GEOLOGIC HAZARDS AND GEOTECHNICAL INVESTIGATION FOR DAY CARE FACILITY DONALD LUM ELEMENTARY SCHOOL ALAMEDA, CALIFORNIA

Kaldveer Associates
Geoscience Consultants

Peter Kaldveer, P.E., G.E.
President
Richard Short, P.E., G.E.
Executive Vice President
Ronald L. Bajuniemi, P.E., G.E.
Vice President Engineering
Patrick Stevens, P.E., G.E.
Associate
David Hoexter, C.E.G., R.E.A.
Associate
Michael McRae, P.E.
Associate
William Bender, P.E., S.E., A.I.A.
Associate
Dawn Rinaldi, P.E.
Barbara L. Potter, P.E.
Randy P. Rowley, R.E.A.
Polly L. Worrell, R.E.A.

March 23, 1990
K1191-8, 15806

Alameda Unified School District
2200 Central Avenue
Alameda, California 94501

Attention: Mr. Claude Kanemori

RE: GEOLOGIC HAZARDS AND
GEOTECHNICAL INVESTIGATION
DAY CARE FACILITY
DONALD LUM ELEMENTARY SCHOOL
ALAMEDA, CALIFORNIA

Gentlemen:

In accordance with your request, we have performed a geologic hazards and geotechnical investigation for the proposed Day Care Facility at the Donald Lum Elementary School. The accompanying report presents the results of our field investigation, laboratory tests, and engineering analysis. The geologic, seismic, soil, and foundation conditions are discussed and recommendations for the geotechnical engineering aspects of the project are presented. In addition, the geologic hazards at the site are evaluated. The conclusions and recommendations contained herein are based upon applicable standards of our profession at the time this report has been prepared. Copies of this report are furnished only to provide the factual data which were gathered and which were summarized in the report.

We refer you to the text of the report for detailed recommendations. If you have any questions concerning our findings, please call us.

Very truly yours,

KALDVEER ASSOCIATES, INC.

Ronald L. Bajuniemi
Vice President Engineering

RLB:pv
Copies: Addressee (3)
Deems, Lewis, McKinley, Architects (6)
Attention: Mr. Roy Miller

GEOLOGICAL HAZARDS AND
GEOTECHNICAL INVESTIGATION

For
DAY CARE FACILITY
DONALD LUM ELEMENTARY SCHOOL
ALAMEDA, CALIFORNIA

To
Alameda Unified School District
2200 Central Avenue
Alameda, California 94501

March, 1990

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GEOLOGIC HAZARDS AND GEOTECHNICAL INVESTIGATION FOR DAY CARE FACILITY DONALD LUM ELEMENTARY SCHOOL ALAMEDA, CALIFORNIA

INTRODUCTION

This report presents the results of our geologic hazards and geotechnical investigation for the proposed Day Care Facility to be added to the existing Donald Lum Elementary School located at 1801 Sandcreek Way in Alameda, California, as shown on the Site Location Map, Figure 1 and the Site Plan, Figure 2. The site is located at Longitude 122° 15'30" and Latitude 37° 46'. The purposes of our investigation were to 1) evaluate potential geologic hazards at the site, and 2) evaluate the foundation soils and provide recommendations concerning the geotechnical engineering aspects of the project.

Based on the information indicated on the Site Plan as well as on our conversations with Mr. Claude Kanemori and Mr. Leonard Yamamoto of the Alameda Unified School District, it is our understanding that the development will consist of a 48 foot by 60 foot modular day care facility. Anticipated loads will be typical for this type of relatively light structure. Minimal grading will be required to develop the site for the subject project.

SCOPE

The scope of work of this investigation included a review of previous geotechnical investigations performed in the area by our firm, a review of available soil and geologic data, a site reconnaissance, subsurface exploration, laboratory testing, engineering analysis of the field and laboratory data and preparation of this report. The data obtained and the analyses performed were for the purposes of 1) evaluating the geologic hazards present at the site and 2) providing design and construction criteria for site earthwork and building foundations.

This report has been prepared in accordance with generally accepted geotechnical engineering practices for the exclusive use of the Alameda Unified School District and their consultants for specific application to the proposed Day Care Facility at Donald Lum Elementary School. In the event that there are any changes in the nature, design or location of the modular building or if any future units or additions are planned, the conclusions and recommendations contained in this report shall not be considered valid unless 1) the project changes are reviewed by Kaldveer Associates and 2) conclusions and recommendations presented in this report are modified or verified in writing.

SITE INVESTIGATION

Subsurface exploration was performed using a trailer-mounted rotary wash drilling system equipped with a 6-inch diameter drill bit. One exploratory boring was drilled on March 2, 1990, to a maximum depth of about 48-1/2 feet. The approximate location of the boring is shown on the Site Plan, Figure 2. The log of the boring and details regarding the field investigation are included in Appendix A. The results of our laboratory tests are discussed in Appendix B.

A. Surface

The site of the proposed day care facility is located at the southwest corner of the existing Donald Lum Elementary School. At the time of our investigation, the site consisted of a parking area paved with about 2-inches of asphaltic concrete over about 8 inches of baserock. The parking area was bounded by chain-link and wooden fencing on the southwest, southeast and northwest. Some large trees and lawn were located southwest of the site and a paved play area to the northwest.

B. Subsurface

The surface soils encountered below the pavement section in our exploratory boring generally consist of artificial fills which extended to a depth of about 15 feet. The fill materials generally consist of loose to medium dense, fine to medium grained sand with varying silt contents. These sandy fills were underlain by a 2-1/2 foot thick layer of very soft, silty clay with some shells which were in turn underlain by loose sands which extended to about 40 feet. Dense sands were encountered at about 40 feet and continued to the maximum depth explored of about 48-1/2 feet. Detailed descriptions of the soils encountered in the exploratory boring are presented on the boring logs in Appendix A.

The attached boring logs and related information depict location specific subsurface conditions, encountered during our field investigation. The approximate location of the boring was determined by pacing and should be considered accurate only to the degree implied by the method used. The passage of time could result in changes in the subsurface conditions due to environmental changes.

C. Ground Water

Free ground water was encountered in Boring 1 at a depth of about 4 feet at the time of drilling. The boring was backfilled immediately after drilling. It should be noted that the borings may not have been left open for a sufficient period of time to establish equilibrium ground water conditions. In addition, fluctuations in the ground water level could occur due to change in seasons, variations in rainfall, and other factors.

D. Geology

The site is located within the historic margin of San Francisco Bay (Nichols and Wright, 1971). The site is underlain by artificial sand fill over the Merritt Sand formation. The Merritt Sand is composed of fine-grained silty, clayey sand with lenses of sandy clay and clay. The maximum known thickness of this formation is 65 feet. Many fills in the area have been derived from excavations in the Merritt Sand and it is quite possible that the fill used at the site was derived from similar sources.

The Merritt Sand is underlain by the Alameda Formation which consists of sandy, silty clay with few pebbles. According to Radbruch (1957), this formation includes several hundred feet of sediments underlying the bay and coastal plain, comprising continental and marine gravels, sands, silts and clays, with some shells and organic material in places.

Franciscan bedrock material, dating back to the Jurassic and Cretaceous periods, underlies the site as well as most of the San Francisco Bay area. During the Pleistocene period, a fault block of the Franciscan formation material that extended for nearly 100 miles along the west side of the Hayward Fault was downthrown, creating the depression which is now the San Francisco Bay. This trough, which was approximately 500 feet deep in the vicinity of the site, was then nearly filled by continental and marine sediments of the Alameda Formation, alluvium of the Temescal Formation and wind-and-water-deposited sands of the Merritt Formation. A geologic map of Alameda is included as Figure 3.

E. Seismicity

The San Francisco Bay Area is recognized by geologists and seismologists as one of the most active seismic regions in the United States. Three major fault zones which pass through the Bay Area in a northwest direction have produced approximately 12 earthquakes per century strong enough to cause structural damage. The faults causing such earthquakes are part of the San Andreas fault system, a major rift in the earth's crust that extends for at least 450 miles along the California Coast and includes the San Andreas, Hayward and Calaveras faults. The site is located approximately 15 miles northeast of the San Andreas fault and approximately 4 and 15 miles southwest of the Hayward and Calaveras faults, respectively, as shown on the Vicinity and Fault Location Map, Figure 4. It should be noted that the site is not located within a Special Studies Fault Rupture Hazard ("Alquist-Priolo") Zone.

Since the early 1800's, major earthquakes have been recorded along the San Andreas, Hayward and Calaveras fault zones. In 1861, an earthquake having Richter magnitude of approximately 6.5 was reported on the Calaveras fault. The presumed epicenter of this earthquake was located approximately 30 miles east of the site. In 1836 and again in 1868, earthquakes having Richter magnitudes of approximately 7.0 were recorded along the Hayward fault. These earthquakes opened fissures at random locations along the fault, from San Pablo to Mission San Jose. The presumed epicenters of the 1836 and 1868 earthquakes were located approximately 6 miles northeast and 21 miles southeast of the site, respectively. The San Francisco Earthquake of 1906 had a Richter magnitude of 8.3 and the epicenter of this earthquake was located approximately 36 miles northwest of the site; also, the San Andreas fault produced an earthquake having an approximate magnitude of 7.0 in 1838, the presumed epicenter of which was located about 21 miles southwest of the site. In 1979 and in 1984, earthquakes with Richter Magnitude of 5.9 and 6.2 were measured on the Calaveras fault; the epicenters of the 1979 and 1984 earthquakes were located approximately 66 and 52 miles southeast of the site, respectively. In addition, numerous earthquakes of magnitude 4.0 or greater have been recorded throughout the Bay Area along all three of these faults.

The most significant seismic event to occur in the vicinity of the elementary school was the October 17, 1989 Loma Prieta earthquake. The distance from the rupture zone to the school is estimated at 59 miles. This magnitude 7.1 earthquake ruptured a 28 mile section of the San Andreas fault. Other significant earthquakes recorded on faults within 100 kilometers (approximately 65 miles) of the site include the following:

Fault System Generating Earthquake	Approximate Earthquake Magnitude (Richter)	Distance of Epicenter From Site (miles)	Date of Occurrence
San Andreas	6.3	Unknown	1865
Antioch	6.0	Unknown	1889
Midland	6.2±	Unknown	1892
Concord	5.4	18 NE	1955
San Andreas	5.3	16 SW	1957
Greenville/ Mt. Diablo	5.2 - 5.8	26 E	1980
Calaveras	5.3	28 SE	1986

Maximum credible and probable values for earthquake magnitudes and resulting maximum credible and probable bedrock accelerations for most of the above mentioned major faults are presented below. We should note that this data is based on the limited information available and state-of-the-art techniques for predicting heretofore unrecorded events. The information presented below was derived from historical information in conjunction with analytical techniques considering the length of causative fault and the distance of the site from the causative fault.

Fault System Generating Earthquake	Maximum Credible Earthquake, Richter Mag.	Maximum Credible Bedrock Accel.(g's)	Maximum Probable Earthquake, Richter Mag.	Maximum Probable Bedrock Accel.(g's)
San Andreas	8.3	0.21	8.3	0.21
Hayward	7.6	0.57	7.0	0.53
Calaveras	7.4	0.32	6.5	0.21
Green Valley	7.0	0.11	*	*
Healdsburg-Rodgers Creek	7.0	0.18	5.7	0.06
Seal Cove	6.8	0.22	*	*
Concord	6.7	0.21	6.0	0.15
Antioch	6.6	0.10	6.0	0.05
Greenville/Mount Diablo	7.0	0.20	6.5	0.13

* Insufficient data available

In addition, we should note that publications of the California Division of Mines and Geology indicate that the site is in a region which experienced earthquake intensities of VI, VII or VIII (Modified Mercalli Intensity Scale) at least 16 times since 1810. To explain the Modified Mercalli Intensity Scale and to correlate intensities on this scale with Richter magnitudes, we have attached Table 1 and Figure 5 to this report. Table 1 presents a scale of intensity of shaking (Modified Mercalli) that can be expected during an earthquake. Figure 5 presents a very idealized and simplified relationship between the size (Richter Magnitude) of an earthquake and observed intensity of shaking (Modified Mercalli) near the epicenter.

EVALUATION - GEOLOGIC HAZARDS STUDIES

Our studies included a review of the Seismic Safety Element of the Alameda County General Plan and the Seismic Safety Element for the City of Alameda as well as other sources. We should note that at least one moderate to severe earthquake will probably occur sometime during the design life of the facility. Geologic hazards in this region are typically more critical during strong earthquakes and can be divided into two general categories; fault offset hazard and shaking hazards. Detailed discussions of these hazards with respect to the site are presented below.

A. Fault Offset Hazard

Based on existing geologic information, there are no active faults that exist within the site. Therefore, the possibility of any hazard due to surface rupture or fault offset is considered remote.

B. Shaking Hazards

During a moderate to severe earthquake, strong ground shaking of the site will probably occur. Strong ground shaking not only can cause structures to shake, but it also has the capability of inducing other phenomena that can indirectly cause substantial damage to structures. These phenomena include soil liquefaction, seismically induced waves such as tsunamis and seiches, inundation due to dam or embankment failure, landsliding and other shaking hazards such as landsliding, lateral spreading, differential compaction and ground cracking. Detailed discussions of the hazards associated with strong ground shaking are presented below.

1. Soil Liquefaction

Soil liquefaction is a phenomenon in which a saturated cohesionless soil layer located relatively close to the ground surface loses strength during cyclic loading, such as imposed by a seismic event. During the loss of strength, the soil acquires a "mobility" sufficient to permit both horizontal and vertical movements. Soils that are most susceptible to liquefaction are clean, loose, saturated, uniformly graded, fine-grained sands that lie within 50 feet of the ground surface.

The materials encountered in our exploratory borings generally consist of loose sands from depths of about 5 to 9 feet and from depths of about 17 1/2 to 40 feet. The silt contents vary and the sand deposits are located below the ground water level and are therefore saturated. Based on our analyses, it is our opinion that the loose materials at the site have a high potential for liquefaction.

If the sands were to liquefy, densification would tend to occur and subsequently the ground surface would settle. The liquefaction induced settlements would occur shortly after the earthquake following the dissipation of excess water pressure. The pattern and distribution of settlements due to liquefaction and subsequent densification cannot be predicted, however, differential settlements on the order of 11 to 13 inches could occur following the maximum credible earthquake on the nearby Hayward fault.

2. Seismically Induced Waves

During a major earthquake, strong waves such as tsunamis or seiches can be generated in large bodies of water and can cause substantial damage to structures affected by them. The tsunami, or seismic sea wave, is an open ocean phenomenon caused by faulting, volcanism or other abrupt movement on the ocean floor often at considerable depth. The seiche is a wave which occurs in an enclosed basin as a result of fault displacement in the basin bottom, large landslides into the basin or from periodic oscillation or sloshing of the water in the basin.

Our evaluation of published data by the U. S. Geological Survey indicates that the site would not be affected by a very large tsunami arriving at the Golden Gate with a wave run-up of 20 feet. In addition, it is our opinion that the site will not be affected by a seiche traversing San Francisco Bay.

3. Inundation Due to Dam or Embankment Failure

There are no large lakes or reservoirs in the immediate vicinity of the site.

4. Flooding Hazards

The San Francisco Bay region periodically experiences damaging floods. The site should not be subject to a 100-year flood according to existing information. A 100-year flood is a flood that has probability of being exceeded once in 100 years, on the average, or a probability of 1 in 100 of being exceeded in any given year. Inundation resulting from ponding of locally heavy rainfall into depressions or low-lying, poorly-drained areas, is not considered.

5. Other Shaking Hazards

We have also considered the possibility of the occurrence of other seismic hazards including lateral spreading and ground cracking. Lateral spreading is considered unlikely because of the relatively level terrain. Ground cracking is a relatively unknown phenomenon, and, in our opinion, it can be caused by any of the phenomena discussed above. However, since most of the phenomena discussed above are considered unlikely, it is improbable that significant ground cracking will occur at the site.

We should note that ground shaking during an earthquake could cause objects within buildings that are not rigidly attached to the structure (such as desks and bookshelves) to undergo some differential movements with respect to the structure. The modular building construction should, therefore, include designs that minimize such potential differential movements and also minimize the adverse effects of such movements where they cannot be prevented.

CONCLUSIONS AND RECOMMENDATIONS

It is our opinion that the site is suitable for the proposed day care facility from a geotechnical engineering standpoint. The conclusions and recommendations presented in this report should be incorporated in the design and construction of the project to minimize possible soil and/or foundation related problems. The primary consideration for foundation design at the site is the potential for liquefaction settlements. In order to provide adequate and uniform support for the modular unit, and to provide the capability for relevelling after seismic related settlements, we recommend that the day care facility be supported on a heavily reinforced structural slab.

Special design considerations for utility connections should be utilized because of the potential differential settlement that could occur on the site. Detailed earthwork and foundation recommendations for use in design and construction of the project are presented below.

We recommend that our firm review the final design and specifications to check that the earthwork and foundation recommendations presented in this report have been properly interpreted and implemented in the design and specifications. We can assume no responsibility for misinterpretation of our recommendations if we do not review the plans and specifications.

A. Earthwork
1. Clearing and Site Preparation

The site should be cleared of all obstructions including asphalt concrete and associated baserock, designated underground utilities, fences and debris. Removed asphaltic concrete and baserock can be used as fill provided the asphalt concrete is broken up to meet the size requirements presented below under Item A.3, "Fill Material". Holes resulting from the removal of underground obstructions extending below the proposed finish grade should be cleared and backfilled with suitable material compacted to the requirements given below under Item A.4, "Compaction". We recommend backfilling operations for any excavations to remove deleterious material be carried out under the observation of the geotechnical engineer.

2. Subgrade Preparation

After the completion of clearing and stripping, soil exposed in areas to receive structural fill or structural slabs should be scarified to a depth of 6 inches, moisture conditioned to slightly above optimum water content and compacted to the requirements for structural fill.

3. Fill Material

On-site soil below the stripped layer and having an organic content of less than 3 percent by volume can be used as fill. All fill placed at the site including on-site soils should not contain rocks or lumps larger than 6 inches in greatest dimension with not more than 15 percent larger than 2.5 inches. In addition, any imported fill should be predominantly granular with a plasticity index of 12 or less.

4. Compaction

Structural fill should be compacted to at least 95 percent relative compaction as determined by ASTM Designation D1557-78. Fill material should be spread and compacted in lifts not exceeding 8 inches in uncompacted thickness.

5. Trench Backfill

Pipeline trenches should be backfilled with fill placed in lifts of approximately 8 inches in uncompacted thickness. However, thicker lifts can be used provided the method of compaction is approved by the geotechnical engineer and the required minimum degree of compaction is achieved.

If on-site soil or imported fill is used as trench backfill it should be compacted to at least 90 percent relative compaction by mechanical means only (no jetting will be allowed). Sufficient water should be added during backfilling operations to prevent the soil from "bulking" during compaction.

The upper 3 feet of trench backfill in slab areas should be compacted to at least 95 percent relative compaction for on-site soils or imported sand backfill.

6. Surface Drainage

Positive surface gradients should be provided adjacent to the day care facility to direct surface water away from foundations and slabs toward suitable discharge facilities. Ponding of surface water should not be allowed adjacent to the structure.

7. Construction During Wet Weather Conditions

If construction proceeds during or shortly after wet weather conditions, the moisture content of the on-site soils could be appreciably above optimum. Consequently, subgrade preparation, placement and/or reworking of on-site soil as structural fill might not be possible. Alternative wet weather construction recommendations can be provided by the geotechnical engineer in the field at the time of construction, if appropriate.

8. Guide Specifications

All earthwork should be performed in accordance with the Guide Specifications - Site Earthwork presented in Appendix C. These specifications are general in nature and the final specifications should incorporate all recommendations presented in this report.

B. Foundation Support
1. Structural Slab

We recommend that the modular day care facility be supported on a heavily reinforced structural slab. The recommended structural slabs should be designed as relatively rigid elements capable of mitigating the effects of the anticipated settlements. In addition, the structural slabs should be appropriately reinforced to provide relevelling capability. The slabs should be supported on properly prepared subgrade as described previously under Item A.2, "Subgrade Preparation".

Slabs should be designed to span a 20-foot diameter circle and the perimeter of the slab should be designed to cantilever a minimum of 5 feet. A minimum of two layers of steel (both top and bottom) should be provided. We recommend that we observe the structural slab excavations prior to placing reinforcing steel or concrete to check that the slabs will be founded on appropriate material.

The structural slab should be designed for an allowable bearing pressure of 550 pounds per square foot due to dead loads, 800 per square foot due to dead plus live loads and 1,050 pounds per square foot for all loads including wind or seismic.

2. Resistance to Lateral Loads

Lateral load resistance for the proposed modular unit can be developed by friction between the foundation bottom and the supporting subgrade. A friction coefficient of 0.40 is considered applicable. As an alternative, a passive resistance equal to an equivalent fluid weighing 400 pounds per cubic foot acting against the vertical face of the foundations could be used. If foundations are poured neat against the soil, the friction and passive resistance can be used in combination.

3. Special Consideration

As previously discussed, there is a potential for areal and differential settlements after a large seismic event. Therefore, we recommend that service connections for utility lines be flexible. We should note that pipelines designed for gravity flow may be disrupted after a seismic event.

C. Construction Observation

The analysis and recommendations submitted in this report are based in part upon the data obtained from the single soil boring. The nature and extent of variations of subsurface conditions may not become evident until construction. If variations then become apparent, it will be necessary to re-evaluate the recommendations of this report.

We recommend that our firm be retained to provide geotechnical services during site grading and foundation installation, to observe compliance with the design concepts, specifications and recommendations presented in this report. Our presence will also allow us to modify design if unanticipated subsurface conditions are encountered.

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TABLE 1
ABRIDGED MODIFIED MERCALLI INTENSITY SCALE

I. Detected only by sensitive instruments.

II. Felt by a few persons at rest, especially on upper floors; delicate suspended objects may swing.

III. Felt noticeably indoors, but not always recognized as a quake; standing autos rock slightly, vibration like passing truck.

IV. Felt indoors by many, outdoors by a few; at night some awaken; dishes, windows, doors disturbed; motor cars rock noticeably.

V. Felt by most people; some breakage of dishes, windows, and plaster; disturbance of tall objects.

VI. Felt by all; many are frightened and run outdoors; falling plaster and chimneys; damage small.

VII. Everybody runs outdoors; damage to buildings varies, depending on quality of construction; noticed by drivers of autos.

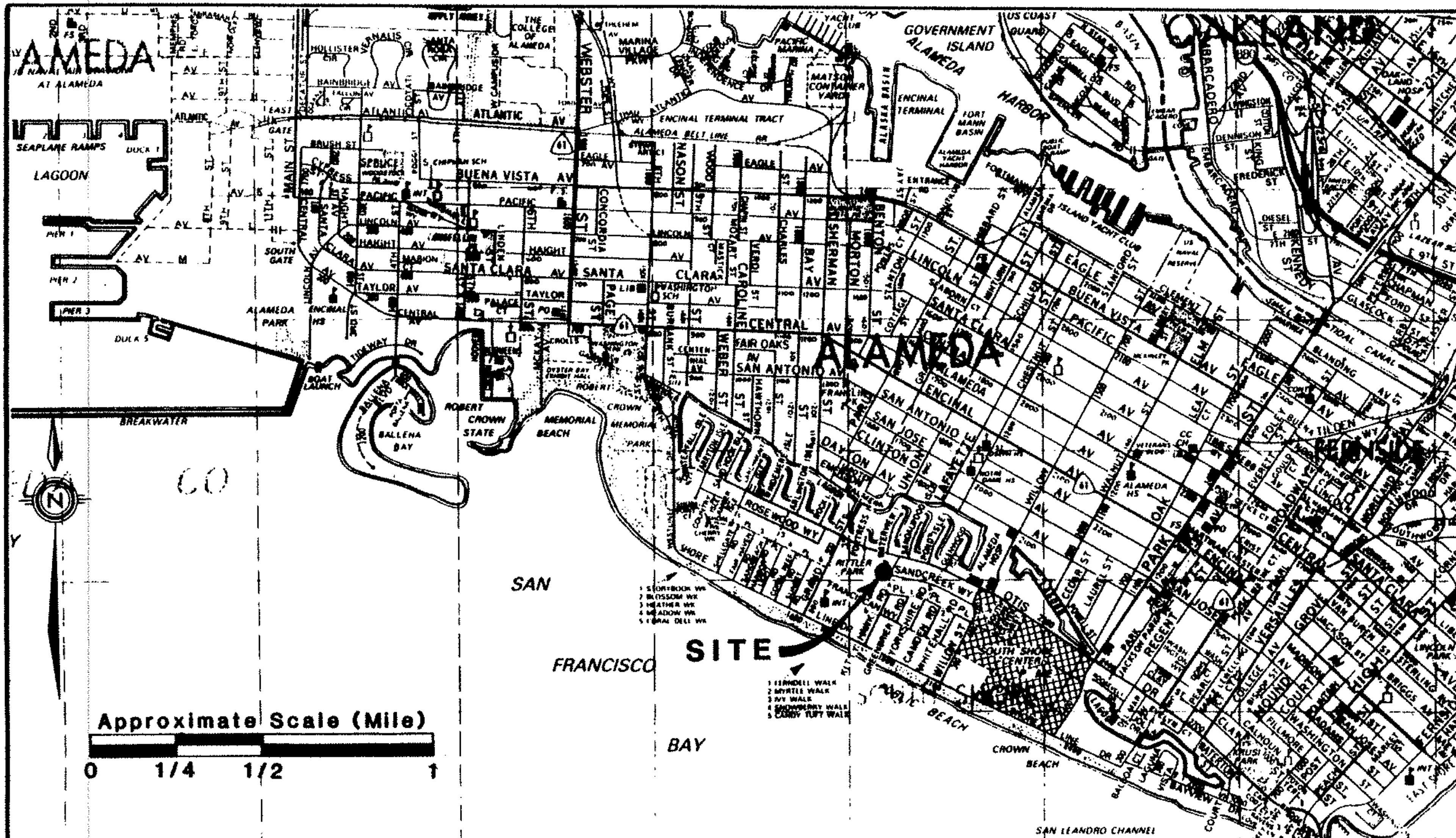
VIII. Panel walls thrown out of frames; fall of walls, monuments, chimneys; sand and mud ejected; drivers of autos disturbed.

IX. Buildings shifted off foundations, cracked, thrown out of plumb; ground cracked, underground pipes broken.

X. Most masonry and frame structures destroyed; ground cracked; rails bent; landslides.

XI. New structures remain standing; bridges destroyed; fissures in ground; pipes broken; landslides; rails bent.

XII. Damage total; waves seen on ground surface; lines sight and level distorted; objects thrown up into air.



Base: Thomas Brothers Map, Alameda County, 1990, Page 8 & 11.

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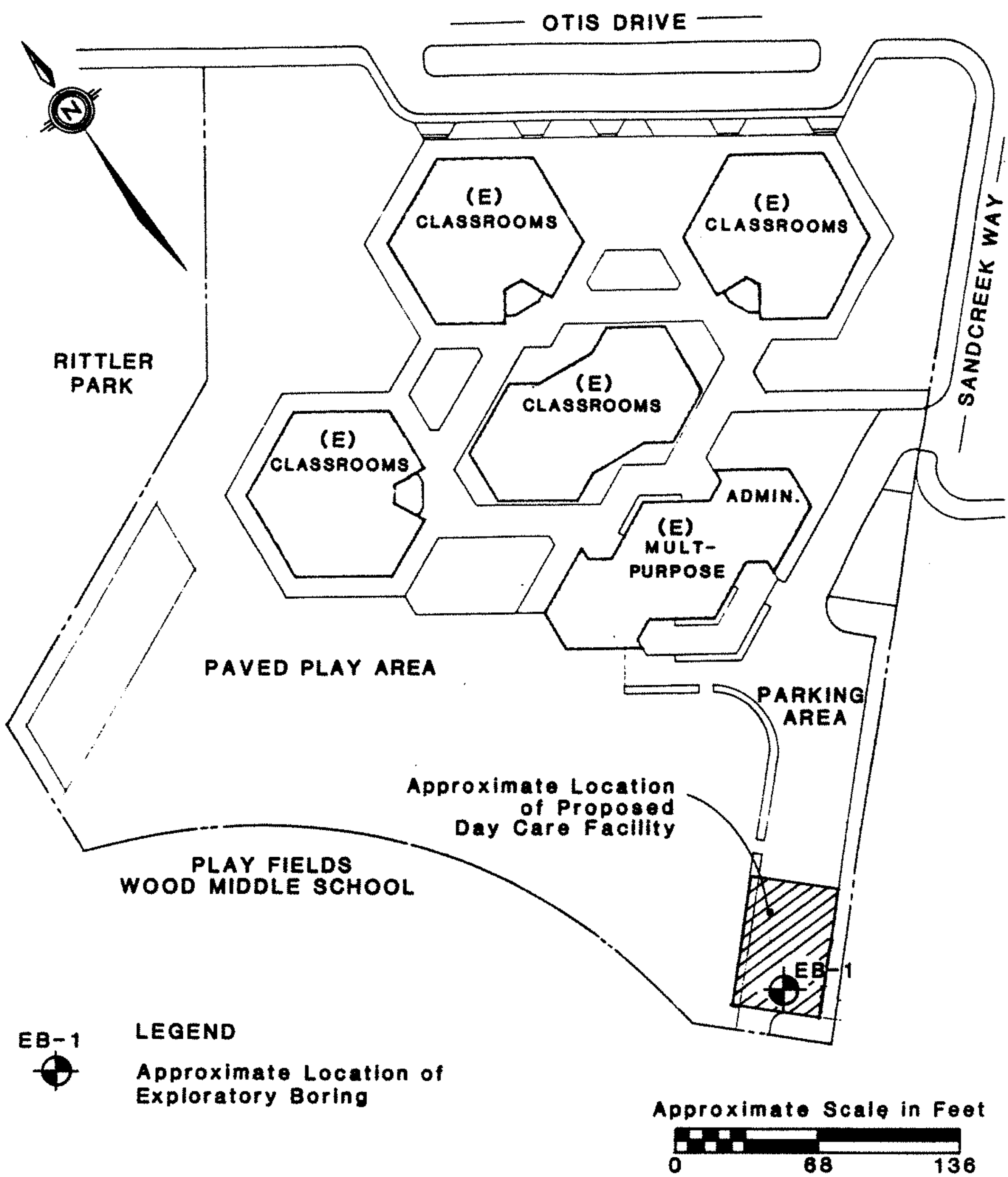
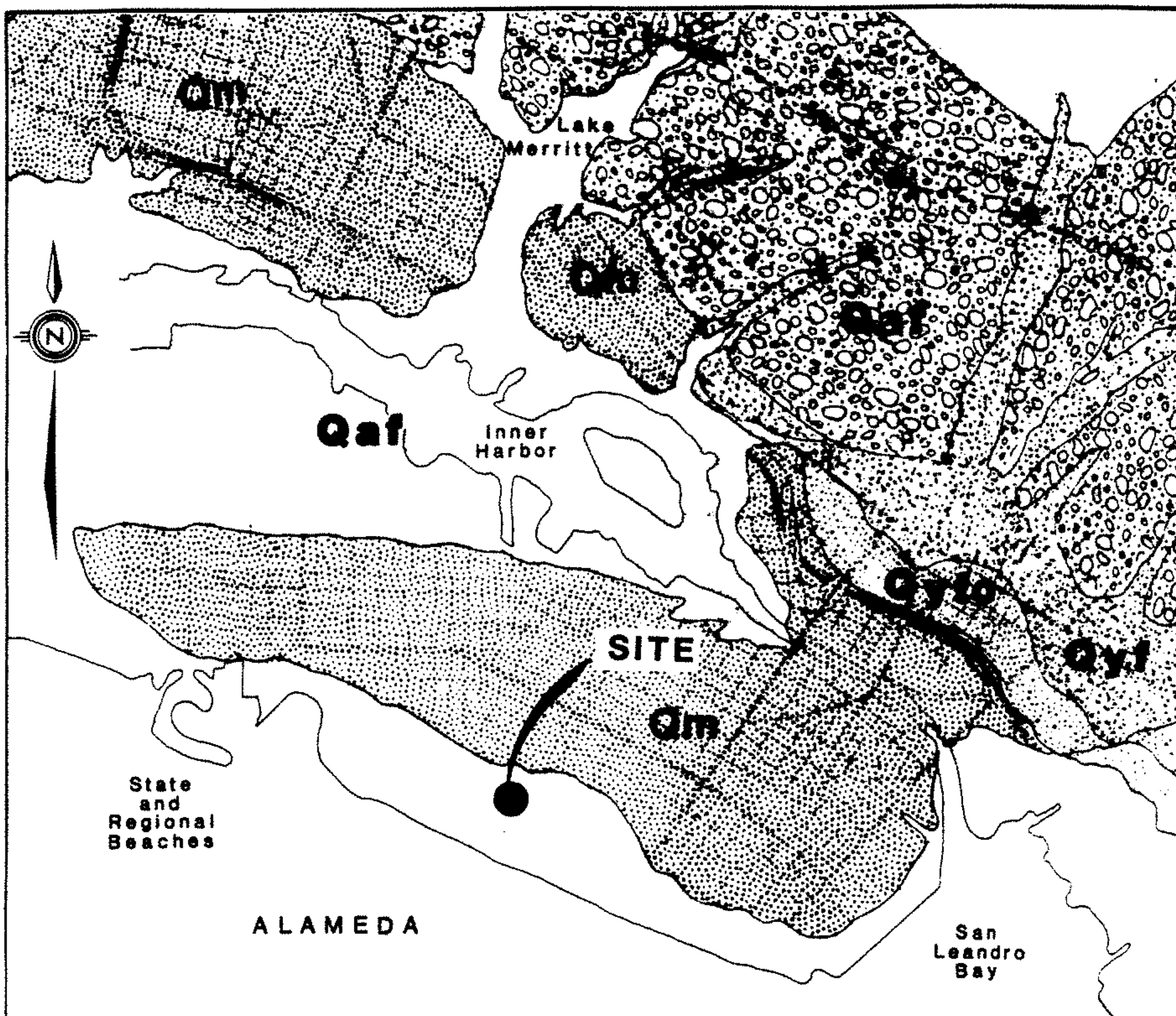
SITE LOCATION MAP		
DAY CARE FACILITIES: DONALD LUM ELEMENTARY SCHOOL Alameda, California		
PROJECT NO	DATE	Figure 1
K1191-8	March 1990	



Base: Site Plan Provided by Alameda Unified School District, Undated

Kaldveer Associates Geoscience Consultants A California Corporation	SITE PLAN		
	DAY CARE FACILITIES DONALD LUM ELEMENTARY SCHOOL Alameda, California		
	PROJECT NO.	DATE	Figure 2
	K1191-8	March 1990	



LEGEND

Qm	Pleistocene Merritt Sand
Qaf	Artificial Fill
Qb	Quaternary Deposit-Bay Mud
Qyf	Younger Alluvial Fan Deposits
Qyfo	Younger Fluvial Deposits

Approximate Scale in Miles

0 1/2 1 2

Base: U.S. Geological Survey, San Francisco Bay Region, Map MF-709.

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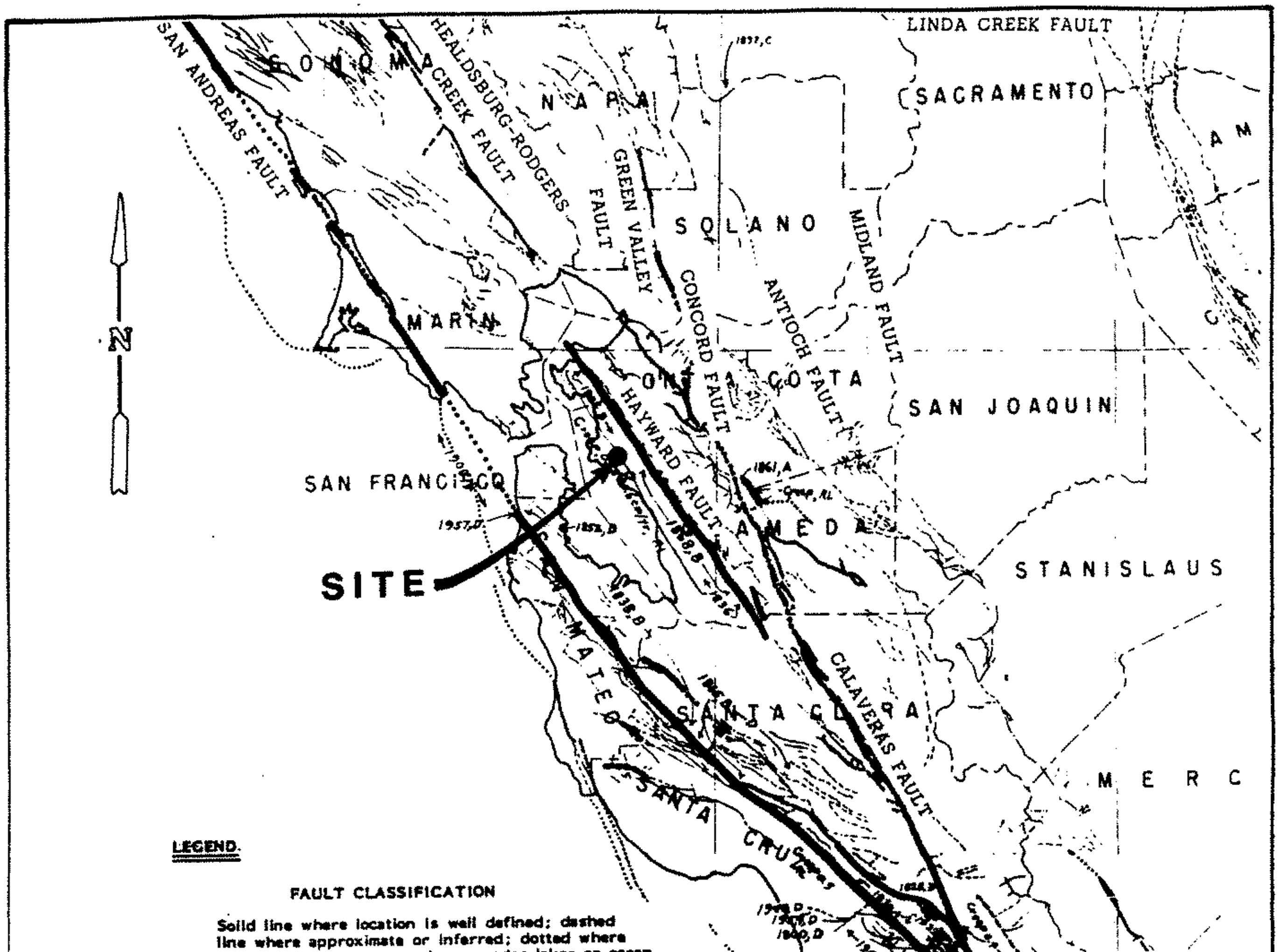
REGIONAL GEOLOGIC MAP

DAY CARE FACILITIES
DONALD LUM ELEMENTARY SCHOOL
Alameda, California

PROJECT NO.	DATE	
K1191-8	March 1990	Figure 3



APPROXIMATE SCALE (miles)

0 10 20 30 40 50

LEGEND

FAULT CLASSIFICATION

Solid line where location is well defined; dashed line where approximate or inferred; dotted where concealed by younger rocks or under lakes or ocean.

Historically active fault associated with one or more of the following:

a. a recorded earthquake with surface rupture (date of latest movement indicated)
b. tectonic creep - slow ground displacement usually without accompanying earthquakes
c. displaced surveyed lines
d. seismic activity - alignment of earthquake epicenters (including microearthquakes)

Quaternary displacement, without historic record. Recognized by displaced alluvium, terraces, or other Quaternary units; offset streams; alignment of sag ponds, trenches, or saddles. Includes concealed fault-controlled groundwater barriers or cascades in Quaternary sediments as indicated by well water data.

Fault without recognized Quaternary movement.

1967, A — Date of related earthquake and quality of documentation indicating surface effects - arrows indicate extent of reported effects.

A — Well-documented reports indicating surface faulting.

B — Poorly documented reports very likely indicating surface faulting.

C — Report indicating ground breakage probably closely related to known faults, indicating possible surface faulting.

D — Report indicating ground breakage not closely related to surface faulting but caused by earthquake shaking.

Creep 1.5 cm/yr.,N — Indicates areas where creep is presently being measured and the average rate where known.

RL = Horizontal Separation in a right-lateral sense.
LL = Horizontal separation in a left-lateral sense.
R = Vertical separation on a reverse or thrust fault.
N = Vertical separation on a normal fault.

Base: "Provisional Fault Map of California" updated 1972, California Division of Mines and Geology.

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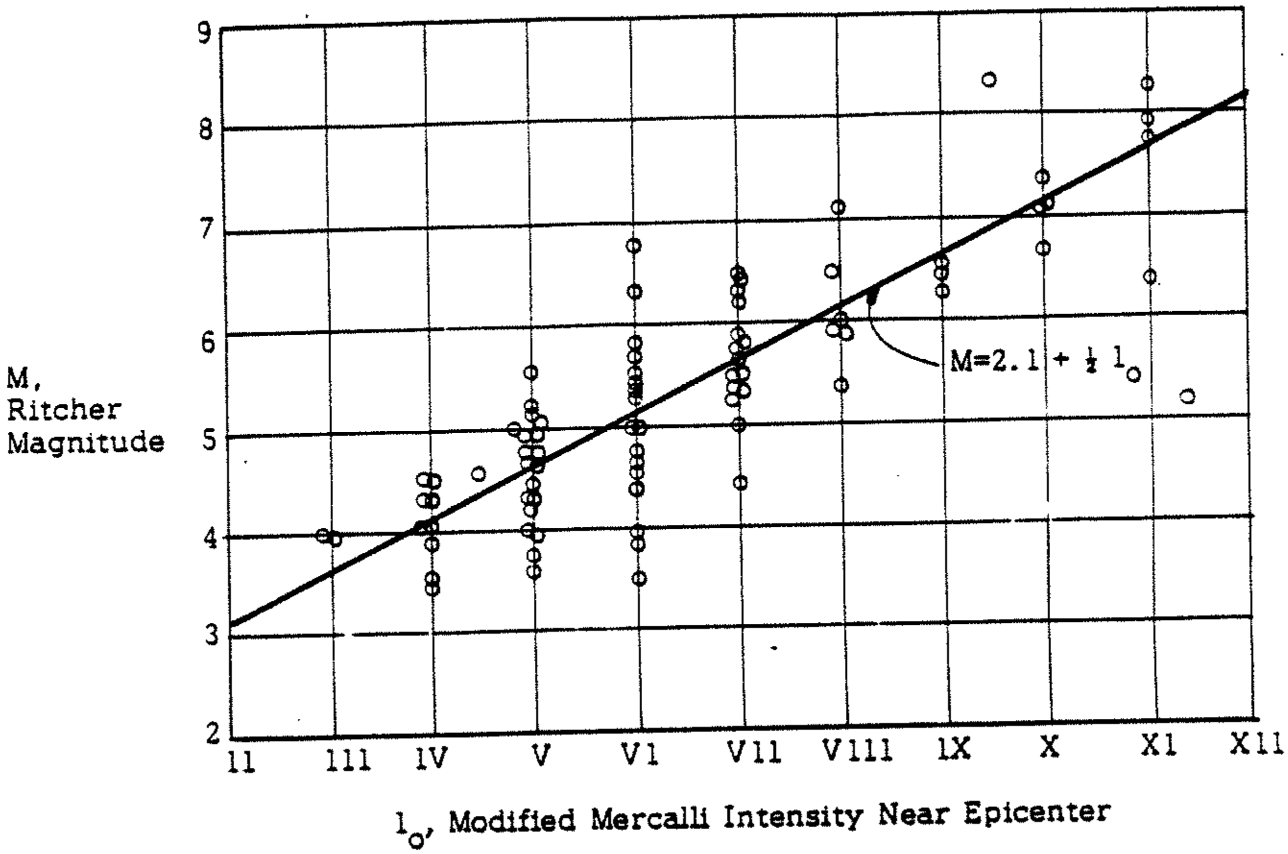
VICINITY AND FAULT LOCATION MAP

**DAY CARE FACILITIES:
DONALD LUM ELEMENTARY SCHOOL
Alameda, California**

PROJECT NO.	DATE	Figure 4
K1191-8	March 1990	



Notes:

(1) This figure is adapted from Krinitzsky and Chan (1975) and the equation shown relating M and I_o is proposed by these authors.

(2) All data points on this figure were recorded in the Western United States; this figure should only be considered representative of this area.

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RELATIONSHIP BETWEEN RICHTER MAGNITUDE AND MODIFIED MERCALLI INTENSITY

DAY CARE FACILITIES:
DONALD LUM ELEMENTARY SCHOOL
Alameda, California

PROJECT NO.	DATE	Figure 5
K1191-8	March 1990	

APPENDIX A - FIELD INVESTIGATION

The field investigation consisted of a surface reconnaissance and a subsurface exploration program using a trailer-mounted rotary wash drilling system equipped with a 6-inch diameter drill bit. One exploratory boring was drilled on March 2, 1990, to a maximum depth of 48-1/2 feet. The location of the exploratory boring is shown on the Site Plan, Figure 2. The soils encountered in the boring were continuously logged in the field by our representative. The soils are described in accordance with the Unified Soil Classification System (ASTM D-2487). The log of the boring as well as a key for the classification of the soil (Figure A-1) are included as part of this appendix.

Representative soil samples were obtained from the exploratory boring at selected depths appropriate to the soil investigation. Disturbed samples were obtained using the 2-inch O.D. split spoon sampler. All samples were transmitted to our laboratory for evaluation and appropriate testing. The sampler type is indicated in the "Sampler" column of the boring logs as designated below:

Split Spoon

Resistance blow counts were obtained with the samplers by dropping a 140-pound hammer through a 30-inch free fall. The sampler was driven 18 inches, and the number of blows were recorded for each 6 inches of penetration. The blows per foot recorded on the boring logs represent the accumulated number of blows that were required to drive the last 12 inches. When the split spoon sampler was used, these blow counts are the standard penetration resistance values.

The attached boring logs and related information show our interpretation of the subsurface conditions at the dates and locations indicated, and it is not warranted that they are representative of subsurface conditions at other locations and times.

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS — MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	SANDS — MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% 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	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS — LIQUID LIMIT IS 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 IS 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

DEFINITION OF TERMS

	U.S. STANDARD SERIES SIEVE: 200	40	10	4	CLEAR SQUARE SIEVE OPENINGS: 3/4"	3"	12"	
SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS	
	FINE	MEDIUM	COARSE	FINE	COARSE			

GRAIN SIZES

SANDS AND GRAVELS	BLOWS/FOOT†
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

RELATIVE DENSITY

SILTS AND CLAYS	STRENGTH‡	BLOWS/FOOT†
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

CONSISTENCY

† Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586).

‡ Unconfined compressive strength in tons/sq. ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586), pocket penetrometer, torvane, or visual observation.

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KEY TO EXPLORATORY BORING LOGS
Unified Soil Classification System (ASTM D-2487)

DAY CARE FACILITIES
DONALD LUM ELEMENTARY SCHOOL
Alameda, California

PROJECT NO.	DATE	Figure
K1191-8	March 1990	A-1

DRILL RIG	Rotary Wash	**SURFACE ELEVATION**	—	**LOGGED BY**	JD
DEPTH TO GROUNDWATER	See note 3	**BORING DIAMETER**	8 Inches	**DATE DRILLED**	3/2/90

DESCRIPTION AND CLASSIFICATION									
DESCRIPTION AND REMARKS	**COLOR**	**CONSIST.**	**SOIL TYPE**	**DEPTH (FEET)**	**SAMPLER**	**PENETRATION RESISTANCE (BLOWS/FT.)**	**WATER CONTENT (%)**	**DRY DENSITY (PCF)**	**UNCONFINED COMPRESSIVE STRENGTH (KSF)**
2" Asphalt over 8" Baserock				0–1					
SAND (fine-to-medium-grained), trace silt	brown	medium dense	SP	1–2	sample	24	7		
				3–4	sample	15	∇		
		loose		5–6	sample	6			
(grading silty) Passing #200 Sieve = 49%			SM-ML	7–8	sample	5			
		medium dense		9–10	sample	13	25		
(grading trace shells) (lens sand, fine-grained, some silt)				12–13	sample	15			
(FILL) ↑				14–15					
CLAY, silty, trace sand (fine-grained), some shells	blue-green	very soft	CL/CH	15–17					
SAND (fine-to-medium-grained), some silt, some shells Passing #200 Sieve = 29%	blue-green	loose	SM	17–18	sample	2			
				19–20					

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EXPLORATORY BORING LOG

DAY CARE FACILITIES
DONALD LUM ELEMENTARY SCHOOL
Alameda, California

PROJECT NO.	DATE	BORING NO.
K1191-8	March 1990	1

DRILL RIG Rotary Wash	SURFACE ELEVATION —	LOGGED BY JD
DEPTH TO GROUNDWATER See note 3	BORING DIAMETER 8 Inches	DATE DRILLED 3/2/90

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)
SAND (fine-to-medium-grained), some silt, some shells	blue-green	loose	SM	21					
				22–23	sample	5			
Passing #200 Sieve = 10% (grading with trace shells) (lens shells)				27–28	sample	5			
				32–33	sample	9	25		
(6" lenses of clay, silty) Passing #200 Sieve = 20%				37–38	sample	3			
	green	medium dense		39–40					

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EXPLORATORY BORING LOG

DAY CARE FACILITIES
DONALD LUM ELEMENTARY SCHOOL
Alameda, California

PROJECT NO.	DATE	BORING NO.
K1191-8	March 1990	1

DRILL RIG Rotary Wash	SURFACE ELEVATION —	LOGGED BY JD
DEPTH TO GROUNDWATER See note 3	BORING DIAMETER 8 Inches	DATE DRILLED 3/2/90

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)
SAND (fine-to-medium-grained), some silt, with shells	green	medium dense	SM	41					
				42–43	X	46	21		
				44–46					
		dense		47–48	X	70			
Bottom of Boring = 48½ Feet				49–60					

Notes:
1. The stratification lines represent the approximate boundaries between soil types and the transition may be gradual.
2. For an explanation of penetration resistance values marked with an asterisk (*) see first page, Appendix A.
3. Groundwater level was measured at 4 feet at time of drilling.

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EXPLORATORY BORING LOG

DAY CARE FACILITIES
DONALD LUM ELEMENTARY SCHOOL
Alameda, California

PROJECT NO.	DATE	BORING NO.
K1191-8	March 1990	1

APPENDIX B - LABORATORY INVESTIGATION

The laboratory testing program was directed toward a quantitative and qualitative evaluation of the physical and mechanical properties of the soils underlying the site.

The natural water content was determined on four samples of the materials recovered from the boring in accordance with ASTM Test Designation D-2216. These water contents are recorded on the boring logs at the appropriate sample depths.

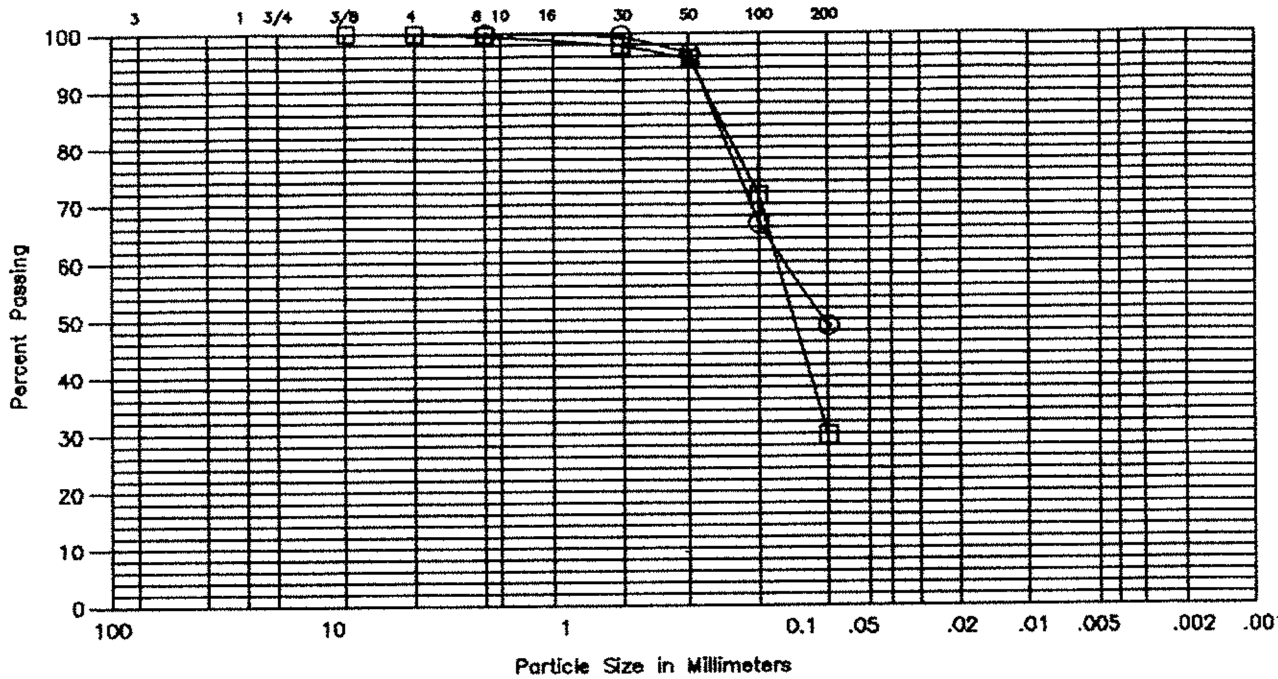
The percent passing the #200 sieve was determined on four samples of the subsurface soils to aid in the classification of these soils. These tests were performed in accordance with ASTM Designation D-1140. The results of these tests are shown on the boring logs at the appropriate sample depths.

Gradation tests were performed on two samples of the subsurface soils in accordance with California Test Method No. 202. These tests were performed to assist in the classification of the soils and to determine their grain size distribution. The results of these tests are presented on Figure B-1.

UNIFIED SOIL CLASSIFICATION SYSTEM

(ASTM D 422-72)

U.S. STANDARD SIEVE SIZES



gravel		sand			silt and clay
coarse	fine	coarse	medium	fine	

KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	ELEV. (feet)	UNIFIED SOIL CLASSIFICATION SYMBOL	SAMPLE DESCRIPTION
○	1	8	--	SC	Tan-Grey Silty Fine-Grained SAND
□	1	18	--	SC	Grey Fine-Grained SAND with Silt and Trace of Shells

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GRADATION TEST DATA		
DAY CARE FACILITIES DONALD LUM ELEMENTARY SCHOOL Alameda, California		
PROJECT NO	DATE	Figure B-1
K1191-8	March 1990	

APPENDIX C
GUIDE SPECIFICATIONS - SITE EARTHWORK
FOR
DAY CARE FACILITIES
DONALD LUM ELEMENTARY SCHOOL
ALAMEDA, CALIFORNIA

1. GENERAL

A. Scope of Work

These specifications and applicable plans pertain to and include all site earthwork including, but not limited to, the furnishing of all labor, tools, and equipment necessary for site clearing and stripping, disposal of excess materials, excavation, preparation of foundation materials for receiving fill, and placement and compaction of fill to the lines and grades shown on the project grading plans.

B. Performance

The Contractor warrants all work to be performed and all materials to be furnished under this contract against defects in materials or workmanship for a period of ____ year(s) from the date of written acceptance of the entire construction work by the Owner.

Upon written notice of any defect in materials or workmanship during said _____ year period, the Contractor shall, at the option of the Owner, repair or replace said defect and any damage to other work caused by or resulting from such defect without cost to the Owner. This shall not limit any rights of the Owner under the "acceptance and inspection" clause of this contract.

The Contractor shall be responsible for the satisfactory completion of all site earthwork in accordance with the project plans and specifications. This work shall be observed and tested by a representative of Kaldveer Associates, Inc., hereinafter known as the Geotechnical Engineer. Both the Geotechnical Engineer and the Architect/Engineer are the Owner's representatives. If the Contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory as determined by the Geotechnical Engineer and the Architect/Engineer. No deviation from the specifications shall be made except upon written approval of the Geotechnical Engineer or Architect/Engineer.

No site earthwork shall be performed without the physical presence or approval of the Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least twenty-four hours prior to commencement of any aspect of the site earthwork.

The Geotechnical Engineer shall be the Owner's representative to observe the grading operations during the site preparation work and the placement and compaction of fills. He shall make enough visits to the site to familiarize himself generally with the progress and quality of the work. He shall make a sufficient number of tests and/or observations to enable him to form an opinion regarding the adequacy of the site preparation, the acceptability of the fill material, and the extent to which the compaction of the fill, as placed, meets the specification requirements. Any fill that does not meet the specification requirements shall be removed and/or recompacted until the requirements are satisfied.

In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal work hours.

Any construction review of the Contractor's performance conducted by the Geotechnical Engineer is not intended to include review of the adequacy of the Contractor's safety measures in, on or near the construction site.

Upon completion of the construction work, the Contractor shall certify that all compacted fills and foundations are in place at the correct locations, have the correct dimensions, are plumb, and have been constructed in accordance with sound construction practice. In addition, he shall certify that the materials used are of the types, quantity and quality required by the plans and specifications.

C. Site and Foundation Conditions

The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the soil report titled,"Geologic Hazards and Geotechnical Investigation, Day Care Facility, Donald Lum Elementary School, Alameda, California", dated March 23, 1990. The Contractor shall not be relieved of liability under the contract for any loss sustained as a result of any variance between conditions indicated by or deduced from the soil report and the actual conditions encountered during the course of the work.

The Contractor shall, upon becoming aware of surface and/or subsurface conditions differing from those disclosed by the original soil investigation, promptly notify the Owner as to the nature and extent of the differing conditions, first verbally to permit verification of the conditions, and then in writing. No claim by the Contractor for any conditions differing from those anticipated in the plans and specifications and disclosed by the soil investigation will be allowed unless the Contractor has so notified the Owner, verbally and in writing, as required above, of such changed conditions.

D. Dust Control

The Contractor shall assume responsibility for the alleviation or prevention of any dust nuisance on or about the site or off-site borrow areas. The Contractor shall assume all liability, including court costs of codefendant, for all claims related to dust or windblown materials attributable to his work.

II. DEFINITION OF TERMS

STRUCTURAL FILL - All soil or soil-rock material placed at the site in order to raise grades or to backfill excavations, and upon which the Geotechnical Engineer has been sufficient tests and/or observations to enable him to issue a written statement that, in his opinion, the fill has been placed and compacted in accordance with the specification requirements.

ON-SITE MATERIAL - Material obtained from the required site excavations.

IMPORT MATERIAL - Material obtained from off-site borrow areas.

ASTM SPECIFICATIONS - The 1989 edition of the American Society for Testing and Materials Standards.

DEGREE OF COMPACTION - The ratio, expressed as a percentage, of the in-place dry density of the compacted fill material to the maximum dry density of the same material as determined by ASTM Test Designation D1557-78.

III. SITE PREPARATION

Clearing and Grubbing

The contractor shall accept the site in its present condition and shall remove from the area of the designated project earthwork all obstructions including asphaltic concrete and associated baserock, designated underground utilities, fences and any other matter determined by the Geotechnical Engineer to be deleterious. Such material shall become the property of the Contractor and shall be removed from the site. Holes resulting from the removal of underground obstructions that extend below finish grades shall be cleared and backfilled with structural fill.

IV. EXCAVATION

All excavations shall be performed to the lines and grades and within the tolerances specified on the project grading plans. All overexcavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the specifications. The Contractor shall assume full responsibility for the stability of all temporary construction slopes at the site.

V. SUBGRADE PREPARATION

Surfaces to receive compacted fill, and those on which concrete slabs will be constructed, shall be scarified to a minimum depth of 6 inches and compacted. All ruts, hummocks, or other uneven surface features shall be removed by surface grading prior to placement of any fill materials. All areas which are to receive fill material shall be approved by the Geotechnical Engineer prior to placement of any fill material.

VI. GENERAL REQUIREMENTS FOR FILL MATERIAL

All fill material must be approved by the Geotechnical Engineer. The material shall be a soil or soil-rock mixture which is free from organic matter or other deleterious substances. The fill material shall not contain rocks or rock fragments over 6 inches in greatest dimension and not more than 15 percent shall be over 2.5 inches in greatest dimension. On-site material having an organic content of less than 3 percent by volume is suitable for use as fill.

All imported fill material shall be non-expansive with a plasticity index of 12 or less.

VII. PLACING AND COMPACTING FILL MATERIAL

All structural fill shall be compacted by mechanical means to produce a minimum degree of compaction of 95 percent as determined by ASTM Test Designation D1557-78. Field density tests shall be performed in accordance with either ASTM Test Designation D1556-64 (Sand-Cone Method) or ASTM Test Designation D2922-81 and D3017-78 (Nuclear Probe Method). The locations and number of field density tests shall be determined by the Geotechnical Engineer. The results of these tests and compliance with these specifications shall be the basis upon which satisfactory completion of work shall be judged by the Geotechnical Engineer.

VIII. TRENCH BACKFILL

Pipeline trenches shall be backfilled with compacted structural fill placed in lifts not exceeding 8 inches of uncompacted thickness. If on-site soils or imported sands are used, the material shall be compacted by mechanical means to a minimum degree of compaction of 90 percent. Sufficient water shall be added during the trench backfilling operations to prevent the soil from bulking during compaction. In all building pad areas, the upper 3 feet of trench backfill shall be compacted to a minimum degree of compaction of 95 percent for on-site soils or imported sand backfill.

IX. TREATMENT AFTER COMPLETION OF EARTHWORK

After the earthwork operations have been completed and the Geotechnical Engineer has finished his observation of the work, no further earthwork operations shall be performed except with the approval of and under the observation of the Geotechnical Engineer.

It shall be the responsibility of the Contractor to prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.