APPENDIX E

PRELIMINARY GEOLOGIC and GEOTECHNICAL ENGINEERING STUDY, PROPOSED BRIDGE for TTM 47449

PRELIMINARY GEOLOGIC AND GEOTECHNICAL ENGINEERING STUDY,
PROPOSED BRIDGE, VISTA VERDE RANCH,
Tract 47449,
San Dimas, California

For

Vista Verde-San Dimas Avenue Property, LLC

December 13, 2005 W.O. 5831

MDN 8692

GeoSoils Consultants Inc.

GeoSoils Consultants Inc.
GEOTECHNICAL · GEOLOGIC · ENVIRONMENTAL

December 13, 2005
W.O. 5831

VISTA VERDE-SAN DIMAS AVENUE PROPERTY, LLC.
10365 West Jefferson Boulevard
Culver City, California 90232

Attention: Mr. Daniel Singh:

Subject: Preliminary Geologic and Geotechnical Engineering Study, Proposed Bridge, Vista Verde Ranch, Tract 47449, San Dimas, California

Dear Mr. Singh:

As requested, GeoSoils Consultants, Inc. (GSC) has performed a preliminary geologic and geotechnical study for the proposed bridge located at the northeastern portion of Tract 47449. This bridge will be constructed as a part of the development of the subject tract.

Our study provides preliminary geotechnical data and recommendations to assist in the design of the proposed bridge. The proposed bridge location is shown on the grading plan prepared by Paas Engineering Corporation as part of the tract map. The portion of the tract map showing the bridge location has been enlarged to a 1"=40', and is included herein as Plate 1.

SITE DESCRIPTION

The subject site is located in an unincorporated portion of Los Angeles County, adjacent to the City of San Dimas. A Site Location Map is included as Figure 1. The portion of the site addressed herein consists of the proposed bridge at the eastern portion of the tract. The bridge will span two north-trending canyon areas, which drain to the north. Additional site descriptions are provided in the referenced reports.

MDN 8692

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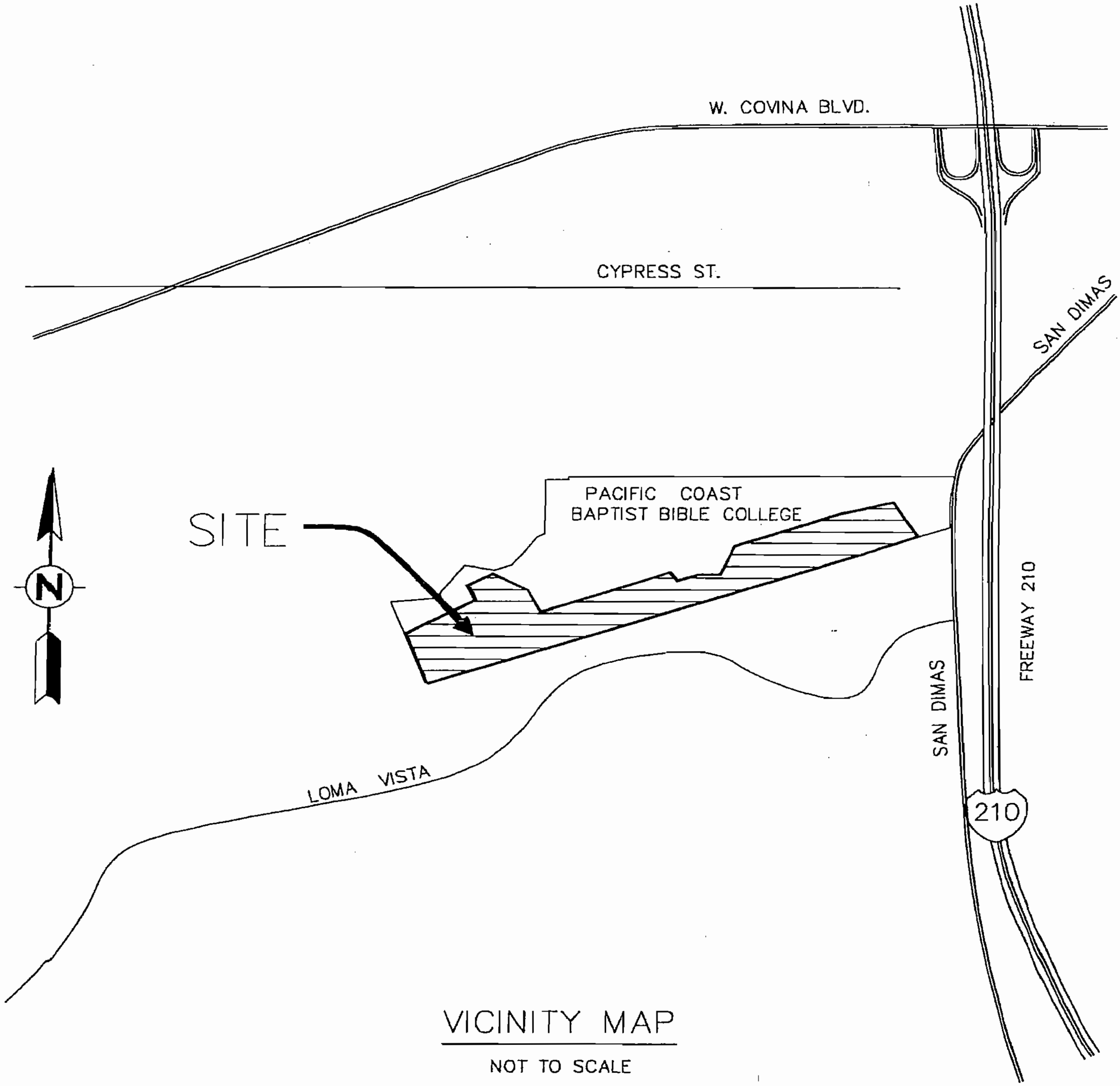

GSC GeoSoils Consultants Inc.
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SITE LOCATION MAP
TRACT 47449
VISTA VERDE SAN DIMAS AVENUE PROPERTY, LLC

DATE 12/2005	W.O. NO. 5831

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FIGURE 1

PROPOSED DEVELOPMENT

The bridge is located at the northeastern portion of the subject tract (see Plate 1). The bridge will be constructed over a two natural canyon areas to provide access for the proposed 70-lot development. The bridge has a span of approximately 720 feet and will be as high as approximately 105 above the lowest existing grades. The bridge will be supported by two abutments (one at each end) and four piers. The approximate location of the abutments and piers are shown on the geologic map and cross-sections.

SCOPE OF SERVICES

The scope of services for this preliminary geologic and geotechnical engineering study was prepared based on limited site access, budget constraints and time constraints. Due to the natural condition of the site, we were unable to obtain detailed subsurface exploration at the location of each abutment and piers. Additional subsurface exploration, laboratory testing, and engineering analyses may be required prior to or during bridge construction. The purpose of the additional exploration is to provide geologic and geotechnical data at each abutment and pier location. Our scope of work presented herein included the following:

- Site observation and review of pertinent geotechnical and geologic data of the general study area, and published geologic maps and previous consultant reports (see References);
- Drilling and logging of two exploratory borings using a tract mounted drill rig. Due to the very dense nature of the bedrock material, the borings were only advanced to a maximum depth of 10 feet. Below this depth, drilling refusal was encountered. Boring logs are included in Appendix A;
- Laboratory testing of selected samples retrieved from the borings. Test results are included in Appendix A;

- Engineering analysis of the data and information obtained from our field study, laboratory testing, and literature review;

- Determination of seismic parameters 1997 UBC (see Appendix B).

- Development of geotechnical recommendations for site preparation and grading, and geotechnical design criteria for bridge foundations.

- Preparation of this report summarizing our findings, conclusions, and recommendations regarding the geologic and geotechnical aspects of the project site.

PREVIOUS STUDIES

Previous studies were prepared on the site by Pacific Soils Engineering, Inc. and Southwest Geotechnical, Inc. A list of references is included herein. Both Pacific Soils Engineering, Inc. and Southwest Geotechnical, Inc. prepared reports addressing the proposed residential development of the subject tract. The reports were prepared prior to modification to the grading plans, which consist of eliminating lots at the eastern portion of the site and the addition of the proposed bridge.

This office has reviewed the referenced reports and accepts geotechnical responsibility for the project.

GEOLOGIC CONDITIONS

Geologic conditions in the area of the bridge were previously presented in the Pacific Soils Engineering, Inc. report dated May 29, 1998 and are summarized herein. The geologic conditions in the area of the proposed bridge consist of Complexly Mixed Volcanics and Sediments of the Glendora Volcanics and Puente Formation (see Reference 1). Exploratory borings excavated by this office encountered refusal due to dense volcanic bedrock at shallow depths. As stated by Pacific Soils, the interbedded mature of these units is interpreted as being lenticular and, therefore, continuous planar features are considered uncommon. Due to the dense nature of the bedrock material, pile excavation may encounter hard drilling conditions. During grading/construction, a geologist should be present to confirm that the geologic conditions encountered in the area of the bridge are consistent with those presented herein. The following sections present our findings concerning subsurface soil conditions, groundwater conditions, and expansion potential of surficial site soils.

WATER

Surface Water

Surface water consists of sheetflow from precipitation falling directly on the site. There are no known springs or seeps on the site. Surface water does flow in the main drainage channels below the proposed bridge during and following periods of precipitation.

Groundwater

Groundwater was not encountered in the borings excavated on the site by this office. It is possible that groundwater exists in the canyon areas of the site.

FAULTING AND SEISMICITY

The project site is not within an Alquist-Priolo Earthquake Fault Zone, and there are no active faults on or adjacent to the property. However, there are faults in close enough proximity to the site to cause moderate to intense ground shaking during the lifetime of the proposed development. Additionally, the site has experienced earthquake-induced ground shaking in the past and can be expected to experience further shaking in the future.

Seismic Design Criteria

Based upon the 1997 UBC (Uniform Building Code), the following table provides design parameters for the subject site:

UBC - CHAP. 16: TABLE NO.	SEISMIC PARAMETER	RECOMMENDED VALUE
16 - I	Seismic Zone Factor Z	0.4
16 – J	Soil Profile Type	S_B
16 – Q	Seismic Coefficient (C_a)	0.52
16 – R	Seismic Coefficient (C_v)	0.64
16 – S	Near Source Factor N_a	1.3
16 – T	Near Source Factor N_v	1.6
16 – U	Seismic Source Type	B

If the structural design is based on UBC lateral-force procedures, we recommend that the design spectrum presented in Appendix B be used as it is based on the UBC seismic coefficients. A description of the UBCSEIS program and the output file from the analysis is also presented in Appendix B.

Conformance to the above criteria for seismic excitation does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a maximum level earthquake occurs. The primary goal of seismic design is to protect life and not to avoid all damage, since such design may be economically prohibitive. Following a major earthquake, a building may be damaged beyond repair, yet not collapse.

Secondary Earthquake Effects

Ground shaking produced during an earthquake can result in a number of potentially damaging phenomena classified as secondary earthquake effects. These secondary effects include ground rupture, liquefaction, and seismically-induced settlement.

Descriptions of each of this phenomenon and an assessment of each, as it affects the proposed bridge, are described below:

Ground Rupture

Ground surface rupture results when the movement along a fault is sufficient to cause a gap or rupture along the upper edge of the fault zone on the surface. Since there are no known active faults that cross the site, the potential for ground rupture is considered remote, in our opinion.

Liquefaction

Liquefaction describes a phenomenon where cyclic stresses, which are produced by earthquake-induced ground motions, creates excess pore pressures in cohesionless soils. As a result, the soils may acquire a high degree of mobility, which can lead to lateral spreading, consolidation and settlement of loose sediments, ground oscillation, flow failure, loss of bearing strength, ground fissuring, and 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 escapes. Descriptions of each of the phenomena associated with liquefaction is described below:

Lateral Spreading: Lateral spreading is the lateral movement of stiff, surficial blocks of sediments as a result of a subsurface layer liquefying. The lateral movements can cause ground fissures or extensional, open cracks at the surface as the blocks move toward a slope face, such as a stream bank or in the direction of a gentle slope. When the shaking stops, these isolated blocks of sediments come to rest in a place different from their original location and may be tilted.

Ground Oscillation: occurs when liquefaction occurs at depth but the slopes are too gentle to permit lateral displacement. In this case, individual blocks may separate and oscillate on a liquefied layer. Sand boils and fissures are often associated with this phenomenon.

Flow Failure: A more catastrophic mode of ground failure than either lateral spreading or ground oscillation, involves large masses of liquefied sediment or blocks of intact material riding on a liquefied layer moving at high speeds over large distances. Generally flow failures are associated with ground slopes steeper than those associated with either lateral spreading or ground oscillation.

Bearing Strength Loss: Bearing strength decreases with a decrease in effective stress. Loss of bearing strength occurs when the effective stresses are reduced due to the cyclic loading caused by an earthquake. Even if the soil does not liquefy, the bearing of the soil may be reduced below its value either prior to or after the earthquake. If the bearing strength is sufficiently reduced, structures supported on the sediments can settle, tilt, or even float upward in the case of lightly loaded structures such as gas pipelines.

Ground Fissuring and Sand Boils: Ground fissuring and sand boils are surface manifestations associated with liquefaction and lateral spreading, ground oscillation, and flow failure. As apparent from the above descriptions, the likelihood of ground fissures developing is high when lateral spreading, ground oscillations, and flow failure occur. Sand boils occur when the high pore water pressures are relieved by drainage to the surface along weak spots that may have been created by fissuring. As the water flows to the surface, it can carry sediments, and if the pore water pressures are high enough create a gusher (sand boils) at the point of exit.

Research has shown that saturated, loose sands with a silt content less than about 25 percent are most susceptible to liquefaction, whereas other soil types are generally considered to have a low susceptibility. According to the SCEC (1999) publication *Recommended Procedures for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Liquefaction in California*, any material having more than 15 percent finer than 0.005 millimeters (clay) was considered not subject to liquefaction. Liquefaction susceptibility is related to numerous factors, and the following conditions must exist for liquefaction to occur:

- Sediments must be relatively young in age and must not have developed large amounts of cementation;
- Sediments must consist mainly of cohesionless sands and silts;
- The sediment must not have a high relative density;
- Free groundwater must exist in the sediment; and
- The site must be exposed to seismic events of a magnitude large enough to induce straining of soil particles.

Results: Based on laboratory data obtained from samples collected during GSC's subsurface exploration, the site is underlain by dense bedrock material. Therefore, according to the SCEC (1999) guidelines, the soils in the area of the bridge should not be considered subject to liquefaction.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on our investigation, the proposed development is feasible from a geotechnical viewpoint. The proposed bridge structure may be founded on drilled cast-in-place, reinforced concrete caisson foundation system. Such a foundation system will give adequate support with expected tolerable settlement. Both excavation shoring and foundation plans should be reviewed and approved by a geotechnical engineer during project design development phase and prior to submittal for review by the governing agencies.

The site, as is all of Southern California, lies in a seismically active area. Site specific seismic design should be used.

BRIDGE STRUCTURE FOUNDATIONS

Deep Foundations

The proposed bridge structure is well suited to rest upon drilled, reinforced concrete, cast-in-place caissons. Since the depth of excavation will vary at different locations across the site, load capacity analyses were conducted for 24 and 30-inch diameter, cast-in-place caissons at various depths of excavation up to foundation level. The results are presented on Appendix C. The allowable load capacity are derived from the supporting strength of the soil which may be found to exceed the structural strength of the caisson itself; in this case, the structural strength of the caisson should be considered to preempt the allowable soil bearing capacity. If pile groups are required, piles should be spaced on center a minimum of 3.0 times their diameter to avoid reduction on the load capacity due to shared influence of the group. The allowable compressive capacity curves have a factor-of-safety of 2.5 and the allowable uplift capacity has a factor-of-safety of 2.5.

Lateral loads may be resisted by passive earth pressure and friction. The allowable value of lateral bearing (passive pressure) for bedrock material is 350 pounds per square foot, per foot of depth, with a maximum lateral bearing of 5,000 pounds per square foot. A coefficient of friction of 0.4 is recommended for concrete/soil interfaces. The above values may be increased by one-third for short duration wind and seismic forces. When combining passive and frictional resistance, the passive component should be reduced by one-third. For design of isolated piles or caisson (i.e., at least three pile diameter spacing), the allowable passive pressure may be increased by 100 percent. Caissons or piles should be tied together into two directions with grade beams and/or tie beams, which can carry by tension and compression a minimum horizontal force equal to ten percent of the larger pile cap or caisson loading.

The recommendation for using drilled cast-in-place caisson was based on practical consideration. There are certain risks and problems associated with the choice of driven piles. These include undesireable movement, vibration, or even structural damage due to presence of conglomerate and hard cobbles.

The potential of caving and providing casings for drilled cast-in-place caissons, within the sandy material, should be considered.

Piles or caissons should be constructed in accordance with Section 205-3 of the Standard Specifications for Public Works Construction (1997 or latest edition). Piles or caisson excavations should be observed by a representative of the Geotechnical Engineer prior to the placement of steel or pouring of concrete. All concrete should be tremied to avoid excessive drop heights and for pouring concrete below water level.

For end-bearing piles, prior to placement of concrete, all loose materials at the bottom of the caisson excavation should be removed. If the caisson excavation has had standing water for 12 hours or more, prior to concrete placement, the bottom should be redrilled at least two more feet and cleaned of all loose debris. Standing water should be pumped out prior to pouring concrete.

In lieu of removing standing water prior to placing concrete (i.e., pumping water), the concrete may be placed by the tremmie method to displace collected water. The solid tremmie tube shall be long enough to reach the bottom of the excavation. When concrete is being placed, the solid tremmie tube must be kept full of concrete at all times, with the lower end immersed in the concrete just deposited. The concrete shall at no time be placed through the water. When water over 3 inches in depth is present in drilled pile holes, a concrete mix with a strength pounds per square inch of 1000 over the design pounds per square inch shall be tremmied from the bottom up. An admixture that reduces the problem of segregation of paste/aggregates and dilution of paste shall be included.

To reduce the potential surface erosion of materials on the exposed portion of the property, these slopes should be planted with drought-resistant vegetation which requires minimum irrigation and cultivation.

SETTLEMENT

Assuming the foundation elements are founded in the recommended bearing soils, we estimate that settlement will not exceed ¾ inch, with differential settlements on the order of ¼ inch. The majority of the settlement will probably occur during the initial loading of the foundation; however, if any undisturbed or soft soils are left within the footing area prior to concrete placement, settlements may be increased substantially.

Leakage from any of the appurtenant plumbing will create an artificial groundwater condition, which could likely render settlement problems; therefore, it is imperative that all underground plumbing fixtures be *absolutely* leak-free.

Once foundation plans, are available which include loading details of total dead and real live loads, they should be reviewed by the Geotechnical Engineer to ensure that total and/or differential settlements are within tolerable limits.

Lateral Load Analysis

A pile loaded by lateral thrust and/or moment at its top, resists the load by deflecting to mobilize the reaction of the surrounding soil. The magnitude and distribution of the resisting pressures are a function of the relative stiffness of pile and soil.

Design criteria is based on maximum combined stress in the piling, allowable deflection at the top or permissible bearing on the surrounding soil. Although one-quarter inch at the pile top is often used as a limit, the allowable lateral deflection should be based on the specific requirements of the structure.

Lateral load analysis with freehead caps and fixed head caps were performed. Design values for lateral resistance of piles were analyzed for lateral deflections of 0.25, 0.50 and 1.0 inch. Pile diameters of 24 and 30 inches and pile lengths of 15, 20, 25, 30, 40, 50 and 60 were considered. The results are presented on Figures L-1 through L-4.

A laterally loaded pile can fail by exceeding the strength of the surrounding soil or by exceeding the bending moment capacity of the pile resulting in a structural failure. For positive moment design, a Factor of safety of 3 should be considered from those values presented under maximum positive moment (last column).

(Note: The allowable load capacities (compression and tension) and the lateral load analysis were based on the design criteria presented in NAVFAC DM-7.2, Chapter 5, Deep Foundations).

RETAINING WALLS

Wall Criteria

Retaining structures are anticipated at the end abutments. The wall foundations should have the minimum required setback of H/3 from the competent descending slope face.

All proposed retaining walls should have a minimum embedment depth of 18 inches and a minimum width of 18 inches and should be designed in accordance to the recommendations presented herein. The equivalent fluid pressures recommended are based on the assumption of a uniform backfill and no build-up of hydrostatic pressure behind the wall. To prevent the build-up of soil pressures in excess of the recommended design pressures, overcompaction of

LATERAL LOAD CAPACITY ANALYSIS

Case I Flexible Cap or Hinged End Condition

CAISSON		Lateral Deflection (inch)	Applied Lateral Load (kips)	Recommended Allowable Lateral Load (kips)	Depth to Maximum Positive Moment (ft)	Depth to Inflection Point (ft)	Depth to Zero Moment (ft)	Maximum Positive Moment (ft - kips)
Length (ft)	Diameter (inches)							
15	24	0.25	15.4	10.3	6.2	10.9	0 & 15.6	56.1
		0.50	30.9	20.6	6.2	10.9	0 & 15.6	112.5
		1.00	61.8	41.2	6.2	10.9	0 & 15.6	225.1
20	24	0.25	17.4	11.6	6.5	11.7	0 & 20.8	69.7
		0.50	34.8	23.2	6.5	11.7	0 & 20.8	139.4
		1.00	69.6	46.4	6.5	11.7	0 & 20.8	278.9
25 and Longer	24	0.25	18.1	12.1	6.5	11.7	0 & 20.8	72.5
		0.50	36.3	24.2	6.5	11.7	0 & 20.8	145.4
		1.00	72.6	48.4	6.5	11.7	0 & 20.8	290.9
15	30	0.25	19.8	13.2	6.2	10.8	0 & 14.3	71.4
		0.50	39.7	26.5	6.2	10.8	0 & 14.3	143.2
		1.00	79.5	53.0	6.2	10.8	0 & 14.3	286.9
20	30	0.25	22.1	14.7	7.4	13.0	0 & 19.9	97.6
		0.50	44.2	29.5	7.4	13.0	0 & 19.9	195.2
		1.00	88.4	58.9	7.4	13.0	0 & 19.9	390.5

Figure L-1

LATERAL LOAD CAPACITY ANALYSIS

Case I Flexible Cap or Hinged End Condition

(Continued)

CAISSON		Lateral Deflection (inch)	Applied Lateral Load (kips)	Recommended Allowable Lateral Load (kips)	Depth to Maximum Positive Moment (ft)	Depth to Inflection Point (ft)	Depth to Zero Moment (ft)	Maximum Positive Moment (ft - kips)
Length (ft)	Diameter (inches)							
25	30	0.25	24.8	16.5	7.7	14.0	0 & 24.8	118.8
		0.50	49.7	33.1	7.7	14.0	0 & 24.8	238.1
		1.00	99.4	66.3	7.7	14.0	0 & 24.8	476.2
30 and Longer	30	0.25	25.9	17.3	7.7	14.0	0 & 24.8	124.0
		0.50	51.9	34.6	7.7	14.0	0 & 24.8	248.0
		1.00	103.8	69.2	7.7	14.0	0 & 24.8	497.3

Figure L-2

LATERAL LOAD CAPACITY ANALYSIS

Case II Fixed Against Rotation at Ground Surface (Rigid)

CAISSON		Lateral Deflection (inch)	Applied Lateral Load (kips)	Recommended Allowable vs Lateral Load (kips)	Depth to Maximum Positive Moment (ft)	Depth to Inflection Point (ft)	Depth to Zero Moment (ft)	Maximum Positive Moment (ft - kips)
Length (ft)	Diameter (inches)							
15	24	0.25	40.1	26.7	9.8	12.4	6.7 & 14.5	196.3
		0.50	80.3	53.5	9.8	12.4	6.7 & 14.5	392.9
		1.00	160.6	107.1	9.8	12.4	6.7 & 14.5	785.8
20	24	0.25	42.6	28.4	10.9	14.5	6.2 & 18.9	201.8
		0.50	85.2	56.8	10.9	14.5	6.2 & 18.9	403.6
		1.00	170.4	113.6	10.9	14.5	6.2 & 18.9	807.2
25 and Longer	24	0.25	44.9	29.9	11.7	16.1	5.7 & 23.4	210.4
		0.50	89.8	59.9	11.7	16.1	5.7 & 23.4	420.7
		1.00	179.6	119.7	11.7	16.1	5.7 & 23.4	841.4
15	30	0.25	55.7	37.1	11.5	14.0	9.3 & 15.5	336.2
		0.50	111.5	74.3	11.5	14.0	9.3 & 15.5	673.0
		1.00	223.1	148.7	11.5	14.0	9.3 & 15.5	1346.6
20	30	0.25	58.5	39.0	11.8	16.1	7.4 & 19.2	331.3
		0.50	117.0	78.0	11.8	16.1	7.4 & 19.2	662.6
		1.00	234.0	156.0	11.8	16.1	7.4 & 19.2	1325.1

Figure L-3

LATERAL LOAD CAPACITY ANALYSIS

Case II Fixed Against Rotation at Ground Surface (Rigid)

(Continued)

CAISSON		Lateral Deflection (inch)	Applied Lateral Load (kips)	Recommended Allowable vs Lateral Load (kips)	Depth to Maximum Positive Moment (ft)	Depth to Inflection Point (ft)	Depth to Zero Moment (ft)	Maximum Positive Moment (ft - kips)
Length (ft)	Diameter (inches)							
25	30	0.25	62.1	41.4	13.0	18.6	6.8 & 23.6	347.8
		0.50	124.3	82.9	13.0	18.6	6.8 & 23.6	696.2
		1.00	248.7	165.8	13.0	18.6	6.8 & 23.6	1392.8
30 and Longer	30	0.25	64.1	42.7	14.0	19.2	6.8 & 23.6	359.0
		0.50	128.3	85.5	14.0	19.2	6.8 & 23.6	718.6
		1.00	256.7	171.1	14.0	19.2	6.8 & 23.6	1437.6

Figure L-4

the fill behind the wall should be avoided. This can be accomplished by placement of the backfill above a 45-degree plane projected upward from the base of the wall in lifts not exceeding eight inches in depth and compacting with hand-operated or small, self-propelled, vibrating plates. (Note: Backfill of free-draining material in this zone could also prevent the build-up of lateral soil pressures).

1. **Conventional (Yielding) Retaining Walls**

All recommendations for active, lateral earth pressures contained herein assume that the retaining structures are in tight contact with the fill soil or bedrock that they are supposed to support. The earth support system must be sufficiently stiff to hold horizontal movements in the soil to less than one percent of the height of the vertical face, but should be free-standing to the point that they yield at the top at least 0.1 percent of the height of the wall.

2. **Earth Pressures on Conventional (Yielding) Walls**

The earth pressures on walls up to 15± feet high, retaining granular materials, compacted fill or undisturbed alluvial or bedrock may be assumed equal to that exerted by an equivalent fluid having a density not less than that shown on the following table:

BACKFILL SLOPE	EQUIVALENT FLUID DENSITY (pcf)
Level	30
2:1	43
1½:1	55

Additional surcharge due to adverse geologic structure is not anticipated; however, wall footing and cut excavation should be observed by a geologist from this office.

Retaining Wall Deflection

It should be noted that non-restrained retaining walls designed for active earth pressure will deflect ¼ to 1 percent of their height over time in response to loading. This deflection is normal and reduces the earth pressure on the wall. Improvements constructed immediately adjacent to or incorporated with non-restrained retaining walls should be designed to accommodate this movement. Curved or angled walls which have a convex, downslope plan pattern should be provided with vertical construction joints at corners or 40 feet on center. A batter is recommended for exterior walls to avoid the visual impression that they are tilting. Decking which caps a retaining wall should be provided with a flexible joint to allow for the normal ¼ to 1 percent deflection of the retaining wall. Decking which does not cap a retaining wall should not be tied to the wall. The space between the wall and the deck will require periodic caulking to prevent moisture intrusions into the retaining wall backfill. Should wall deflection be undesirable, please contact our office for higher, at rest earth pressures which will reduce wall deflection significantly.

3. **Restrained (Non-Yielding) Walls**

Earth pressures will be greater on walls yielding at the top of the wall is limited to less one-thousandth the height of the wall either by stiffness (i.e., return walls, etc.) or structural network prior to backfilling. Utilizing the recommended backfill compaction of 90 percent, Proctor Density per ASTM D-1557-00, we recommend a 50 percent increase in the equivalent-fluid density from those recommended for conventional (yielding) walls be used for non-yielding walls.

4. **General**

a) Any anticipated, superimposed loading (i.e., upper retaining walls, other structures, traffic surcharge, etc.) within 45-degree (1:1) projection plane upward from the wall bottom, except retained earth, shall be considered as surcharge and provided for in the design.

b) A vertical component equal to one-third of the horizontal force so obtained may be assumed at the plane of application of force.

The depth of the retained earth shall be the vertical distance below the ground surface measured at the wall face for stem design or measured at the heel of the footing for overturning and sliding.

c) If water is allowed to saturate the backfill, the lateral pressure could exceed the active earth pressure recommended. Clayey or expansive soils should not be used for backfilling behind retaining walls.

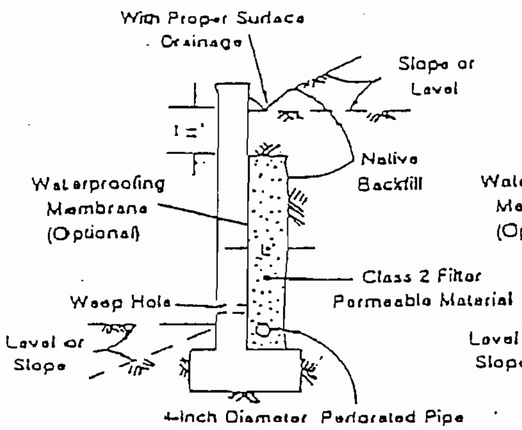
d) The walls should be constructed with weepholes near the bottom on five-foot centers or perforated drain pipe in a gravel envelope at the bottom and behind the wall. A one-foot zone of clean, granular, free-draining material should be placed behind the wall to within three feet the surface (see Figure 2).

On-site soil may be used for the remainder of the backfill and should be compacted to 90 percent relative compaction as determined by ASTM Test Designation D-1557-00. All proposed subterranean walls and other walls where moisture migration through the walls is undesirable, should be waterproofed and backdrained.

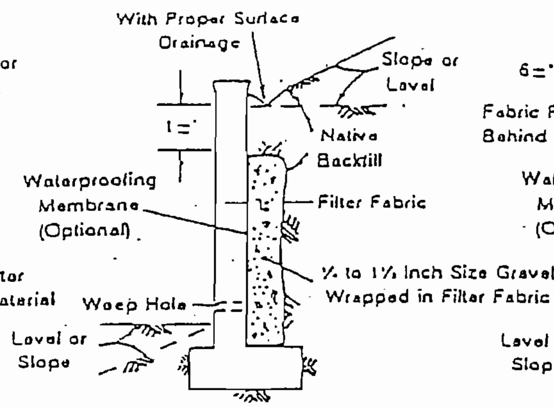
e) A concrete-lined swale is recommended to be placed behind retaining walls that can intercept surface runoff from upslope areas. This surface runoff shall be transferred to an approved channel via non-erosive drainage devices. The retaining walls should be provided with a minimum of 12 inches of freeboard for slough protection.

SUBDRAIN OPTIONS FOR NATIVE MATERIAL BACKFILL

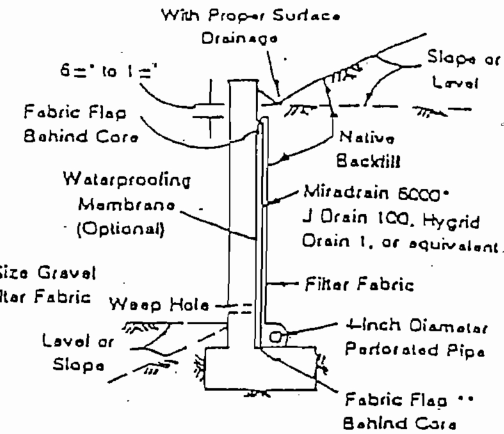
OPTION N2: Pipe Surrounded with Class 2 Material



OPTION N1: Gravel Wrapped in Filter Fabric



OPTION N3: Geotextile Drain



Class 2 Filter Permeable Material Grading
Per Caltrans Specifications

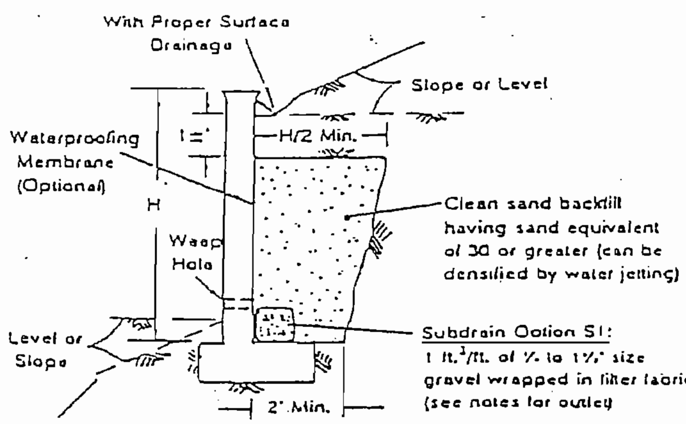
Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

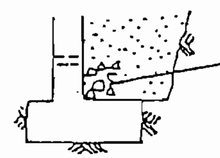
Proper Outlet Should be Provided for Gravel Subdrain (See Notes)

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

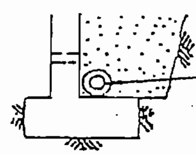
**Peel back the bottom fabric flap, place pipe next to core, wrap fabric around pipe and tuck behind core.

SUBDRAIN OPTIONS FOR CLEAN SAND BACKFILL





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 4545, 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' maximum 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

Figure No. 2

GeoSoils Consultants Inc.

ADDITIONAL WORK

As stated above, the recommendations presented herein are based on limited subsurface exploration and laboratory testing. This was due to time constraints, limited access, equipment availability, and budget constraints. The recommendations presented herein are intended to provide preliminary design criteria for bridge design. Prior to or during construction, addition subsurface exploration, laboratory testing, and engineering analyses should be considered at each abutment and pier location. Once access for drilling equipment is provided, test borings should be excavated in the actual bridge foundation locations as an alternative, pile excavations should be downhole logged and sampled. Laboratory testing should be performed on representative samples to confirm the recommendations presented herein.

LIMITATIONS

The findings and recommendations of this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice for the County of Los Angeles at this time. We make no other warranty, either express or implied. The conclusions and recommendations contained in this report are based on site conditions disclosed in our subsurface investigation and the referenced reports. However, soil conditions can vary significantly between borings and natural outcrops, therefore, further refinements of our recommendations contained herein may be necessary due to changes in the bridge plans.

Since our investigation was based on the site conditions observed, selective laboratory testing, and engineering analyses, the conclusions and recommendations contained herein are professional opinions. Further, these opinions have been derived in accordance with standard engineering practices, and no warranty is expressed or implied.

CLOSURE

We appreciate this opportunity to be of continued service to you. If you have any questions regarding the content of this report or any other aspects of the project, please do not hesitate to contact us.

Very truly yours,

GEOSOILS CONSULTANTS, INC.

WILLIAM A. CIRIDON
GE 217

LANCE R. PUTNUM
Staff Geologist

RUDY F. RUBERTI
CEG 1708

WAC.LRP.RFR:W:Prelim Geo Eng. Study

Encl: References
- Plate 1, Geologic Map
- Plate 2, Geologic Cross-Section
- Appendix A, Field Exploration and Laboratory Testing
  - Plates A-1 and A-2, Boring Logs
  - Plates SH-1, Shear Test Diagram
- Appendix B, 1997 UBC Seismic Design Parameters
- Appendix C, Pile Capacity Analysis
  - Plates C-1 through C-6

cc: (5) Addressee

December 13, 2005
W.O. 5831

APPENDIX A

FIELD EXPLORATION AND LABORATORY TESTING

MDN 8692

REFERENCES

1. Pacific Soils Engineering, Inc. dated May 29, 1998, "Preliminary Geotechnical Report, Tentative Tract 47449, City of San Dimas, California".

2. Southwest Geotechnical, Inc. dated October 22, 1999, "Response to County of Los Angeles Department of Public Works Materials Engineering Division "Soils Engineering Review Sheet" and "Geologic Review", dated 7/6/99 and 7/1/99, respectively, for Tentative Tract 47449, San Dimas, California".

3. Southwest Geotechnical, Inc. dated March 24, 2000 "Response to County of Los Angeles Department of Public Works Materials Engineering Division "Soils Engineering Review Sheet" and "Geologic Review", dated 12/2/99, and 11/17/99, respectively, for Tentative Tract 47449, San Dimas, California".

4. Southwest Geotechnical, Inc. dated May 15, 2000, "Response to County of Los Angeles Department of Public Works, Land Development Division, Geologic Review Sheet dated 4-17-00, and Soils Engineering Review Sheet dated 5-11-00".

APPENDIX A

FIELD EXPLORATION AND LABORATORY TESTING

Field Exploration

Subsurface conditions were explored by drilling two exploratory borings to a maximum depth of 10 feet at the locations shown on the attached Plate 1. The depth and number of borings were limited due to access constraints and hard rock. Drilling was observed by one of our staff and/or project geologists, who continuously logged and classified the soils encountered by visual examination in accordance with the Unified Soil Classification System. The borings were excavated using a 24-inch diameter tract-mounted limited access bucket rig. Ring samples were obtained by driving a ring sampler. Soil samples were retained in a series of brass rings, each having an inside diameter of 2.36 (6.0 centimeter) and a height of 1.00 inch (2.54 centimeter). The central portion of the samples was retained in close-fitting, moisture-tight containers for shipment to our laboratory.

Direct Shear Test

Direct shear tests were performed in a strain-control type Direct Shear Machine. The rate of deformation was approximately 0.05 inches per minute. The sample was sheared under varying confining loads in order to determine the Coulomb shear strength parameters, cohesion, and angle of internal friction. All samples were tested in an artificially-saturated condition. The results are plotted on the Shear Test Diagram included with this report as Plates SH-1.

Moisture-Density

The field moisture content and dry unit weights were determined for each of the undisturbed ring samples. The data was obtained to determine the in-place densities and moisture of underlying material. These values are shown on the Boring Logs.

Appendix A

Compaction Tests

To determine the compaction character of the on-site soils, compaction testing was performed in accordance with ASTM Test Designation D-1557-91. The maximum density and optimum moisture were determined and are summarized below:

Boring	Description	Maximum Dry Density (pcf)	Optimum Moisture (%)	Expansion Index
B-1 @ 2-4'	Med. Brown Sandy CLAY w/ Rock Fragments.	105.0	19.5	Medium
B-1 @ 10'	Orange Brown Clayey fine to coarse SAND with Abundant Rock Fragments.	109.0	17.5	Low

Expansion Index Tests

To determine the expansion characteristics of on-site soil material. Expansion Index Tests were performed in accordance to 1997 Uniform Building Code Standard 18-2. Test results indicate on-site soil have a low to medium expansion index (see above Compaction Tests).

GEOTECHNICAL BORING LOG

PROJECT NAME Vista Verde Ranch — W.O. NO. 5831
DRILLING COMPANY Roy Bros. — DATE STARTED: 11-4-05 — BORING NO. B-1
TYPE OF DRILL RIG Limited Access — LOGGED BY LP — SHEET 1 OF 1
DRILLING METHOD Flight Auger — HAMMER WEIGHT (LBS) — GROUND ELEVATION (FT)
DIAMETER OF HOLE 24 — DROP (IN) — GW ELEVATION
BORING LOCATION:

DEPTH (FT)	SAMPLE TYPE	BLOWS/ 6 IN.	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	OTHER TESTS
			TOPSOIL/SPILL FILL Gray-brown SAND with abundant cobble to 1', dense, dry.			
5			**BEDROCK: Puente Formation(Tplv) and Glendora Volcanics (Tgv)** @ 1-5.5', Gray SANDSTONE conglomerate, abundant cobble, hard cobble to 1'. @ 5.5-6.5', Light orange SANDSTONE conglomerate, scattered cobble to 1', hard, faint bedding E-W/20N conglomerate. @ 6.5-9', Gray-brown SANDSTONE conglomerate, abundant cobble to 1.5, hard. @ 9-10', Dark orange-brown VOLCANICS, very hard, hard drilling from 1-10'.			
10			T.D. 10'. Refusal. No groundwater. No caving.			
15						
20						
25						

LEGEND

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample
- Shelby Tube
- Water Seepage
- Groundwater

SIEVE: GRAIN SIZE ANALYSIS
MAX: MAXIMUM DRY DENSITY
DS: DIRECT SHEAR
CONS: CONSOLIDATION
HYDR: HYDROMETER ANALYSIS
EXPAN: EXPANSION INDEX
CHEM: CHEMICAL TESTS

PLATE A-1

GeoSoils Consultants, Inc
GEOTECHNICAL * GEOLOGIC * ENVIRONMENTAL

GEOTECHNICAL BORING LOG

PROJECT NAME Vista Verde Ranch — W.O. NO. 5831
DRILLING COMPANY Roy Bros. — DATE STARTED: 11-7-05 — BORING NO. B-2
TYPE OF DRILL RIG Limited Access — LOGGED BY LP — SHEET 1 OF 1
DRILLING METHOD Flight Auger — HAMMER WEIGHT (LBS) — GROUND ELEVATION (FT)
DIAMETER OF HOLE 24 — DROP (IN) — GW ELEVATION
BORING LOCATION:

DEPTH (FT)	SAMPLE TYPE	BLOWS/ 6 IN.	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	OTHER TESTS
			BEDROCK: Puente Formation (Tplv/Tgv) @ 0-3', Gray-brown SANDSTONE conglomerate, hard, cobble to 2'.			
			T.D. @ 3'. Refusal.			
5						
10						
15						
20						
25						

LEGEND

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample
- Shelby Tube
- Water Seepage
- Groundwater

SIEVE: GRAIN SIZE ANALYSIS
MAX: MAXIMUM DRY DENSITY
DS: DIRECT SHEAR
CONS: CONSOLIDATION
HYDR: HYDROMETER ANALYSIS
EXPAN: EXPANSION INDEX
CHEM: CHEMICAL TESTS

PLATE A-2

GeoSoils Consultants, In
GEOTECHNICAL * GEOLOGIC * ENVIRONMENTA

Vista Verde
W.O.: 5831

Date of Test: 11/05

Sample: **B-1 @ 10.0'**

GeoSoils Consultants, Inc.

Geotechnical Engineering * Engineering Geology

PLATE SH-1

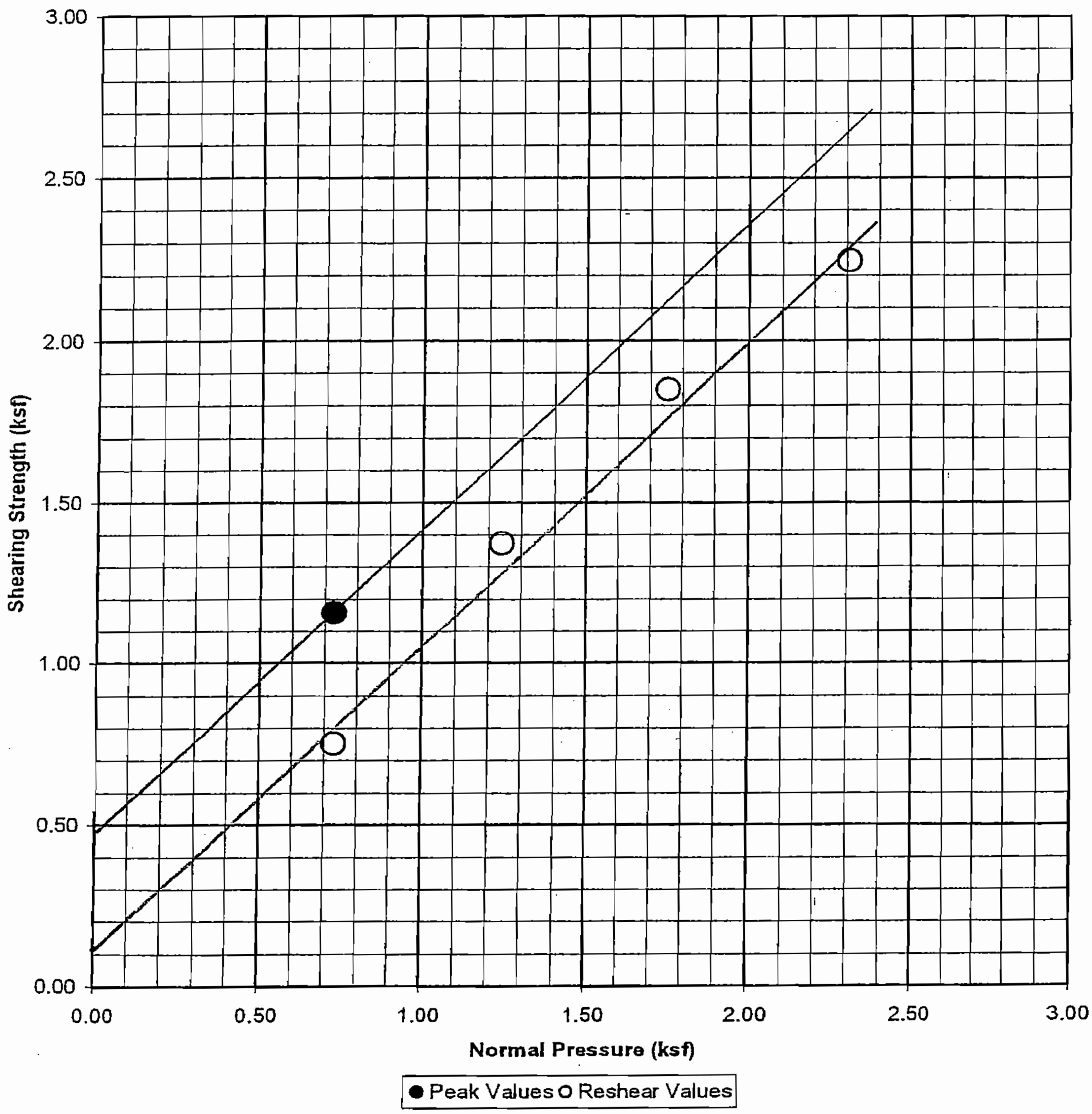
Shear Test Diagram

Peak

C(psf): **480** Phi (degrees): **45.0**

Reshear

C(psf): **120** Phi (degrees): **45.0**



Undisturbed **Natural** Shear-Saturated

Yellow-brown, sandy, clayey SILT, w/ rock fragments.

27.5% Saturated Moisture Content

M.J. SCHIFF & ASSOCIATES, INC.
431 West Baseline Road
Claremont, CA 91711

TEL (909) 626-0967 / FAX (909) 626-3316
E-mail: mjsa@mjschiff.com http://www.mjschiff.com

TRANSMITTAL LETTER

DATE: November 23, 2005

ATTENTION: Mr. Ron Allen

To: GeoSoils Consultants, Inc.
6634 Valijean Ave.
Van Nuys, CA 91304

SUBJECT: Laboratory Test Data
Vista Verde
Your #5831
MJS&A #05-1662LAB

COMMENTS: Enclosed are the results for the subject project.

James T. Keegan Laboratory Manager

SCHIFF ASSOCIATES

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Table 1 - Laboratory Tests on Soil Samples

GeoSoils Consultants
Vista Verde
Your #5831, MJS&A #05-1662LAB
16-Nov-05

Sample ID			Boring #1 @3.0' - 4.0'	Boring #1 @10.0'
Resistivity		**Units**		
as-received		ohm-cm	33,000	16,000
minimum		ohm-cm	1,300	1,600
pH			7.4	7.8
Electrical Conductivity		mS/cm	0.31	0.18
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	297	148
magnesium	Mg^{2+}	mg/kg	15	ND
sodium	Na^{1+}	mg/kg	ND	27
Anions				
carbonate	CO_3^{2-}	mg/kg	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	744	458
chloride	Cl^{1-}	mg/kg	ND	ND
sulfate	SO_4^{2-}	mg/kg	115	52
Other Tests				
ammonium	NH_4^{1+}	mg/kg	10.4	1.7
nitrate	NO_3^{1-}	mg/kg	ND	16.7
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Minimum resistivity per CTM 643, sulfate per CTM 417, and chloride per CTM 422

Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.626.0967 · Fax: 909.626.3316

December 13, 2005
W.O. 5831

APPENDIX B

1997 UBC SEISMIC DESIGN PARAMETERS

MDN 8692

December 13, 2005
W.O. 5831

APPENDIX B

1997 UBC SEISMIC DESIGN PARAMETERS

UBCSEIS

The UBCSEIS program was written by Thomas F. Blake to read a fault-data file and compute the distances between a site and each of the faults in that data file. Then, using those distances, the program selects the corresponding Uniform Building Code seismic coefficients and constructs a design response spectrum.

UBCSEIS, a computer program for the estimation of Uniform Building Code seismic design coefficients from a California fault-data file, performs fault searches using a modified version of the fault-data file for the State of California that was recently compiled by the California Division of Mines and Geology (CDMG). Most of the original fault data are available from CDMG through their web site at:

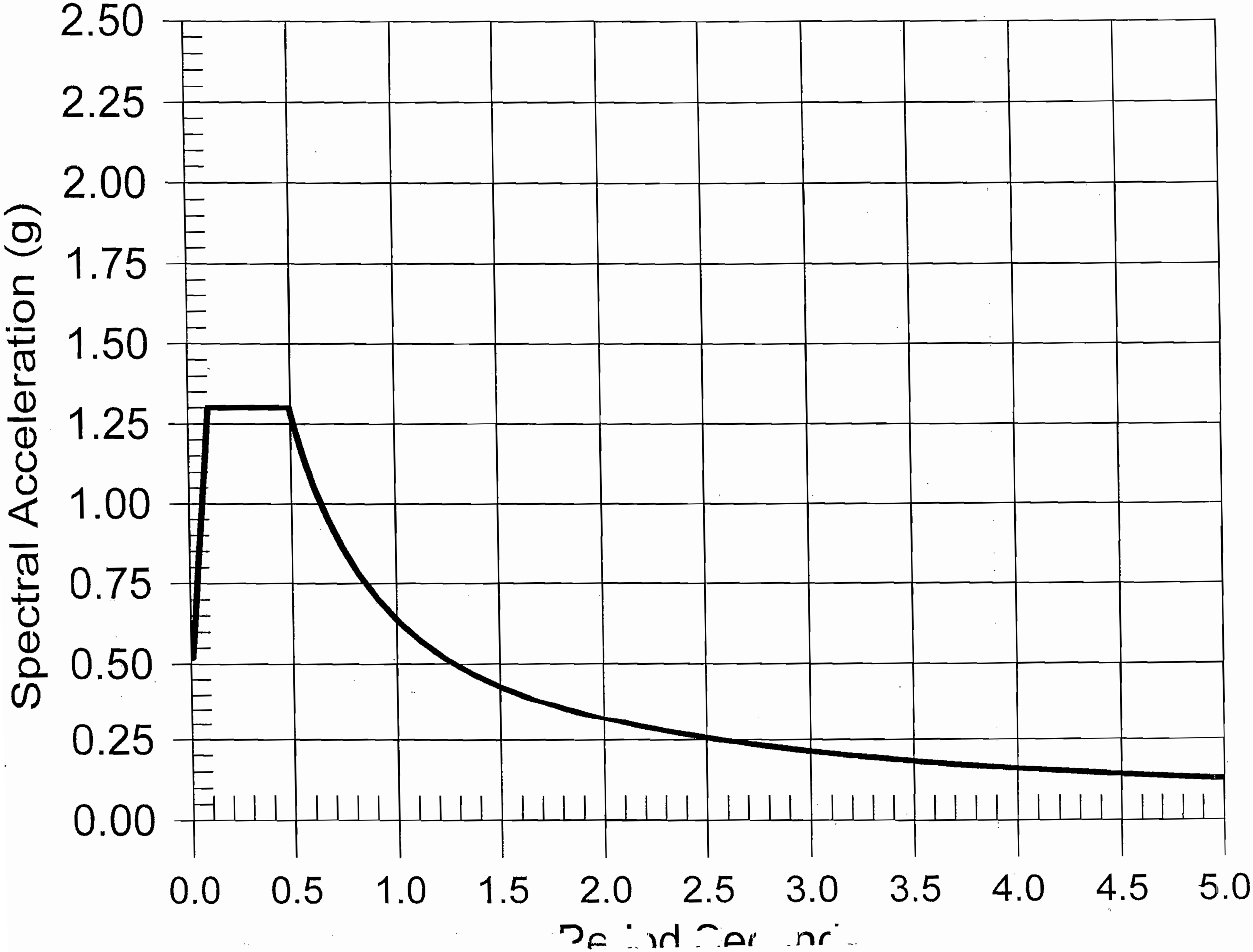
http://www.consrv.ca.gov/dmg/shezp/fltindex.html

UBCSEIS – GENERAL PROCEDURES

1. The program searches the fault-data file to compute the distances to nearby faults.
2. For each fault, the distance between the fault and the site is computed. As specified by the Uniform Building Code, the closest distance between the site and the surface projection of the fault plane is used. Note that the down-dip fault coordinates should be limited so that the fault plane does not project below a depth of 10 km to be consistent with the Uniform Building Code.
3. After computing the site-to-fault distances, the program selects the closest Type A, Type B, and Type C faults.
4. The corresponding Na, Nv, Ca, and Cv coefficients for each Type A, Type B, and Type C fault types.
5. In order to construct a design spectrum, the Ts and To coefficients are computed in conjunction with the largest of the Na, Nv, Ca, and Cv coefficients.

DESIGN RESPONSE SPECTRUM

Seismic Zone: 0.4 Soil Profile: SB



```
***********************
*                     *
*    U B C S E I S    *
*                     *
*    Version  1.03    *
*                     *
***********************
```

COMPUTATION OF 1997
UNIFORM BUILDING CODE
SEISMIC DESIGN PARAMETERS

```
JOB NUMBER: WO 5831                                    DATE: 12-14-2005

JOB NAME: VISTA VERDE-SAN

FAULT-DATA-FILE NAME: CDMGUBCR.DAT

SITE COORDINATES:
   SITE LATITUDE:  34.0915
   SITE LONGITUDE:  117.8199

UBC SEISMIC ZONE:  0.4

UBC SOIL PROFILE TYPE:  SB

NEAREST TYPE A FAULT:
   NAME:  CUCAMONGA
   DISTANCE:  9.2  km

NEAREST TYPE B FAULT:
   NAME:  SAN JOSE
   DISTANCE:  0.2  km

NEAREST TYPE C FAULT:
   NAME:  □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
   DISTANCE:  99999.0  km

SELECTED UBC SEISMIC COEFFICIENTS:
   Na:  1.3
   Nv:  1.6
   Ca:  0.52
   Cv:  0.64
   Ts:  0.492
   To:  0.098

   *******************************************************************
   * 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.    *
   *******************************************************************
```

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)
SAN JOSE	0.2	B	6.5	0.50	DS
SIERRA MADRE (Central)	4.5	B	7.0	3.00	DS
CUCAMONGA	9.2	A	7.0	5.00	DS
CHINO-CENTRAL AVE. (Elsinore)	9.3	B	6.7	1.00	DS
CLAMSHELL-SAWPIT	15.7	B	6.5	0.50	DS
ELSINORE-WHITTIER	17.9	B	6.8	2.50	SS
RAYMOND	19.0	B	6.5	0.50	DS
VERDUGO	28.2	B	6.7	0.50	DS
ELSINORE-GLEN IVY	31.3	B	6.8	5.00	SS
SAN JACINTO-SAN BERNARDINO	33.4	B	6.7	12.00	SS
SAN ANDREAS - 1857 Rupture	33.8	A	7.8	34.00	SS
SAN ANDREAS - Southern	36.0	A	7.4	24.00	SS
HOLLYWOOD	37.9	B	6.5	1.00	DS
CLEGHORN	40.9	B	6.5	3.00	SS
NEWPORT-INGLEWOOD (L.A.Basin)	44.7	B	6.9	1.00	SS
SIERRA MADRE (San Fernando)	48.3	B	6.7	2.00	DS
SAN GABRIEL	49.3	B	7.0	1.00	SS
SANTA MONICA	54.2	B	6.6	1.00	DS
SAN JACINTO-SAN JACINTO VALLEY	54.3	B	6.9	12.00	SS
NORTH FRONTAL FAULT ZONE (West)	55.1	B	7.0	1.00	DS
PALOS VERDES	55.3	B	7.1	3.00	SS
NEWPORT-INGLEWOOD (Offshore)	56.3	B	6.9	1.50	SS
MALIBU COAST	65.5	B	6.7	0.30	DS
ELSINORE-TEMECULA	66.1	B	6.8	5.00	SS
SANTA SUSANA	67.3	B	6.6	5.00	DS
HOLSER	75.9	B	6.5	0.40	DS
ANACAPA-DUME	81.4	B	7.3	3.00	DS
HELENDALE - S. LOCKHARDT	85.3	B	7.1	0.60	SS
OAK RIDGE (Onshore)	88.7	B	6.9	4.00	DS
SAN JACINTO-ANZA	91.9	A	7.2	12.00	SS
CORONADO BANK	92.0	B	7.4	3.00	SS
SIMI-SANTA ROSA	92.8	B	6.7	1.00	DS
SAN CAYETANO	94.8	B	6.8	6.00	DS
NORTH FRONTAL FAULT ZONE (East)	94.8	B	6.7	0.50	DS
PINTO MOUNTAIN	101.1	B	7.0	2.50	SS
ELSINORE-JULIAN	108.8	A	7.1	5.00	SS
LENWOOD-LOCKHART-OLD WOMAN SPRGS	109.7	B	7.3	0.60	SS
SANTA YNEZ (East)	112.8	B	7.0	2.00	SS
ROSE CANYON	112.9	B	6.9	1.50	SS
JOHNSON VALLEY (Northern)	115.5	B	6.7	0.60	SS
GARLOCK (West)	117.3	A	7.1	6.00	SS
LANDERS	118.5	B	7.3	0.60	SS
GRAVEL HILLS - HARPER LAKE	118.8	B	6.9	0.60	SS
VENTURA - PITAS POINT	124.9	B	6.8	1.00	DS
BLACKWATER	127.4	B	6.9	0.60	SS
PLEITO THRUST	127.6	B	6.8	2.00	DS

SUMMARY OF FAULT PARAMETERS

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
EMERSON So. - COPPER MTN.	127.8	B	6.9	0.60	SS
CALICO - HIDALGO	129.5	B	7.1	0.60	SS
BURNT MTN.	130.3	B	6.5	0.60	SS
M.RIDGE-ARROYO PARIDA-SANTA ANA	130.9	B	6.7	0.40	DS
EUREKA PEAK	131.4	B	6.5	0.60	SS
GARLOCK (East)	134.0	A	7.3	7.00	SS
BIG PINE	136.1	B	6.7	0.80	SS
RED MOUNTAIN	138.8	B	6.8	2.00	DS
SAN JACINTO-COYOTE CREEK	139.9	B	6.8	4.00	SS
WHITE WOLF	143.5	B	7.2	2.00	DS
PISGAH-BULLION MTN.-MESQUITE LK	146.0	B	7.1	0.60	SS
EARTHQUAKE VALLEY	152.4	B	6.5	2.00	SS
SANTA CRUZ ISLAND	156.5	B	6.8	1.00	DS
So. SIERRA NEVADA	159.8	B	7.1	0.10	DS
LITTLE LAKE	169.5	B	6.7	0.70	SS
SANTA YNEZ (West)	172.6	B	6.9	2.00	SS
SAN JACINTO - BORREGO	179.6	B	6.6	4.00	SS
TANK CANYON	180.1	B	6.5	1.00	DS
ELSINORE-COYOTE MOUNTAIN	183.6	B	6.8	4.00	SS
PANAMINT VALLEY	189.1	B	7.2	2.50	SS
OWL LAKE	189.5	B	6.5	2.00	SS
SANTA ROSA ISLAND	192.3	B	6.9	1.00	DS
BRAWLEY SEISMIC ZONE	211.5	B	6.5	25.00	SS
DEATH VALLEY (South)	213.0	B	6.9	4.00	SS
SUPERSTITION MTN. (San Jacinto)	213.2	B	6.6	5.00	SS
LOS ALAMOS-W. BASELINE	215.2	B	6.8	0.70	DS
ELMORE RANCH	216.1	B	6.6	1.00	SS
SUPERSTITION HILLS (San Jacinto)	218.4	B	6.6	4.00	SS
SAN JUAN	229.5	B	7.0	1.00	SS
LIONS HEAD	232.4	B	6.6	0.02	DS
OWENS VALLEY	233.9	B	7.6	1.50	SS
ELSINORE-LAGUNA SALADA	234.4	B	7.0	3.50	SS
SAN LUIS RANGE (S. Margin)	236.8	B	7.0	0.20	DS
DEATH VALLEY (Graben)	237.5	B	6.9	4.00	DS
IMPERIAL	245.0	A	7.0	20.00	SS
CASMALIA (Orcutt Frontal Fault)	248.4	B	6.5	0.25	DS
LOS OSOS	266.2	B	6.8	0.50	DS
HUNTER MTN. - SALINE VALLEY	267.5	B	7.0	2.50	SS
INDEPENDENCE	269.2	B	6.9	0.20	DS
HOSGRI	278.1	B	7.3	2.50	SS
RINCONADA	282.2	B	7.3	1.00	SS
DEATH VALLEY (Northern)	286.4	A	7.2	5.00	SS
BIRCH CREEK	324.3	B	6.5	0.70	DS
SAN ANDREAS (Creeping)	329.9	B	5.0	34.00	SS
WHITE MOUNTAINS	330.1	B	7.1	1.00	SS
DEEP SPRINGS	349.7	B	6.6	0.80	DS

SUMMARY OF FAULT PARAMETERS

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
ROUND VALLEY (E. of S.N.Mtns.)	358.2	B	6.8	1.00	DS
DEATH VALLEY (N. of Cucamongo)	358.5	A	7.0	5.00	SS
FISH SLOUGH	367.3	B	6.6	0.20	DS
HILTON CREEK	384.0	B	6.7	2.50	DS
HARTLEY SPRINGS	407.6	B	6.6	0.50	DS
ORTIGALITA	410.7	B	6.9	1.00	SS
CALAVERAS (So.of Calaveras Res)	418.4	B	6.2	15.00	SS
MONTEREY BAY - TULARCITOS	424.9	B	7.1	0.50	DS
PALO COLORADO - SUR	428.9	B	7.0	3.00	SS
QUIEN SABE	430.9	B	6.5	1.00	SS
MONO LAKE	443.4	B	6.6	2.50	DS
ZAYANTE-VERGELES	450.3	B	6.8	0.10	SS
SARGENT	455.1	B	6.8	3.00	SS
SAN ANDREAS (1906)	455.6	A	7.9	24.00	SS
ROBINSON CREEK	474.4	B	6.5	0.50	DS
SAN GREGORIO	499.6	A	7.3	5.00	SS
GREENVILLE	502.2	B	6.9	2.00	SS
HAYWARD (SE Extension)	504.1	B	6.5	3.00	SS
MONTE VISTA - SHANNON	505.1	B	6.5	0.40	DS
ANTELOPE VALLEY	514.5	B	6.7	0.80	DS
HAYWARD (Total Length)	523.3	A	7.1	9.00	SS
CALAVERAS (No.of Calaveras Res)	523.3	B	6.8	6.00	SS
GENOA	539.4	B	6.9	1.00	DS
CONCORD - GREEN VALLEY	569.8	B	6.9	6.00	SS
RODGERS CREEK	608.8	A	7.0	9.00	SS
WEST NAPA	609.2	B	6.5	1.00	SS
POINT REYES	629.8	B	6.8	0.30	DS
HUNTING CREEK - BERRYESSA	630.7	B	6.9	6.00	SS
MAACAMA (South)	670.8	B	6.9	9.00	SS
COLLAYOMI	687.1	B	6.5	0.60	SS
BARTLETT SPRINGS	689.9	A	7.1	6.00	SS
MAACAMA (Central)	712.3	A	7.1	9.00	SS
MAACAMA (North)	771.1	A	7.1	9.00	SS
ROUND VALLEY (N. S.F.Bay)	776.3	B	6.8	6.00	SS
BATTLE CREEK	798.0	B	6.5	0.50	DS
LAKE MOUNTAIN	834.6	B	6.7	6.00	SS
GARBERVILLE-BRICELAND	852.0	B	6.9	9.00	SS
MENDOCINO FAULT ZONE	908.7	A	7.4	35.00	DS
LITTLE SALMON (Onshore)	914.3	A	7.0	5.00	DS
MAD RIVER	916.5	B	7.1	0.70	DS
CASCADIA SUBDUCTION ZONE	922.7	A	8.3	35.00	DS
McKINLEYVILLE	927.1	B	7.0	0.60	DS
TRINIDAD	928.6	B	7.3	2.50	DS
FICKLE HILL	929.2	B	6.9	0.60	DS
TABLE BLUFF	935.0	B	7.0	0.60	DS
LITTLE SALMON (Offshore)	948.2	B	7.1	1.00	DS
BIG LAGOON - BALD MTN.FLT.ZONE	965.1	B	7.3	0.50	DS

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December 13, 2005
W.O. 5831

APPENDIX C

PILE CAPACITY ANALYSIS

MDN 8692

SPREADSHEET NOTES

This spreadsheet is based on the effective stress method, which is similar to the Beta Method

Reference: *Design of Pile Foundations*, Technical Engineering and Design Guides as Adopted from the US ARMY Corps of Engineers, No. 1, ASCE, pp. 13 - 24

Related References
- *Soil Mechanics Design Manual* 7.01, Naval Facilities Engineering Command (NAVFAC)
- *Design and Construction of Driven Pile Foundations*, Workshop Manual - Vol. 1 (Working Draft), National Highway Institute (NHI), U.S. Department of Transporation, Federal Highway Administration, Jan 1996
- *Transmission Line Structure Foundations for Uplift-Compression Loading*, Electric Power Research Institute (EPRI), EPRI EL-2860, Project 1493-1, Final Report, February 1983
- *Foundation Analysis and Design*, Bowles
- *Bearing Capacity of Auger-Cast Piles in Sand*, William J Neely, ASCE,pp 331 - 345

CALCULATION SHEET NOTES - C.O.E., NAVFAC

$f_s = K * \tan(\phi)*\sigma_{vt}'$ where $K = K_c$ or K_t Not based on Ko

Based on estimated ϕ

LINE No.	
2	For rock assume friction angle max = 45
4	Nq formula comes from NAVFAC 7.2-194 (Curve fitted data)
5	Ko is not used in this spreadsheet For soils with blows < 50 blows/ft, soil probably normally consolidated Normally Consolodated: Ko = (1-sin(phi)) For soils with blows > 50 blows/ft, soil probably over consolidated Over Consolodated: Ko = (1-sin(phi)) * (OCR)^.8
9	Bearing pressure and skin friction increase with a vertical effective stress, Po, up to a limiting depth of embedment, depending on groundwater depth and soil density. Beyond this depth (10B to 40B), or D > 20B, limit vertical effective stress, Po, to that value at a depth corresponding to D = 20B. *NAVFAC 7.2-193, Figure 1, Note-1.*
11	From NAVFAC 7.2-194
12	From NAVFAC 7.2-194
13	Delta: For sand against concrete = 3/4 - 1.0(phi) See NAVFAC 7.2-194
14a	Relative downward movement of as little as 0.6 inch of the soil with respect to the pile may be sufficient to mobilize full negative skin friction (*Design of Pile Foundations, page 22*)
16	Weight of concrete = 160 pcf
18	Same as column 15 because took out wieght of pier from safety factor
19	A factor of safety is not applied to negative skin friction - it is applied to the load
20	Allow: Ultimate compressive capacity divded by safety factor + weight of pier
Other:	If a bitimus coating is applied, the reduction in negative skin friction is also applied to uplift capacity in skin tension

CALCULATION SHEET NOTES - KULHAWY

$f_s = K * \tan(\phi)*\sigma_{vt}'$ where $K = (K_o * K/K_o) = K_{ht}$ or K_{hc}

Based on measured in-situ for ϕ, K_o, and OCR or estimated ϕ, $K_o = (1-\sin(\phi)*OCR^{0.85}$, and OCR

LINE No.	
9	Kulhawy's method has a depth factor built in (Ko), therefore, Svt is not used, but Svo is.
11	Values of K/Ko, where Khc=Kht = Ko x K/Ko, are found in EPRI, Table 8-2, Horizontal Soil Stress Coefficiant, page 8-14
12	Values of K/Ko, where Khc=Kht = Ko x K/Ko, are found in EPRI, Table 8-2, Horizontal Soil Stress Coefficiant, page 8-14

SPREADSHEET ASSUMPTIONS

1. Input parameters for allowable compressive capacities must be extrapolated to a depth at least 4 below deepest capacity considered for evaluation, otherwise, "ERROR" message will result.
2. Nq=0 for depth down to 1 x Pier Diameter

Depth Factor

D_c = 10B for loose sands

D_c = 15B for medium-dense sands

D_c = 20B for dense sands

Current Literature states that σ_v' increases linearly at any depth

$\sigma_v' = \gamma' D$ for $D < D_c$

$\sigma_v' = \gamma' D_c$ for $D \geq D_o$

DRILLED PIER CALCULATIONS

CORP OF ENGINEERS/NAVFAC METHOD

Project Name: RAD DEVELOPMENT
Project Number: WO 5831
Date: 12/05
Boring Location: Boring B-1

Drilled Pier Diameter (feet) = 2
Reduction Factor for Negative Skin Friction (%) = 0
Factor of Safety = 2.5

Input Parameters					Tip Capacity					Skin Friction Capacity									Total Capacity	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	14a	15	16	17	18	19	20
Depth (feet)	Friction Angle (phi) (deg)	Soil Density (Gamma) (pcf)	Nq	Ko	Bvo' (tsf)	Uo (tsf)	Bvo (tsf)	Bvt' (tsf)	Ultimate Tip Capacity Qt (ton)	Ko	Kt	Delta (deg)	Skin Compression Qsc (ton)	Negative Skin Compression Qsc (ton)	Skin Tension Qst (ton)	Weight of Pile Wp (tons)	Ultimate Compressive Capacity (Qult C) (ton)	Ultimate Skin Friction Capacity (Qult T) (ton)	Allowable Compressive Capacity (Qa C) (ton)	Allowable Uplift Capacity (Qa T) (ton)
1	38.5	130	0	0.00	0.065	0.000	0.065	0.065	0	1.50	0.50	36.6	0	0	0	0.3	0.5	0.2	0	0
2	38.5	130	0	0.00	0.130	0.000	0.130	0.130	0	1.50	0.50	36.6	1	0	0	0.5	1.4	0.5	0	0
3	38.5	130	52	0.00	0.195	0.000	0.195	0.195	32	1.50	0.50	36.6	3	0	1	0.8	34.4	0.9	14	1
4	38.5	130	52	0.00	0.260	0.000	0.260	0.260	42	1.50	0.50	36.6	5	0	2	1.0	46.7	1.5	19	2
5	38.5	130	52	0.00	0.325	0.000	0.325	0.325	53	1.50	0.50	36.6	7	0	2	1.3	59.5	2.3	24	2
6	38.5	130	52	0.00	0.390	0.000	0.390	0.390	63	1.50	0.50	36.6	10	0	3	1.5	72.8	3.2	29	3
7	38.5	130	52	0.00	0.455	0.000	0.455	0.455	74	1.50	0.50	36.6	13	0	4	1.8	86.5	4.2	35	3
8	38.5	130	52	0.00	0.520	0.000	0.520	0.520	84	1.50	0.50	36.6	16	0	5	2.0	100.7	5.5	40	4
9	38.5	130	52	0.00	0.585	0.000	0.585	0.585	95	1.50	0.50	36.6	20	0	7	2.3	115.3	6.8	46	5
10	38.5	130	52	0.00	0.650	0.000	0.650	0.650	106	1.50	0.50	36.6	25	0	8	2.5	130.4	8.3	52	6
11	38.5	139	52	0.00	0.720	0.000	0.720	0.720	117	1.50	0.50	36.6	30	0	10	2.8	146.7	10.0	59	7
12	38.5	130	52	0.00	0.785	0.000	0.785	0.785	127	1.50	0.50	36.6	36	0	12	3.0	162.7	11.8	65	8
13	38.5	130	52	0.00	0.850	0.000	0.850	0.850	138	1.50	0.50	36.6	41	0	14	3.3	179.2	13.8	72	9
14	38.5	130	52	0.00	0.915	0.000	0.915	0.915	148	1.50	0.50	36.6	48	0	16	3.5	196.2	16.0	78	10
15	38.5	130	52	0.00	0.980	0.000	0.980	0.980	159	1.50	0.50	36.6	55	0	18	3.8	213.6	18.2	85	11
16	38.5	130	52	0.00	1.045	0.000	1.045	1.045	169	1.50	0.50	36.6	62	0	21	4.0	231.4	20.7	93	12
17	38.5	130	52	0.00	1.110	0.000	1.110	1.110	180	1.50	0.50	36.6	70	0	23	4.3	249.7	23.3	100	14
18	38.5	130	52	0.00	1.175	0.000	1.175	1.175	190	1.50	0.50	36.6	78	0	26	4.5	268.5	26.0	107	15
19	38.5	130	52	0.00	1.240	0.000	1.240	1.240	201	1.50	0.50	36.6	87	0	29	4.8	287.7	28.9	115	16
20	38.5	130	52	0.00	1.305	0.000	1.305	1.305	212	1.50	0.50	36.6	96	0	32	5.0	307.3	31.9	123	18
21	38.5	130	52	0.00	1.370	0.000	1.370	1.370	222	1.50	0.50	36.6	105	0	35	5.3	327.5	35.1	131	19
22	38.5	130	52	0.00	1.435	0.000	1.435	1.435	233	1.50	0.50	36.6	115	0	38	5.5	348.0	38.5	139	21
23	38.5	130	52	0.00	1.500	0.000	1.500	1.500	243	1.50	0.50	36.6	126	0	42	5.8	369.1	42.0	148	23
24	38.5	130	52	0.00	1.565	0.000	1.565	1.565	254	1.50	0.50	36.6	137	0	46	6.0	390.5	45.6	156	24
25	38.5	130	52	0.00	1.630	0.000	1.630	1.630	264	1.50	0.50	36.6	148	0	49	6.3	412.5	49.4	165	26
26	38.5	130	52	0.00	1.695	0.000	1.695	1.695	275	1.50	0.50	36.6	160	0	53	6.5	434.9	53.4	174	28
27	38.5	130	52	0.00	1.760	0.000	1.760	1.760	285	1.50	0.50	36.6	172	0	57	6.8	457.7	57.5	183	30
28	38.5	120	52	0.00	1.820	0.000	1.820	1.820	295	1.50	0.50	36.6	185	0	62	7.0	480.2	61.7	192	32
29	38.5	130	52	0.00	1.885	0.000	1.885	1.885	306	1.50	0.50	36.6	198	0	66	7.3	503.9	66.1	202	34
30	38.5	130	52	0.00	1.950	0.000	1.950	1.950	316	1.50	0.50	36.6	212	0	71	7.5	528.1	70.6	211	36
31	38.5	130	52	0.00	2.015	0.000	2.015	2.015	327	1.50	0.50	36.6	226	0	75	7.8	552.7	75.3	221	38
32	38.5	130	52	0.00	2.080	0.000	2.080	2.080	337	1.50	0.50	36.6	241	0	80	8.0	577.8	80.2	231	40
33	38.5	130	52	0.00	2.145	0.000	2.145	2.145	348	1.50	0.50	36.6	256	0	85	8.3	603.3	85.2	241	42
34	38.5	130	52	0.00	2.210	0.000	2.210	2.210	358	1.50	0.50	36.6	271	0	90	8.5	629.3	90.3	252	45
35	38.5	130	52	0.00	2.275	0.000	2.275	2.275	369	1.50	0.50	36.6	287	0	96	8.8	655.7	95.6	262	47
36	38.5	130	52	0.00	2.340	0.000	2.340	2.340	379	1.50	0.50	36.6	303	0	101	9.0	682.7	101.1	273	49
37	38.5	130	52	0.00	2.405	0.000	2.405	2.405	390	1.50	0.50	36.6	320	0	107	9.3	710.0	106.7	284	52
38	38.5	130	52	0.00	2.470	0.000	2.470	2.470	400	1.50	0.50	36.6	337	0	112	9.6	737.8	112.4	295	55
39	38.5	130	52	0.00	2.535	0.000	2.535	2.535	411	1.50	0.50	36.6	355	0	118	9.8	766.1	118.3	306	57
40	38.5	130	52	0.00	2.600	0.000	2.600	2.600	422	1.50	0.50	36.6	373	0	124	10.1	794.6	124.4	318	60
41	38.5	130	52	0.00	2.665	0.000	2.665	2.600	422	1.50	0.50	36.6	391	0	130	10.3	813.0	130.5	325	62
42	38.5	130	52	0.00	2.730	0.000	2.730	2.600	422	1.50	0.50	36.6	410	0	137	10.6	831.2	136.5	332	65
43	38.5	130	52	0.00	2.795	0.000	2.795	2.600	422	1.50	0.50	36.6	428	0	143	10.8	849.3	142.6	340	68
44	38.5	130	52	0.00	2.860	0.000	2.860	2.600	422	1.50	0.50	36.6	446	0	149	11.1	867.5	148.6	347	71
45	38.5	130	52	0.00	2.925	0.000	2.925	2.600	422	1.50	0.50	36.6	464	0	155	11.3	885.7	154.7	354	73
46	38.5	130	52	0.00	2.990	0.000	2.990	2.600	422	1.50	0.50	36.6	482	0	161	11.6	903.9	160.8	362	76
47	38.5	130	52	0.00	3.055	0.000	3.055	2.600	422	1.50	0.50	36.6	500	0	167	11.8	922.1	166.8	369	79
48	38.5	130	52	0.00	3.120	0.000	3.120	2.600	422	1.50	0.50	36.6	519	0	173	12.1	940.2	172.9	376	81
49	38.5	130	52	0.00	3.185	0.000	3.185	2.600	422	1.50	0.50	36.6	537	0	179	12.3	958.4	178.9	383	84
50	38.5	130	52	0.00	3.250	0.000	3.250	2.600	422	1.50	0.50	36.6	555	0	185	12.6	976.6	185.0	391	87
51	38.5	130	52	0.00	3.315	0.000	3.315	2.600	422	1.50	0.50	36.6	573	0	191	12.8	994.8	191.1	398	89
52	38.5	130	52	0.00	3.380	0.000	3.380	2.600	422	1.50	0.50	36.6	591	0	197	13.1	1012.9	197.1	405	92
53	38.5	130	52	0.00	3.445	0.000	3.445	2.600	422	1.50	0.50	36.6	610	0	203	13.3	1031.1	203.2	412	95
54	38.5	130	52	0.00	3.510	0.000	3.510	2.600	422	1.50	0.50	36.6	628	0	209	13.6	1049.3	209.2	420	97
55	38.5	130	52	0.00	3.575	0.000	3.575	2.600	422	1.50	0.50	36.6	646	0	215	13.8	1067.5	215.3	427	100
56	38.5	130	52	0.00	3.640	0.000	3.640	2.600	422	1.50	0.50	36.6	664	0	221	14.1	1085.7	221.4	434	103
57	38.5	130	52	0.00	3.705	0.000	3.705	2.600	422	1.50	0.50	36.6	682	0	227	14.3	1103.8	227.4	442	105
58	38.5	130	52	0.00	3.770	0.000	3.770	2.600	422	1.50	0.50	36.6	700	0	233	14.6	1122.0	233.5	449	108
59	38.5	130	52	0.00	3.835	0.000	3.835	2.600	422	1.50	0.50	36.6	719	0	240	14.8	1140.2	239.5	456	111
60	38.5	130	52	0.00	3.900	0.000	3.900	2.600	422	1.50	0.50	36.6	737	0	246	15.1	1158.4	245.6	463	113
61	38.5	130	52	0.00	3.965	0.000	3.965	2.600	422	1.50	0.50	36.6	755	0	252	15.3	1176.6	251.7	471	116
62	38.5	130	52	0.00	4.030	0.000	4.030	2.600	422	1.50	0.50	36.6	773	0	258	15.6	1194.7	257.7	478	119
63	38.5	130	52	0.00	4.095	0.000	4.095	2.600	422	1.50	0.50	36.6	791	0	264	15.8	1212.9	263.8	485	121
64	38.5	130	52	0.00	4.160	0.000	4.160	2.600	422	1.50	0.50	36.6	810	0	270	16.1	1231.1	269.8	492	124
65	38.5	130	52	0.00	4.225	0.000	4.225	2.600	422	1.50	0.50	36.6	828	0	276	16.3	1249.3	275.9	500	127
66	38.5	130	52	0.00	4.290	0.000	4.290	2.600	422	1.50	0.50	36.6	846	0	282	16.6	1267.4	282.0	507	129
[illegible]	38	130		[illegible]	4.3		4.355		422	[illegible]	0.5		[illegible]	0	[illegible]		[illegible]	288.0	514	[illegible]

Plate C-1

DRILLED PIER CALCULATIONS

Corp of Engineers/NAVFAC Method

Project Name: RAD DEVELOPMENT
Project Number: WO 5831
Date: 12/05
Boring Location: Boring B-1

Drilled Pier Diameter (feet) = 2.5
Reduction Factor for Negative Skin Friction (%) = 0
Factor of Safety = 2.5

Input Parameters					Tip Capacity					Skin Friction Capacity									Total Capacity	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	14a	15	16	17	18	19	20
Depth (feet)	Friction Angle (phi) (deg)	Soil Density (Gamma) (pcf)	Nq	Kc	Svo (tsf)	Uo (tsf)	Svo' (tsf)	Sv' (tsf)	Ultimate Tip Capacity (Qt) (ton)	Ko	K1	Delta (deg)	Skin Compression Qsc (ton)	Negative Skin Compression Qsc (ton)	Skin Tension Qst (ton)	Weight of Pile Wp (tons)	Ultimate Compressive Capacity (Qult C) (ton)	Ultimate Skin Friction Capacity (Qult T) (ton)	Allowable Compressive Capacity (Qa C) (ton)	Allowable Uplift Capacity (Qa T) (ton)
1	38.5	130	0	0.00	0.065	0.000	0.065	0.065	0	1.50	0.50	36.6	1	0	0	0.4	0.6	0.2	0	0
2	38.5	130	0	0.00	0.130	0.000	0.130	0.130	0	1.50	0.50	36.6	2	0	1	0.8	1.7	0.6	0	0
3	38.5	130	52	0.00	0.195	0.000	0.195	0.195	49	1.50	0.50	36.6	3	0	1	1.2	52.8	1.1	21	2
4	38.5	130	52	0.00	0.260	0.000	0.260	0.260	66	1.50	0.50	36.6	6	0	2	1.6	71.6	1.9	29	2
5	38.5	130	52	0.00	0.325	0.000	0.325	0.325	82	1.50	0.50	36.6	9	0	3	2.0	90.5	2.8	36	3
6	38.5	130	52	0.00	0.390	0.000	0.390	0.390	99	1.50	0.50	36.6	12	0	4	2.4	110.8	4.0	44	4
7	38.5	130	52	0.00	0.455	0.000	0.455	0.455	115	1.50	0.50	36.6	16	0	5	2.7	131.2	5.3	52	5
8	38.5	130	52	0.00	0.520	0.000	0.520	0.520	132	1.50	0.50	36.6	20	0	7	3.1	152.2	6.8	61	6
9	38.5	130	52	0.00	0.585	0.000	0.585	0.585	148	1.50	0.50	36.6	26	0	9	3.5	173.8	8.5	70	7
10	38.5	130	52	0.00	0.650	0.000	0.650	0.650	165	1.50	0.50	36.6	31	0	10	3.9	196.0	10.4	78	8
11	38.5	139	52	0.00	0.720	0.000	0.720	0.720	182	1.50	0.50	36.6	38	0	13	4.3	219.9	12.5	88	9
12	38.5	130	52	0.00	0.785	0.000	0.785	0.785	199	1.50	0.50	36.6	44	0	15	4.7	243.2	14.8	97	11
13	38.5	130	52	0.00	0.850	0.000	0.850	0.850	215	1.50	0.50	36.6	52	0	17	5.1	267.1	17.3	107	12
14	38.5	130	52	0.00	0.915	0.000	0.915	0.915	232	1.50	0.50	36.6	60	0	20	5.5	291.6	19.9	117	13
15	38.5	130	52	0.00	0.980	0.000	0.980	0.980	248	1.50	0.50	36.6	68	0	23	5.9	316.6	22.8	127	15
16	38.5	130	52	0.00	1.045	0.000	1.045	1.045	265	1.50	0.50	36.6	78	0	26	6.3	342.2	25.8	137	17
17	38.5	130	52	0.00	1.110	0.000	1.110	1.110	281	1.50	0.50	36.6	87	0	29	6.7	368.4	29.1	147	18
18	38.5	130	52	0.00	1.175	0.000	1.175	1.175	298	1.50	0.50	36.6	97	0	32	7.1	395.1	32.5	158	20
19	38.5	130	52	0.00	1.240	0.000	1.240	1.240	314	1.50	0.50	36.6	108	0	36	7.5	422.4	36.1	169	22
20	38.5	130	52	0.00	1.305	0.000	1.305	1.305	331	1.50	0.50	36.6	120	0	40	7.9	450.3	39.8	180	24
21	38.5	130	52	0.00	1.370	0.000	1.370	1.370	347	1.50	0.50	36.6	132	0	44	8.2	478.7	43.9	191	26
22	38.5	130	52	0.00	1.435	0.000	1.435	1.435	364	1.50	0.50	36.6	144	0	48	8.6	507.7	48.1	203	28
23	38.5	130	52	0.00	1.500	0.000	1.500	1.500	380	1.50	0.50	36.6	157	0	52	9.0	537.3	52.4	215	30
24	38.5	130	52	0.00	1.565	0.000	1.565	1.565	396	1.50	0.50	36.6	171	0	57	9.4	567.5	57.0	227	32
25	38.5	130	52	0.00	1.630	0.000	1.630	1.630	413	1.50	0.50	36.6	185	0	62	9.8	598.2	61.8	239	35
26	38.5	130	52	0.00	1.695	0.000	1.695	1.695	429	1.50	0.50	36.6	200	0	67	10.2	629.5	66.7	252	37
27	38.5	130	52	0.00	1.760	0.000	1.760	1.760	446	1.50	0.50	36.6	215	0	72	10.6	661.3	71.8	265	39
28	38.5	120	52	0.00	1.820	0.000	1.820	1.820	461	1.50	0.50	36.6	231	0	77	11.0	692.4	77.1	277	42
29	38.5	130	52	0.00	1.885	0.000	1.885	1.885	478	1.50	0.50	36.6	248	0	83	11.4	725.4	82.6	290	44
30	38.5	130	52	0.00	1.950	0.000	1.950	1.950	494	1.50	0.50	36.6	265	0	88	11.8	758.9	88.3	304	47
31	38.5	130	52	0.00	2.015	0.000	2.015	2.015	510	1.50	0.50	36.6	282	0	94	12.2	793.0	94.2	317	50
32	38.5	130	52	0.00	2.080	0.000	2.080	2.080	527	1.50	0.50	36.6	301	0	100	12.6	827.6	100.2	331	53
33	38.5	130	52	0.00	2.145	0.000	2.145	2.145	543	1.50	0.50	36.6	319	0	106	13.0	862.8	106.5	345	56
34	38.5	130	52	0.00	2.210	0.000	2.210	2.210	560	1.50	0.50	36.6	339	0	113	13.4	898.6	112.9	359	59
35	38.5	130	52	0.00	2.275	0.000	2.275	2.275	576	1.50	0.50	36.6	359	0	120	13.7	935.0	119.5	374	62
36	38.5	130	52	0.00	2.340	0.000	2.340	2.340	593	1.50	0.50	36.6	379	0	126	14.1	971.9	126.3	389	65
37	38.5	130	52	0.00	2.405	0.000	2.405	2.405	609	1.50	0.50	36.6	400	0	133	14.5	1009.4	133.4	404	68
38	38.5	130	52	0.00	2.470	0.000	2.470	2.470	626	1.50	0.50	36.6	422	0	141	14.9	1047.4	140.5	419	71
39	38.5	130	52	0.00	2.535	0.000	2.535	2.535	642	1.50	0.50	36.6	444	0	148	15.3	1086.1	147.9	434	74
40	38.5	130	52	0.00	2.600	0.000	2.600	2.600	659	1.50	0.50	36.6	467	0	156	15.7	1125.2	156.5	450	78
41	38.5	130	52	0.00	2.665	0.000	2.665	2.665	675	1.50	0.50	36.6	490	0	163	16.1	1165.0	163.3	466	81
42	38.5	130	52	0.00	2.730	0.000	2.730	2.730	692	1.50	0.50	36.6	514	0	171	16.5	1205.3	171.2	482	85
43	38.5	130	52	0.00	2.795	0.000	2.795	2.795	708	1.50	0.50	36.6	538	0	179	16.9	1246.2	179.4	498	89
44	38.5	130	52	0.00	2.860	0.000	2.860	2.860	725	1.50	0.50	36.6	563	0	188	17.3	1287.7	187.7	515	92
45	38.5	130	52	0.00	2.925	0.000	2.925	2.925	741	1.50	0.50	36.6	589	0	198	17.7	1329.7	196.2	532	96
46	38.5	130	52	0.00	2.990	0.000	2.990	2.990	758	1.50	0.50	36.6	615	0	205	18.1	1372.3	204.9	549	100
47	38.5	130	52	0.00	3.055	0.000	3.055	3.055	774	1.50	0.50	36.6	641	0	214	18.5	1415.5	213.8	566	104
48	38.5	130	52	0.00	3.120	0.000	3.120	3.120	790	1.50	0.50	36.6	669	0	223	18.8	1459.3	222.9	584	108
49	38.5	130	52	0.00	3.185	0.000	3.185	3.185	807	1.50	0.50	36.6	697	0	232	19.2	1503.6	232.2	601	112
50	38.5	130	52	0.00	3.250	0.000	3.250	3.250	823	1.50	0.50	36.6	725	0	242	19.6	1548.4	241.7	619	116
51	38.5	130	52	0.00	3.315	0.000	3.315	3.250	823	1.50	0.50	36.6	753	0	251	20.0	1576.8	251.1	631	120
52	38.5	130	52	0.00	3.380	0.000	3.380	3.250	823	1.50	0.50	36.6	782	0	261	20.4	1605.3	260.6	642	125
53	38.5	130	52	0.00	3.445	0.000	3.445	3.250	823	1.50	0.50	36.6	810	0	270	20.8	1633.7	270.1	653	129
54	38.5	130	52	0.00	3.510	0.000	3.510	3.250	823	1.50	0.50	36.6	839	0	280	21.2	1662.1	279.5	665	133
55	38.5	130	52	0.00	3.575	0.000	3.575	3.250	823	1.50	0.50	36.6	867	0	289	21.6	1690.5	289.0	676	137
56	38.5	130	52	0.00	3.640	0.000	3.640	3.250	823	1.50	0.50	36.6	895	0	298	22.0	1718.9	298.5	688	141
57	38.5	130	52	0.00	3.705	0.000	3.705	3.250	823	1.50	0.50	36.6	924	0	308	22.4	1747.3	307.9	699	146
58	38.5	130	52	0.00	3.770	0.000	3.770	3.250	823	1.50	0.50	36.6	952	0	317	22.8	1775.7	317.4	710	150
59	38.5	130	52	0.00	3.835	0.000	3.835	3.250	823	1.50	0.50	36.6	981	0	327	23.2	1804.1	326.9	722	154
60	38.5	130	52	0.00	3.900	0.000	3.900	3.250	823	1.50	0.50	36.6	1009	0	336	23.6	1832.5	336.4	733	158
61	38.5	130	52	0.00	3.965	0.000	3.965	3.250	823	1.50	0.50	36.6	1037	0	346	24.0	1860.9	345.8	744	162
62	38.5	130	52	0.00	4.030	0.000	4.030	3.250	823	1.50	0.50	36.6	1066	0	355	24.3	1889.3	355.3	756	166
63	38.5	130	52	0.00	4.095	0.000	4.095	3.250	823	1.50	0.50	36.6	1094	0	365	24.7	1917.7	364.8	767	171
64	38.5	130	52	0.00	4.160	0.000	4.160	3.250	823	1.50	0.50	36.6	1123	0	374	25.1	1946.1	374.2	778	175
65	38.5	130	52	0.00	4.225	0.000	4.225	3.250	823	1.50	0.50	36.6	1151	0	384	25.5	1974.5	383.7	790	179
66	38.5	130	52	0.00	4.290	0.000	4.290	3.250	823	1.50	0.50	36.6	1179	0	393	25.9	2002.9	393.2	801	183
67	38.5	130	52	0.00	4.355	0.000	4.355	3.250	823	1.50	0.50	36.6	1208	0	403	26.3	2031.3	402.6	813	187

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[illegible]	38.5	130	52	0.00	4.420	0.000	4.420	2.600	422	1.50	0.50	36.6	882	0	294	17.1	1303.8	294.1	522	135
69	38.5	130	52	0.00	4.485	0.000	4.485	2.600	422	1.50	0.50	36.6	900	0	300	17.3	1322.0	300.1	529	137
70	38.5	130	52	0.00	4.550	0.000	4.550	2.600	422	1.50	0.50	36.6	919	0	306	17.6	1340.2	306.2	536	140
71	38.5	130	52	0.00	4.615	0.000	4.615	2.600	422	1.50	0.50	36.6	937	0	312	17.8	1358.3	312.3	543	143
72	38.5	130	52	0.00	4.680	0.000	4.680	2.600	422	1.50	0.50	36.6	955	0	318	18.1	1376.5	318.3	551	145
73	38.5	130	52	0.00	4.745	0.000	4.745	2.600	422	1.50	0.50	36.6	973	0	324	18.3	1394.7	324.4	558	148
74	38.5	130	52	0.00	4.810	0.000	4.810	2.600	422	1.50	0.50	36.6	991	0	330	18.6	1412.9	330.4	565	151
75	38.5	130	52	0.00	4.875	0.000	4.875	2.600	422	1.50	0.50	36.6	1009	0	336	18.8	1431.1	336.5	572	153
76	38.5	130	52	0.00	4.940	0.000	4.940	2.600	422	1.50	0.50	36.6	1028	0	343	19.1	1449.2	342.5	580	156
77	38.5	130	52	0.00	5.005	0.000	5.005	2.600	316	1.50	0.50	36.6	1046	0	349	19.4	1362.0	348.6	545	159
78	38.5	130	52	0.00	5.070	0.000	5.070	2.600	211	1.50	0.50	36.6	1064	0	355	19.6	1274.8	354.7	510	161
79	38.5	130	52	0.00	5.135	0.000	5.135	2.600	105	1.50	0.50	36.6	1082	0	361	19.9	1187.6	360.7	475	164
80	38.5	130	52	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	36.6	1100	0	367	20.1	1100.4	366.8	440	167
81	0	0	0	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	0.0	1100	0	367	20.4	1100.4	0.0	0	0
82	0	0	0	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	0.0	1100	0	367	20.6	1100.4	0.0	0	0
83	0	0	0	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	0.0	1100	0	367	20.9	1100.4	0.0	0	0
84	0	0	0	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	0.0	1100	0	367	21.1	1100.4	0.0	0	0
85	0	0	0	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	0.0	1100	0	367	21.4	1100.4	0.0	0	0
86	0	0	0	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	0.0	1100	0	367	21.6	1100.4	0.0	0	0
87	0	0	0	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	0.0	1100	0	367	21.9	1100.4	0.0	0	0
88	0	0	0	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	0.0	1100	0	367	22.1	1100.4	0.0	0	0
89	0	0	0	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	0.0	1100	0	367	22.4	1100.4	0.0	0	0
90	0	0	0	0.00	5.200	0.000	5.200	2.600	0	1.50	0.50	0.0	1100	0	367	22.6	1100.4	0.0	0	0

DRILLED PIER CALCULATIONS

CORP OF ENGINEERS/NAVFAC METHOD

Project Name: RAD DEVELOPMENT
Project Number: WO 5831
Date: 12/05
Boring Location: Boring B-1

Drilled Pier Diameter (feet) = 3
Reduction Factor for Negative Skin Friction (%) = 0
Factor of Safety = 2.5

Input Parameters					Tip Capacity					Skin Friction Capacity									Total Capacity	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	14a	15	16	17	18	19	20
Depth (feet)	Friction Angle (phi) (deg)	Soil Density (Gamma) (pcf)	Nq	Ko	Svo (tsf)	Uo (tsf)	Svo' (tsf)	Svt' (tsf)	Ultimate Tip Capacity Qt (ton)	Kc	Kt	Delta (deg)	Skin Compression Qsc (ton)	Negative Skin Compression Qsc (ton)	Skin Tension Qst (ton)	Weight of Pile Wp (tons)	Ultimate Compressive Capacity (Qult C) (ton)	Ultimate Skin Friction Capacity (Qult T) (ton)	Allowable Compressive Capacity (Qa C) (ton)	Allowable Uplift Capacity (Qa T) (ton)
1	38.5	130	0	0.00	0.065	0.000	0.065	0.065	0	1.50	0.50	36.6	1	0	0	0.6	0.7	0.2	0	0
2	38.5	130	0	0.00	0.130	0.000	0.130	0.130	0	1.50	0.50	36.6	2	0	1	1.1	2.0	0.7	0	0
3	38.5	130	0	0.00	0.195	0.000	0.195	0.195	0	1.50	0.50	36.6	4	0	1	1.7	4.1	1.4	0	0
4	38.5	130	52	0.00	0.260	0.000	0.260	0.260	95	1.50	0.50	36.6	7	0	2	2.3	101.7	2.3	41	3
5	38.5	130	52	0.00	0.325	0.000	0.325	0.325	119	1.50	0.60	36.6	10	0	3	2.8	128.6	3.4	52	4
6	38.5	130	52	0.00	0.390	0.000	0.390	0.390	142	1.50	0.50	36.6	14	0	5	3.4	156.6	4.8	63	5
7	38.5	130	52	0.00	0.455	0.000	0.455	0.455	166	1.50	0.50	36.6	19	0	6	4.0	185.1	6.4	74	7
8	38.5	130	52	0.00	0.520	0.000	0.520	0.520	190	1.50	0.50	36.6	25	0	8	4.5	214.3	8.2	86	8
9	38.5	130	52	0.00	0.585	0.000	0.585	0.585	213	1.50	0.50	36.6	31	0	10	5.1	244.1	10.2	98	9
10	38.5	130	52	0.00	0.650	0.000	0.650	0.650	237	1.50	0.50	36.6	38	0	13	5.7	274.7	12.5	110	11
11	38.5	139	52	0.00	0.720	0.000	0.720	0.720	263	1.50	0.50	36.6	45	0	15	6.2	307.6	15.0	123	12
12	38.5	130	52	0.00	0.785	0.000	0.785	0.785	286	1.50	0.50	36.6	53	0	18	6.8	339.5	17.8	136	14
13	38.5	130	52	0.00	0.850	0.000	0.850	0.850	310	1.50	0.50	36.6	62	0	21	7.4	372.2	20.7	149	16
14	38.5	130	52	0.00	0.915	0.000	0.915	0.915	334	1.50	0.50	36.6	72	0	24	7.9	405.5	23.9	162	17
15	38.5	130	52	0.00	0.980	0.000	0.980	0.980	357	1.50	0.50	36.6	82	0	27	8.6	439.6	27.4	176	19
16	38.5	130	52	0.00	1.045	0.000	1.045	1.045	381	1.50	0.50	36.6	93	0	31	9.0	474.2	31.0	190	21
17	38.5	130	52	0.00	1.110	0.000	1.110	1.110	405	1.50	0.50	36.6	105	0	35	9.6	509.5	34.9	204	24
18	38.5	130	52	0.00	1.175	0.000	1.175	1.175	429	1.50	0.50	36.6	117	0	39	10.2	545.5	39.0	218	26
19	38.5	130	52	0.00	1.240	0.000	1.240	1.240	452	1.50	0.50	36.6	130	0	43	10.7	582.3	43.3	233	28
20	38.5	130	52	0.00	1.305	0.000	1.305	1.305	476	1.50	0.50	36.6	144	0	48	11.3	619.7	47.9	248	30
21	38.5	130	52	0.00	1.370	0.000	1.370	1.370	500	1.50	0.50	36.6	158	0	53	11.9	657.8	52.7	263	33
22	38.5	130	52	0.00	1.435	0.000	1.435	1.435	523	1.50	0.50	36.6	173	0	58	12.4	696.5	57.7	279	36
23	38.5	130	52	0.00	1.500	0.000	1.500	1.500	547	1.50	0.50	36.6	189	0	63	13.0	736.0	62.9	294	38
24	38.5	130	52	0.00	1.565	0.000	1.565	1.565	571	1.50	0.50	36.6	205	0	68	13.6	776.1	68.4	310	41
25	38.5	130	52	0.00	1.630	0.000	1.630	1.630	595	1.50	0.50	36.6	222	0	74	14.1	818.9	74.1	327	44
26	38.5	130	52	0.00	1.695	0.000	1.695	1.695	618	1.50	0.50	36.6	240	0	80	14.7	858.4	80.0	343	47
27	38.5	130	52	0.00	1.760	0.000	1.760	1.760	642	1.50	0.50	36.6	259	0	86	15.3	900.6	86.2	360	50
28	38.5	120	52	0.00	1.820	0.000	1.820	1.820	664	1.50	0.50	36.6	278	0	93	15.8	941.6	92.5	377	53
29	38.5	130	52	0.00	1.885	0.000	1.885	1.885	688	1.50	0.50	36.6	297	0	99	16.4	985.0	99.1	394	56
30	38.5	130	52	0.00	1.950	0.000	1.950	1.950	711	1.50	0.50	36.6	318	0	108	17.0	1029.2	105.9	412	59
31	38.5	130	52	0.00	2.015	0.000	2.015	2.015	735	1.50	0.50	36.6	339	0	113	17.5	1074.1	113.0	430	63
32	38.5	130	52	0.00	2.080	0.000	2.080	2.080	759	1.50	0.50	36.6	361	0	120	18.1	1119.6	120.3	448	66
33	38.5	130	52	0.00	2.145	0.000	2.145	2.145	783	1.50	0.50	36.6	383	0	128	18.7	1165.8	127.8	466	70
34	38.5	130	52	0.00	2.210	0.000	2.210	2.210	806	1.50	0.50	36.6	406	0	135	19.2	1212.7	135.5	485	73
35	38.5	130	52	0.00	2.275	0.000	2.275	2.275	830	1.50	0.50	36.6	430	0	143	19.8	1260.3	143.4	504	77
36	38.5	130	52	0.00	2.340	0.000	2.340	2.340	854	1.50	0.50	36.6	455	0	152	20.4	1308.5	151.6	523	81
37	38.5	130	52	0.00	2.405	0.000	2.405	2.405	877	1.50	0.50	36.6	480	0	160	20.9	1357.5	160.0	543	85
38	38.5	130	52	0.00	2.470	0.000	2.470	2.470	901	1.50	0.50	36.6	506	0	169	21.5	1407.1	168.7	563	89
39	38.5	130	52	0.00	2.535	0.000	2.535	2.535	925	1.50	0.50	36.6	533	0	178	22.1	1457.4	177.5	583	93
40	38.5	130	52	0.00	2.600	0.000	2.600	2.600	949	1.50	0.50	36.6	560	0	187	22.6	1508.4	186.6	603	97
41	38.5	130	52	0.00	2.665	0.000	2.665	2.665	972	1.50	0.50	36.6	588	0	196	23.2	1560.1	195.9	624	102
42	38.5	130	52	0.00	2.730	0.000	2.730	2.730	996	1.50	0.50	36.6	616	0	205	23.8	1612.4	205.5	645	106
43	38.5	130	52	0.00	2.795	0.000	2.795	2.795	1020	1.50	0.50	36.6	646	0	215	24.3	1665.4	215.2	666	110
44	38.5	130	52	0.00	2.860	0.000	2.860	2.860	1043	1.50	0.50	36.6	676	0	225	24.9	1719.2	225.2	688	115
45	38.5	130	52	0.00	2.925	0.000	2.925	2.925	1067	1.50	0.50	36.6	706	0	235	25.4	1773.6	235.5	709	120
46	38.5	130	52	0.00	2.990	0.000	2.990	2.990	1091	1.50	0.50	36.6	738	0	246	26.0	1828.6	245.9	731	124
47	38.5	130	52	0.00	3.055	0.000	3.055	3.055	1115	1.50	0.50	36.6	770	0	257	26.6	1884.4	256.8	754	129
48	38.5	130	52	0.00	3.120	0.000	3.120	3.120	1138	1.50	0.50	36.6	803	0	268	27.1	1940.8	267.5	776	134
49	38.5	130	52	0.00	3.185	0.000	3.185	3.185	1162	1.50	0.50	36.6	836	0	279	27.7	1998.0	278.6	799	139
50	38.5	130	52	0.00	3.250	0.000	3.250	3.250	1186	1.50	0.50	36.6	870	0	290	28.3	2055.8	290.0	822	144
51	38.5	130	52	0.00	3.315	0.000	3.315	3.315	1209	1.50	0.50	36.6	905	0	302	28.8	2114.2	301.6	846	149
52	38.5	130	52	0.00	3.380	0.000	3.380	3.380	1233	1.50	0.50	36.6	940	0	313	29.4	2173.4	313.4	869	155
53	38.5	130	52	0.00	3.445	0.000	3.445	3.445	1257	1.50	0.50	36.6	976	0	325	30.0	2233.3	325.5	893	160
54	38.5	130	52	0.00	3.510	0.000	3.510	3.510	1281	1.50	0.50	36.6	1013	0	338	30.5	2293.8	337.7	918	166
55	38.5	130	52	0.00	3.575	0.000	3.575	3.575	1304	1.50	0.50	36.6	1051	0	350	31.1	2356.0	350.2	942	171
56	38.5	130	52	0.00	3.640	0.000	3.640	3.640	1328	1.50	0.50	36.6	1089	0	363	31.7	2416.9	362.9	967	177
57	38.5	130	52	0.00	3.705	0.000	3.705	3.705	1352	1.50	0.50	36.6	1128	0	376	32.2	2479.5	375.9	992	183
58	38.5	130	52	0.00	3.770	0.000	3.770	3.770	1375	1.50	0.50	36.6	1167	0	389	32.8	2542.7	389.1	1017	188
59	38.5	130	52	0.00	3.835	0.000	3.835	3.835	1399	1.50	0.50	36.6	1207	0	402	33.4	2606.7	402.5	1043	194
60	38.5	130	52	0.00	3.900	0.000	3.900	3.900	1423	1.50	0.50	36.6	1248	0	416	33.9	2673.3	416.1	1069	200
61	38.5	130	52	0.00	3.965	0.000	3.965	3.900	1423	1.50	0.50	36.6	1289	0	430	34.5	2712.2	429.8	1085	206
62	38.5	130	52	0.00	4.030	0.000	4.030	3.900	1423	1.50	0.50	36.6	1330	0	443	35.1	2753.1	443.4	1101	212
63	38.5	130	52	0.00	4.095	0.000	4.095	3.900	1423	1.50	0.50	36.6	1371	0	457	35.6	2794.0	457.0	1118	218
64	38.5	130	52	0.00	4.160	0.000	4.160	3.900	1423	1.50	0.50	36.6	1412	0	471	36.2	2834.9	470.7	1134	224
65	38.5	130	52	0.00	4.225	0.000	4.225	3.900	1425	1.50	0.50	36.6	1453	0	484	36.8	2875.8	484.3	1150	230
66	38.5	130	52	0.00	4.290	0.000	4.290	3.900	1423	1.50	0.50	36.6	1494	0	498	37.3	2916.7	497.9	1167	236
67	38.5	130	52	0.00	4.355	0.000	4.355	3.900	1423	1.50	0.50	36.6	1535	0	512	37.9	2957.6	511.6	1183	243

[illegible]	[illegible]	[illegible]	52	[illegible]	4.420	0.000	[illegible]	3.250	[illegible]	[illegible]	0.50	[illegible]	1236	0	[illegible]	[illegible]	2059.7	412.1	824	[illegible]
69	38.5	130	52	0.00	4.485	0.000	4.485	3.250	823	1.50	0.50	36.6	1265	0	422	27.1	2088.1	421.6	835	196
70	38.5	130	52	0.00	4.550	0.000	4.550	3.250	823	1.50	0.50	36.6	1293	0	431	27.5	2116.6	431.0	847	200
71	38.5	130	52	0.00	4.615	0.000	4.615	3.250	823	1.50	0.50	36.6	1322	0	441	27.9	2144.9	440.5	858	204
72	38.5	130	52	0.00	4.680	0.000	4.680	3.250	823	1.50	0.50	36.6	1350	0	450	28.3	2173.4	450.0	869	208
73	38.5	130	52	0.00	4.745	0.000	4.745	3.250	823	1.50	0.50	36.6	1378	0	459	28.7	2201.8	459.4	881	212
74	38.5	130	52	0.00	4.810	0.000	4.810	3.250	823	1.50	0.50	36.6	1407	0	469	29.1	2230.2	468.9	892	217
75	38.5	130	52	0.00	4.875	0.000	4.875	3.250	823	1.50	0.50	36.6	1435	0	478	29.5	2258.5	478.4	900	221
76	38.5	130	52	0.00	4.940	0.000	4.940	3.250	823	1.50	0.50	36.6	1464	0	488	29.8	2287.0	487.8	915	225
77	38.5	130	52	0.00	5.005	0.000	5.005	3.250	618	1.50	0.50	36.6	1492	0	497	30.2	2109.5	497.3	844	229
78	38.5	130	52	0.00	5.070	0.000	5.070	3.250	412	1.50	0.50	36.6	1520	0	507	30.6	1932.1	506.8	773	233
79	38.5	130	52	0.00	5.135	0.000	5.135	3.250	206	1.50	0.50	36.6	1549	0	516	31.0	1754.6	516.3	702	238
80	38.5	130	52	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	36.6	1577	0	526	31.4	1577.2	525.7	631	242
81	0	0	0	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	0.0	1577	0	526	31.8	1577.2	0.0	0	0
82	0	0	0	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	0.0	1577	0	526	32.2	1577.2	0.0	0	0
83	0	0	0	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	0.0	1577	0	526	32.6	1577.2	0.0	0	0
84	0	0	0	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	0.0	1577	0	526	33.0	1577.2	0.0	0	0
85	0	0	0	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	0.0	1577	0	526	33.4	1577.2	0.0	0	0
86	0	0	0	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	0.0	1577	0	526	33.8	1577.2	0.0	0	0
87	0	0	0	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	0.0	1577	0	526	34.2	1577.2	0.0	0	0
88	0	0	0	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	0.0	1577	0	526	34.6	1577.2	0.0	0	0
89	0	0	0	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	0.0	1577	0	526	35.0	1577.2	0.0	0	0
90	0	0	0	0.00	5.200	0.000	5.200	3.250	0	1.50	0.50	0.0	1577	0	526	[illegible]	1577.2	0.0	0	0

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.420	[illegible]	4.420	[illegible]	1423	[illegible]	0.50	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	525.2	1199	249
69	38.5	130	52	0.00	4.485	0.000	4.485	3.900	1423	1.50	0.50	36.6	1617	0	539	39.0	3039.4	538.8	1216	255
70	38.5	130	52	0.00	4.550	0.000	4.550	3.900	1423	1.50	0.50	36.6	1657	0	552	39.6	3080.3	552.6	1232	261
71	38.5	130	52	0.00	4.615	0.000	4.615	3.900	1423	1.50	0.50	36.6	1698	0	566	40.1	3121.3	566.1	1249	267
72	38.5	130	52	0.00	4.680	0.000	4.680	3.900	1423	1.50	0.50	36.6	1739	0	580	40.7	3162.2	579.7	1265	273
73	38.5	130	52	0.00	4.745	0.000	4.745	3.900	1423	1.50	0.50	36.6	1780	0	593	41.3	3203.1	593.4	1281	279
74	38.5	130	52	0.00	4.810	0.000	4.810	3.900	1423	1.50	0.50	36.6	1821	0	607	41.8	3244.0	607.0	1298	285
75	38.5	130	52	0.00	4.875	0.000	4.875	3.900	1423	1.50	0.50	36.6	1862	0	621	42.4	3284.9	620.6	1314	291
76	38.5	130	52	0.00	4.940	0.000	4.940	3.900	1423	1.50	0.50	36.6	1903	0	634	43.0	3325.8	634.3	1330	297
77	38.5	130	52	0.00	5.005	0.000	5.005	3.900	1067	1.50	0.50	36.6	1944	0	648	43.5	3010.9	647.9	1204	303
78	38.5	130	52	0.00	5.070	0.000	5.070	3.900	711	1.50	0.50	36.6	1985	0	662	44.1	2696.1	661.5	1078	309
79	38.5	130	52	0.00	5.135	0.000	5.135	3.900	356	1.50	0.50	36.6	2026	0	675	44.7	2381.3	675.2	953	315
80	38.5	130	52	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	36.6	2066	0	689	45.2	2066.5	688.8	827	321
81	0	0	0	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	0.0	2066	0	689	45.8	2066.5	0.0	0	0
82	0	0	0	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	0.0	2066	0	689	46.4	2066.5	0.0	0	0
83	0	0	0	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	0.0	2066	0	689	46.9	2066.5	0.0	0	0
84	0	0	0	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	0.0	2066	0	689	47.5	2066.5	0.0	0	0
85	0	0	0	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	0.0	2066	0	689	48.1	2066.5	0.0	0	0
86	0	0	0	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	0.0	2066	0	689	48.6	2066.5	0.0	0	0
87	0	0	0	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	0.0	2066	0	689	49.2	2066.5	0.0	0	0
88	0	0	0	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	0.0	2066	0	689	49.8	2066.5	0.0	0	0
89	0	0	0	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	0.0	2066	0	689	50.3	2066.5	0.0	0	0
90	0	0	0	0.00	5.200	0.000	5.200	3.900	0	1.50	0.50	0.0	2066	0	689	50.9	2066.5	0.0	0	0