# SID GEOTECHNICAL, INC.

**Soil Engineering, Geology, Environmental Engineering**

June 30, 1998

Project No. 980040-02

TO: The Forecast Group, LP
10670 Civic Center Drive
Rancho Cucamonga, California 91730

ATTENTION: Mr. Dorian Johnson

SUBJECT: Preliminary Soil Investigation Report, Westra Dairy, A 110± Acres Site, Eucalyptus and Cleveland Avenue, Ontario Area, California

In accordance with your authorization, SID Geotechnical, Inc. has conducted a preliminary soils investigation for the subject site. The accompanying report presents a summary of our findings, with conclusions and recommendations for single family residential development. An environmental/hazard waste assessment of the site was provided under separate cover on June 22, 1998.

A rough grading plan was not available at the time of this investigation. The approximate locations of our exploratory trenches for this work are plotted on a reduced copy of the provided boundary map prepared by L.D. King Engineers of, Ontario, California.

If you should have any questions regarding this report, please do not hesitate to call our office. We appreciate this opportunity to be of service.

Very truly yours,

SID GEOTECHNICAL, INC.

Haytham Nabilsi, GE 2375
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
HAYTHAM NABILSI
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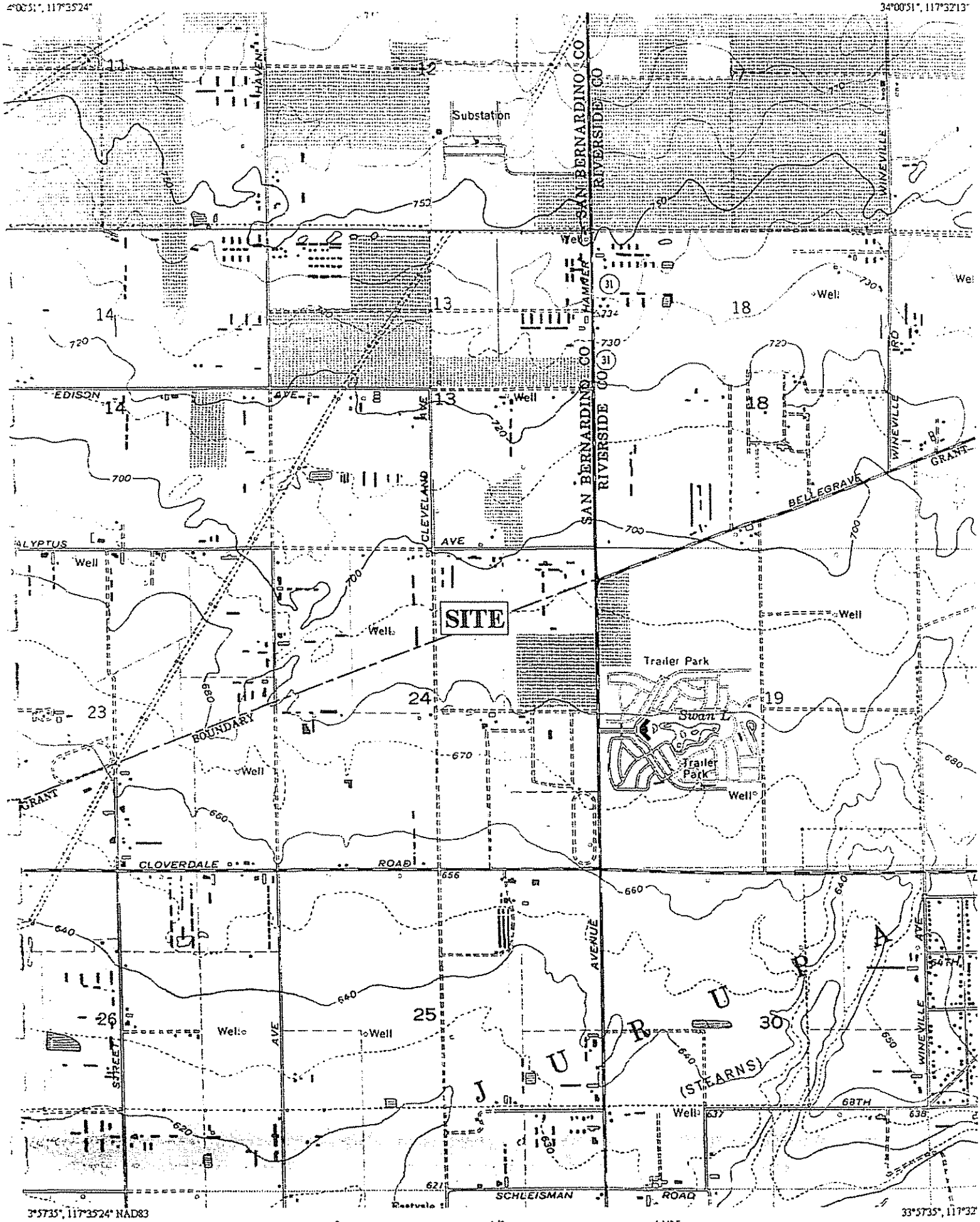

34°00'51", 117°35'24"
34°00'51", 117°32'13"
SITE
Substation
Well
Trailer Park
Swan L
SAN BERNARDINO CO
RIVERSIDE CO
HAVEN AVE
WINEVILLE RD
EDISON AVE
CLEVELAND AVE
BELLEGRAVE
GRANT
BOUNDARY
CLOVERDALE ROAD
AVENUE
(STEARNS)
68TH
SCHLEISMAN ROAD
33°57'35", 117°35'24" NAD83
33°57'35", 117°32'
1/2
1 MILE
1000 0 1000 2000 3000 4000 FEET

# INTRODUCTION AND SCOPE

The scope of our work included the following:

- Review soils data, maps, and reports pertinent to the site.
- Exploration of the site by means of 11 backhoe pits, upto to 11 feet deep, logging, sampling of select soils, observation for old fills, manure depth, caving condition, saturated soils, excavation characteristics, water seepage, etc.
- Laboratory testing of select soil samples to include moisture, density, maximum density, sieve analysis, and sand equivalent.
- Preparation of this report (3 bound copies) summarizing our findings, conclusions, and recommendations for site preparation, overexcavation/removal depth, allowable bearing, footings/slab-on-grade, depth/thickness, general grading specifications, and tentative pavement design. The report also includes seismicity of the site based on a computer search of known major faults within a 50 miles radius of the site.

# SUMMARY OF SITE CONDITIONS AND PROPOSED DEVELOPMENT

## *Site Conditions*

The subject property consists of a nearly rectangular shaped 110-acre parcel of land, which currently supports an active dairy farm. The property is located along Eucalyptus Avenue just west of Milliken/Hamner Avenue in the Ontario area of San Bernardino County, California. The southern most portion of the site is located within Riverside County, California. For site location refer to Figure 1, Site Location Map.

The subject property currently exists as a working dairy farm with appurtenant facilities such as fences, driveways, buildings, residences, and equipment. The majority of the southern site area is open land formerly used for agricultural crops in support of the dairy farm. Agricultural farming is no longer conducted at the property. The dairy processing and maintenance facilities, as well as residences, are located in the northern portion of the site, near Eucalyptus Avenue. Other related facilities include barns and covered storage areas.

Topographically, the site is generally flat with a gradient of less than two percent toward the south. Surface run-off is directed toward the south as sheet flow.

Three underground fuel storage tanks with associated pump dispensers were observed on-site. One tank and filling area is present in the northern part of the site near the entrance to the dairy along Eucalyptus Avenue. The other two tanks are located near the equipment maintenance/storage barn and are currently not used. Two above ground diesel storage tanks were also noted on the property. One is mounted on a concrete pad and is used in association with a diesel generator, the other is used to fill tractors and farm equipment.

Several water wells are present on-site and used for both domestic and irrigation supply.

Three separate residences were noted along the northern portion of the site. Two homes are present along the north side of Eucalyptus and one is located along the south side. These facilities include associated driveways and domestic storage.

The dairy processing facility is located in the north central portion of the site and includes equipment for the processing of cow milk.

## *Proposed Development*

We understand that the site will be developed for single family residential development. It is expected that the residences will be of light wood frame/stucco construction supported on shallow footings with concrete slabs-on-grade.

No plans were available during this site investigation, however, based on the flat nature of the site, minor cut and fill grading is anticipated.

# SUMMARY OF GEOTECHNICAL CONDITIONS

## *Subsurface Exploration*

Eleven exploratory trenches were excavated on June 29, 1998 to a maximum depth of 11 feet below existing ground surface utilizing a Case 580 backhoe equipped with a 24-inch bucket. The trench locations were selected at random accessible locations (see Exploratory Trench Location Map, Plate 1).

The earth materials are non-homogeneous and variable in texture and plasticity. The materials essentially consist of a mantle of organics and manure from zero to 12± inches thick and alluvial deposits. Isolated scattered thicker manure piles on the order of 1½ feet and large piles were also observed.

The materials noted in our trenches varied in classifications from sandy silt, silty sand, clayey sand, to sand. The materials vary in density/consistency from medium dense to loose. The sandy silt encountered was very moist. In the northern part of the site, silty sand was the predominant material in the upper five feet which was underlain by indurated clayey sand. In the central portion of the site sandy silt was predominantly exposed in the trenches with sand/gravel exposed only in trench T5 at nine feet below ground surface. In the southern portion of the site, the exposed material was scattered silty sand and clayey sand.

A descriptions of the materials are presented in the form of Geotechnical Trench Logs in Appendix B. According to the Generalized Maps by County of San Bernardino Planning Department, the subject site is underlain by alluvium on the order of 400 feet thick.

## *Windblown Sand*

The site is located within an area effected by blown sand during northerly windstorms. This should be considered during planning.

## *Laboratory Testing*

In order to determine the engineering properties of the underlying soils, laboratory tests were performed on selected samples obtained from the trenches. The tests consisted primarily of natural moisture contents, densities, sieve analysis, and maximum dry density/optimum moisture content. The soil classifications are in conformance with the Unified Soil Classifications System (USCS), as outlined in the Classification and Symbols Chart (Appendix B). A summary of our laboratory testing is presented in Appendix C.

## *Groundwater*

No groundwater was encountered within our exploratory trenches at the time this work was done. According to County of San Bernardino Generalized Maps, depth to groundwater may be on the order of 125 feet below ground surface. Perched zones may however exist above relatively impervious alluvial surfaces which may rise during winter rainfall season.

Water wells were noted on the property and are apparently used for irrigation and domestic purposes. Groundwater elevations could not be recorded from these wells during our site investigation. Groundwater data for site vicinity obtained from Western Municipal Water District regional well measuring program is as follows:

| WELL NO | ELEVATION | DEPTH TO WATER | WATER ELEVATION | DATE |
|---|---|---|---|---|
| 2S6W19E01S | 685 | 104.5 | 580.5 | 12/28/97 |
| 2S6W19E02S | 687.5 | 102 | 585.5 | 12/28/97 |
| 2S6W19E03S | -- | 102.9 | 584.6 | 12/2/97 |
| 2S7W24C | -- | 113.4 | -- | 6/29/96 |
| 2S7W24D | -- | 139.1 | -- | 10/28/94 |
| 2S7W24K | -- | 115.6 | -- | 5/31/94 |

***Flooding***

Based on generalized maps, the site is not located in 100-year flood zone as designated by FEMA. The potential for flooding should however be evaluated by the design civil engineer and considered in planning and development.

***Faulting/Seismicity***

The latest assessments of seismogenic fault sources generally include estimating the maximum credible earthquake (MCE) and the maximum probable earthquake (MPE). The California Division of Mines and Geology (CDMG Note No. 43) defines the MCE as the maximum earthquake that appears capable of occurring under the presently-known tectonic framework. The MPE has been defined as being the largest or maximum earthquake that is likely to occur during a 100-year interval and shall not be less than the maximum historical event.

A computer search of all known Quaternary major faults within 50 miles of the site is presented in Appendix D. The computer search was performed by EQFAULT program.

In EQFAULT, the "mean" represents the best-fit curve for the range of acceleration levels (the median value or the 50th percentile of data scattered about a regression curve). The "mean+1 sigma" (one standard deviation) encompasses 84 percent of the data about a regression curve.

The tables in Appendix D summarize the shortest distance to the causative faults, magnitude of the maximum credible and maximum probable earthquakes, and horizontal peak ground accelerations at the site.

It is probable that not all active or potentially active faults in the region have been identified. Furthermore, seismic potential of the smaller and less notable faults is not sufficiently developed for assignment of maximum credible and maximum probable magnitudes and associated levels of ground shaking that might occur at the site due to these faults.

***Seismically Induced Settlement***

Seismically induced settlement generally occurs within areas of loose soils with relatively low density. The possibility of seismically induced settlement within surficial soils cannot be entirely precluded.

***Secondary Seismic Hazards***

Considering the location, topography, subsurface conditions and absence of near by large bodies of water, tsunamis, seiches, landslides rock falls, and liquefaction are not a potential hazard for this site. Flash flooding and general flooding potential at the site should be evaluated by the design engineer and considered during planning and development.

# CONCLUSIONS

## *General*

Based on the results of our field investigation, laboratory testing, and our analysis, it is our opinion that the proposed development is feasible from a geotechnical standpoint, provided the recommendations presented in this report are incorporated fully into the design and construction of the project.

- Undocumented fills, existing structures, reservoirs, windmills foundations, remnants/foundations of old demolished structures, old foundations, buried structures and buried utilities/irrigation lines, leach lines, septic tanks, etc. associated with current site use may be encountered throughout the project area. Therefore, extensive demolition, site clearance, and efforts to locate and remove all subsurface obstructions should be an important consideration.

- The earth materials at the site vary considerably in classification, and moisture content/consistency. Overexcavation, thorough mixing, moisture conditioning, drying back, and recompaction would therefore be a consideration.

- The onsite soils exclusive of oversize rock (larger than 6-inches in diameter, if any) and deleterious materials may be used as compacted fill materials.

- It is anticipated that all earth materials can be excavated by conventional earthmoving equipment in good working condition. Based on the types of earth materials, the use of heavy sheepsfoot rollers may provide the best compaction results. Caving of excavations in sandy materials should be anticipated

- Based on soil classifications and laboratory testing, the expansion potential of the near-surface soils at the site is expected to be very low to low. This would require evaluation of individual pads subsequent to completion of rough grading.

- Subsequent to site preparation, the use of shallow spread footings appears feasible for the proposed construction.

- The site is expected to be subject to strong to severe ground shaking from regional seismic events within the projected life of the proposed.

- The potential for liquefaction of the onsite soils is considered to be low.

- Blowing sand should be anticipated during northerly windstorms. Considerations may be required for mitigating blown sand during construction, and providing ground cover upon completion.

# RECOMMENDATIONS

## *Site Preparation*

All grading should be performed in accordance with our General Earthwork and Grading Specifications presented in Appendix E except as modified within the text of this report. The site should be cleared of all vegetation, roots system, manure, underground structures, foundations, metal/plastic irrigation pipes, abandoned utilities, leach lines, septic tanks, and all other deleterious materials which should be hauled offsite.

Serious effort should be made during removal of existing concrete walks and slabs to locate and remove any underground utilities, leach lines, seepage pits, septic tanks, buried trash, manure, etc. Abandonment of water wells should be performed in accordance with the general guidelines presented on Plate 2 and/or requirements of the Counties.

Depressions resulting from clearing operations, should be backfilled in a controlled manner. Any underground storage tanks, if encountered, should be removed in accordance with the Counties requirements. Concrete irrigation pipes may be crushed in-place and incorporated in the compacted fills. Unreinforced concrete may be broken into pieces (smaller than 6-inches) and dispersed into compacted fills, however nesting must not be permitted.

## *Overexcavation and Alluvium Removals*

After site clearance as outlined above, areas extending at least five feet beyond building lines in plan should be overexcavated to a depth of at least four feet below existing ground or proposed grade, whichever is lower in elevation. Tree and vegetation roots should be traced and completely removed if encountered in bottom of the overexcavated areas. After overexcavation, the exposed surfaces should be further scarified to a depth of at least 12-inches, dried back or moisture conditioned and recompacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557-91 Test Method; prior to placement of fill. Deeper overexcavations specially to remove unsuitable saturated soils, remove existing deep structures or clean the bottom, may be required depending upon field observations of excavated bottoms by the soil engineer or his representative. The overexcavation criteria may be based on better than 85 percent relative compaction of the underlying natural soils evaluated by testing of excavated bottoms during grading. Street areas may be overexcavated and recompacted to a depth of 24 inches prior to placement of fills.

## *Compacted Fills/Imported Soils*

Any soil to be placed as fill, whether presently onsite, from adjacent borrow areas or import, should be approved by the soil engineer or his representative prior to their placement. All onsite soils to be used as fill should be cleansed of any roots, oversize rock, or other deleterious materials. Cobbles and boulders, larger than 6-inches in diameter should not be placed in the vicinity of foundations and utility lines trenches. All fills should be placed in 6- to -8 inch loose lifts, thoroughly watered, or aerated to near optimum moisture content, mixed and compacted to at least 90 percent relative compaction. This is relative to the maximum dry density determined by ASTM D1557-91 Test Method. Heavy vibratory equipment and sheepsfoot rollers may provide the best compactive efforts.

Onsite soils with organic content may be diluted by mixing with underlying clean soils and may be utilized in fills provided the organic content is less than five percent. The mix should be continuously sampled and tested during grading. Any imported soils should be sandy (preferably USCS "SM" or "SW", and very low to low in expansion potential) and approved by the soil engineer. Imported fill from adjacent areas or offsite should be subject to appropriate tests prior to importing operation. The soil engineer or his representative should observe the placement of all fill and take sufficient tests to monitor the moisture content and the uniformity and degree of compaction obtained.

***Cut/Fill Slopes***

In general, cut slopes and fill slopes should be designed at inclination of 2:1 (horizontal to vertical) or flatter. Fill slopes should be compacted to at least 90 percent of the maximum dry density; to the outer slope face. We recommend overfilling, compacting and trimming to grade for fill slope construction. It is recommended that all slopes be planted as soon as possible subsequent to construction.

***Building and Footing Setbacks***

Buildings located adjacent to the top of slopes, and walls footings; should be setback one-half the height of the slope. The setback, however need not exceed 15 feet with a minimum setback of 5 feet per guidelines of the Uniform Building Code. This distance should be measured horizontally from the firm face of the slope to the closest element of the structure. The footings may be deepened to achieve the setback, as recommended.

***Shrinkage and Subsidence***

We estimate that shrinkage of alluvium soils upon removal and recompaction should be approximately 10 (±5) percent. Shrinkage is defined as the decrease in volume of soil upon removal and recompaction expressed as a percentage of the in-place volume. This shrinkage is exclusive of any losses due to removal of tree roots, debris, manure or removal of any underground structures and is based on 90 percent relative compaction. An increase in relative compaction obtained would increase the shrinkage factor. Furthermore, a subsidence of approximately 0.20 (±0.05) feet may also be considered during site preparation. The above shrinkage and subsidence estimates should be used with caution since they are not absolute values. We recommend that an earthwork balance area should be designated to allow for variations in the indicated shrinkage and subsidence estimates.

***Tentative Foundation Design***

Following site preparation and grading in accordance with the recommendations presented herein, the use of shallow spread footings is feasible. An allowable bearing value of 1500 psf is recommended. This bearing value may be increased by one third for temporary (wind or seismic) loads. Reinforcement and other requirements are presented on Plate 3 and may be tentatively designed for low expansion category. Expansion potential of foundation soils should be tested at the conclusion of rough grading.

Slabs-on-grade should be at least 4 inches thick (nominal) and should be reinforced with at least No 3 bars at 24-inches on-center both ways (or equivalent), properly centered in mid thickness of slabs. Slab reinforcement should be supported on concrete spacers for proper positioning at mid thickness. Slabs-on-grade should be provided with a 6-mil Visqueen moisture barrier properly protected with at least one inch of clean sand above the Visqueen and two inches of compacted clean sand below the Visqueen. Other recommendations are presented on Plate 3. Additional or heavier reinforcement than indicated above may be required by structural considerations and should be determined by the structural design engineer.

All concrete flat work including slabs subgrade should be compacted to at least 90 percent of the maximum dry density. Excess soils generated from foundation excavations should not be placed on building pads without proper moisture and compaction and should be verified to contain near optimum moisture content to a depth of 12 inches prior to placement of slab building materials. Moisture content should be tested in the field by the soil engineer.

The potential for slab cracking may be lessened by the addition of fiber mesh in the concrete, and careful control of water/cement ratios. In hot or windy weather, the contractor must take appropriate curing precautions after the placement of concrete.

The use of low slump mechanically compacted concrete (approximately 4 inches at the time of placement) is recommended.

***Lateral Earth Pressures/Walls Below Grade***

The following lateral earth pressures and soil parameters in conjunction with the above recommended bearing value (1500 psf), may be used for design of retaining walls with free draining level compacted backfills. If passive earth pressure and friction are combined to provide required resistance to lateral forces, the value of the passive pressure should be reduced to two-thirds of the following recommendations.

| | |
|---|---|
| • Active Earth Pressure with level backfill ($P_a$) | 30 psf (EFP), drained, yielding |
| • Active Earth Pressure, 2:1 ascending slope | 45 psf (EFP), drained, yielding |
| • At Rest Pressure ($P_0$) | 45 psf (EFP), drained, non-yielding (part of building wall) |
| • Passive Earth Pressure($P_p$) | 250 psf (EFP), drained,maximum of 2500 psf |
| • Horizontal Coefficient of Friction ($\mu$) | 0.35 |
| • Unit Soil Weight ($\gamma_t$) | 110 pcf |

All retaining walls and block walls footings should be founded in compacted fill or firm native soils. We recommend drainage for retaining walls to be provided in accordance with Plate 4 of this report. Maximum precautions should be taken when placing drainage materials and during backfilling. All wall backfills should be properly compacted to at least 90 percent relative compaction.

***Surface Drainage***

The surface of all lots should be graded to provide positive drainage away from structures. Drainage should be directed to established swales and then to appropriate drainage structures to minimize the possibility of serious erosion. Surface drainage must be directed and maintained away from the foundations and slopes. Water, either natural or by irrigation, should not be permitted to run over slopes or to pond/saturate the surface soils.

***Cement Type/Corrosion Potential***

We recommend Type II cement for all concrete work in contact with soil. Ferrous metal pipes should be protected from potential corrosion by bituminous coating, etc.. We recommend that all utility pipes be nonmetallic and/or corrosion resistant. Considering the use of the site as a major dairy operation, the corrosion potential of the soils related to concrete and metal, should be evaluated by a qualified corrosion consultant.

***Seismic Considerations***

The site vicinity is located in Seismic Zone 4 (UBC 1997). Moderate to severe ground shaking can be expected at the site. The structural engineer should consider Counties codes, Uniform Building Code, seismic data presented in this report, the latest requirements of the Structural Engineers Association, and any other pertinent data in selecting design parameters.

***Shoring/Trench Backfill***

Trenches greater than four feet in depth should be shored or sloped at 1:1 (horizontal to vertical) or flatter in compliance with California OSHA requirements.

All utility trench and retaining wall backfills should be mechanically compacted to the minimum requirements of at least 90 percent relative compaction. Onsite soils derived from trench excavations can be used as trench backfill. Based on the sand equivalent test result of near surface soils backfills should be placed in thin lifts and compacted by mechanical means. No jetting, ponding, or flooding should be permitted within the building area or where trenches are in zone of influence of footing loads. Excavated material from footing trenches should not be placed in slab-on-grade areas unless properly compacted and tested.

***Erosion Control***

Once ground cover is removed, wind erosion can be expected to be a serious problem, in the event of strong north winds. We recommend that consideration be given to this aspect during all phases of development, with permanent solution, in the form of adequate ground cover and wind breaks, provided at the conclusion of construction.

***Tentative Pavement Design***

On the basis of classifications of onsite soils, the tentative pavement design may be based on an R-value of about 35 or better, corresponding to the near surface silty sands and sands. A Traffic Index of 5.5 is assumed for interior low volume streets. Based on our experience in this area, the corresponding structural sections should consist of at least 0.3 foot of asphalt concrete over 0.5 foot of Class 2 aggregate base over compacted native subgrade. Minimum pavement thickness by the Counties may apply.

The upper at least 12 inches of pavement subgrade should be scarified, watered as necessary and compacted to at least 90 percent relative compaction per maximum dry density determined by ASTM D1557-91. The base should be compacted to at least 95 percent relative compaction. All subgrade and base must be firm and unyielding prior to placement of asphalt concrete.

Final pavement design recommendations should be based on R-value tests of representative pavement subgrade soils upon the completion of rough grading and Traffic Indices provided by the Counties (pavement thickness will increase if the R-value of subgrade soils drops below 35).

***Rough Grading Plan Review***

The recommendations provided in this report are based on preliminary design information and subsurface conditions as interpreted from limited exploratory trenches at the site. SID Geotechnical, Inc. should review the rough grading plans prior to start of earthwork and construction. Drilling of a few deep borings and consolidation tests to further evaluate the depth of alluvium removals should also be considered. Our preliminary conclusions and recommendations therefore will be reviewed and monitored during site grading, and revised accordingly if exposed geotechnical conditions vary from our preliminary findings and interpretations.

***Additional Observation and/or Testing***

SID Geotechnical, Inc. should observe and/or test at the following stages of construction.

- During site clearance and removal of any underground obstructions.
- During all overexcavations, fill placement, and compaction.
- Following footing excavations and prior to placement of footing materials.
- During all utility trench backfills, subgrade of streets, sidewalks, curb/gutter, and streets base compaction prior to paving.
- When any unusual conditions are encountered.

***Report of Field Density Testing During Grading***

A report of field density tests should be prepared subsequent to the completion of grading. The report should include a summary of work performed, laboratory test results, and the results and locations of field density tests performed during grading.

# LIMITATION OF INVESTIGATION

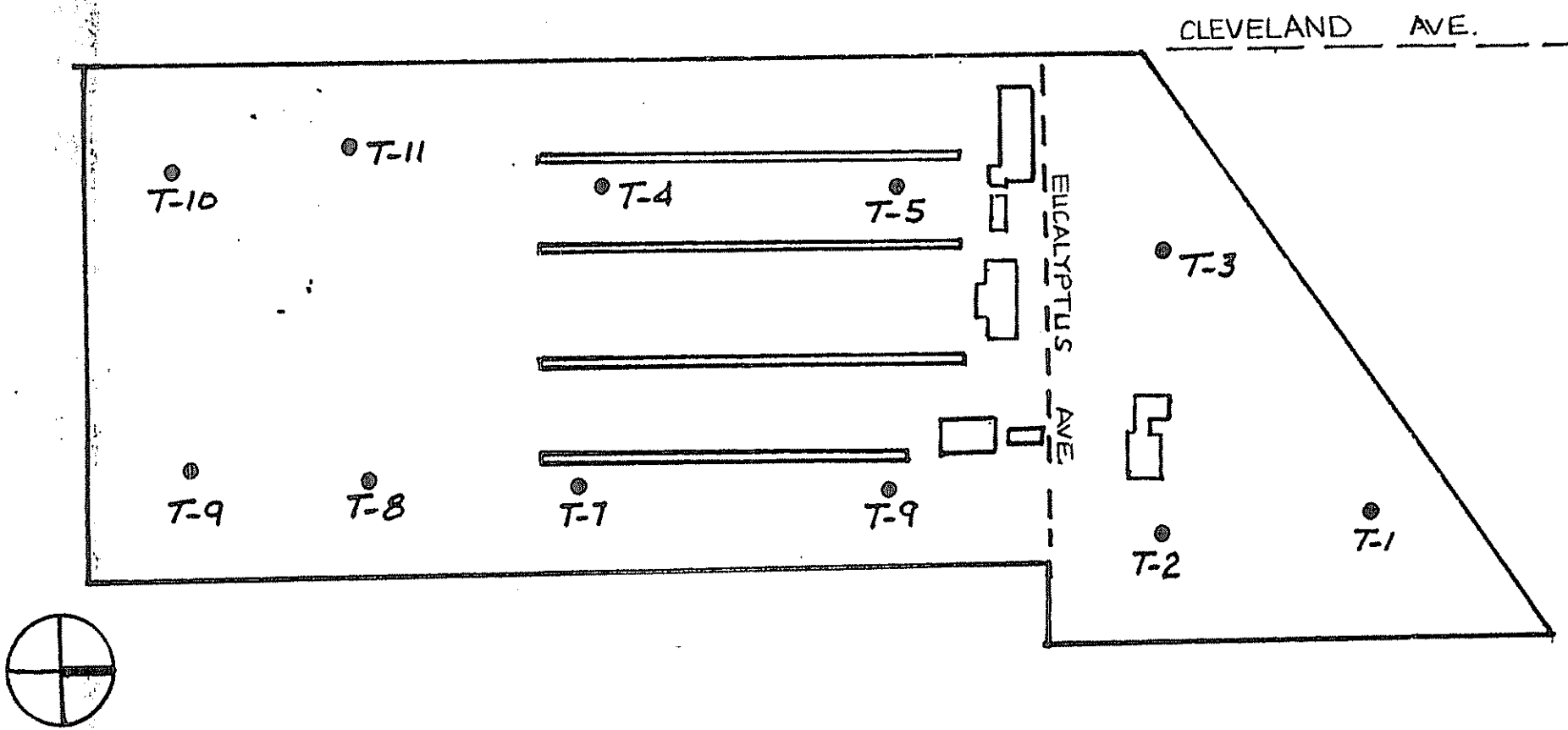
Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers practicing in this or similar locations. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

The test pits, field and laboratory test data are believed representative of the project site; however, soil conditions can vary significantly between test pits. As in most major projects, conditions revealed by excavation may be at variance with preliminary findings. If this condition occurs, the possible variations must be evaluated by the Project Geotechnical Engineer and designs adjusted as required or alternate design recommended.

This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractor carry out such recommendations in the field.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for other than our own personnel on the site; therefore, the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein to be unsafe.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In additions, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge.




T-11 Approximate Location of Exploratory Trench

WESTRA DAIRY, 110± ACRES
ONTARIO AREA, CALIFORNIA

Project No 980040-02
Date 6/30/98
Plate No 1

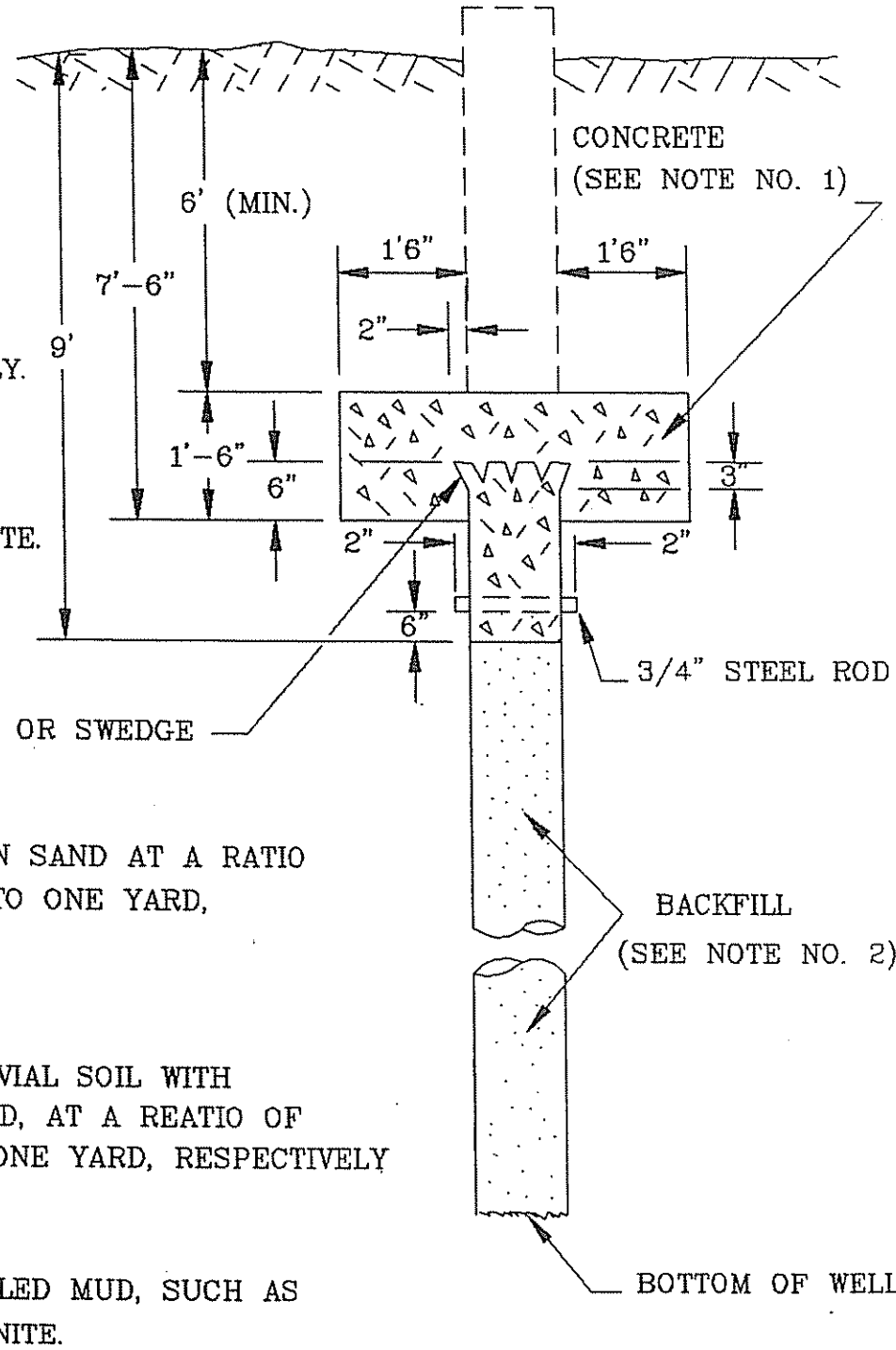
SID GEOTECHNICAL, INC.

NOTE NO. 1: USE:

CEMENT, SAND, AND ROCK IN A 1:3:4 RATIO, RESPECTIVELY.

OR

2000 PSI/28-DAY READY-MIX CONCRETE.




NOTE NO. 2: USE:

CEMENT AND CLEAN SAND AT A RATIO OF THREE SACKS TO ONE YARD, RESPECTIVELY

OR

CEMENT AND ALLUVIAL SOIL WITH LITTLE OR NO SAND, AT A REATIO OF THREE SACKS TO ONE YARD, RESPECTIVELY

OR

CLEAN, WELL PUDDLED MUD, SUCH AS ROTARY OR BENTONITE.

| SPECIFICATIONS FOR THE BACKFILLING OF ABANDONED WATER WELLS | PROJECT NO. 980040-02<br>PLATE NO. 2 |
|---|---|

## MUM FOUNDATION AND SLAB RECOMMENDATIONS F XPANSIVE SOILS

### (ONE- AND TWO- STORY RESIDENTIAL BUILDINGS)

| | U.B.C. EXPANSION INDEX 0-20 VERY LOW EXPANSION | U.B.C. EXPANSION INDEX 21-50 LOW EXPANSION | U.B.C. EXPANSION INDEX 51-90 MEDIUM EXPANSION | U.B.C EXPANSION INDEX 91-130 HIGH EXPANSION |
|---|---|---|---|---|
| 1-Story Footings (See Note 1) | All footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom. | All footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom. | Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom. | Exterior footings 24" deep. Int footings 18" deep. Reinforcemer continuous footings: one No. 5 ba and bottom; alternately, two No. 4 top, two No. 4 bars bottom. |
| 2-Story Footings (See Note 1) | Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom | Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom. | Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom. | Exterior footings 24" deep. Int footings 18" deep. Reinforcemer continuous footings: one No. 5 ba and bottom; alternately, two No. 4 top, two No. 4 bars bottom. |
| Minimum Footing Width | Continuous: 12" for 1-story. Continuous: 15" for 2-story. Isolated column: 24" | Continuous: 12" for 1-story. Continuous: 15" for 2-story. Isolated column: 24". | Continuous: 12" for 1-story. Continuous: 15" for 2-story. Isolated column: 24" | Continuous: 12" for 1-story. Continu 15" for 2-story. Isolated column: 2 |
| Garage Door Grade Seam (See Note 2 | A grade beam 12" wide x 12" deep (18" deep for 2-story) should be provided across the garage entrance. | A grade beam 12" wide by 12" deep (18" deep for 2-story) should be provided across the garage entrance. | A grade beam 12" wide x 18" deep should be provided across the garage entrance. | A grade beam 12" wide x 24" d should be provided across the ga entrance. |
| Living Area Floor Slabs (See Notes 3, 4 and 5) | Nominal 4" thick slab. 6x6 - 10/10 WWF reinforcement at mid-height. 6-mil Visqueen moisture barrier on pad grade with 1" sand above Visqueen. | Nominal 4" thick slab. 6x6 - 10/10 WWF reinforcement at mid-height. 6-mil Visqueen moisture barrier above 2" sand base with 1" sand above Visqueen. | Nominal 4" thick slab. 6x6 - 6/6 WWF reinforcement at mid-height. 6-mil Visqueen moisture barrier above 3" sand base with 1" sand above Visqueen. | Full 4" thick slab. 6x6 - 6/6 W reinforcement at mid-height. 6 Visqueen moisture barrier above 4" s base with 1" sand above Visqueen. |
| Garage Floor Slabs (See Notes 4 and 6 | Nominal 4" thick slab on pad grade. Garage slabs should be quarter-sawn. | Nominal 4" thick slab on 2" sand base. Garage slabs should be quarter-sawn. | Nominal 4" thick slab on 3" sand base. Garage should be quarter-sawn or reinforced with 6x6 -10/10 WWF at mid-height. | Nominal 4" thick slab on 4" sand b Garage slabs should be quarter-s and reinforced with 6x6 - 6/6 WW mid-height. |
| Presoaking of Living Area and Garage Slabs | Near-optimum to a depth of 8". | (1.2) x optimum to a depth of 12". | (1.3) x optimum to a depth of 18".* | (1.4) x optimum to a depth of 24".* |

*Presoaking of living areas and garage slabs in lots with medium expansion and high expansion potential should be observed and tested

NOTES:

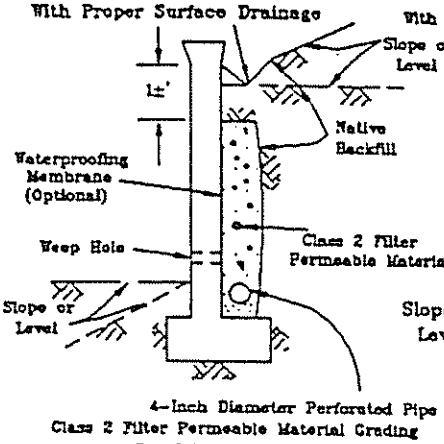
1. Depth of interior or exterior footings to be measured from lowest adjacent finish grade.
2. The base of the grade beam should be at the same elevation as that of the adjoining footings.
3. Living areas slabs may be tied to the footings as directed by the structural engineer. For HIGH EXPANSION: Dowels consis of No. 3 bars should be placed at 36 inches on centers in the footings and bent 3 feet into the slab.
4. It has been observed that welded wire fabric reinforcement seldom stays at the design height within concrete slabs. We recom the use of No. 3 bars at 24 inches O.C. instead of 6x6 - 10/10 WWF and No. 3 bars at 18 inches O.C. instead of 6x6 - 6/6 W
5. 6-mil Visqueen sheeting has proved successful. Equivalents are acceptable.
6. Garage slabs should be isolated from stem wall footings with a minimum 3/8" felt expansion joint.
7. Sand base should have a Sand Equivalent (SE) of 30 or greater (e.g., washed concrete sand).

Post-Tensioned Slabs

As an alternative to conventional foundations, building may be supported on post-tensioned slabs, to be designed by a struct engineer in consultation with the geotechnical consultant. In addition, a post-tensioned slab is also recommended for VERY expansion potential (Expansion Index greater than 130), if encountered. Post-tensioned slabs should have perimeter footings embe a minimum of 12 inches below the adjacent grade. The slabs should be designed such that they can be deformed approximately 1- vertically over a width of 30 feet without distress in the event of shrinkage or swelling of the supporting soils. Living area s should be underlain by a 6-mil Visqueen moisture barrier covered by a 1-inch layer of sand. Presoaking is recommended for p tensioned slabs: (1.2) x optimum to a depth of 12 inches, (1.3) x optimum to a depth of 18 inches, and (1.4) x optimum to a d of 24 inches for MEDIUM, HIGH and VERY HIGH expansion potential soils, respectively. Placement of 4 inches of sand base is suggested for post-tensioned slab systems.

## SUBDRAIN OPTIONS FOR NATIVE MATERIAL BACKFILL

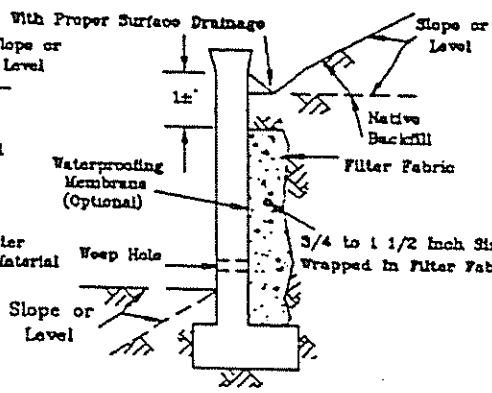
**OPTION N2: Pipe Surrounded with Class 2 Material**




Class 2 Filter Permeable Material Grading Per Caltran Specifications

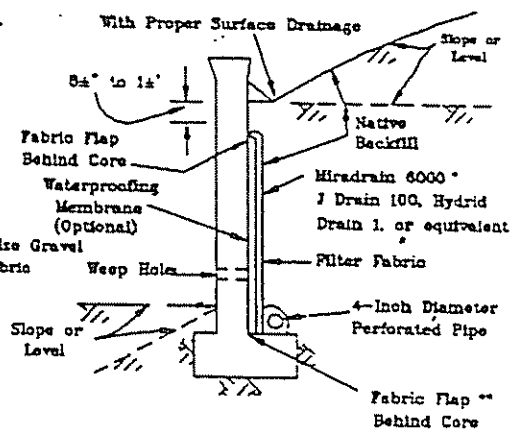
| Sieve Size | Percent Passing |
|---|---|
| 1" | 100 |
| 3/4" | 90–100 |
| 3/8" | 40–100 |
| No. 4 | 25–40 |
| No. 8 | 18–33 |
| No. 30 | 5–15 |
| No. 50 | 0–7 |
| No. 200 | 0–3 |

**OPTION N1: Gravel Wrapped in Filter Fabric**




Proper Outlet Should be Provided for Gravel Subdrain (See Notes)

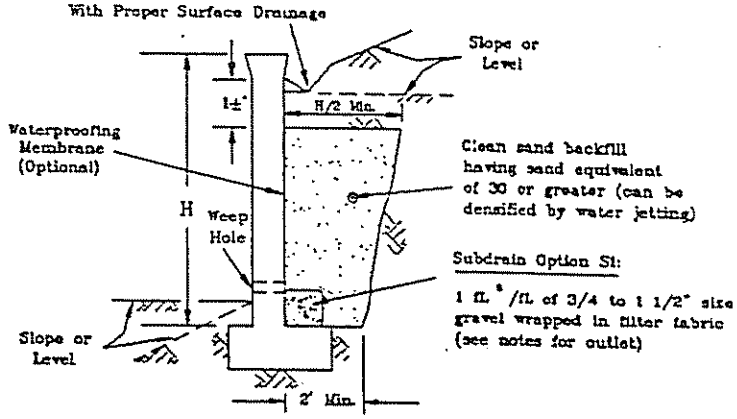
**OPTION N3: Geotextile Drain**




* Miradrain 6000 or J Drain 100 for non-waterproofed walls; Miradrain 6200 or J 200 for completed waterproofed walls

Peel back the bottom fabric flap, place pipe next to core, wrap fabric around pipe and tuck behind core.

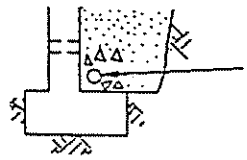
## SUBDRAIN OPTIONS FOR CLEAN SAND BACKFILL




Clean sand backfill having sand equivalent of 30 or greater (can be densified by water jetting)

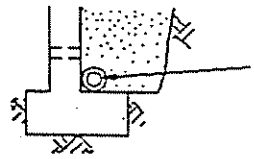
**Subdrain Option S1:**

1 ft.³/ft. of 3/4 to 1 1/2" size gravel wrapped in filter fabric (see notes for outlet)



**Subdrain Option S2:**

4" diameter perforated pipe surrounded with 1 ft.³/ft. of Class 2 filter material per Caltrans specifications as above



**Subdrain Option S3:**

4" diameter perforated pipe wrapped in filter fabric

Notes:

- Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down.
- Filter fabric should be Mirafi 140N, 140NS, Supac 4NP, Amoco 45-45, Trevira 1114, or approved equivalent. All drains should have a gradient of 1 percent minimum.
- Outlet portion for gravel subdrain should have a 4"-diameter pipe with the perforated portion inserted into the gravel approximately 2' minimum and the nonperforated portion extending approximately 1' outside the gravel. Proper sealing should be provided at the pipe insertion enabling water to run from the gravel portion into rather than outside the pipe.
- Waterproofing membrane may be required for a specific retaining wall such as a stucco or basement wall.
- Weephole should be 2" minimum diameter and provided at 25' minimum in length of wall. If exposure is permitted, weephole should be located at 3 above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to discharge through the curb face or equivalent should be provided, or for a basement-type wall, a proper subdrain outlet system should be provided. Open vertical masonry joints(i.e., omit mortar from joints of first course above finished grade)at 32' maximum intervals may be substituted for weepholes. Screening such as with a filter fabric should be provided for weepholes/open joints to prevent earth materials from entering the holes/joints.

# RETAINING WALL BACKFILL AND SUBDRAIN DETAIL

PROJECT NO. 980040-02

PLATE NO. 4

# APPENDIX A

# REFERENCES


- SID Geotechnical, Inc. "Preliminary Environmental Site Assessment Report (Phase I), 110± Acres, Eucalyptus and Cleveland Avenue, Ontario Area, California." Report Dated June 22, 1998, Project No 980040-01.
- L.D. King Engineers, Boundary Map, Printed on April 29, 1998.
- San Bernardino Planning Department, San Bernardino County Valley Planning Area, Generalized Map Showing Thickness of Alluvium, Map No 9.
- San Bernardino Planning Department, San Bernardino County Valley Planning Area, Generalized Map Showing Depth of Groundwater, Map No 10.
- Seismic Hazards Map, Riverside County, West Sheet, Plate IA, Envicom, September 1976.
- Safety Element Map, Riverside County, West Sheet, Plate IB, Envicom, September 1976.
- California Division of Mines and Geology, Special Report 113, Generalized Geologic Map of Southwestern of San Bernardino County, California, Series A, Plate A.
- California Division of Mines and Geology, Special Report 113, Map Showing Surface Water and Marches of Southwestern of San Bernardino County, California, Series A, Plate A.
- USGS, 1967, 7½ Min. Series, Corona North Quadrangle, 1967, Revised 1981.

# APPENDIX B

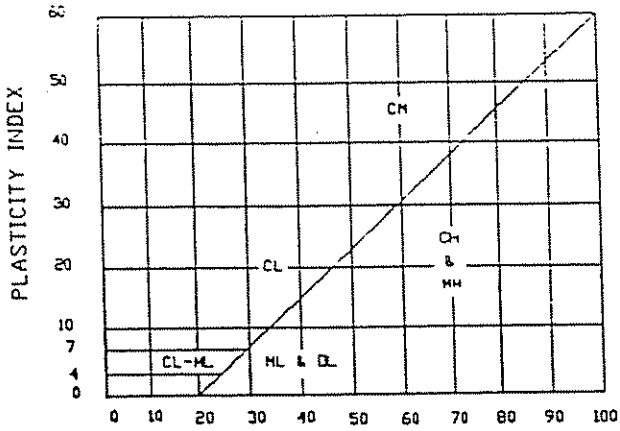
| MAJOR DIVISIONS | | SYMBOLS | TYPICAL NAMES |
|---|---|---|---|
| COARSE-GRAINED SOILS (More than 1/2 of soil < no. 200 sieve) | GRAVELS (More than 1/2 of coarse fraction > no. 4 sieve size) | GW | Well-graded gravels or gravel-sand mixtures, little or no fines |
| | | GP | Poorly graded gravels or gravel-sand mixtures, little or fines |
| | | GM | Silty gravels, gravel-sand-silt mixtures |
| | | GC | Clayey gravels, gravel-sand-clay mixtures |
| | SANDS (More than 1/2 of coarse fraction < no. 4 sieve size | SW | Well-graded sands or gravelly sands, little or no fines |
| | | SP | Poorly graded sands or gravelly sands, little or no fines |
| | | SM | Silty sands, sand-silt mixtures |
| | | SC | Clayey sands, sand-clay mixtures |
| FINE-GRAINED SOILS (More than 1/2 of soil < no. 200 sieve) | SILTS & CLAYS LL < 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 & CLAYS LL > 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 silty clays, organic silts |
| HIGHLY ORGANIC SOILS | | Pt | Peat and other highly organic soils |

## CLASSIFICATION CHART

(UNIFIED SOIL CLASSIFICATION SYSTEM)

| CLASSIFICATION | RANGE OF GRAIN SIZES | |
|---|---|---|
| | U.S. Standard Sieve Size | Grain Size in Millimeters |
| BOULDER | ABOVE 12" | ABOVE 305 |
| COBBLES | 12" to 3" | 305 TO 76.2 |
| GRAVEL | 3" to No. 4 | 76.2 to 4.76 |
| COARSE | 3" to 3/4" | 76.2 to 19.1 |
| FINE | 3/4" to No.4 | 19.1 to 4.76 |
| SAND | No. 4 to 200 | 4.76 to 0.074 |
| COARSE | No. 4 to 10 | 4.76 to 2.00 |
| MEDIUM | No. 10 to 40 | 2.00 to 0.420 |
| FINE | No. 40 to 200 | 0.420 to 0.074 |
| SILT & CLAY | BELOW No. 200 | BELOW 0.074 |

GRAIN SIZE CHART




PLASTICITY CHART

## METHOD OF SOIL CLASSIFICATION

Project No. : _____

Plate No. : _____

| | |
|---|---|
| | NO RECOVERY |
|  | RING SAMPLE |
|  | BAG SAMPLE |
|  | STANDARD PENETRATION TEST |
| (90) | RELATIVE COMPACTION |
| GS | GRAIN SIZE ANALYSIS |
| SE | SAND EQUIVALENT |
| CP | MAXIMUM DRY DENSITY/OPTIMUM MOISTURE |
| CN | CONSOLIDATION |
| DS | DIRECT SHEAR |
| RS | REMOLDED SHEAR |
| EI | EXPANSION INDEX |
| AL | ATTERBERG LIMITS |
|  | GROUND WATER |

- Classification in accordance with ASTM D2487 " Classification of Soils for Engineering Purposes"
- Description and visual identification in accordance with ASTM D2488 "Description and Identification of Soils (Visual/Manual Procedure).
- All Sieve sizes shown are US Standard.
- Refusal with the Standard Penetration Test is defined as one of the following:
  10 blows for no apparent advancement of the sampler; or
  50 blows for less than 6-inches advancement of the sampler; or
  100 blows for 6-inch to 18-inch advancement of the sampler.

# KEY FOR GEOTECHNICAL LOGS

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 1

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 711±

| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | | | SM | SILTY SAND: |
| 2 | | | 98 | 4 | | Medium brown, fine to coarse grained, dry. Rootlets in upper one foot. |
| 3 | | | | | | % Passing #200 = 27 |
| 4 | | | | | | Sand Equivalent = 36 |
| 5 | | GS SE | 102 | 7 | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | TOTAL DEPTH 11' |
| 13 | | | | | | NO GROUNDWATER |
| 14 | | | | | | TRENCH BACKFILLED |
| 15 | | | | | | |

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 2

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 706±

| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | | | SM | SILTY SAND: |
| 2 | | | 99 | 4 | | Tan brown, fine to coarse grained, dry. |
| 3 | | CP | | | | |
| 4 | | | 95 | 5 | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | SC | CLAYEY SAND: |
| 11 | | | | | | Tan brown, fine to coarse grained. |
| 12 | | | | | | TOTAL DEPTH 9' |
| 13 | | | | | | NO GROUNDWATER |
| 14 | | | | | | EASY EXCAVATION |
| 15 | | | | | | TRENCH BACKFILLED |

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 3

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 702±

| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | 97 | 5 | SM | SILTY SAND: Tan brown, fine to coarse grained. Rootlets in upper one foot. |
| 2 | | | | | | |
| 3 | | | 101 | 16 | | @ 3' becoming very moist. |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | SC | CLAYEY SAND: Brown, fine to coarse grained |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | TOTAL DEPTH 11' NO GROUND WATER TRENCH BACKFILLED |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 4

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 691±

| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | | | ML | SANDY SILT: |
| 2 | | CP | 97 | 14 | | Tan gray, fine to medium grained, moist. |
| 3 | | | | | | Manure in upper one foot, |
| 4 | | | 91 | 17 | | and piles of manure to 1½'. |
| 5 | | | | | | Porous in upper 2½'. |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | CP | | | SP | SAND: |
| 9 | | | | | | Brown, fine to coarse grained |
| 10 | | | | | | with gravel |
| 11 | | | | | | TOTAL DEPTH 10' |
| 12 | | | | | | NO GROUNDWATER |
| 13 | | | | | | TRENCH BACKFILLED |
| 14 | | | | | | |
| 15 | | | | | | |

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 5

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 701±

| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | | | ML | SANDY SILT: |
| 2 | | GS SE | 91 | 19 | | Tan gray. fine to medium grained. Moist. Manure in upper 1'. |
| 3 | | | | | | |
| 4 | | | 100 | 14 | | % Passing #200 = 68 Sand Equivalent = 20 Porous in upper 2½'. |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | SP | GRAVELLY SAND: |
| 11 | | | | | | Brown. fine to coarse grain with cobbles. |
| 12 | | | | | | TOTAL DEPTH 11' NO GROUNDWATER TRENCH BACKFILLED. |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 6

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 695±

| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | 94 | 19 | ML | SANDY SILT: Tan Gray, fine to medium grained. Moist. Manure in upper 1'. Scattered manure piles to 1½'. Porous in upper 2½'. |
| 2 | | | | | | |
| 3 | | | 92 | 18 | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | TOTAL DEPTH 10' NO GROUNDWATER TRENCH BACKFILLED. |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 7

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 688±

| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | | | ML | SANDY SILT: Grayish tan, fine to medium grained, moist. Porous in upper 2½'. |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | 92 | 18 | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | TOTAL DEPTH 10' NO GROUNDWATER TRENCH BACKFILLED |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 8

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 684±

| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | | | ML | SANDY SILT: |
| 2 | | | 93 | 20 | | Tan gray, fine to medium grained moist. Porous and rootlets in upper 2½'. |
| 3 | | | 89 | 19 | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | TOTAL DEPTH 10' NO GROUNDWATER TRENCH BACKFILLED |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 9

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 681±

| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | | | ML | SANDY SILT: |
| 2 | | ■ | 95 | 19 | | Dark brown, Gray, fine to coarse grained, Moist. Porous and rootlets in upper 2½'. |
| 3 | | | | | | |
| 4 | | ■ | 94 | 17 | | Becoming more Sandy below 4'. |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | TOTAL DEPTH 10' NO GROUNDWATER TRENCH BACKFILLED |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 10

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 676±

| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | | | SM | SILTY SAND: |
| 2 | | GS SE | 107 | 7 | | Tan gray, fine to coarse grained, dry. |
| 3 | | | | | | Porous and rootlets in upper 3'. |
| 4 | | | 94 | 11 | | % Passing #200 = 38 |
| 5 | | | | | | Sand Equivalent = 20 |
| 6 | | | | | SC | CLAYEY SAND: |
| 7 | | | | | | Grayish, fine to coarse grain |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | TOTAL DEPTH 10' |
| 12 | | | | | | NO GROUNDWATER |
| 13 | | | | | | TRENCH BACKFILLED |
| 14 | | | | | | |
| 15 | | | | | | |

# GEOTECHNICAL TRENCH LOGS

Trench No. T - 11

Date: June 29, 1998 Project No: 980040-02

Project Name: Westra 110± Acres Equipment Type: Case 580

Equipment Company: Blair Johnson Elevation: 683±

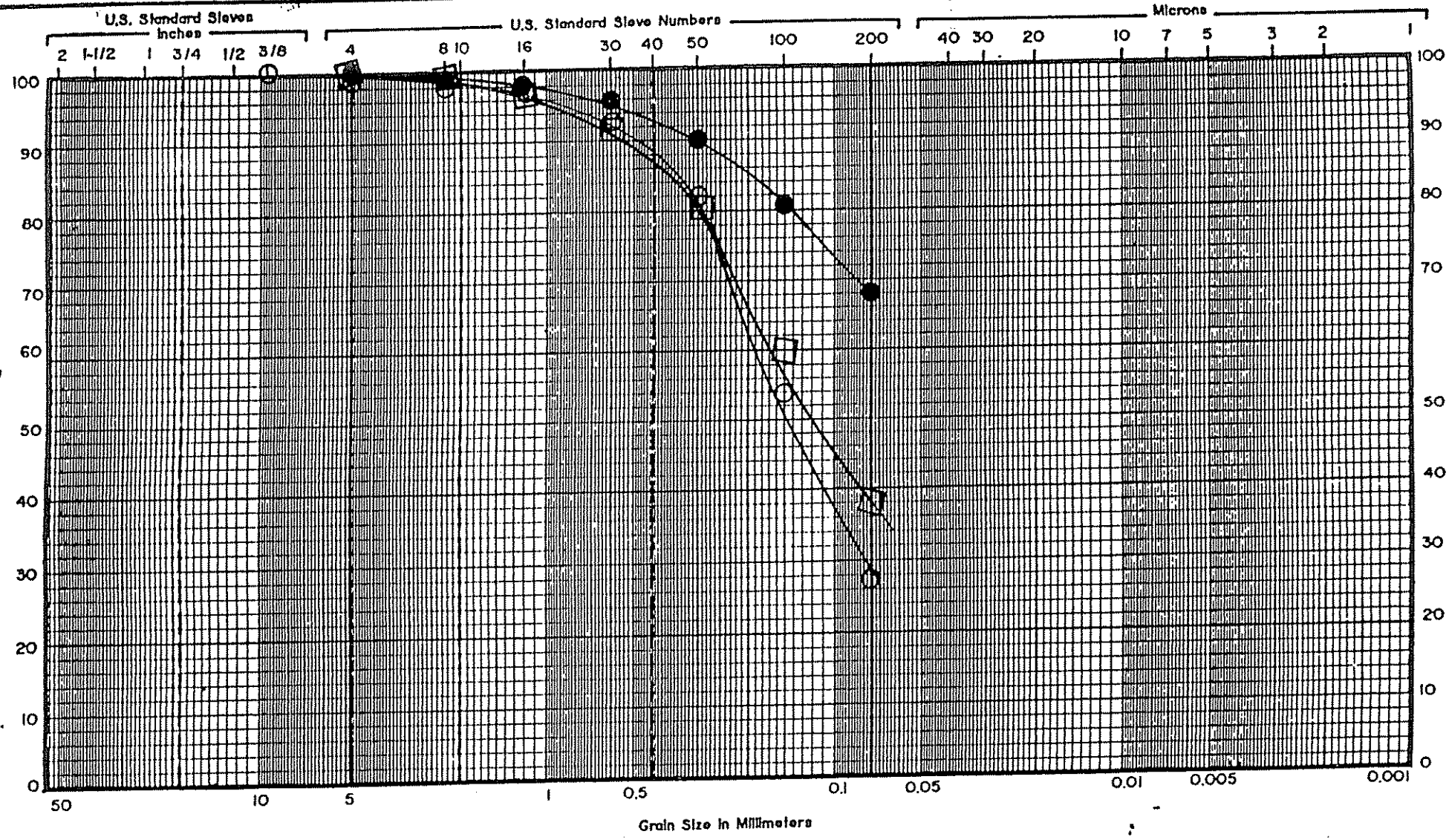
| DEPTH (feet) | EARTH MATERIAL | TYPE OF TEST | DRY DENSITY | MOISTURE (%) | SOIL CLASSF. | Description Logged By HS Sampled By HS |
|---|---|---|---|---|---|---|
| 1 | | | | | SM | SILTY SAND: tan brown, fine to coarse grained, occasional cohesion. moist. Porous in upper 2½'. |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | — | — | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | TOTAL DEPTH 10' NO GROUNDWATER, EASY EXCAVATION TRENCH BACKFILLED. |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |

# APPENDIX C

# LABORATORY TEST RESULTS

| SAMPLE | DESCRIPTION | MAXIMUM DRY DENSITY (pcf) | OPTIMUM MOISTURE (%) |
|---|---|---|---|
| T-2 @ 3' | SILTY SAND: Tan brown, fine to coarse grained | 115.0 | 9.0 |
| T-4 @ 2' | SANDY SILT: Tan gray, fine to medium grained | 121.0 | 10.0 |
| T-4 @ 8' | SAND: Brown, fine to coarse grained with gravel | 119.0 | 9.5 |

**MAXIMUM DRY DENSITY**




| Gravel | | | | Sand | | | | | | | Silt or Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Coarse | Fine | | | Coarse | Medium | | Fine | | | | |
| Symbol | Sample Location | Sample No. | Field Moisture (%) | LL (%) | PI (%) | Activity PI/-2u | Cu $D_{60}/D_{10}$ | Cc $\frac{(D_{30})^2}{D_{10} \times D_{60}}$ | Percent Passing No.200 | Percent Passing 2u | U.S.C.S. |
| ○ | T1@5' | | | | | | | | 27 | | SM |
| ● | T5@2' | | | | | | | | 68 | | ML |
| □ | T10@2' | | | | | | | | 38 | | SM |

## GRADATION TEST RESULTS

Project No. 980040-02

Project Name Westra

Date

Figure No.

# APPENDIX D

# EQFAULT Ver 2.20

## *Estimation of Peak Horizontal Acceleration Digitized California Faults*

| | |
|---|---|
| SEARCH PERFORMED FOR: | THE FORECAST GROUP, LP |
| JOB NUMBER: | 980040-02 |
| JOB NAME: | 110± ACRES, WESTRA DAIRY |
| SEARCH RADIUS: | 50 mi |
| ATTENUATION RELATION: | 1) Campbell & Bozorgnia (1994) Horiz. - Alluvium |
| UNCERTAINTY (M=Mean, S=Mean+1): | M |
| FAULT-DATA FILE USED: | CALIFLT.DAT, Attenuation File |
| SITE COORDINATES: | LATITUDE: 33.9875N, LONGITUDE: 117.5653W |

DETERMINISTIC SITE PARAMETERS

| ABBREVIATED FAULT NAME | APPROX. DISTANCE mi (km) | MAX. CREDIBLE EVENT | | | MAX. PROBABLE EVENT | | |
|---|---|---|---|---|---|---|---|
| | | MAX. CRED. MAG. | PEAK SITE ACC. g | SITE INTENS MM | MAX. PROB. MAG. | PEAK SITE ACC. g | SITE INTENS MM |
| CASA LOMA-CLARK (S.Jacin.) | 33 ( 53) | 7.00 | 0.082 | VII | 7.00 | 0.082 | VII |
| CHINO | 7 ( 12) | 7.00 | 0.420 | X | 5.40 | 0.162 | VIII |
| CLAMSHELL-SAWPIT | 24 ( 38) | 6.60 | 0.095 | VII | 4.90 | 0.025 | V |
| COMPTON-LOS ALAMITOS | 33 ( 54) | 7.20 | 0.142 | VIII | 5.80 | 0.048 | VI |
| CORONADO BANK-AGUA BLANCA | 50 ( 80) | 7.50 | 0.075 | VII | 6.70 | 0.037 | V |
| CUCAMONGA | 12 ( 20) | 6.90 | 0.254 | IX | 6.10 | 0.152 | VIII |
| ELSINORE | 15 ( 24) | 7.50 | 0.273 | IX | 6.60 | 0.148 | VIII |
| ELYSIAN PARK SEISMIC ZONE | 32 ( 52) | 7.10 | 0.092 | VII | 5.80 | 0.034 | V |
| GLN.HELEN-LYTLE CR-CLREMNT | 15 ( 25) | 7.00 | 0.196 | VIII | 6.70 | 0.157 | VIII |
| HELENDALE | 47 ( 76) | 7.30 | 0.068 | VI | 5.50 | 0.014 | III |
| HOT S-BUCK RDG.(S.Jacinto) | 39 ( 63) | 7.00 | 0.066 | VI | 6.10 | 0.030 | V |
| NEWPORT-INGLEWOOD (NORTH) | 37 ( 59) | 6.70 | 0.055 | VI | 4.20 | 0.006 | II |
| NEWPORT-INGLEWOOD-OFFSHORE | 33 ( 54) | 7.10 | 0.088 | VII | 5.90 | 0.031 | V |
| NORTH FRONTAL FAULT ZONE | 22 ( 36) | 7.70 | 0.218 | IX | 6.00 | 0.056 | VI |
| PALOS VERDES HILLS | 42 ( 68) | 7.20 | 0.071 | VI | 6.20 | 0.029 | V |
| RAYMOND | 28 ( 46) | 7.50 | 0.144 | VIII | 4.90 | 0.019 | IV |
| SAN ANDREAS (Mojave) | 21 ( 35) | 8.00 | 0.275 | IX | 7.40 | 0.185 | VIII |
| SAN ANDREAS (S. Bern.Mtn.) | 20 ( 32) | 8.00 | 0.293 | IX | 6.70 | 0.118 | VII |
| SAN GABRIEL | 33 ( 53) | 7.40 | 0.113 | VII | 5.60 | 0.024 | IV |
| SAN GORGONIO - BANNING | 19 ( 31) | 7.50 | 0.227 | IX | 6.60 | 0.126 | VIII |
| SAN JOSE | 11 ( 18) | 6.70 | 0.221 | IX | 5.00 | 0.053 | VI |
| SANTA MONICA - HOLLYWOOD | 40 ( 64) | 7.00 | 0.064 | VI | 5.80 | 0.025 | V |
| SANTA MONICA MTNS. THRUST | 41 ( 66) | 7.20 | 0.108 | VII | 6.30 | 0.054 | VI |
| SIERRA MADRE-SAN FERNANDO | 13 ( 20) | 7.30 | 0.310 | IX | 6.30 | 0.174 | VIII |
| VERDUGO | 35 ( 56) | 6.70 | 0.061 | VI | 5.20 | 0.018 | IV |
| WHITTIER - NORTH ELSINORE | 9 ( 14) | 7.10 | 0.324 | IX | 6.00 | 0.163 | VIII |
| WILSHIRE ARCH | 40 ( 64) | 5.70 | 0.034 | V | 5.00 | 0.019 | IV |

**********

27 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS. THE CHINO FAULT IS CLOSEST TO THE SITE. IT IS ABOUT 7.2 MILES AWAY.

LARGEST MAXIMUM-CREDIBLE SITE ACCELERATION: 0.420 g
LARGEST MAXIMUM-PROBABLE SITE ACCELERATION: 0.185 g

# APPENDIX E

# APPENDIX E

# GENERAL EARTHWORK AND GRADING SPECIFICATIONS

## 1.0 GENERAL INTENT

These specifications present general procedures and requirements for grading and earthwork as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installations of subdrains, and excavations. The recommendations contained in the geotechnical report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict. Evaluations performed bythe consultant during the course of grading may result in new recommendations which could supersede these specifications or the recommendations of the geotechnical report.

## 2.0 EARTHWORK OBSERVATIONS AND TESTING

Prior to the commencement of grading, a qualified geotechnical consultant (soils engineer and engineering geologist, and their representatives) shall be employed for the purpose of observing earthwork procedures and testing the fills for conformance with the recommendations of the geotechnical report and these specifications. It will be necessary that the consultant provide adequate testing and observations so that he may determine that the work was accomplished as specified. It shall be the responsibility of the contractor to assist the consultant and keep him apprised of work schedules and changes so that he may schedule his personnel accordingly.

It shall be the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and approved grading plans. If, in the opinion of the consultant, unsatisfactory conditions, such as questionable soil, poor moisture conditions, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the consultant will be empowered to reject the work and recommend that construction be stopped until the unsatisfactory conditions are rectified.

Maximum dry density tests used to determine the degree of compaction will be performed in accordance with the American Society of Testing and Materials, test method ASTM D1557-78.

## 3.0 PREPARATION OF AREAS TO BE FILLED

### 3.1 Clearing and Grubbing

All brush, vegetation, and debris shall be removed or piled and otherwise disposed of.

3.2 Processing

The existing ground which is determined to be satisfactory for support of fill shall be scarified to a minimum depth of 6 inches. Existing ground which is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until the soils are broken down and free of large clay lumps or clods and until the working surface is reasonably uniform and free of uneven features which would inhibit uniform compaction.

3.3 Overexcavation

Soft, dry, spongy, highly fractured or otherwise unsuitable ground, extending to such depth that surface processing cannot adequately improve the condition, shall be overexcavated down to firm ground, approved by the consultant.

3.4 Moisture Conditioning

Overexcavated and processed soils shall be watered, dried-back, blended, and/or mixed, as required to attain a uniform moisture content near optimum.

3.5 Recompaction

Overexcavation and processed soils which have been properly mixed and moisture-conditioned shall be recompacted to a minimum relative compaction of 90 percent.

3.6 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal : vertical), the ground shall be stepped or benched. The lowest bench shall be a minimum of 15 feet wide, shall be at least 2 feet deep, shall expose firm materials, and shall be approved by the consultant. Other benches shall be excavated in firm materials for a minimum width of 4 feet. Ground sloping flatter than 5:1 (horizontal : vertical) shall be benched or otherwise overexcavated when considered necessary by the consultant.

3.7 Approval

All areas to receive fill, including processed areas, removal areas and toe-of-fill benches shall be approved by the consultant prior to fill placement.

## 4.0 FILL MATERIAL

4.1 General

Material to be placed as fill shall be free of organic matter and other deleterious substances, and shall be approved by the consultant. Soils of poor gradation, expansion, or strength characteristics shall be placed in areas designated by consultant or shall be mixed with other soils to serve as satisfactory fill material.

4.2 Oversize

Oversize materials defined as rock, or other irreducible material with maximum dimension greater than 12 inches, shall not be buried or placed in fills, unless the location, materials, and disposal methods are specifically approved by the consultant. Oversize disposal operations shall be such that nesting of oversize material does not occur, and such that the oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet vertically of finish grade or within the range of future utilities or underground construction, unless specifically approved by the consultant.

4.3 Import

If importing of fill material is required for grading, the import material shall meet the requirements of Section 4.1.

## 5.0 FILL PLACEMENT AND COMPACTION

5.1 Fill Lifts

Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding 6 inches in compacted thickness. The consultant may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to attain uniformity of material and moisture in each layer.

5.2 Fill Moisture

Fill layers at a moisture content less than optimum shall be watered and mixed, and wet fill layers shall be aerated by scarification or shall be blended with drier material. Moisture conditioning and mixing of fill layers shall continue until the fill material is at a uniform moisture content at or near optimum.

5.3 Compaction of Fill

After each layer has been evenly spread, moisture-conditioned, and mixed, it shall be uniformly compacted to not less than 90 percent of maximum dry density. Compaction equipment shall be adequately sized and shall be either specifically designed for soil compaction or of proven reliability, to efficiently achieve the specified degree of compaction.

5.4 Fill Slopes

Compacting of slopes shall be accomplished, in addition to normal compacting procedures, by backrolling of slopes with sheepsfoot rollers at frequent increments of 2 to 3 feet in fill elevation gain, or by other methods producing satisfactory results. At the completion of grading, the relative compaction of the slope out to the slope face shall be at least 90 percent.

5.5 Compaction Testing

Field tests to check the fill moisture and degree of compaction will be performed by the consultant. The location and frequency of tests shall be at the consultant's discretion. In general, the tests will be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of embankment.

## 6.0 SUBDRAIN INSTALLATION

Subdrain systems, if required, shall be installed in approved ground to conform to the approximate alignment and details shown on the plans or herein. The subdrain location or materials shall not be changed or modified without the approval of the consultant. The consultant, however, may recommend and upon approval, direct changes in subdrain line, grade or material. All subdrains should be surveyed for line and grade after installation and sufficient time shall be allowed for the surveys, prior to commencement of filling over the subdrain.

## 7.0 EXCAVATION

Excavations and cut slopes will be examined during grading. If directed by the consultant, further excavation or overexcavation and refilling of cut areas shall be performed, and/or remedial grading of cut slopes shall be performed. Where fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope shall be made and approved by the consultant prior to placement of materials for construction of the fill portion of the slope.

## 8.0 TRENCH BACKFILLS

8.1 Trench excavations for utility pipes shall be backfilled under engineering supervision.

8.2 After the utility pipe has been laid, the space under and around the pipe shall be backfilled with clean sand or approved granular soil to a depth of at least one foot over the top of the pipe. The sand backfill shall be uniformly jetted into place before the controlled backfill is placed over the sand.

8.3 The onsite materials, or other soils approved by the soil engineer, shall be watered and mixed as necessary prior to placement in lifts over the sand backfill.

8.4 The controlled backfill shall be compacted to at least 90 percent of the maximum dry density as determined by the ASTM D1557-78 test method.

8.5 Field density tests and inspection of the backfill procedures shall be made by the soil engineer during backfilling to see that proper moisture content and uniform compaction is being maintained. The contractor shall provide test holes and exploratory pits as required by the soil engineer to enable sampling and testing.

# UPDATE GEOTECHNICAL STUDY
# TRACT NO. 16261, CITY OF ONTARIO
# SAN BERNARDINO COUNTY, CALIFORNIA

FOR

FORECAST HOMES, INC.
3750 BEDFORD CANYON ROAD
CORONA, CALIFORNIA 91719
W.O. 3723-A1-OC OCTOBER 12, 2001

GeoSoils, Inc.

Geotechnical • Geologic • Environmental

1446 E. Chestnut Ave. • Santa Ana, California 92701 • (714) 647-0277 • FAX (714) 647-0745

October 12, 2001

W.O. 3723-A1-OC

**Forecast Homes**
3750 Bedford Canyon Road
Corona, California 91719

Attention: Mr. Kevin Manning

Subject: Update Geotechnical Study, Tract No. 16261, City of Ontario, San Bernardino County, California

References: Appendix A

Gentlemen:

This report has been prepared by GeoSoils, Inc. (GSI), at your request, in order to update a *Preliminary Soil Investigation Report* previously prepared by Sid Geotechnical (1998a), which addresses most of the subject property. The herein study includes updated seismic and design criteria, preliminary earthwork recommendations, and general grading guidelines.

## SCOPE OF SERVICES

The scope of our services has consisted of:

1. Review of the referenced reports.

2. Reconnaissances of the site.

3. Geologic engineering and analysis of data obtained from the referenced items.

4. Preparation of this report which presents our findings, conclusions and recommendations for currently anticipated site development.

This report includes a site location map (Figure 1); a conceptual grading plan prepared by L.D. King, Inc. (Plate 1); seismicity analysis (Appendix B); and, general earthwork and grading guidelines (Appendix C).

## LOCATION AND SITE DESCRIPTION

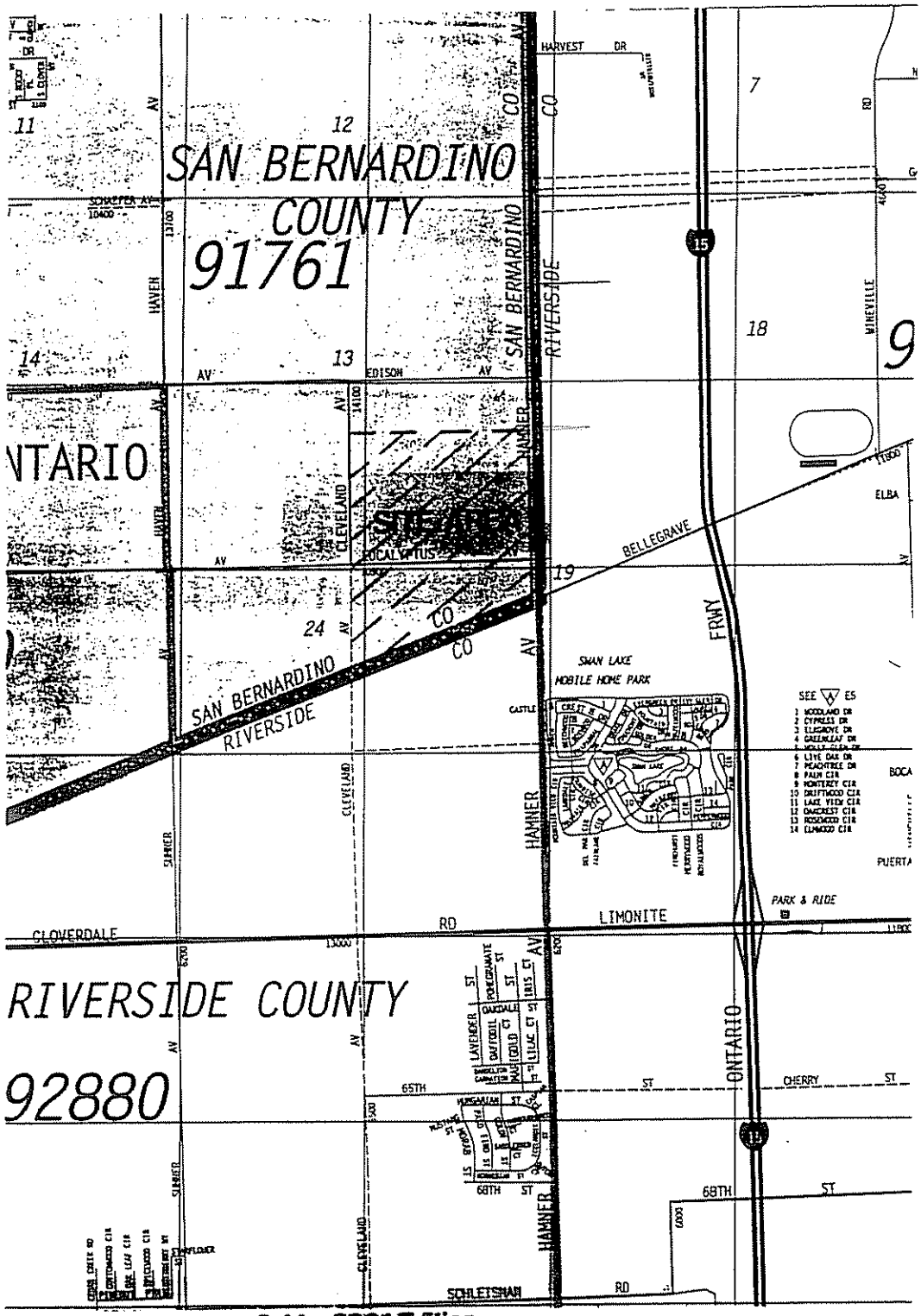
The subject property is located adjacent to and north of Bellegrave Avenue, west of Milliken (Hamner) Avenue, and East of Cleveland Avenue in the City of Ontario, San Bernardino County, California (Figure 1). Tract 16261 is comprised of approximately 183.5 acres of land. Topographically the site is relatively level. Surface drainage on the property appears to generally be directed to the south, via sheet-flow. A desilting basin is located near the southwest corner of the tract. Elevations across the site range from approximately 680 to 720 msl. Existing residential structures are located along Eucalyptus Ave., with the remaining site areas having been/being utilized for agricultural and/or dairy purposes. Some other structures (sheds, fences, etc.) were also noted at various locations across the property. Concrete slabs and other debris from the previous dairy activities are located along and to the south of Eucalyptus Ave. Some miscellaneous debris and scattered fills are also located across the remaining tract areas.

## CURRENTLY PROPOSED DEVELOPMENT

Site development is currently understood to consist of the construction of: one- and/or two-story single family residential structure(s); attached residential structures; a school site; and, park site facilities. Project construction is anticipated to utilize wood-frame and/or masonry- type construction with continuous footings and slabs-on-grade. Conventional and/or post-tensioned design is anticipated to be utilized in building foundation construction.

Building loads are assumed to be typical for this type of construction. In addition to the above, site development is also expected to consist of roadways, retaining walls, as well as associated concrete flatwork and landscaped areas. Typical cut/fill grading is anticipated for the site. Manufactured slope gradients are expected to be 2:1 (horizontal to vertical) or flatter.

Based on past dairy activities across most of the site, and known methane generation on similar dairy properties in the site vicinity, it is GSI's opinion that an evaluation for the potential for methane generation on the subject property is warranted/recommended.




From: Thomas Bros. Guide, 2001 Edition

Approximate Scale: 1"=2,400'

GeoSoils, Inc.

# SITE LOCATION MAP

DATE 10-12-01 | W.O. NO. 3723-A1-OC

Geotechnical • Geologic • Environmental

FIGURE 1

## GEOTECHNICAL INVESTIGATION

As previously indicated, a *Preliminary Soil Investigation* report has previously been prepared by Sid Geotechnical (1998a) which covers most of the current tract area. In addition to the above, GSI is the geotechnical consultant for the adjacent residential development to the south (Tract 28933), and has extensive knowledge of soils in the immediate site vicinity. GSI's current evaluation of the site has included a review of the referenced reports, and site reconnaissances.

Based on our site reconnaissances and review of the referenced reports, currently anticipated site development appears suitable from a geotechnical viewpoint. Site conditions are anticipated to be similar to those as described in Sid's 1998 study. Updated preliminary geotechnical recommendations for site construction are included herein. GSI should review site development plans as they are produced, in order that more specific recommendations can be provided. Additional field exploration and analyses may be warranted, and should be anticipated, based upon specific site development plans.

## SEISMICITY mod → high

No known active or potentially active faults are shown crossing the site on published maps reviewed (Jennings, 1994). No evidence for active or potentially active faulting was described in any of the exploratory excavations described in the referenced reports reviewed for this study.

There are a number of faults in the southern California area which are considered active and will have an effect on the site in the form of moderate to strong ground shaking, should they be the source of an earthquake. These include, but are not limited to: the Chino-Central Ave. (Elsinore) fault, the San Andreas fault, the San Jacinto fault, the Elsinore fault and the Sierra Madre fault. The approximate location of these and other major faults relative to the site is presented in Appendix B. The possibility of ground acceleration or shaking at the site may be considered as approximately similar to the southern California region as a whole.

The Chino-Central Ave. (Elsinore) fault zone is located as close as approximately 11.1 kilometers from the site, and the Elsinore-Whittier fault zone as close as 16.6 kilometers from the site. A probabilistic seismic hazard analysis was performed using the computer program FRISKSP Version 4.00 (Blake 2000). The necessary input for such an analysis consists of (1) a source model incorporating known regional active faults, (2) a seismic activity and frequency magnitude relationship, and (3) an attenuation equation relating maximum horizontal ground acceleration, earthquake magnitude, and source-site distance. Major active and potentially active faults within approximately 100 kilometers of the project site were considered in this seismic risk analysis and modeled as linear sources.

The probability of exceedance (%) of various levels of maximum horizontal ground acceleration (g) for exposure times of up to 100 years are presented on Plate B-5. The average return periods (years) for various levels of maximum horizontal ground acceleration are presented on Plate B-6. The data is summarized for 50 and 100 year design life in Table below. Detailed results are presented in Appendix B.

| Design Life (years) | Earthquake Level | Probability of Exceedance (%) | Calculated Peak Ground Acceleration (g) | Calculated Return Period (years) |
|---|---|---|---|---|
| 100 | Operating | 50 | 0.375 | 150 |
| 100 | Contingency | 10 | 0.70 | 900 |
| 50 | Operating | 50 | 0.25 | 55 |
| 50 | Contingency | 10 | 0.60 | 500 |

The following seismic design parameters should be used to draw the Design Response Spectrum, per Chapter 16 of the 1997 UBC:

| 1997 U.B.C. | DESCRIPTION | FACTOR |
|---|---|---|
| Table 16-J | Soil Profile Type | $S_D$ |
| Figure 16-2 | Seismic Zone | 4 |
| Table 16-I | Seismic Zone Factor *Z* | 0.40 |
| Table 16-Q | Seismic Coefficient, *Ca* | 0.44 $N_a$ |
| Table 16-R | Seismic Coefficient, *Cv* | 0.64 $N_v$ |
| Table 16-S | Near Source Factor, *Na* | 1.0 |
| Table 16-T | Near Source Factor, *Nv* | 1.0 |
| Table 16-U | Seismic Source Type | B |
| Nearest Fault | Chino-Central Ave. (Elsinore) | 11.1 Km |

## GROUNDWATER Deep

According to Sid Geotechnical (1998a), a groundwater depth of approximately 125 feet below the ground surface has been estimated for the site. This depth was based on "County of San Bernardino Generalized Maps."

## LIQUEFACTION Not Likely

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless soils. These soils may thereby acquire a high degree of mobility, which can lead to lateral movement, sliding, consolidation and settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below the water table; but after liquefaction has developed, it can propagate upward into overlying non-saturated soil, as excess pore water dissipates.

One of the primary factors controlling the potential for liquefaction is depth to groundwater. Typically, liquefaction has a low potential where groundwater is greater than 40 feet deep and is virtually unknown below 60 feet.

Since the groundwater beneath the site has been estimated to be at least 125 feet below the ground surface, the potential for liquefaction at the subject site is considered negligible.

## CONCLUSIONS

Based on recent site reconnaissances, recent geotechnical experience in the immediate site vicinity and review of the referenced reports, it is GSI's opinion that the site is suitable for the anticipated development from a geotechnical engineering and geologic viewpoint, providing that the recommendations presented herein are incorporated into design and construction phases of development.

The geologic and engineering analyses performed concerning site preparation and the recommendations presented herein, have been completed using the information provided. Conclusions and recommendations contained in this report shall not be considered valid unless the site development plans are reviewed and the recommendations of this report are verified or modified in writing by this office. The following general recommendations are preliminary and will require updating subsequent to review of final site grading and development plans.

## RECOMMENDATIONS - EARTHWORK CONSTRUCTION

### Site Preparation and Grading

Grading should be accomplished under the observation and testing of the project soils engineer in accordance with the recommendations contained herein, the current guidelines of the City of Ontario and County of San Bernardino, and GSI's "Earthwork and Grading Guidelines," (Appendix C).

During earthwork construction, all removals and the general grading procedures should be observed and the fill selectively tested by a representative of GSI. Oversized (>12") materials, if encountered, should be separated and not placed in foundation area engineered fills. Materials greater than six inches (6") in diameter should not be placed within five (5) feet of proposed finish grades. If unusual or unexpected conditions are exposed in the field, they should be reviewed by this office and if warranted, modified and/or additional recommendations will be offered. All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act and the Construction Safety Act should be met.

### Clearing and Grubbing

Prior to initiating grading operation(s), all existing surficial vegetation, trees and root systems, debris and other deleterious material should be removed from the site. This includes razing any existing site structures and improvements, etc. Concrete and asphaltic concrete, which is free of steel reinforcement, may be broken down and placed in site fills upon observation and approval of the project geotechnical engineer. Regardless of size, this material should be kept a minimum of five (5) feet below proposed finish grade elevations.

### Removals

Complete removal of existing undocumented fills on the site is recommended. Removal of organic material (including manure) is recommended. Removals of soft and compressible colluvial and alluvial materials is also recommended. Based on review of the referenced reports, site materials generally become denser below a depth of approximately four (4) feet, and may be left in place depending upon exposed conditions and proposed site improvements. Actual removal depths will be determined during grading when subsurface conditions are more fully exposed, and subsequent to review of specific site development plans. Undocumented fill, unsuitable colluvial and alluvial materials may be re-used as engineered fill provided they are essentially free of biodegradable and deleterious matter (including steel).

For estimating purposes, removals across proposed fill portions of the site are anticipated to be approximately 4 feet, but may locally be deeper. Overexcavations of proposed cut areas will depend on materials encountered, and are likely to minimally extend 3 feet below proposed finish grade elevations, or two feet below the bottom of proposed foundations, whichever is greater. Structural removals should minimally extend down and out at a 1:1 projection to competent natural material, as measured from 5 feet outside proposed building envelope(s) and/or structural improvements. Streets, sidewalks, and driveways are considered structural. Removal bottoms should be tested to have a minimum in-place density of 85% relative compaction (90% subsequent to processing and recompaction), and be comprised of uniform material which is not visibly porous or subject to adverse affects of consolidation. Once approved, removal bottoms should be scarified and moisture conditioned prior to fill placement.

If encountered, special handling and placement (i.e., windrowing or placing "rock blankets") may be recommended if warranted by the quantity of any larger (6" in diameter or greater) material. Preliminary guidelines for placement of over-size material(s) are included in Appendix C.

## Transition Areas

In order to establish a more uniform subgrade beneath proposed foundations, the cut portions of cut/fill transition areas should be overexcavated a minimum of three (3) feet, or two (2) feet below the bottom of proposed foundations, whichever is deeper, and replaced with compacted fill. (This could be deepened based on proposed construction and/or exposed soil conditions.) Prior to replacing the overexcavated area with compacted fill, the exposed subsoils should be well scarified to a minimum depth of 6 inches, brought to at least optimum moisture content, and compacted to a minimum relative compaction of 90 percent of the laboratory standard. Specific overexcavation depths for transition areas will be determined when site plans become finalized, or based upon conditions exposed during grading. Overexcavations should minimally extend five (5) feet outside proposed building envelope(s), or at a 1:1 (h:v) projection from the outside edge of the anticipated perimeter footing for a given structure. Overexcavations are recommended in order to reduce the potential for future differential settlement in building areas.

## Fill Placement

Subsequent to completing the removals and any overexcavation(s), the excavated onsite soils that are free of vegetation and deleterious debris may be placed in relatively thin (4 to 8± inches loose) lifts, brought to at least optimum moisture content and compacted to a minimum relative compaction of 90 percent of the laboratory standard (ASTM D-1557). The organic content within structural site fills should be kept below 5%.

All grading should conform to the guidelines presented in Appendix C of this report, the 1997 UBC and the requirements of the City of Ontario and County of San Bernardino, except where specifically superseded in the text of this report and reviewed and approved by representatives of the City of Ontario.

## Slopes

No slopes steeper than 2:1 (horizontal to vertical) are recommended to be constructed. Proposed slopes constructed at gradients of 2:1 (h:v) or shallower, comprised of engineered fill derived from existing site materials or exposing competent site materials, are anticipated to be both grossly and surficially stable. Temporary backcuts should be laid back at 1:1 (horizontal to vertical) gradients or flatter.

## Suitability of Imported Materials

Any proposed import soil material should be evaluated and approved by the project geotechnical consultant prior to import. Additional laboratory testing (including sulfate content, expansion and corrosion potential) may be performed on representative samples of proposed import material.

## Material Shrinkage

Estimates for material shrinkage will vary with material type and location. The earthwork shrinkage/bulking factor for removed material may be approximated by using the parameters provided below. These parameters are based upon laboratory data, and GSI's experience on similar projects.

| | |
|---|---|
| Undocumented Fill | 10% to 25% shrinkage |
| Colluvium | 10% to 20% shrinkage |
| Older Alluvium | 0% to 10% shrinkage |

## Subsidence

Proposed fills, to the depths anticipated on the project site, should produce negligible amounts of post grading subsidence on underlying natural materials (below the engineered fill and reprocessed alluvium depths).

# RECOMMENDATIONS - FOUNDATIONS

## General

The foundation design and construction recommendations presented herein are based on preliminary laboratory testing and engineering analysis of onsite earth materials. Recommendations for conventional and post-tension foundation design are provided in

the following sections. Due to the potential for post-grading soil shrinkage cracking (known to exist in the site area), post-tension slabs are recommended to be utilized on the subject site. Proposed foundation system(s) should be founded in competent bearing material and be designed and constructed in accordance with the guidelines contained in the 1997 UBC.

## Bearing Capacity and Lateral Resistance

Conventional spread and continuous footings may be used to support site walls and non-residential site improvements provided they are founded entirely in properly compacted fill or competent native material.

For preliminary purposes, an allowable bearing value of 1500 pounds per square foot may be used for design of continuous and column footings 15 inches wide and 24 inches deep and isolated footings 24 inches square and 24 inches deep into the properly compacted fill. This value may be increased by 100 pounds per square foot for each additional 12 inches in depth and by 50 pounds per square foot for each additional 12 inches in width, to a maximum of 2500 pounds per square foot. These value(s) may be increased by one-third when considering short duration seismic or wind loads. Final values may be revised when plans become available for review.

For lateral sliding resistance, a coefficient of friction of 0.35 may be utilized for a concrete to soil contact when multiplied by the dead load.

Passive earth pressure may be computed as an equivalent fluid having a density of 250 psf per foot of depth, to a maximum earth pressure of 2500 pounds per square foot.

When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

All footings should maintain a minimum five foot horizontal set back from the base of the footing and any adjacent descending slope and comply with the guidelines depicted in the 1997 UBC.

## Foundation Setbacks

Foundation setbacks should be in accordance with the requirements of the 1997 UBC, or the minimum requirements of the Governing Ordinance, whichever controls.

## Post-Tensioned Slab Design

"Post-tensioned" foundation/slab systems are recommended to be utilized at the subject site. From a geotechnical standpoint, a fairly common contributing factor to distress of structures using "post-tensioned" slabs is due to soil expansion and shrinkage as a result

of significant fluctuation in the moisture content of soils underlying the perimeter of the slab relative to the center causing a "dishing" or "arching" of the slabs. In order to mitigate this condition, a combination of soil presaturation and construction of a perimeter grade beam to cut off access or loss of moisture into or from the soils directly underneath the perimeter area should be employed.

Specific recommendations are presented below:

1. The information and recommendations presented herein are not meant to supersede design by a registered structural engineer or civil engineer familiar with "Post-tensioned" slab design or corrosion engineering consultant. Upon request, GSI could provide additional data/consultation regarding soil parameters as related to "Post-tensioned" slab design.

2. "Post-tensioned slabs should be designed using sound engineering practice and be in accordance with the requirements of the 1997 UBC. Since local pockets of medium expansion materials are also present at the site, the following recommendations are based on "very low" to "medium" expansion potential. Geotechnical parameters for "post-tensioned" slab design are presented below:

| | |
|---|---|
| Expansion Potential | "very low" to "medium" |
| % Clay | assumed 30 |
| Constant Suction | 3.6 |
| Depth to Constant Suction (feet) | 7 |
| Clay Type | montmorillonite (assumed) |
| Thornthwaite Moisture Index | (Per Code) - 20 |
| Moisture Velocity | 0.7 inches/month |
| $e_m$ (Center Lift) ft. | 6 |
| $e_m$ (Edge Lift) ft. | 3 |
| $Y_m$ (Edge Lift) inches | 3.2 |
| $Y_m$ (Edge Lift) inches | 0.9 |
| Minimum Slab Thickness (inches) | 5 |
| Modulus of Subgrade Reaction (psi per inch) | 100 |

3. Perimeter foundation bottoms should be at least 18 inches below the lowest adjacent grade, and should be a minimum of 12 inches wide.

4. The subgrade soils within the slab areas should be at least 2 to 3 percentage points above the optimum moisture content to a depth of 18 inches and be verified prior to footing excavation.

5. Concrete slabs in moisture sensitive areas should be underlain by a vapor barrier consisting of a minimum of six mil polyvinyl chloride membrane with all laps sealed. This membrane should be sandwiched by two 1-inch-thick layers of clean sand (SE>30). Care should be taken to avoid puncturing the membrane during construction.

6. The structural engineer should review the above minimum requirements in light of the residential structures' locations (i.e., proximity to slopes, etc.).

7. Slab subgrade should be graded such that water will flow away from the structure to prevent ponding of water under the slab. Soil generated from footing excavations to be used onsite should be compacted to a minimum 90 percent relative compaction whether it is to be placed inside the foundation perimeter or in the yard/driveway areas. This material must not alter positive drainage patterns away from the structural areas and toward the street.

## Presaturation

Presaturation is recommended for site soil conditions utilizing post-tension foundations; the moisture content of subgrade soils should be 2 to 3 percentage points above optimum moisture content to a depth of 18 inches for "very low" to "medium" expansive soils. Verification of presaturation should be performed prior to pouring slabs and prior to placing visqueen or reinforcement.

## Retaining Wall Construction

The design parameters provided below assume that "very low" to "medium" expansive soils are used to backfill site retaining walls. If higher expansive soils are used to backfill any proposed walls, increased active and at-rest earth pressures will need to be utilized for retaining wall design.

1. Retaining walls should be designed to resist active earth pressures equivalent to pressures exerted by fluid having the following densities:

| BACKFILL HORIZONTAL:VERTICAL | EQUIVALENT FLUID DENSITY (pcf) |
|---|---|
| Level | 40 |
| 2:1 | 60 |

Design pressure for restrained walls may be given, if necessary.

2. The foundation system for any proposed retaining walls should be designed in accordance with the recommendations presented in the "Foundations" section of this report.

3. All retaining walls should be provided with an adequate backdrain and outlet system to prevent buildup of hydrostatic pressures in accordance with the detail provided in Appendix "C".

4. Walls should be backfilled with fill compacted to a minimum 90 percent relative compaction. A cushion of at least two feet of granular soils, approved by the geotechnical engineer, should be maintained adjacent to the wall. The upper 18 inches should consist of native materials and positive surface drainage should be provided.

5. For restrained walls, such as subterranean parking and basement walls, an at rest design value of 65 pounds per cubic foot should be used.

6. Retaining wall footings adjacent to descending slopes should be provided with a minimum 5-foot foundation setback measured from the leading bottom edge of the footing to the competent face of the adjacent slope.

## CONCRETE FLATWORK

Recommendations for concrete flatwork construction were developed in an attempt to mitigate a majority of the potential uplift, lateral movement and/or distress that might occur, due primarily to soil expansion and shrinkage. Realizing that the potential cannot be totally eliminated, the intent of these recommendations is to decrease the potential for flatwork repair and replacement. Additionally, more stringent recommendations (beyond those provided) could be developed to further minimize the need for repair or replacement.

The following minimum criteria should be incorporated into construction designs:

1. Sidewalks and exterior slabs should be constructed with a four inch minimum thick concrete slab and reinforced with welded wire mesh (6" x 6", No. 10 x No. 10) supported near the vertical midpoint of the slab. "Hooking" of the reinforcement is not considered an acceptable method of positioning the steel. This thickness design was determined based upon experience with the onsite soils and the presence of expansive soil at depth and at grade. The primary purpose of the wire mesh is to minimize vertical separation along cracks and expansion joints.

2. If "shade" sand in any of the utility trenches is exposed below the flatwork, at least 12 inches of the sand should be removed and replaced with compacted fill soils (if possible). This should further minimize the potential for water to enter the subgrade soils. Consideration should be given to the geometry of the trench relative to the flatwork and the width of the trench used.

3. The subgrade area for concrete slabs should be compacted to achieve a minimum 90 percent relative compaction, and be moisture conditioned to 2 to 3 percentage points above the optimum moisture content to a depth of 18 inches and be verified within 72 hours prior to pouring concrete.

4. Concrete slabs should be cast over or clean low-expansive sand and wetted down completely prior to pouring concrete to minimize loss of concrete moisture to the surrounding earth materials.

5. In order to reduce the potential for unsightly cracks, slabs may be reinforced at mid-height with a minimum of 6" x 6" - no. 10 x no. 10 welded wire mesh.

6. Exterior slabs should be at minimum 4-inches thick (nominally). Driveway slabs and approaches should be at least 4-inches thick.

7. Prior to pouring concrete all loose or otherwise deleterious materials should be removed. The subgrade soils should be reasonably compact. Observation, probing and testing, if deemed necessary, may be required to verify adequate results.

8. The exterior slabs should be scored or saw cut ½ to 3/8 inches deep, often enough so that no section is greater than 10 feet by 10 feet. For sidewalks or narrow slabs, control joints should be provided every 6 feet or less. The slabs should be separated from the foundations and sidewalks with expansion joint material.

9. No traffic should be allowed upon the newly poured concrete slabs until they have been properly cured to within 75 percent of design strength.

10. Positive site drainage should be maintained at all times. Adjacent landscaping should be graded to drain into the street or other approved area. All surface water should be appropriately directed to areas designed for site drainage.

11. In areas directly adjacent to a continuous source of moisture (i.e. irrigation, planters, etc.), all (concrete) joints should be sealed with flexible mastic.

## DEVELOPMENT CRITERIA

### Utility Trench Backfill

1. All interior utility trench backfill should use native backfill brought to at least two percent above optimum moisture content and then compacted to obtain a minimum relative compaction of 90 percent of the laboratory standard. To prevent introduction of water underneath the slab areas, clean sand backfills should not be used. Observation, probing and testing should be provided to verify the desired results.

2. Exterior trenches adjacent to and within areas extending below a 1:1 plane projected from the outside bottom edge of the footing, and all trenches beneath hardscape features and in slopes, should be compacted to at least 90 percent of the laboratory standard. Compaction testing and observations, along with probing, should be accomplished to verify the desired results.

3. All trench excavations should conform to CAL-OSHA and local safety codes.

### Lot Drainage

1. Subsequent to the rough grading of the building pads, the designed drainage devices on the pads and slopes should be maintained to allow surface runoff to drain towards the street or designed area drain. Failure to maintain positive drainage may contribute to foundation distress, utility trench settlement, and/or slope failures.

2. During and subsequent to any homeowner improvements, the positive drainage away from the residential structures and top of slopes should be maintained.

### Landscape and Irrigation

1. Slope surfaces should be landscaped as soon as possible. Slope vegetation should consist of deep routing vegetation that is capable of surviving in an arid climate.

2. The irrigation program for the slope areas should be decreased as soon as the vegetation has germinated or rooted. The irrigation should be adjusted for frequency and duration based upon seasonal changes.

3. Irrigation should not promote runoff or ponding of water. The irrigation cycles should be of a short period of time that is adequate to support the vegetation.

## Geotechnical Observation/Testing

Observation and/or testing should be performed by the geotechnical consultant at each of the following stages:

1. During precise grading/recertification.

2. After excavation for footings of buildings, retaining walls, and free-standing walls, and prior to pouring concrete.

3. During subdrain installation for retaining walls, if any, and prior to placement of backfill.

4. During placement of backfill for area drain, interior plumbing and utility line trenches, and retaining walls, if any.

5. After presoaking building pad and other flatwork subgrade and prior to pouring slabs.

6. During slope or erosion repair, if any.

7. When any unusual soil conditions are encountered during any construction operation subsequent to issuance of this report.

## PLAN REVIEW

Site development and foundation plans should be submitted to this office for review and comment, as the plans become available, for the purpose of minimizing any misunderstandings between the plans and recommendations presented herein. In addition, foundation excavations and any additional earthwork construction performed on the site should be observed and tested by this office. If conditions are found to differ substantially from those stated, appropriate recommendations would be offered at that time.

## LIMITATIONS

The materials described on the project site are believed representative of the area; however, soil materials vary in character between excavations or conditions exposed during mass grading. Site conditions may vary due to seasonal changes or other factors. GSI assumes no responsibility or liability for work, testing, or recommendations performed or provided by others.

Inasmuch as this study is based upon the site materials described, the conclusions and recommendations are professional opinions. These opinions have been derived in accordance with current standards of practice and no warranty is expressed or implied. Standards of practice are subject to change with time.

## CLOSURE

The opportunity to be of service is greatly appreciated. If you have any questions concerning this report or if we may be of further assistance, please do not hesitate to contact the undersigned.

Respectfully submitted,

**GeoSoils, Inc.**

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Engineering Geologist, CEG 1892

Ben Shahrvini
Civil Engineer, RCE 39350
Geotechnical Engineer, GE 2396

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STATE OF CALIFORNIA

EHL/BBS/agw

Enclosures:
- Appendix A - References
- Appendix B - Seismicity Analysis
- Appendix C - Earthwork and Grading Guidelines
- Plate 1 - Conceptual Grading Plan

Distribution:
- (6) Addressee
- (1) L.D. King, Inc. ; Attn: Larry Popp

# APPENDIX A

# REFERENCES

## APPENDIX A

### References


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# APPENDIX B

# SEISMICITY ANALYSIS

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**********
*        *
*  U B C S E I S  *
*        *
*  Version 1.03  *
*        *
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COMPUTATION OF 1997
UNIFORM BUILDING CODE
SEISMIC DESIGN PARAMETERS

JOB NUMBER: 3723-A1-OC DATE: 10-02-2001

JOB NAME: FORECAST HOMES

FAULT-DATA-FILE NAME: CDMGUBCR.DAT

SITE COORDINATES:
SITE LATITUDE: 33.9892
SITE LONGITUDE: 117.5600

UBC SEISMIC ZONE: 0.4

UBC SOIL PROFILE TYPE: SD

NEAREST TYPE A FAULT:
NAME: CUCAMONGA
DISTANCE: 20.1 km

NEAREST TYPE B FAULT:
NAME: CHINO-CENTRAL AVE. (Elsinore)
DISTANCE: 11.1 km

NEAREST TYPE C FAULT:
NAME:
DISTANCE: 99999.0 km

SELECTED UBC SEISMIC COEFFICIENTS:
Na: 1.0
Nv: 1.0
Ca: 0.44
Cv: 0.64
Ts: 0.582
To: 0.116

```
**********************************************************************
* CAUTION:  The digitized data points used to model faults are       *
*           limited in number and have been digitized from small-    *
*           scale maps (e.g., 1:750,000 scale).  Consequently,       *
*           the estimated fault-site-distances may be in error by    *
*           several kilometers.  Therefore, it is important that     *
*           the distances be carefully checked for accuracy and      *
*           adjusted as needed, before they are used in design.      *
**********************************************************************
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SUMMARY OF FAULT PARAMETERS

Page 1

| ABBREVIATED FAULT NAME | APPROX. DISTANCE (km) | SOURCE TYPE (A,B,C) | MAX. MAG. (Mw) | SLIP RATE (mm/yr) | FAULT TYPE (SS,DS,BT) |
|---|---|---|---|---|---|
| CHINO-CENTRAL AVE. (Elsinore) | 11.1 | B | 6.7 | 1.00 | DS |
| ELSINORE-WHITTIER | 16.6 | B | 6.8 | 2.50 | SS |
| ELSINORE-GLEN IVY | 16.6 | B | 6.8 | 5.00 | SS |
| SAN JOSE | 18.3 | B | 6.5 | 0.50 | DS |
| CUCAMONGA | 20.1 | A | 7.0 | 5.00 | DS |
| SIERRA MADRE (Central) | 22.3 | B | 7.0 | 3.00 | DS |
| SAN JACINTO-SAN BERNARDINO | 22.9 | B | 6.7 | 12.00 | SS |
| SAN JACINTO-SAN JACINTO VALLEY | 29.9 | B | 6.9 | 12.00 | SS |
| SAN ANDREAS - Southern | 32.4 | A | 7.4 | 24.00 | SS |
| SAN ANDREAS - 1857 Rupture | 35.8 | A | 7.8 | 34.00 | SS |
| CLEGHORN | 36.5 | B | 6.5 | 3.00 | SS |
| CLAMSHELL-SAWPIT | 38.4 | B | 6.5 | 0.50 | DS |
| ELSINORE-TEMECULA | 43.2 | B | 6.8 | 5.00 | SS |
| NORTH FRONTAL FAULT ZONE (West) | 43.7 | B | 7.0 | 1.00 | DS |
| RAYMOND | 45.5 | B | 6.5 | 0.50 | DS |
| NEWPORT-INGLEWOOD (L.A.Basin) | 53.6 | B | 6.9 | 1.00 | SS |
| VERDUGO | 54.8 | B | 6.7 | 0.50 | DS |
| NEWPORT-INGLEWOOD (Offshore) | 55.0 | B | 6.9 | 1.50 | SS |
| HOLLYWOOD | 63.5 | B | 6.5 | 1.00 | DS |
| SAN JACINTO-ANZA | 65.4 | A | 7.2 | 12.00 | SS |
| PALOS VERDES | 69.2 | B | 7.1 | 3.00 | SS |
| SIERRA MADRE (San Fernando) | 74.9 | B | 6.7 | 2.00 | DS |
| NORTH FRONTAL FAULT ZONE (East) | 75.0 | B | 6.7 | 0.50 | DS |
| HELENDALE - S. LOCKHARDT | 75.8 | B | 7.1 | 0.60 | SS |
| SAN GABRIEL | 75.8 | B | 7.0 | 1.00 | SS |
| PINTO MOUNTAIN | 77.6 | B | 7.0 | 2.50 | SS |
| SANTA MONICA | 78.9 | B | 6.6 | 1.00 | DS |
| ELSINORE-JULIAN | 84.7 | A | 7.1 | 5.00 | SS |
| CORONADO BANK | 87.0 | B | 7.4 | 3.00 | SS |
| MALIBU COAST | 89.7 | B | 6.7 | 0.30 | DS |
| SANTA SUSANA | 93.9 | B | 6.6 | 5.00 | DS |
| LENWOOD-LOCKHART-OLD WOMAN SPRGS | 94.3 | B | 7.3 | 0.60 | SS |
| ROSE CANYON | 96.4 | B | 6.9 | 1.50 | SS |
| JOHNSON VALLEY (Northern) | 100.8 | B | 6.7 | 0.60 | SS |
| HOLSER | 102.4 | B | 6.5 | 0.40 | DS |
| ANACAPA-DUME | 104.6 | B | 7.3 | 3.00 | DS |
| BURNT MTN. | 106.9 | B | 6.5 | 0.60 | SS |
| LANDERS | 107.1 | B | 7.3 | 0.60 | SS |
| EUREKA PEAK | 108.6 | B | 6.5 | 0.60 | SS |
| EMERSON So. - COPPER MTN. | 111.9 | B | 6.9 | 0.60 | SS |
| SAN JACINTO-COYOTE CREEK | 113.6 | B | 6.8 | 4.00 | SS |
| GRAVEL HILLS - HARPER LAKE | 114.2 | B | 6.9 | 0.60 | SS |
| OAK RIDGE (Onshore) | 115.2 | B | 6.9 | 4.00 | DS |
| SIMI-SANTA ROSA | 119.0 | B | 6.7 | 1.00 | DS |
| SAN CAYETANO | 121.5 | B | 6.8 | 6.00 | DS |
| CALICO - HIDALGO | 121.5 | B | 7.1 | 0.60 | SS |

SUMMARY OF FAULT PARAMETERS

Page 2

| ABBREVIATED FAULT NAME | APPROX. DISTANCE (km) | SOURCE TYPE (A,B,C) | MAX. MAG. (Mw) | SLIP RATE (mm/yr) | FAULT TYPE (SS,DS,BT) |
|---|---|---|---|---|---|
| BLACKWATER | 125.5 | B | 6.9 | 0.60 | SS |
| EARTHQUAKE VALLEY | 127.3 | B | 6.5 | 2.00 | SS |
| PISGAH-BULLION MTN.-MESQUITE LK | 129.8 | B | 7.1 | 0.60 | SS |
| SANTA YNEZ (East) | 139.5 | B | 7.0 | 2.00 | SS |
| GARLOCK (West) | 140.2 | A | 7.1 | 6.00 | SS |
| GARLOCK (East) | 150.3 | A | 7.3 | 7.00 | SS |
| VENTURA - PITAS POINT | 151.1 | B | 6.8 | 1.00 | DS |
| PLEITO THRUST | 153.4 | B | 6.8 | 2.00 | DS |
| SAN JACINTO - BORREGO | 153.5 | B | 6.6 | 4.00 | SS |
| M.RIDGE-ARROYO PARIDA-SANTA ANA | 157.4 | B | 6.7 | 0.40 | DS |
| ELSINORE-COYOTE MOUNTAIN | 158.6 | B | 6.8 | 4.00 | SS |
| BIG PINE | 162.3 | B | 6.7 | 0.80 | SS |
| RED MOUNTAIN | 165.1 | B | 6.8 | 2.00 | DS |
| WHITE WOLF | 166.8 | B | 7.2 | 2.00 | DS |
| So. SIERRA NEVADA | 174.6 | B | 7.1 | 0.10 | DS |
| SANTA CRUZ ISLAND | 180.3 | B | 6.8 | 1.00 | DS |
| LITTLE LAKE | 180.4 | B | 6.7 | 0.70 | SS |
| BRAWLEY SEISMIC ZONE | 185.2 | B | 6.5 | 25.00 | SS |
| TANK CANYON | 185.9 | B | 6.5 | 1.00 | DS |
| SUPERSTITION MTN. (San Jacinto) | 187.3 | B | 6.6 | 5.00 | SS |
| ELMORE RANCH | 190.0 | B | 6.6 | 1.00 | SS |
| PANAMINT VALLEY | 190.4 | B | 7.2 | 2.50 | SS |
| OWL LAKE | 190.5 | B | 6.5 | 2.00 | SS |
| SUPERSTITION HILLS (San Jacinto) | 192.3 | B | 6.6 | 4.00 | SS |
| SANTA YNEZ (West) | 198.9 | B | 6.9 | 2.00 | SS |
| ELSINORE-LAGUNA SALADA | 209.0 | B | 7.0 | 3.50 | SS |
| DEATH VALLEY (South) | 209.1 | B | 6.9 | 4.00 | SS |
| SANTA ROSA ISLAND | 216.4 | B | 6.9 | 1.00 | DS |
| IMPERIAL | 218.9 | A | 7.0 | 20.00 | SS |
| DEATH VALLEY (Graben) | 240.0 | B | 6.9 | 4.00 | DS |
| LOS ALAMOS-W. BASELINE | 241.7 | B | 6.8 | 0.70 | DS |
| OWENS VALLEY | 247.9 | B | 7.6 | 1.50 | SS |
| SAN JUAN | 256.1 | B | 7.0 | 1.00 | SS |
| LIONS HEAD | 258.9 | B | 6.6 | 0.02 | DS |
| SAN LUIS RANGE (S. Margin) | 263.6 | B | 7.0 | 0.20 | DS |
| CASMALIA (Orcutt Frontal Fault) | 275.1 | B | 6.5 | 0.25 | DS |
| HUNTER MTN. - SALINE VALLEY | 276.8 | B | 7.0 | 2.50 | SS |
| INDEPENDENCE | 283.6 | B | 6.9 | 0.20 | DS |
| DEATH VALLEY (Northern) | 291.2 | A | 7.2 | 5.00 | SS |
| LOS OSOS | 292.9 | B | 6.8 | 0.50 | DS |
| HOSGRI | 304.7 | B | 7.3 | 2.50 | SS |
| RINCONADA | 308.9 | B | 7.3 | 1.00 | SS |
| BIRCH CREEK | 339.8 | B | 6.5 | 0.70 | DS |
| WHITE MOUNTAINS | 344.5 | B | 7.1 | 1.00 | SS |
| SAN ANDREAS (Creeping) | 355.8 | B | 5.0 | 34.00 | SS |
| DEEP SPRINGS | 363.3 | B | 6.6 | 0.80 | DS |

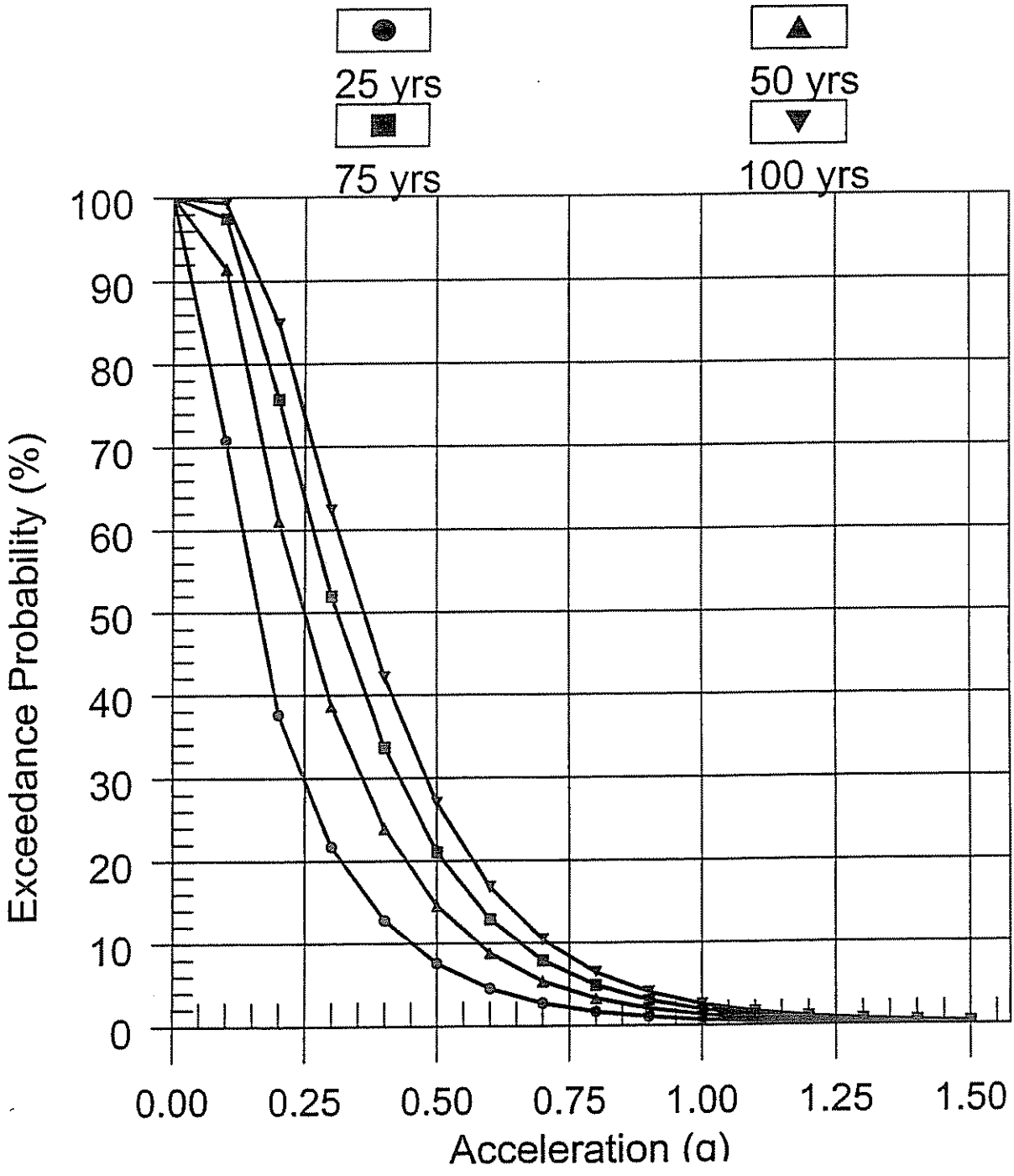
SUMMARY OF FAULT PARAMETERS

Page 3

| ABBREVIATED FAULT NAME | APPROX. DISTANCE (km) | SOURCE TYPE (A,B,C) | MAX. MAG. (Mw) | SLIP RATE (mm/yr) | FAULT TYPE (SS,DS,BT) |
|---|---|---|---|---|---|
| DEATH VALLEY (N. of Cucamongo) | 369.7 | A | 7.0 | 5.00 | SS |
| ROUND VALLEY (E. of S.N.Mtns.) | 374.8 | B | 6.8 | 1.00 | DS |
| FISH SLOUGH | 382.7 | B | 6.6 | 0.20 | DS |
| HILTON CREEK | 400.9 | B | 6.7 | 2.50 | DS |
| HARTLEY SPRINGS | 425.2 | B | 6.6 | 0.50 | DS |
| ORTIGALITA | 435.9 | B | 6.9 | 1.00 | SS |
| CALAVERAS (So.of Calaveras Res) | 444.1 | B | 6.2 | 15.00 | SS |
| MONTEREY BAY - TULARCITOS | 451.3 | B | 7.1 | 0.50 | DS |
| PALO COLORADO - SUR | 455.6 | B | 7.0 | 3.00 | SS |
| QUIEN SABE | 456.4 | B | 6.5 | 1.00 | SS |
| MONO LAKE | 461.2 | B | 6.6 | 2.50 | DS |
| ZAYANTE-VERGELES | 476.1 | B | 6.8 | 0.10 | SS |
| SARGENT | 480.8 | B | 6.8 | 3.00 | SS |
| SAN ANDREAS (1906) | 481.4 | A | 7.9 | 24.00 | SS |
| ROBINSON CREEK | 492.5 | B | 6.5 | 0.50 | DS |
| SAN GREGORIO | 525.9 | A | 7.3 | 5.00 | SS |
| GREENVILLE | 527.2 | B | 6.9 | 2.00 | SS |
| HAYWARD (SE Extension) | 529.5 | B | 6.5 | 3.00 | SS |
| MONTE VISTA - SHANNON | 530.8 | B | 6.5 | 0.40 | DS |
| ANTELOPE VALLEY | 532.9 | B | 6.7 | 0.80 | DS |
| HAYWARD (Total Length) | 548.6 | A | 7.1 | 9.00 | SS |
| CALAVERAS (No.of Calaveras Res) | 548.6 | B | 6.8 | 6.00 | SS |
| GENOA | 558.4 | B | 6.9 | 1.00 | DS |
| CONCORD - GREEN VALLEY | 594.7 | B | 6.9 | 6.00 | SS |
| RODGERS CREEK | 633.9 | A | 7.0 | 9.00 | SS |
| WEST NAPA | 634.1 | B | 6.5 | 1.00 | SS |
| HUNTING CREEK - BERRYESSA | 655.1 | B | 6.9 | 6.00 | SS |
| POINT REYES | 655.5 | B | 6.8 | 0.30 | DS |
| MAACAMA (South) | 695.8 | B | 6.9 | 9.00 | SS |
| COLLAYOMI | 711.8 | B | 6.5 | 0.60 | SS |
| BARTLETT SPRINGS | 714.2 | A | 7.1 | 6.00 | SS |
| MAACAMA (Central) | 737.2 | A | 7.1 | 9.00 | SS |
| MAACAMA (North) | 795.8 | A | 7.1 | 9.00 | SS |
| ROUND VALLEY (N. S.F.Bay) | 800.6 | B | 6.8 | 6.00 | SS |
| BATTLE CREEK | 819.6 | B | 6.5 | 0.50 | DS |
| LAKE MOUNTAIN | 858.8 | B | 6.7 | 6.00 | SS |
| GARBERVILLE-BRICELAND | 876.6 | B | 6.9 | 9.00 | SS |
| MENDOCINO FAULT ZONE | 933.6 | A | 7.4 | 35.00 | DS |
| LITTLE SALMON (Onshore) | 938.6 | A | 7.0 | 5.00 | DS |
| MAD RIVER | 940.4 | B | 7.1 | 0.70 | DS |
| CASCADIA SUBDUCTION ZONE | 947.9 | A | 8.3 | 35.00 | DS |
| McKINLEYVILLE | 951.1 | B | 7.0 | 0.60 | DS |
| TRINIDAD | 952.5 | B | 7.3 | 2.50 | DS |
| FICKLE HILL | 953.3 | B | 6.9 | 0.60 | DS |
| TABLE BLUFF | 959.4 | B | 7.0 | 0.60 | DS |
| LITTLE SALMON (Offshore) | 972.5 | B | 7.1 | 1.00 | DS |

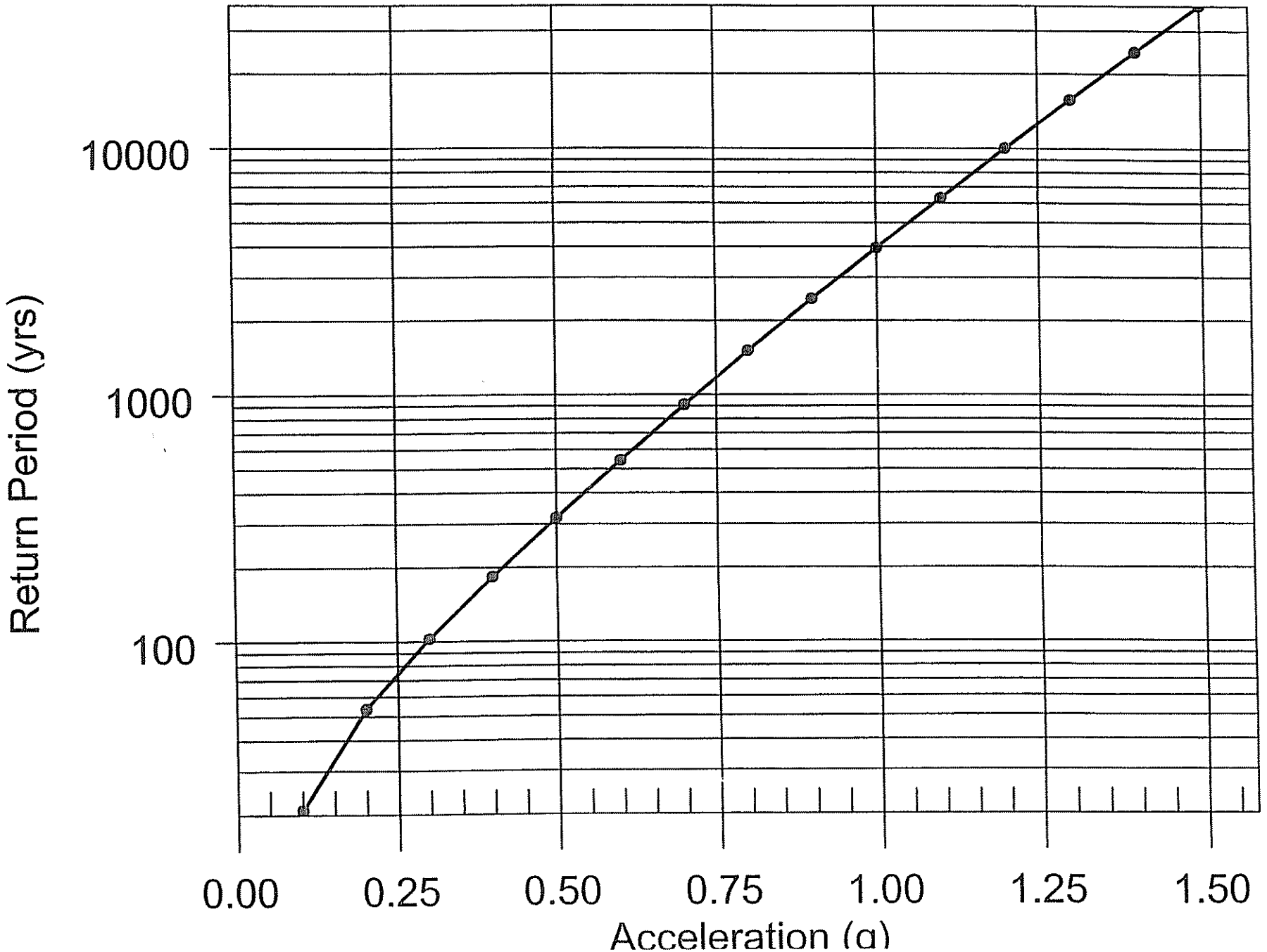
# PROBABILITY OF EXCEEDANCE

CAMP. & BOZ. (1997 Rev.) AL 1



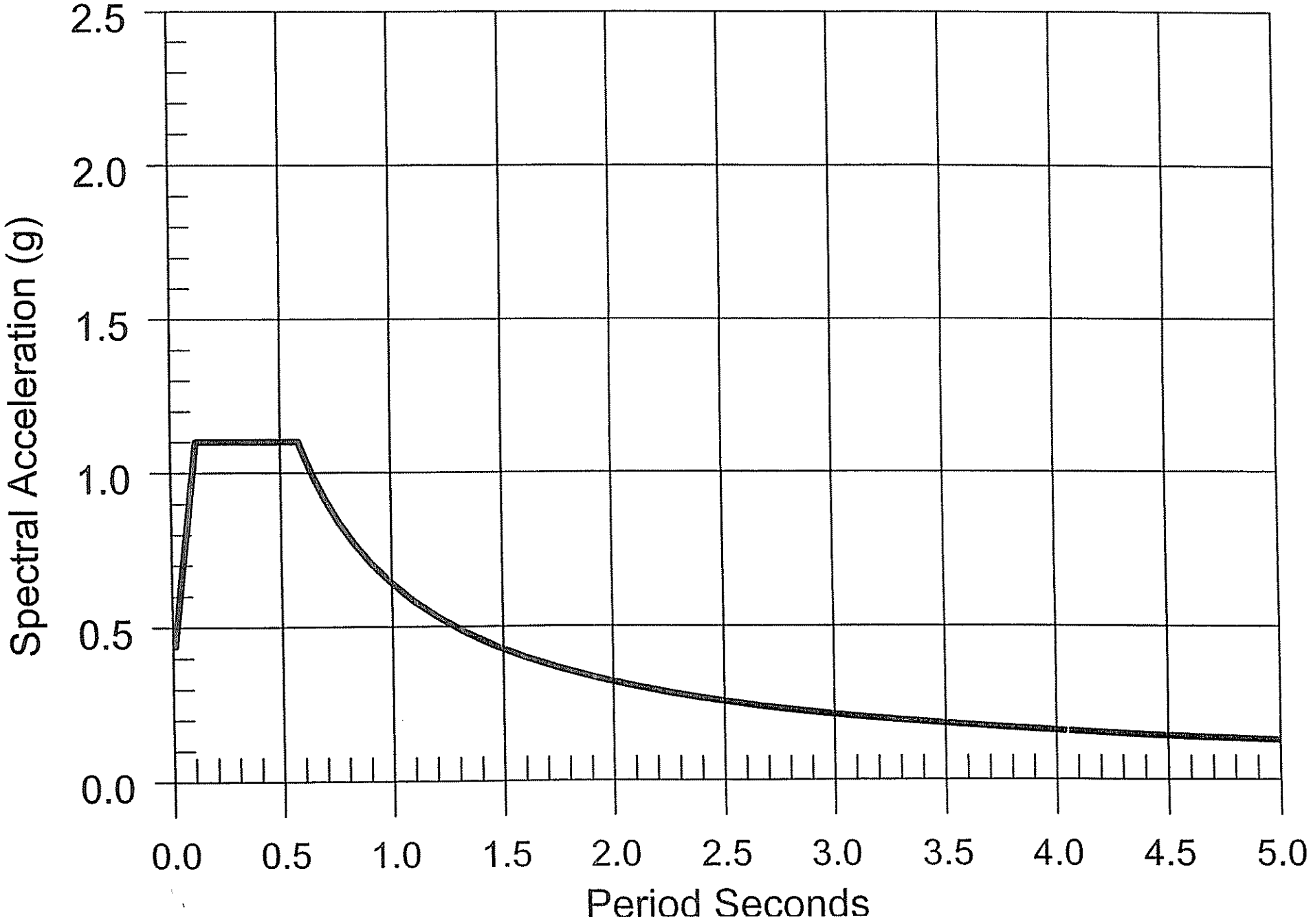
# RETURN PERIOD vs. ACCELERATION

## CAMP. & BOZ. (1997 Rev.) AL 1



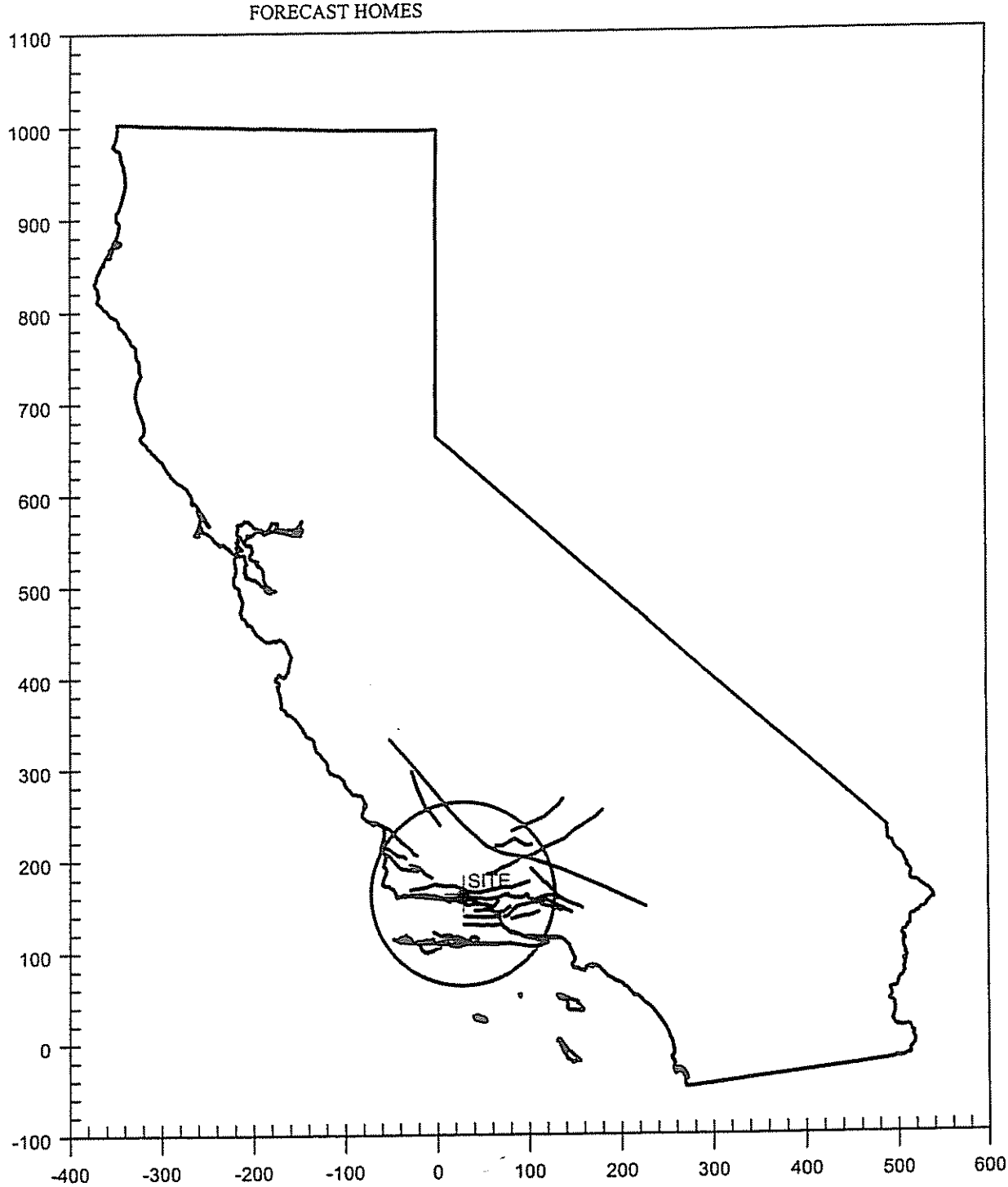
# DESIGN RESPONSE SPECTRUM

Seismic Zone: 0.4 Soil Profile: SD



# CALIFORNIA FAULT MAP

FORECAST HOMES



# APPENDIX C

# EARTHWORK AND GRADING GUIDELINES

# GENERAL EARTHWORK AND GRADING GUIDELINES

## GENERAL

These guidelines present general procedures and requirements for earthwork and grading as shown on the approved grading plans, including preparation of areas to filled, placement of fill, installation of subdrains and excavations. The recommendations contained in the geotechnical report are part of the earthwork and grading guidelines and would supersede the provisions contained hereafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new recommendations which could supersede these guidelines or the recommendations contained in the geotechnical report.

The contractor is responsible for the satisfactory completion of all earthwork in accordance with provisions of the project plans and specifications. The project soil engineer and engineering geologist (geotechnical consultant) or their representatives should provide observation and testing services, and geotechnical consultation during the duration of the project.

## EARTHWORK OBSERVATIONS AND TESTING

### Geotechnical Consultant

Prior to the commencement of grading, a qualified geotechnical consultant (soil engineer and engineering geologist) should be employed for the purpose of observing earthwork procedures and testing the fills for conformance with the recommendations of the geotechnical report, the approved grading plans, and applicable grading codes and ordinances.

The geotechnical consultant should provide testing and observation so that determination may be made that the work is being accomplished as specified. It is the responsibility of the contractor to assist the consultants and keep them apprised of anticipated work schedules and changes, so that they may schedule their personnel accordingly.

All clean-outs, prepared ground to receive fill, key excavations, and subdrains should be observed and documented by the project engineering geologist and/or soil engineer prior to placing and fill. It is the contractors's responsibility to notify the engineering geologist and soil engineer when such areas are ready for observation.

### Laboratory and Field Tests

Maximum dry density tests to determine the degree of compaction should be performed in accordance with American Standard Testing Materials test method ASTM designation D-1557-78. Random field compaction tests should be performed in accordance with test method ASTM designation D-1556-82, D-2937 or D-2922 and D-3017, at intervals of approximately 2 feet of fill height or every 100 cubic yards of fill placed. These criteria would vary depending on the soil conditions and the size of the project. The location and frequency of testing would be at the discretion of the geotechnical consultant.

## Contractor's Responsibility

All clearing, site preparation, and earthwork performed on the project should be conducted by the contractor, with observation by geotechnical consultants and staged approval by the governing agencies, as applicable. It is the contractor's responsibility to prepare the ground surface to receive the fill, to the satisfaction of the soil engineer, and to place, spread, moisture condition, mix and compact the fill in accordance with the recommendations of the soil engineer. The contractor should also remove all major non-earth material considered unsatisfactory by the soil engineer.

It is the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the earthwork in accordance with applicable grading guidelines, codes or agency ordinances, and approved grading plans. Sufficient watering apparatus and compaction equipment should be provided by the contractor with due consideration for the fill material, rate of placement, and climatic conditions. If, in the opinion of the geotechnical consultant, unsatisfactory conditions such as questionable weather, excessive oversized rock, or deleterious material, insufficient support equipment, etc., are resulting in a quality of work that is not acceptable, the consultant will inform the contractor, and the contractor is expected to rectify the conditions, and if necessary, stop work until conditions are satisfactory.

During construction, the contractor shall properly grade all surfaces to maintain good drainage and prevent ponding of water. The contractor shall take remedial measures to control surface water and to prevent erosion of graded areas until such time as permanent drainage and erosion control measures have been installed.

## SITE PREPARATION

All major vegetation, including brush, trees, thick grasses, organic debris, and other deleterious material should be removed and disposed of off-site. These removals must be concluded prior to placing fill. Existing fill, soil, alluvium, colluvium, or rock materials determined by the soil engineer or engineering geologist as being unsuitable in-place should be removed prior to fill placement. Depending upon the soil conditions, these materials may be reused as compacted fills. Any materials incorporated as part of the compacted fills should be approved by the soil engineer.

Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, or other structures not located prior to grading are to be removed or treated in a manner recommended by the soil engineer. Soft, dry, spongy, highly fractured, or otherwise unsuitable ground extending to such a depth that surface processing cannot adequately improve the condition should be over-excavated down to firm ground and approved by the soil engineer before compaction and filling operations continue. Overexcavated and processed soils which have been properly mixed and moisture conditioned should be re-compacted to the minimum relative compaction as specified in these guidelines.

Existing ground which is determined to be satisfactory for support of the fills should be scarified to a minimum depth of 6 inches or as directed by the soil engineer. After the scarified ground is brought to optimum moisture content or greater and mixed, the materials should be compacted as specified herein. If the scarified zone is grater that 6 inches in depth, it may be necessary to remove the excess and place the material in lifts restricted to about 6 inches in compacted thickness.

Existing ground which is not satisfactory to support compacted fill should be over-excavated as required in the geotechnical report or by the on-site soils engineer and/or engineering geologist. Scarification, disc harrowing, or other acceptable form of mixing should continue until the soils are broken down and free of large lumps or clods, until the working surface is reasonably uniform and free from ruts, hollow, hummocks, or other uneven features which would inhibit compaction as described previously.

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical), the ground should be stepped or benched. The lowest bench, which will act as a key, should be a minimum of 15 feet wide and should be at least 2 feet deep into firm material, and approved by the soil engineer and/or engineering geologist. In fill over cut slope conditions, the recommended minimum width of the lowest bench or key is also 15 feet with the key founded on firm material, as designated by the Geotechnical Consultant. As a general rule, unless specifically recommended otherwise by the Soil Engineer, the minimum width of fill keys should be approximately equal to ½ the height of the slope.

Standard benching is generally 4 feet (minimum) vertically, exposing firm, acceptable material. Benching may be used to remove unsuitable materials, although it is understood that the vertical height of the bench may exceed 4 feet. Pre-stripping may be considered for unsuitable materials in excess of 4 feet in thickness.

All areas to receive fill, including processed areas, removal areas, and the toe of fill benches should be observed and approved by the soil engineer and/or engineering geologist prior to placement of fill. Fills may then be properly placed and compacted until design grades (elevations) are attained.

## COMPACTED FILLS

Any earth materials imported or excavated on the property may be utilized in the fill provided that each material has been determined to be suitable by the soil engineer. These materials should be free of roots, tree branches, other organic matter or other deleterious materials. All unsuitable materials should be removed from the fill as directed by the soil engineer. Soils of poor gradation, undesirable expansion potential, or substandard strength characteristics may be designated by the consultant as unsuitable and may require blending with other soils to serve as a satisfactory fill material.

Fill materials derived from benching operations should be dispersed throughout the fill area and blended with other bedrock derived material. Benching operations should not result in the benched material being placed only within a single equipment width away from the fill/bedrock contact.

Oversized materials defined as rock or other irreducible materials with a maximum dimension greater than 12 inches should not be buried or placed in fills unless the location of materials and disposal methods are specifically approved by the soil engineer. Oversized material should be taken off-site or placed in accordance with recommendations of the soil engineer in areas designated as suitable for rock disposal. Oversized material should not be placed within 10 feet vertically of finish grade (elevation) or within 20 feet horizontally of slope faces. To facilitate future trenching, rock should not be placed within the range of foundation excavations, future utilities, or underground construction unless specifically approved by the soil engineer and/or the developers representative.

If import material is required for grading, representative samples of the materials to be utilized as compacted fill should be analyzed in the laboratory by the soil engineer to determine its physical properties. If any material other than that previously tested is encountered during grading, an appropriate analysis of this material should be conducted by the soil engineer as soon as possible.

Approved fill material should be placed in areas prepared to receive fill in near horizontal layers that when compacted should not exceed 6 inches in thickness. The soil engineer may approve thick lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer should be spread evenly and blended to attain uniformity of material and moisture suitable for compaction.

Fill layers at a moisture content less than optimum should be watered and mixed, and wet fill layers should be aerated by scarification or should be blended with drier material. Moisture condition, blending, and mixing of the fill layer should continue until the fill materials have a uniform moisture content at or above optimum moisture.

After each layer has been evenly spread, moisture conditioned and mixed, it should be uniformly compacted to a minimum of 90 percent of maximum density as determined by ASTM test designation, D-1557-78, or as otherwise recommended by the soil engineer. Compaction equipment should be adequately sized and should be specifically designed for soil compaction or of proven reliability to efficiently achieve the specified degree of compaction.

Where tests indicate that the density of any layer of fill, or portion thereof, is below the required relative compaction, or improper moisture is in evidence, the particular layer or portion shall be re-worked until the required density and/or moisture content has been attained. No additional fill shall be placed in an area until the last placed lift of fill has been tested and found to meet the density and moisture requirements, and is approved by the soil engineer.

Compaction of slopes should be accomplished by over-building a minimum of 3 feet horizontally, and subsequently trimming back to the design slope configuration. Testing shall be performed as the fill is elevated to evaluate compaction as the fill core is being developed. Special efforts may be necessary to attain the specified compaction in the fill slope zone. Final slope shaping should be performed by trimming and removing loose materials with appropriate equipment. A final determination of fill slope compaction should be based on observation and/or testing of the finished slope face. Where compacted fill slopes are designed steeper than 2:1 (horizontal to vertical), specific material types, a higher minimum relative compaction, and special grading procedures, may be recommended.

If an alternative to over-building and cutting back the compacted fill slopes is selected, then special effort should be made to achieve the required compaction in the outer 10 feet of each lift of fill by undertaking the following:

1. An extra piece of equipment consisting of a heavy short shanked sheepsfoot should be used to roll (horizontal) parallel to the slopes continuously as fill is placed. The sheepsfoot roller should also be used to roll perpendicular to the slopes, and extend out over the slope to provide adequate compaction to the face of the slope.

2. Loose fill should not be spilled out over the face of the slope as each lift is compacted. Any loose fill spilled over a previously completed slope face should be trimmed off or be subject to re-rolling.

3. Field compaction tests will be made in the outer (horizontal) 2 to 8 feet of the slope at appropriate vertical intervals, subsequent to compaction operations.

4. After completion of the slope, the slope face should be shaped with a small tractor and then re-rolled with a sheepsfoot to achieve compaction to near the slope face. Subsequent to testing to verify compaction, the slopes should be grid-rolled to achieve compaction to the slope face. Final testing should be used to confirm compaction after grid rolling.

5. Where testing indicates less than adequate compaction, the contractor will be responsible to rip, water, mix and re-compact the slope material as necessary to achieve compaction. Additional testing should be performed to verify compaction.

6. Erosion control and drainage devices should be designed by the project civil engineer in compliance with ordinances of the controlling governmental agencies, and/or in accordance with the recommendation of the soil engineer or engineering geologist.

## SUBDRAIN INSTALLATION

Subdrains should be installed in approved ground in accordance with the approximate alignment and details indicated by the geotechnical consultant. Subdrain locations or materials should not be changed or modified without approval of the geotechnical consultant. The soil engineer and/or engineering geologist may recommend and direct changes in subdrain line, grade and drain material in the field, pending exposed conditions. The location of constructed subdrains should be recorded by the project civil engineer.

## EXCAVATIONS

Excavations and cut slopes should be examined during grading by the engineering geologist. If directed by the engineering geologist, further excavations or overexcavation and re-filling of cut areas should be performed and/or remedial grading of cut slopes should be performed. When fill over cut slopes are to be graded, unless otherwise approved, the cut portion of the slope should be observed by the engineering geologist prior to placement of materials for construction of the fill portion of the slope.

The engineering geologist should observe all cut slopes and should be notified by the contractor when cut slopes are started.

If, during the course of grading, unforeseen adverse or potential adverse geologic conditions are encountered, the engineering geologist and soil engineer should investigate, evaluate and make recommendations to treat these problems. The need for cut slope buttressing or stabilizing should be based on in-grading evaluation by the engineering geologist, whether anticipated or not.

Unless otherwise specified in soil and geological reports, no cut slopes should be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies. Additionally, short-term stability of temporary cut slopes is the contractors responsibility.

Erosion control and drainage devices should be designed by the project civil engineer and should be constructed in compliance with the ordinances of the controlling governmental agencies, and/or in accordance with the recommendations of the soil engineer or engineering geologist.

## COMPLETION

Observation, testing and consultation by the geotechnical consultant should be conducted during the grading operations in order to state an opinion that all cut and filled areas are graded in accordance with the approved project specifications.

After completion of grading and after the soil engineer and engineering geologist have finished their observations of the work, final reports should be submitted subject to review by the controlling governmental agencies. No further excavation or filling should be undertaken without prior notification of the soil engineer and/or engineering geologist.

All finished cut and fill slopes should be protected from erosion and/or be planted in accordance with the project specifications and/or as recommended by a landscape architect. Such protection and/or planning should be undertaken as soon as practical after completion of grading.

## JOB SAFETY

### General

At GeoSoils, Inc. (GSI) getting the job done safely is of primary concern. The following is the company's safety considerations for use by all employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading and construction projects. GSI recognizes that construction activities will vary on each site and that site safety is the prime responsibility of the contractor; however, everyone must be safety conscious and responsible at all times. To achieve our goal of avoiding accidents, cooperation between the client, the contractor and GSI personnel must be maintained.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of field personnel on grading and construction projects:

**Safety Meetings:** GSI field personnel are directed to attend contractors regularly scheduled and documented safety meetings.

**Safety Vests:** Safety vests are provided for and are to be worn by GSI personnel at all times when they are working in the field.

**Safety Flags:** Two safety flags are provided to GSI field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

**Flashing Lights:** All vehicles stationary in the grading area shall use rotating or flashing amber beacon, or strobe lights, on the vehicle during all field testing. While operating a vehicle in the grading area, the emergency flasher on the vehicle shall be activated.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

## Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. A primary concern should be the technicians's safety. Efforts will be made to coordinate locations with the grading contractors authorized representative, and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative (dump man, operator, supervisor, grade checker, etc.) should direct excavation of the pit and safety during the test period. Of paramount concern should be the soil technicians safety and obtaining enough tests to represent the fill.

Test pits should be excavated so that the spoil pile is placed away form oncoming traffic, whenever possible. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates the fill be maintained in a driveable condition. Alternatively, the contractor may wish to park a piece of equipment in front of the test holes, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits. No grading equipment should enter this zone during the testing procedure. The zone should extend approximately 50 feet outward from the center of the test pit. This zone is established for safety and to avoid excessive ground vibration which typically decreased test results.

When taking slope tests the technician should park the vehicle directly above or below the test location. If this is not possible, a prominent flag should be placed at the top of the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during this testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location, well away from the equipment traffic pattern.

The contractor should inform our personnel of all changes to haul roads, cut and fill areas or other factors that may affect site access and site safety.

In the event that the technicians safety is jeopardized or compromised as a result of the contractors failure to comply with any of the above, the technician is required, by company policy, to immediately withdraw and notify his/her supervisor. The grading contractors representative will eventually be contacted in an effort to effect a solution. However, in the interim, no further testing will be performed until the situation is rectified. Any fill place can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor brings this to his/her attention and notify this office. Effective communication and coordination between the contractors representative and the soils technician is strongly encouraged in order to implement the above safety plan.

## Trench and Vertical Excavation

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed.

Our personnel are directed not to enter any excavation or vertical cut which 1) is 5 feet or deeper unless shored or laid back, 2) displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or 3) displays any other evidence of any unsafe conditions regardless of depth.

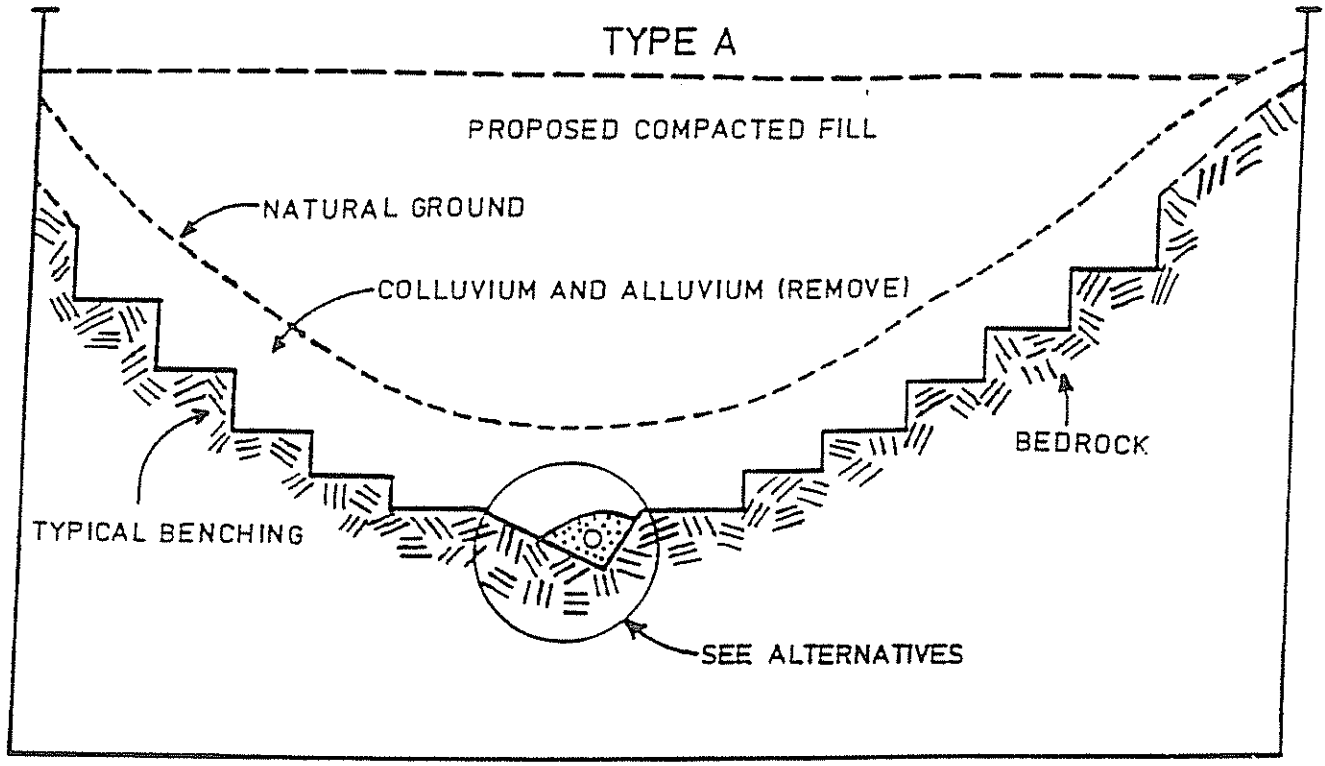
All trench excavations or vertical cuts in excess of 5 feet deep, which any person enters, should be shored or laid back.

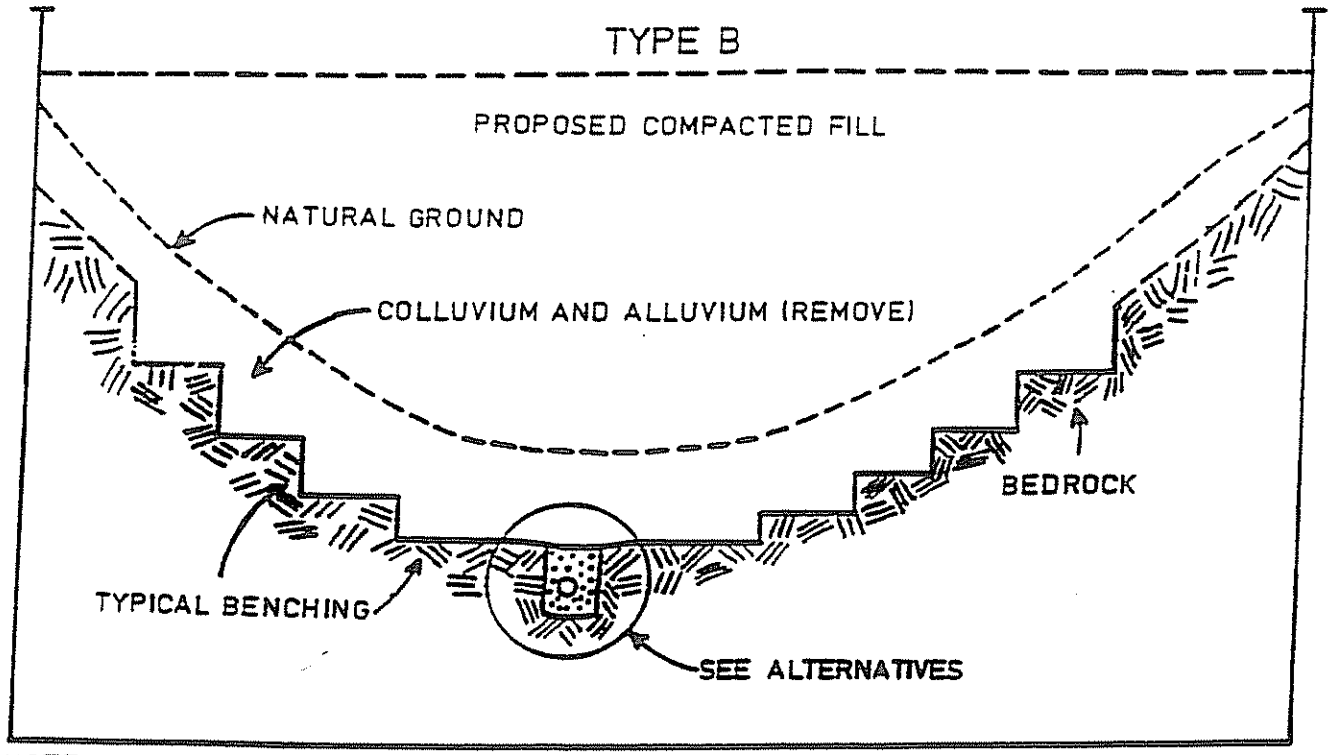
Trench access should be provided in accordance with CAL-OSHA and/or state and local standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraw and notify his/her supervisor. The contractors representative will eventually be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons could be subject to reprocessing and/or removal.

If GSI personnel become aware of anyone working beneath an unsafe trench wall or vertical excavation, we have a legal obligation to put the contractor and owner/developer on notice to immediately correct the situation. If corrective steps are not taken, GSI then has an obligation to notify CAL-OSHA and/or the proper authorities.

# CANYON SUBDRAIN DETAIL



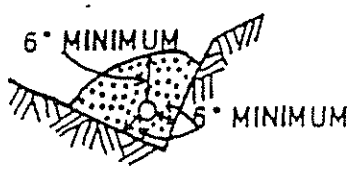




NOTE: ALTERNATIVES, LOCATION AND EXTENT OF SUBDRAINS SHOULD BE DETERMINED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST DURING GRADING.

PLATE EG—1

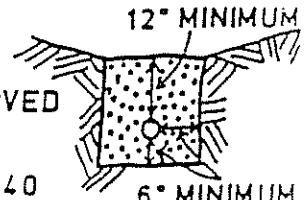
# CANYON SUBDRAIN ALTERNATE DETAILS

## ALTERNATE 1: PERFORATED PIPE AND FILTER MATERIAL



A—1

FILTER MATERIAL: MINIMUM VOLUME OF 9 FT.³ /LINEAR FT. 6" ø ABS OR PVC PIPE OR APPROVED SUBSTITUTE WITH MINIMUM 8 (1/4" ø) PERFS. LINEAR FT. IN BOTTOM HALF OF PIPE.
ASTM D2751, SDR 35 OR ASTM D1527, SCHD. 40
ASTM D3034, SDR 35 OR ASTM D1785, SCHD. 40
FOR CONTINUOUS RUN IN EXCESS OF 500 FT. USE 8" ø PIPE

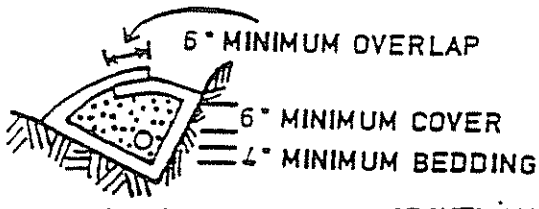


B—1

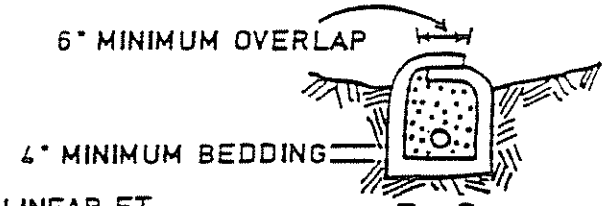
### FILTER MATERIAL

| SIEVE SIZE | PERCENT PASSING |
|---|---|
| 1 INCH | 100 |
| 3/4 INCH | 90—100 |
| 3/8 INCH | 40—100 |
| NO. 4 | 25—40 |
| NO. 8 | 18—33 |
| NO. 30 | 5—15 |
| NO. 50 | 0—7 |
| NO. 200 | 0—3 |

## ALTERNATE 2: PERFORATED PIPE, GRAVEL AND FILTER FABRIC



A—2

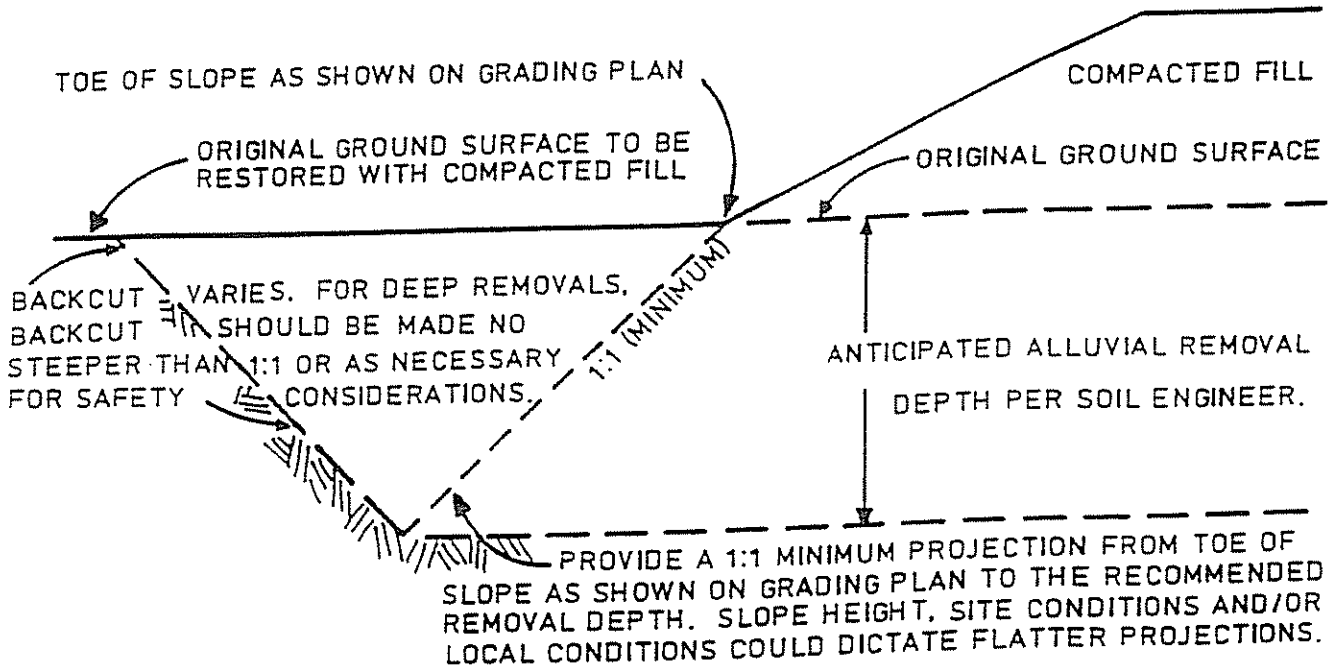


B—2

GRAVEL MATERIAL 9 FT³/LINEAR FT.
PERFORATED PIPE: SEE ALTERNATE 1
GRAVEL: CLEAN 3/4 INCH ROCK OR APPROVED SUBSTITUTE
FILTER FABRIC: MIRAFI 140 OR APPROVED SUBSTITUTE

PLATE EG—2

# DETAIL FOR FILL SLOPE TOEING OUT ON FLAT ALLUVIATED CANYON




# REMOVAL ADJACENT TO EXISTING FILL

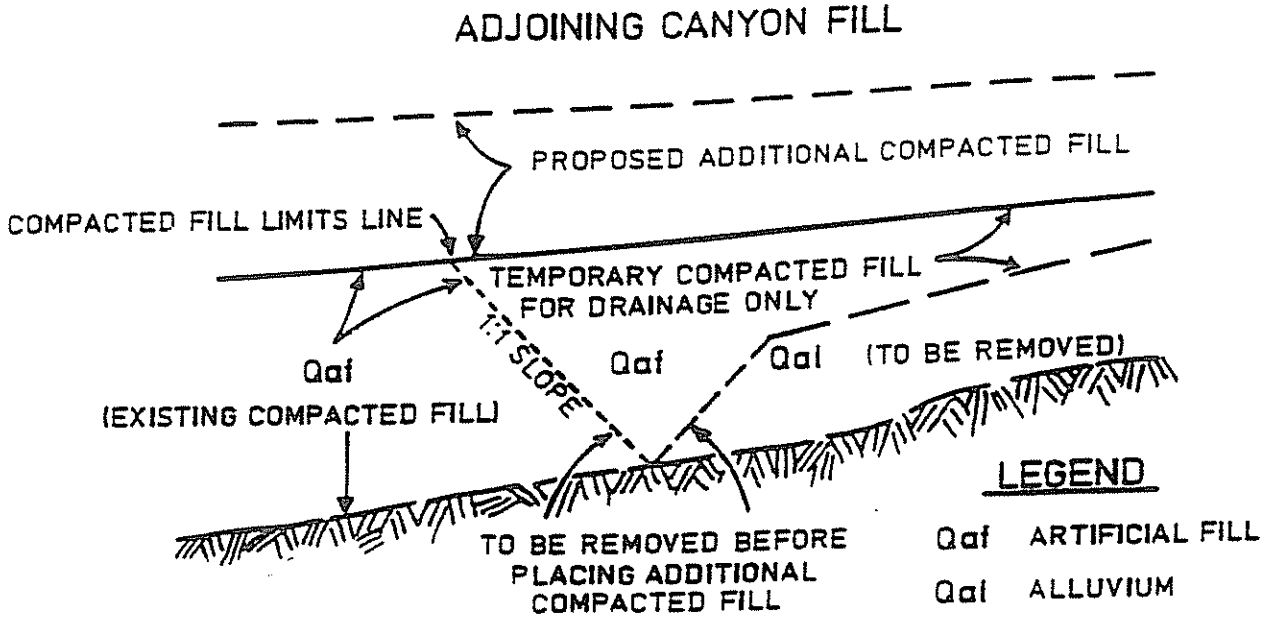



PLATE EG—3

# TYPICAL STABILIZATION / BUTTRESS FILL DETAIL

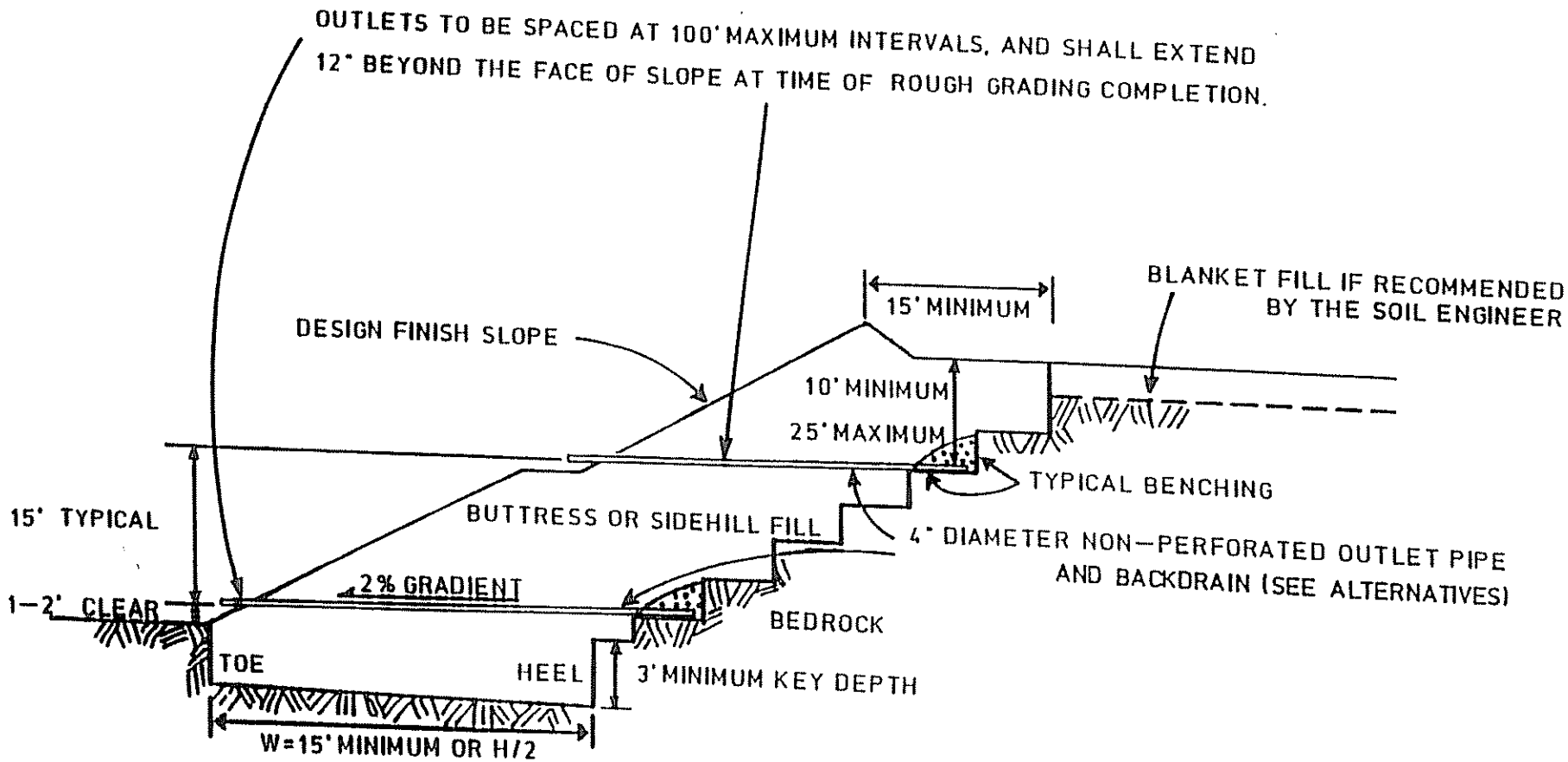
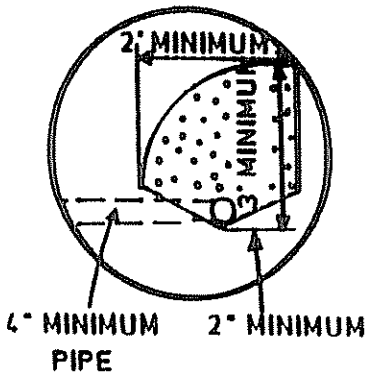



PLATE EG-4

# TYPICAL STABILIZATION / BUTTRESS SUBDRAIN DETAIL



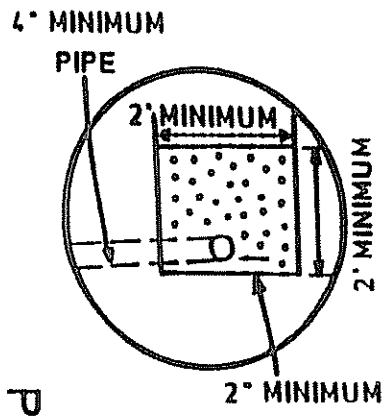




PLATE EG-5

FILTER MATERIAL: MINIMUM OF FIVE FT³/LINEAR FT OF PIPE OR FOUR FT³/LINEAR FT OF PIPE WHEN PLACED IN SQUARE CUT TRENCH.

ALTERNATIVE IN LIEU OF FILTER MATERIAL: GRAVEL MAY BE ENCASED IN APPROVED FILTER FABRIC. FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12" ON ALL JOINTS.

MINIMUM 4" DIAMETER PIPE: ABS—ASTM D—2751, SDR 35 OR ASTM D—1527 SCHEDULE 40 PVC—ASTM D—3034, SDR 35 OR ASTM D—1785 SCHEDULE 40 WITH A CRUSHING STRENGTH OF 1,000 POUNDS MINIMUM, AND A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS OF BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE AT 2% TO OUTLET PIPE. OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW.

NOTE: 1. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON—SITE SOIL.

2. BACKDRAINS AND LATERAL DRAINS SHALL BE LOCATED AT ELEVATION OF EVERY BENCH DRAIN. FIRST DRAIN LOCATED AT ELEVATION JUST ABOVE LOWER LOT GRADE. ADDITIONAL DRAINS MAY BE REQUIRED AT THE DISCRETION OF THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST.

FILTER MATERIAL SHALL BE OF THE FOLLOWING SPECIFICATION OR AN APPROVED EQUIVALENT:

| SIEVE SIZE | PERCENT PASSING |
|---|---|
| 1 INCH | 100 |
| 3/4 INCH | 90—100 |
| 3/8 INCH | 40—100 |
| NO. 4 | 25—40 |
| NO. 8 | 18—33 |
| NO. 30 | 5—15 |
| NO. 50 | 0—7 |
| NO. 200 | 0—3 |

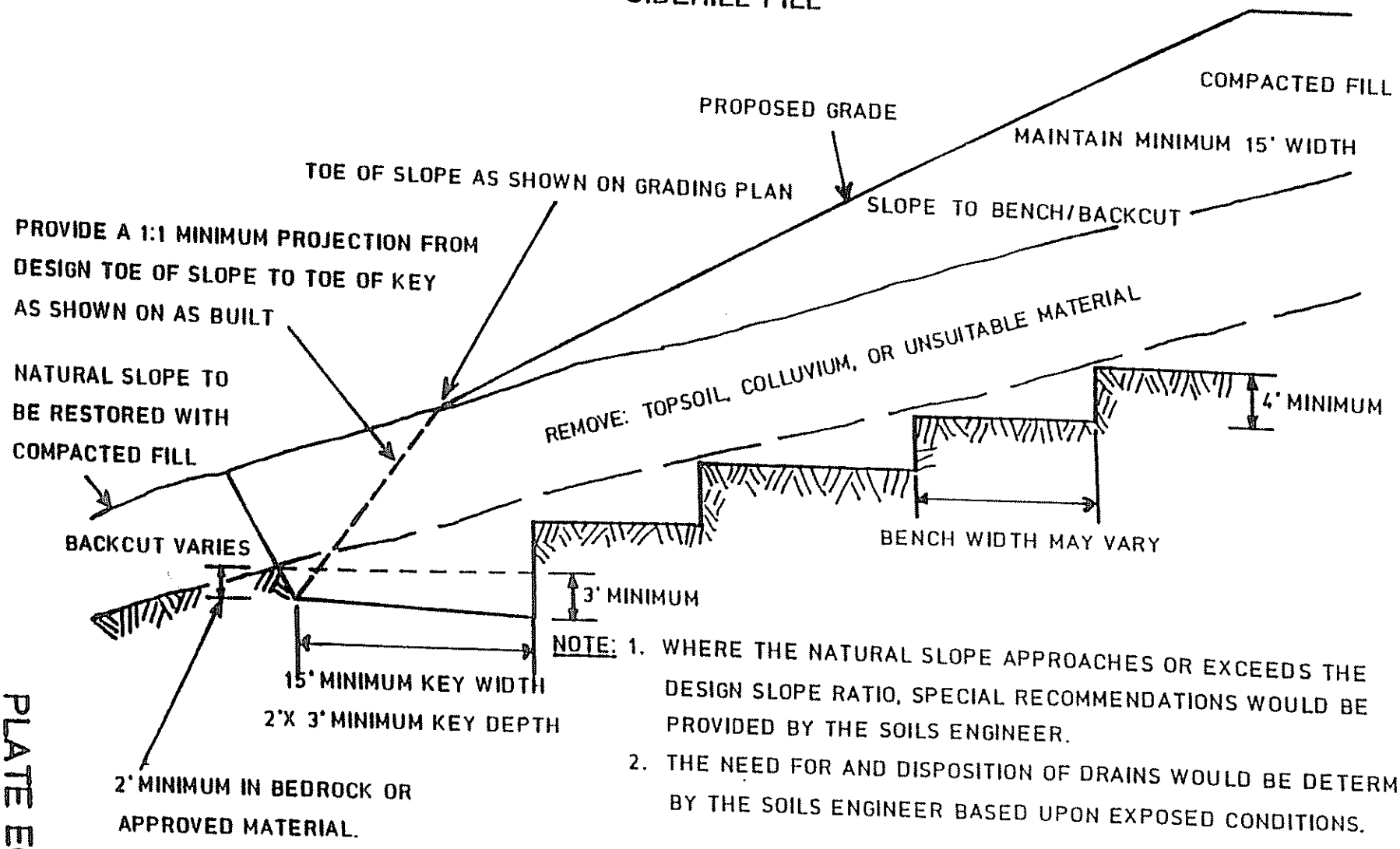
GRAVEL SHALL BE OF THE FOLLOWING SPECIFICATION OR AN APPROVED EQUIVALENT:

| SIEVE SIZE | PERCENT PASSING |
|---|---|
| 1 1/2 INCH | 100 |
| NO. 4 | 50 |
| NO. 200 | 8 |

SAND EQUIVALENT: MINIMUM OF 50

# FILL OVER NATURAL DETAIL

## SIDEHILL FILL

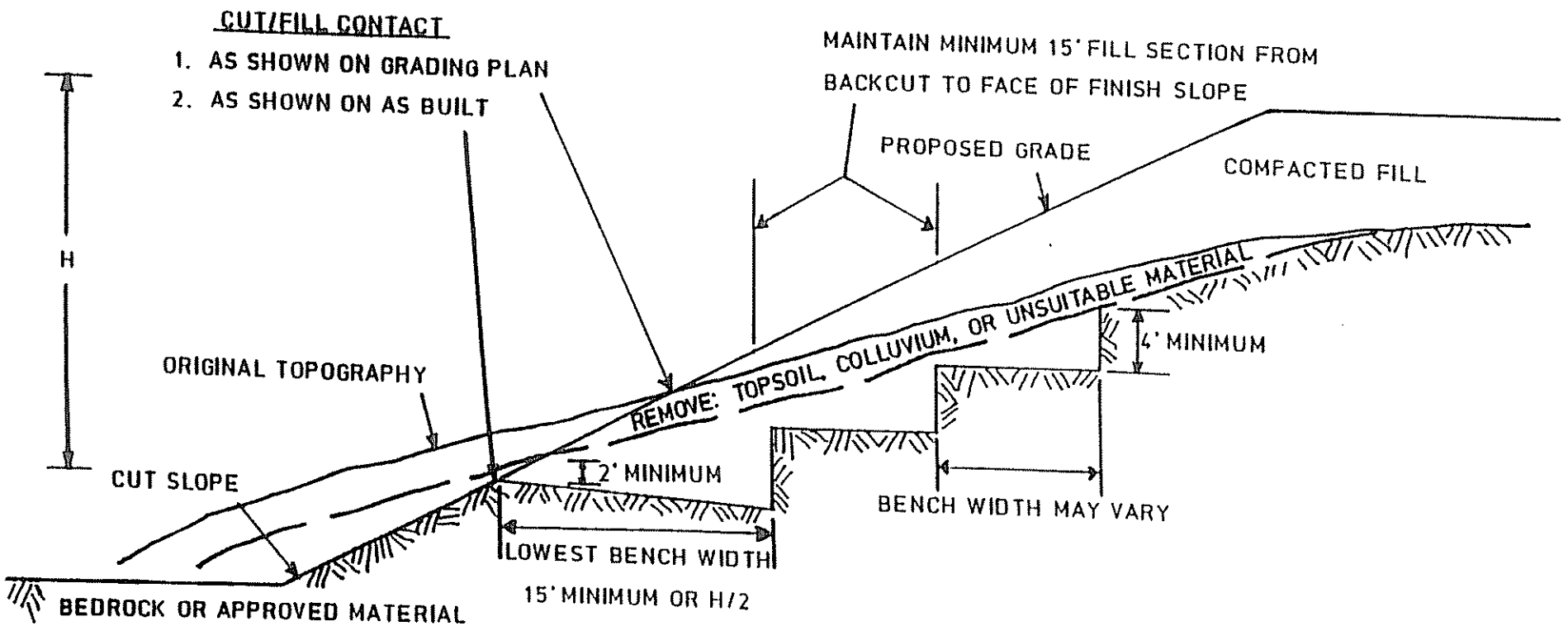



NOTE: 1. WHERE THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN SLOPE RATIO, SPECIAL RECOMMENDATIONS WOULD BE PROVIDED BY THE SOILS ENGINEER.

2. THE NEED FOR AND DISPOSITION OF DRAINS WOULD BE DETERMINED BY THE SOILS ENGINEER BASED UPON EXPOSED CONDITIONS.

PLATE EG-6

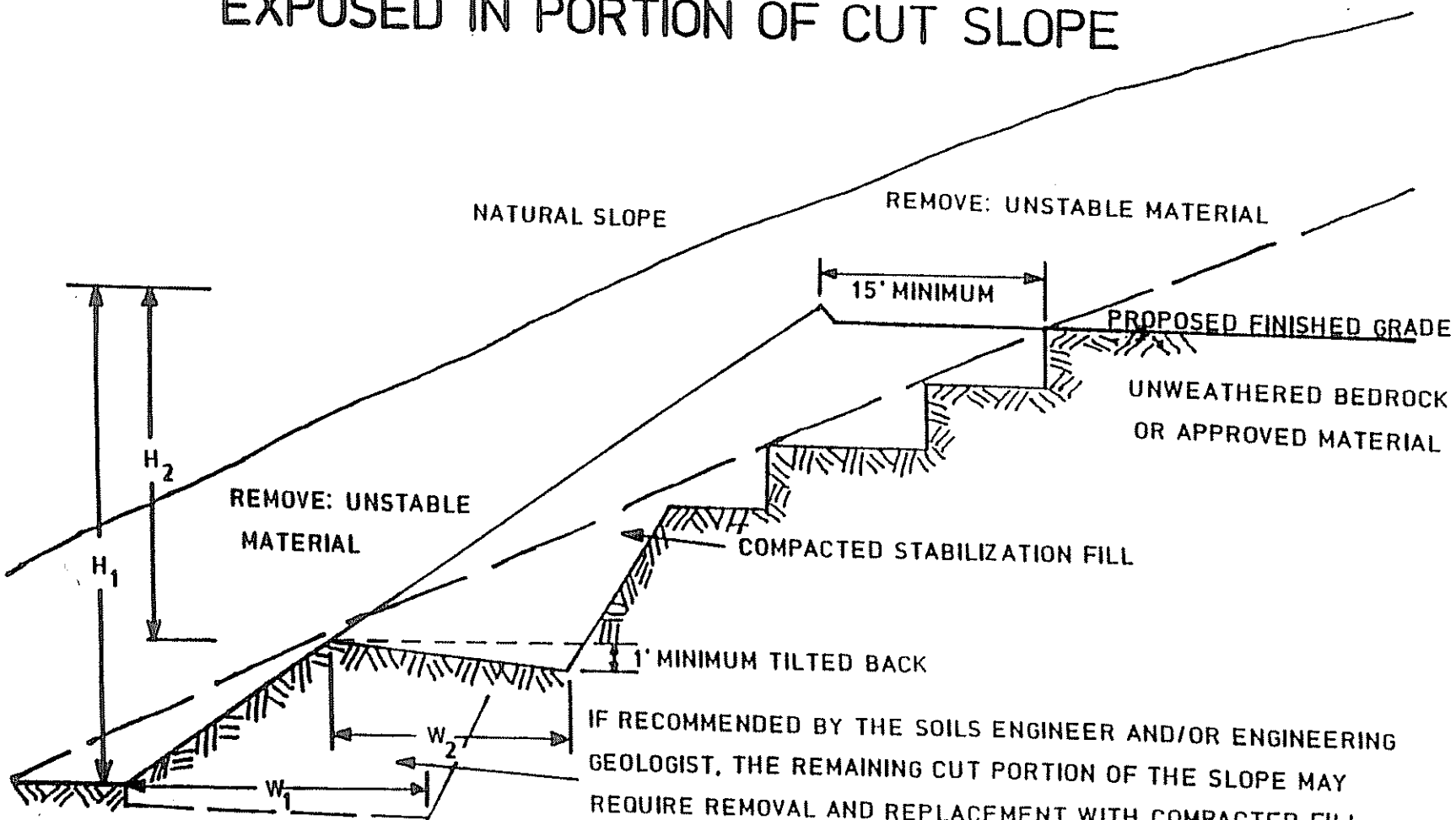
# FILL OVER CUT DETAIL




NOTE: THE CUT PORTION OF THE SLOPE SHOULD BE EXCAVATED AND EVALUATED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST PRIOR TO CONSTRUCTING THE FILL PORTION.

PLATE EG-7

# STABILIZATION FILL FOR UNSTABLE MATERIAL EXPOSED IN PORTION OF CUT SLOPE

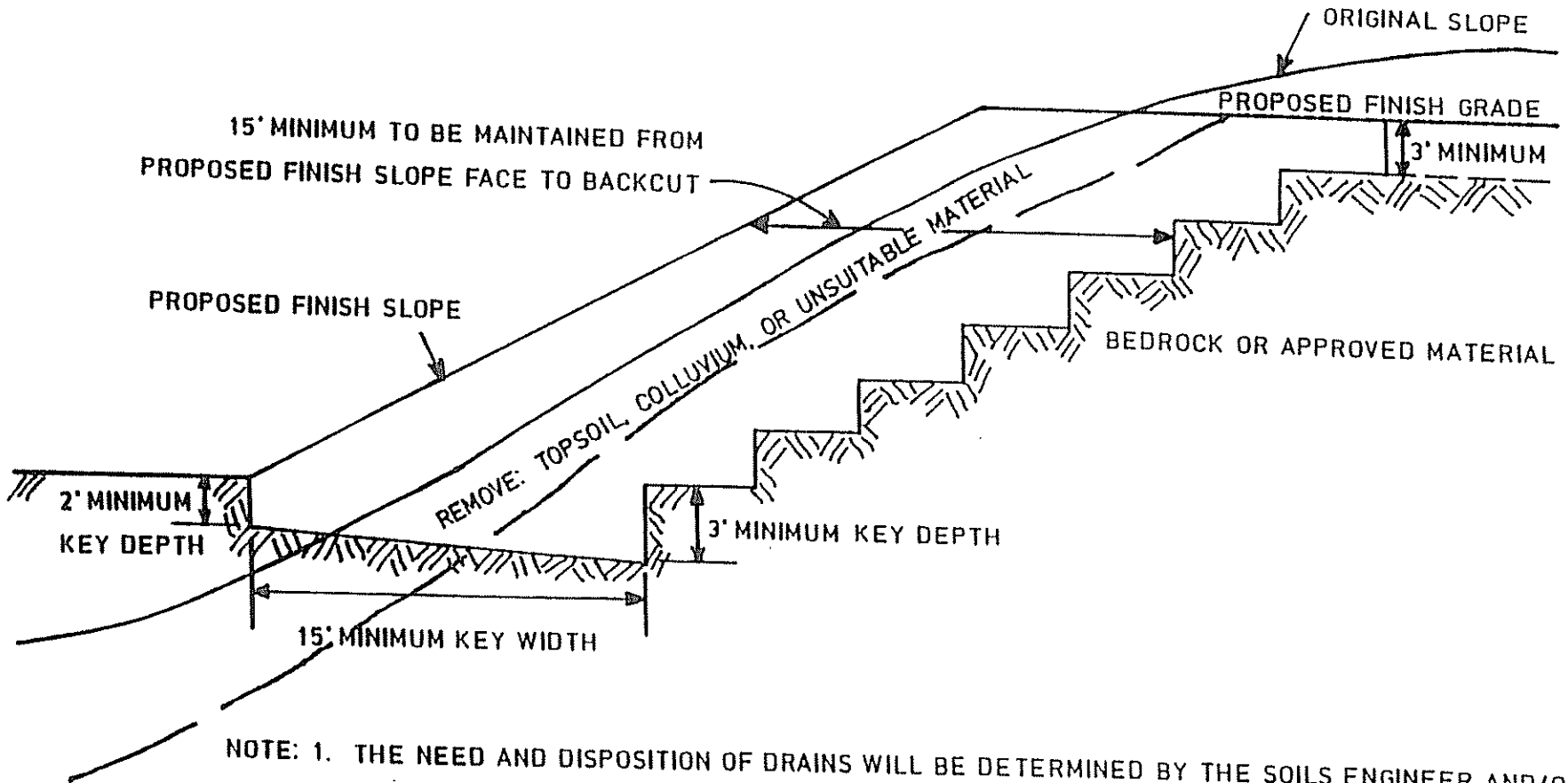



NOTE: 1. SUBDRAINS ARE NOT REQUIRED UNLESS SPECIFIED BY SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST.

2. "W" SHALL BE EQUIPMENT WIDTH (15') FOR SLOPE HEIGHTS LESS THAN 25 FEET. FOR SLOPES GREATER THAN 25 FEET "W" SHALL BE DETERMINED BY THE PROJECT SOILS ENGINEER AND /OR ENGINEERING GEOLOGIST. AT NO TIME SHALL "W" BE LESS THAN H/2.

PLATE EG—8

# SKIN FILL OF NATURAL GROUND

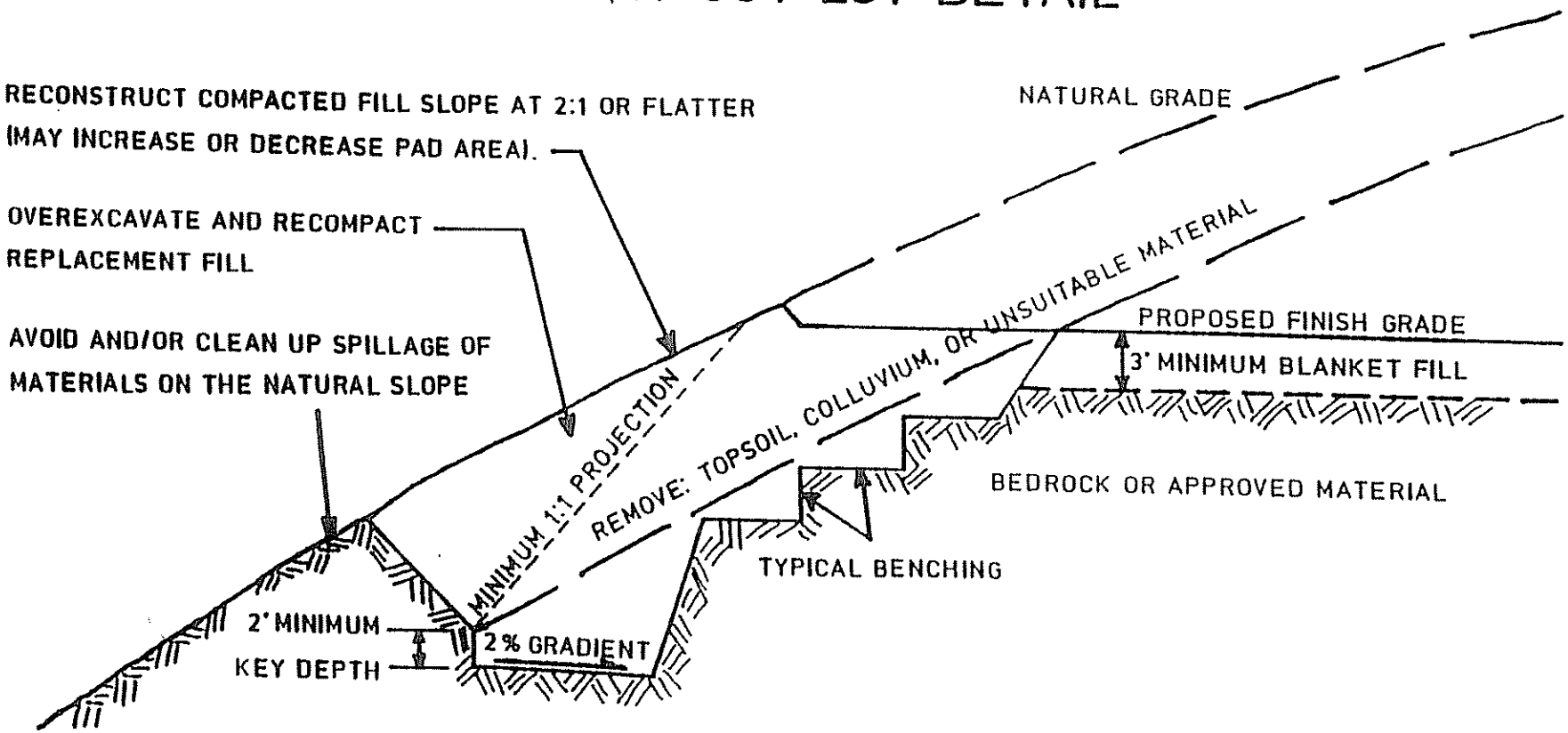



NOTE: 1. THE NEED AND DISPOSITION OF DRAINS WILL BE DETERMINED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST BASED ON FIELD CONDITIONS.

2. PAD OVEREXCAVATION AND RECOMPACTION SHOULD BE PERFORMED IF DETERMINED TO BE NECESSARY BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST.

PLATE EG-9

# DAYLIGHT CUT LOT DETAIL



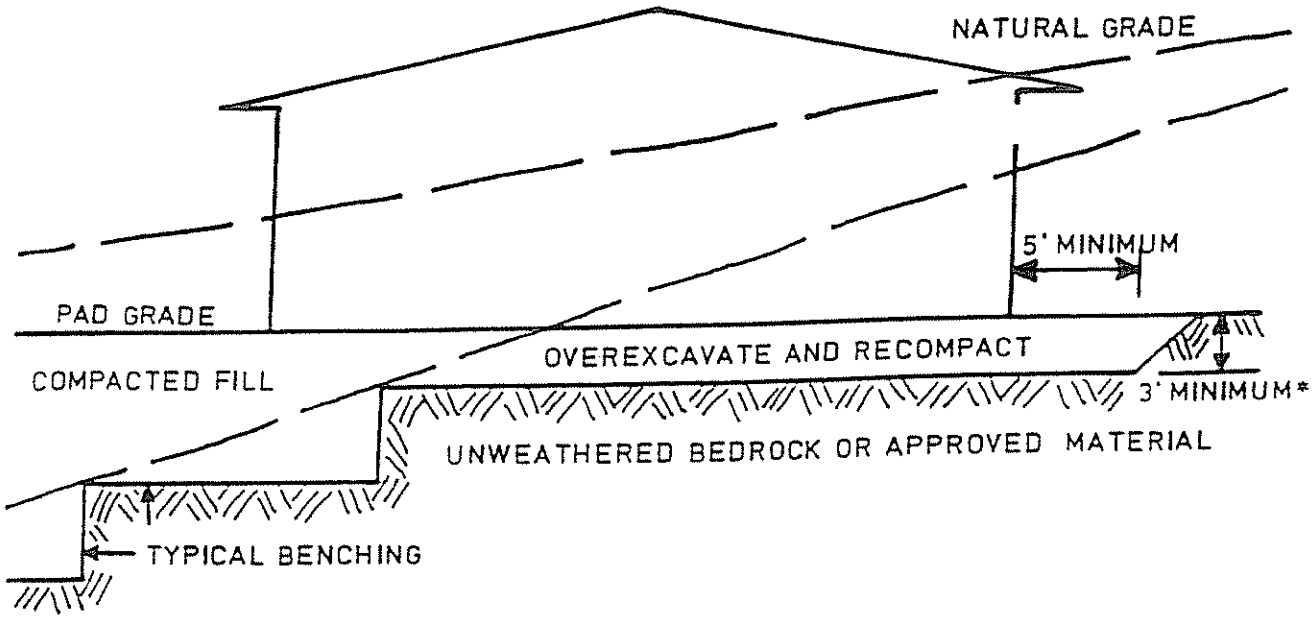

NOTE: 1. SUBDRAIN AND KEY WIDTH REQUIREMENTS WILL BE DETERMINED BASED ON EXPOSED SUBSURFACE CONDITIONS AND THICKNESS OF OVERBURDEN.

2. PAD OVER EXCAVATION AND RECOMPACTION SHOULD BE PERFORMED IF DETERMINED NECESSARY BY THE SOILS ENGINEER AND/OR THE ENGINEERING GEOLOGIST.

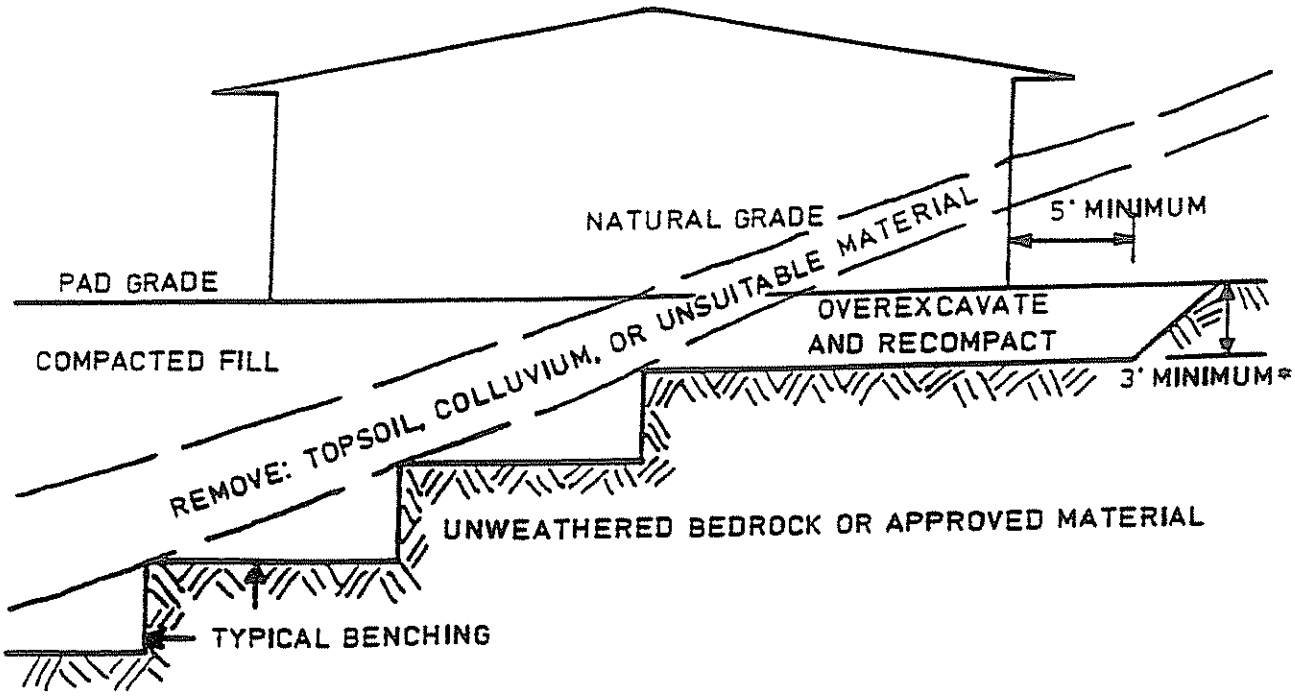
PLATE EG—10

# TRANSITION LOT DETAIL

## CUT LOT (MATERIAL TYPE TRANSITION)




## CUT—FILL LOT (DAYLIGHT TRANSITION)



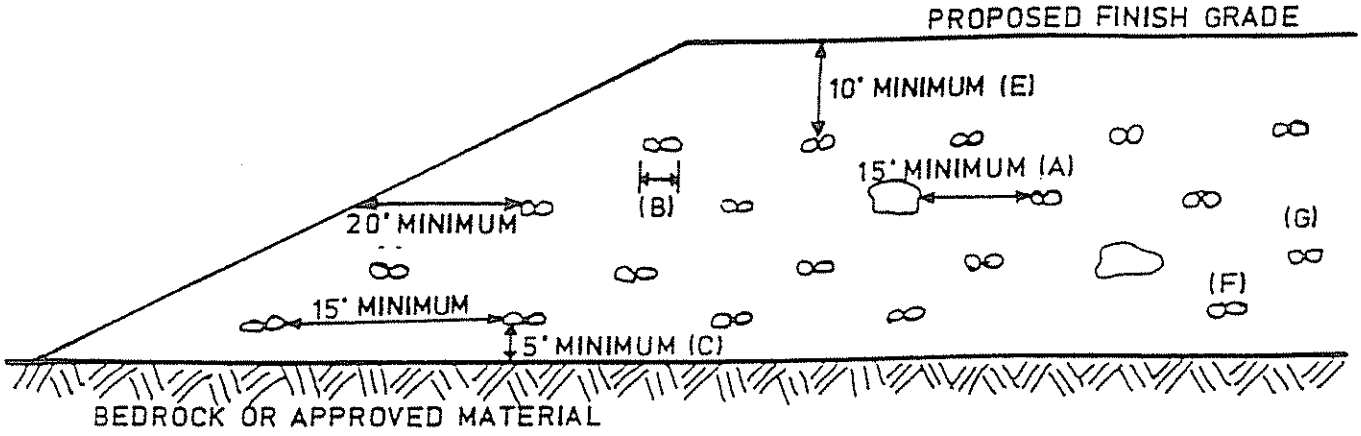

NOTE: * DEEPER OVEREXCAVATION MAY BE RECOMMENDED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST IN STEEP CUT—FILL TRANSITION AREAS.

PLATE EG—11

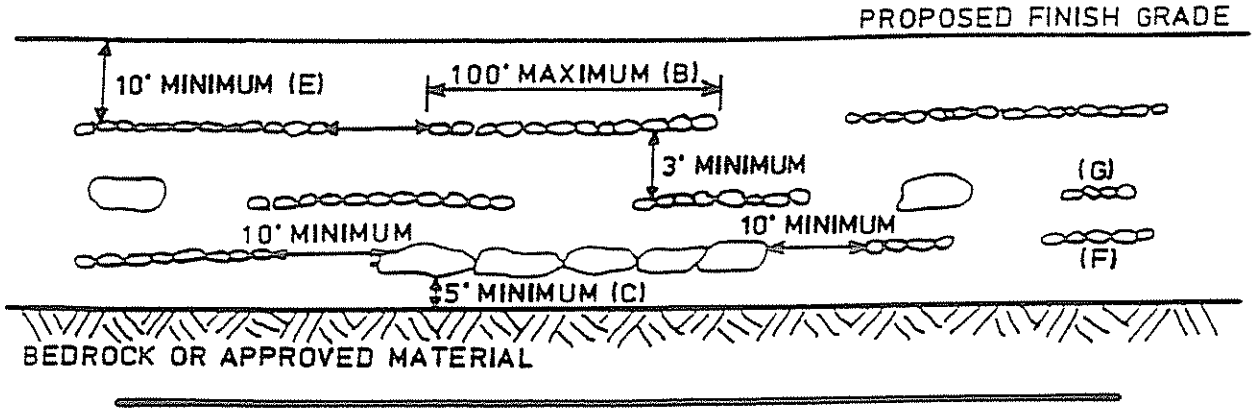
# OVERSIZE ROCK DISPOSAL

VIEWS ARE DIAGRAMMATIC ONLY. ROCK SHOULD NOT TOUCH AND VOIDS SHOULD BE COMPLETELY FILLED IN.

## VEIW NORMAL TO SLOPE FACE




## VIEW PARALLEL TO SLOPE FACE




NOTE: (A) ONE EQUIPMENT WIDTH OR A MINIMUM OF 15 FEET.

(B) HEIGHT AND WIDTH MAY VARY DEPENDING ON ROCK SIZE AND TYPE OF EQUIPMENT USED. LENGTH OF WINDROW SHALL BE NO GREATER THAN 100' MAXIMUM.

(C) IF APPROVED BY THE SOILS ENGINEER AND/OR ENGINEERNG GEOLOGIST, WINDROWS MAY BE PLACED DIRECTLY ON COMPETENT MATERIALS OR BEDROCK PROVIDED ADEQUATE SPACE IS AVAILABLE FOR COMPACTION.

(D) ORIENTATION OF WINDROWS MAY VARY BUT SHALL BE AS RECOMMENDED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST. STAGGERING OF WINDROWS IS NOT NECESSARY UNLESS RECOMMENDED.

(E) CLEAR AREA FOR UTILITY TRENCHES, FOUNDATIONS AND SWIMMING POOLS.

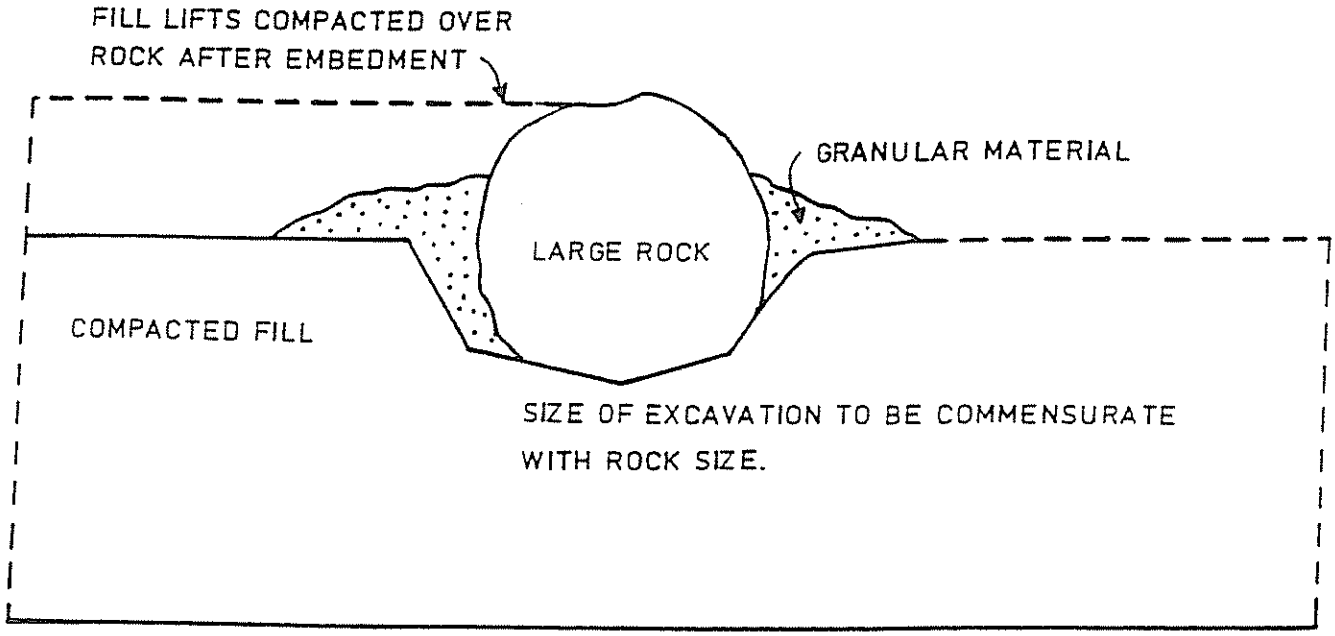
(F) VOIDS IN WINDROW SHALL BE FILLED BY FLOODING GRANULAR SOIL INTO PLACE. GRANULAR SOIL SHALL BE ANY SOIL WHICH HAS A UNIFIED SOIL CLASSIFICATION SYSTEM (UBC 29—1) DESIGNATION OF SM, SP, SW, GP, OR GW. ALL FILL OVER AND AROUND ROCK WINDROW SHALL BE COMPACTED TO 90% RELATIVE COMPACTION.

(G) AFTER FILL BETWEEN WINDROWS IS PLACED AND COMPACTED WITH THE LIFT OF FILL COVERING WINDROW, WINDROW SHALL BE PROOF ROLLED WITH A D—9 DOZER OR EQUIVALENT.

(H) OVERSIZED ROCK IS DEFINED AS LARGER THAN 12", AND LESS THAN 4 FEET IN SIZE.

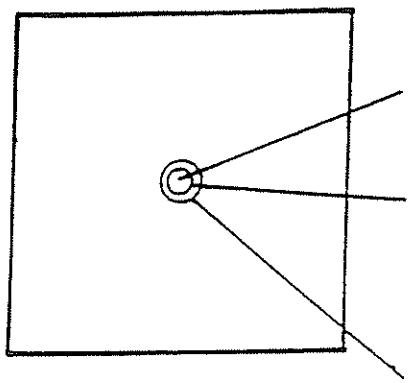
PLATE EG—12

# ROCK DISPOSAL PITS




NOTE:
1. LARGE ROCK IS DEFINED AS ROCK LARGER THAN 4 FEET IN MAXIMUM SIZE.
2. PIT IS EXCAVATED INTO COMPACTED FILL TO A DEPTH EQUAL TO 1/2 OF ROCK SIZE.
3. GRANULAR SOIL SHOULD BE PUSHED INTO PIT AND DENSIFIED BY FLOODING. USE A SHEEPSFOOT AROUND ROCK TO AID IN COMPACTION.
4. A MINIMUM OF 4 FEET OF REGULAR COMPACTED FILL SHOULD OVERLIE EACH PIT.
5. PITS SHOULD BE SEPARATED BY AT LEAST 15 FEET HORIZONTALLY.
6. PITS SHOULD NOT BE PLACED WITHIN 20 FEET OF ANY FILL SLOPE.
7. PITS SHOULD ONLY BE USED IN DEEP FILL AREAS.

# SETTLEMENT PLATE AND RISER DETAIL

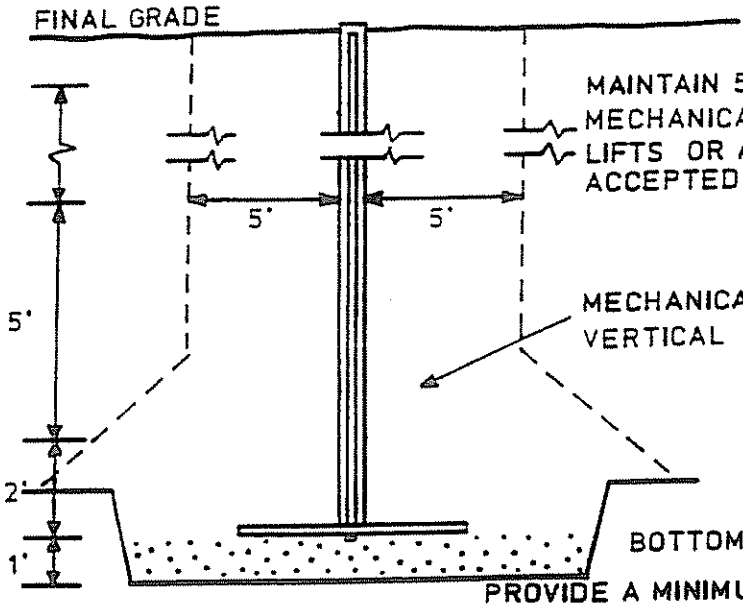


2'X 2'X 1/4" STEEL PLATE

STANDARD 3/4" PIPE NIPPLE WELDED TO TOP OF PLATE.

3/4" X 5' GALVANIZED PIPE, STANDARD PIPE THREADS TOP AND BOTTOM. EXTENSIONS THREADED ON BOTH ENDS AND ADDED IN 5' INCREMENTS.

3 INCH SCHEDULE 40 PVC PIPE SLEEVE, ADD IN 5' INCREMENTS WITH GLUE JOINTS.




MAINTAIN 5' CLEARANCE OF HEAVY EQUIPMENT. MECHANICALLY HAND COMPACT IN 2' VERTICAL LIFTS OR ALTERNATIVE SUITABLE TO AND ACCEPTED BY THE SOILS ENGINEER.

MECHANICALLY HAND COMPACT THE INITIAL 5' VERTICAL WITHIN A 5' RADIUS OF PLATE BASE.

BOTTOM OF CLEANOUT

PROVIDE A MINIMUM 1' BEDDING OF COMPACTED SAND

NOTE:

1. LOCATIONS OF SETTLEMENT PLATES SHOULD BE CLEARLY MARKED AND READILY VISIBLE (RED FLAGGED) TO EQUIPMENT OPERATORS.
2. CONTRACTOR SHOULD MAINTAIN CLEARANCE OF A 5' RADIUS OF PLATE BASE AND WITHIN 5' (VERTICAL) FOR HEAVY EQUIPMENT. FILL WITHIN CLEARANCE AREA SHOULD BE HAND COMPACTED TO PROJECT SPECIFICATIONS OR COMPACTED BY ALTERNATIVE APPROVED BY THE SOILS ENGINEER.
3. AFTER 5' (VERTICAL) OF FILL IS IN PLACE, CONTRACTOR SHOULD MAINTAIN A 5' RADIUS EQUIPMENT CLEARANCE FROM RISER.
4. PLACE AND MECHANICALLY HAND COMPACT INITIAL 2' OF FILL PRIOR TO ESTABLISHING THE INITIAL READING.
5. IN THE EVENT OF DAMAGE TO THE SETTLEMENT PLATE OR EXTENSION RESULTING FROM EQUIPMENT OPERATING WITHIN THE SPECIFIED CLEARANCE AREA, CONTRACTOR SHOULD IMMEDIATELY NOTIFY THE SOILS ENGINEER AND SHOULD BE RESPONSIBLE FOR RESTORING THE SETTLEMENT PLATES TO WORKING ORDER.
6. AN ALTERNATE DESIGN AND METHOD OF INSTALLATION MAY BE PROVIDED AT THE DISCRETION OF THE SOILS ENGINEER.

PLATE EG—14

# TYPICAL SURFACE SETTLEMENT MONUMENT

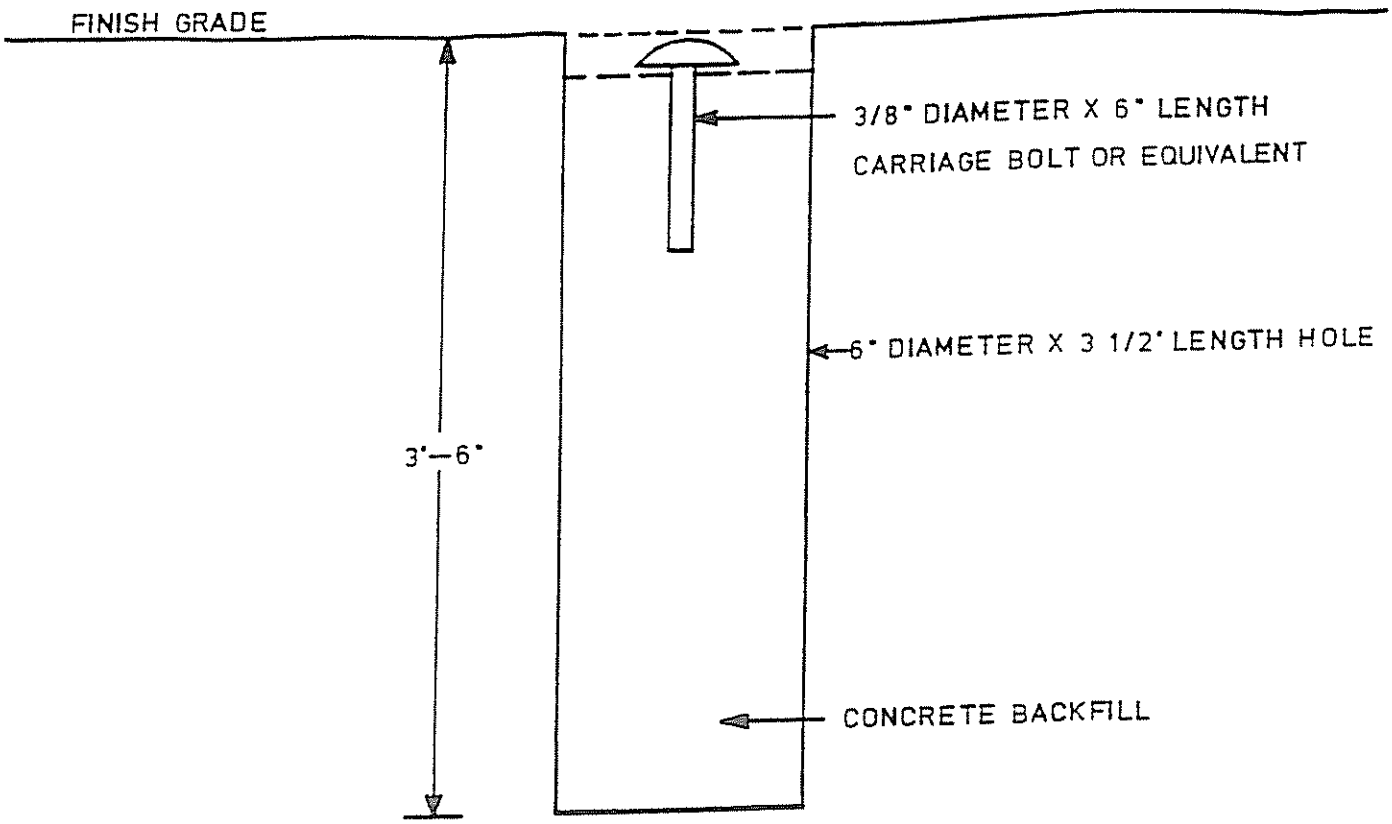
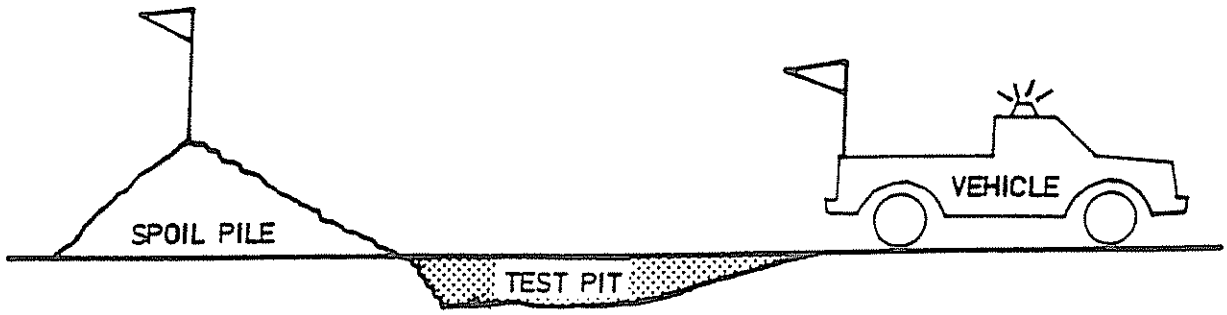



PLATE EG—15

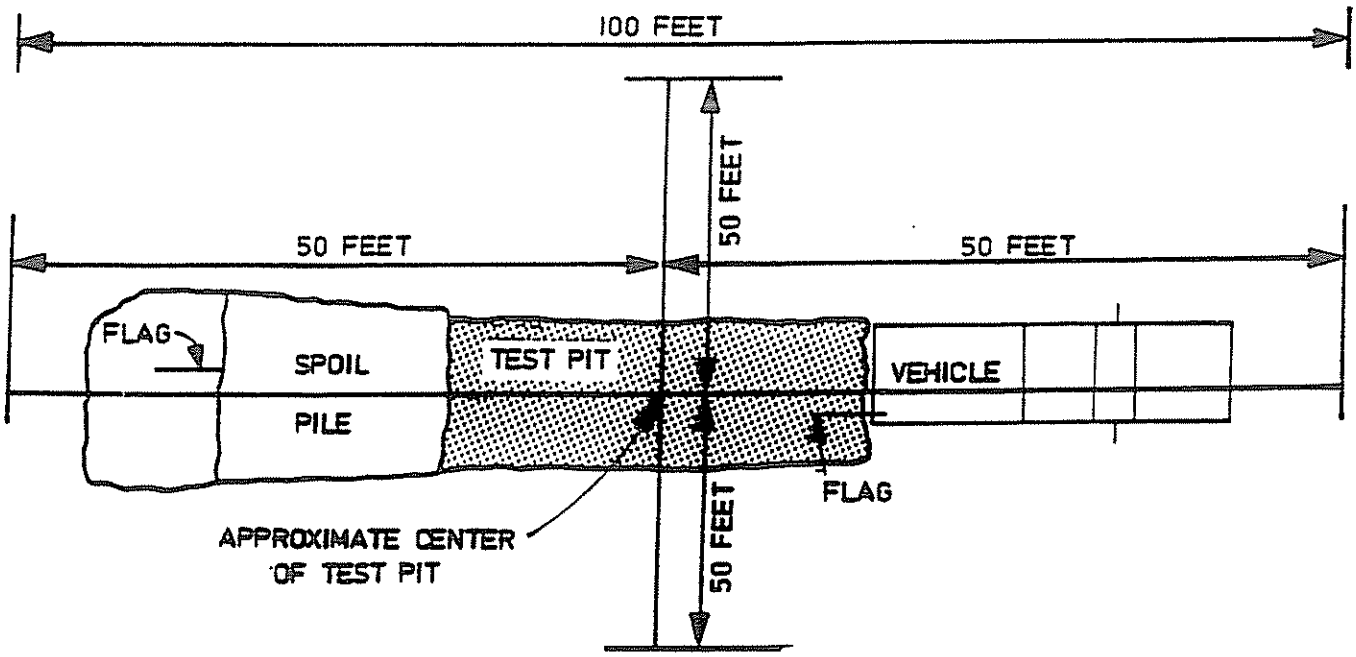
# TEST PIT SAFETY DIAGRAM

SIDE VIEW




( NOT TO SCALE )

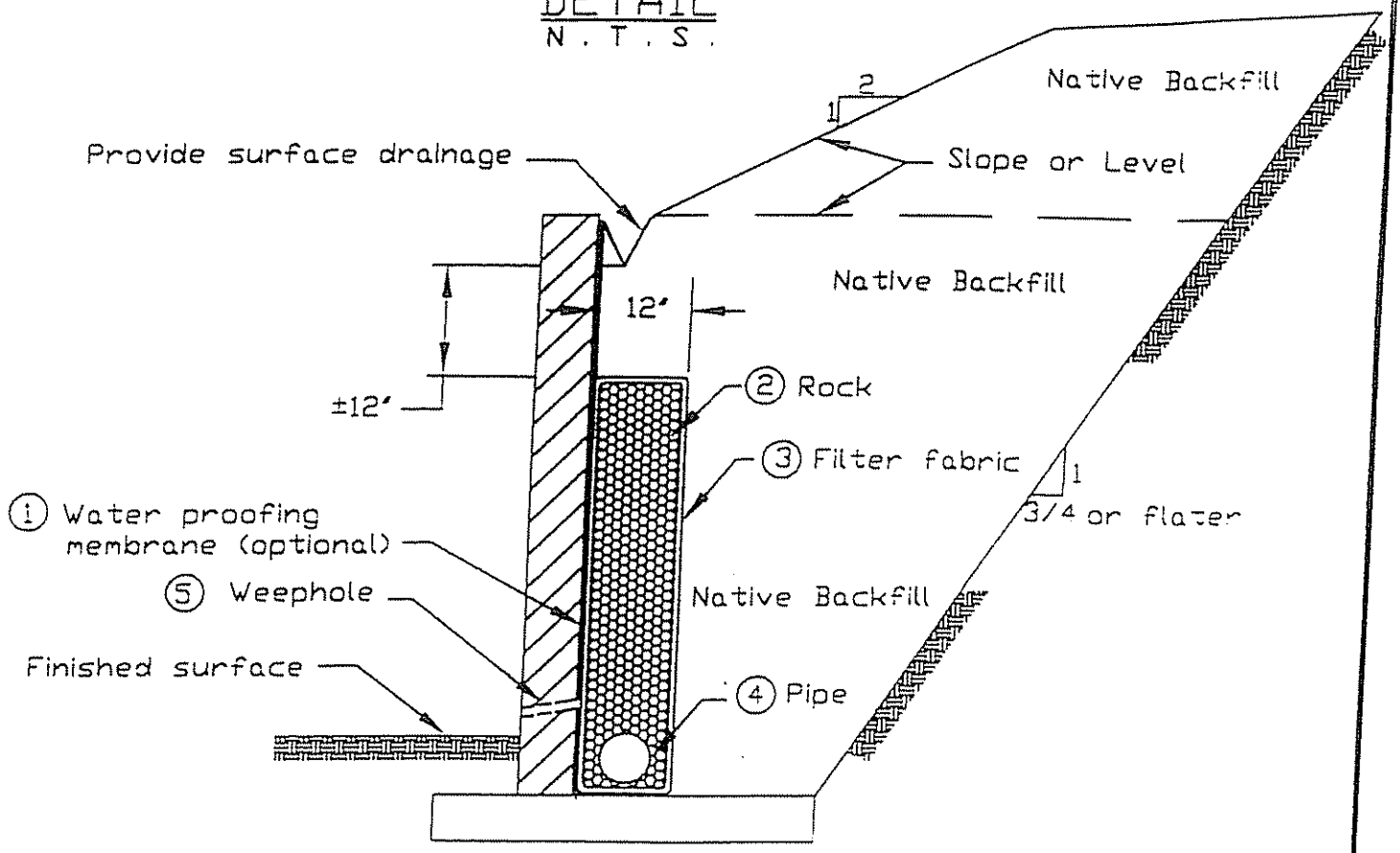
TOP VIEW




( NOT TO SCALE )

PLATE EG-16

# DETAIL
N. T. S.




① WATER PROOFING MEMBRANE (optional):
Liquid boot or approved equivalent.

② ROCK:
3/4 to 1-1/2" (inches) rock.

③ FILTER FABRIC:
Mirafi 140N or approved equivalent place fabric flap behind core.

④ PIPE:
4" (inches) diameter perforated PVC. schedule 40 or approved alternative with minimum of 1% gradient to proper outlet point.

⑤ WEEPHOLE:
Minimum 2" (inches) diameter placed at 20' (feet) on centers along the wall, and 3" (inches) above finished surface.

GeoSoils, Inc.

**TYPICAL RETAINING WALL BACKFILL AND DRAINAGE DETAIL**

DATE 10-12-01 | W.O. NO. 3723-A1-OC

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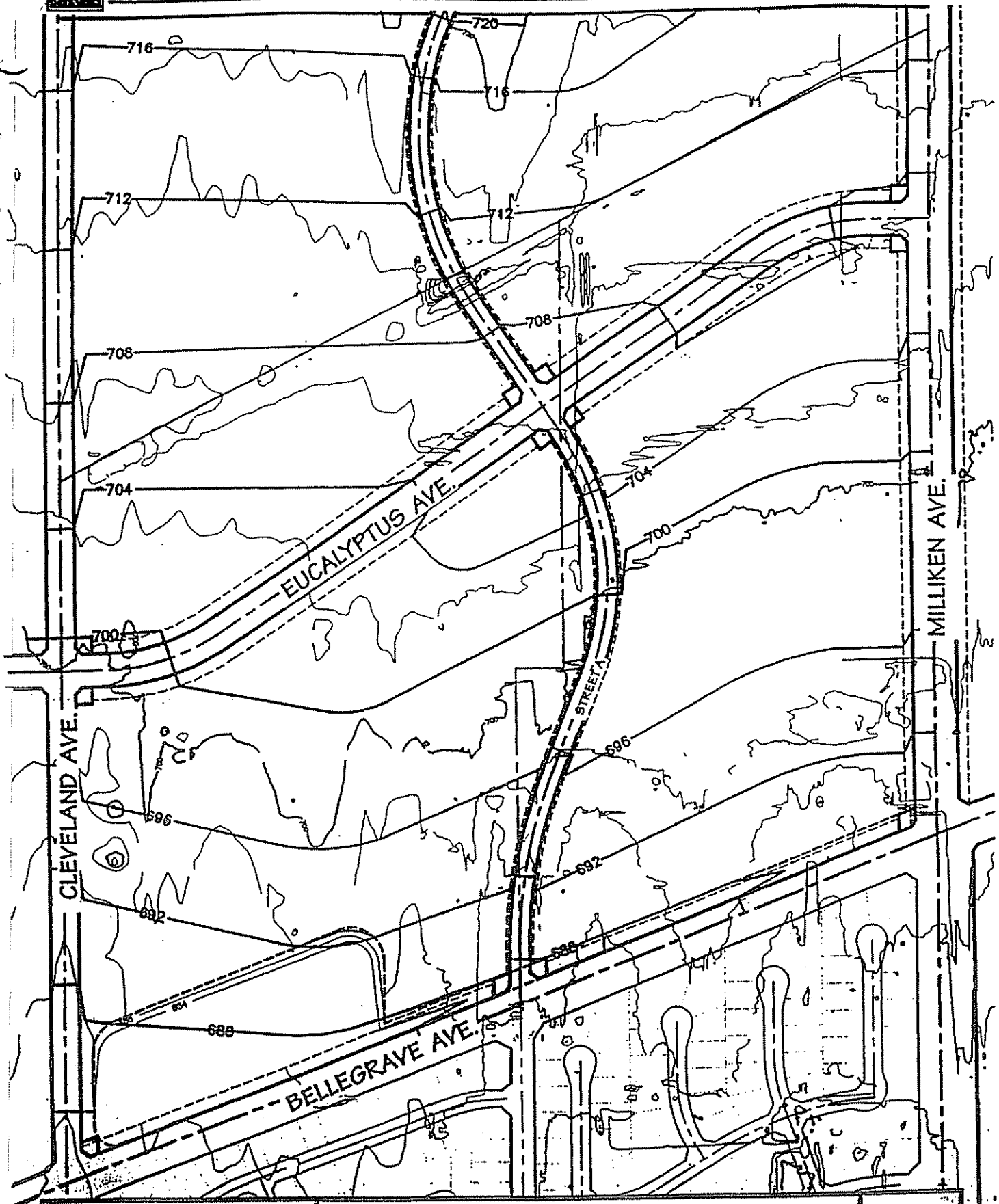
PLATE EG-17




NORTH

LDKING

0' 200' 400'

# *Conceptual Grading Plan*

PLATE 1

PREPARED BY LD KING, INC. ENGINEERS / PLANNERS / SURVEYORS / LANDSCAPE ARCHITECTS 2151 Convention Center Way, Suite 100 Ontario, California 91764-4464 (909) 937-0200