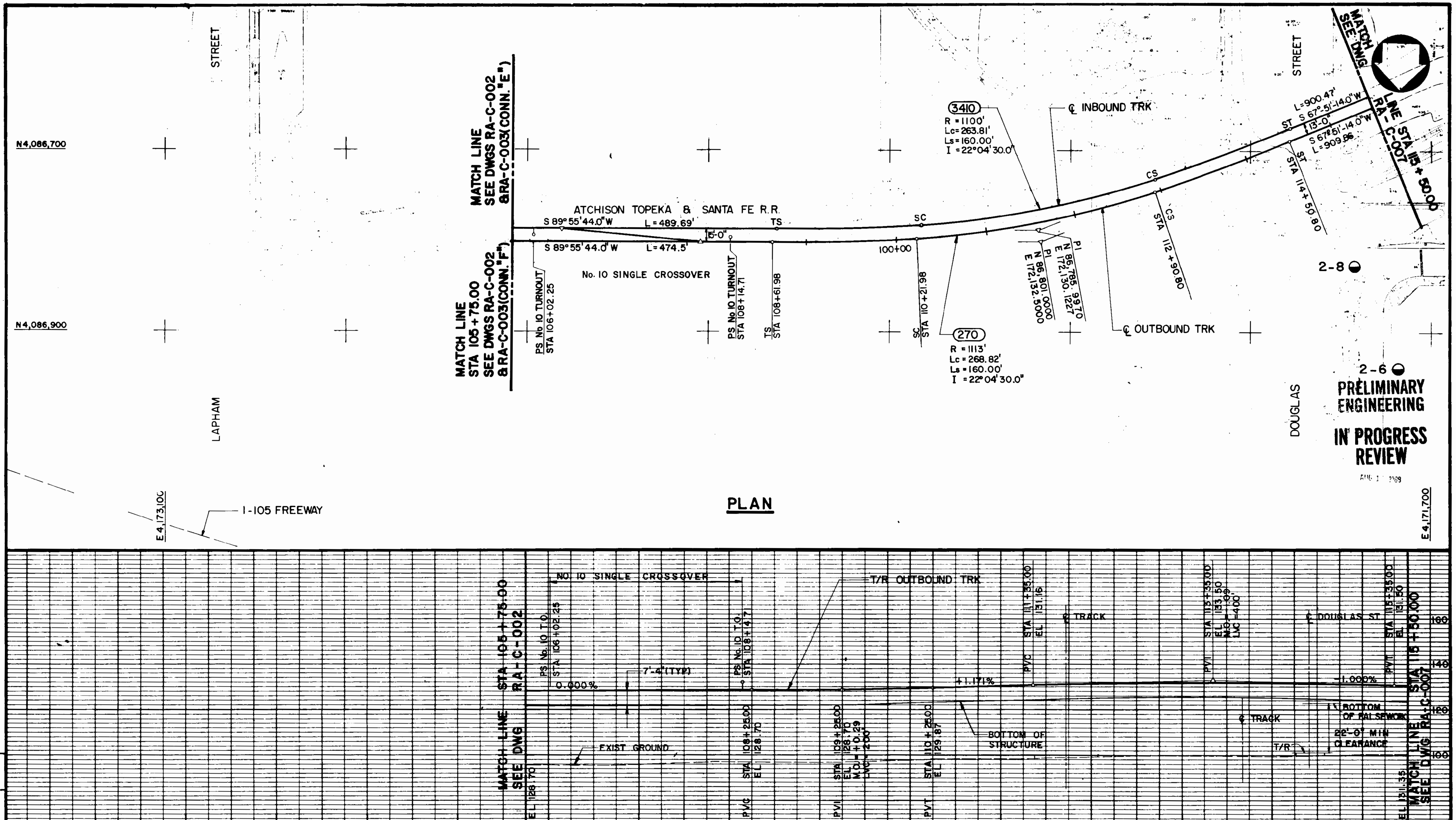
CONNECTOR "C", "D", "E", AND "F"

CONTRACT NO.
DRAWING NO. RA-C-003
REV.
SHEET NO. 12
SCALE AS NOTED

PLATE 5.4

Work Element / Physical Entity / Contract Designator / Line Item / Cost Element / Project Number

ADEF-88044 6 DATE 8-29-89 CHKD.



REV.	DATE	DESCRIPTION	BY	APP.

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DRAWN BY A. BOYADJIAN
CHECKED BY
APPROVED BY
DATE 8/15/88

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Norwalk – El Segundo Rail Transit Project

LeROY CRANDALL AND ASSOCIATES
GEOTECHNICAL CONSULTANTS

TRANSCAL Transit Consultants of Southern California

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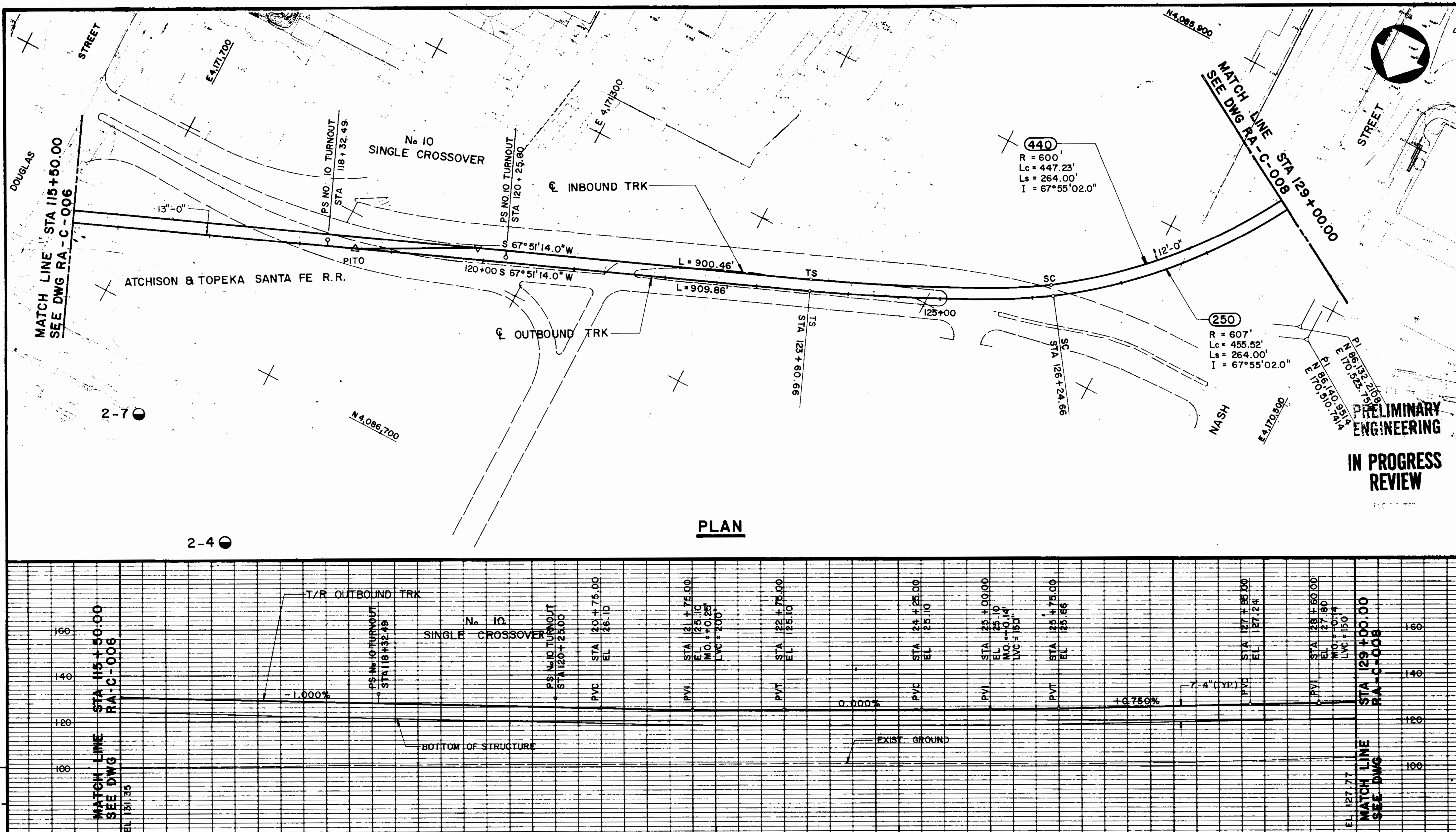
TENTATIVE BASELINE PLAN AND PROFILE
STA 105+75.00 TO STA 115+50.00

CONTRACT NO.
DRAWING NO. RA-C-006
REV.
SHEET NO. 15
SCALE AS NOTED

PLATE 5.5



VERT: 20 0 20 40 — 1" = 40' GRAPHIC SCALE

HORIZ: 50 0 50 100 — 1" = 100' GRAPHIC SCALE

REV.	DATE	DESCRIPTION	BY	APP.

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DRAWN BY A. BOYADJIAN

CHECKED BY

APPROVED BY

DATE 8/15/88

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

Norwalk – El Segundo Rail Transit Project

LACTC

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STA 115+50.00 TO STA 129+00.00

CONTRACT NO.

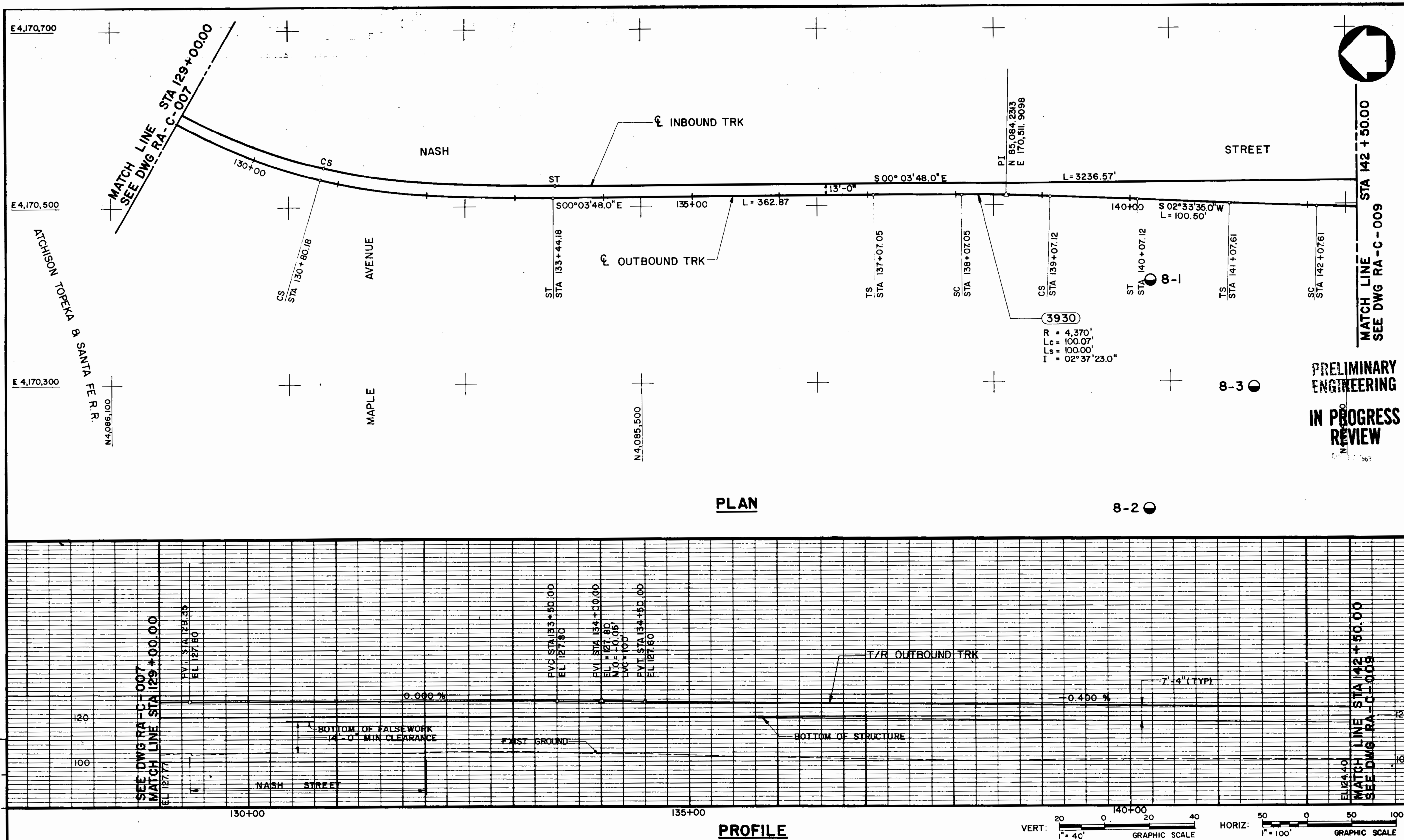
DRAWING NO. RA-C-007

REV.

SHEET NO. 16

SCALE AS NOTED

PLATE 5.6



REV.	DATE	DESCRIPTION	BY	APP.

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DRAWN BY A. BOYADJIAN
CHECKED BY
APPROVED BY
DATE 8/15/88

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Norwalk – El Segundo Rail Transit Project

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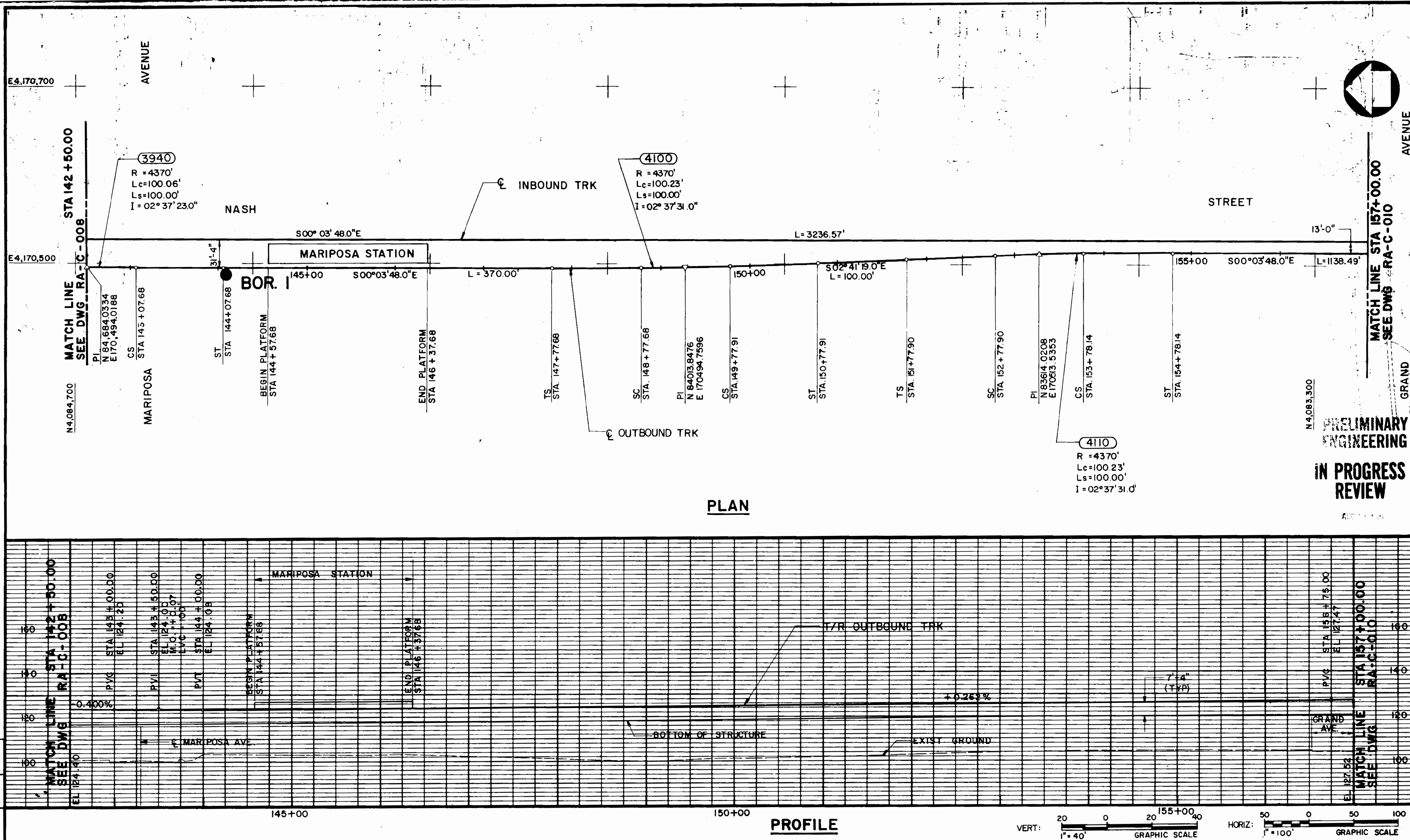
CONTRACT NO.
DRAWING NO. RA-C-008
REV.
SHEET NO. 17
SCALE AS NOTED

PLATE 5.7



REV.	DATE	DESCRIPTION	BY	APP.

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DESIGNED BY J. DVORAK
DRAWN BY A. BOYADJIAN
CHECKED BY
APPROVED BY
DATE 8/15/88

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Norwalk – El Segundo Rail Transit Project

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GEOTECHNICAL CONSULTANTS

TRANSCAL Transit Consultants of Southern California
APPROVED:

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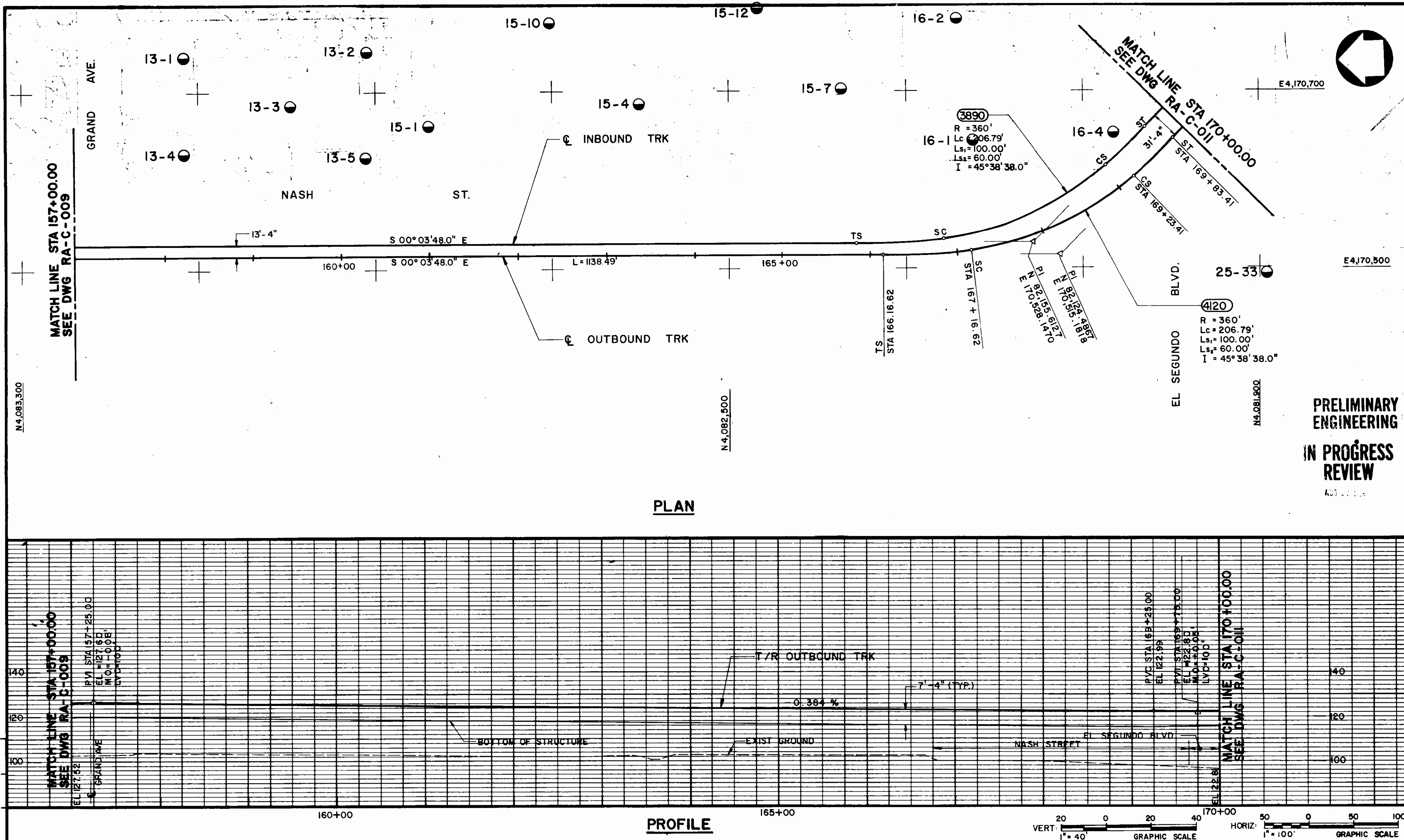
STA 142+50.00 TO STA 157+00.00

CONTRACT NO.
DRAWING NO. RA-C-009
REV.
SHEET NO. 18
SCALE AS NOTED

PLATE 5.8



REV.	DATE	DESCRIPTION	BY	APP.

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DESIGNED BY J. DVORAK
DRAWN BY Zohreh Malayeri
CHECKED BY
APPROVED BY
DATE 8/15/88

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Norwalk – El Segundo Rail Transit Project

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TRANSCAL Transit Consultants of Southern California
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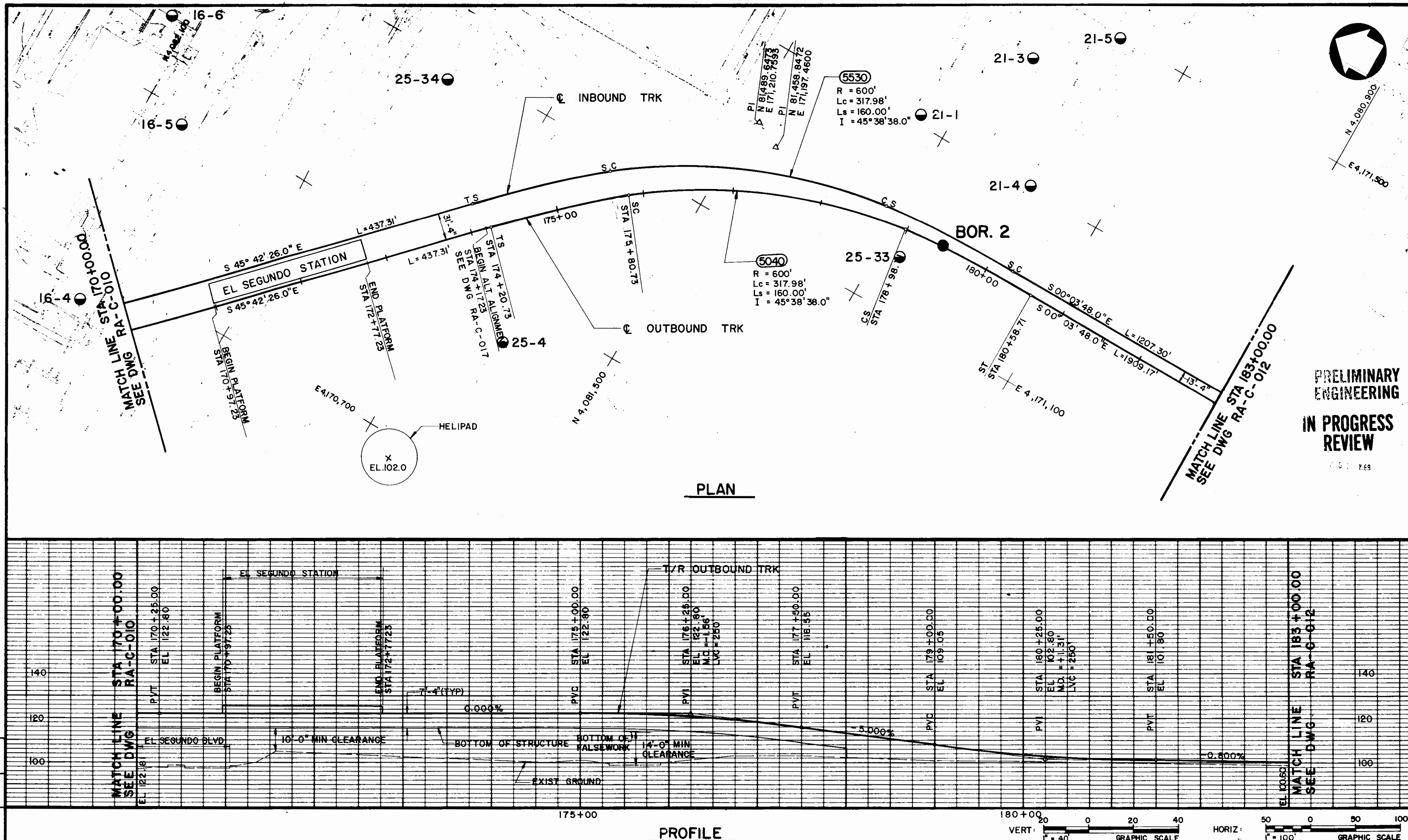
APPROVED:

TENTATIVE BASELINE PLAN AND PROFILE
STA 157+00.00 TO STA 170+00.00

CONTRACT NO.
DRAWING NO. RA-C-010
REV.
SHEET NO. 19
SCALE AS NOTED

PLATE 5.9



REV.	DATE	DESCRIPTION	BY	APP.

Information confidential: all plans, drawings, specifications, and/or information furnished herewith shall remain the property of the Los Angeles County Transportation Commission; shall be held confidential; and shall not be used for any purpose not provided for in agreements with the Los Angeles County Transportation Commission.

DESIGNED BY J. DVORAK
DRAWN BY Zohreh Malayeri
CHECKED BY
APPROVED BY
DATE 8/15/88

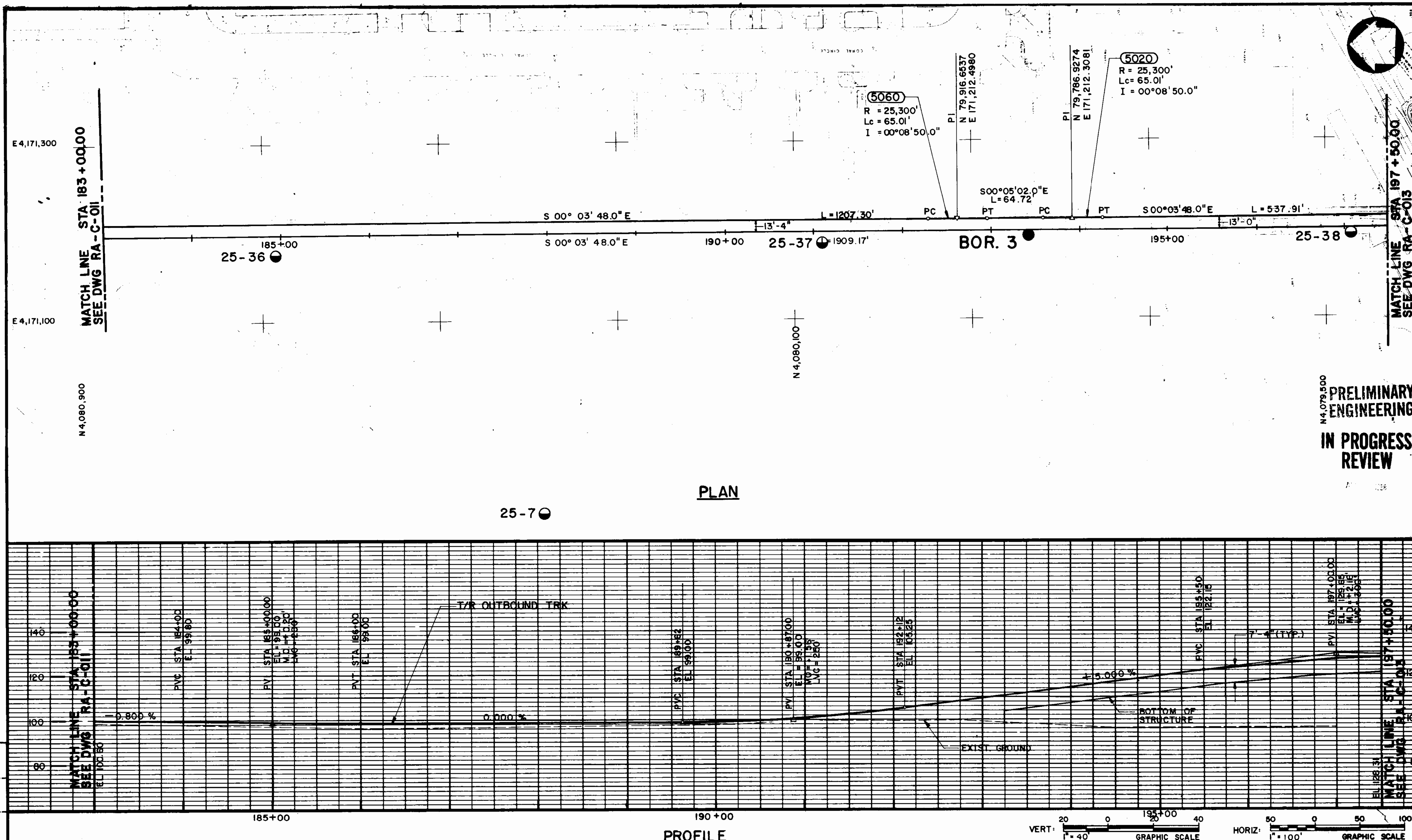
LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Norwalk – El Segundo Rail Transit Project

LeROY CRANDALL AND ASSOCIATES
GEOTECHNICAL CONSULTANTS

TRANSCAL Transit Consultants of Southern California
APPROVED:

TENTATIVE BASELINE PLAN AND PROFILE
STA 170+00.00 TO STA 183+00.00

CONTRACT NO.
DRAWING NO. RA-C-011
REV.
SHEET NO. 20
SCALE AS NOTED



REV.	DATE	DESCRIPTION	BY	APP.

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DESIGNED BY J. DVORAK
DRAWN BY V. GHAMBARI
CHECKED BY
APPROVED BY
DATE 8/15/88

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Norwalk – El Segundo Rail Transit Project

LeROY CRANDALL AND ASSOCIATES
GEOTECHNICAL CONSULTANTS

TRANSCAL Transit Consultants of Southern California

APPROVED:

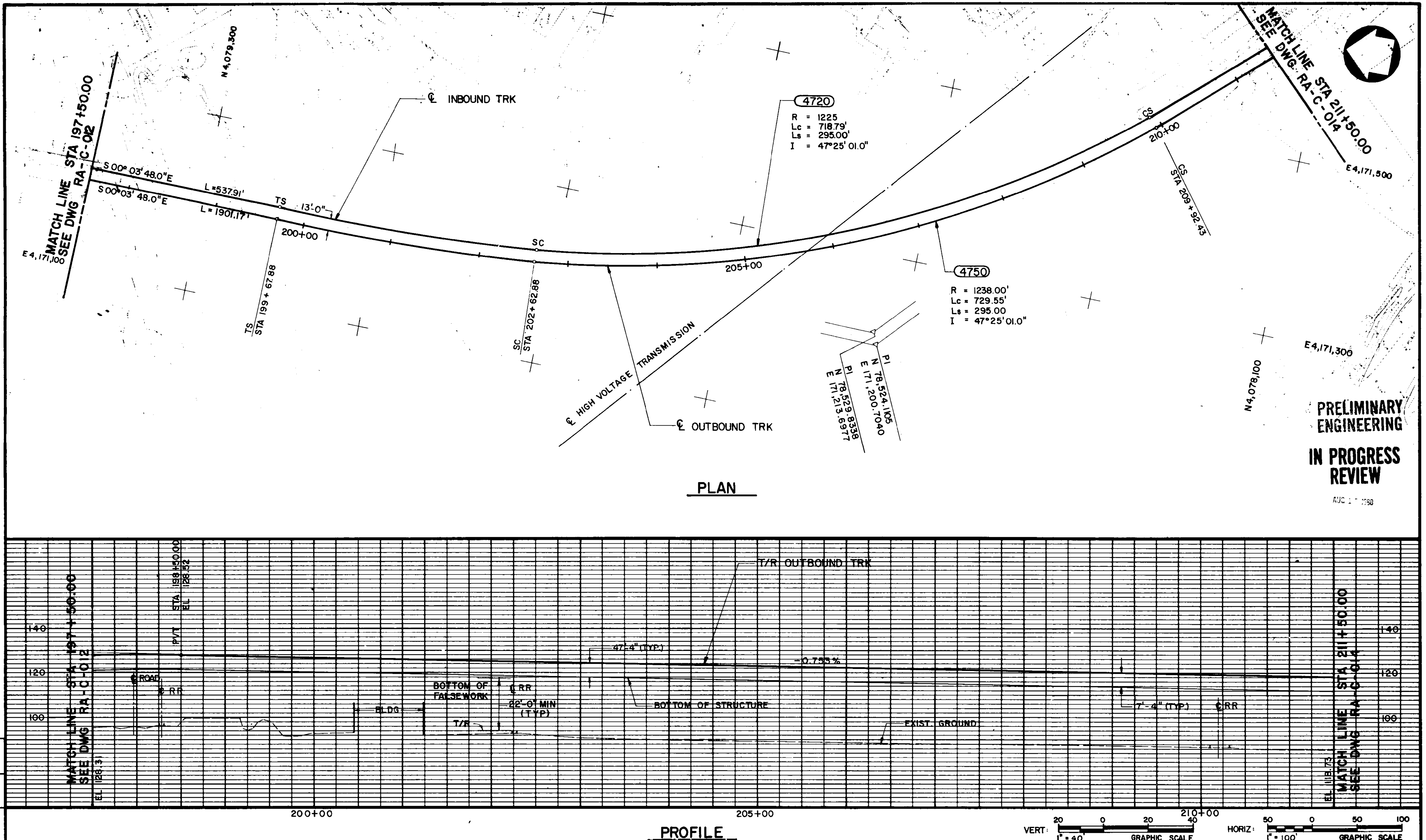
TENTATIVE BASELINE PLAN AND PROFILE
STA 183+00.00 TO STA 197+50.00

CONTRACT NO. CB01-01-01
DRAWING NO. RA-C-012
REV.
SHEET NO. 21
SCALE AS NOTED

PLATE 5.11

Project Number | Cost Element | Line Item | Contract Designator | Physical Entity | Work Element

JOB [illegible] F-[illegible] 14 DATE 8 [illegible] 88 CHKD.



REV.	DATE	DESCRIPTION	BY	APP.

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DESIGNED BY J. DVORAK
DRAWN BY V. GHAMBARI
CHECKED BY
APPROVED BY
DATE 8/15/88

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Norwalk – El Segundo Rail Transit Project

LeROY CRANDALL AND ASSOCIATES
GEOTECHNICAL CONSULTANTS

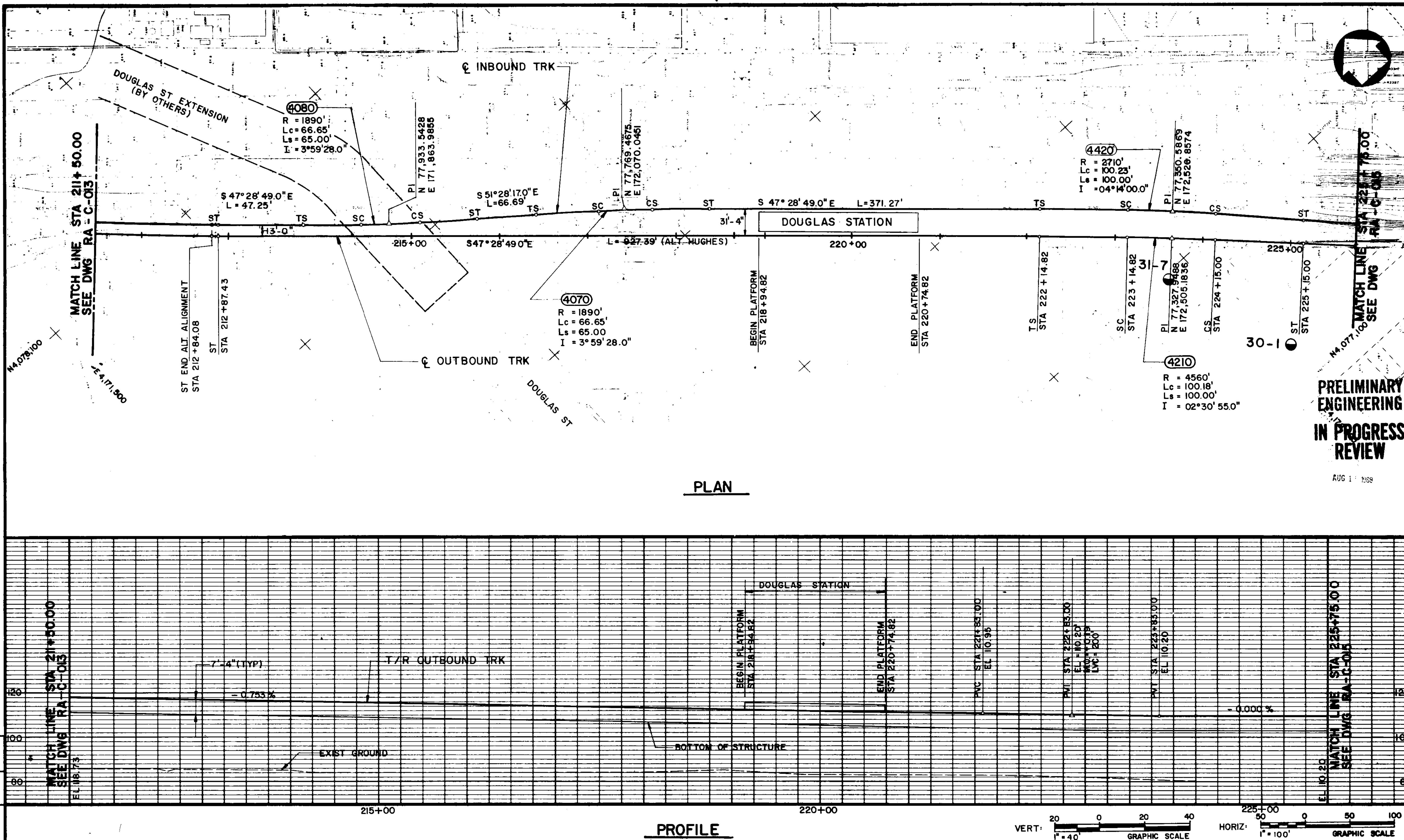
TRANSCAL Transit Consultants of Southern California

APPROVED:

TENTATIVE BASELINE
PLAN AND PROFILE
STA 197+50.00 TO STA 211+50.00

CONTRACT NO.
DRAWING NO. RA-C-013
REV.
SHEET NO. 22
SCALE AS NOTED

JOB ADEF-88044-6 DATE 8-29-88 CHKD. DM



REV.	DATE	DESCRIPTION	BY	APP.

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DESIGNED BY J. DVORAK
DRAWN BY V. GHAMBARI
CHECKED BY
APPROVED BY
DATE 8/15/88

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Norwalk – El Segundo Rail Transit Project
LACTC
TRANSCAL Transit Consultants of Southern California
LeROY CRANDALL AND ASSOCIATES
GEOTECHNICAL CONSULTANTS
APPROVED:

TENTATIVE BASELINE
PLAN AND PROFILE
STA 211+50.00 TO STA 225+75.00

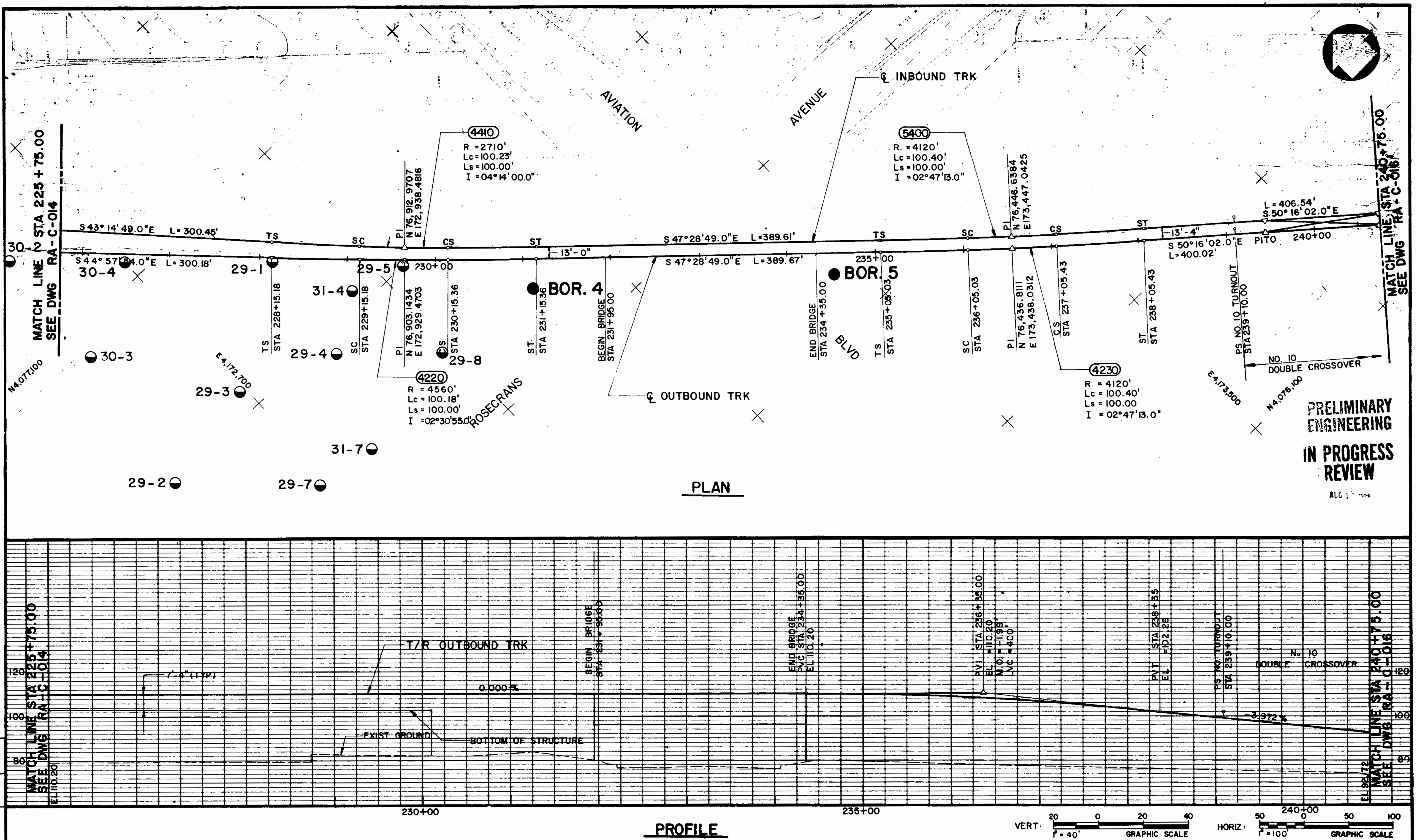
CONTRACT NO.
DRAWING NO. RA-C-014
REV.
SHEET NO. 23
SCALE AS NOTED

Project Number | Cost Element | Line Item | Contract Designator | Physical Entity | Work Element

[redacted] DATE [redacted] CHKD [redacted]

PLATE 5.13

JOB F-[redacted]44 DATE 8-[redacted]-88 CHKD.



REV.	DATE	DESCRIPTION	BY	APP.

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DESIGNED BY J. DVORAK
DRAWN BY T. BALSHEM
CHECKED BY
APPROVED BY
DATE 8/15/88

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Norwalk – El Segundo Rail Transit Project

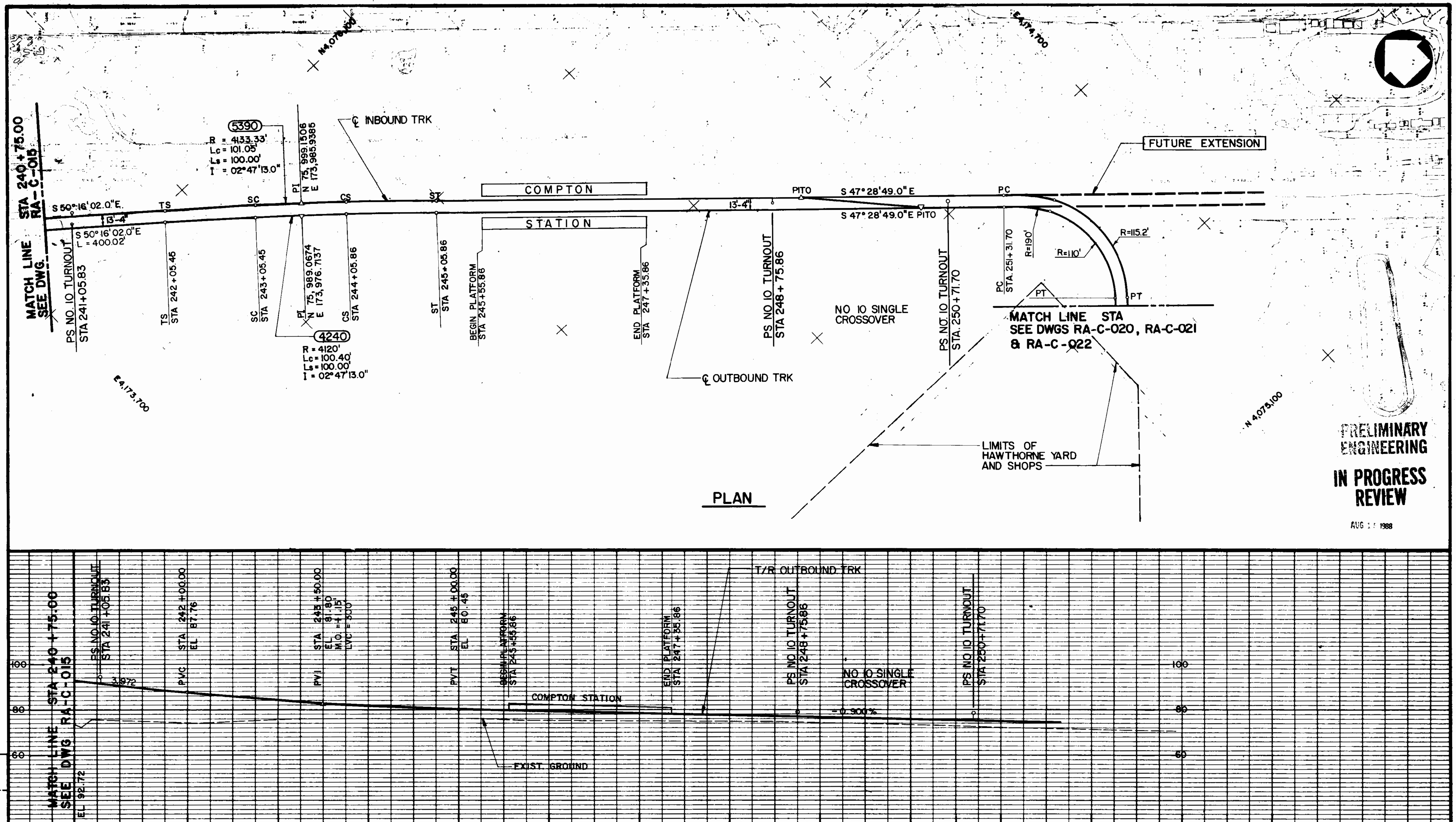
LeROY CRANDALL AND ASSOCIATES
GEOTECHNICAL CONSULTANTS

TRANSCAL Transit Consultants of Southern California
APPROVED:

TENTATIVE BASELINE PLAN AND PROFILE STA 225+75.00 TO STA 240+75.00

CONTRACT NO.
DRAWING NO. RA-C-015
REV.
SHEET NO. 24
SCALE AS NOTED

PLATE 5.14



VERT: 1" = 40' GRAPHIC SCALE (20 0 20 40)

HORIZ: 1" = 100' GRAPHIC SCALE (50 0 50 100)

REV.	DATE	DESCRIPTION	BY	APP.

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DESIGNED BY J. DVORAK
DRAWN BY T. BALSHEM
CHECKED BY
APPROVED BY
DATE 8/15/88

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Norwalk – El Segundo Rail Transit Project

LeROY CRANDALL AND ASSOCIATES
GEOTECHNICAL CONSULTANTS

TRANSCAL Transit Consultants of Southern California

APPROVED:

TENTATIVE BASELINE
PLAN AND PROFILE
STA 240+75.00 TO STA

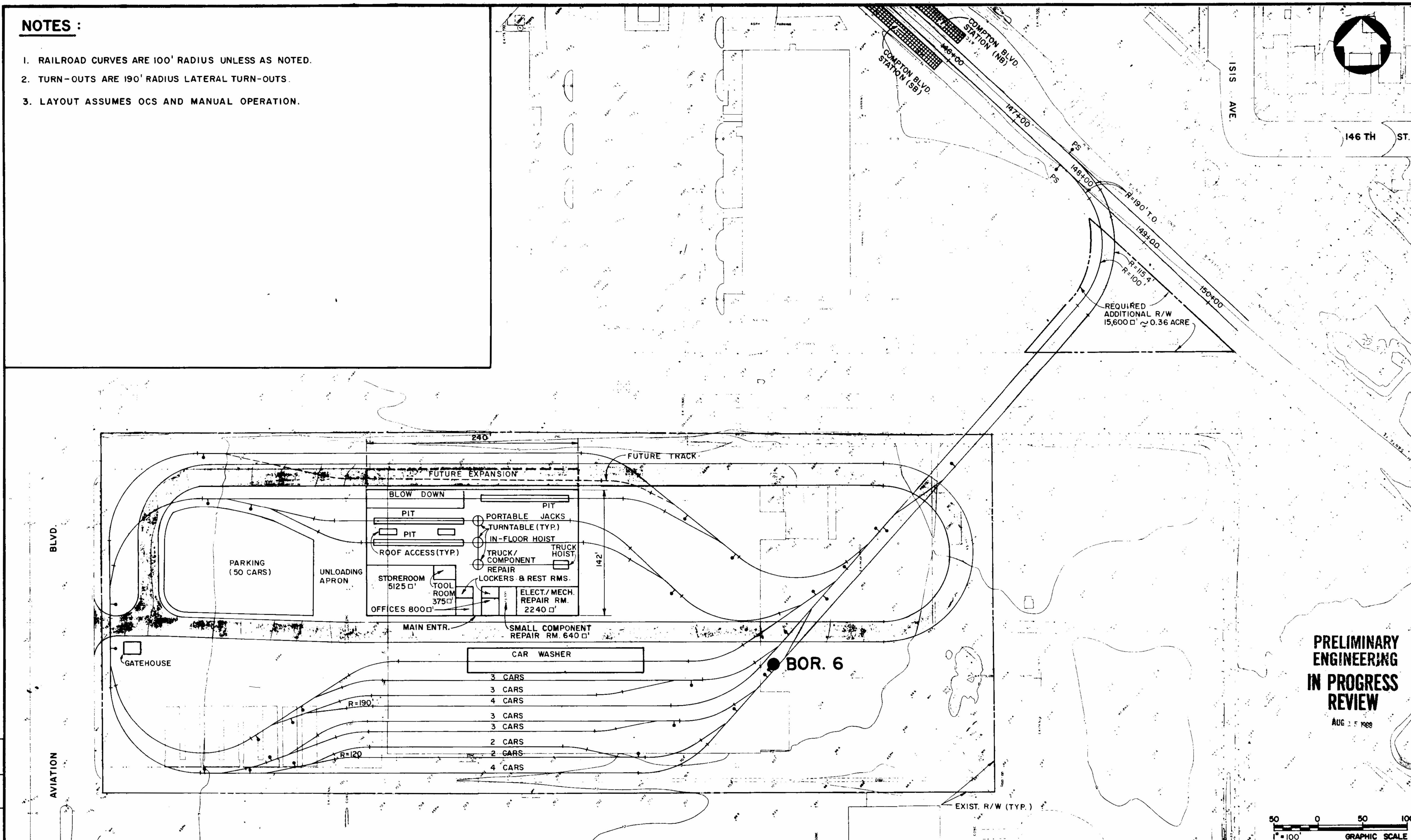
CONTRACT NO.
DRAWING NO. RA-C-016
REV.
SHEET NO. 25
SCALE AS NOTED

PLATE 5.15

JOB F- 44 DATE 8- 88 CHKD. DM

NOTES :

1. RAILROAD CURVES ARE 100' RADIUS UNLESS AS NOTED.
2. TURN-OUTS ARE 190' RADIUS LATERAL TURN-OUTS.
3. LAYOUT ASSUMES OCS AND MANUAL OPERATION.



PRELIMINARY ENGINEERING IN PROGRESS REVIEW
AUG 15 1988

Project Number	Cost Element	Line Item	Contract Designator	Physical Entity	Work Element

REV.	DATE	DESCRIPTION	BY	APP.

Information confidential: all plans, drawings, specifications, and/or information furnished herewith shall remain the property of the Los Angeles County Transportation Commission; shall be held confidential; and shall not be used for any purpose not provided for in agreements with the Los Angeles County Transportation Commission.

DESIGNED BY: CHRIS ANDERSEN
DRAWN BY: ROBERT GHOTANIAN
CHECKED BY:
APPROVED BY:
DATE: 3 MAY 1988

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
LACTC
Norwalk-El Segundo Rail Transit Project

LeROY CRANDALL AND ASSOCIATES
GEOTECHNICAL CONSULTANTS

TRANSCAL Transit Consultants of Southern California
A Joint Venture of: Parsons Brinckerhoff Quade & Douglas, Inc. – Daniel, Mann, Johnson & Mendenhall – Kaiser Engineers (California) Corp. – North Pacific Construction Management

APPROVED:

TENTATIVE BASELINE
PLAN AND PROFILE
HAWTHORNE YARD-LAYOUT B

CONTRACT NO.
DRAWING NO. RA-C-020
REV.
SHEET NO. 29
SCALE AS NOTED

PLATE 5.16

Section 6.0

Limited Field Explorations and Laboratory Testing

SECTION 6.0:
FIELD EXPLORATION AND LABORATORY TESTING

6.1 FIELD EXPLORATION PROGRAM

The field exploration program was performed in accordance with the statement of work described in the limited notice to proceed from TRANSCAL dated May 31, 1988. However, the number of borings drilled for this preliminary investigative phase was reduced from seven to six.

A detailed description of the drilling exploration program, boring logs, and laboratory testing is presented in Appendix C.

6.1.1 Borings

Six exploration borings were drilled at the locations shown on Plate 6.1, Boring Location Plan; the boring locations are also shown in more detail on Plates 5.8, 5.10, 5.11, 5.14, and 5.16. One boring was drilled near the intersection of Nash Street and Mariposa Avenue. Two borings were drilled along the proposed alignment on the east boundary of the Hughes EDSG Facility. Two borings were drilled near the intersection of Rosecrans Avenue and Aviation Boulevard, which is the site of the proposed bridge over that intersection. Finally, one boring was drilled within the Hawthorne Yard and Shops area.

The borings ranged in depth from 30 to 100 feet below the existing grade. Casing was installed in Boring 4 to permit a downhole seismic survey to be performed; the results of that survey will be presented in the final geotechnical report. Well casing was installed in Boring 5 to permit future water level measurements.

The locations and depths of borings were planned in collaboration with TRANSCAL and were modified as necessary in the field to avoid underground utilities and overhead power lines. The logs of the borings are presented in Appendix C. In addition to the current borings, data were available from prior investigations along the alignment, as discussed in prior Section 5.0; the logs of applicable prior borings are presented in Appendix B.

The logs give descriptions of the earth materials encountered, the depth and type of samples obtained, and the laboratory tests performed. Although the transition may be gradual, the stratigraphic lines shown on the logs represent the approximate boundaries between soil types.

The drilling was performed during the period of August 8 through August 12, 1988.

6.1.2 Drilling Equipment

The drilling was performed using 18-inch-diameter bucket-type drilling equipment and 5-inch-diameter rotary wash-type equipment.

6.1.3 Logging and Sampling

The soils encountered were logged by our field representatives, and both undisturbed and bulk samples were obtained for laboratory inspection and testing. Undisturbed samples were obtained with the Crandall sampler at depth intervals of about five feet and at major changes in soil stratigraphy. Detailed descriptions of the field exploration procedures are presented in Appendices B and C.

6.1.4 Soil Classification

The soils were classified using the Unified Soil Classification System. The field soil classifications were verified by visual inspection in the laboratory by staff engineers and further verified (as necessary) by laboratory tests.

6.1.5 Ground Water Measurement

As part of the field exploration program, casing was installed in Boring 5 to permit future observation of the ground water level. Two-inch PVC (Schedule 40) flush-threaded well casing, with the lower 50 feet perforated, was lowered into the boring excavation. Sand was used to backfill the annular space surrounding the perforated interval to roughly above the perforated zone. The remaining portion of the well was sealed with grout.

6.2 LABORATORY TESTING PROGRAM

Each soil sample was first visually observed in the laboratory to verify the sample description and classification assigned by the field personnel. A laboratory testing program was then developed that would provide the soil parameters required in performing various engineering analyses. The various tests performed included the following:

- Moisture Content/Dry Density
- Direct Shear
- Consolidation
- Compaction
- Expansion Index
- Mechanical Analyses

The test procedures and results are presented in Appendix C. The field moisture content and dry density of the undisturbed soil samples are shown to the left of the boring logs presented in Appendix C.

6.3 INVESTIGATIVE RESULTS

6.3.1 Subsurface Materials

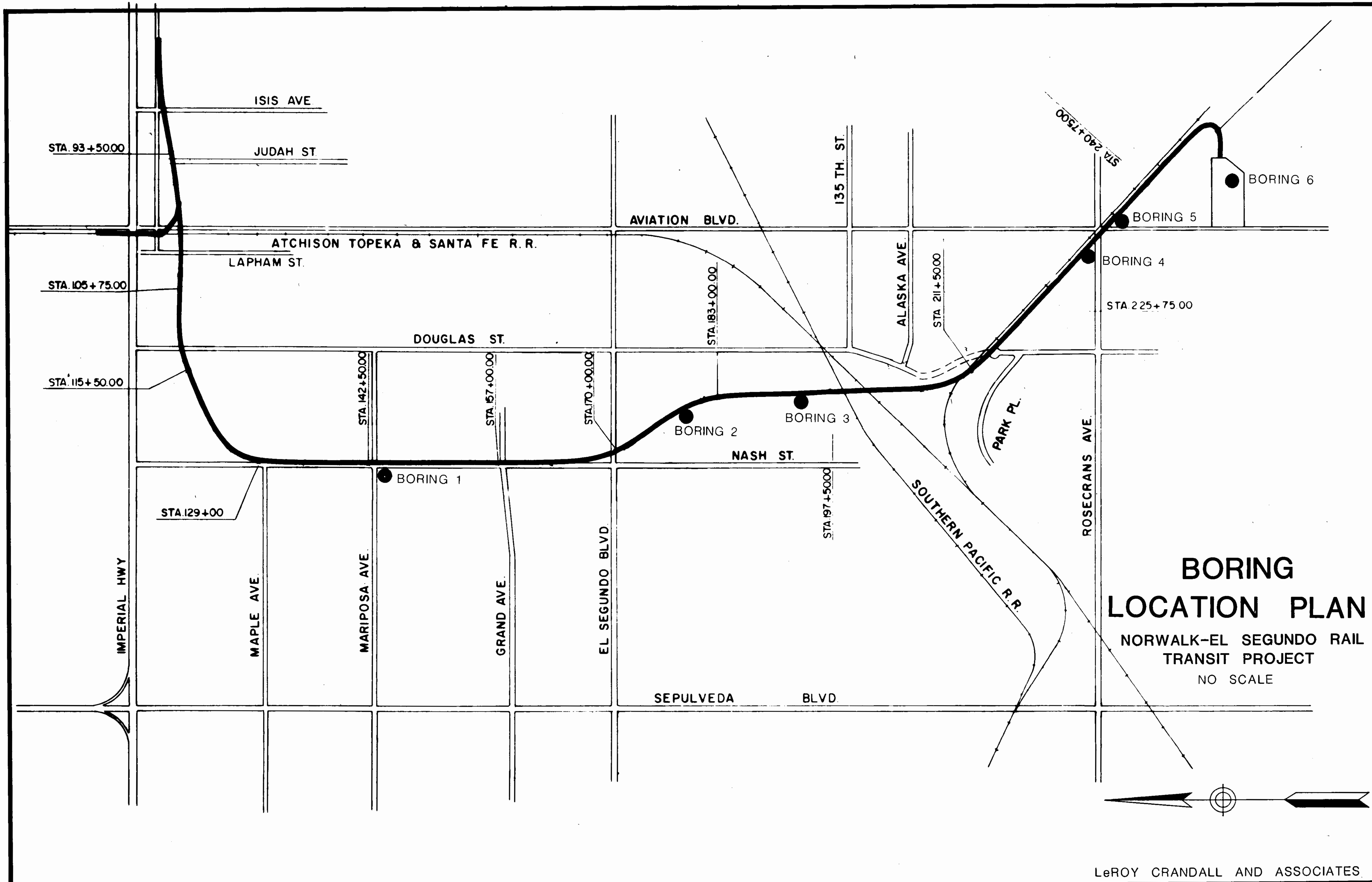
The subsurface materials encountered during drilling are graphically presented on the boring logs in Appendix C.

Fill soils were encountered to depths of four to six feet in the six borings. The fill material typically consisted of clay, silty sand, and sand with varying amounts of gravel and debris.

The natural soils generally consisted of inter-bedded clay, silt, silty to clayey to clean fine to coarse sand and fine to coarse gravel.

6.3.2 Water Conditions

Slight water seepage was encountered in Boring 3 at depths of 3 to 9 feet. Water was measured in Boring 5 at a depth of 73 feet on August 23, which was 12 days after completion of drilling. Water was not encountered or measured in the other borings.



BORING LOCATION PLAN

NORWALK-EL SEGUNDO RAIL TRANSIT PROJECT

NO SCALE

LeROY CRANDALL AND ASSOCIATES

Section 7.0
Preliminary Recommendations and Conclusions

7.0 PRELIMINARY RECOMMENDATIONS AND CONCLUSIONS

7.1 GEOLOGIC-SEISMIC

No geologic/seismic constraints were identified during this preliminary evaluation.

A review of published literature indicates that no known active or potentially active fault cross the alignment. Accordingly, the possibility of surface rupture along the alignment due to faulting is considered remote. The possibility of liquefaction occurring within the underlying deposits is also considered remote. Although the area could be subject to severe ground shaking in the event of a major earthquake, this hazard is common to Southern California and the effects of the shaking can be minimized by proper structural design and proper construction.

7.2 ENGINEERING RECOMMENDATIONS

7.2.1 General Soil Conditions

Fill materials should be anticipated along the alignment; the fill should be generally shallow, but local deep deposits could occur. Native materials generally consist of moderately firm but expansive clay near the surface, underlain by dense and firm sands and silty sand with clay and silt. The sand deposits have very little cohesion.

Ground water is relatively deep beneath the alignment. Water was measured at a depth of 73 feet near the intersection of Rosecrans Avenue and Aviation Boulevard towards the southern end of the alignment. Near the north end, perched ground water could be encountered at a shallower depth. Seepage at shallow depths was encountered in one current boring and several previous borings.

Our environmental audit report should be referred to for a discussion of the contamination potential along the alignment. As discussed in that report, the H. Kramer site is identified as a Superfund cleanup site. If remediation is accomplished prior to construction, the site should have little or no effect upon the rail project.

7.2.2 Support of Aerial Structures

It is anticipated that aerial structures (rail guideways and elevated stations) will be supported spans typically about 100 feet in length and that a single column bent may be utilized. Consequently, loads are estimated to be on the order of over 1,000 to perhaps 3,000 kips.

Although the deeper sands and silty sand are relatively dense and firm, the anticipated loads could result in significant settlement of the aerial structures. To provide foundation support with minimum settlement, we anticipate that friction piling will be appropriate. Friction piling would also provide resistance to seismic loads. This type of foundation system has also been utilized for support of the Caltrans-designed Century

Freeway project and for the elevated roadway at the Los Angeles International Airport, as well as for support of some of the aerial structures of the Long Beach-Los Angeles Rail Transit Project.

7.2.2.1 Drilled Piling

Because of the soil conditions and general lack of water, drilled cast-in-place concrete piling may be used. Either groups of piles or single large diameter concrete piles may be used. For estimating purposes, the downward and upward capacities of 4-, 6-, and 8-foot-diameter drilled piles are presented on Plate 7.1, Preliminary Drilled Pile Capacities. Dead plus live load capacities are shown; a one-third increase may be used for wind or seismic loads.

Lateral loads may be resisted by the piles. For preliminary estimating, it may be assumed that the soils adjacent to a single 6-foot-diameter pile, at least 40 feet long, can resist horizontal loads imposed at the top of the pile of 150 kips. The lateral resistance of other sizes of piles may be assumed to be proportional to the diameter.

Water may be shallower towards the southern portion of the El Segundo segment alignment. Caving resulting in termination of drilling occurred in one of the current borings and in a significant percentage of the previous borings. The use of high speed drilling equipment would cause disturbance of the soils.

It should be noted that the caving potential will increase as the diameter of the excavation increases. The soils are relatively cohesionless, and may be held together by small capillary forces. If allowed to dry out, the soils would lose that capillary force and would be more likely to cave.

Special techniques may be required to satisfactorily install the piles. Such techniques could include the use of drilling mud and/or casing. Only competent drilling contractors with demonstrated experience should be considered for the work; careful inspection will be required to check the bearing, dimensions and alignment of each drilled shaft.

7.2.3 Rosecrans Avenue/Aviation Boulevard Bridge

The proposed bridge will span the intersection of Rosecrans Avenue and Aviation Boulevard. The bridge will extend about 270 feet over the intersection to allow for future widening. There are numerous utility lines in the area, including oil and gas pipelines.

To provide support for the proposed bridge, friction piling should be used. The preliminary recommendations presented above in Section 7.2.2.1 would be applicable.

For design of the bridge retaining walls, where the backfill is level or nearly level, it may be assumed that drained backfill soils will exert an active lateral earth pressure equal to that developed by a fluid with a density of 35 pounds per cubic foot. Where the earth slopes upward at 2:1, an equivalent fluid pressure of 53 pounds per cubic foot should be used.

7.2.4 Seismic Criteria for Aerial Structures and Rosecrans/Aviation Bridge

7.2.4.1 Input to CALTRANS Seismic Criteria for Bridges. The proposed bridge will be designed in accordance with the bridge design criteria of the State of California Department of Transportation (CALTRANS). The geotechnical information needed for the CALTRANS criteria is the depth to rock and the expected peak bedrock acceleration. Based on a review of the soils and geologic data, the depth to rock is greater than 150 feet. The expected peak bedrock acceleration is 0.7g based on the proximity of the Charnock and Newport-Inglewood Faults.

7.2.4.2 Effect of Strong Ground Shaking on Pile Foundations.

There is concern that lateral movement of piles during strong earthquake ground shaking would result in a void or gap between the piles and the soil. It is our opinion that this effect is insignificant. Except for minor amounts of clay (perhaps near the surface), most of the soils will be granular sands or silty sands with little or no cohesion. Because of their granular nature, we believe the soils will maintain substantial contact with the pile, and that the pile capacities will not be significantly reduced due to strong ground shaking.

7.2.5 <u>At-Grade Structures</u>

7.2.5.1 <u>Station Platform</u> (Compton Avenue Station)

Based on the preliminary information, the proposed Compton Avenue Station may be supported on spread footings. If existing fill soils are excavated and replaced as properly compacted fill, and any required additional fill is properly compacted, footings may be established in either properly compacted fill or the natural soils. For preliminary estimating, it may be assumed that spread footings established in the undisturbed natural soils or properly compacted fill could be designed to impose a dead plus live load pressure of 2,000 pounds per square foot. The on-site soils, except for debris and clay, may be used as fill material.

7.2.5.2 <u>Yard and Shops Area</u>

Based on the preliminary information, the proposed structures within the Yard and Shops area may be may be supported on spread footings. There are existing fill soils and the removal of the facilities will result in disturbance of the upper soils. If existing fill soils and disturbed natural soils are excavated and replaced as properly compacted fill, and any required additional fill is properly compacted, footings for light structures may be established in either properly compacted fill or the natural soils.

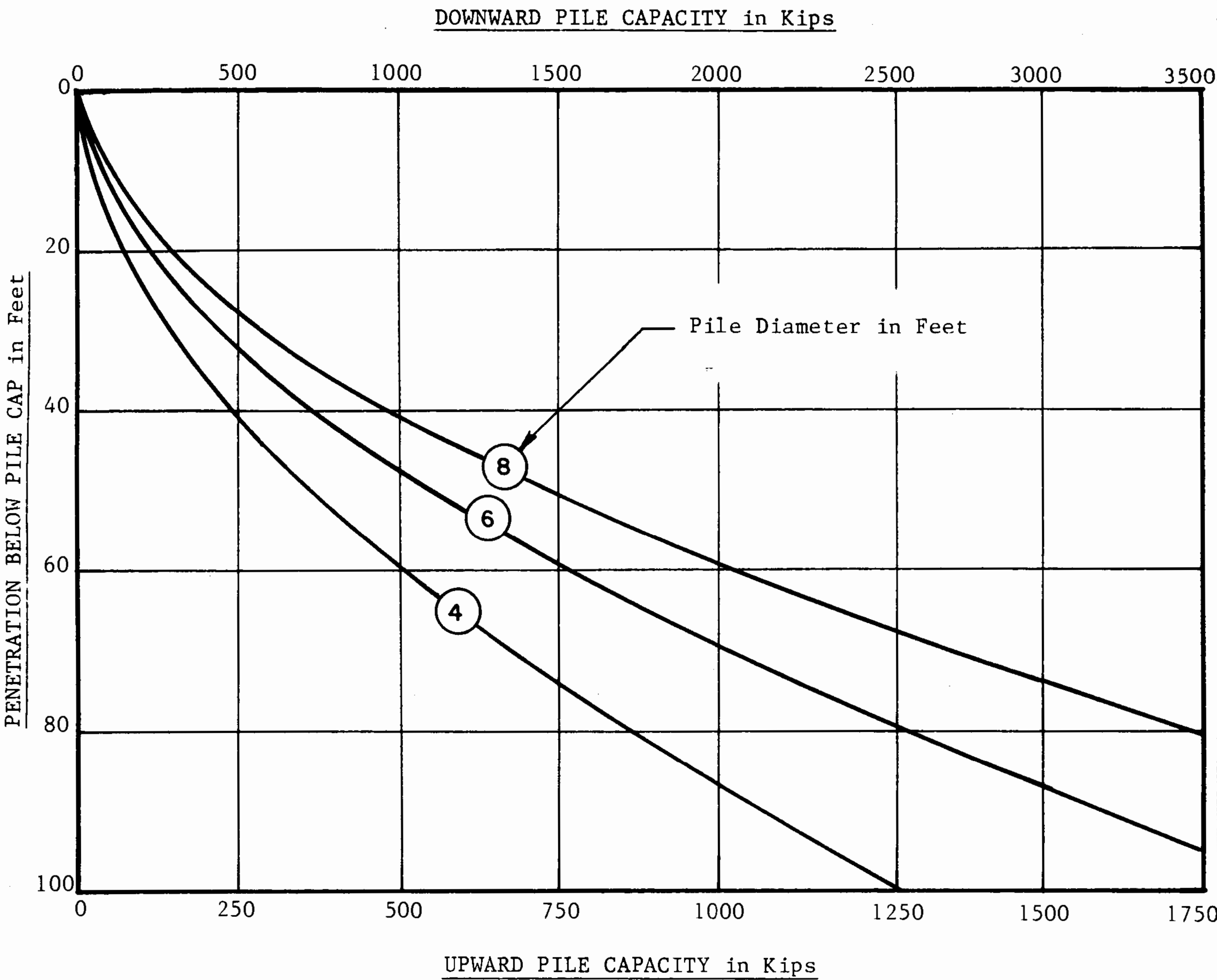
For preliminary estimating, it may be assumed that spread footings established in the undisturbed natural soils or properly compacted fill could be designed to impose a dead plus live load pressure of 2,000 pounds per square foot. The on-site soils, except for debris and clay, may be used as fill material.

7.2.5.3 Tracks on Grade

We anticipate that some reworking of the soils beneath the sub-ballast level will be required. It may be assumed that the upper soils should be excavated so as to permit the placement of at least one foot of properly compacted subgrade fill beneath the sub-ballast. Where deep fill is encountered, more than one foot of compacted fill may be required.

7.2.6 Preliminary Conclusions

The conclusions presented above are based on the six current borings and a review of our prior projects adjacent to and near the alignment. A comprehensive investigation should be performed to provide data for definitive design.



NOTES:

(1) The indicated values refer to the total of dead plus live loads; a one-third increase may be used when considering wind or seismic loads.

(2) Piles in groups should be spaced a minimum of 2½ diameters on centers, and should be drilled and filled alternately with the concrete permitted to set at least 8 hours before drilling an adjacent hole.

(3) The indicated values are based on the strength of the soils; the actual pile capacities may be limited to lesser values by the strength of the piles.

PRELIMINARY DRILLED PILE CAPACITIES

LeROY CRANDALL AND ASSOCIATES

PLATE 7.1

FORM 120 [redacted] A[redacted]44[redacted] DATE [redacted] DR. [redacted] W.T. [redacted] dmh [redacted] C.E. [redacted] CHKD. [redacted]

APPENDIX A
Seismicity Computer Search

APPENDIX A
SEISMICITY COMPUTER SEARCH

The seismicity of the region surrounding the El Segundo segment of the rail transit project was determined from a computer search of a magnetic tape catalog of earthquakes. The catalog of earthquakes included those with a Richter magnitude greater than 4.0, within a radius of 100 kilometers of the site, compiled by the California Institute of Technology for the period 1932 to 1981, and those earthquakes for the period 1812 to 1931 compiled by Richter and the U.S. National Oceanic and Atmospheric Administration (NOAA). The computer printout of the earthquakes is presented in this Appendix.

The information listed for each earthquake found in the computer scan includes date and time in Greenwich Civil Time (GCT), location of the epicenter in latitude and longitude, quality of epicentral determination (Q), depth in kilometers, and magnitude. Where a depth of 0.0 is given, the solution was based on an assumed 16-kilometer focal depth. The explanation of the letter code for the quality factor of the data is presented on the first page of the scan.

LIST OF HISTORIC EARTHQUAKES OF MAGNITUDE 4.0 OR GREATER WITHIN 100 KM OF THE SITE
(CAL TECH DATA 1932-1981)

DATE	TIME	LATITUDE	LONGITUDE	Q	DIST	DEPTH	MAGNITUDE
3-11-1933	1:54: 8	33.62 N	117.97 W	A	50	.0	6.3
3-11-1933	2: 4: 0	33.75 N	118.08 W	C	34	.0	4.9
3-11-1933	2: 5: 0	33.75 N	118.08 W	C	34	.0	4.3
3-11-1933	2: 9: 0	33.75 N	118.08 W	C	34	.0	5.0
3-11-1933	2:10: 0	33.75 N	118.08 W	C	34	.0	4.6
3-11-1933	2:11: 0	33.75 N	118.08 W	C	34	.0	4.4
3-11-1933	2:16: 0	33.75 N	118.08 W	C	34	.0	4.8
3-11-1933	2:17: 0	33.60 N	118.00 W	E	50	.0	4.5
3-11-1933	2:22: 0	33.75 N	118.08 W	C	34	.0	4.0
3-11-1933	2:27: 0	33.75 N	118.08 W	C	34	.0	4.6
3-11-1933	2:30: 0	33.75 N	118.08 W	C	34	.0	5.1
3-11-1933	2:31: 0	33.60 N	118.00 W	E	50	.0	4.4
3-11-1933	2:52: 0	33.75 N	118.08 W	C	34	.0	4.0
3-11-1933	2:57: 0	33.75 N	118.08 W	C	34	.0	4.2
3-11-1933	2:58: 0	33.75 N	118.08 W	C	34	.0	4.0
3-11-1933	2:59: 0	33.75 N	118.08 W	C	34	.0	4.6
3-11-1933	3: 5: 0	33.75 N	118.08 W	C	34	.0	4.2
3-11-1933	3: 9: 0	33.75 N	118.08 W	C	34	.0	4.4
3-11-1933	3:11: 0	33.75 N	118.08 W	C	34	.0	4.2
3-11-1933	3:23: 0	33.75 N	118.08 W	C	34	.0	5.0
3-11-1933	3:36: 0	33.75 N	118.08 W	C	34	.0	4.0
3-11-1933	3:39: 0	33.75 N	118.08 W	C	34	.0	4.0
3-11-1933	3:47: 0	33.75 N	118.08 W	C	34	.0	4.1
3-11-1933	4:36: 0	33.75 N	118.08 W	C	34	.0	4.6
3-11-1933	4:39: 0	33.75 N	118.08 W	C	34	.0	4.9
3-11-1933	4:40: 0	33.75 N	118.08 W	C	34	.0	4.7
3-11-1933	5:10:22	33.70 N	118.07 W	C	38	.0	5.1
3-11-1933	5:13: 0	33.75 N	118.08 W	C	34	.0	4.7
3-11-1933	5:15: 0	33.75 N	118.08 W	C	34	.0	4.0
3-11-1933	5:18: 4	33.57 N	117.98 W	C	53	.0	5.2
3-11-1933	5:21: 0	33.75 N	118.08 W	C	34	.0	4.4
3-11-1933	5:24: 0	33.75 N	118.08 W	C	34	.0	4.2
3-11-1933	5:53: 0	33.75 N	118.08 W	C	34	.0	4.0
3-11-1933	5:55: 0	33.75 N	118.08 W	C	34	.0	4.0

NOTE: Q IS A FACTOR RELATING THE QUALITY OF EPICENTRAL DETERMINATION

A = SPECIALLY INVESTIGATED
B = EPICENTER PROBABLY WITHIN 5 KM, ORIGIN TIME TO NEAREST SECOND
C = EPICENTER PROBABLY WITHIN 15 KM, ORIGIN TIME TO A FEW SECONDS
D = EPICENTER NOT KNOWN WITHIN 15 KM, ROUGH LOCATION
E = EPICENTER ROUGHLY LOCATED, ACCURACY LESS THAN "D"
P = PRELIMINARY

DATE	TIME	LATITUDE	LONGITUDE		Q	DIST	DEPTH	MAGNITUDE
3-11-1933	6:11: 0	33.75 N	118.08	W	C	34	.0	4.4
3-11-1933	6:18: 0	33.75 N	118.08	W	C	34	.0	4.2
3-11-1933	6:29: 0	33.85 N	118.27	W	C	13	.0	4.4
3-11-1933	6:35: 0	33.75 N	118.08	W	C	34	.0	4.2
3-11-1933	6:58: 3	33.68 N	118.05	W	C	40	.0	5.5
3-11-1933	7:51: 0	33.75 N	118.08	W	C	34	.0	4.2
3-11-1933	7:59: 0	33.75 N	118.08	W	C	34	.0	4.1
3-11-1933	8: 8: 0	33.75 N	118.08	W	C	34	.0	4.5
3-11-1933	8:32: 0	33.75 N	118.08	W	C	34	.0	4.2
3-11-1933	8:37: 0	33.75 N	118.08	W	C	34	.0	4.0
3-11-1933	8:54:57	33.70 N	118.07	W	C	38	.0	5.1
3-11-1933	9:10: 0	33.75 N	118.08	W	C	34	.0	5.1
3-11-1933	9:11: 0	33.75 N	118.08	W	C	34	.0	4.4
3-11-1933	9:26: 0	33.75 N	118.08	W	C	34	.0	4.1
3-11-1933	10:25: 0	33.75 N	118.08	W	C	34	.0	4.0
3-11-1933	10:45: 0	33.75 N	118.08	W	C	34	.0	4.0
3-11-1933	11: 0: 0	33.75 N	118.08	W	C	34	.0	4.0
3-11-1933	11: 4: 0	33.75 N	118.13	W	C	30	.0	4.6
3-11-1933	11:29: 0	33.75 N	118.08	W	C	34	.0	4.0
3-11-1933	11:38: 0	33.75 N	118.08	W	C	34	.0	4.0
3-11-1933	11:41: 0	33.75 N	118.08	W	C	34	.0	4.2
3-11-1933	11:47: 0	33.75 N	118.08	W	C	34	.0	4.4
3-11-1933	12:50: 0	33.68 N	118.05	W	C	40	.0	4.4
3-11-1933	13:50: 0	33.73 N	118.10	W	C	33	.0	4.4
3-11-1933	13:57: 0	33.75 N	118.08	W	C	34	.0	4.0
3-11-1933	14:25: 0	33.85 N	118.27	W	C	13	.0	5.0
3-11-1933	14:47: 0	33.73 N	118.10	W	C	33	.0	4.4
3-11-1933	14:57: 0	33.88 N	118.32	W	C	7	.0	4.9
3-11-1933	15: 9: 0	33.73 N	118.10	W	C	33	.0	4.4
3-11-1933	15:47: 0	33.75 N	118.08	W	C	34	.0	4.0
3-11-1933	16:53: 0	33.75 N	118.08	W	C	34	.0	4.8
3-11-1933	19:44: 0	33.75 N	118.08	W	C	34	.0	4.0
3-11-1933	19:56: 0	33.75 N	118.08	W	C	34	.0	4.2
3-11-1933	22: 0: 0	33.75 N	118.08	W	C	34	.0	4.4
3-11-1933	22:31: 0	33.75 N	118.08	W	C	34	.0	4.4
3-11-1933	22:32: 0	33.75 N	118.08	W	C	34	.0	4.1
3-11-1933	22:40: 0	33.75 N	118.08	W	C	34	.0	4.4
3-11-1933	23: 5: 0	33.75 N	118.08	W	C	34	.0	4.2
3-12-1933	0:27: 0	33.75 N	118.08	W	C	34	.0	4.4
3-12-1933	0:34: 0	33.75 N	118.08	W	C	34	.0	4.0
3-12-1933	4:48: 0	33.75 N	118.08	W	C	34	.0	4.0
3-12-1933	5:46: 0	33.75 N	118.08	W	C	34	.0	4.4
3-12-1933	6: 1: 0	33.75 N	118.08	W	C	34	.0	4.2
3-12-1933	6:16: 0	33.75 N	118.08	W	C	34	.0	4.6
3-12-1933	7:40: 0	33.75 N	118.08	W	C	34	.0	4.2
3-12-1933	8:35: 0	33.75 N	118.08	W	C	34	.0	4.2
3-12-1933	15: 2: 0	33.75 N	118.08	W	C	34	.0	4.2
3-12-1933	16:51: 0	33.75 N	118.08	W	C	34	.0	4.0

DATE	TIME	LATITUDE	LONGITUDE	Q	DIST	DEPTH	MAGNITUDE
3-12-1933	17:38: 0	33.75 N	118.08 W	C	34	.0	4.5
3-12-1933	18:25: 0	33.75 N	118.08 W	C	34	.0	4.1
3-12-1933	21:28: 0	33.75 N	118.08 W	C	34	.0	4.1
3-12-1933	23:54: 0	33.75 N	118.08 W	C	34	.0	4.5
3-13-1933	3:43: 0	33.75 N	118.08 W	C	34	.0	4.1
3-13-1933	4:32: 0	33.75 N	118.08 W	C	34	.0	4.7
3-13-1933	6:17: 0	33.75 N	118.08 W	C	34	.0	4.0
3-13-1933	13:18:28	33.75 N	118.08 W	C	34	.0	5.3
3-13-1933	15:32: 0	33.75 N	118.08 W	C	34	.0	4.1
3-13-1933	19:29: 0	33.75 N	118.08 W	C	34	.0	4.2
3-14-1933	0:36: 0	33.75 N	118.08 W	C	34	.0	4.2
3-14-1933	12:19: 0	33.75 N	118.08 W	C	34	.0	4.5
3-14-1933	19: 1:50	33.62 N	118.02 W	C	47	.0	5.1
3-14-1933	22:42: 0	33.75 N	118.08 W	C	34	.0	4.1
3-15-1933	2: 8: 0	33.75 N	118.08 W	C	34	.0	4.1
3-15-1933	4:32: 0	33.75 N	118.08 W	C	34	.0	4.1
3-15-1933	5:40: 0	33.75 N	118.08 W	C	34	.0	4.2
3-15-1933	11:13:32	33.62 N	118.02 W	C	47	.0	4.9
3-16-1933	14:56: 0	33.75 N	118.08 W	C	34	.0	4.0
3-16-1933	15:29: 0	33.75 N	118.08 W	C	34	.0	4.2
3-16-1933	15:30: 0	33.75 N	118.08 W	C	34	.0	4.1
3-17-1933	16:51: 0	33.75 N	118.08 W	C	34	.0	4.1
3-18-1933	20:52: 0	33.75 N	118.08 W	C	34	.0	4.2
3-19-1933	21:23: 0	33.75 N	118.08 W	C	34	.0	4.2
3-20-1933	13:58: 0	33.75 N	118.08 W	C	34	.0	4.1
3-21-1933	3:26: 0	33.75 N	118.08 W	C	34	.0	4.1
3-23-1933	8:40: 0	33.75 N	118.08 W	C	34	.0	4.1
3-23-1933	18:31: 0	33.75 N	118.08 W	C	34	.0	4.1
3-25-1933	13:46: 0	33.75 N	118.08 W	C	34	.0	4.1
3-30-1933	12:25: 0	33.75 N	118.08 W	C	34	.0	4.4
3-31-1933	10:49: 0	33.75 N	118.08 W	C	34	.0	4.1
4- 1-1933	6:42: 0	33.75 N	118.08 W	C	34	.0	4.2
4- 2-1933	8: 0: 0	33.75 N	118.08 W	C	34	.0	4.0
4- 2-1933	15:36: 0	33.75 N	118.08 W	C	34	.0	4.0
5-16-1933	20:58:55	33.75 N	118.17 W	C	27	.0	4.0
8- 4-1933	4:17:48	33.75 N	118.18 W	C	26	.0	4.0
10- 2-1933	9:10:18	33.78 N	118.13 W	A	28	.0	5.4
10- 2-1933	13:26: 1	33.62 N	118.02 W	C	47	.0	4.0
10-25-1933	7: 0:46	33.95 N	118.13 W	C	24	.0	4.3
11-13-1933	21:28: 0	33.87 N	118.20 W	C	18	.0	4.0
11-20-1933	10:32: 0	33.78 N	118.13 W	B	28	.0	4.0
1- 9-1934	14:10: 0	34.10 N	117.68 W	A	69	.0	4.5
1-18-1934	2:14: 0	34.10 N	117.68 W	A	69	.0	4.0
1-20-1934	21:17: 0	33.62 N	118.12 W	B	41	.0	4.5
4-17-1934	18:33: 0	33.57 N	117.98 W	C	53	.0	4.0
10-17-1934	9:38: 0	33.63 N	118.40 W	B	31	.0	4.0
11-16-1934	21:26: 0	33.75 N	118.00 W	B	40	.0	4.0
6-19-1935	11:17: 0	33.72 N	117.52 W	B	83	.0	4.0

DATE	TIME	LATITUDE	LONGITUDE	Q	DIST	DEPTH	MAGNITUDE
7-13-1935	10:54:17	34.20 N	117.90 W	A	56	.0	4.7
9- 3-1935	6:47: 0	34.03 N	117.32 W	B	100	.0	4.5
12-25-1935	17:15: 0	33.60 N	118.02 W	B	49	.0	4.5
8-22-1936	5:21: 0	33.77 N	117.82 W	B	55	.0	4.0
10-29-1936	22:35:36	34.38 N	118.62 W	C	56	.0	4.0
1-15-1937	18:35:47	33.56 N	118.06 W	B	49	.0	4.0
3-19-1937	1:23:38	34.11 N	117.43 W	A	92	.0	4.0
7- 7-1937	11:12: 0	33.57 N	117.98 W	B	53	.0	4.0
9- 1-1937	13:48: 8	34.21 N	117.53 W	A	86	.0	4.5
9- 1-1937	16:35:34	34.18 N	117.55 W	A	83	.0	4.5
5-21-1938	9:44: 0	33.62 N	118.03 W	B	46	.0	4.0
5-31-1938	8:34:55	33.70 N	117.51 W	B	85	.0	5.5
7- 5-1938	18: 6:56	33.68 N	117.55 W	A	82	.0	4.5
8- 6-1938	22: 0:56	33.72 N	117.51 W	B	84	.0	4.0
8-31-1938	3:18:14	33.76 N	118.25 W	A	21	.0	4.5
11-29-1938	19:21:16	33.90 N	118.43 W	A	4	.0	4.0
12- 7-1938	3:38: 0	34.00 N	118.42 W	B	10	.0	4.0
12-27-1938	10: 9:29	34.13 N	117.52 W	B	84	.0	4.0
11- 4-1939	21:41: 0	33.77 N	118.12 W	B	29	.0	4.0
12-27-1939	19:28:49	33.78 N	118.20 W	A	23	.0	4.7
1-13-1940	7:49: 7	33.78 N	118.13 W	B	28	.0	4.0
2- 8-1940	16:56:17	33.70 N	118.07 W	B	38	.0	4.0
2-11-1940	19:24:10	33.98 N	118.30 W	B	11	.0	4.0
4-18-1940	18:43:44	34.03 N	117.35 W	A	97	.0	4.4
5-18-1940	9:15:12	34.60 N	118.90 W	C	90	.0	4.0
6- 5-1940	8:27:27	33.83 N	117.40 W	B	92	.0	4.0
7-20-1940	4: 1:13	33.70 N	118.07 W	B	38	.0	4.0
10-11-1940	5:57:12	33.77 N	118.45 W	A	16	.0	4.7
10-12-1940	0:24: 0	33.78 N	118.42 W	B	15	.0	4.0
10-14-1940	20:51:11	33.78 N	118.42 W	B	15	.0	4.0
11- 1-1940	7:25: 3	33.78 N	118.42 W	B	15	.0	4.0
11- 1-1940	20: 0:46	33.63 N	118.20 W	B	36	.0	4.0
11- 2-1940	2:58:26	33.78 N	118.42 W	B	15	.0	4.0
1-30-1941	1:34:47	33.97 N	118.05 W	A	32	.0	4.1
3-22-1941	8:22:40	33.52 N	118.10 W	B	51	.0	4.0
3-25-1941	23:43:41	34.22 N	117.47 W	B	92	.0	4.0
4-11-1941	1:20:24	33.95 N	117.58 W	B	75	.0	4.0
10-22-1941	6:57:19	33.82 N	118.22 W	A	19	.0	4.9
11-14-1941	8:41:36	33.78 N	118.25 W	A	19	.0	5.4
4-16-1942	7:28:33	33.37 N	118.15 W	C	64	.0	4.0
9- 3-1942	14: 6: 1	34.48 N	118.98 W	C	84	.0	4.5
9- 4-1942	6:34:33	34.48 N	118.98 W	C	84	.0	4.5
10-24-1943	0:29:21	33.93 N	117.37 W	C	94	.0	4.0
6-19-1944	0: 3:33	33.87 N	118.22 W	B	16	.0	4.5
6-19-1944	3: 6: 7	33.87 N	118.22 W	C	16	.0	4.4
2-24-1946	6: 7:52	34.40 N	117.80 W	C	77	.0	4.1
6- 1-1946	11: 6:31	34.42 N	118.83 W	C	70	.0	4.1
3- 1-1948	8:12:13	34.17 N	117.53 W	B	85	.0	4.7

DATE	TIME	LATITUDE	LONGITUDE	Q	DIST	DEPTH	MAGNITUDE
4-16-1948	22:26:24	34.02 N	118.97 W	B	55	.0	4.7
10- 3-1948	2:46:28	34.18 N	117.58 W	A	81	.0	4.0
1-11-1950	21:41:35	33.94 N	118.20 W	A	18	.0	4.1
1-24-1950	21:56:59	34.67 N	118.83 W	C	94	.0	4.0
8-22-1950	22:47:58	34.15 N	119.35 W	B	93	.0	4.2
9-22-1951	8:22:39	34.12 N	117.34 W	A	100	.0	4.3
2-10-1952	13:50:55	33.58 N	119.18 W	C	82	.0	4.0
8-23-1952	10: 9: 7	34.52 N	118.20 W	A	70	.0	5.0
10-26-1954	16:22:26	33.73 N	117.47 W	B	87	.0	4.1
11-17-1954	23: 3:51	34.50 N	119.12 W	B	94	.0	4.4
5-15-1955	17: 3:26	34.12 N	117.48 W	A	87	.0	4.0
5-29-1955	16:43:35	33.99 N	119.06 W	B	63	.0	4.1
1- 3-1956	0:25:49	33.72 N	117.50 W	B	85	.0	4.7
2- 7-1956	2:16:57	34.53 N	118.64 W	B	73	.0	4.2
2- 7-1956	3:16:39	34.59 N	118.61 W	A	78	.0	4.6
3-25-1956	3:32: 2	33.60 N	119.10 W	A	74	.0	4.2
3-18-1957	18:56:28	34.12 N	119.22 W	B	80	.0	4.7
6-28-1960	20: 0:48	34.12 N	117.47 W	A	88	.0	4.1
10- 4-1961	2:21:32	33.85 N	117.75 W	B	60	.0	4.1
10-20-1961	19:49:51	33.65 N	117.99 W	B	47	.0	4.3
10-20-1961	20: 7:14	33.66 N	117.98 W	B	47	.0	4.0
10-20-1961	21:42:41	33.67 N	117.98 W	B	46	.0	4.0
10-20-1961	22:35:34	33.67 N	118.01 W	B	44	.0	4.1
11-20-1961	8:53:35	33.68 N	117.99 W	B	45	.0	4.0
9-14-1963	3:51:16	33.54 N	118.34 W	B	41	.0	4.2
8-30-1964	22:57:37	34.27 N	118.44 W	B	40	.0	4.0
1- 1-1965	8: 4:18	34.14 N	117.52 W	B	84	.0	4.4
4-15-1965	20: 8:33	34.13 N	117.43 W	B	92	.0	4.5
7-16-1965	7:46:22	34.48 N	118.52 W	B	64	.0	4.0
1- 8-1967	7:37:30	33.63 N	118.47 W	B	32	.0	4.0
1- 8-1967	7:38: 5	33.66 N	118.41 W	C	28	.0	4.0
6-15-1967	4:58: 6	34.00 N	117.97 W	B	40	.0	4.1
2-28-1969	4:56:12	34.57 N	118.11 W	A	78	.0	4.3
5- 5-1969	16: 2:10	34.30 N	117.57 W	B	87	.0	4.4
10-24-1969	20:26:43	33.34 N	119.10 W	B	91	.0	4.7
10-27-1969	13:16: 2	33.55 N	117.81 W	B	67	.0	4.5
10-31-1969	10:39:29	33.43 N	119.10 W	B	85	.0	4.8
9-12-1970	14:10:11	34.27 N	117.52 W	A	90	.0	4.1
9-12-1970	14:30:53	34.27 N	117.54 W	A	88	.0	5.4
9-13-1970	4:47:49	34.28 N	117.55 W	A	88	.0	4.4
2- 9-1971	14: 0:42	34.41 N	118.40 W	B	55	.0	6.4
2- 9-1971	14: 1: 8	34.41 N	118.40 W	D	55	.0	5.8
2- 9-1971	14: 1:33	34.41 N	118.40 W	D	55	.0	4.2
2- 9-1971	14: 1:40	34.41 N	118.40 W	D	55	.0	4.1
2- 9-1971	14: 1:50	34.41 N	118.40 W	D	55	.0	4.5
2- 9-1971	14: 1:54	34.41 N	118.40 W	D	55	.0	4.2
2- 9-1971	14: 1:59	34.41 N	118.40 W	D	55	.0	4.1
2- 9-1971	14: 2: 3	34.41 N	118.40 W	D	55	.0	4.1

DATE	TIME	LATITUDE	LONGITUDE	Q	DIST	DEPTH	MAGNITUDE
2- 9-1971	14: 2:30	34.41 N	118.40 W	D	55	.0	4.3
2- 9-1971	14: 2:31	34.41 N	118.40 W	D	55	.0	4.7
2- 9-1971	14: 2:44	34.41 N	118.40 W	D	55	.0	5.8
2- 9-1971	14: 3:25	34.41 N	118.40 W	D	55	.0	4.4
2- 9-1971	14: 3:46	34.41 N	118.40 W	D	55	.0	4.1
2- 9-1971	14: 4: 7	34.41 N	118.40 W	D	55	.0	4.1
2- 9-1971	14: 4:34	34.41 N	118.40 W	C	55	.0	4.2
2- 9-1971	14: 4:39	34.41 N	118.40 W	D	55	.0	4.1
2- 9-1971	14: 4:44	34.41 N	118.40 W	D	55	.0	4.1
2- 9-1971	14: 4:46	34.41 N	118.40 W	D	55	.0	4.2
2- 9-1971	14: 5:41	34.41 N	118.40 W	D	55	.0	4.1
2- 9-1971	14: 5:50	34.41 N	118.40 W	D	55	.0	4.1
2- 9-1971	14: 7:10	34.41 N	118.40 W	D	55	.0	4.0
2- 9-1971	14: 7:30	34.41 N	118.40 W	D	55	.0	4.0
2- 9-1971	14: 7:45	34.41 N	118.40 W	D	55	.0	4.5
2- 9-1971	14: 8: 4	34.41 N	118.40 W	D	55	.0	4.0
2- 9-1971	14: 8: 7	34.41 N	118.40 W	D	55	.0	4.2
2- 9-1971	14: 8:38	34.41 N	118.40 W	D	55	.0	4.5
2- 9-1971	14: 8:53	34.41 N	118.40 W	D	55	.0	4.6
2- 9-1971	14:10:21	34.36 N	118.31 W	B	50	.0	4.7
2- 9-1971	14:10:28	34.41 N	118.40 W	D	55	.0	5.3
2- 9-1971	14:16:13	34.34 N	118.33 W	C	48	.0	4.1
2- 9-1971	14:19:50	34.36 N	118.41 W	B	50	.0	4.0
2- 9-1971	14:34:36	34.34 N	118.64 W	C	53	.0	4.9
2- 9-1971	14:39:18	34.39 N	118.36 W	C	53	.0	4.0
2- 9-1971	14:40:17	34.43 N	118.40 W	C	58	.0	4.1
2- 9-1971	14:43:47	34.31 N	118.45 W	B	45	.0	5.2
2- 9-1971	15:58:21	34.33 N	118.33 W	B	47	.0	4.8
2- 9-1971	16:19:26	34.46 N	118.43 W	B	61	.0	4.2
2-10-1971	3:12:12	34.37 N	118.30 W	B	52	.0	4.0
2-10-1971	5: 6:36	34.41 N	118.33 W	A	56	.0	4.3
2-10-1971	5:18: 7	34.43 N	118.41 W	A	58	.0	4.5
2-10-1971	11:31:35	34.38 N	118.45 W	A	52	.0	4.2
2-10-1971	13:49:54	34.40 N	118.42 W	A	54	.0	4.3
2-10-1971	14:35:27	34.36 N	118.49 W	A	51	.0	4.2
2-10-1971	17:38:55	34.40 N	118.37 W	A	54	.0	4.2
2-10-1971	18:54:42	34.45 N	118.44 W	A	60	.0	4.2
2-21-1971	5:50:53	34.40 N	118.44 W	A	55	.0	4.7
2-21-1971	7:15:12	34.39 N	118.43 W	A	53	.0	4.5
3- 7-1971	1:33:41	34.35 N	118.46 W	A	49	.0	4.5
3-25-1971	22:54:10	34.36 N	118.47 W	A	50	.0	4.2
3-30-1971	8:54:43	34.30 N	118.46 W	A	44	.0	4.1
3-31-1971	14:52:23	34.29 N	118.51 W	A	44	.0	4.6
4- 1-1971	15: 3: 4	34.43 N	118.41 W	A	58	.0	4.1
4- 2-1971	5:40:25	34.28 N	118.53 W	A	43	.0	4.0
4-15-1971	11:14:32	34.26 N	118.58 W	B	43	.0	4.2
4-25-1971	14:48: 7	34.37 N	118.31 W	B	52	.0	4.0
6-21-1971	16: 1: 8	34.27 N	118.53 W	B	42	.0	4.0

DATE	TIME	LATITUDE	LONGITUDE		Q	DIST	DEPTH	MAGNITUDE
6-22-1971	10:41:19	33.75 N	117.48	W	B	86	.0	4.2
2-21-1973	14:45:57	34.06 N	119.03	W	B	61	.0	5.9
3- 9-1974	0:54:32	34.40 N	118.47	W	C	55	.0	4.7
8-14-1974	14:45:55	34.43 N	118.37	W	A	58	.0	4.2
1- 1-1976	17:20:13	33.96 N	117.89	W	A	47	.0	4.2
4- 8-1976	15:21:38	34.35 N	118.66	W	A	55	.0	4.6
8-12-1977	2:19:26	34.38 N	118.46	W	B	53	.0	4.5
9-24-1977	21:28:24	34.46 N	118.41	W	C	61	.0	4.2
5-23-1978	9:16:51	33.91 N	119.17	W	C	72	.0	4.0
1- 1-1979	23:14:39	33.94 N	118.68	W	B	27	.0	5.0
10-17-1979	20:52:37	33.93 N	118.67	W	C	26	.0	4.2
10-19-1979	12:22:38	34.21 N	117.53	W	B	86	.0	4.1
9- 4-1981	15:50:50	33.67 N	119.11	W	C	72	.0	5.3
10-23-1981	17:28:17	33.63 N	119.02	W	C	66	.0	4.6
10-23-1981	19:15:52	33.64 N	119.06	W	C	69	.0	4.6

S E A R C H   O F   E A R T H Q U A K E   D A T A   F I L E 1

SITE: TRANSCAL ADEF-88044-3

COORDINATES OF SITE	33.91 N 118.39 W
DISTANCE PER DEGREE	110.9 KM-N 92.5 KM-W
MAGNITUDE LIMITS	4.0 - 8.5
TEMPORAL LIMITS	1932 - 1981
SEARCH RADIUS (KM)	100
NUMBER OF YEARS OF DATA	50
NUMBER OF EARTHQUAKES IN FILE	2789
NUMBER OF EARTHQUAKES IN AREA	289

L E R O Y   C R A N D A L L   A N D   A S S O C I A T E S

LIST OF HISTORIC EARTHQUAKES OF MAGNITUDE 6.0 OR
GREATER WITHIN 100 KM OF THE SITE
(RICHTER DATA 1906-1931)

DATE	TIME	LATITUDE	LONGITUDE	Q	DIST	DEPTH	MAGNITUDE
5-15-1910	15:47: 0	33.70 N	117.40 W	D	94	.0	6.0

S E A R C H O F E A R T H Q U A K E D A T A F I L E 2

SITE: TRANSCAL ADEF-88044-3

COORDINATES OF SITE .... 33.91 N 118.39 W

DISTANCE PER DEGREE ..... 110.9 KM-N 92.5 KM-W

MAGNITUDE LIMITS .... 6.0 - 8.5

TEMPORAL LIMITS .... 1906 - 1931

SEARCH RADIUS (KM) 100

NUMBER OF YEARS OF DATA 26

NUMBER OF EARTHQUAKES IN FILE 35

NUMBER OF EARTHQUAKES IN AREA 1

L E R O Y C R A N D A L L A N D A S S O C I A T E S

LIST OF HISTORIC EARTHQUAKES OF MAGNITUDE 7.0 OR GREATER WITHIN 100 KM OF THE SITE
(NOAA/CDMG DATA 1812-1905)

DATE	TIME	LATITUDE	LONGITUDE	Q	DIST	DEPTH	MAGNITUDE
2- 9-1890	4: 6: 0	34.00 N	117.50 W	D	83	.0	7.0

SEARCH OF EARTHQUAKE DATA FILE 3

SITE: TRANSCAL ADEF-88044-3

COORDINATES OF SITE .... 33.91 N 118.39 W

DISTANCE PER DEGREE ..... 110.9 KM-N 92.5 KM-W

MAGNITUDE LIMITS .... 7.0 - 8.5

TEMPORAL LIMITS .... 1812 - 1905

SEARCH RADIUS (KM) 100

NUMBER OF YEARS OF DATA 94

NUMBER OF EARTHQUAKES IN FILE 9

NUMBER OF EARTHQUAKES IN AREA 1

LEROY CRANDALL AND ASSOCIATES

S U M M A R Y   O F   E A R T H Q U A K E   S E A R C H

* * *

NUMBER OF HISTORIC EARTHQUAKES WITHIN 100 KM RADIUS OF SITE

MAGNITUDE RANGE	NUMBER
4.0 - 4.5	202
4.5 - 5.0	62
5.0 - 5.5	18
5.5 - 6.0	5
6.0 - 6.5	3
6.5 - 7.0	0
7.0 - 7.5	1
7.5 - 8.0	0
8.0 - 8.5	0

* * *

L E R O Y   C R A N D A L L   A N D   A S S O C I A T E S

C O M P U T A T I O N   O F   R E C U R R E N C E   C U R V E

L O G   N = A - B M

* * *

BIN	MAGNITUDE	RANGE	NO/YR (N)
1	4.00	4.00 - 8.50	5.79
2	4.50	4.50 - 8.50	1.75
3	5.00	5.00 - 8.50	.505
4	5.50	5.50 - 8.50	.145
5	6.00	6.00 - 8.50	.454E-01
6	6.50	6.50 - 8.50	.588E-02 NU
7	7.00	7.00 - 8.50	.588E-02 NU
8	7.50	7.50 - 8.50	.000
9	8.00	8.00 - 8.50	.000

A = 1.344   B = .6077   (NORMALIZED)
A = 4.996   B = 1.0582   SIGMA = .107E-01

* * *

L E R O Y   C R A N D A L L   A N D   A S S O C I A T E S

C O M P U T A T I O N   O F   D E S I G N   M A G N I T U D E

C O N S T A N T   A R E A

* * *

TABLE OF DESIGN MAGNITUDES

RISK		RETURN PERIOD (YEARS)					DESIGN MAGNITUDE			
		DESIGN LIFE (YEARS)								
		25	50	75	100		25	50	75	100
.01	..	2487	4974	7462	9949	..	7.84	8.05	8.15	8.22
.05	..	487	974	1462	1949	..	7.24	7.51	7.66	7.76
.10	..	237	474	711	949	..	6.96	7.23	7.39	7.50
.20	..	112	224	336	448	..	6.65	6.93	7.10	7.21
.30	..	70	140	210	280	..	6.46	6.74	6.91	7.02
.50	..	36	72	108	144	..	6.19	6.47	6.64	6.76
.70	..	20	41	62	83	..	5.97	6.25	6.41	6.53
.90	..	10	21	32	43	..	5.70	5.98	6.15	6.27

MMIN = 4.00   MMAX = 8.50
MU = 5.80   BETA = 2.437

* * *

L E R O Y   C R A N D A L L   A N D   A S S O C I A T E S

Appendix B

Representative Logs of Prior Nearby Projects

APPENDIX B

REPRESENTATIVE LOGS OF PRIOR NEARBY PROJECTS

The approximate locations of representative prior projects along the alignment or in close proximity thereto are shown on Plate 5.1, Locations of Prior Geotechnical Investigations.

Logs of the following selected prior borings are presentedin this Appendix:

LC&A Job No.	Project No.	Boring No.
A-81025	2	8
59293	8	1
A-71185	13	3
A-81113	16	4
ADE-78034-B	25	4
"	25	37
"	25	38
A-85123	29	5
A-88225	30	4

The borings were logged continuously during the drilling. Undisturbed samples were obtained with the Crandall sampler at depth intervals of about five feet and at major changes in soil stratigraphy. The Crandall sampler is a brass ring lined 3.188 inch (outside diameter) tube that is driven with a kelly bar. The inside diameter is 2.625 inches.

The logs of the borings are presented on Plates B-1 through B-9; the depths at which undisturbed samples were obtained are indicted to the left of the boring logs.

The energy required to drive the Crandall sampler twelve inches is indicated on the logs. The energy is determined based on the following relationship:

$E = \frac{WBS}{P}$, where:
W = Driving Weight = 400 to 1685 pounds
B = Number of Blows of Driving Weight
S = Stroke of Driving Weight = 1 to 1½ feet
P = Penetration of LC&A Sampler = 1 foot

The soils are classified in accordance with the Unified Soil Classification System described in Appendix C.

BORING 2-8

DATE DRILLED: January 17, 1981
EQUIPMENT USED: 24" - Diameter Bucket to 25'
18" - Diameter Bucket below 25'

ELEVATION 99

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	USCS	DESCRIPTION
						ML	4" Concrete Slab with Wire Mesh
						CL	FILL - SILTY SAND and CLAY - brown
						CL	SILTY CLAY - dark grey
		21.6	102	2	■		
95							Light brown
	5	16.2	114	5	■		
		17.1	113	5	■		
						ML	CLAYEY SILT - light brown
90	10	32.3	87	5	■		
85		27.9	95	5	■		
	15						
						SP	SAND - fine, light brown
80		4.3	104	5	■		
	20						
75		4.6	102	8	■		
	25						
70		3.8	101	12	■		
	30						
65		9.6	94	7	■		
	35						

(CONTINUED ON FOLLOWING PLATE)

Note: The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/29/88 F.T. ___ DR. dmh O.E. DM *DM* W.P. dmh CHKD *ml*

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 2-8 (Continued)

DATE DRILLED: January 17, 1981
EQUIPMENT USED: 24" - Diameter Bucket to 25'
18" - Diameter Bucket below 25'

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	CLAYEY SILT - greyish brown Thin layers of Clay and Sandy Silt
60			25.1	99	4	■		
	40							
55			44.7	75	4	■		
	45						SP	SAND - fine, light brown
50			9.9	96	9	■		
	50							

NOTE: Water not encountered. No caving.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE B - 1. 2

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/29/88 F.T. DR. dmh O.E. DM W.P. dmh CHKD

BORING 8-1

DATE DRILLED: July 28, 1959
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 101 (Approximate)

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
100						
			2.1	103	–	■
			12.0	114	–	■
95	5					
			22.2	99	–	■
90	10		8.6	112	–	■
85	15		10.5	115	–	■
	20					

SM — SILTY SAND - Sand predominantly fine, medium amount of Silt, slightly cemented, light brown

SC — CLAYEY SAND - Sand predominantly very fine, large amount of Clay, yellowish brown

CL — LEAN CLAY - mottled brown

SP — POORLY GRADED SAND - fine, medium amount of fines, moderately cemented, mottled light to reddish brown

Layer of lean Clay, brown

NOTE: Water not encountered. No caving.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE B-2

JOB A-88044-6 DATE 8/29/88 F.T. DR. dmh O.E. DM DM W.P. dmh CHKD [handwritten initials]

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13-3

DATE DRILLED: August 27, 1971
EQUIPMENT USED: 24" - Diameter Bucket

ELEVATION 104 (Approximate)

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		Description
							SM	FILL - SILTY SAND - fine, mottled brown
			9.4	121	–			
			7.6	124	–			Dark grey
100								Some organic matter, odorous
	5		17.5	109	–		CL	SILTY CLAY - black
			12.1	108	–			Layer of Sandy Silt, dark brownish grey
								Sandy
95								Brown
	10		15.4	117	–			
							SM	SILTY SAND - fine, brown
90								
	15		5.7	100	–			
85								Less Silty
	20		3.8	93	–			
								Lenses of Sand, fine
80								
	25		2.4	97	–			
								Large amount of sea shells
								Layer of Sand, coarse, sea shells, greyish brown
75								
	30		2.1	106	–			Grey
								Few Gravel
70								
	35							

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/29/88 F.T. ___ DR. dmh O.E. DM DM W.P. dmh CHKD ml

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

JOB A-88044-6 DATE 8/29/88 F.T. ____ DR. dmh O.E. DM DM W.P. dmh CHKD [initials]

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13-3 (Continued)

DATE DRILLED: August 27, 1971
EQUIPMENT USED: 24" - Diameter Bucket

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			4.5	94	–	
65	40		5.2	96	–	
60	45					
55	50					

Fine and coarse

NOTE: Water not encountered. Caving from 24' to 28' (to 36" in diameter).

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE B - 3.2

BORING 16-4

DATE DRILLED: March 26, 1981
EQUIPMENT USED: 20" - Diameter Bucket

ELEVATION 99.1

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		Description
							SM	3" Asphaltic Paving FILL - SILTY SAND - fine, mottled dark brown
			7.1	118	11	■		
95	5		12.8	120	3	■	ML	SANDY SILT - brown Patches of Silty Sand
			13.5	112	11	■		
90	10		15.8	112	6	■		
85			3.6	97	8	■	SP	SAND - fine, light brown
	15		4.0	93	10	■		
80	20		4.1	96	19	■		
75	25		3.5	98	22	■		
70	30		4.5	99	22	■		

NOTE: Water not encountered. Caving from 14' to 16'.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/29/88 F.T. DR. dmh O.E. DM DM W.P. dmh CHKD ine

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 25-4

DATE DRILLED: January 29, 1978
EQUIPMENT USED: 20" - Diameter Bucket

ELEVATION 97

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
95						
			5.8	109	6	■
	5					
90						
			7.9	111	18	■
	10					
85						
			8.8	103	10	■
	15					
80						
			6.0	100	14	■
	20					
75						
			5.2	104	8	■
	25					
70						
			3.9	98	6	■
	30					
65						
			6.4	92	10	■
	35					

SP SM FILL - SAND and SILTY SAND - brown

SM SILTY SAND - fine, dark brown

Light brown and reddish brown

Patches of Sand

SP SAND - fine, light brown

Small amount of Gravel

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/29/88 F.T. DR. dmh O.E. DM *DM* W.P. dmh CHKD *[initials]*

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

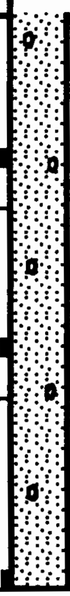
JOB A-88044-6 DATE 8/29/88 F.T. ____ DR. dmh O.E. DM DM W.P. dmh CHKD ml

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 25-4 (Continued)

DATE DRILLED: January 29, 1978
EQUIPMENT USED: 20" - Diameter Bucket

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
60						
			7.6	91	11	■
	40					
55						
			7.0	95	11	■
	45					
50						
	50		10.2	101	7	■



NOTE: Water not encountered. No caving.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE B - 5.2

BORING 25-37

DATE DRILLED: August 11, 1978
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 91

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		Description
90			3.8	119	3	■	ML CL	FILL - SILT and CLAY - some Sand and Gravel, small amount of concrete pieces, brown
							SM	SILTY SAND - fine, brown
85	5		14.0	109	5	■		
80	10		16.5	111	8	■		
75	15		15.6	100	14	■		
70	20		10.3	103	19	■		
							SP	SAND - fine, brown
65	25		6.5	100	20	■		
60	30		7.7	90	9	■		
	35							

NOTE: Water not encountered. Caving from 6' to 11' (to 4' in diameter).

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/29/88 F.T. ____ DR. dmh O.E. DM DM W.P. dmh CHKD ____

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 25-38

DATE DRILLED: August 11, 1978
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 93

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		DESCRIPTION
							ML CL	FILL - SILT and CLAY - some Sand, small amount of concrete and asphaltic paving pieces, brown
90			7.4	115	5	■		
	5							Very wet
85			13.6	119	3	■	SC	CLAYEY SAND - fine, reddish brown
							ML	CLAYEY SILT - some Sand, brown
	10		18.0	110	10	■		
							SC	CLAYEY SAND - fine, light brown
			6.6	105	14	■		
80								
	15							
			5.1	102	16	■		
75							SM	SILTY SAND - fine, some Clayey Sand, brown
	20							
			7.6	102	22	■		
70								
	25							
			7.3	99	14	■		
65								
	30							
			4.5	95	14	■		
60								
	35							

NOTE: Water not encountered. No caving.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/29/88 F.T. ____ DR. dmh O.E. DM DM W.P. dmh CHKD inl

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE B-7

BORING 29-5

DATE DRILLED: April 19, 1985
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 83.0

DEPTH (ft.) (approx.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
	5.2	118	5
	5.6	113	6
5	8.3	117	1
	11.8	116	6
10	15.3	111	6
15	12.8	115	5
20	8.1	122	8
25	5.4	103	11
30	4.4	106	6
35	7.3	98	14
40	4.1	100	13

Elevation scale (ft.): 80, 75, 70, 65, 60, 55, 50, 45

SM — 4" Asphaltic Paving
FILL - SILTY SAND - fine, brown

SM — SILTY SAND - fine, dark brown

SC — CLAYEY SAND - fine, light brown

SP — SAND - fine, light brown

About 10% Gravel

About 25% Gravel

NOTE: Water not encountered. No caving.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/29/88 F.T. DR. dmh O.E. DM DM W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE B - 8

BORING 30-4

DATE DRILLED: June 14, 1988
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 85.3

JOB A-88044-B DATE 8/29/88 F.T. ___ DR. dmh O.E. DM DM W.P. dmh CHKD ___

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
85				
		9.4	121	10
		9.6	118	12
80	5			
		8.8	119	12
		12.0	110	7
		13.5	121	7
75	10			
		14.9	114	10
		16.9	112	13
70	15			
		14.6	110	13
		12.1	109	12
65	20			
		9.3	113	17
		7.0	107	17
60	25			
		8.8	99	9
55	30			
		7.1	98	9
50	35			
		6.6	100	10
	40			

Depth (approx.)	USCS	Description
0	SM	4" Crushed Base
		FILL - SILTY SAND - fine, brown
		Mottled grey
		Hydrocarbon odor
		Few rootlets
		Pieces of wood and brick, few Gravel
6.5	SM	SILTY SAND - fine, lenses of Clayey Sand, light greyish brown
9.5	CL	SANDY CLAY - greyish brown
13	SC	CLAYEY SAND - fine, light brown
		Few Gravel
		About 10% Gravel
28	SP	SAND - fine, lenses of Silty Sand, about 10% Gravel, light brown

NOTE: Water seepage encountered from 7-1/2' to 8'. Raveling below 20' (to 2' in diameter).

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Appendix C

Field and Laboratory Data

APPENDIX C
FIELD EXPLORATION PROGRAM

The field explorations consisted of subsurface drilling, sampling, and testing. Six exploration borings were drilled to depths ranging from 30 to 100 feet below the existing grade. The general locations of the exploration borings are shown on Plate 6.1; the locations are also shown on Plates 5.8, 5.10, 5.11, 5.14, and 5.16.

The borings were drilled using 18-inch-diameter bucket-type drilling equipment and/or 5-inch-diameter rotary wash-type equipment. Raveling and caving of the bucket borings occurred during drilling, as indicated on the boring logs. Drilling mud was used with the rotary wash-type equipment to prevent caving.

After completion of Boring 4, a PVC pipe was installed in the boring to permit measurements of compressional and shear wave velocities by a downhole seismic survey. This survey has been completed and the results will be included in the comprehensive geotechnical report. The PVC pipe in this boring was backfilled after the downhole seismic survey was completed in accordance with the agreement with the property owner. After completion of Boring 5, a PVC pipe with the lower portion perforated was installed in the boring to permit future measurement of the water level.

Each of the borings was backfilled upon completion of drilling. The borings were logged continuously during the drilling. Undisturbed samples were obtained with the Crandall sampler at depth intervals of about five feet and at major changes in soil stratigraphy. The Crandall sampler is a brass ring lined 3.188 inch (outside diameter) tube that is driven with a kelly bar. The inside diameter is 2.625 inches. Bulk samples of the upper soils were obtained to permit the performance of laboratory compaction tests.

The logs of the borings are presented on Plates C-1.1 through C-1.6; the depths at which undisturbed samples were obtained are indicted to the left of the boring logs. The energy required to drive the Crandall sampler twelve inches is indicated on the logs. The energy is determined based on the following relationship:

$$E = \frac{WBS}{P}$$, where:
W = Driving Weight = 400 to 1685 pounds
B = Number of Blows of Driving Weight
S = Stroke of Driving Weight = 1 to $1\frac{1}{2}$ feet
P = Penetration of LC&A Sampler = 1 foot

The soils are classified in accordance with the Unified Soil Classification System described on C-2.

LABORATORY TESTING

The laboratory program included testing of undisturbed samples, as well as tests on bulk materials. The undisturbed samples were placed in plastic bags and stored in sealed cans until ready for use, and the bulk samples were stored in plastic bags.

The first phase of the testing program consisted of determining the classification of the soils. The primary classifications were made by making a visual inspection. Representative samples were then selected for more specific studies to determine pertinent shear strength and consolidation parameters.

Moisture Content

Moisture contents were determined by first weighing the material at natural moisture content, drying it in an oven at a temperature of about 230°F, weighing the completely oven-dried sample, and calculating the moisture content. Natural water contents were determined on the undisturbed samples shortly after the samples arrived at the laboratory. The results of the tests are presented to the left of the boring logs.

Dry Density

Dry density was determined by carefully measuring a ring sample of the soil with a known volume, weighing the sample after it had been oven-dried, and calculating the unit weight. Results of the dry density determinations are presented to the left of the boring logs.

Direct Shear Tests

Direct shear tests were performed on selected undisturbed samples. The tests were performed at field moisture contents and at surcharge pressures equal to the existing overburden pressures. Selected samples were tested at an increased surcharge pressure to provide more complete data. All of the samples were tested at a constant strain of 0.05 inches per minute. The yield-point values determined from the direct shear tests are presented on Plates C-3.1 through C-3.4, Direct Shear Test Data.

Consolidation Tests

Undisturbed samples were tested in consolidometers to determine the consolidation characteristics of the soils. Vertical loads were instantaneously applied in increments, and the rate of vertical consolidation was measured for each increment. Each load was allowed to consolidate the sample for at least 12 hours before a new increment was added. Water was added to selected samples during the tests to illustrate the effect of moisture on the compressibility; the other samples were tested at field moisture content. The results of the consolidation tests are presented on Plates C-4.1 through C-4.8, Consolidation Test Data.

Compaction Tests

The optimum moisture content and maximum dry density of the soils in the yard and shops area were determined by performing a compaction test on a sample obtained from Boring 6. The test was performed in accordance with the ASTM Designation D1557-78 method of compaction. This method of compaction utilizes a 1/30 cubic-foot mold, in which each of five layers of soil is compacted by 25 blows of a 10-pound hammer falling 18 inches. The results of the compaction test are presented on Plate C-5, Compaction Test Data.

Expansion Index Test Data

The Expansion Index of the soils was determined by testing two samples in accordance with the Uniform Building Code Standard No. 29-2 method. The results of the tests are shown on Plate C-6, Expansion Index Test Data.

Mechanical Analyses

To determine the particle size distribution of the soils and to aid in classifying the soils, mechanical analyses were performed on four samples. The results of the mechanical analyses are presented on Plates C-7.1 and C-7.2, Particle Size Distribution.

BORING 1

DATE DRILLED: August 9 & 12, 1988
EQUIPMENT USED: 18" - Diameter Bucket (0' to 56')
5" - Diameter Rotary Wash (to 75')
ELEVATION 104 *

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		DESCRIPTION
							CL	FILL - SANDY CLAY - some Silt, pieces of concrete and asphalt, mottled greyish brown
			19.4	112	3	■		
100			11.8	115	5	■		Traces of organic matter
	5						CL	SILTY CLAY - dark brown
			13.0	116	7	■		
			11.8	103	7	■	SC	CLAYEY SAND - fine, brown Lenses of Silty Sand
95	10		13.9	105	7	■		
			10.4	124	10	■	SM	SILTY SAND - fine, some Clay, brown
90	15							
			12.8	115	10	■	SC	CLAYEY SAND - fine, brown
85							SP	SAND - fine to medium, some Gravel, light brown
	20		2.0	102	10	■		
80	25		2.6	99	13	■		Fine
75	30		2.5	104	9	■		
70	35		6.2	100	13	■		
65							SP SM	SAND and SILTY SAND - fine, light brown
	40		6.0	96	12	■		

* Elevations refer to datum of Plan and Profile drawings provided by TRANSCAL.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE C - 1.1a

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/19/88 F.T. AKH DR. dmh O.E. DM W.P. dmh CHKD

BORING 1 (Continued)

DATE DRILLED: August 9 & 12, 1988
EQUIPMENT USED: 18" - Diameter Bucket (0' to 56')
5" - Diameter Rotary Wash (to 75')

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		Soil Class	Description
								SP	SAND - fine, light brown
60	45		4.7	101	10	■			
55	50		3.3	104	18	■			
50	55		2.7	112	14	■			Fine to medium, about 10% Gravel (TERMINATED BUCKET BORING DUE TO HEAVY CAVING. BORING CONTINUED WITH ROTARY WASH EQUIPMENT).
45	60		16.9	110	54	■			About 20% Gravel
								CL	SILTY CLAY - greyish brown
40	65		37.8	84	9	■			
								ML	CLAYEY SILT - grey
35	70		21.0	98	21	■		ML	SANDY SILT - grey Lenses of Clayey Silt
30	75		24.4	93	12	■			

NOTE: Bucket Boring: Water not encountered. Heavy caving from 17' to 22' and below 47' (to 3' in diameter). Terminated boring due to heavy caving.

Rotary Wash Boring: Drilling mud used in drilling process. Mud removed after completion of drilling. Water level not established.

Note: The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/19/88 F.T. AKH DR. dmh O.E. DM W.P. dmh CHKD [signature]

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE C - 1.1b

BORING 2

DATE DRILLED: August 8, 1988
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 101

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	USCS	DESCRIPTION
100							SM	FILL - SILTY SAND - fine, some Clay, brown
			10.1	114	5	■		
			8.1	110	5	■		
	5							
95			11.4	116	5	■		
							SP SM	FILL - SAND and SILTY SAND - fine, brown
			12.1	112	5	■		
	10							
90			9.8	114	4	■	SM	SILTY SAND - fine, light brown
	15		14.3	107	5	■		
85								
	20		16.1	108	13	■		
80								
							SP SM	SAND and SILTY SAND - fine, light brown
	25		15.8	104	12	■		
75								
	30		9.9	101	14	■		
70								Lenses of Sand
							SP	SAND - fine, light brown
	35		6.9	100	18	■		
65								Few Cobbles
								Fine to medium
	40		11.7	96	12	■		

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/19/88 F.T. AKH DR. dmh O.E. DM W.P. dmh CHKD SK

BORING 2 (Continued)

DATE DRILLED: August 8, 1988
EQUIPMENT USED: 18" - Diameter Bucket

DEPTH (ft.)	ELEVATION (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
45		6.7	98	15
50		6.6	105	15
55		13.3	97	7
60		11.1	94	14
65		2.7	112	22
70		5.7	107	7
75		17.8	112	17

Elevation scale: 60, 55, 50, 45, 40, 35, 30

Some Gravel

Fine

SM SILTY SAND - fine, light brown

SP SAND - fine, light brown

CL SILTY CLAY - greyish brown

Lenses of Silty Sand

SM SILTY SAND - fine, light brown

NOTE: Water not encountered. No caving.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/19/88 F.T. AKH DR. dmh O.E. DM W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE C - 1.2b

JOB A-88044-6 DATE 8/23/88 F.T. AKH DR. dmh O.E. DM W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3

DATE DRILLED: August 8 & 9, 1988
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 98

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SP SM	FILL - SAND and SILTY SAND - fine, brown
			12.4	115	5	■		
95								Traces of Clay, pieces of asphalt
			13.1	114	7	■		
	5						CL	FILL - SANDY CLAY - pieces of asphalt, brown
			13.1	119	4	■		
							SM	FILL - SILTY SAND - fine, some Clay, brown
90			16.6	115	2	■		
	10						SC	CLAYEY SAND - fine, light greyish brown
			12.3	120	3	■		
85								
	15		13.7	117	7	■		
80							SP SM	SAND and SILTY SAND - fine, light brown
	20		5.9	101	7	■		
75								
	25		6.0	103	8	■		
70								
	30		5.8	103	13	■		
65								
	35		5.9	100	19	■		
							SP	SAND - fine and medium, light brown
60								
	40		6.6	96	8	■		

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 3 (Continued)

DATE DRILLED: August 8 & 9, 1988
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
55						
	45		8.3	97	12	■
50						
	50		9.0	91	13	■
45						
	55		8.5	95	10	■
40						
	60		7.6	101	12	■

SM — SILTY SAND - fine, light brown

SP SM — SAND and SILTY SAND - fine, few Gravel, light brown

Some Gravel

NOTE: Small amount of water seepage encountered at 3' to 9'.
Raveling from 8' to 9' and 18' to 30' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/23/88 F.T. AKH DR. dmh O.E. DM W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE C - 1.3b

BORING 4

DATE DRILLED: August 12, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 80

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		Description
							SM	FILL - SILTY SAND - fine, reddish brown
			4.0	100	5	■		
			6.8	109	2	■	SM	SILTY SAND - fine, brown
75	5							
			10.0	117	7	■		
			5.0	127	9	■		
70	10						SC	CLAYEY SAND - fine, few Gravel, brown
			18.7	110	7	■		
								Fine to medium
65	15		17.4	110	12	■		
							SP	SAND - fine, about 20% Gravel, some large Cobbles, light brown
60	20							
							SM	SILTY SAND - fine, light brown
55	25		13.3	109	49	■		
								Layers of Sand
50	30		17.4	103	33	■		
45	35		14.3	98	43	■		
							SP	SAND - fine to medium, brown
40	40		12.5	108	54	■		

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB	DATE	F.T.	DR.	O.E.	W.P.	CHKD
A-88044-6	8/23/88	AKH	dmh	DM	dmh	[signature]

LeROY CRANDALL AND ASSOCIATES

BORING 4 (Continued)

DATE DRILLED: August 12, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		Description
35	45		12.3	99	43	■		
							SM	SILTY SAND - fine, light brown
30	50		10.6	97	43	■		
							SP	SAND - fine to medium, light brown
25	55		18.5	110	77	■		
20	60		17.4	106	60	■		
							SP SM	SAND and SILTY SAND - fine, light brown
15	65		16.5	100	60	■		
10	70		24.6	92	54	■		
5	75		22.3	98	43	■		
0	80		24.0	96	30	■		

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/23/88 F.T. AKH DR. dmh O.E. DM W.P. dmh CHKD [illegible]

LeROY CRANDALL AND ASSOCIATES

BORING 4 (Continued)

DATE DRILLED: August 12, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-5	85		21.5	100	54	■
-10	90		24.4	97	43	■
-15	95		24.5	98	43	■
-20	100		22.9	104	43	■

Fine to medium

NOTE: Drilling mud used in drilling process. Mud removed after completion of drilling. Water level not established. Installed 100' of 2"-diameter PVC pipe for downhole seismic survey. Annular space backfilled with gravel.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/23/88 F.T. AKH DR. dmh O.E. DM W.P. dmh CHKD [initials]

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 5

DATE DRILLED: August 11, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 80

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SM	FILL - SILTY SAND - fine, some Gravel and Cobbles, reddish brown
			7.5	113	7	■		
							SM	SILTY SAND - fine, brown
			5.7	108	2	■		
75	5							
			8.7	117	7	■		
			11.1	120	9	■		
							CL	SANDY CLAY - brown
70	10							
			15.6	116	10	■		
							SM	SILTY SAND - fine, about 10% Gravel and Cobbles, brown
			13.6	118	18	■		
65	15							
							SP	SAND - medium, about 20% Gravel, light brown
			8.6	118	21	■		
60	20							
								Fine to medium, about 10% Gravel
			14.1	113	18	■		
55	25							
			19.4	99	36	■		
			12.9	122	60	■		Medium
50	30							
							SP SM	SAND and SILTY SAND - fine, light brown
			11.0	101	30	■		
45	35							
			10.4	101	27	■		
40	40							

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/23/88 F.T. AKH DR. dmh O.E. DM W.P. dmh CHKD [illegible]

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 5 (Continued)

DATE DRILLED: August 11, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		Description
35	45		12.4	105	45	■		
								Thin layer of Gravel
30	50		17.7	97	33	■		
								Some Gravel and Cobbles
								Medium to coarse
25	55		14.4	114	45	■		
20	60		16.6	101	30	■		
							SP	SAND - fine to medium, light brown
15	65		14.3	99	45	■		
							SP SM	SAND and SILTY SAND - fine, light brown
10	70		22.7	92	40	■		
5	75		23.3	96	60	■		
0	80		22.5	97	60	■		

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/23/88 F.T. AKH DR. dmh O.E. DM W.P. dmh CHKD [signature]

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 5 (Continued)

DATE DRILLED: August 11, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-5	85		23.2	96	54	
-10	90		24.2	95	36	
-15	95		27.8	96	36	
-20	100		20.1	107	77	

NOTE: Drilling mud used in drilling process. Mud removed after completion of drilling. Installed 100' of 2" - diameter PVC pipe (bottom 50' perforated to permit future water level measurements). Water level measured at 73' on 8/23/88.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/23/88 F.T. AKH DR. dmh O.E. DM DM W.P. dmh CHKD [signature]

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 6

DATE DRILLED: August 10, 1988
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 71

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
70			3.4	110	3	■
			23.6	99	2	■
65	5		24.1	101	1	■
			30.1	91	3	■
60	10		32.7	89	3	■
			15.3	120	8	■
55	15		2.9	109	15	■
50	20		2.9	117	17	■
45	25		4.8	106	24	■
	30		5.8	101	19	■

6" Asphaltic Paving - 6" Base Course

SP SM — FILL - SAND and SILTY SAND - fine, pieces of concrete, few Gravel, light brown

CL — SILTY CLAY - dark brown

Some Sand, brown

Greyish brown

CL — SANDY CLAY - brown

SM — SILTY SAND - fine, about 10% Gravel, brown

SP — SAND - fine, about 10% Gravel, light brown

Lenses of Gravel

Few Gravel

NOTE: Water not encountered. Raveling from 16' to 24' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB A-88044-6 DATE 8/23/88 F.T. AKH DR. dmh O.E. DM DM W.P. dmh CHKD Sh

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE C - 1.6

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS (More than 50 % of coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amt. of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50 % of coarse fraction is SMALLER than the No. 4 sieve size)	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amt. of fines)	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than 50 % of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty 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 clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

PARTICLE SIZE LIMITS

SILT OR CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

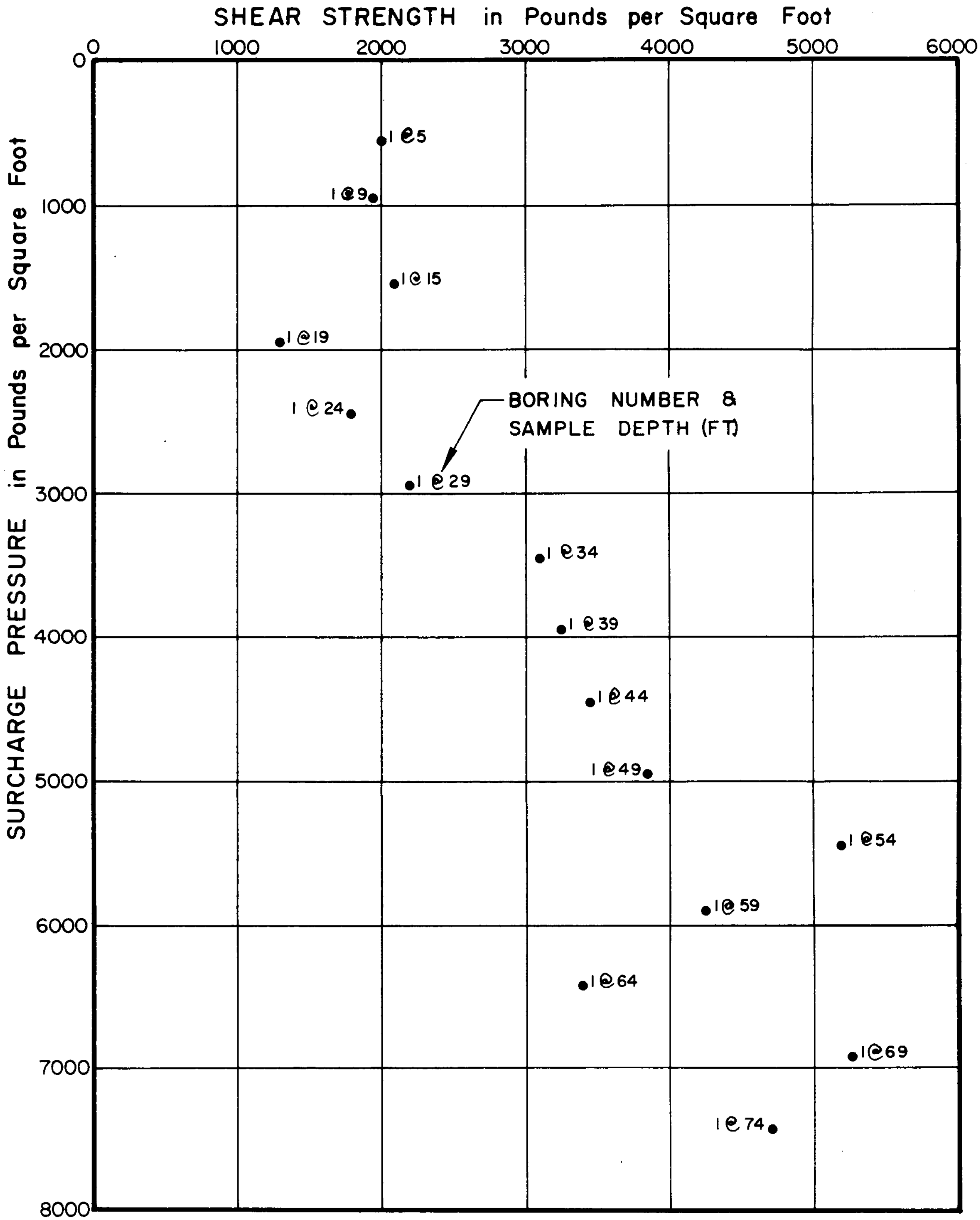
NO. 200 — NO. 40 — NO. 10 — NO. 4 — 3/4 in. — 3 in. — (12 in.)

U. S. STANDARD SIEVE SIZE

UNIFIED SOIL CLASSIFICATION SYSTEM

Reference :
The Unified Soil Classification System, Corps of Engineers, U. S. Army Technical Memorandum No. 3-357, Vol. I, March, 1953. (Revised April, 1960)

LEROY CRANDALL & ASSOCIATES



KEY:

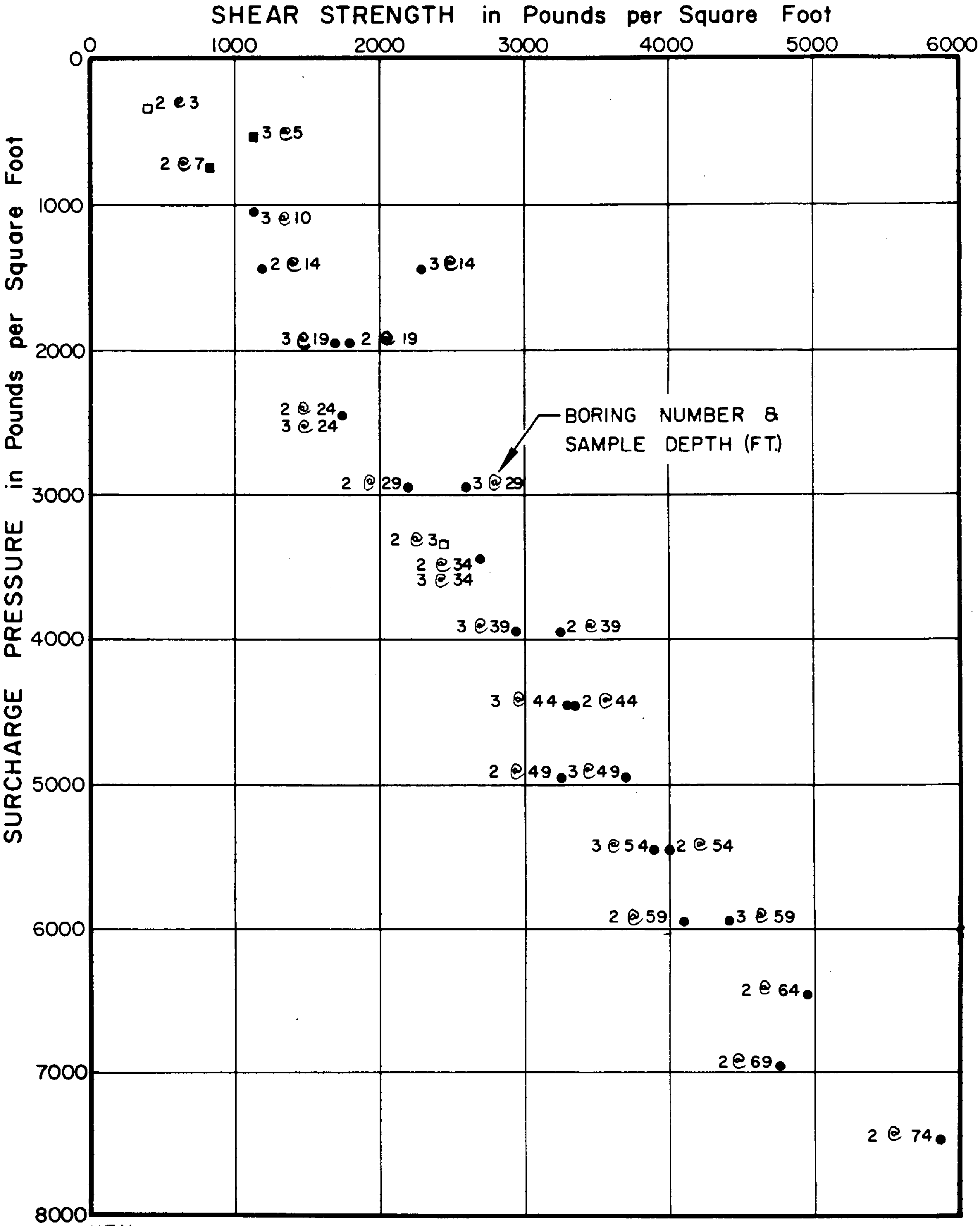
- Samples tested at field moisture content

DIRECT SHEAR TEST DATA

LEROY CRANDALL & ASSOCIATES

PLATE C-3.1

JOB A-[redacted] DATE [redacted] BY [redacted] CH [redacted]



KEY:

□ ■ Fill soils

● Natural soils

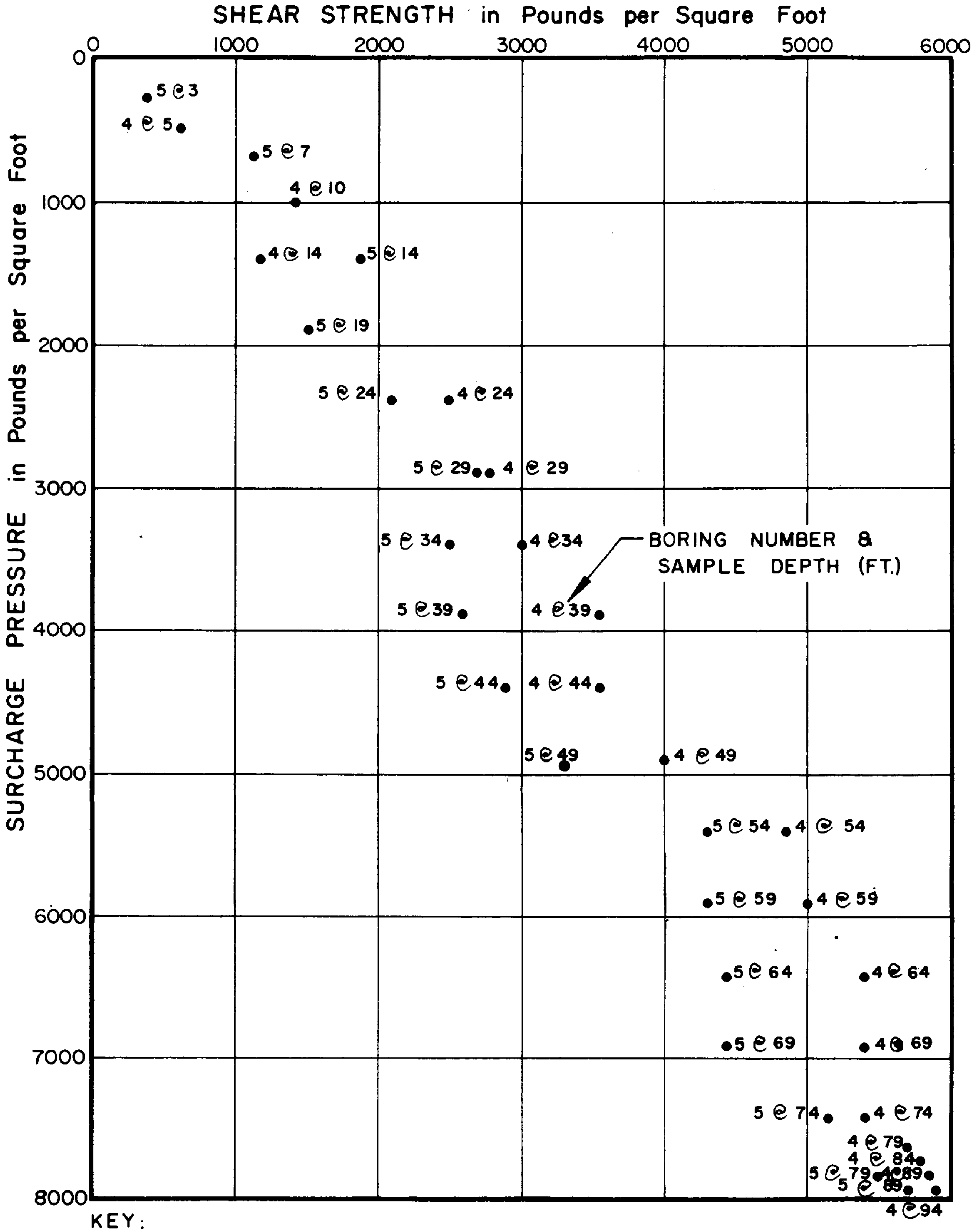
└ Tests at field moisture content

└ Tests at increased moisture content

DIRECT SHEAR TEST DATA

LEROY CRANDALL & ASSOCIATES

PLATE C-3.2



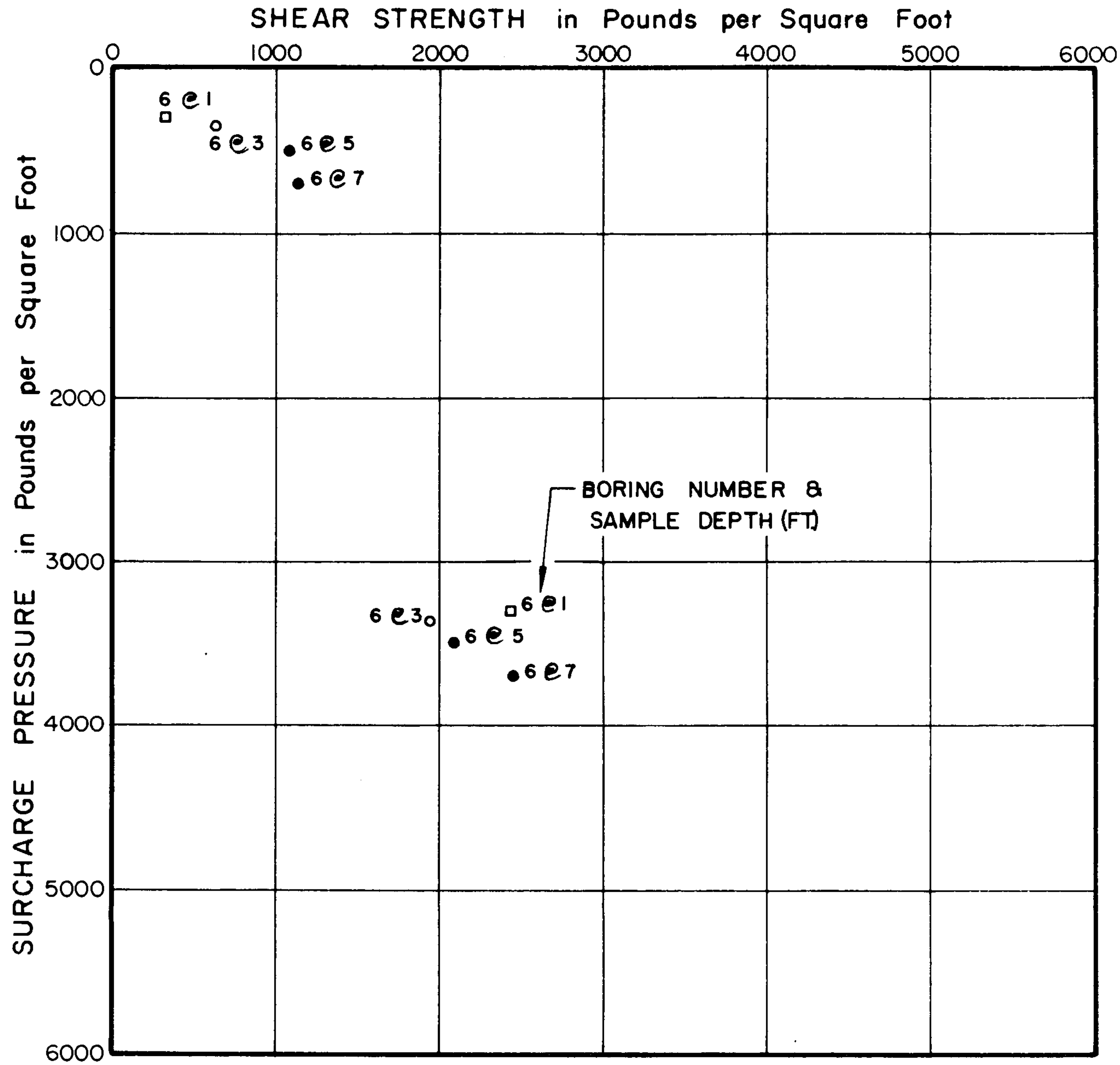
KEY:

• Tests at field moisture content

DIRECT SHEAR TEST DATA

LEROY CRANDALL & ASSOCIATES

PLATE C-3.3



KEY:

□ Fill soils

● ○ Natural soils

○ Tests at increased moisture content

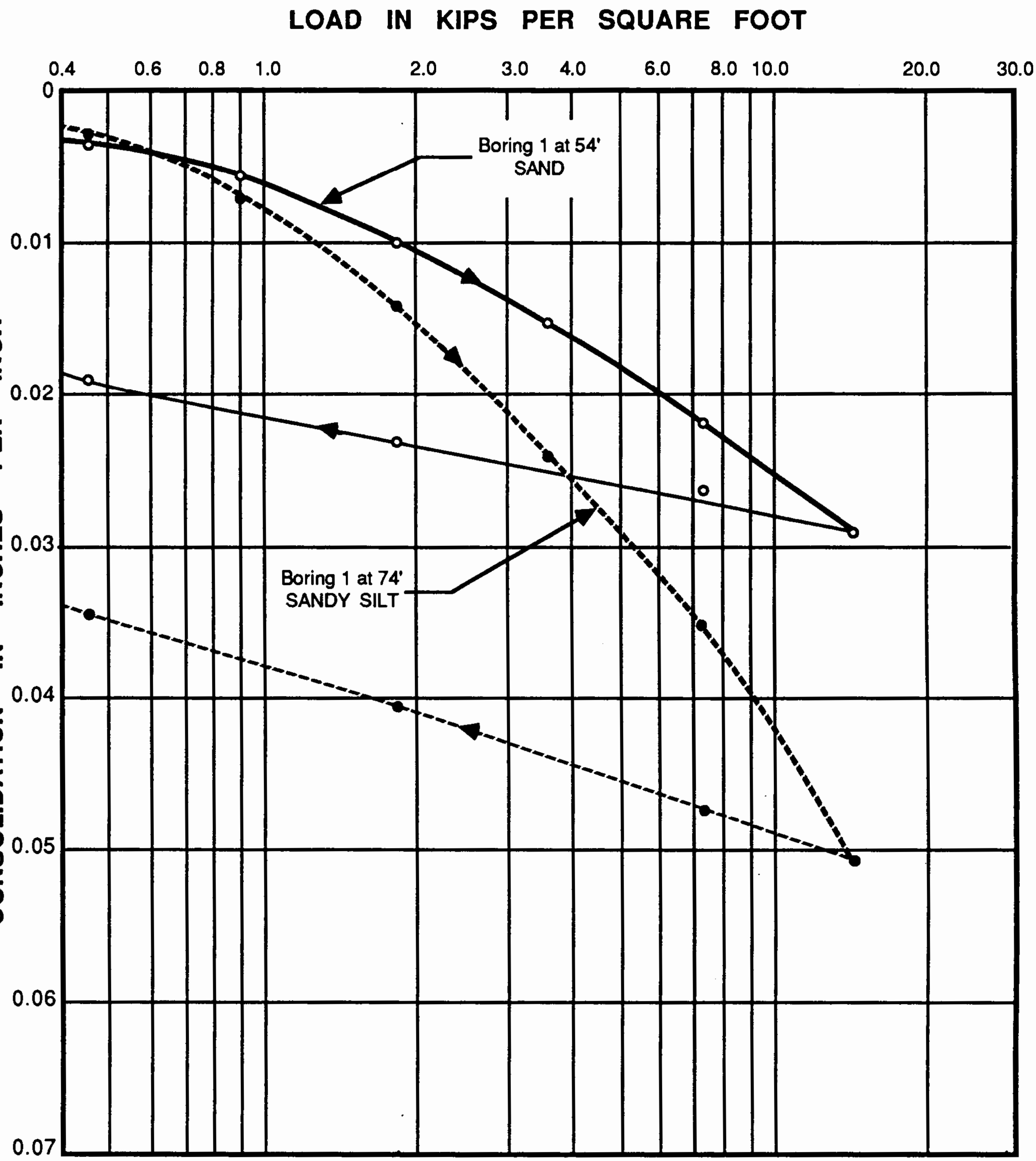
● Tests at field moisture content

DIRECT SHEAR TEST DATA

LEROY CRANDALL & ASSOCIATES

PLATE C-3.4

JOB A-88044-6 DATE 8-24-88 BY G T



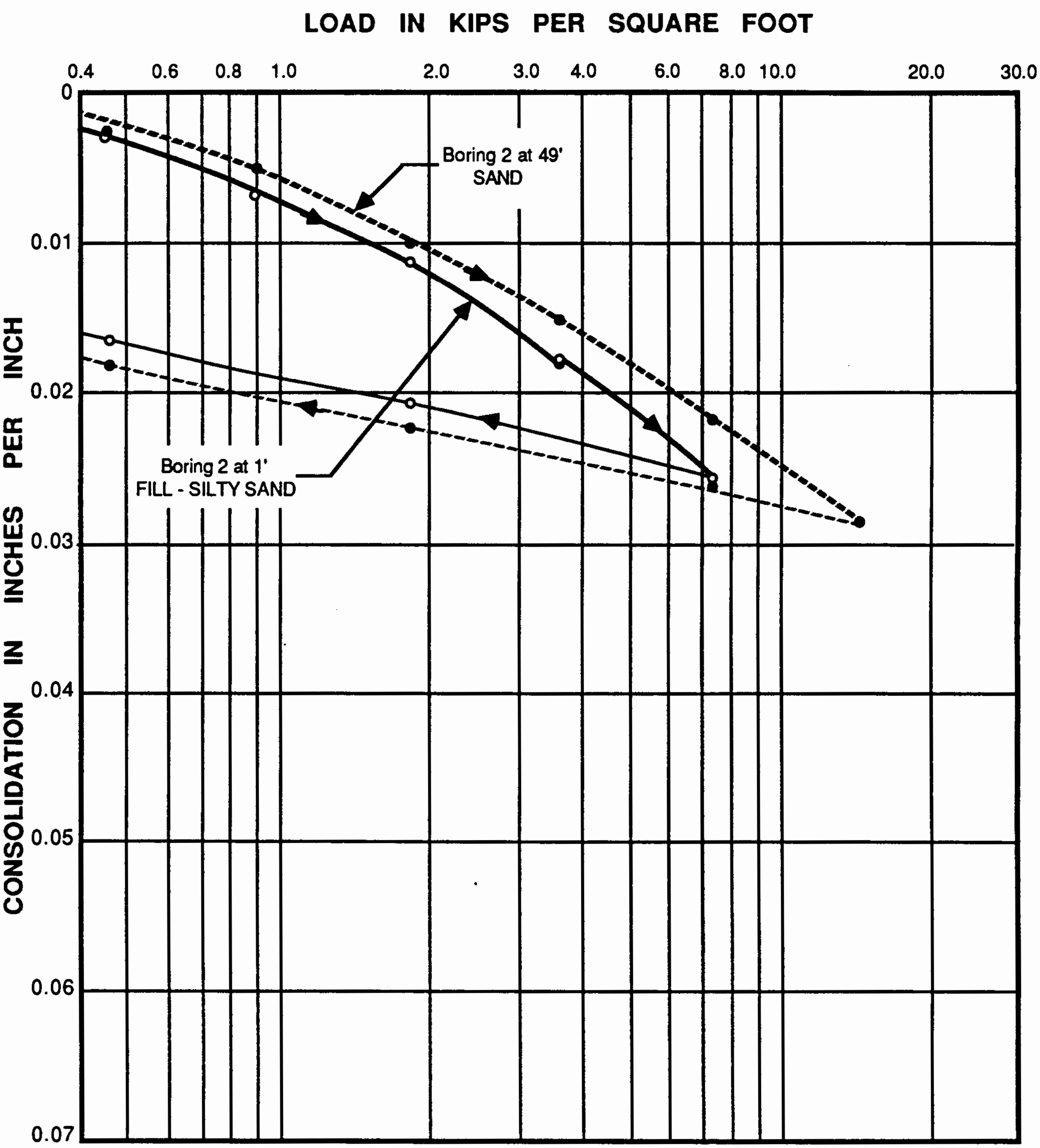
NOTE: Samples tested at field moisture content.

JOB A-88044-6 DATE 8/23/88 DR. lp W.P. lp O.E. DM DM CHKD SK

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

PLATE C-4.1



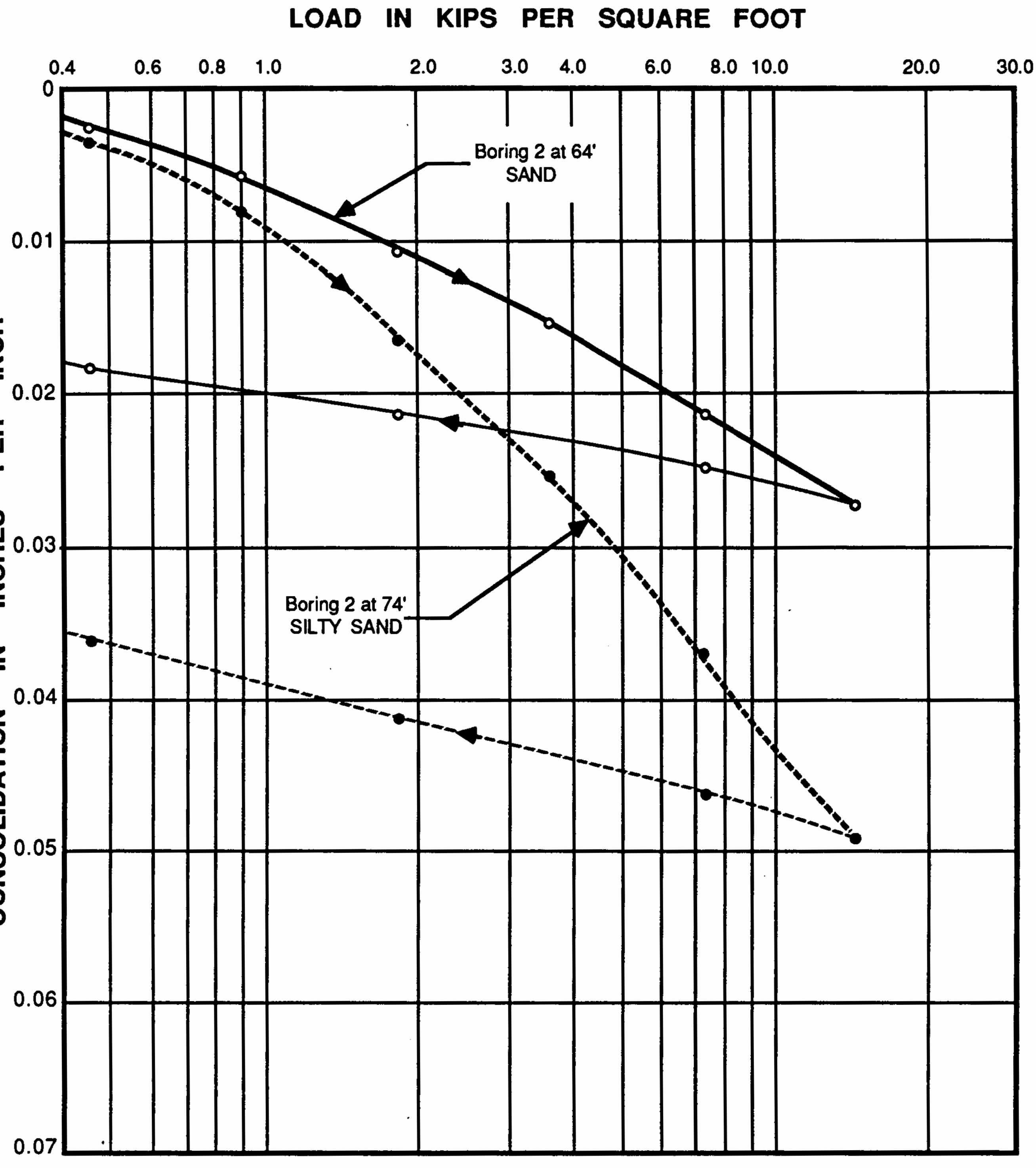
JOB A-88044-6 DATE 8/23/88 DR. lp W.P. lp O.E. DM DM CHKD

NOTE: Water added to sample from 1' after consolidation under a load of 3.6 kips square foot.
The other sample tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

JOB A-88044-6 DATE 8/23/88 DR. lp W.P. lp O.E. DM DM CHKD SK

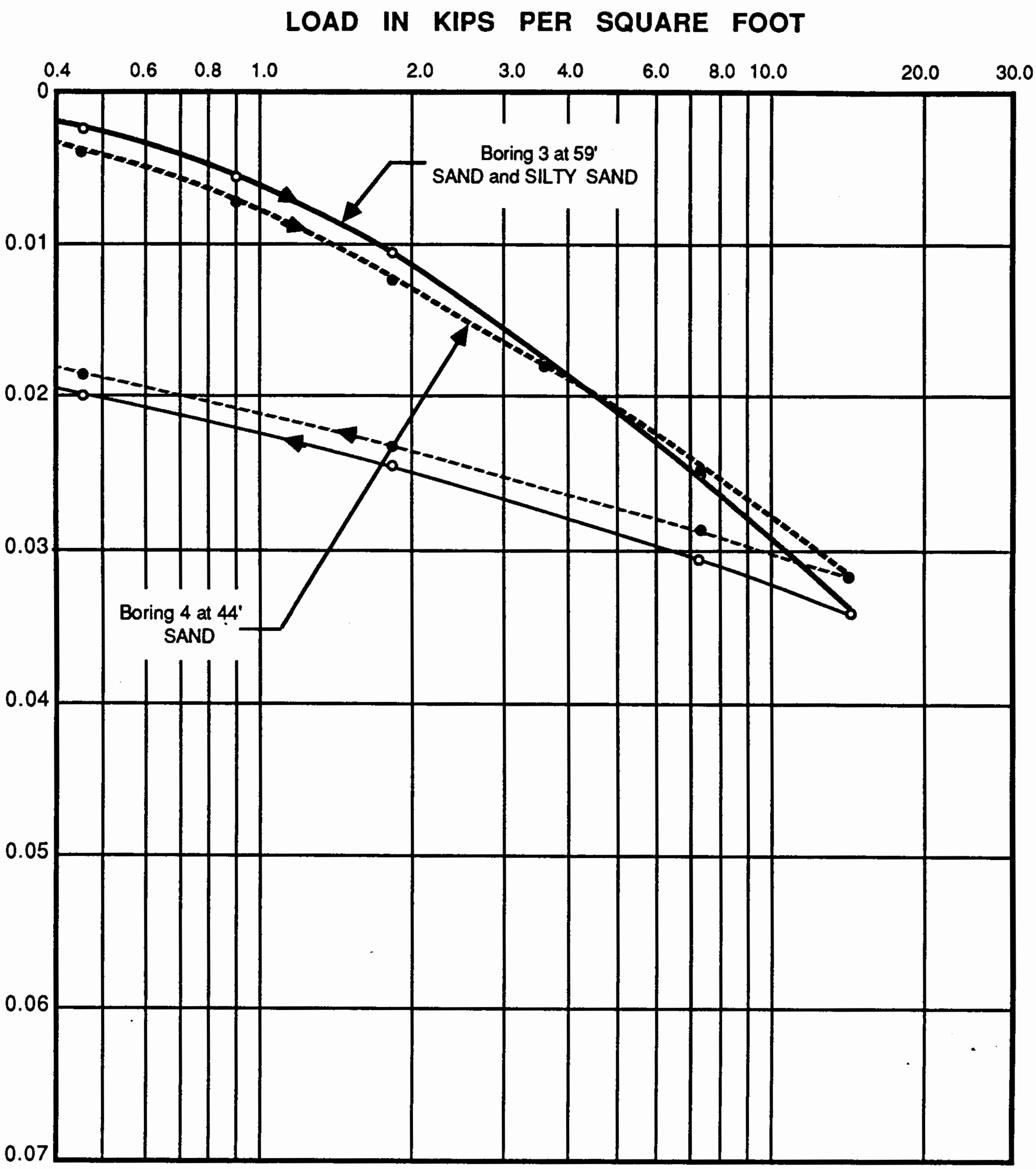


NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

PLATE C - 4.3



NOTE: Samples tested at field moisture content.

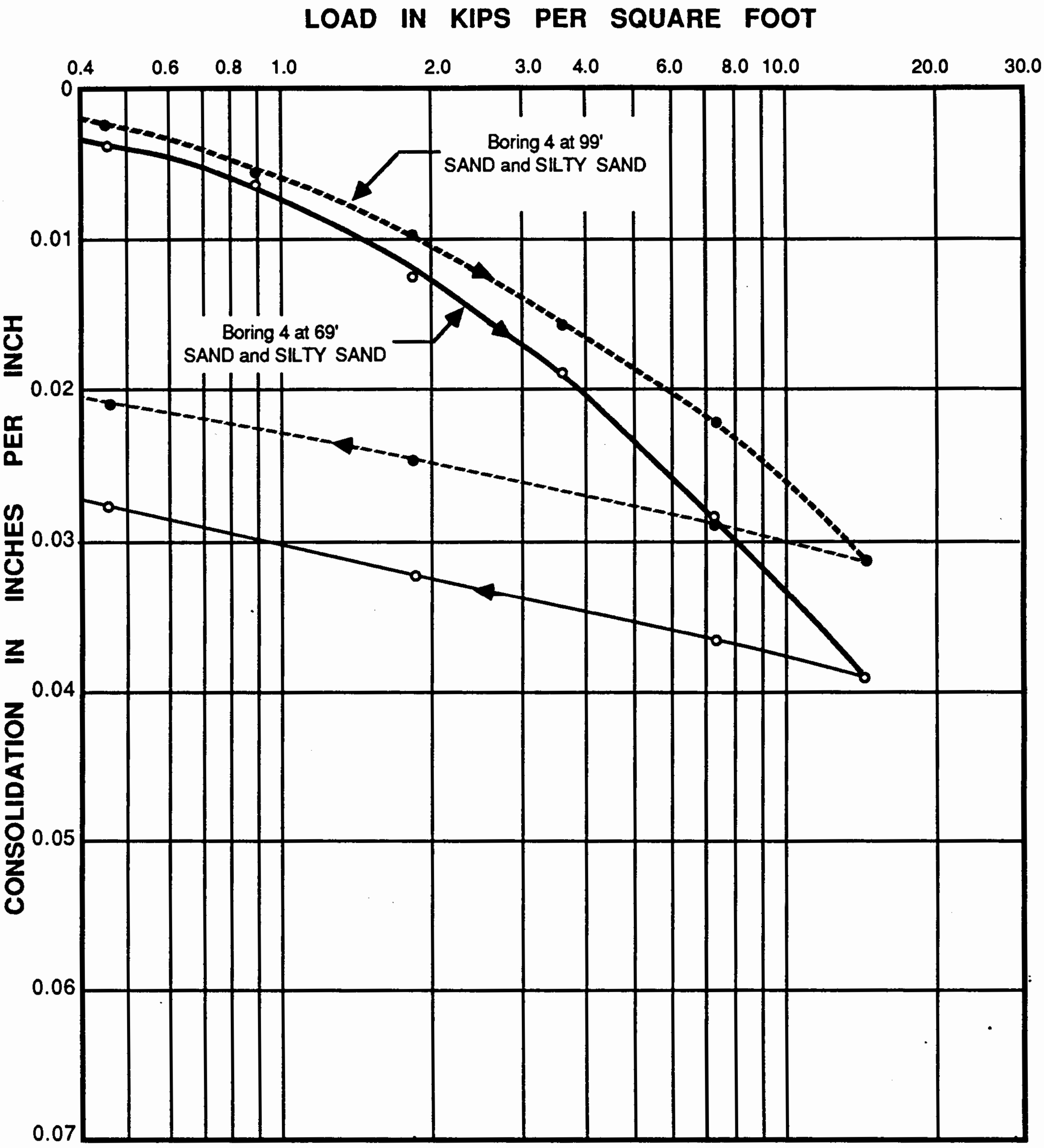
CONSOLIDATION TEST DATA

JOB A-88044-6 DATE 8/23/88 DR. lp W.P. lp O.E. DM DM CHKD

LeROY CRANDALL AND ASSOCIATES

PLATE C-4.4

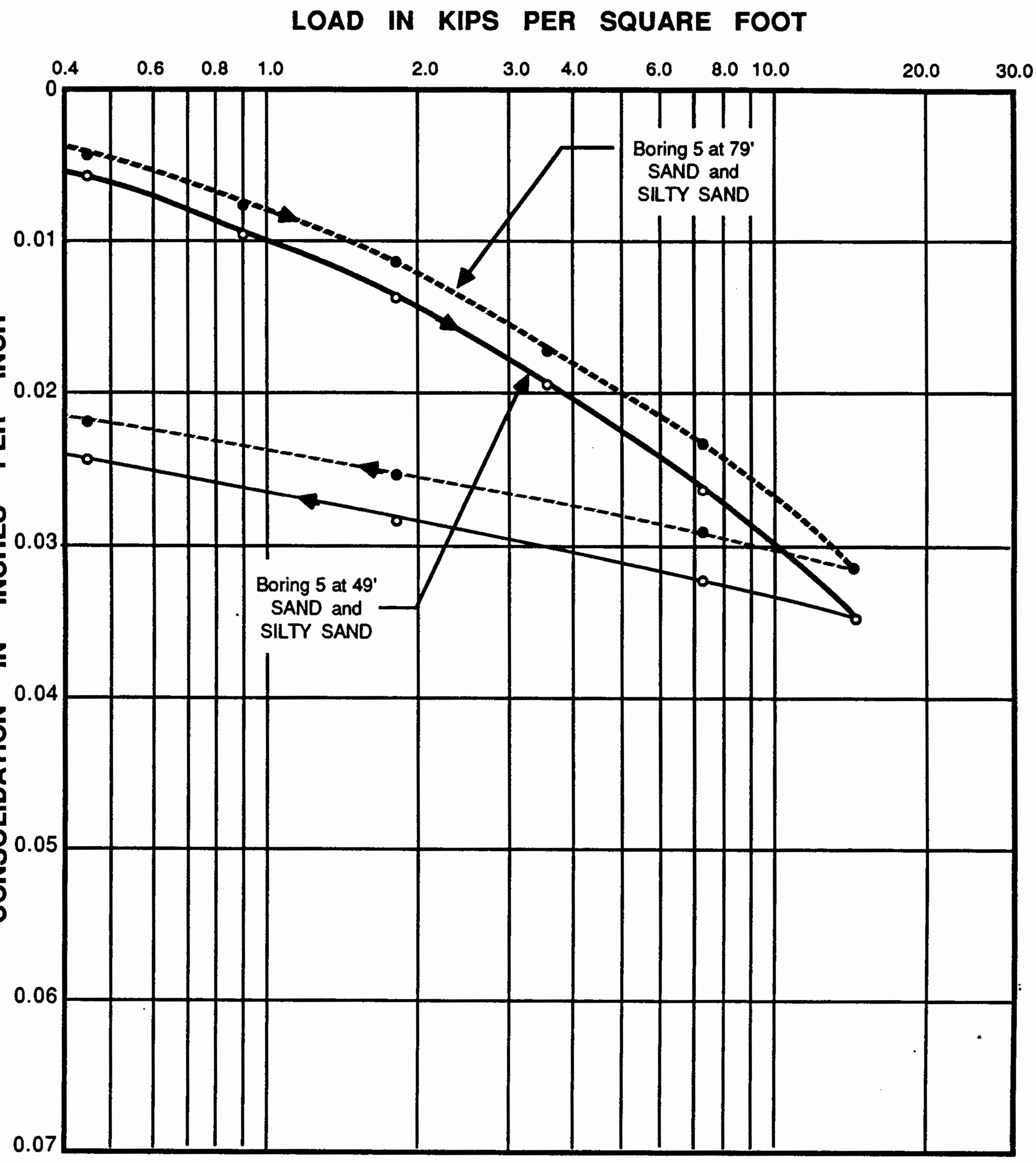
JOB A- 88044-6 DATE 8/23/88 DR. lp W.P. lp O.E. DM DM CHKD SK



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES



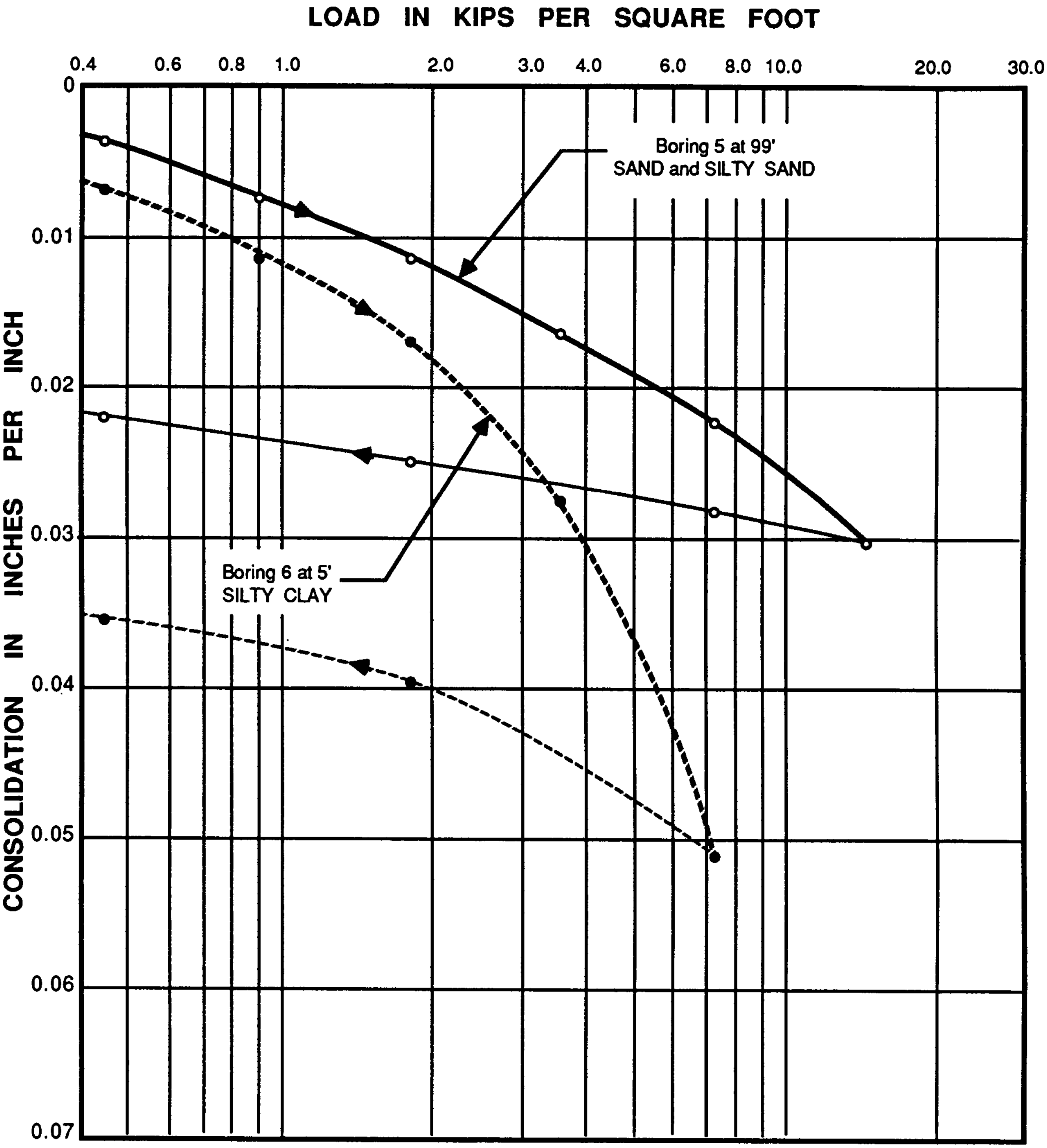
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

PLATE C-4.6

JOB A-88044-6 DATE 8/23/88 DR. dmh W.P. dmh O.E. DM DM CHKD SK



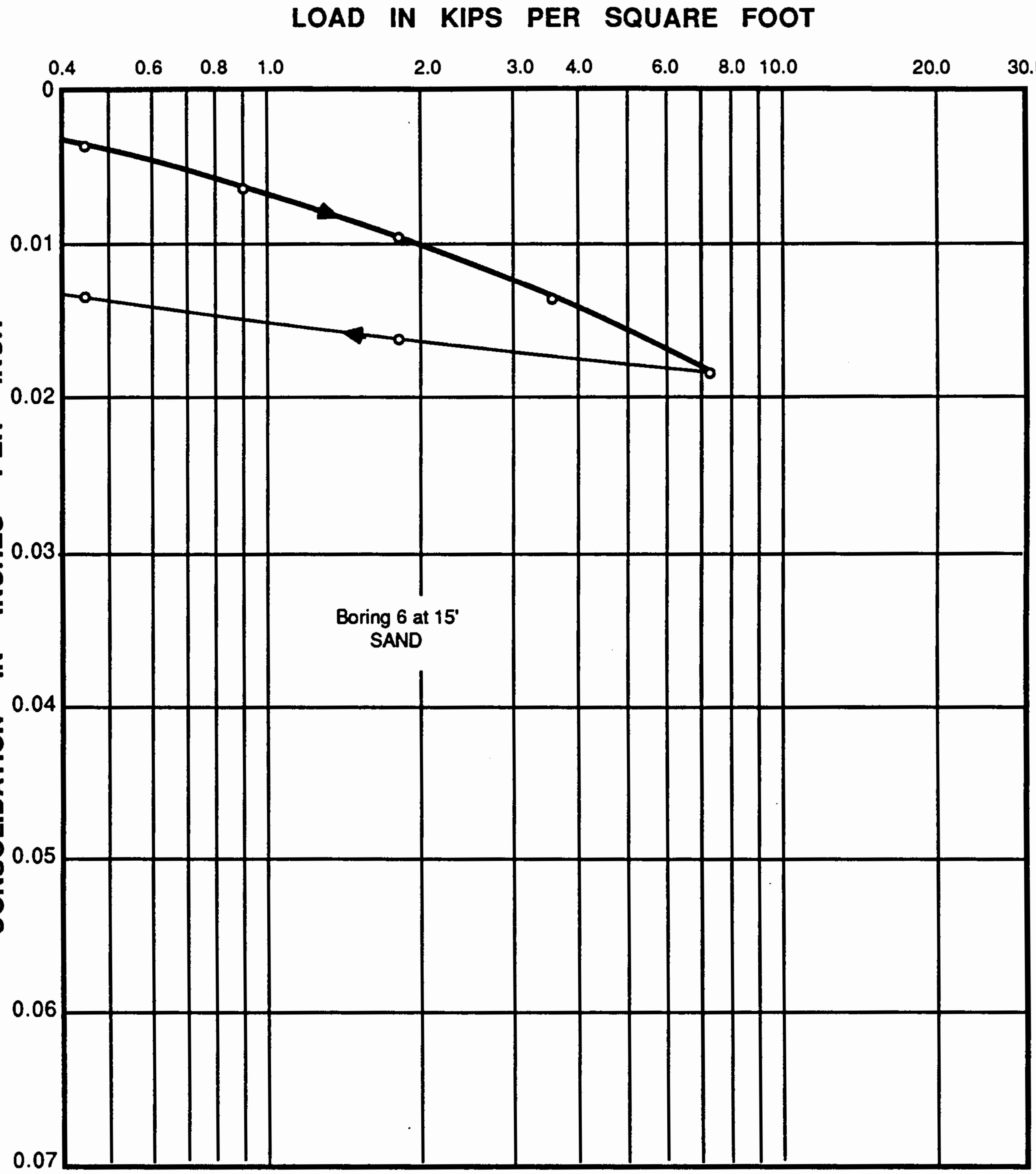
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

JOB A-88044-6 DATE 8/23/88 DR. dmh W.P. dmh O.E. DM DM CHKD

LeROY CRANDALL AND ASSOCIATES

PLATE C - 4.7



NOTE: Sample tested at field moisture content.

JOB A-88044-6 DATE 8/23/88 DR. dmh W.P. dmh O.E. DM DM CHKD SK

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

JOB A-88044-6 DATE 8/23/88 W.P. dmh O.E. DM DM CHKD Sk

BORING NUMBER
AND SAMPLE DEPTH : 6 at 1' to 3'

SOIL TYPE : FILL - SAND and SILTY SAND

MAXIMUM DRY DENSITY : 125
(lbs./cu. ft.)

OPTIMUM MOISTURE CONTENT : 9
(% of dry wt.)

TEST METHOD : ASTM Designation D1557 - 78

COMPACTION TEST DATA

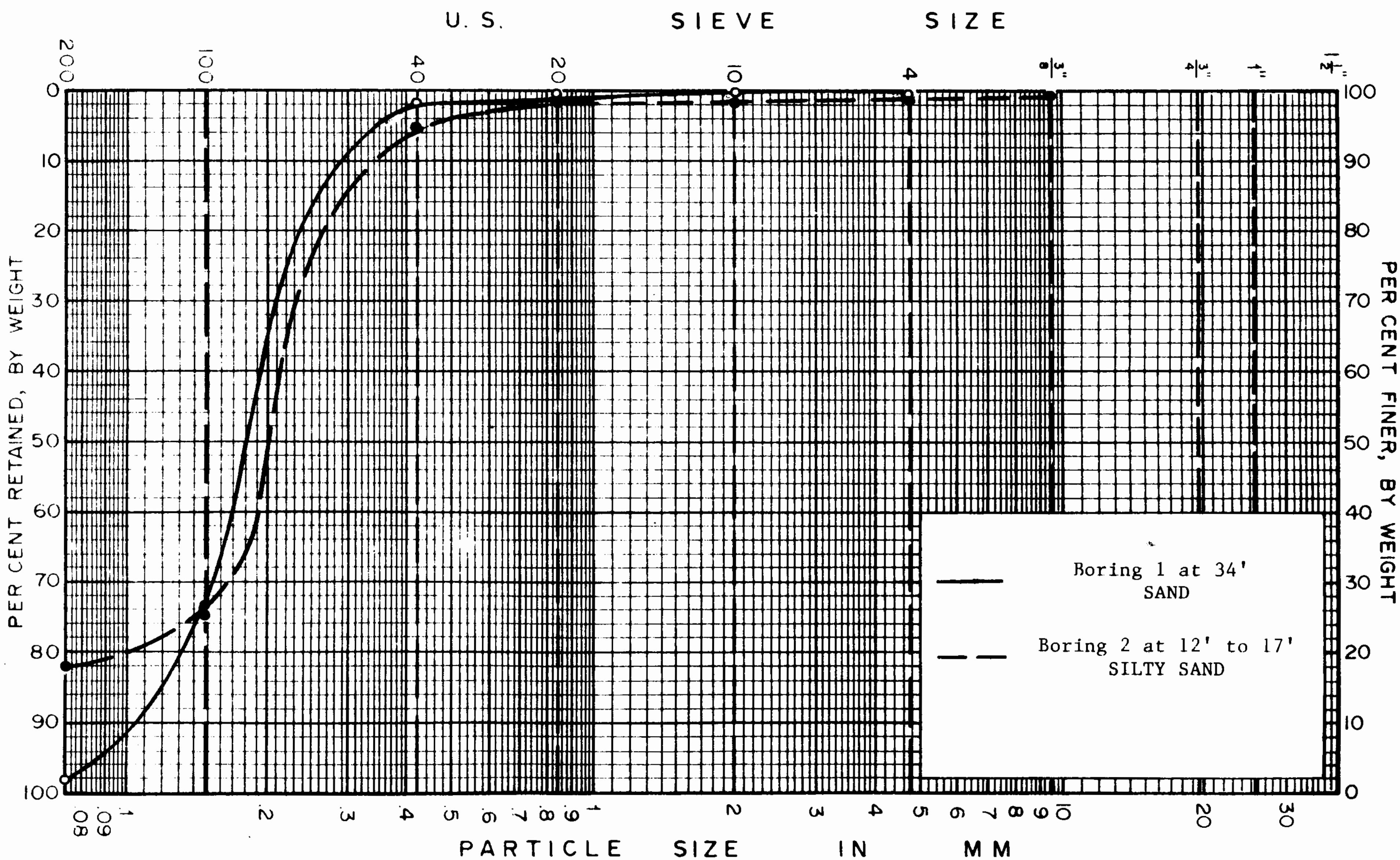
JOB A-88044-6 DATE 8/23/88 W.P. dmh O.E. DM DM CHKD SK

BORING NUMBER AND SAMPLE DEPTH:	1 at 5' to 7'	6 at 5' to 9'
SOIL TYPE:	SILTY CLAY	SILTY CLAY
CONFINING PRESSURE: (lbs./sq. ft.)	144	144
INITIAL MOISTURE CONTENT: (% of dry wt.)	11.3	13.5
FINAL MOISTURE CONTENT: (% of dry wt.)	29.7	34.0
DRY DENSITY: (lbs./cu. ft.)	104	98
EXPANSION INDEX:	99	127

TEST METHOD: Uniform Building Code Standard No. 29-2, Expansion Index Test

EXPANSION INDEX TEST DATA

FORM 121 JOB A-88044-6 DATE 8/19/88 DR. JOHN O.E. DM DM W.P. lp CHKD. [illegible]

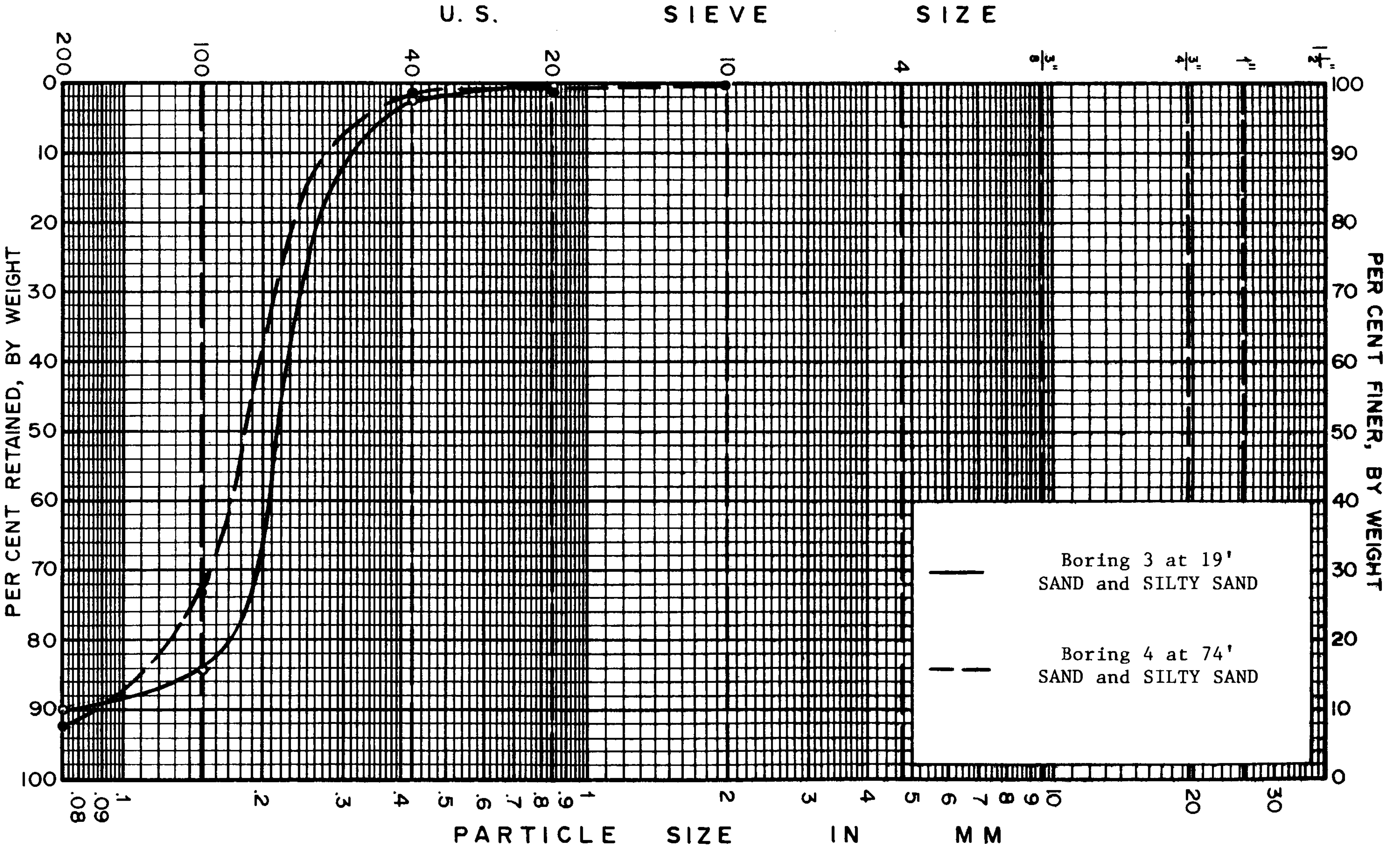


PARTICLE SIZE DISTRIBUTION

LeROY CRANDALL AND ASSOCIATES

PLATE C-7.1

FORM 121 JOB A-88044-6 DATE 8/19/88 DR. JOHN O.E. DM DM W.P. 1p CHKD. sk



PARTICLE SIZE DISTRIBUTION

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PLATE C-7.2