GEOTECHNICAL ENGINEERING STUDY - UPDATE
for
BROADSTONE CROSSING PARCEL 6
Folsom, California

Project No. E02215.018
April 2019

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CONSULTING GROUP, INC.

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35 YEARS

Project No: E02215.018
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Attention: Mr. Matt May

Subject: **BROADSTONE CROSSING, PARCEL 6**
Healthy Way, Folsom, California
GEOTECHNICAL ENGINEERING STUDY - UPDATE

References:
1. Geotechnical Engineering Study on Woodward Ranch by Youngdahl & Associates, Inc. dated 16 January 1990 (Project No. 89490.E).
2. Geotechnical Engineering Study Update on Broadstone - Unit 3 by Youngdahl & Associates, Inc. dated 5 March 1999 (Project No. 89490.0).
3. Geotechnical Engineering Study on Broadstone 3 Retail Center by Youngdahl & Associates, Inc. dated 9 May 2002 (Project No. 02215).
4. Progress Report of Consultation, Observation and Compaction Testing Services during Mass Grading Operations and Site Improvements, prepared by Youngdahl Consulting Group, Inc., dated 5 February 2003 (Project No 02215.2).
5. Report of Compaction Testing Services during Earthwork Operations for Building Pad Construction, prepared by Youngdahl Consulting Group, Inc., dated 11 December 2007 (Project No. E02215.011).

Dear Mr. May:

In accordance with your request, Youngdahl Consulting Group, Inc. has performed a review of the referenced Geotechnical Engineering Study (Reference No. 3) and has updated it for use on the subject property. The purpose of our review was to determine the applicability of the referenced report for use in describing the current surface and subsurface conditions on the subject property, as well as update the report to conform to the 2016 California Building Code provisions. The scope of this study included a review of the geotechnical reports completed for the development and preparation of this report summarizing our geotechnically related findings, conclusions, and recommendations regarding the suitability of the subject property for development.

SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The project site is designated as Parcel 6 of the Broadstone Crossing retail development in Folsom, California. The site is located at the northeast corner of Serpa Way and Healthy Way, and is bounded by an open space/wetland area to the north and east, by Healthy Way to the south and by Serpa Way to the west. The project site is relatively flat and situated approximately 35 feet higher than the intersection of Serpa Way and Healthy Way.

During a recent site visit, our representative observed that the site conditions to be relatively unchanged from our initial involvement during the mass grading operations, with the exception of the recently constructed fill area/asphalt concrete pavements at the southeast area of the site. We understand this area was used to accommodate portable trailers used during construction of the fitness facility on the south side of Healthy Way. Within the pavement area, underground utility connections were observed to protrude through the surface.

We understand that grading plans have not been completed for the proposed development. Based on a review of the preliminary layout plans, the proposed development will consist of a four-story senior living facility with associated ancillary structures, pavements and underground utilities. The structure is anticipated to be of wood/metal frame construction and be supported on shallow conventional foundations and concrete slab-on-grade floors.

For the purposes of this report, we have assumed that grading operations will consist of cuts and fills on the order of 5 feet or less. Foundation loads, once available, should be made available for our review and to confirm the applicability of our current recommendations.

Background
A review of our records indicates that the Broadstone Crossing Development was mass graded during the late summer of 2002 to the winter of 2003. To the best of our knowledge, grading operations for Parcel 6 included cuts on the order of about 20 feet or less at the southeast corner of the site, and placement of engineered fills on the order of about 25 feet or less on the northwest side. Following these operations, additional fill construction occurred in 2007 during installation of a berm along a portion of the northeast perimeter of the site. As detailed in Reference Nos. 4 and 5, the project site was graded in general accordance with the Reference No. 3 Geotechnical Engineering Study (GES). During the original mass grading operations, the northwest corner of the site was left approximately 5 to 6 feet low, as such, we anticipate the future site grading operations will include additional cuts and fills in order to establish the proposed finished grades.

If studies or plans exist that pertain to the site which are not cited as a reference in this report, we should be afforded the opportunity to review and modify our conclusions and recommendations as necessary.

CONCLUSIONS
Based on our review of the referenced geotechnical reports, and on the current site conditions, the recommendations contained in the referenced report (Reference No. 3) are generally considered to be applicable to the subject property, provided the following updated conclusions and recommendations are incorporated into the project plans and specifications and adhered to during development.

Seismicity
Based on our literature review of shear-wave velocity characteristics of geologic units in California (Wills and Silva; August 1998: Earthquake Spectra, Volume 14, No. 3) and subsurface interpretations, we recommend that the project site be classified as Site Class C in accordance with section 1613.3.2 of the 2016 California Building Code.

Liquefaction, Slope Instability and Surface Rupture Potential
Liquefaction is the sudden loss of soil shear strength and sudden increase in porewater pressure caused by shear strains, as could result from an earthquake. Research has shown that saturated, loose to medium-dense sands with a silt content less than about 25 percent located within the top 40 feet are most susceptible to liquefaction and surface rupture/lateral spreading. Slope instability can occur as a result of seismic ground motions and/or in combination with weak soils and saturated conditions.

Due to the relatively shallow depth to bedrock and the relatively low seismicity of the area, the potential for damage due to site liquefaction, slope instability and surface rupture are considered negligible. For the above-mentioned reasons, mitigation for these potential hazards is typically not recommended in the geographic region of the project site.

Naturally Occurring Asbestos
The Sacramento Metropolitan Air Quality Management District (SMAQMD) is the lead agency for regulating NOA in Sacramento County, and has implemented the construction Air Toxic Control Measure (ATCM) (CCR Section 93015) for projects in East Folsom located within the metavolcanic Copper Hill and Gopher Ridge Formations. Following release of a generalized geologic map of eastern Sacramento County by the California Geologic Survey in 2006, the SMAQMD established a policy of applying the construction ATCM (CCR Section 93105) to all areas identified on the map as being underlain by rocks moderately likely to contain NOA. Based on our experience within the Broadstone development, trace levels of asbestos (less than 0.25% as measured by California Air Resources Board Test Method 435) have been encountered. As such, prior grading operations in the development have assumed NOA to be present, and the site grading performed in accordance with the ATCM requirements.

Soil Expansion Potential
Intermittent or isolated pockets of highly expansive clay soils may be present on top of the weathered bedrock. In concentrated amounts, such clays could cause distress to concrete slab-on-grade floors and foundations if present in the upper 3 feet of the structural improvement areas. However, given their limited presence, it has been our experience that these materials can be sufficiently blended such that expansive soil mitigation measures may not be required.

Drainage
The site is located within the foothills where shallow bedrock conditions are present and the potential for perched groundwater conditions exist. As such, any excavations that approach the underlying bedrock materials that encounter the perched groundwater condition may require mitigation measures. Any measures to mitigate these conditions should be based on the conditions observed during construction.

RECOMMENDATIONS
Site Preparation and Grading
The following paragraphs state our geotechnical comments and recommendations concerning site preparation and grading.

Demolition: As part of the demolition operation, any unwanted foundation, structural improvement, or site improvement elements (including underground utilities) should be exhumed and removed from the site. In addition, any underground storage tanks, abandoned wells or other utilities not intended for reuse should be removed or backfilled in accordance with the appropriate regulations.

Concrete and asphalt separated from the other debris, and adequately broken down in particle size, may be mixed thoroughly with soil and placed as engineered fill as described below. If this option is exercised, a representative from our firm should be contacted to observe the adequacy of grading operations associated with the breaking and mixing of these elements.

Site Drainage Controls: We recommend that initial site preparation involve intercepting and diverting any potential sources of surface or near-surface water within the construction zones. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and methods used by the contractor, final decisions regarding drainage systems are best made in the field at the time of construction. All drainage and/or water diversion performed for the site should be in accordance with the Clean Water Act and applicable Storm Water Pollution Prevention Plan.

Dust Control: Dust control provisions should be provided for as required by the local jurisdiction's grading ordinance (i.e. water truck or other adequate water supply during grading) and ATCM requirements.

Clearing and Stripping: Clearing and stripping operations should include the removal of all organic laden materials and any soft or loose soil generated by the removal operations. Surface grass stripping operations may be necessary depending upon the in-situ conditions at the time of grading. Short or mowed dry grasses may be pulverized and lost within fill materials provided no concentrated pockets of organics result. It is the responsibility of the grading contractor to remove excess organics from the fill materials. No more than 2 percent of organic material, by weight, should be allowed within the fill materials at any given location.

General site clearing should also include removal of any disturbed, loose or saturated materials from the proposed structural improvement and pavement areas. A representative of our firm should be present during site clearing operations to identify the location and depth of potential non-engineered fills not disclosed by this report, to observe removal of deleterious materials, and to identify any existing site conditions which may require mitigation prior to site development.

Exposed Grade Compaction: Exposed soil grades following initial site preparation activities should be scarified to a minimum depth of 8 inches and compacted to the requirements for engineered fill. Prior to placing fill, the exposed subgrades should be in a firm and unyielding state. Any localized zones of soft or pumping soils observed within a subgrade should either be scarified and recompacted or be overexcavated and replaced with engineered fill as detailed in the engineered fill section below.

Suitability of Onsite Materials: We expect that soil generated from excavations on the site, excluding deleterious material, may be used as engineered fill provided the material does not exceed 12 inches in maximum size.

Fill Placement and Compaction: All areas proposed to receive fill should be scarified to a minimum depth of 8 inches, moisture conditioned as necessary, and compacted to at least 90 percent of the maximum dry density based on the ASTM D1557 test method. The fill should be placed in thin horizontal lifts not to exceed 12 inches in uncompacted thickness. The fill should be moisture conditioned as necessary and compacted to a relative compaction of not less than 90 percent based on the ASTM D1557 test method. The upper 8 inches of fills placed under proposed pavement areas should be compacted to a relative compaction of not less than 95 percent based on the ASTM D1557 test method.

Expansive clays, if encountered, should be mixed thoroughly with less expansive on site materials (silts, sands, and gravels) and should not be present in concentration within 5 feet of the building envelope, either vertically or laterally. Proper disposition of clays on site should be observed and documented by a representative of Youngdahl Consulting Group, Inc.

Fill soil compaction should be evaluated by means of in-place density tests performed during fill placement so that adequacy of soil compaction efforts may be determined as earthwork progresses, or by method specification if the quantity of rock fragments in the fills preclude traditional compaction testing. This will likely include the excavation of test pits within the fill materials to observe and document that a uniform over-optimum moisture condition, and absence of large and/or concentrated voids has been achieved prior to additional fill placement.

Compaction Equipment: We anticipate that a Caterpillar 815 or approved equivalent will be capable of achieving the compaction requirements for engineered fill provided the soil is placed and compacted within 0 to 3 percent over the optimum moisture content as determined by the ASTM D1557 test method and in lifts not greater than 12 inches in uncompacted thickness. The use of handheld equipment such as jumping jack or plate vibration compactors may require thinner lifts of 6 inches or less to achieve the desired relative compaction parameters.

Slope Configuration and Grading
Generally a cut slope orientation of 2H:1V is considered stable with the material types encountered on the site. A fill slope constructed at the same orientation is considered stable if compacted to the engineered fill recommendations as stated in the recommendations section of this report. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

Placement of Fills on Slopes: Placement of fill material on natural slopes should be stabilized by means of keyways and benches. Where the slope of the original ground equals or exceeds 5H:1V, a keyway should be constructed at the base of the fill. The keyway should consist of a trench excavated to a depth of at least two feet into firm, competent materials. The keyway trench should be at least eight feet wide or as designated by our firm based on the conditions at the time of construction. Benches should be cut into the original slope as the filling operation proceeds. Each bench should consist of a level surface excavated at least six feet horizontally into firm soils or four feet horizontally into rock. The rise between successive benches should not exceed 36 inches. The need for subdrainage should be evaluated at the time of construction.

Slope Face Compaction: All slope fills should be laterally overbuilt and cut back such that the required compaction is achieved at the proposed finish slope face. As a less preferable alternative, the slope face could be track walked or compacted with a wheel. If this second alternative is used, additional slope maintenance may be necessary.

Slope Drainage: Surface drainage should not be allowed to flow uncontrolled over any slope face. Adequate surface drainage control should be designed by the project civil engineer in accordance with the latest applicable edition of the CBC. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

Excavation Characteristics
Any utility trenches excavated below the engineered fill zone beneath the building pad or within the existing cut bedrock materials may encounter hard rock excavation conditions. Utility contractors should be prepared to use special rock trenching equipment such as large excavators (Komatsu PC400 or CAT 345 or larger). Blasting to achieve utility line grades cannot be precluded. Water inflow into any excavation approaching the hard rock surface is likely to be experienced in all but the driest summer and fall months.

In addition, due to rocky nature of the on-site fill materials, any utility line or sump (i.e. elevator) excavations deeper than 5 feet may encounter larger rock fragments. Utility contractors should have the equipment capable of excavating/lifting large boulders within the deeper excavations.

Underground Improvements
Trench Excavation: Trenches or excavations in soil should be shored or sloped back in accordance with current OSHA regulations prior to persons entering them.

Backfill Materials: Backfill materials for utilities should conform to the local jurisdiction's requirements. It should be realized that permeable backfill materials will likely carry water at some time in the future.

A common problem occurs on sites graded with large equipment and rocky fill materials where the excavated spoils from the site utilities are too rocky to place as engineered fill back in the trench with the common compaction practices employed by the subcontractors installing these utilities. We recommend that where excavated soils are too rocky to place and compact to a tight condition with low void space, these materials be replaced with a proper import material for compaction.

Backfill Compaction: All backfill, placed after the underground facilities have been installed, including onsite wet/dry utilities and lateral connections, should be compacted a minimum of 90 percent relative compaction. Compaction should be accomplished using lifts which do not exceed 12 inches. However, thickness of the lifts should be determined by the contractor. If the contractor can achieve the required compaction using thicker lifts, the method may be judged acceptable based on field verification by a representative of our firm using standard density testing procedures. Lightweight compaction equipment may require thinner lifts to achieve the required densities.

Drainage Considerations: In developments with the potential for a perched groundwater condition (i.e. shallow bedrock), underground utilities can become collection points for subsurface water. Temporary dewatering measures may be necessary and could include the installation of submersible pumps and/or point wells.

Foundations

In our opinion, isolated or continuous shallow spread footings will provide adequate support for the proposed buildings if the subgrades are properly prepared as described above and in the referenced GES report. We offer the following comments and recommendations for purposes of footing design and construction. The provided minimums do not constitute a structural design of foundations which should be performed by the project structural engineer. In addition to the provided recommendations, foundation design and construction should conform to applicable sections of the 2016 California Building Code.

Bearing Capacities: An allowable dead plus live load bearing pressure of 3,000 psf may be used for design of footings founded a minimum of 18 inches into firm native soils or engineered fills (depths may vary based on type of structure). The above allowable pressure is for support of dead plus live loads and may be increased by 1/3 for short term wind and seismic loads.

Generally, for structures bearing on similar foundation materials, a total settlement of less than 1 inch is anticipated, with a differential settlement of ½ the total. This settlement is based upon the assumption that foundation loads are sized in accordance with the provided allowable bearing capacities.

Lateral Pressures: Lateral forces on structures may be resisted by passive pressure acting against the sides of shallow footings and/or friction between the soil and the bottom of the footing. For resistance to lateral loads, a friction factor of 0.35 may be utilized for sliding resistance at the base of spread footings in firm native materials or engineered fill. A passive resistance of 350 pcf equivalent fluid weight may be used against the side of shallow footings in firm native soil or engineered fill. If friction and passive pressures are combined, the lesser value should be reduced by 50 percent.

Footing Configuration: Foundation reinforcement should be provided by the structural engineer. The reinforcement schedule should account for typical construction issues such as load consideration, concrete cracking, and the presence of isolated irregularities. At a minimum, we recommend that continuous spread footing foundations be reinforced with four No. 4 reinforcing bars, two located near the bottom of the footing and two near the top of the stem wall.

All footings should be founded below an imaginary 2H:1V plane projected up from the bottoms of adjacent footings, downhill slopes and/or parallel utility trenches, or to a depth that achieves a minimum horizontal clearance of 6 feet from the outside toe of the footings to the slope face, whichever requires a deeper excavation.

Foundations for the proposed 4-story structure should be a minimum of 18 inches in width, and be founded a minimum of 24 inches below the lowest adjacent grade. Footings for any ancillary structures should be a minimum of 12 inches wide and founded a minimum of 18 inches below the lowest adjacent grade. Isolated pad footings should be a minimum of 24 inches wide.

Subgrade Conditions: Footings should never be cast atop soft, loose, organic, slough, debris, nor atop subgrades covered by ice or standing water. A representative of our firm should be retained to observe all subgrades during footing excavation and prior to concrete placement so that a determination as to the adequacy of subgrade preparation can be made.

Shallow Footing / Stemwall Backfill: All footing/stemwall backfill soil should be compacted to at least 90 percent of the maximum dry density (based on ASTM D1557).

Seismic Criteria

Based on the 2016 California Building Code, Chapter 16, and the previous site investigation findings, the following seismic parameters are recommended from a geotechnical perspective for structural design. The final choice of design parameters, however, remains the purview of the project structural engineer.

Seismic Design Parameters

2016 CBC	ASCE 7-10	Seismic Parameter	Recommended Value
	Table 20.3-1	Site Class	C
Figure 1613.3.1(1)		Short-Period MCE at 0.2s, S_S	0.465g
Figure 1613.3.1(2)		1.0s Period MCE, S_1	0.239g
Table 1613.3.3(1)		Site Coefficient, F_a	1.200
Table 1613.3.3(2)		Site Coefficient, F_v	1.561
Equation 16-37		Adjusted MCE Spectral Response Parameters, $S_{MS} = F_aS_s$	0.558g
Equation 16-38		Adjusted MCE Spectral Response Parameters, $S_{M1} = F_vS_1$	0.373g
Equation 16-39		Design Spectral Acceleration Parameters, $S_{DS} = ⅔S_{MS}$	0.372g
Equation 16-40		Design Spectral Acceleration Parameters, $S_{D1} = ⅔S_{M1}$	0.248g
Table 1613.3.5(1)		Seismic Design Category (Short Period), Occupancy I to III	C
Table 1613.3.5(1)		Seismic Design Category (Short Period), Occupancy IV	D
Table 1613.3.5(2)		Seismic Design Category (1-Second Period), Occupancy I to III	D
Table 1613.3.5(2)		Seismic Design Category (1-Second Period), Occupancy IV	D
	Figure 22-7	Maximum Considered Earthquake Geometric Mean (MCE_C) PGA	0.147g
	Table 11.8-1	Site Coefficient F_{PGA}	1.20
	Equation 11.8-1	$PGA_M = F_{PGA}$ PGA	0.176g

*Based on the online calculator available at http://earthquake.usgs.gov/designmaps/us/application.php

Retaining Walls

Our design recommendations and comments regarding retaining walls for the project site are discussed below.

Retaining Wall Foundations: An allowable dead plus live load bearing pressure of 3,000 psf may be used for design of retaining wall footings based a minimum of 12 inches into firm native soils or engineered fills. The above allowable pressure is for support of dead plus live loads and may be increased by 1/3 for short term wind and seismic loads.

Resisting Forces: Lateral forces on the retaining walls may be resisted by passive pressure acting against the side of the wall footing and/or friction between the soil and the bottom of the footing. A passive equivalent fluid weight of 350 pcf may be used against the sides of shallow footings founded in firm native soil or engineered. A friction factor of 0.35 may be used at the base of footings founded on soil or engineered fill. If friction and passive pressures are combined, the lesser value should be reduced by 50 percent. All backfill placed behind retaining walls or against retaining wall footings should be compacted to the requirements of engineered fill as discussed above and in the Reference No. 3 report.

Retaining Wall Lateral Pressures: Based on our observations and testing, the retaining wall should be designed to resist lateral pressure exerted from a soil media having an equivalent fluid weight provided in the table below. In accordance with Section 1803.5.12.1 of the 2016 California Building Code, application of the seismic design values for earthquake loading are required for retaining walls supporting more than 6 feet of backfill.

Retaining Wall Pressures

Wall Type	Wall Slope Configuration	Equivalent Fluid Weight (pcf)	Surcharge Load (psf)*	Lateral Pressure Coefficient	Earthquake Loading (plf)***	
Free Cantilever	Flat	40	per structural	0.29	$9H^2$	Applied 0.6H above the base of the wall
	2H:1V	60	per structural	0.46		
Restrained**	Flat	60	per structural	0.46	$25H^2$	

* The surcharge loads should be applied as uniform loads over the full height of the walls as follows: Surcharge Load (psf) = (q) (K), where q = surcharge in psf, and K = coefficient of lateral pressure. Final design is the purview of the project structural engineer.

** Restrained conditions shall be defined as walls which are structurally connected to prevent flexible yielding, or rigid wall configurations (i.e. walls with numerous turning points) which prevent the yielding necessary to reduce the driving pressures from an at-rest state to an active state.

*** Section 1803.5.12 of the 2016 California Building Code states that a determination of lateral pressures on basement and retaining walls due to earthquake loading shall be provided for structures to be designed in Seismic Design Categories D, E or F (Load value derived from Wood (1973) and modified by Whitman (1991)).

Site Wall Drainage: The above criteria are based on fully drained conditions as detailed on Figure No. 1, attached. For these conditions, we recommend that a blanket of filter material be placed behind all proposed walls. The blanket of filter material should be a minimum of 12 inches thick and should extend from the bottom of the wall to within 12 inches of the ground surface. The filter material should conform to Class One, Type B permeable material as specified in Section 68 of the California Department of Transportation Standard Specifications, current edition. A clean ⅜ inch angular gravel or ¾ inch crushed rock is also acceptable, provided filter fabric is used to separate the open graded gravel/rock from the surrounding soils. The top 12 inches of wall backfill should consist of a compacted native soil cap. A filter fabric should be placed on top of the gravel filter material to separate it from the native soil cap. A 4 inch diameter drain pipe should be installed near the bottom of the filter blanket with perforations facing down. The drain pipe should be underlain by at least 4 inches of filter-type material. Adequate gradients should be provided to discharge water that collects behind the retaining wall to a controlled discharge system.

The configuration of a long retaining wall generally does not allow for a positive drainage gradient within the perforated drain pipe behind the wall since the wall footing is generally flat with no gradient for drainage. Where this condition is present, to maintain a positive drainage behind the walls, we recommend that the wall drains be provided with a discharge to an appropriate non-erosive outlet a maximum of 50 feet on center. **In addition, if the wall drain outlets are temporarily stubbed out in front of the walls for future connection during site construction, it is imperative that the outlets be routed into the tight pipe area drainage system and not buried and rendered ineffective.**

Swimming Pool Design Considerations: From a geotechnical perspective, the proposed swimming pool should be designed for the at-rest soil pressure as detailed in the Retaining Wall Pressure table above. Due to the potential for perched groundwater conditions, the pool design should incorporate a hydrostatic relief valve and be constructed on a blanket drain consisting of a minimum of 4 inches of permeable materials (i.e. crushed rock). Final selection of appropriate design and construction configurations remains the purview of the pool designer.

Slab-on-Grade Construction

It is our opinion that soil-supported slab-on-grade floors could be used for the main floor, contingent on proper subgrade preparation. Often the geotechnical issues regarding the use of slab-on-grade floors include proper soil support and subgrade preparation, proper transfer of loads through the slab underlayment materials to the subgrade soils, and the anticipated presence or absence of moisture at or above the subgrade level. We offer the following comments and recommendations concerning support of slab-on-grade floors. The slab design (concrete mix, reinforcement, joint spacing, moisture protection and underlayment materials) is the purview of the project Structural Engineer.

Slab Subgrade Preparation: All subgrades proposed to support slab-on-grade floors should be prepared and compacted to the requirements of engineered fill as discussed above and in the Reference No. 3 report.

Slab Underlayment: As a minimum for slab support conditions, the slab should be underlain by a minimum 4 inch crushed rock layer that is covered by a minimum 10-mil thick moisture retarding plastic membrane. The membrane may only be functional when it is above the vapor sources and should be placed immediately below the concrete slab. The bottom of the crushed rock layer should be above the exterior grade to act as a capillary break and not a reservoir, unless it is provided with an underdrain system. The slab design and underlayment should be in accordance with ASTM E1643 and E1745.

A sand blotter is commonly placed below the concrete slab to aid in curing. If the blotter sand layer is omitted (as may be required if slab design and construction is to be performed according to the 2016 Green Building Code), special wet curing procedures will be necessary. In all cases, development of appropriate slab mix design and curing procedures remains the purview of the project structural engineer.

Slab Moisture Protection: Due to the potential for landscape to be present directly adjacent to the slab edge/foundation or for drainage to be altered following our involvement with the project, varying levels of moisture below, at, or above the pad subgrade level should be anticipated. The slab designer should include the potential for moisture vapor transmission when designing the slab. Our experience has shown that vapor transmission through concrete is controlled through slab thickness as well as proper concrete mix design.

It should be noted that placement of the recommended plastic membrane, proper mix design, and proper slab underlayment and detailing per ASTM E1643 and E1745 will not provide a waterproof

condition. If a waterproof condition is desired, we recommend that a waterproofing expert be consulted for slab design.

Slab Thickness and Reinforcement: Geotechnical reports have historically provided minimums for slab thickness and reinforcement for general crack control. The concrete mix design and construction practices can additionally have a large impact on concrete crack control. All concrete should be anticipated to crack. As such, these minimums should not be considered to be stand alone items to address crack control, but are suggested to be considered in the slab design methodology.

In order to help control the growth of cracks in interior concrete from becoming significant, we suggest the following minimums. Interior concrete slabs-on-grade not subject to heavy loads should be a minimum of 4 inches thick. A 4 inch thick slab should be reinforced. A minimum of No. 3 deformed reinforcing bars placed at 24 inches on center both ways, at the center of the structural section is suggested. Joint spacing should be provided by the structural engineer. Expansion joint felt should be provided to separate floating slabs from foundations and at least at every third joint. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

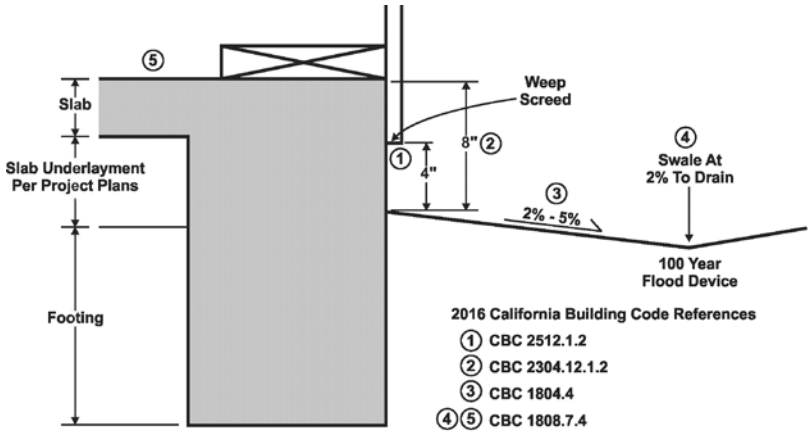
Vertical Deflections: Soil-supported slab-on-grade floors can deflect downward when vertical loads are applied, due to elastic compression of the subgrade. For design of concrete floors, a modulus of subgrade reaction of k = 150 psi per inch would be applicable for native soils and engineered fills.

Exterior Flatwork (Pool Decking): All exterior flatwork areas should be constructed on subgrade soils that have been compacted to at least 90 percent relative compaction as determined by the ASTM D1557 test method. From a geotechnical perspective, exterior flatwork areas should consist of at least 4 inches of concrete. A minimum of No. 3 deformed reinforcing bars placed at 24 inches on center both ways, at the center of the structural section is suggested. The exterior concrete flatwork should be underlain by a minimum 4 inch rock cushion. This could consist of vibroplate compacted crushed rock or ¾ inch aggregate baserock compacted to at least 90 percent relative compaction as determined by the ASTM D1557 test method.

If exterior flatwork concrete is against the floor slab edge without a moisture separator it may transfer moisture to the floor slab. Expansion joint felt should be provided to separate exterior flatwork from foundations and at least at every third joint. Contraction / groove joints should be provided to a depth of at least 1/4 of the slab thickness and at a spacing of less than 30 times the slab thickness flatwork, dividing the slab into nearly square sections. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side. Additionally, proper placement of contraction / groove joints can minimize the appearance of cracks in areas of irregular shapes (i.e. minimize joint patterns resulting in curved shapes or points).

Drainage Adjacent to Slabs: All grades should provide rapid removal of surface water runoff; ponding water should not be allowed on building pads or adjacent to foundations or other structural improvements (during and following construction). All soils placed against foundations during finish grading should be compacted to minimize water infiltration. Finish and landscape grading should include positive drainage away from all foundations. Section 1808.7.4 of the 2016 California Building Code (CBC) states that for graded soil sites, the top of any exterior foundation shall extend above the elevation of the street gutter at the point of discharge or the inlet of an approved drainage device a minimum of 12 inches plus 2 percent. If overland flow is not achieved adjacent to buildings, the drainage device should be designed to accept flows from a 100 year event. Grades directly adjacent to foundations should be no closer than 8 inches from the top of the slab (CBC

2304.12.1.2), and weep screeds are to be placed a minimum of 4 inches clear of soil grades and 2 inches clear of concrete or other hard surfacing (CBC 2512.1.2). From this point, surface grades should slope a minimum of 2 percent away from all foundations for at least 5 feet but preferably 10 feet, and then 2 percent along a drainage swale to the outlet (CBC 1804.4). Downspouts should be tight piped via an area drain network and discharged to an appropriate non-erosive outlet away from all foundations.



Typical 2016 California Building Code Drainage Requirements

The above referenced elements pertaining to drainage of the proposed structures is provided as general acknowledgement of the California Building Code requirements, restated and graphically illustrated for ease of understanding. Surface drainage design is the purview of the Project Architect/Civil Engineer. Review of drainage design and implementation adjacent to the building envelopes is recommended as performance of these improvements is crucial to the performance of the foundation and construction of rigid improvements.

It should be noted that due to the Americans with Disabilities Act (ADA) requirements, design and construction of alternative site drainage configurations may be necessary, particularly for senior living developments. In this case, design and construction of adequate drainage adjacent to foundations and slabs are essential to preserving foundation support and reducing the potential for wet slab related issues. A typical example of this condition occurs in commercial developments where the landscape grades are situated at the same elevation as the parking areas so as to not create a drop off between the grades. This condition subsequently results in flat grades between the building, landscape area, and parking lot which do not meet building code requirements.

Asphalt Concrete Pavement Design

We understand that asphalt pavements will be used for the associated roadways. The following comments and recommendations are given for pavement design and construction purposes. All pavement construction and materials used should conform to applicable sections of the latest edition of the California Department of Transportation Standard Specifications.

Subgrade Compaction: After installation of any underground facilities, the upper 8 inches of subgrade soils under pavements sections should be compacted to a minimum relative compaction of 95 percent based on the ASTM D1557 test method at a moisture content near or above optimum. Aggregate bases should also be compacted to a minimum relative compaction of 95 percent based on the aforementioned test method.

Subgrade Stability: All subgrades and aggregate base should be proof-rolled with a full water truck or equivalent immediately before paving, in order to evaluate their condition. If unstable subgrade conditions are observed, these areas should be overexcavated down to firm materials and the

resulting excavation backfilled with suitable materials for compaction (i.e. drier native soils or aggregate base). Areas displaying significant instability may require geotextile stabilization fabric within the overexcavated area, followed by placement of aggregate base. Final determination of any required overexcavation depth and stabilization fabric should be based on the conditions observed during subgrade preparation.

Design Criteria: Critical features that govern the durability of a pavement section include the stability of the subgrade; the presence or absence of moisture, free water, and organics; the fines content of the subgrade soils; the traffic volume; and the frequency of use by heavy vehicles. Soil conditions can be defined by a soil resistance value, or "R-Value," and traffic conditions can be defined by a Traffic Index (TI).

Design Values: The following table provides recommended pavement sections based on the R-Value test (CTM 301) previously performed (and provided in the Reference No. 3 report) on a bulk sample representative of the materials expected to be exposed at subgrade, as well as our experience with similar materials in the area.

Design values provided are based upon properly drained subgrade conditions. Although the R-Value design to some degree accounts for wet soil conditions, proper surface and landscape drainage design is integral in performance of adjacent street sections with respect to stability and degradation of the asphalt. If clay soils are encountered and cannot be sufficiently blended with non-expansive soils, we should review pavement subgrades to determine the appropriateness of the provided sections, and provide additional pavement design recommendations as field conditions dictate. Even minor clay constituents will greatly reduce the design R-Value.

The recommended design thicknesses presented in the following table were calculated in accordance with the methods presented in the Sixth Edition of the California Department of Transportation Highway Design Manual. A varying range of traffic indices are provided for use by the project Civil Engineer for roadway design.

Asphalt Pavement Section Recommendations

Design Traffic Indices	Alternative Pavement Sections (Inches)	
	Asphalt Concrete *	Aggregate Base **
4.5	3.0	4.5
5.0	3.0	5.5
5.5	3.0 3.5	7.5 6.5
6.0	3.0 3.5	8.5 7.5
6.5	3.5 4.0	9.5 8.5

* Asphalt Concrete: must meet specifications for Caltrans Hot Mix Asphalt Concrete
** Aggregate Base: must meet specifications for Caltrans Class II Aggregate Base (R-Value = minimum 78)

Portland Cement Concrete Pavement Design

We understand that Portland cement concrete pavements may be considered for various aspects of exterior paving for the site. The American Concrete Institute (ACI) Concrete Pavement Design method (ACI 330R-08) was used for design of the exterior concrete (rigid) pavements at the site. The pavement thicknesses were evaluated based on the soil design parameters provided in the following table.

Soil Parameters

Subgrade Soil Description	k, Modulus of Subgrade Reaction*	Base Course
Silty SAND	150 pci	6 inches

* Based on an R-Value of 40 as recommended above and correlated to a k-value recommended by ACI 330R.

Based on the subgrade soil parameters shown in the above table, the recommended concrete thicknesses for various traffic descriptions are presented in the table below. The recommended thicknesses provided below assume the use of plain (non-reinforced) concrete pavements.

We recommend that the rigid pavement be placed on at least 6 inches of aggregate base compacted to at least 95 percent of the maximum dry density per the ASTM D 1557 test method. From a geotechnical perspective, contraction joints should be placed in accordance with the American Concrete Institute (ACI) recommendations which include providing a joint spacing about 30 times the slab thickness up to a maximum of 10 feet. The joint patterns should also divide the slab into nearly square panels. If increased joint spacing is desired, reinforcing steel should be installed within the pavement in accordance with ACI recommendations. Final determination of steel reinforcement configurations (if used within the pavements) remains the purview of the Project Structural Engineer.

Concrete Pavement Section Recommendations

Category	ADTT*	Pavement Traffic Description	Thickness (inches)	
			3000 psi**	4000 psi**
A	1	Car parking areas and access lanes	5.0	4.5
A	10	Autos, pickups, and panel trucks only	5.5	5.0
B	25	Shopping center entrance and service lanes Bus parking areas and interior lanes	6.0	5.5
B	300	Single-unit truck parking areas and interior lanes	7.0	6.0
C	100	Roadway Entrances and Exterior Lanes	7.0	6.5
C	300		7.5	6.5
C	700		7.5	7.0

* Average Daily Truck Traffic
** 28-day concrete compressive strength

Drainage

In order to maintain the engineering strength characteristics of the soil presented for use in this Geotechnical Engineering Study Update, maintenance of the site will need to be performed. This maintenance generally includes, but is not limited to, proper drainage and control of surface and subsurface water which could affect structural support and fill integrity. A difficulty exists in determining which areas are prone to the negative impacts resulting from high moisture conditions due to the diverse nature of potential sources of water; some of which are outlined in the paragraph below. We suggest that measures be installed to minimize exposure to the adverse effects of moisture, but this will not guarantee that excessive moisture conditions will not affect the structure.

Some of the diverse sources of moisture could include water from landscape irrigation, annual rainfall, offsite construction activities, runoff from impermeable surfaces, collected and channeled water, and water perched in the subsurface soils on the bedrock horizon or present in fractures in the weathered bedrock. Some of these sources can be controlled through drainage features installed either by the developer. Others may not become evident until they, or the effects of the presence of excessive moisture, are visually observed on the property.

Some measures that can be employed to minimize the build up of moisture include, but are not limited to; proper backfill materials and compaction of utility trenches on the site and within the

footprint of the proposed structure (potentially minimizing the transmission of moisture through these areas); grout plugs at foundation penetrations; collection and channeling of drained water from impermeable surfaces (i.e. roofs or flatwork areas); installation of subdrain/cut-off drain provisions; utilization of low flow irrigation systems.

Post Construction: All drainage related issues may not become known until after construction and landscaping are complete. Therefore, some mitigation measures may be necessary following site development. Landscape watering is typically the largest source of water infiltration into the subgrade. Given the soil conditions on site, excessive or even normal landscape watering may contribute to groundwater levels rising, which could contribute to moisture related problems and/or cause distress to foundations and slabs, pavements, and underground utilities, as well as creating a nuisance where seepage occurs. In order to mitigate these conditions, additional drainage measures than those detailed in the California Building Code may be necessary, which could include but is not limited to, installation of subdrainage provisions.

Construction Monitoring

Construction monitoring is a continuation of the findings and recommendations provided in this and the Reference No. 3 report. It is essential that our representative be involved with all grading activities in order for us to provide supplemental recommendations as field conditions dictate. Youngdahl Consulting Group, Inc. should be notified at least two working days before site clearing or grading operations commence, and should observe the stripping of deleterious material, overexcavation of any unsuitable materials, and provide consultation to the Grading Contractor in the field.

Post Construction Monitoring

All drainage related issues may not become known until after construction and landscaping are complete. Therefore, some mitigation measures may be necessary following site development. Any necessary measures to mitigate the observed moisture conditions should be provided on an as requested and site specific basis. Youngdahl Consulting Group, Inc. can provide consultation services upon request that relate to proper design and installation of drainage features during and following site development.

Limitations and Uniformity of Conditions

1. This report has been prepared for the exclusive use of Avenida Partners for specific application to the Broadstone Crossing Parcel 6 project. Youngdahl Consulting Group, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Youngdahl Consulting Group, Inc. makes no other warranty, express or implied.

2. As of the present date, the findings of this report are valid for the property studied. With the passage of time, changes in the conditions of a property can occur whether they be due to natural processes or to the works of man on this or adjacent properties. Legislation or the broadening of knowledge may result in changes in applicable standards. Changes outside of our control may cause this report to be invalid, wholly or partially. Therefore, this report should not be relied upon after a period of three years without our review nor should it be used or is it applicable for any properties other than those studied.

3. Section [A] 107.3.4 of the 2016 California Building Code states that, in regard to the design professional in responsible charge, the building official shall be notified in writing by the owner if the registered design professional in responsible charge is changed or is unable to continue to perform the duties.

WARNING: Do not apply any of this report's conclusions or recommendations if the nature, design, or location of the facilities is changed. If changes are contemplated, Youngdahl Consulting Group, Inc. must review them to assess their impact on this report's applicability. Also note that Youngdahl Consulting Group, Inc. is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of this report's subsurface data or engineering analyses without the express written authorization of Youngdahl Consulting Group, Inc.

4. The analyses and recommendations contained in this report are based on limited windows into the subsurface conditions and data obtained from subsurface exploration. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any variations or undesirable conditions be encountered during the development of the site, Youngdahl Consulting Group, Inc. will provide supplemental recommendations as dictated by the field conditions.

5. The recommendations included in this report have been based in part on assumptions about strata variations that may be tested only during earthwork. Accordingly, these recommendations should not be applied in the field unless Youngdahl Consulting Group, Inc. is retained to perform construction observation and thereby provide a complete professional geotechnical engineering service through the observational method. Youngdahl Consulting Group, Inc. cannot assume responsibility or liability for the adequacy of its recommendations when they are used in the field without Youngdahl Consulting Group, Inc. being retained to observe construction. Unforeseen subsurface conditions containing soft native soils, loose or previously placed non-engineered fills should be a consideration while preparing for the grading of the property. It should be noted that it is the responsibility of the owner or his/her representative to notify Youngdahl Consulting Group, Inc., in writing, a minimum of 48 hours before any excavations commence at the site.

6. Our experience has shown that vapor transmission through concrete is controlled through proper concrete mix design. As such, proper control of moisture vapor transmission should be considered in the design of the slab as provided by the project architect, structural or civil engineer. It should be noted that placement of the recommended plastic membrane, proper mix design, and proper slab underlayment and detailing per ASTM E1643 and E1745 <u>will not</u> provide a <u>waterproof</u> condition. If a waterproof condition is desired, we recommend that a waterproofing expert be consulted for slab design.

7. Following site development, additional water sources (i.e. landscape watering, downspouts) are generally present. The presence of low permeability materials can prohibit rapid dispersion of surface and subsurface water drainage. Utility trenches typically provide a conduit for water distribution. Provisions may be necessary to mitigate adverse effects of perched water conditions. Mitigation measures may include the construction of cut-off systems and/or plug and drain systems. Close coordination between the design professionals regarding drainage and subdrainage conditions may be warranted.

   Seepage may be observed emanating from the cut slopes following their excavation during the following rainy season or following development of the areas above the cut. Generally this seepage is not enough flow to be a stability issue to the cut slope, but may be an issue for the owner of the lot at the base of the cut from a surface drainage and standing water (damp spot) standpoint. This amount of water is generally collected easily with landscaping drainage, surface drainage at the toe of the slope, or subsurface toe drains.

Recommendations may be provided at the time of observed seepage; however, we recommend that the developer of the property disclose this possibility to future owners.

Should you have any questions or require additional information, please contact our office at your convenience.

Sincerely Yours,
Youngdahl Consulting Group, Inc.

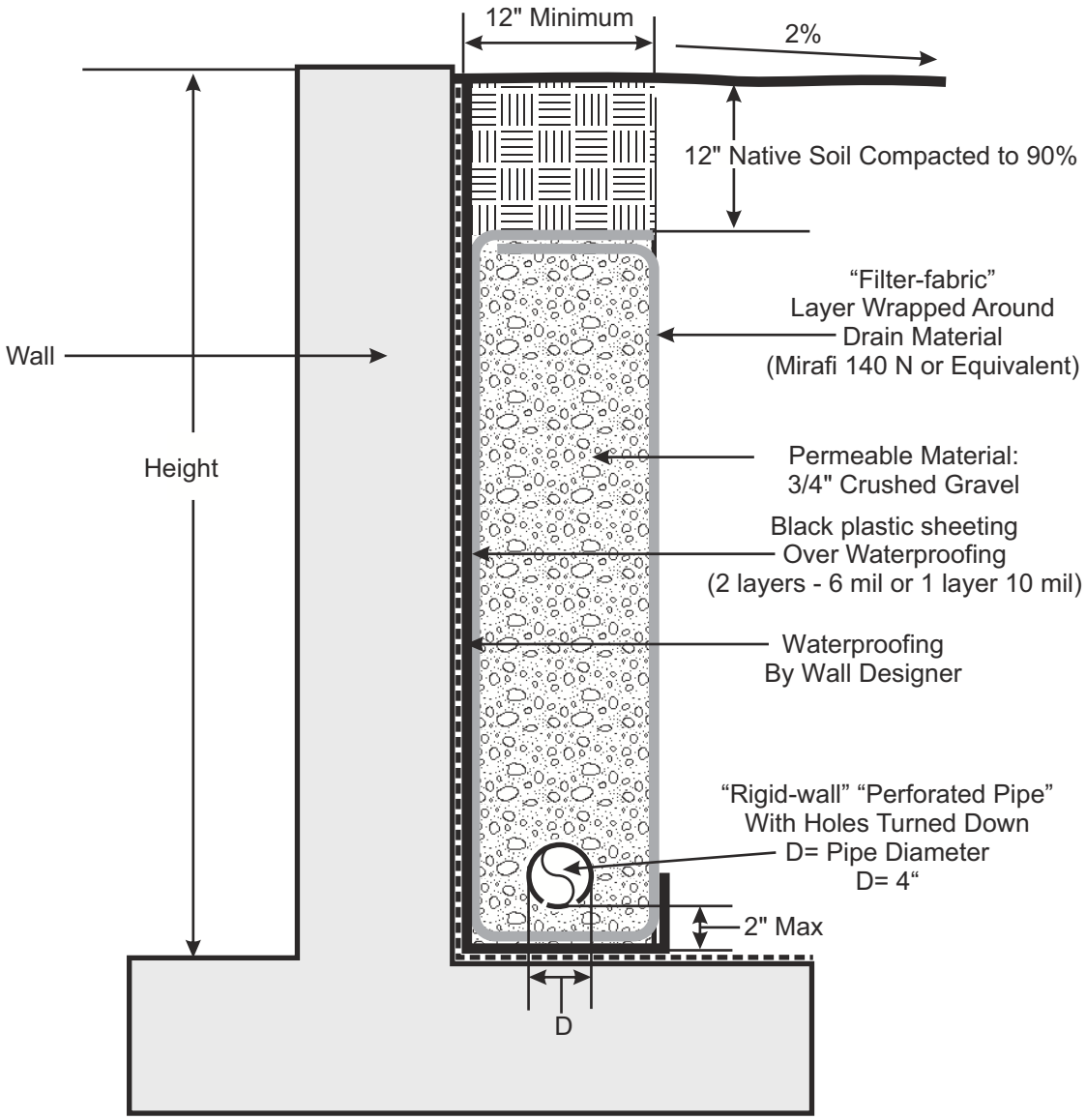
REGISTERED PROFESSIONAL ENGINEER
BRANDON KIYOMI SHIMIZU
No. GE 02712
Exp. 06-30-19
GEOTECHNICAL
STATE OF CALIFORNIA

Brandon K. Shimizu, P.E., G.E.
Senior Engineer

Attachments: Figure No. 1, Retaining Wall Detail
Reference No. 3, Geotechnical Engineering Study

Retaining Wall With "Perforated Pipe Sub-Drain"

(Typical Cross Section)



Notes:

1. Slope footing and "rigid-wall" pipes along flow line parallel to wall at least 1% gradient to drain to an appropriate outfall area away from residence.
2. Use "sweeps" for directional changes in pipe flow **(do not use 90°elbows)**.
3. Provide periodic "clean-outs".
4. Washed clean permeable material.

Not To Scale

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: E02215.018	**RETAINING WALL DRAIN DETAIL**	**FIGURE**
	April 2019	**Broadstone Crossing Parcel 6**	**1**
		Folsom, California	

GEOTECHNICAL ENGINEERING STUDY
for
BROADSTONE 3 RETAIL CENTER
Folsom, California

Project No. 02215
May 2002

YOUNGDAHL
CONSULTING GROUP, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING

Project No. 02215
9 May 2002

Elliott Homes, Inc.
2390 East Bidwell Street
Folsom, California 95630

Attention: Mr. Price Walker

Subject: **BROADSTONE 3 RETAIL CENTER**
Folsom, California
GEOTECHNICAL ENGINEERING STUDY

References:
1. Geotechnical Engineering Study Update on Broadstone - Unit 3 by Youngdahl & Associates, Inc. dated 5 March 1999.
2. Geotechnical Engineering Study on Woodward Ranch by Youngdahl & Associates, Inc. dated 16 January 1990.
3. Preliminary Grading Plan for Broadstone 3 Retail Center, prepared by G.C. Wallace of California, Inc., dated 12 April 2002.

Dear Mr. Walker:

In accordance with your authorization, Youngdahl Consulting Group, Inc., has performed a geotechnical engineering study for the project site located along the south side of Iron Point Road in Folsom, California. The purpose of this study was to explore and evaluate the surface and subsurface soil and rock conditions at the site, and to develop geotechnical information and design criteria for the proposed project.

Our study consisted of a site reconnaissance, subsurface exploration, as well as surface and subsurface soil and rock sampling. We also performed a review of available published and unpublished literature and reports pertaining to the subject site. Field tests were performed on selected soil samples collected during the field study in order to evaluate the materials as they relate to the proposed commercial development. We performed an engineering analysis of the data and information obtained from our field study, laboratory testing of soils and rock on the site, and literature review. Recommendations for site preparation and grading, geotechnical design criteria for foundations, retaining structures, slabs-on-grade, asphalt concrete pavements, and underground facilities are included in this report.

This report has been prepared for the exclusive use of Elliott Homes, Inc. and their consultants, for specific application to this project, in accordance with generally accepted geotechnical engineering practice.

Should you have any questions or require additional information, please contact our office at your convenience.

Very truly yours,
Youngdahl Consulting Group, Inc.

Brandon K. Shimizu, P.E.
Project Engineer

Reviewed by:

John C. Youngdahl, P.E.
Principal Engineer

Roy C. Kroll, C.E.G
Associate Engineering Geologist

Distribution: 4 to Elliott Homes, Inc., Attention: Mr. Price Walker
2 to G.C. Wallace of California, Inc., Attention: Mr. Chris Schulze

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GEOTECHNICAL ENGINEERING STUDY
for
BROADSTONE 3 RETAIL CENTER
Folsom, California

1.0 INTRODUCTION

This report presents the results of our Geotechnical Engineering Study performed for the proposed commercial development planned to be constructed along the south side of Iron Point Road in Folsom, California.

1.1 Purpose and Scope

The purpose of this study was to explore and evaluate the surface and subsurface conditions at the site and to develop geotechnical information and design criteria for the proposed project. The scope of this study includes the following:

1. A review of available published and unpublished geotechnical and geologic data pertinent to the project site.

2. A field study consisting of a visual site reconnaissance, followed by an exploratory test pit program and geophysical seismic refraction lines to characterize the subsurface soil and rock conditions.

3. A laboratory testing program performed on representative soil and rock samples collected during our field study.

4. Engineering analysis of the data and information obtained from our field study, laboratory testing, and literature review. Development of recommendations for site preparation and grading, and geotechnical design criteria for foundations, slabs on grade, retaining structures, pavements and underground facilities.

5. Preparation of this report summarizing our findings, conclusions, and recommendations regarding the geotechnical aspects for the project.

2.0 PROJECT DESCRIPTION

Proposed construction is expected to consist of commercial buildings along with associated driveways, street pavements, parking areas and underground utilities. A review of the referenced grading plans (Reference No. 3), indicate maximum cuts on the order of 35 feet, and fills on the order of 40 feet.

The structures are expected to be of wood/metal frame, concrete masonry unit (CMU), or concrete tilt-up panel construction with concrete slab-on-grade floors. Additional construction is expected to include 2 to 12 foot high tiered rockery retaining walls along the west end of the project site. It is anticipated that up to 40 feet of fill materials will be retained by two and three tier walls. Design of rockery walls and proposed stability analysis associated with the tier walls was not covered under our current scope of work.

3.0 SITE CONDITIONS

3.1 Surface Conditions

The project site consists of undeveloped property located along the south side of Iron Point Road, immediately east of East Bidwell Street in Folsom, California. Overall site boundaries are generally delineated by Iron Point Road to the north, by undeveloped land to the east, by State Highway 50 to the south, and by railroad tracks and East Bidwell Street to the west.

At the time of our subsurface exploration, a representative from our firm observed site topography to consist of gently westward sloping terrain ranging from 20H:1V to 10H:1V (Horizontal to Vertical) in the western portion (Parcels 1 and 2). The ridge area gradients vary from 16H:1V along the central crestline to approximately 4H:1V along the ridge flanks. A northwest trending topographic ridge is situated in the southeast and central portion of the site. The remainder of the site slopes in a west/northwest direction at gradients ranging from 12H:1V to 2.5H:1V due to an active drainage. The site was observed to be covered in a heavy growth of grasses. An east to west trending drainage swale was observed to traverse the northern and northeastern portions of the project site. Some isolated tree growth was observed within portions of the swale alignment. The maximum elevation of 598 feet above mean sea level (MSL) occurs on the southeast ridge line area of proposed Parcel 7; while the minimum elevation of 425 feet MSL occurs along the west edge or the property adjoining the railroad easement where the existing drainage outlets from proposed Parcel 1.

3.2 Subsurface Conditions

Our field study included a site reconnaissance by a Youngdahl Consulting Group, Inc., representative followed by a subsurface exploration program conducted on 25 and 26 April 2002, which included the excavation of 20 test pits under his direction at the approximate locations shown on Figure A-2, Appendix A. The test pits were excavated at strategic locations across the site to supplement the subsurface explorations previously performed (Reference No. 2). Excavation of the test pits was accomplished with a Komatsu PC400 excavator equipped with a 28 inch wide bucket. Bulk soil and rock samples were collected from the pits and returned to our lab for further examination and testing. Selected test pits were also geologically logged to characterize bedrock structure for cut slope stability evaluation.

The test pits completed for this investigation encountered relatively similar soil and rock conditions within the maximum 25.0 foot depth of exploration. Test Pits 17 and18 encountered FILL materials in a loose and slightly moist to saturated condition from the surface to depths approaching 5½ to 12 feet. Test Pit 17 was excavated into an existing fill stockpile located south of the intersection of Cavitt Drive and Iron Point Road. Test Pit 18 was excavated in the vicinity of the previously backfilled construction water detention pond used during construction of the neighboring Broadstone development to the north. It is not clearly discernable if the materials encountered here are soft saturated native materials or fill materials associated with backfill of the pond. Test Pits 1 through 9, 11 through 16, and 20 encountered sandy SILT materials in a stiff and slightly moist condition from the surface to depths of 1 to 3 feet. Test Pits 10 and 19 encountered silty SAND materials in a loose and dry condition from the surface to depths of ½ to 1½ feet. Underlying the surface materials in Test Pits 1 through 5, 7 through 9, 11 through 14, and 20, sandy CLAY materials in a very stiff and slightly moist condition were encountered from the surface to depths of 2 to 5 feet.

Underlying the fill materials and native soils, weathered metavolcanic BEDROCK was encountered to the maximum depth explored in each pit. The bedrock generally graded less weathered with increased depth. Seepage from perched groundwater was encountered in Test Pits 1 and 2 at depths of 12 to 25 feet, respectively, during our study. A more detailed description of the soils encountered is presented graphically on the "Exploratory Test Pit Logs", Figures A-3 and A-22, presented in Appendix A. These logs show a graphic representation of the soil profile, the location and depths at which samples were collected.

3.3 Regional Geologic Conditions

The project site is situated on the east edge of Sacramento County, located within the foothills of the Sierra Nevada geomorphic province of California. This province consists mostly of the Sierra Nevada Mountain Range. Tectonic building of the range occurred since the late Triassic period with the onset of active plate subduction along the continental margin. Continuing during much of the Jurassic period, island arc, atolls, and other remnants of land collided with the continental land mass and resulted in the uplift of the Sierra Nevada Mountain Range. Extensive mountain formation caused by subduction, granitic intrusive activity and uplift continued on into the Cretaceous period. Concurrently, large volumes of material were eroded off the mountain terrain and carried to deep marine basins, which now comprise the Great Valley sedimentary beds to the west. During the late Tertiary period, the marine sediments were buried by extensive lava flows, ash flows, and volcanic mud flows from eruptions of andesitic volcanoes high in the Sierra Nevada. Volcanic flows were channeled down the Tertiary streams that coursed westward. The volcanic deposits were resistant over long periods to erosion and exist presently as ridge forming outcrops in the foothills. Faults in the province, which generally strike northwest and dip eastward, were typically generated by either collision or subduction along the tectonic plate margin last active in the Quaternary age (approximately 600 thousand to 1.6 million years before present) and are represented in the vicinity today by the Mormon Island Shear Zone to the east and the Bear Mountains and Melones Fault Zones to the east (Loyd, 1984). The Mormon Island Shear Zone straddles the El Dorado County-Sacramento County immediately east of the site (Tierra Engineering Consultants, 1983). The Bear Mountains Fault Zone has two traces in the Sierra foothills. The west branch of this fault zone is mapped approximately 2.5 kilometers to the east of the site, and the east branch is mapped approximately 16 kilometers to the east of the site. The Melones Fault Zone is located about 23 kilometers east of the site. The nearest active faults are the Dunnigan Hills Fault 65 kilometers to the northwest and Cleveland Fault 88 kilometers north. Other active and potentially active faults within a 100 kilometer radius, as well as their estimated empirical ground motion potentials are listed in the Seismicity Table C-1, Appendix C.

3.4 Site Geology

The geologic portion of this report included a review of geologic data pertinent to the site, and an interpretation of our observations and the exploratory pit logs excavated during the field study on 25 and 26 April 2002.

The site is located at the base of the Sierra Foothills region of the Sierra Nevada Mountain Range. According to the "Generalized Geology of the Folsom 15-Minute Quadrangle" (CDMG, 1984) and confirmed by our subsurface exploration, the site is predominantly underlain by undifferentiated metavolcanic rocks of the Copper Hill Formation (Jch) formed during the Jurassic Period (Figure C-1, Appendix C). The metavolcanic bedrock is characterized by a greenish gray color, predominantly fine grained and is usually observed to contain various degrees of fracturing and weathering. The degree of weathering typically decreases with depth.

The onsite soils are derived mainly from the weathering of the underlying bedrock and consist primarily of sandy SILTS and silty SANDS with abundant outcrops of boulders and cobbles. No other rock types were observed at the project site either during the field study or during previous site visits.

The Mormon Island Shear Zone and the west branch of the Bear Mountains Fault Zone are the closest faults to the site. These faults are considered only potentially active, per Alquist-Priolo (fault hazard) criteria. No evidence of recent shear movement, such as soil off-set, springs, seeps,

sag ponds or other indications of recent ground rupture were observed on the project site. Slope stability does not appear to be a significant problem at the proposed site.

3.5 Laboratory Testing

The laboratory testing of collected samples was directed towards determining the physical and engineering properties of the soil underlying the site. A description of the tests performed are presented in Appendix B.

3.6 Seismic Refraction Survey

Seismic lines (see attached Seismic Rippability Survey prepared by Gasch & Associates: Appendix D) and test pit excavations performed at the project site gives an indication of the amount of effort that may be required for excavation during construction. A total of 5 seismic lines were conducted along the proposed location of major cuts. A standard impact hammer/plate with trip sensor was employed to generate seismic signals along the roadway.

The study compiled in the attached report was conducted with state-of-the-technology geophysical equipment operated by an experienced geophysical team, familiar with the local geology and the typical engineering characteristics of the local metavolcanic bedrock. While every attempt has been made to provide accuracy and reliability to the findings submitted, readers and users of the attached report must keep in mind that the profiles and estimated depths to non-rippable rock are professional interpretations based on experience and familiarity with the equipment and software used. As such, site-specific conditions may be encountered on a localized basis that differ from the professional interpretations expressed in this engineering geologic evaluation and the geophysicists's attached seismic refraction rippability report.

4.0 CONCLUSIONS

Development plans call for the construction of a commercial development along with the associated underground utilities and asphaltic concrete pavements at the project site. We offer the following general geotechnical conclusions and recommendations concerning this development project.

Bearing Capacity: The native soils, rock, and/or engineered fills composed of like materials and processed and compacted as recommended below are considered suitable for support of the planned improvements.

Expansive Soils: Much of the surficial soils and rock encountered on the site are non-plastic materials which are considered to be relatively non-expansive. We encountered intermittent clay layers in several of the test pits excavated. The clayey materials could cause distress to concrete slab-on-grade floors and foundations if present within the top three feet of the building pad if left in concentrated amounts. However, due to the limited presence of the expansive materials, and the mixing with less expansive material which typically occurs during mass grading operations, we do not anticipate that special design considerations pertaining to these materials will need to be addressed for the design or construction of most of the planned improvements.

Groundwater: Seepage from perched groundwater was encountered in Test Pits 1 and 2. A perched water table often develops in shallow, fractured and weathered bedrock horizons as surface water percolates down through the surface soils and perches on top of the relatively impermeable, deeper, less weathered bedrock horizon. At all times of the year, groundwater levels would likely fluctuate in response to precipitation patterns, off-site construction activities, and site utilization.

The perched water can saturate surface soils. Saturated soils may be unstable under construction equipment, and may require considerable aeration in order to achieve a moisture content which will allow compaction. The prospect of saturated soils should be considered in construction scheduling. Water inflow into any excavation approaching hard rock surface is likely to be experienced in all but the driest summer and fall months.

Subdrainage: Building pads or pavement areas constructed in cut which approach the weathered bedrock horizon may require subdrainage measures. Such measures may include an increase in the crushed rock capillary break and/or installation of subdrain trenches beneath or around the building pads and/or design pavement section. The potential for additional subdrainage where cuts into fractured bedrock are proposed cannot be precluded. Final subdrainage requirements should be based on our observation of building pad and pavement areas following rough grading.

Excavation: The test pits were excavated using a Komatsu PC400 excavator equipped with a 28 inch wide bucket. The degree of difficulty encountered in excavating our test pits is an indication of the effort that will be required for excavation during construction. Based on our test pits, we expect that the surficial site soils can be excavated using normal earthmoving equipment such as a rubber tired backhoe. Excavations into the weathered bedrock will require larger equipment such as the excavator used to excavate the test pits. Test Pits 1 through 3 were excavated to the maximum 25 foot reach of the equipment so that bedrock samples could be collected. According to the equipment operator, additional equipment effort as well as lengthening and widening of the test pits were required to achieve these depths. The shallower excavation depths and practical equipment refusal encountered in many of the other test pits are more indicative of application of moderate trenching efforts.

The underlying rock materials can likely be excavated to depths of several feet using dozers equipped with rippers. Our excavations encountered essential equipment refusal at depths of 7 to 13 feet in many of the test pits. We expect that the upper, weathered portion of the rock will require use of Caterpillar D9 or D10 equipped with single shank rippers, or similar equipment. Excavations in general approaching 25 to 40 feet, which represents less weathered rock, will require heavier equipment, such as a 10R, or similar. Drilling and blasting of localized resistant core stones may be necessary during excavation of the deeper cuts to achieve design grade. Reference should be made to the seismic refraction study (Appendix D, attached) for additional detail regarding site rippability.

Utility trenches will likely encounter hard rock excavation conditions especially in deeper cut areas (greater than 25 to 40 feet deep). Utility contractors should be prepared to use special rock trenching equipment such as rock wheel excavators or large excavators such as a CAT 235, 245, or 375, with rock buckets. Blasting to achieve utility line grades, especially in planned deep cut areas, cannot be precluded. Water inflow into any excavation approaching hard rock surface is likely to be experienced in all but the driest summer and fall months.

Liquefaction: Liquefaction is the sudden loss of soil shear strength and sudden increase in porewater pressure caused by shear strains, as could result from an earthquake. Research has shown that saturated, loose to medium-dense sands with a silt content less than about 25 percent located within the top 40 feet are most susceptible to liquefaction. Due to the relatively low seismicity of the area, the absence of a permanent shallow groundwater table, and the hard bedrock encountered at shallow depths during our study, the potential for liquefaction on the subject site is considered negligible.

Slope Stability: Generally a cut slope orientation of 2H:1V is considered stable with the soil material types encountered on the site. A fill slope constructed at the same orientation is considered stable if compacted to the engineered fill recommendations as stated in the recommendations section of this report. Cut slopes in metamorphic bedrock up to a 1.5H:1H orientation are considered stable, subject to geologic field verification. In addition, all surficial soils overlying a steepened bedrock cut orientation should be laid back to a gradient of 2H:1V , or flatter. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

Seismic Considerations: Based on our literature review and subsurface interpretations, we recommend that the project be designed in accordance with the 1998 CBC, Chapter 16. This site is located within Seismic Risk Zone 3 and based on our subsurface interpretations is classified as Soil Profile Type S_B.

5.0 RECOMMENDATIONS

5.1 General

The site is suitable for the proposed improvements provided the recommendations presented in this report are incorporated into the project plans and specifications.

All grading and foundation plans should be reviewed by Youngdahl Consulting Group, Inc., hereinafter described as the Geotechnical Engineer, prior to contract bidding. A review should be performed to determine whether the recommendations contained within this report are incorporated into the project plans and specifications.

The Geotechnical Engineer should be notified at least two working days before site clearing or grading operations commence, and should observe the stripping of deleterious material and provide consultation to the Grading Contractor in the field.

Field observation and testing during the grading operations should be provided by the Geotechnical Engineer so that an opinion may be formed regarding the adequacy of the site preparation, the acceptability of fill materials, and the extent to which the earthwork construction and the degree of compaction comply with the project geotechnical specifications. Any work related to grading performed without the full knowledge of, and under direct observation by the Geotechnical Engineer may render the recommendations of this report invalid.

Our recommendations are based on limited windows into the subsurface conditions. Section 3317.8 in Appendix Chapter 33 of the 1998 California Building Code states that, in regard to the transfer of responsibility, if the Geotechnical Engineer of Record for the project site is not maintained through the grading phase of the project, the work shall be stopped until the replacement has agreed in writing to accept their responsibility within the area of technical competence for approval upon completion of the work. Our design recommendations should not be relied upon without our consultation, observation and testing services during all aspects of grading on the site.

5.2 Site Preparation

Preparation of the project site should involve temporary drainage, clearing, stripping, overexcavation, subgrade compaction, and groundwater considerations. The following paragraphs state our geotechnical comments and recommendations concerning site preparation.

Temporary Drainage: We recommend that initial site preparation involve intercepting and diverting any potential sources of surface or near-surface water within the construction zones. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and contractor's methods, final decisions regarding drainage systems are best made in the field at the time of construction.

Clearing and Stripping: Surface grass stripping operations may be necessary depending upon the in-situ conditions at the time of mass grading. Dry grasses may be pulverized and lost within fill materials provided no concentrated pockets of organics result. General site clearing should also include removal of any loose or saturated materials from the proposed structural improvement and pavement areas. A representative of our firm should be present during site clearing operations to identify the location and depth of fills not disclosed by this report.

Overexcavation: All existing non-engineered fills within proposed improvement areas should be overexcavated down to firm native materials, and grade restored with engineered fill. Reference should be made to the test pit logs and site plan for the anticipated depths and location of existing fills. Additionally, test pits should be reexcavated and backfilled with engineered fill.

To reduce the potential for differential support and provide a relatively uniform bearing condition in the building areas, cut-fill transition building pads may require overexcavation of the cut-portion. Actual depth of pad overexcavation should be determined following final grading plan review. Alternatively, footings could be deepened to minimize fill depths beneath the footings (see "foundation" section).

Subgrade Compaction: Exposed subgrades following initial site preparation activities should be scarified to a minimum depth of 8 inches and compacted to the requirements for engineered fill. Prior to placing fill, the exposed subgrades should be in a firm, unyielding state. Any localized zones of soft or pumping soils observed within a subgrade should either be scarified and recompacted or be overexcavated and replaced with engineered fill as defined below in Section 5.3.

Groundwater Considerations: Due to the nature of the soils encountered in the area of the project site, we anticipate that a perched groundwater table will be encountered near the bedrock contact. Where cuts are proposed, subdrains may need to be installed to catch the water flowing along the soil/bedrock contact.

5.3 Engineered Fills

"Engineered fill" refers to any materials placed under foundations, retaining walls, slab-on-grade floors, sidewalks, pavements, and other structures. Our comments and recommendations concerning structural fill are presented in the following paragraphs.

On-site Soils: We anticipate that a large amount of on-site soils will be generated during mass grading operations. We expect that soil generated from excavations on and adjacent to the site, excluding deleterious material, may be used as engineered fill provided the material does not exceed the maximum size specifications listed below.

Rock fragments or boulders exceeding 24 inches in maximum dimension should not be placed within the upper five feet of lot and street grade. The upper two feet of lot or street grades should

consist of predominantly rocks and rock fragments less than 12 inches in maximum dimension with no more than 20 percent between 12 and 24 inches in maximum dimension. The rock fragments should be thoroughly mixed with soil so that a uniform mixture of rocks and compacted soil is obtained without voids. Boulders over 24 inches in maximum dimension should be placed within the deeper portions of fill embankments below a depth of 5 feet and a minimum of 5 feet from the finish slope face. The individual boulders should be spaced such that compaction of finer rock and soil materials between the boulders can be achieved. Materials placed between the boulders should consist of predominantly soil and rock less than 12 inches in maximum dimension. The soil/rock mixture should be placed between the boulders so as to preclude nesting or the formation of voids and compacted to the requirements of engineered fill. Should insufficient deep fill areas exist for oversize rock disposal, contractor should (at his option) either dispose of the excess materials to an offsite location or mechanically reduce the rocks to less than 24 inches in maximum dimension.

Existing Fills: Following general site clearing, all existing non-engineered fills and fill stockpiles should be over-excavated down to firm native materials. *Prior to, or at the inception of mass grading operations, we recommend that additional potholes be excavated at the northwest corner of the project site, in the vicinity of the backfilled water detention pond, so that a determination of the horizontal and vertical extent and adequacy of any existing fills can be made.* Reference should be made to the site description and test pit logs for anticipated fill locations. Any depressions extending below final grade resulting from the removal of fill materials or other deleterious materials should be backfilled with engineered fill. Prior to placement of engineered fill, the exposed soil surfaces receiving fills should be scarified to a minimum depth of 8 inches, moisture conditioned as necessary, and compacted to at least 90 percent of the maximum dry density based on the ASTM D1557 test method.

Fill Placement and Compaction: All areas proposed to receive fill should be scarified to a minimum depth of 8 inches, moisture conditioned as necessary, and compacted to at least 90 percent of the maximum dry density based on the ASTM D1557 test method. The fill should be placed in thin horizontal lifts not to exceed 12 inches in uncompacted thickness. The fill should be moisture conditioned as necessary and compacted to a relative compaction of not less than 90% based on the ASTM D1557 test method. The upper 8 inches of fills placed under proposed pavement areas should be compacted to a relative compaction of not less than 95% based on the ASTM D1557 test method. Expansive clays, if encountered, should not be placed within the upper three feet of building pad and pavement subgrade level. Alternatively, clays may be mixed thoroughly with less expansive on site materials (silts, sands, and gravels). Proper disposition of clays on site should be verified by a representative of Youngdahl Consulting Group, Inc.

Review of the referenced grading plans indicate fills on the order of 40 feet in design thickness. To mitigate the potential for deep fill settlement, fills exceeding 15 feet in thickness should be compacted to a minimum of 95% relative compaction. The fills should be placed at a minimum of two percent over optimum moisture content.

Compaction Equipment: In areas to receive structural fill, a Caterpillar 825 steel-wheel compactor, or approved equivalent, should be employed as a minimum to facilitate breakdown of oversize bedrock materials and generation of soil fines during the fill placement process. If the quantity of rock fragments in the fills preclude traditional compaction testing, then the proposed fills should be compacted using method specifications as indicated below.

Soils exposed in excavations should be moisture conditioned and compacted in place by a minimum of four completely covering passes with a Caterpillar 825, or approved equivalent. The

compactor's last two passes should be at 90 degrees to the initial passes. In areas where 95% relative compaction is designated, an additional two passes should be applied, with three completely covering passes made at 90 degrees to the initial three passes. Engineered fill should be constructed in lifts not exceeding 12 inches in uncompacted thickness, moisture conditioned and compacted in accordance with the above specification.

Earthwork Bulking Values: Estimations of earthwork bulking values for the subject site are provided in the table below. These estimated values are based upon an assumed average relative compaction during grading of 95 percent for the rocky fill materials. These numbers are based upon in place rock densities taken at 10 and 20 feet below current site grades compared to the maximum dry density of the rocky fill materials as determined by the ASTM D1557 test method, results of which are detailed in Figure Nos. B-4 through B-9, Appendix B. NOTE: Either an increase or decrease in compaction attained by the contractor will cause actual bulking to change.

It should be noted that the following earthwork shrinkage values are approximate, and have been provided to assist in preparation of earthwork quantities. Due to the inherent variability of soils, these estimates may not purport actual quantities. Actual quantities will likely vary depending on material types used for construction, and the compaction efforts applied.

Depth Below Current Site Grades (ft)	Estimated Bulking (%)
0-15	10-15
15-20+	20-25

Placement of Fills on Slopes: Placement of fill material on natural slopes should be stabilized by means of keyways and benches. Where the slope of the original ground equals or exceeds 5H:1V, a keyway should be constructed at the base of the fill. The keyway should consist of a trench excavated to a depth of at least two feet into firm, competent materials. The keyway trench should be at least 10 feet wide or as designated by the Geotechnical Engineer. Benches should be cut into the original slope as the filling operation proceeds. Each bench should consist of a level surface excavated at least six feet horizontally into firm soils or four feet horizontally into rock. The rise between successive benches should not exceed 36 inches.

Import Materials: If imported fill material is needed for this project, import material should be approved by the Geotechnical Engineer prior to transporting it to the project. It is preferable that import material meet the following requirements:

1. Plasticity index not to exceed 12.
2. "R"-value of not less than 30.
3. Should not contain rocks larger than 6 inches in diameter.
4. Not more than 15% passing through the No. 200 sieve.

If these requirements are not met, additional testing and evaluation may be necessary to determine the appropriate design parameters for foundations, pavement and other improvements.

Subgrade Verification and Compaction Testing: Fill soil compaction should be verified by means of in-place density tests performed during fill placement so that adequacy of soil compaction efforts may be evaluated as earthwork progresses, or by method specification if the quantity of rock fragments in the fills preclude traditional compaction testing. This will likely include the excavation

of test pits within the fill materials to verify that a uniform over-optimum moisture condition, and absence of large and/or concentrated voids has been achieved prior to additional fill placement.

Soil Moisture Considerations: The near-surface fine grained soils may become partially or completely saturated during the rainy season. Grading operations during this time period may be difficult since compaction efforts may be hampered by saturated materials. It is, therefore, suggested that consideration be given to the seasonal limitations and costs of winter grading operations on the site.

5.4 Finish Soilgrade Preparation

Finish building pad soilgrades should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557 test method. Pavement subgrades should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557 test method and should be proof-rolled with a full water truck or equivalent immediately before paving, in order to verify their condition.

5.5 Drainage Considerations

All final grades should be provided with positive drainage away from all foundations. Final grades should provide rapid removal of surface water runoff; ponding water should not be allowed on building pads or adjacent to foundations. During wet weather operations, the soil should be graded to drain and should be sealed by rubber tire rolling to minimize water infiltration.

Special attention should be given regarding the drainage of the project site. If the project is expected to work through the wet season, the contractor should install appropriate temporary drainage systems at the construction site and should minimize traffic over exposed subgrades due to the moisture-sensitive nature of the on-site soils. If the project improvements are constructed prior to the wet season, but are not proposed to be fine graded for permanent drainage until the next dry season, temporary drainage or erosion protection provisions should be made to address the possibility of erosion to cut and fill slopes.

5.6 Seismic Design Criteria

Based on the 1998 California Building Code, Chapter 16, Division IV, and our site investigation findings, the following seismic parameters are recommended from a geotechnical perspective for structural design. The final choice of design parameters, however, remains the purview of the project structural engineer.

CBC - CHAP. 16 TABLE NO.	SEISMIC PARAMETER	RECOMMENDED VALUE
16-I	Seismic Zone Factor Z	0.30
16-J	Soil Profile Type	S_B
16-Q	Seismic Coefficient (C_a)	0.30
16-R	Seismic Coefficient (C_v)	0.30
16-S,-T	Near Source Factors (N_a, N_v)	1.0
16-U	Seismic Source Type	C

5.7 Foundations

In our opinion, continuous and shallow spread footings will provide adequate support for the proposed buildings if the subgrades are properly prepared as described in the Site Preparation section. We offer the following comments and recommendations for purposes of footing design and construction. *The recommendations provided below are subject to change. Our firm should be afforded the opportunity to review grading and foundation plans to confirm the applicability of the recommendations provided below. Any necessary modifications to these recommendations will be made at the time of our review.*

Footing Configuration: Continuous footings should be reinforced with a minimum of four No. 4 reinforcing bars, two located near the bottom of the footing and two near the top of the stem wall. All footings should be founded below an imaginary 2.5H:1V plane projected up from the bottoms of adjacent footings, downhill slopes and/or parallel utility trenches, or to a depth that achieves a minimum horizontal clearance of 8 feet from the outside toe of the footings to the slope face, whichever requires a deeper excavation.

Footing Depths and Widths: Foundations for the structures should be a minimum of 12 inches in width and founded a minimum of 18 inches below the lowest adjacent grade. If clay soils are encountered in the building pads for the subject site, they should be overexcavated and replaced with engineered fill composed of non-expansive material. The depth and width of footings should be based on the actual loads being supported.

As an alternative to overexcavation of cut portions of cut-fill transition building pads as detailed in Section 5.2, structural footings within fill portions may be deepened to minimize the differential condition. Specific recommendations can be provided following our review of the project plans but would likely consist of deepening of the proposed footings and subsequent use of a sand/cement slurry as backfill up to the bottom of design footing bottoms.

Bearing Capacities: An allowable dead plus live load bearing pressure of 3,000 pounds per square foot (p.s.f.) may be used for design of footings based on native soils or engineered fills. An allowable dead plus live load bearing pressure of 4,500 p.s.f. may be used for design of footings based on weathered bedrock. A total settlement of less than ½ inch is anticipated on similarly loaded foundations bearing on like materials.

Transient Bearing Capacities: The above allowable pressures are for support of dead plus live loads and may be increased by one-third for short term wind and seismic loads.

Subgrade Conditions: Footings should never be cast atop soft, loose, organic, slough, debris, nor atop subgrades covered by ice or standing water. A representative of our firm should be retained to observe all subgrades before any concrete is poured in order to verify that they have been adequately prepared.

Footing / Stemwall Backfill: We recommend that all footing or stemwall excavations be backfilled after the concrete has been poured. Either imported engineered fill or non-organic on-site soils can be used for this purpose. All footing backfill soil should be compacted to at least 90 percent of the maximum dry density (based on ASTM D-1557).

Lateral Pressures: Lateral forces on structures may be resisted by passive pressure acting against the sides of shallow footings and/or friction between the soil and the bottom of the footing. For

resistance to lateral loads, a friction factor of 0.35 may be utilized for sliding resistance at the base of spread footings in undisturbed native materials or engineered fill. A passive resistance of 350 pcf equivalent fluid weight may be used against the side of shallow footings. If friction and passive pressures are combined, the lesser value should be reduced by 50%.

5.8 Slab-on-Grade Construction

It is our opinion that soil-supported slab-on-grade floors could be used for the main floor, contingent on proper subgrade preparation. We offer the following comments and recommendations concerning slab-on-grade floors.

Moisture Protection: Where interior concrete slabs-on-grade are to be constructed, the slabs should be underlain by a minimum of 4 inches of clean crushed rock to serve as a cushion and a capillary break. Where floor coverings or storage are anticipated, a Visquene-type membrane should be placed between the cushion and the slab to help minimize moisture vapor transmission through the slab. It is suggested that a 1 to 2 inch thick sand layer be placed on top of the membrane to assist in the curing of the concrete. The Visquene-type membrane is only effective if it is above the exterior grades. As an addition to the Visquene vapor barrier, a concrete additive called Moxie 1800 could be used to help minimize moisture vapor transmission through the slab.

Slab thickness and Reinforcement: Interior concrete slabs-on-grade not subject to heavy loads should be a minimum of 4 inches thick. A 4 inch thick slab should be reinforced with a minimum of No. 3 deformed reinforcing bars placed at 36 inches on center both ways, at the center of the structural section. The aforementioned reinforcement may be used for anticipated floor loads not exceeding 250 psf. If floor loads greater than 250 psf are anticipated, the slab should be evaluated by a structural engineer. Joints should be provided at a spacing of less than 30 times the slab thickness for unreinforced slabs to divide the slab into nearly square sections. All floor slab areas should be sized to account for construction loads.

Concrete Design and Placement: The concrete mix design should consider moisture vapor transmission through the slab and its effect on moisture sensitive floor coverings and adhesives. Based on our experience, this can be reduced through an appropriate water/cement ratio and quality control during placement. If concrete is placed with an excessive water content and/or a high water/cement ratio it tends to cure more slowly and the porosity is generally increased, which inhibits the placement of floor coverings/adhesives and also allows for greater moisture vapor penetration. In addition, excessive water content is the major cause of concrete shrinkage cracking, which can also be a conduit for water vapor transmission through the slab. Ultimately, concrete slab and mix design is the purview of the design civil/structural engineer.

Vertical Deflections: Soil-supported slab-on-grade floors can deflect downward when vertical loads are applied, due to elastic compression of the subgrade. For design of concrete floors, a modulus of subgrade reaction of k = 150 psi per inch would be applicable for native soils and engineered fills.

Exterior Flatwork: Exterior concrete flatwork need not be underlain by a rock cushion where non-expansive soils are encountered. However, some vertical movement of slabs should be anticipated when arranging outside concrete flatwork joints where rock is omitted. Where expansive soils are encountered, a 4 inch rock cushion under concrete flatwork and presaturation is recommended.

5.9 Underground Facilities Construction

Based on our interpretations of subsurface conditions, utility trenches will likely encounter hard rock excavation conditions especially in deeper cut areas (greater than 25 to 40 feet deep). Utility contractors should be prepared to use special rock trenching equipment such as rock wheel excavators or large excavators such as a CAT 235, 245, or 375, with rock buckets. Blasting to achieve utility line grades, especially in planned deep cut areas, cannot be precluded. We offer the following comments and recommendations concerning underground facility construction.

Trench Sidewalls: Trenches or excavations in soil should be shored or sloped back in accordance with OSHA regulations prior to persons entering them. Where clay rind in combination with moist conditions is encountered in fractured bedrock, the project engineering geologist should be consulted for appropriate mitigation measures. The potential use of a shield to protect workers cannot be precluded.

Backfill Materials: Native soil should be used for trench backfill within structural areas and 5 feet beyond for underground facilities extending outside of structures in order to prohibit rapid lateral migration of drainage waters. Beyond the 5 foot distance from structures, native or import material may be used.

Backfill Compaction: All backfill, placed after the underground facilities have been installed, should be compacted a minimum of 90% relative compaction within the structural areas and 85% in landscaped areas. Compaction should be accomplished using lifts which do not exceed 12 inches. However, thickness of the lifts should be determined by the contractor. If the contractor can achieve the required compaction throughout the lift using thicker lifts, the method will be acceptable by field verification by a representative of our firm using standard density testing procedures.

5.10 Retaining Walls

Our design recommendations and comments regarding retaining walls for the project site are discussed below.

Overturning Forces: In general, retaining walls should be designed to resist active lateral pressures exerted from a soil media having an equivalent fluid weight as follows:

Gradient of Backslope (horizontal : vertical)	Equivalent Fluid Weight (pcf)
Flat	40
2:1	60

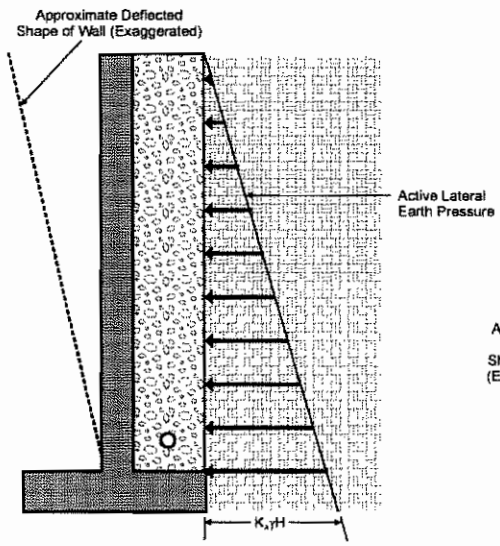
Restrained Top: Retaining walls having a flat back slope gradient and restrained at top may be designed to resist active lateral pressures as defined above but with an additional superimposed equivalent fluid weight of 10 pcf. The lateral pressure due to any surcharge shall be in addition to this equivalent fluid pressure loading.

Restrained Sides: Retaining walls having a length to height ratio of 4 or less and restrained at both sides are acted upon by higher lateral earth pressures as compared to identical but not restrained

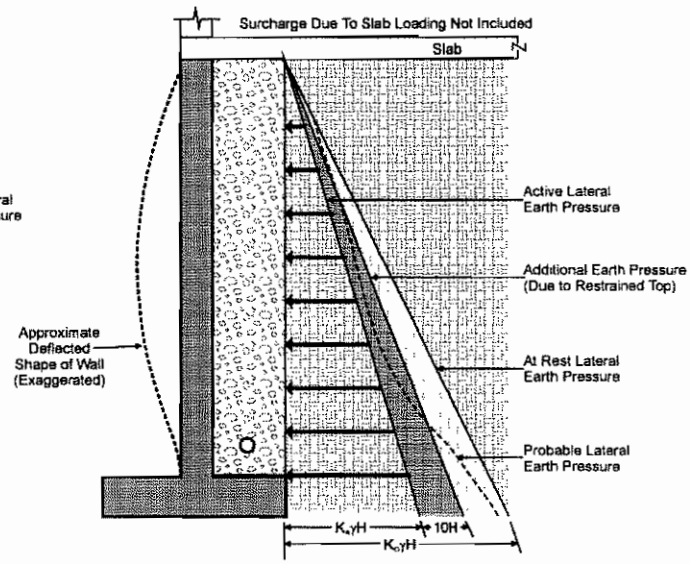
walls. The lateral earth pressure for the these restrained walls may approach the at rest pressure, especially near the edges. However the design lateral pressure need to be evaluated on a case by case basis.

Acting lateral earth pressures on curved (in plan) retaining walls are also higher than active lateral pressure. Design lateral pressures need to be evaluated on a case by case basis.

CANTILEVER RETAINING WALL



CANTILEVER RETAINING WALL RESTRAINED AT TOP



Resisting Forces: Lateral forces on the retaining walls may be resisted by passive pressure acting against the side of the wall footing and/or friction between the soil and the bottom of the footing. A passive equivalent fluid weight of 350 pcf may be used against the sides of shallow footings founded in native soil or engineered fill. A friction factor of 0.35 may be used at the base of footings founded on soil or engineered fill. All backfill placed behind retaining walls or against retaining wall footings should be compacted in accordance with the "Engineered Fill" section of this report. The allowable bearing pressure and depth of foundation should be as given in the "Foundations" section of this report.

Wall Drainage: The above criteria is based on fully drained conditions. For these conditions, we recommend that a blanket of filter material be placed behind all proposed walls. The blanket of filter material should be a minimum of 12 inches thick and should extend from the bottom of the wall to within 12 inches of the ground surface. The filter material should conform to Class One, Type B permeable material as specified in Section 68 of the California Department of Transportation Standard Specifications, current edition. A typical 1"x #4 concrete coarse aggregate mix approximates this specification. A clean pea gravel is also acceptable. The top 12 inches of wall backfill should consist of a compacted native soil cap. A filter fabric should be placed on top of the gravel filter material to separate it from the native soil cap. A 4 inch diameter drain pipe should be installed near the bottom of the filter blanket with perforations facing down. The drain

pipe should be underlain by at least 4 inches of filter-type material. As an alternative to drain pipe, weep holes may be provided, if applicable. Adequate gradients should be provided to discharge water that collects behind the retaining wall to an adequately controlled discharge system.

Modular Block Walls: If rockery walls or keyed or interlocking non-mortared walls such as Keystone or Earthstone walls are utilized, the following soil parameters would be applicable for design within on-site, native materials:

Internal Angle of Friction	32°
Cohesion (Remolded)	0 psf
Bulk Unit Weight	135 pcf

For walls constructed within imported fill materials, the soil parameters should be determined on a site specific basis through sampling and laboratory testing.

All wall backcuts exposing fractured and jointed bedrock, should be geologically inspected for assignment of appropriate surcharge pressures.

5.11 Pavement Design

We understand that asphaltic pavements will be used for the associated roadways. The following comments and recommendations are given for pavement design and construction purposes. All pavement construction and materials used should conform to applicable sections of the latest edition of the California Department of Transportation Standard Specifications.

Subgrade Compaction: After installation of any underground facilities, the top 8 inches of subgrade soils under pavements sections should be compacted to a minimum relative compaction of 95% based on the ASTM D1557 test method at a moisture content above optimum. Aggregate bases should also be compacted to a minimum relative compaction of 95% based on the aforementioned test method. All subgrades should be proof-rolled with a full water truck or equivalent immediately before paving, in order to verify their condition.

Design Criteria: Critical features that govern the durability of a pavement section include the stability of the subgrade; the presence or absence of moisture, free water, and organics; the fines content of the subgrade soils; the traffic volume; and the frequency of use by heavy vehicles. Soil conditions can be defined by a soil resistance value, or "R"-Value, and traffic conditions can be defined by a Traffic Index (TI).

Design Values: Table 1 provides recommended pavement sections based on the "R" - Value tests (California Test Method 301-F) performed on bulk samples representative of the materials expected to be exposed at subgrade. An "R"-Value of 30 was determined for the Sandy SILT materials tested. *If soils containing significant quantities of clay are encountered, we should review pavement subgrades to determine the appropriateness of the provided sections, and provide additional pavement design recommendations as field conditions dictate. Even minor clay constituents will greatly reduce the R-Value design value.* The recommended design thicknesses presented in Table 1 were calculated in accordance with the methods presented in the latest update of the Fifth Edition of the California Department of Transportation Highway Design Manual.

Table 1. Recommended Pavement Design Thickness

A minimum traffic index of 4.5 is recommended for automobile parking stalls. A traffic index of at least 5.5 is recommended for driveways subject to channelized automobile traffic and/or occasional delivery and garbage truck traffic. The actual traffic index used should be based on cost and desired level of future maintenance.

DESIGN TRAFFIC INDICES	ALTERNATIVE PAVEMENT SECTIONS (INCHES)	
	ASPHALT CONCRETE *	AGGREGATE BASE **
4.5	2.5 3.0	5.5 4.5
5.0	2.5 3.0	7.0 5.5
5.5	3.0 3.5	7.5 6.5
6.0	3.0 3.5	8.5 7.5
6.5	3.5 4.0	9.5 8.5

NOTES:

* Asphaltic Concrete: must meet specifications for CAL TRANS Type B Asphaltic Concrete
** Aggregate Base: must meet specifications for CAL TRANS Class II Aggregate Base ("R"-Value = minimum 78)

Due to the redistribution of materials which occurs during mass grading operations, we should review pavement subgrades to determine the appropriateness of the provided sections.

6.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. This report has been prepared for the exclusive use of Elliott Homes, Inc., for specific application to BROADSTONE 3 RETAIL CENTER project. Youngdahl Consulting Group, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Youngdahl Consulting Group, Inc. makes no other warranty, express or implied.

2. As of the present date, the findings of this report are valid for the property studied. With the passage of time, changes in the conditions of a property can occur whether they be due to natural processes or to the works of man on this or adjacent properties. Legislation or the broadening of knowledge may result in changes in applicable standards. Changes outside of our control may cause this report to be invalid, wholly or partially. Therefore, this report should not be relied upon after a period of three years without our review nor should it be used or is it applicable for any properties other than those studied.

3. Section 3317.8 in Appendix Chapter 33 of the 1997 (and previous) Uniform Building Code is applicable to this report. This section states that, in regard to the transfer of responsibility, if the Geotechnical Engineer of Record for the project site is not maintained into and through the grading phase of the project, the work shall be stopped until the replacement has agreed in writing to accept their responsibility within the area of technical competence for approval upon completion of the work.

   WARNING: Do not apply any of this report's conclusions or recommendations if the nature, design, or location of the facilities is changed. If changes are contemplated, Youngdahl Consulting Group, Inc. must review them to assess their impact on this report's applicability. Also note that Youngdahl Consulting Group, Inc. is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of this report's subsurface data or engineering analyses without the express written authorization of Youngdahl Consulting Group, Inc.

4. The analyses and recommendations contained in this report are based on limited windows into the subsurface conditions and data obtained from subsurface exploration. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any variations or undesirable conditions be encountered during the development of the site, Youngdahl Consulting Group, Inc., will provide supplemental recommendations as dictated by the field conditions.

5. The recommendations included in this report have been based in part on assumptions about strata variations that may be tested only during earthwork. Accordingly, these recommendations should not be applied in the field unless Youngdahl Consulting Group, Inc. is retained to perform construction observation and thereby provide a complete professional geotechnical engineering service through the observational method. Youngdahl Consulting Group, Inc. cannot assume responsibility or liability for the adequacy of its recommendations when they are used in the field without Youngdahl Consulting Group, Inc. being retained to observe construction. Unforseen subsurface conditions containing soft native soils, loose or previously placed non-engineered fills should be a consideration while preparing for the grading of the property. It should be noted that it is the responsibility of the owner or his/her representative to notify Youngdahl Consulting Group, Inc., in writing, a minimum of 48 hours before any excavations commence at the site.

CHECKLIST OF RECOMMENDED SERVICES

	Item Description	Recommended	Not Anticipated
1	Provide foundation design parameters	Included	
2	Review grading plans and specifications	✓	
3	Review foundation plans and specifications	✓	
4	Observe and provide recommendations regarding demolition		✓
5	Observe and provide recommendations regarding site stripping	✓	
6	Observe and provide recommendations on moisture conditioning removal, and/or precompaction of unsuitable existing soils	✓	
7	Observe and provide recommendations on the installation of subdrain facilities	✓	
8	Observe and provide testing services on fill areas and/or imported fill materials	✓	
9	Review as-graded plans and provide additional foundation recommendations, if necessary	✓	
10	Observe and provide compaction tests on storm drains, water lines and utility trenches	✓	
11	Observe foundation excavations and provide supplemental recommendations, if necessary, prior to placing concrete	✓	
12	Observe and provide moisture conditioning recommendations for foundation areas and slab-on-grade areas prior to placing concrete	✓	
13	Provide design parameters for retaining walls	Included	
14	Provide finish grading and drainage recommendations	Included	
15	Provide geologic observations and recommendations for keyway excavations and cut slopes during grading	✓	
16	Excavate and recompact all test pits within structural areas	✓	

APPENDIX A

Field Study

Vicinity Map
Site Plan
Logs of Test Pits

Introduction

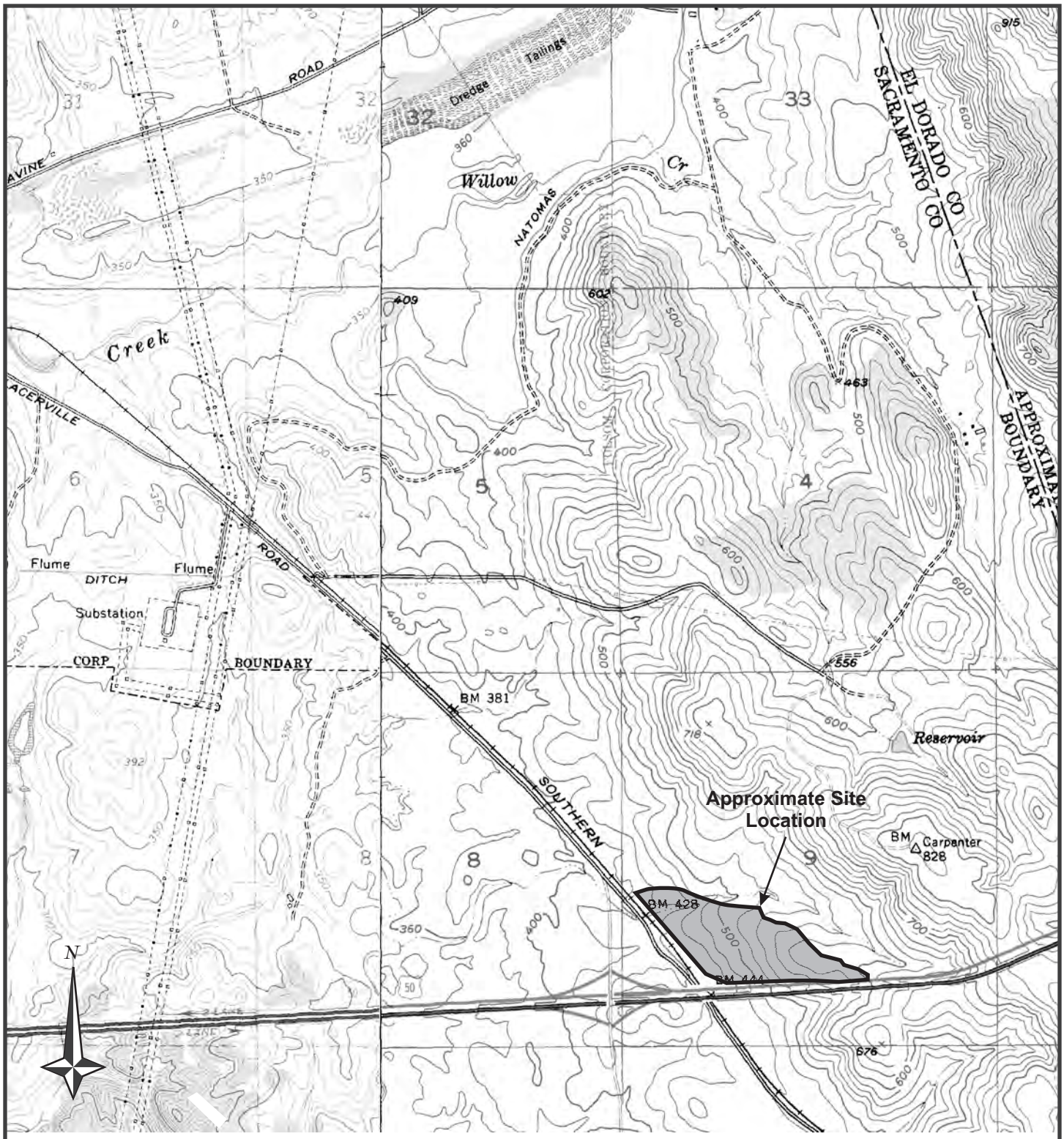
The contents of this appendix shall be integrated with the geotechnical engineering study of which it is a part. They shall not be used in whole or in part as a sole source for information or recommendations regarding the subject site.

Field study

Our field study included a site reconnaissance by a Youngdahl Consulting Group, Inc., representative followed by a subsurface exploration program conducted on 25 and 26 April 2002, which included the excavation of 20 test pits under his direction at the approximate locations shown on Figure A-2, this Appendix. Excavation of the test pits was accomplished with a Komatsu PC400 excavator equipped with a 28 inch wide bucket. Tube samples were collected to obtain the in place dry density and moisture content. Bulk and bag samples were also collected from the pits and returned to our lab for further examination and testing. Selected test pits were also geologically logged to characterize bedrock structure for cut slope stability evaluation.

The Exploratory Test Pit Logs describe the vertical sequence of soils and materials encountered in each test pit, based primarily on our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradual, our logs indicate the average contact depth. Our logs also graphically indicate the sample type, sample number and approximate depth of each soil sample obtained from the test pits.

The soils encountered were logged during excavation and provide the basis for the "Logs of Test Pits", Figures A-3 through A-22, this Appendix. These logs show a graphic representation of the soil profile, the location and depths at which samples were collected and the laboratory test results.



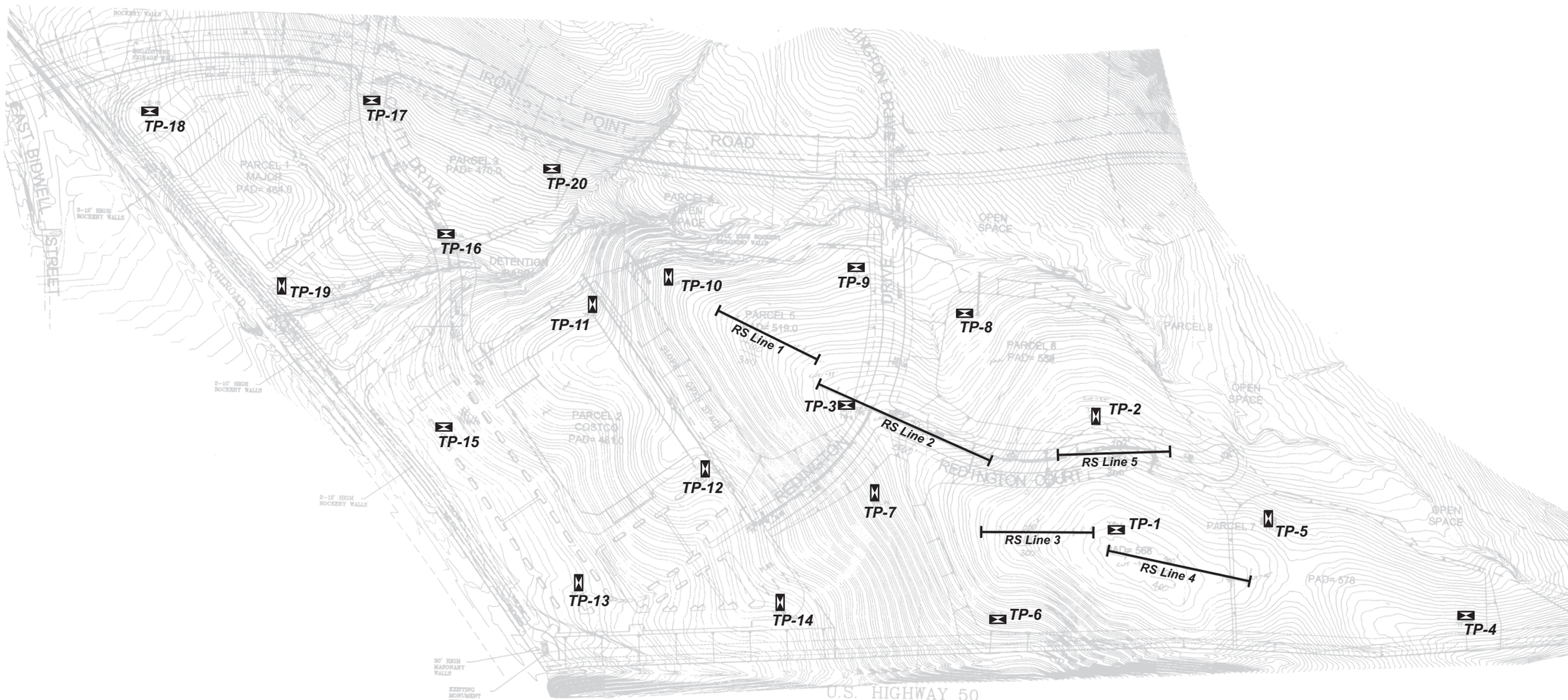
1 ½ 0 1 Mile

1000 0 1000 3000 4000 5000 6000 7000 Feet

Scale: 1:24,000

BASE MAP REFERENCE: U.S.G.S. 7.5 Minute Topographic Series, Clarksville Quadrangle, Dated 1953, Revised 1980.
U.S.G.S. 7.5 Minute Topographic Series, Folsom Quadrangle, Dated 1967, Revised 1980.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215	**VICINITY MAP**	**FIGURE**
	May 2002	**Broadstone 3 Retail Center** Folsom, California	**A-1**



N

0 150 300 600

Approximate Scale: 1" = 300'

= Approximate Test Pit Location

= Approximate Location of Seismic Refraction Line

BASE MAP REFERENCE: *Preliminary Grading Plan for Broadstone 3 Retail Center, G.C. Wallace of California, Inc., Dated April 12, 2002*

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May 2002

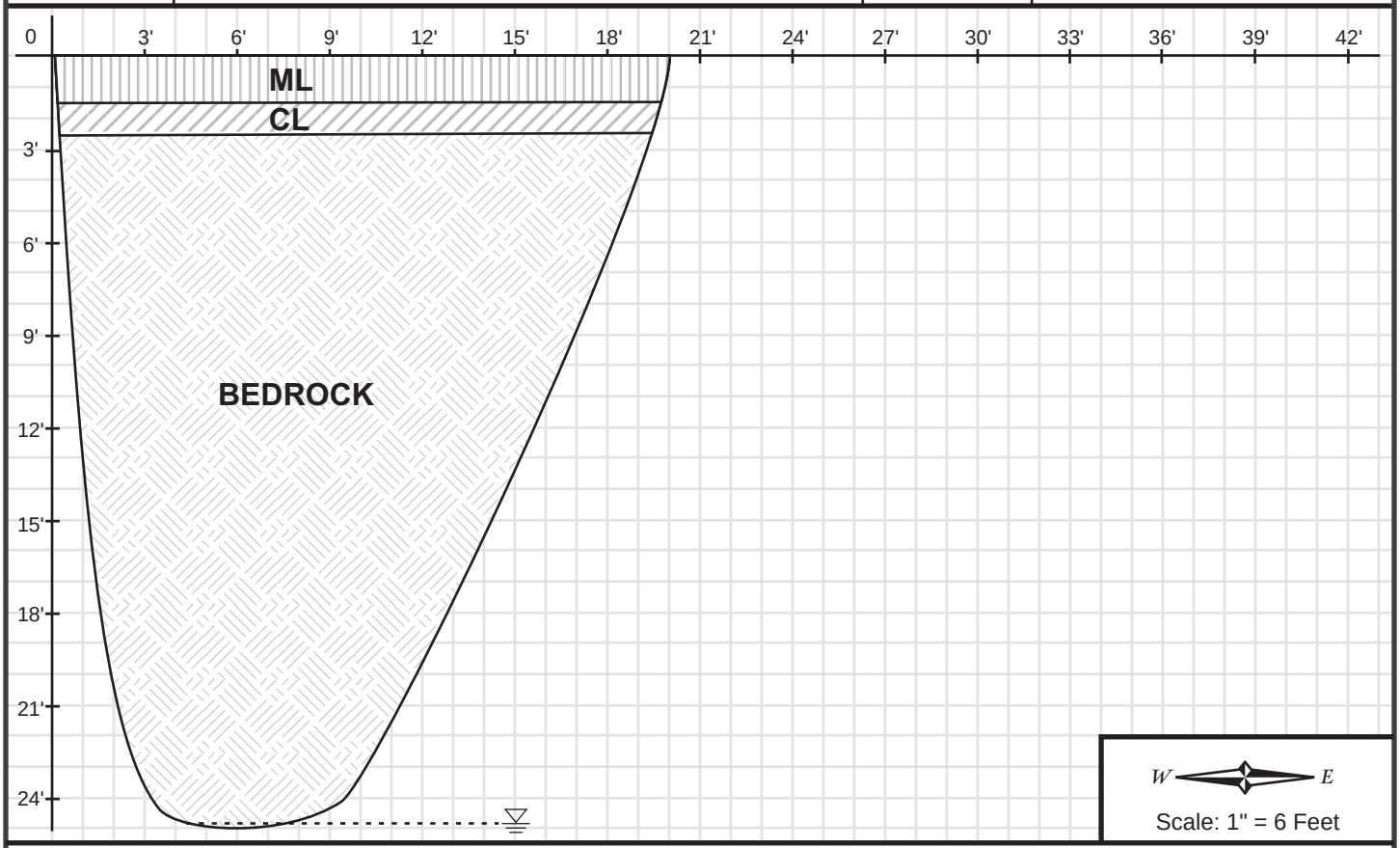
SITE PLAN

Broadstone 3 Retail Center
Folsom, California

FIGURE
A-2

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	**TP-1**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1.5'	Red brown sandy **SILT (ML)**, stiff, slightly moist		
@ 1.5' - 2.5'	Yellow brown sandy **CLAY (CL)**, very stiff, slightly moist		
@ 2.5' - 15'	Yellow brown metavolcanic **BEDROCK**, highly to completely weathered, indurated, closely jointed, joints closed with black staining to open ¼" with clay filling	**Rock** @ 10'	
@ 15' - 25'	*Grades moderately to highly weathered, indurated to well indurated, gray on fresh surfaces*	**Rock** @ 20'	
	Test pit terminated at 25' (max reach) Free water encountered at 25' No caving noted		

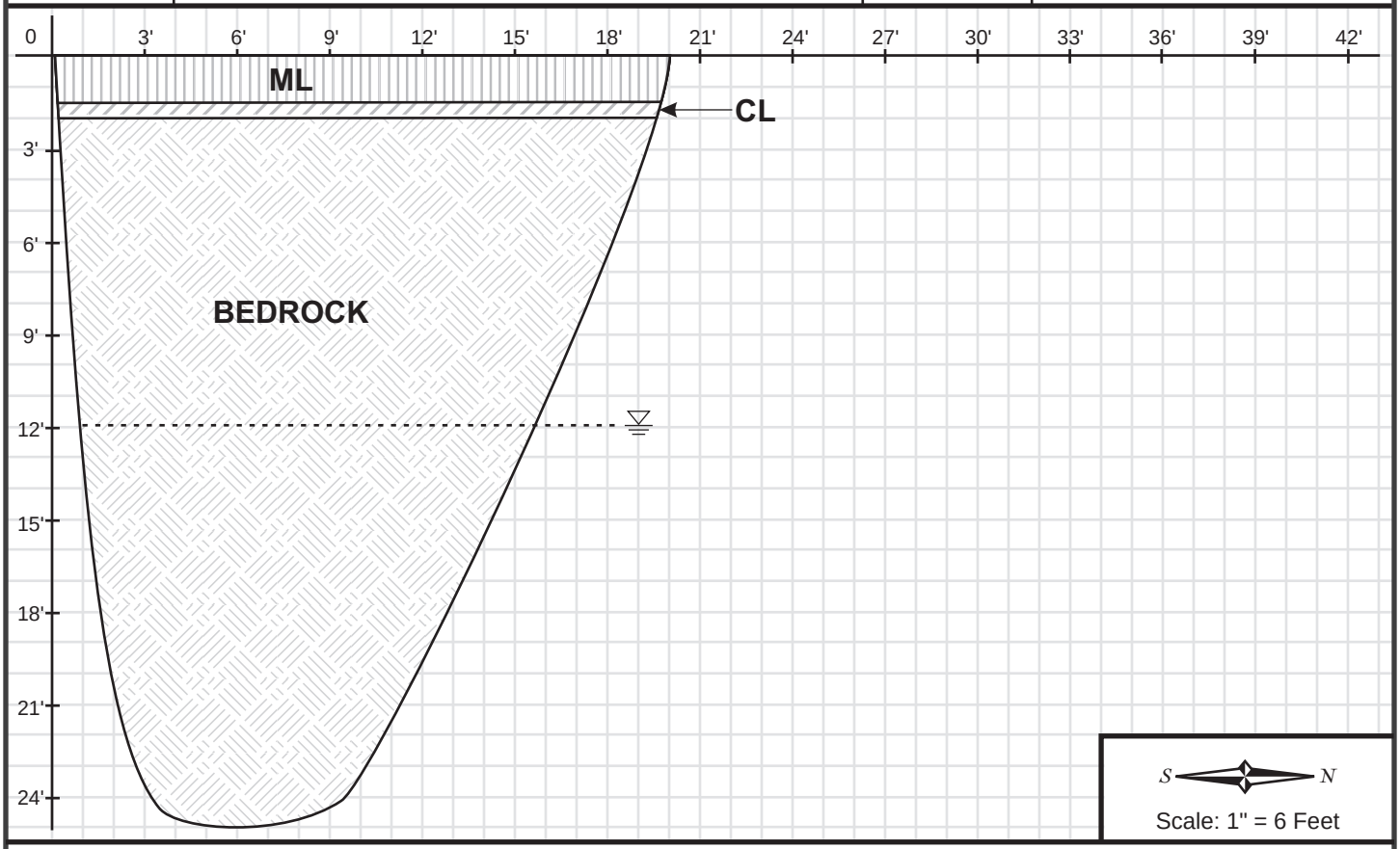


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-3**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **S - N**	**TP-2**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1.5'	Red brown sandy **SILT (ML)** with gravel and cobbles, stiff, slightly moist		
@ 1.5' - 2'	Yellow brown sandy **CLAY (CL)**, with gravel and cobbles, very stiff, slightly moist	**Rock** @ 10'	
@ 2' - 25'	Yellow brown to gray metavolcanic **BEDROCK**, highly to moderately weathered, well to highly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling	**Rock** @ 20'	
	Test pit terminated at 25' (max reach) Free water encountered at 12' Caving noted from 10' to 25'		

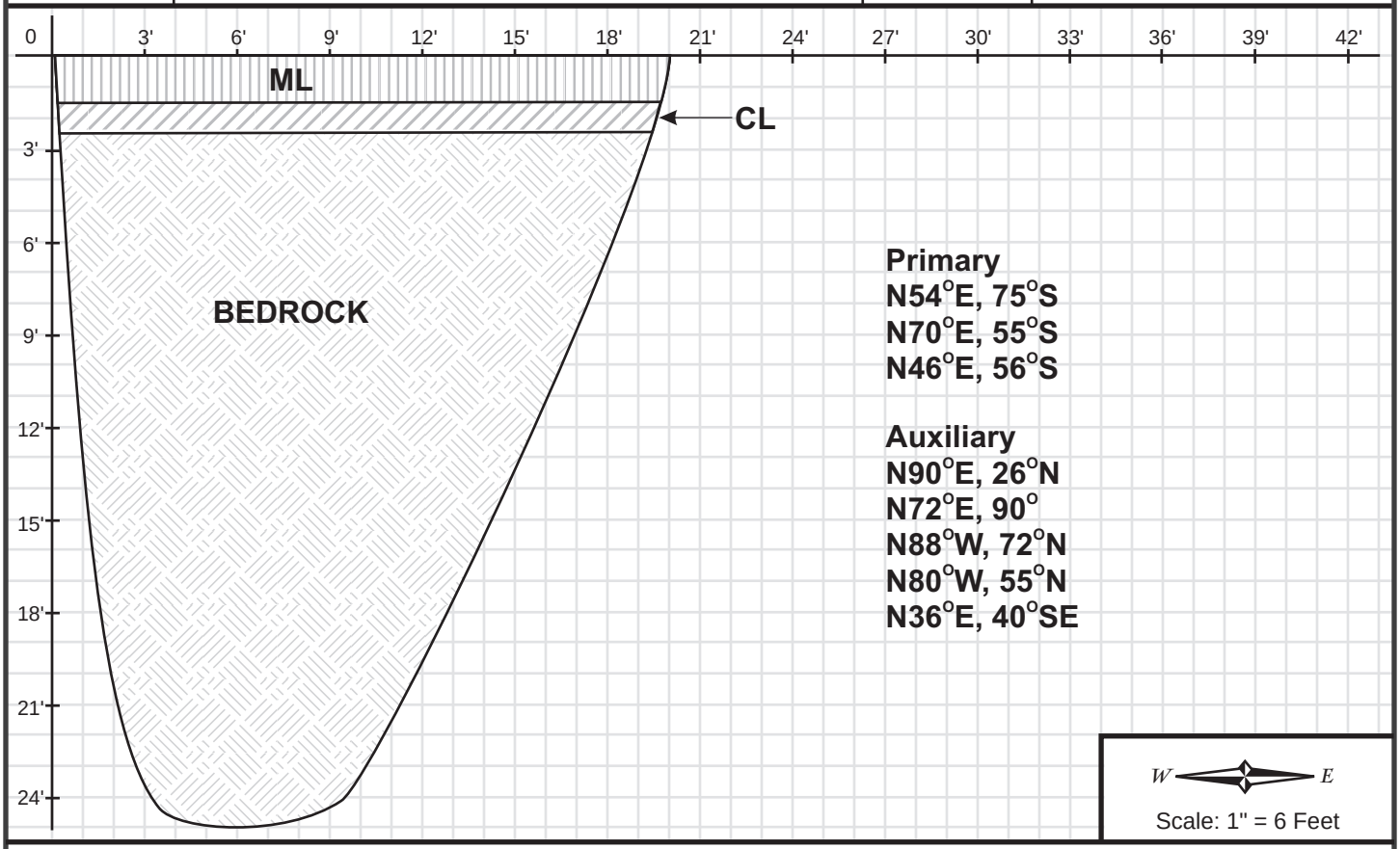


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215	**EXPLORATORY TEST PIT LOG**	**FIGURE**
	May 2002	**Broadstone 3 Retail Center** Folsom, California	**A-4**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	**TP-3**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1.5'	Red brown sandy **SILT (ML)** with gravel and cobbles, stiff, slightly moist	**Bulk 1** @ 0 - 1.5'	
@ 1.5' - 2.5'	Yellow brown sandy **CLAY (CL)**, with gravel and cobbles, very stiff, slightly moist	**Rock** @ 10'	
@ 2.5' - 15'	Yellow brown metavolcanic **BEDROCK**, highly to completely weathered, indurated, closely jointed, joints closed with black staining to open ¼" with clay filling	**Rock** @ 20'	
@ 15' - 25'	*Grades moderately weathered to highly weathered, indurated to well indurated, gray on fresh on surfaces*		
	Test pit terminated at 25' (max reach) No free water encountered Caving noted from 7' to 25'		

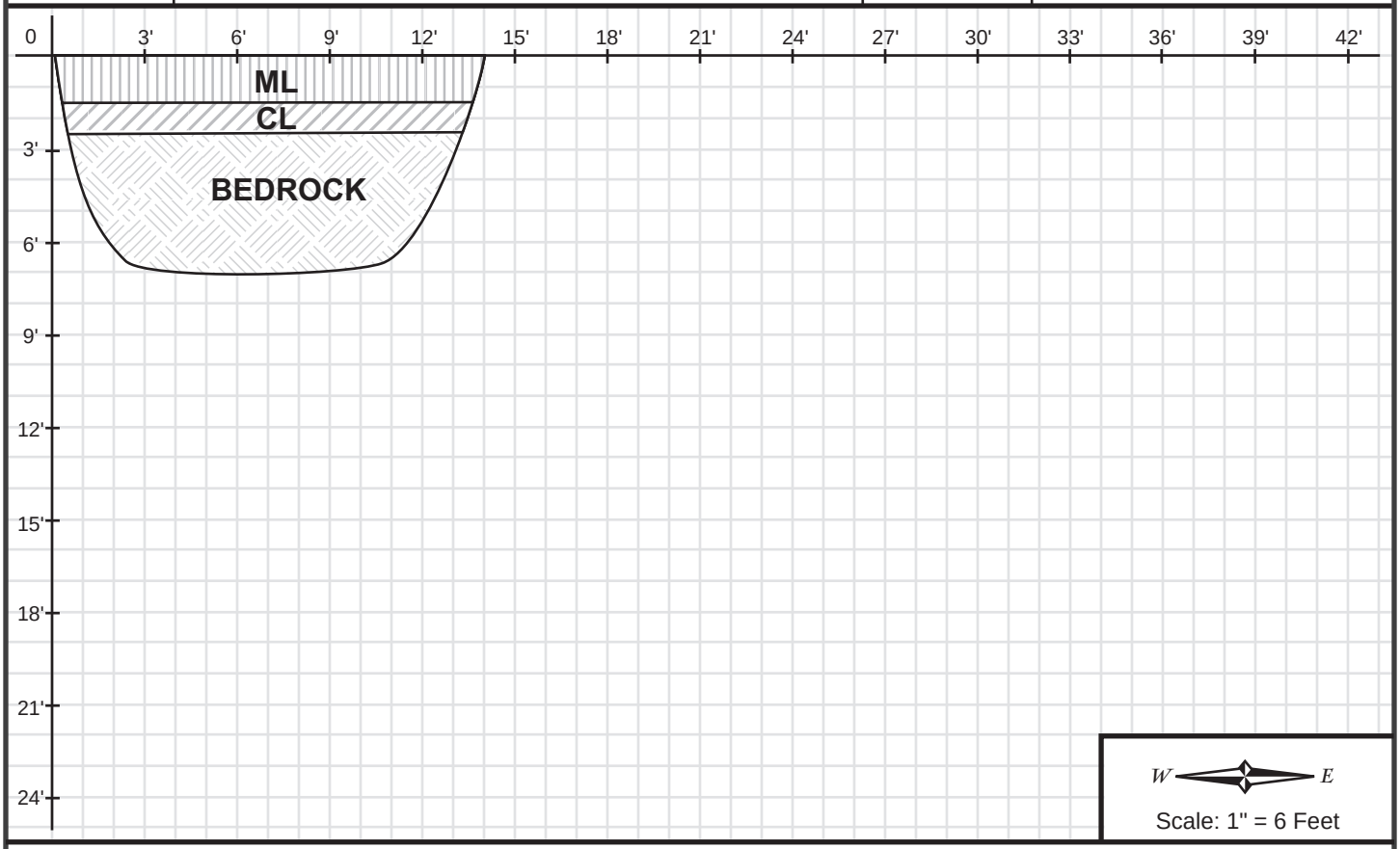


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-5**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No. **TP-4**
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1.5'	Red brown sandy **SILT (ML)** with gravel and cobbles, stiff, slightly moist		
@ 1.5' - 2.5'	Yellow brown sandy **CLAY (CL)**, with gravel and cobbles, very stiff, slightly moist		*Smoked the teeth for 5 min at 7'*
@ 2.5' - 7'	Yellow brown to gray metavolcanic **BEDROCK**, highly to moderately weathered, well to highly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
	Test pit terminated at 7' (practical refusal) No free water encountered No caving noted		*Less than 3"/min*



Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

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Project No.: 02215

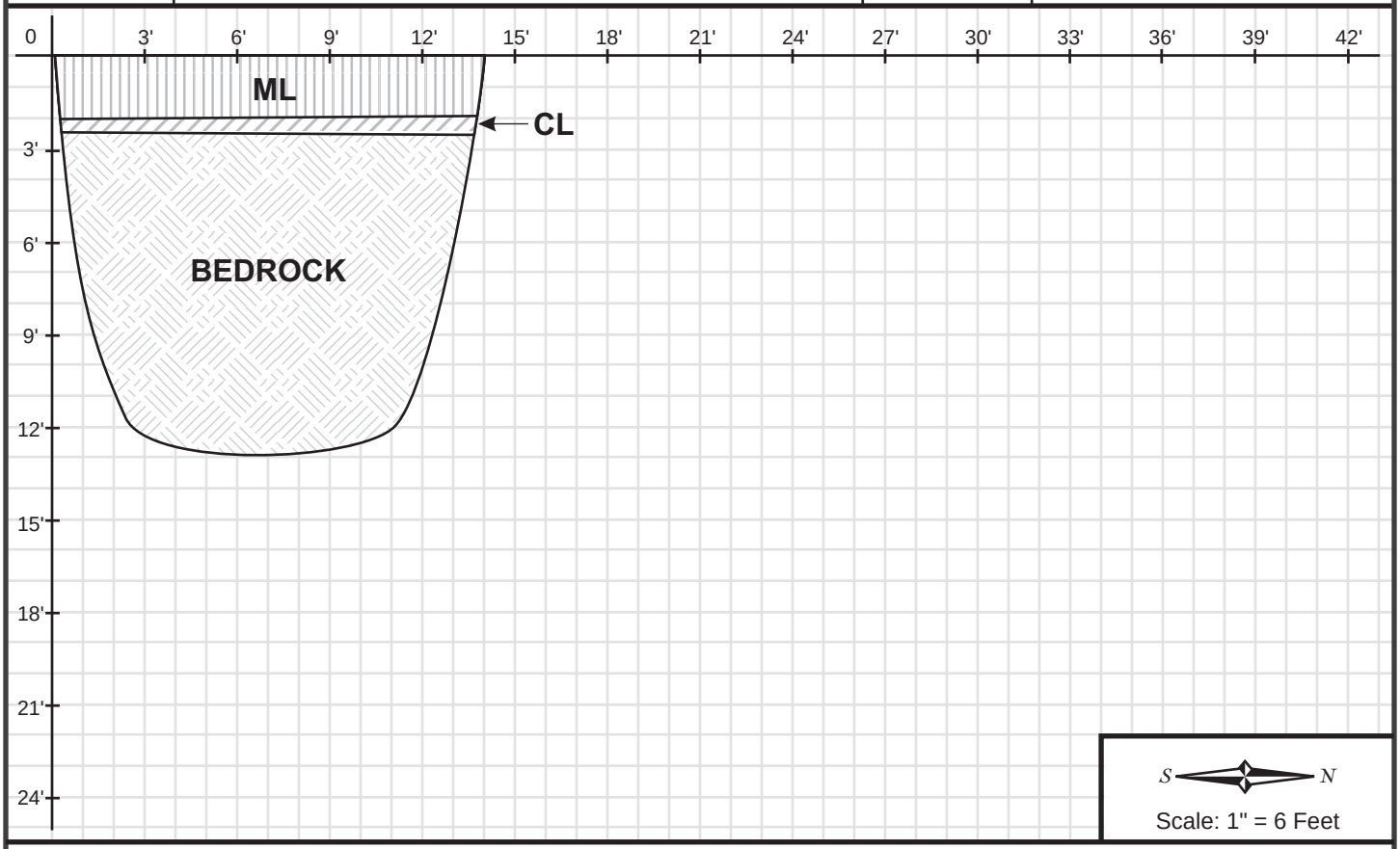
May 2002

EXPLORATORY TEST PIT LOG
Broadstone 3 Retail Center
Folsom, California

FIGURE A-6

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **S - N**	**TP-5**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 2'	Red brown sandy **SILT (ML)** with gravel and cobbles, stiff, slightly moist		**Field Moisture Density Test @ 0'** DD = 119.7 pcf MC = 7.1%
@ 2' - 2.5'	Yellow brown sandy **CLAY (CL)**, with gravel and cobbles, very stiff, slightly moist		
@ 2.5' - 13'	Yellow brown to gray metavolcanic **BEDROCK**, highly to moderately weathered, well to highly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
	Test pit terminated at 13' (practical refusal) No free water encountered No caving noted		

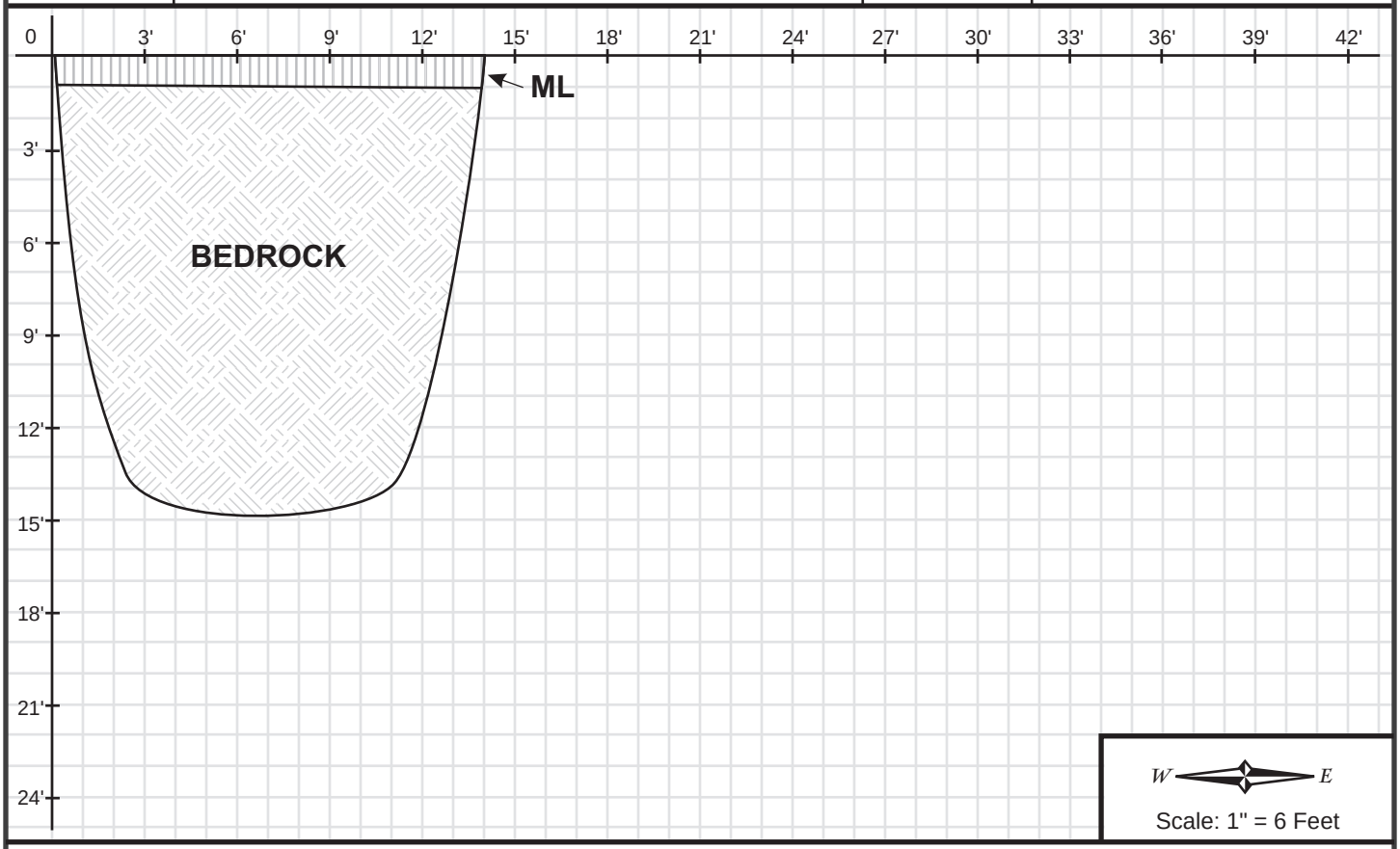


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-7**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	**TP-6**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1'	Red brown sandy **SILT (ML)** with gravel and cobbles, stiff, slightly moist		
@ 1' - 6'	Yellow brown metavolcanic **BEDROCK**, highly to completely weathered, indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
@ 6' - 15'	*Grades moderately to highly weathered, indurated to well indurated, gray on fresh surfaces*		
	Test pit terminated at 15' (practical refusal) No free water encountered Caving noted from 6' - 15'		



Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

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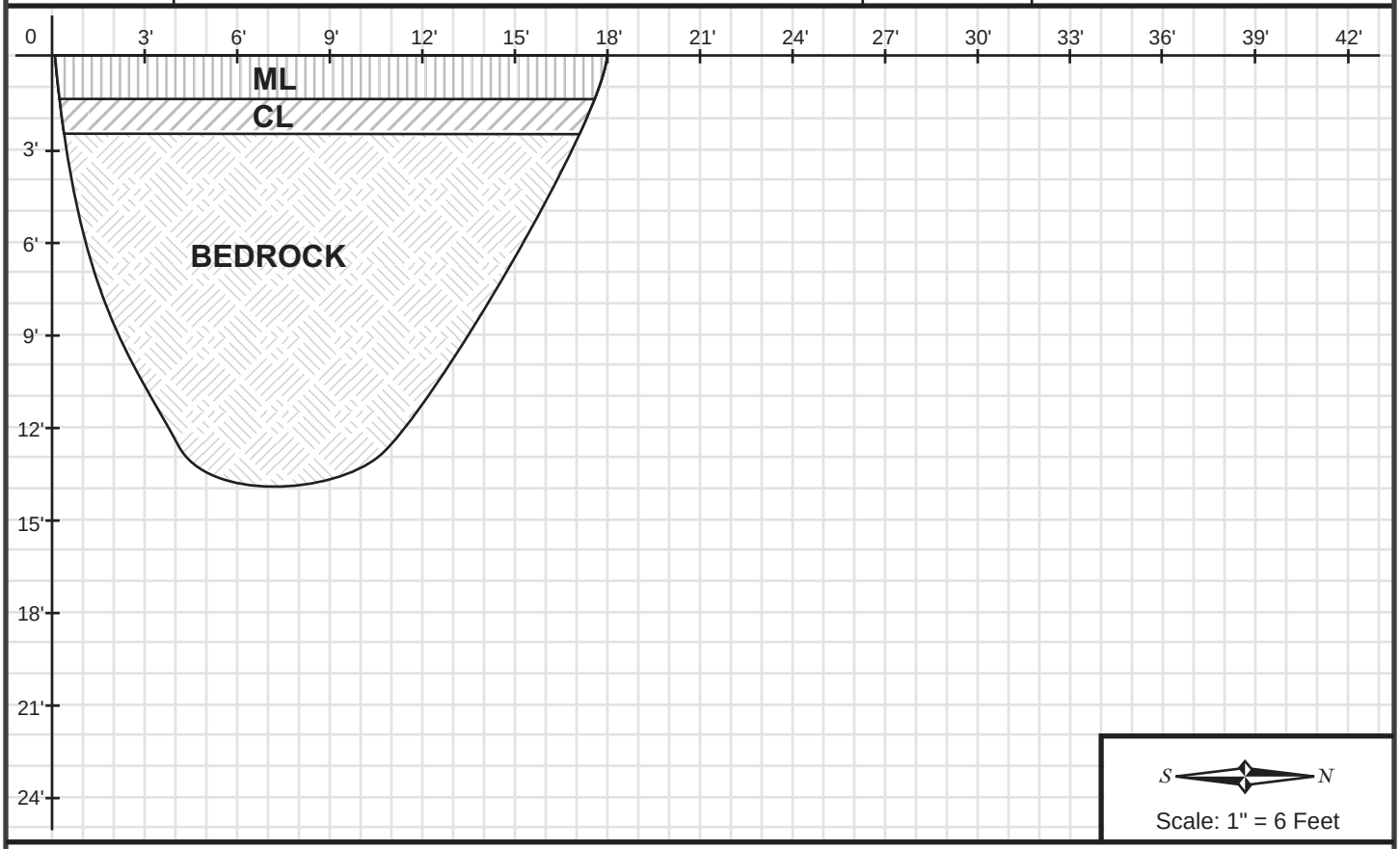
May 2002

EXPLORATORY TEST PIT LOG
Broadstone 3 Retail Center
Folsom, California

FIGURE
A-8

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **N - S**	**TP-7**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1.5'	Red brown sandy **SILT (ML)** with gravel and cobbles, stiff, slightly moist	**Bulk 2** @ 0 - 1.5'	
@ 1.5' - 2.5'	Yellow brown sandy **CLAY (CL)**, with gravel and cobbles, very stiff, slightly moist	**Bulk 3** @ 1.5'-2.5'	
@ 2.5' - 7'	Yellow brown metavolcanic **BEDROCK**, highly to completely weathered, indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
@ 7' - 14'	*Grades moderately to highly weathered, indurated to well indurated, gray on fresh surfaces*		
	Test pit terminated at 14' (practical refusal) No free water encountered No caving noted		

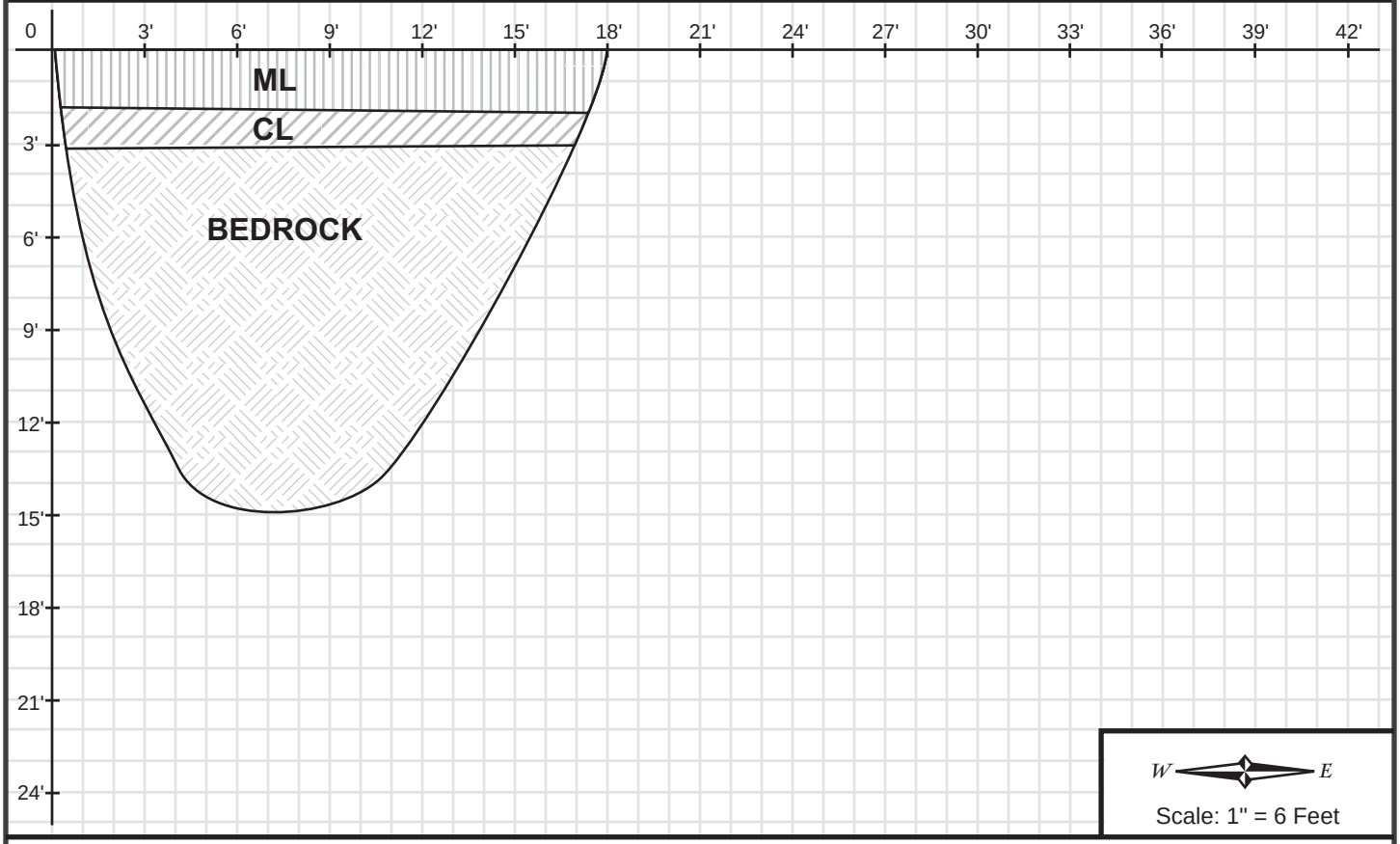


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-9**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	**TP-8**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 2'	Red brown sandy **SILT (ML)**, stiff, slightly moist		
@ 2' - 3'	Yellow brown sandy **CLAY (CL)**, very stiff, slightly moist		**Field Moisture Density Test @ 2'** DD = 99.4 pcf MC = 27.4%
@ 3' - 5'	Yellow brown metavolcanic **BEDROCK**, highly to completely weathered, indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
@ 5' - 15'	*Grades moderately to highly weathered, indurated to well indurated, gray on fresh surfaces*		
	Test pit terminated at 15' (practical refusal) No free water encountered Caving noted from 5' - 15'		

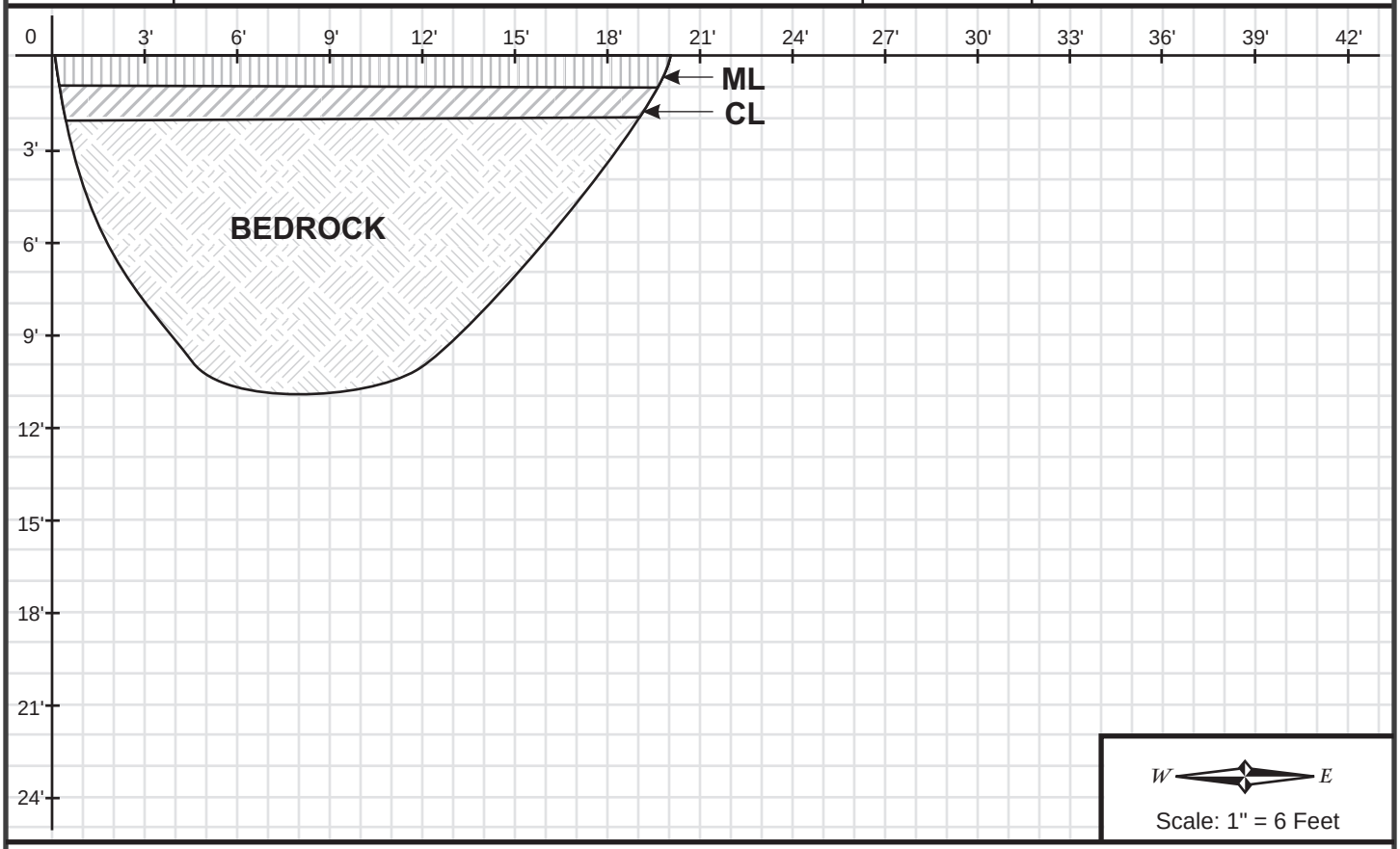


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-10**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	**TP-9**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1'	Red brown sandy **SILT (ML)**, stiff, slightly moist		**Field Moisture Density Test @ 0'** DD = 114.4 pcf MC = 8.6%
@ 1' - 2'	Yellow brown sandy **CLAY (CL)**, with gravel and cobbles, very stiff, slightly moist		
@ 2' - 11'	Yellow brown to gray metavolcanic **BEDROCK**, highly to moderately weathered, well to highly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
	Test pit terminated at 11' (practical refusal) No free water encountered Caving noted from 1' - 11'		

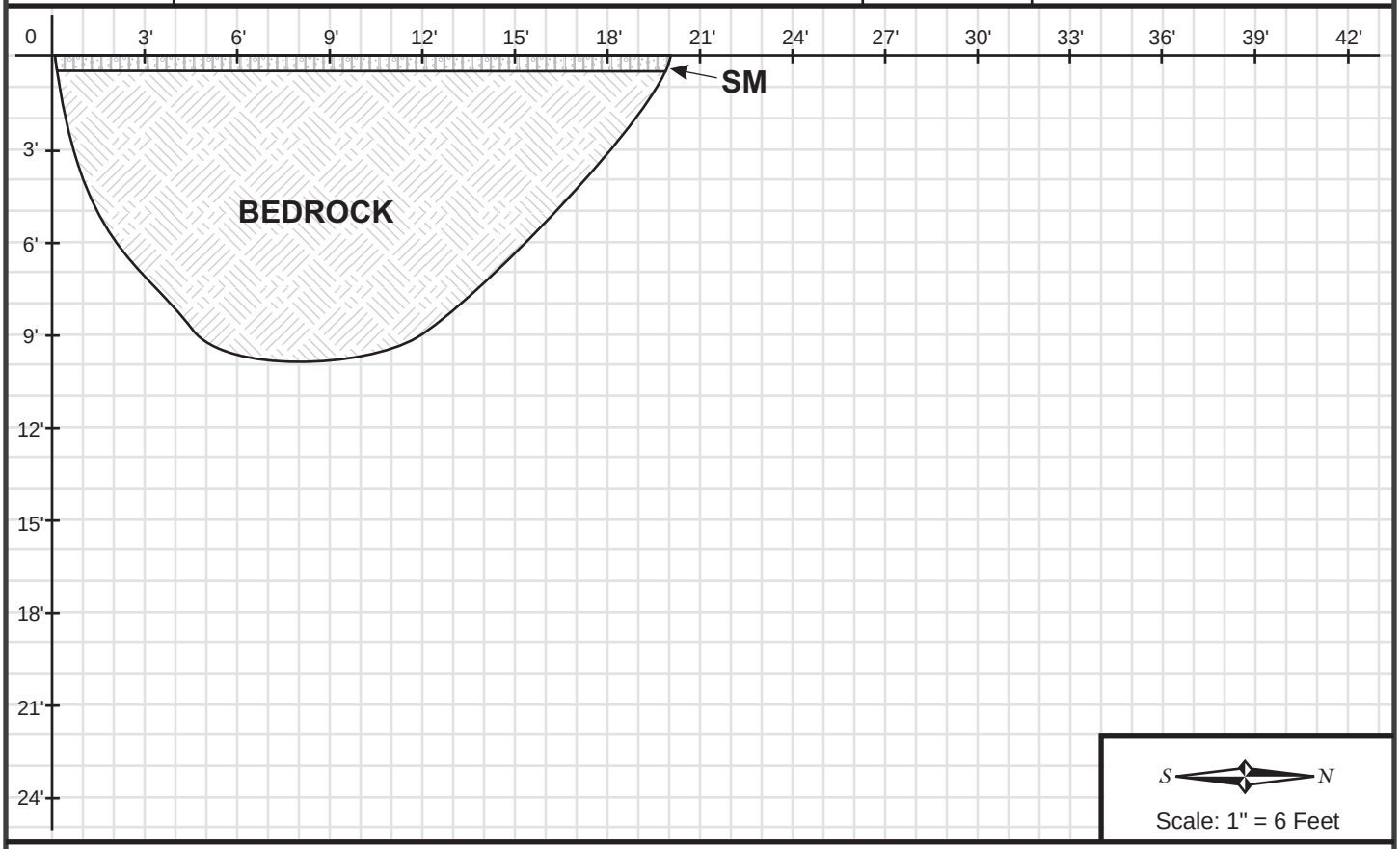


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-11**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **S - N**	**TP-10**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 0.5'	Brown silty **SAND (SM)** with gravel and occasional cobbles, loose, dry		
@ 0.5' - 10'	Yellow brown to gray metavolcanic **BEDROCK**, highly to moderately weathered, well to highly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
	Test pit terminated at 10' (practical refusal) No free water encountered No caving noted		

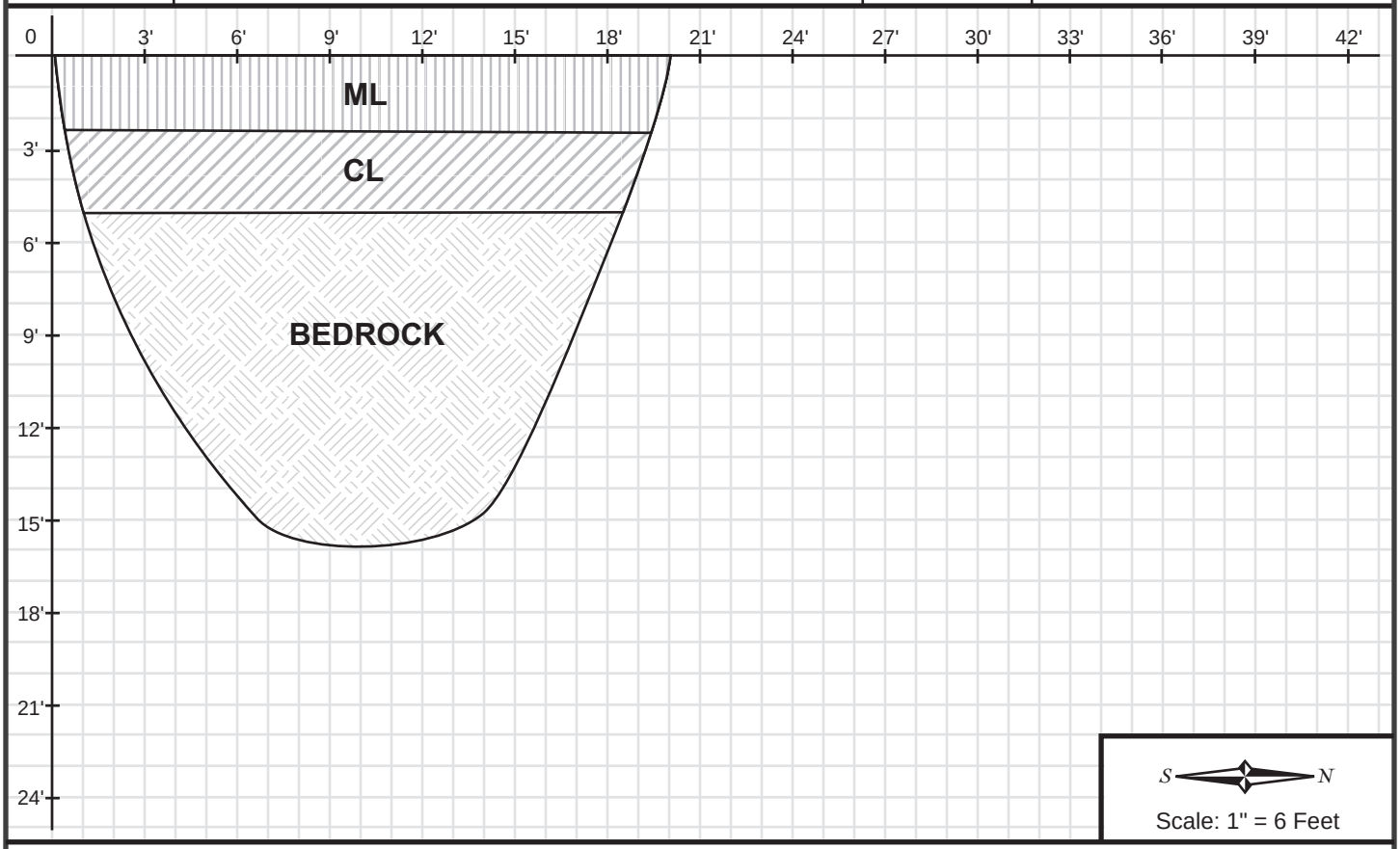


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-12**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **S - N**	**TP-11**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 2.5'	Red brown sandy **SILT (ML)**, stiff, slightly moist		**Field Moisture Density Test @ 0'** DD = 107.8 pcf MC = 13.4%
@ 2.5' - 5'	Yellow brown sandy **CLAY (CL)**, very stiff, slightly moist		
@ 5' - 7.5'	Olive brown metavolcanic **BEDROCK**, completely weathered, weakly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
@ 7.5' - 15'	*Grades highly weathered, indurated*		
@ 15' - 16'	*Grades moderately to highly weathered, well indurated, gray on fresh surfaces*		
	Test pit terminated at 16' (practical refusal) No free water encountered No caving noted		

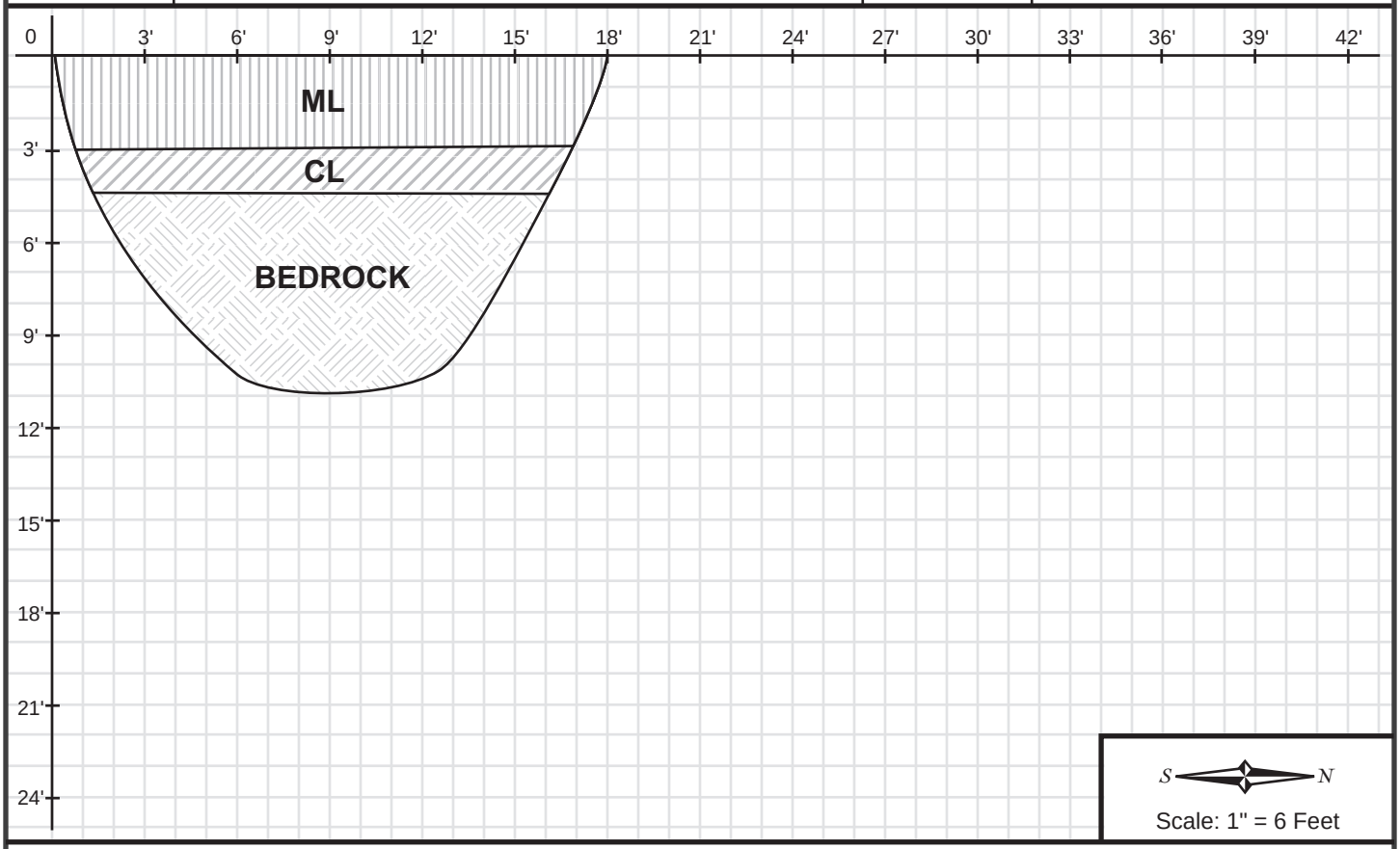


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-13**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **S - N**	**TP-12**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 3'	Red brown sandy **SILT (ML)**, stiff, slightly moist		**Field Moisture Density Test @ 0'** DD = 109.1 pcf MC = 10.8%
@ 3' - 4.5'	Yellow brown sandy **CLAY (CL)**, very stiff, slightly moist		
@ 4.5' - 7.5'	Yellow brown metavolcanic **BEDROCK**, completely weathered, weakly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
@ 7.5' - 10.5'	*Grades highly weathered, indurated*		
@ 10.5' - 11'	*Grades moderately to highly weathered, well indurated, gray on fresh surfaces*		
	Test pit terminated at 11' (practical refusal) No free water encountered Caving noted from 3' - 8'		

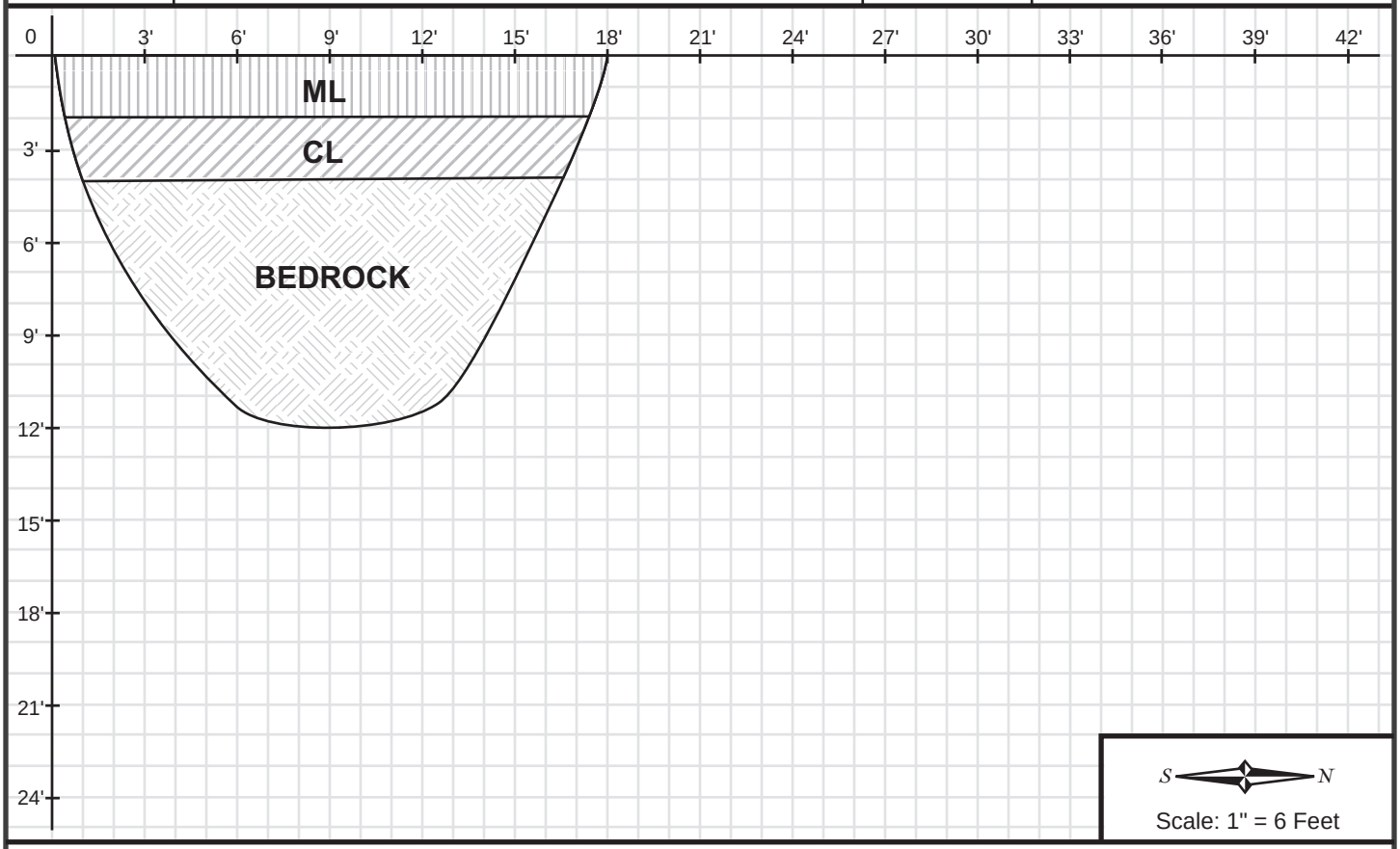


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-14**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **S - N**	**TP-13**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 2'	Red brown sandy **SILT (ML)**, stiff, slightly moist		**Field Moisture Density Test @ 0'** DD = 102.0 pcf MC = 15.9%
@ 2' - 4'	Yellow brown sandy **CLAY (CL)**, very stiff, slightly moist		
@ 4' - 6'	Yellow brown metavolcanic **BEDROCK**, completely weathered, weakly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
@ 6' - 11'	*Grades highly weathered, indurated*		
@ 11' - 12'	*Grades moderately to highly weathered, well indurated, gray on fresh surfaces*		
	Test pit terminated at 12' (practical refusal) No free water encountered Caving noted from 6' - 12'		

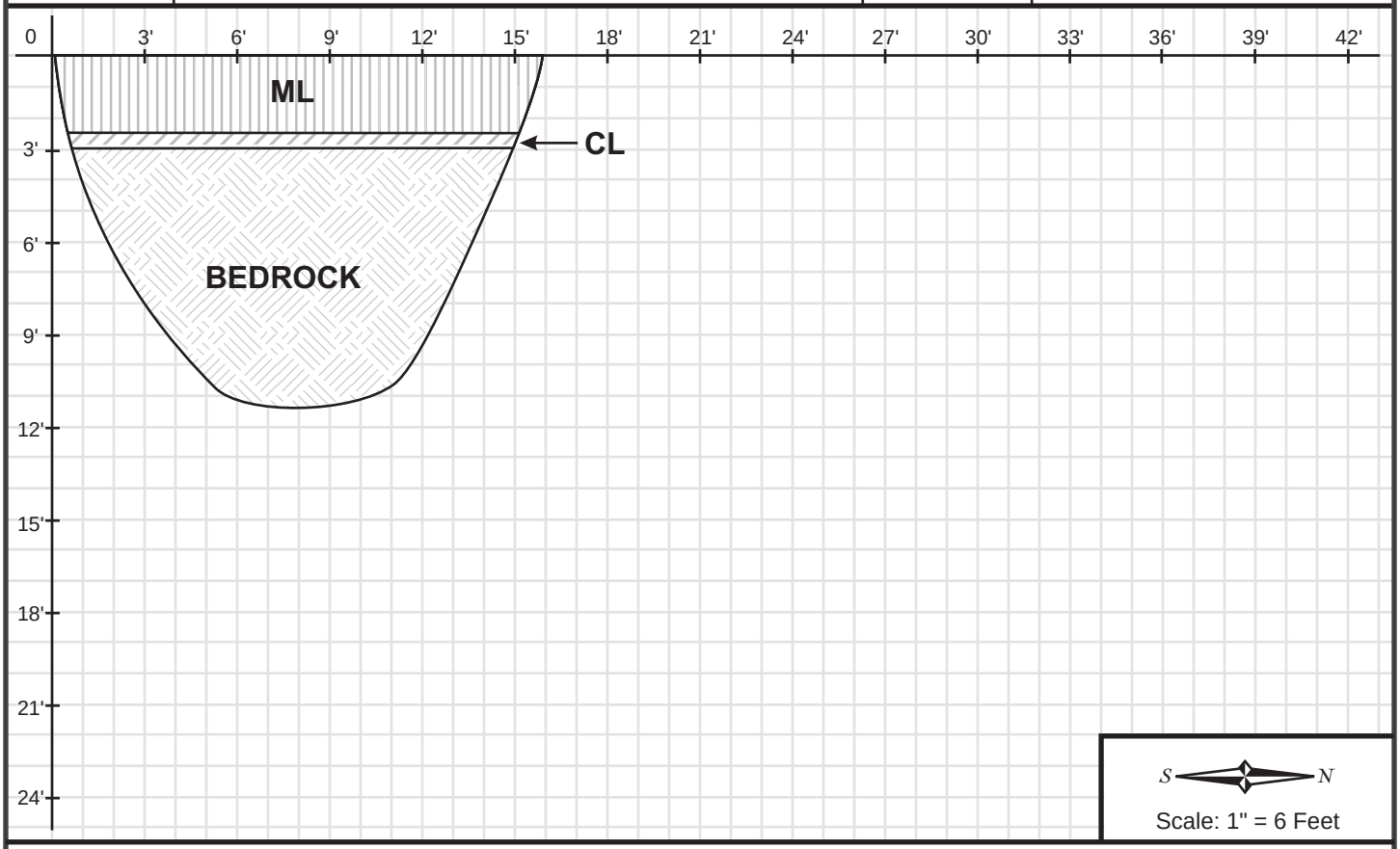


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-15**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **S - N**	**TP-14**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 2.5'	Red brown sandy **SILT (ML)**, stiff, slightly moist		
@ 2.5' - 3'	Yellow brown sandy **CLAY (CL)**, with gravel and cobbles, very stiff, slightly moist		
@ 3' - 11.5'	Yellow brown to gray metavolcanic **BEDROCK**, highly to moderately weathered, well to highly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
	Test pit terminated at 11.5' (practical refusal) No free water encountered Caving noted from 3' - 11.5'		

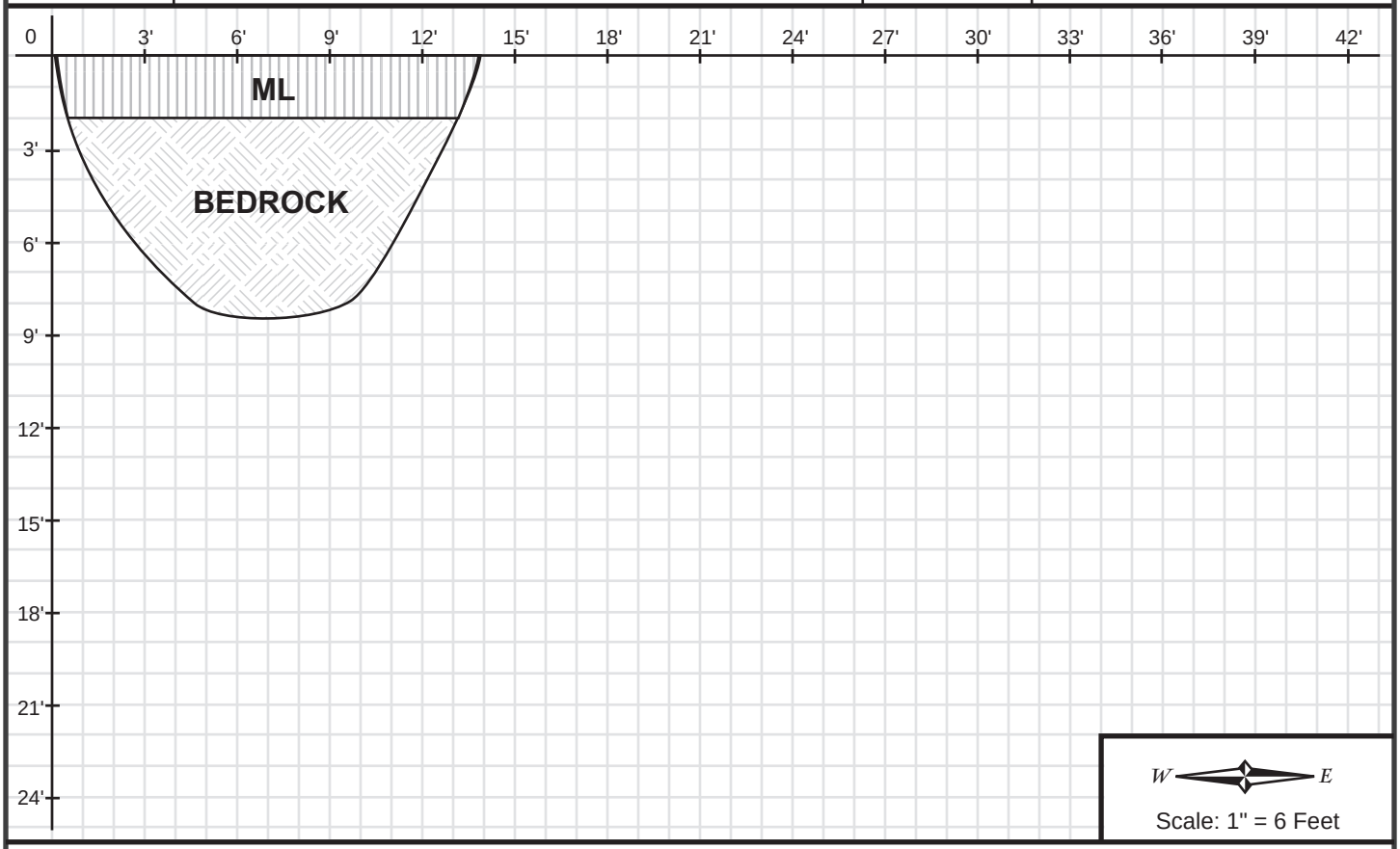


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215	**EXPLORATORY TEST PIT LOG**	**FIGURE**
	May 2002	**Broadstone 3 Retail Center** Folsom, California	**A-16**

Logged By: **KEM**	Date: **25 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	**TP-15**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 2'	Red brown sandy **SILT (ML)**, stiff, slightly moist		
@ 2' - 5.5'	Yellow brown metavolcanic **BEDROCK**, highly to completely weathered, indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
@ 5.5' - 8.5'	*Grades moderately to highly weathered, indurated to well indurated, gray on fresh surfaces*		
	Test pit terminated at 8.5' (practical refusal) No free water encountered No caving noted		

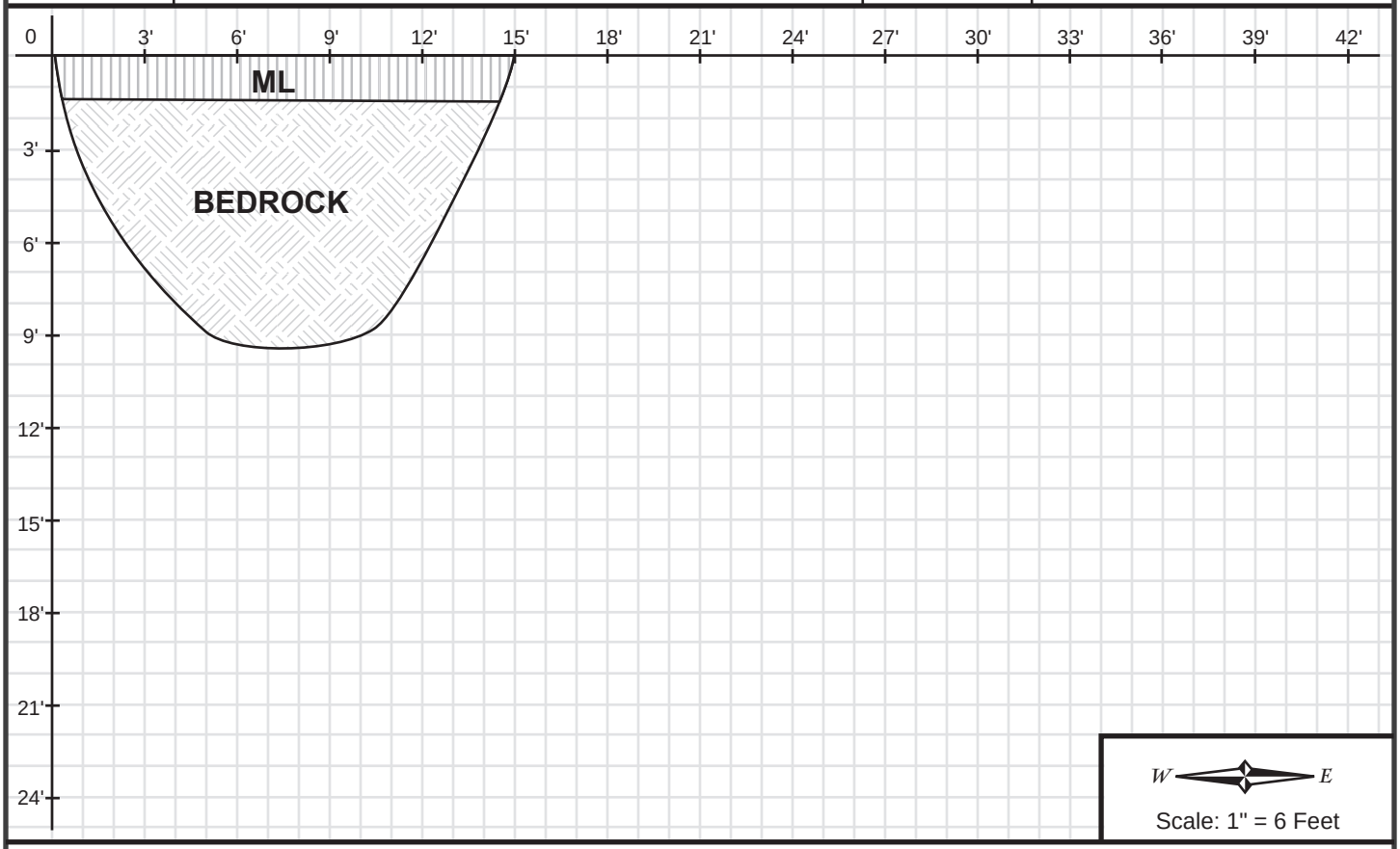


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-17**

Logged By: **KEM**	Date: **26 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	**TP-16**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1.5'	Red brown sandy **SILT (ML)** with gravel and cobbles, stiff, slightly moist		
@ 1.5' - 9.5'	Yellow brown to gray metavolcanic **BEDROCK**, highly to moderately weathered, well to highly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
	Test pit terminated at 9.5' (practical refusal) No free water encountered No caving noted		

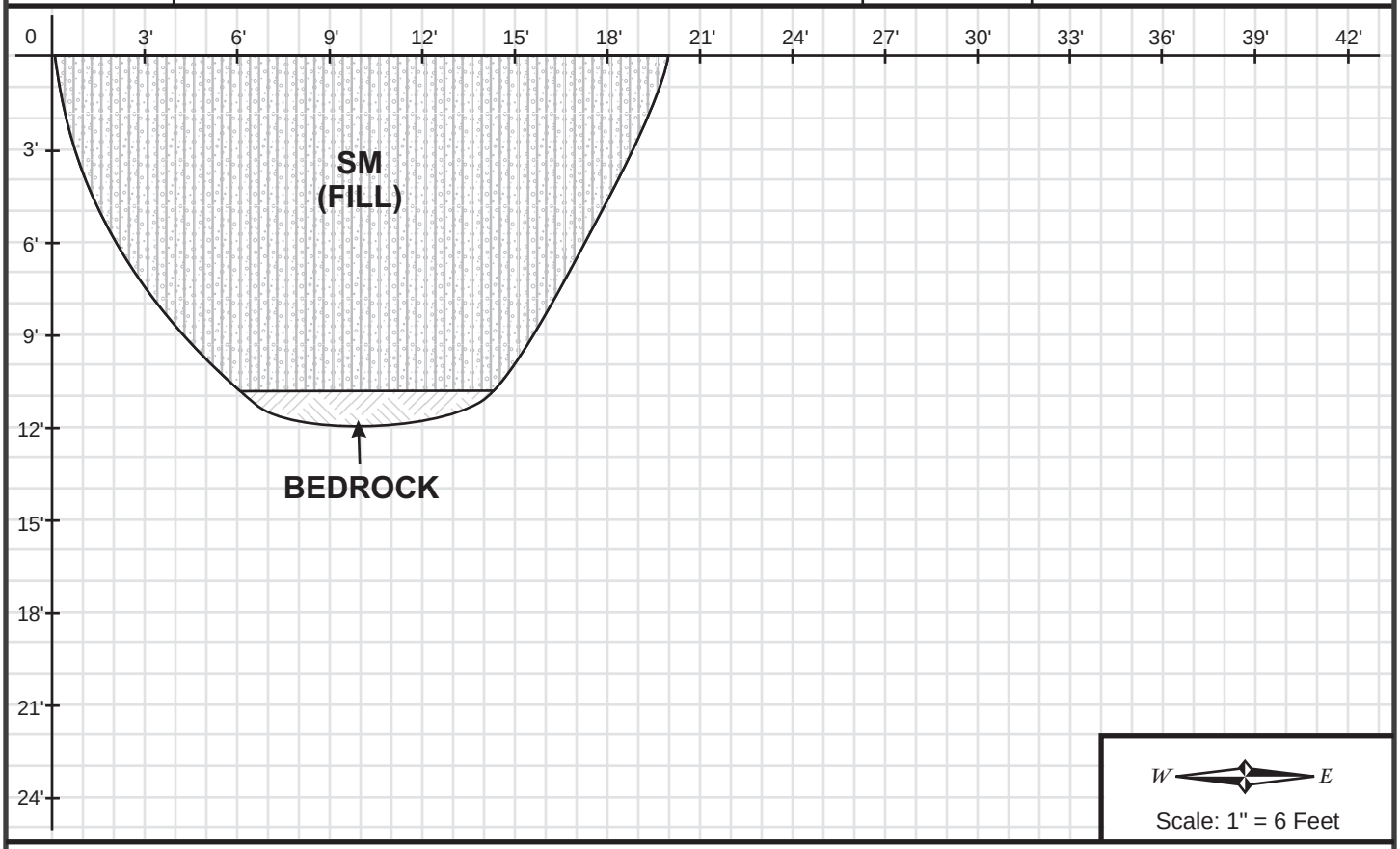


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-18**

Logged By: **KEM**	Date: **26 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	**TP-17**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 6'	Brown silty **SAND (SM)** with gravel and ~50% rock (3"-18"), loose, slightly moist (FILL)		
@ 6' - 11'	*Grades olive and red brown (FILL)*		
@ 11' - 12'	Yellow brown to gray metavolcanic **BEDROCK**, highly to moderately weathered, well to highly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
	Test pit terminated at 12' (practical refusal) No free water encountered Caving noted from 6' - 11'		

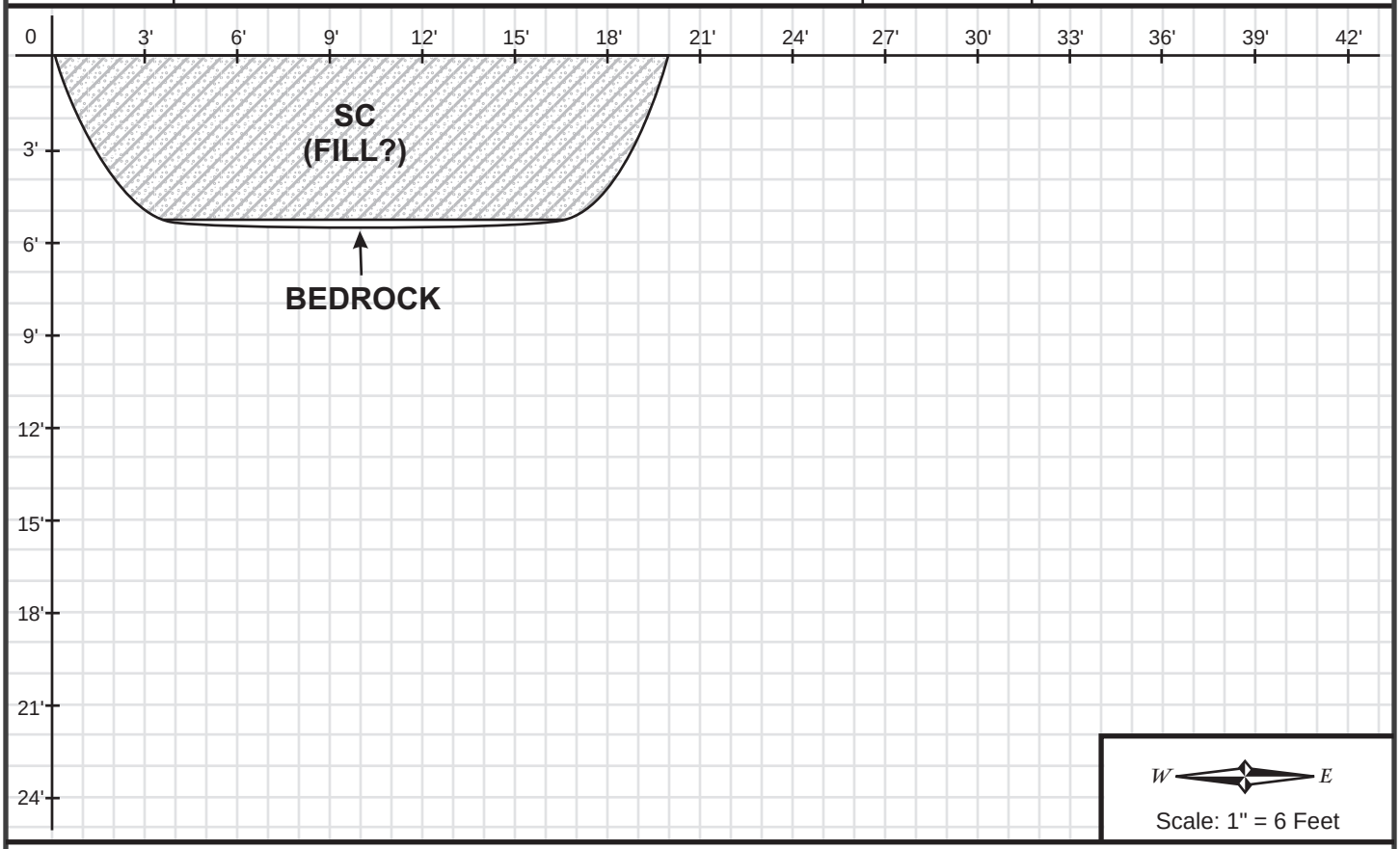


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215	**EXPLORATORY TEST PIT LOG**	**FIGURE**
	May 2002	**Broadstone 3 Retail Center** Folsom, California	**A-19**

Logged By: **KEM**	Date: **26 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	**TP-18**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 5.5'	Brown clayey **SAND (SC)** with gravel and occasional cobbles, loose, saturated (FILL?)		
@ 5.5'	Yellow brown to gray metavolcanic **BEDROCK**, highly to moderately weathered, well to highly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
	Test pit terminated at 5.5' (due to flowing mud) No free water encountered (mud from 1/2') Caving noted from 0 - 5.5'		

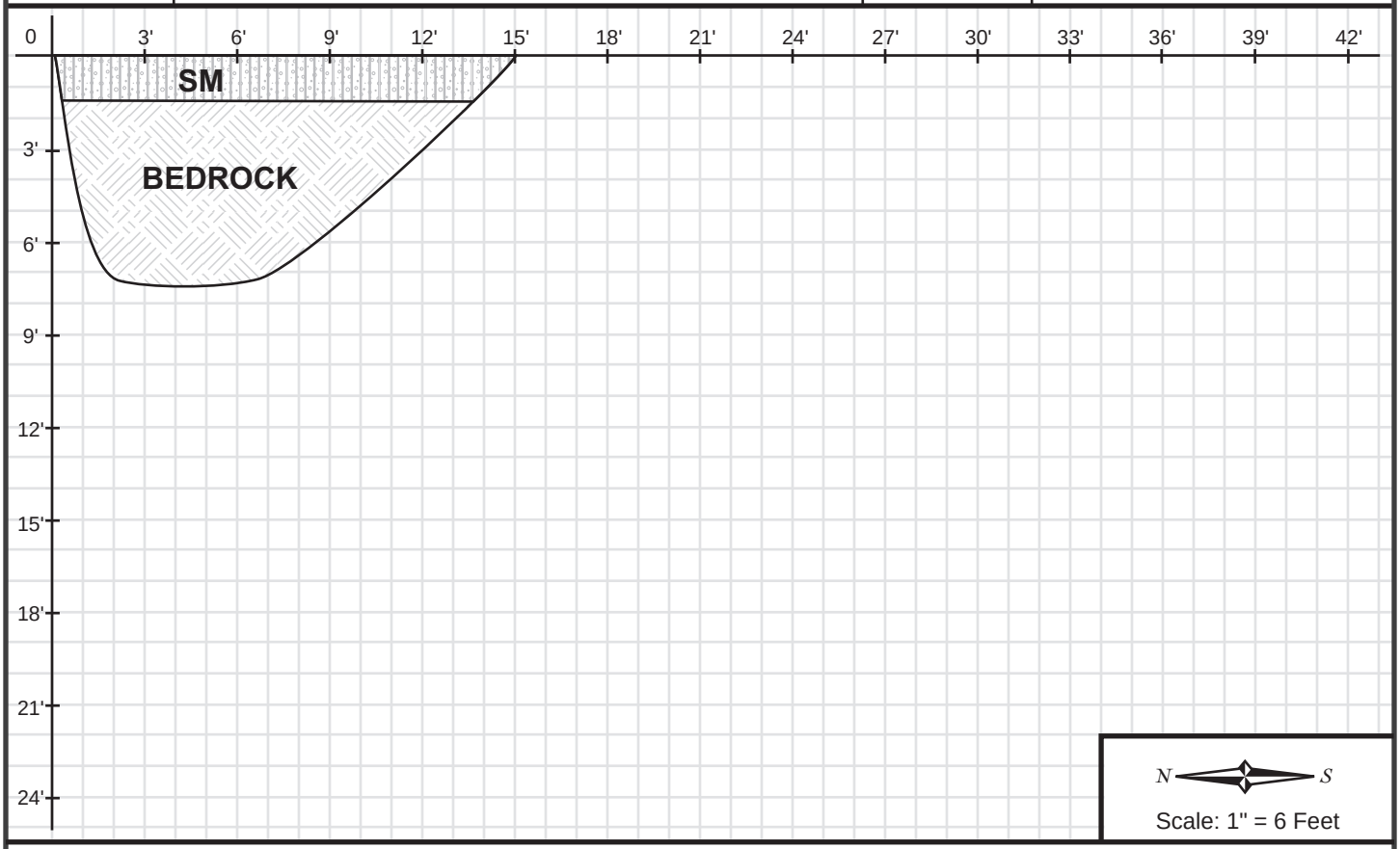


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-20**

Logged By: **KEM**	Date: **26 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **S - N**	**TP-19**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1.5'	Dark yellow brown silty **SAND (SM)** with gravel, cobbles, loose, dry		
@ 1.5' - 7.5'	Yellow brown to gray metavolcanic **BEDROCK**, highly to moderately weathered, well to highly indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
	Test pit terminated at 7.5' (practical refusal) No free water encountered Caving noted from 0' - 7.5'		

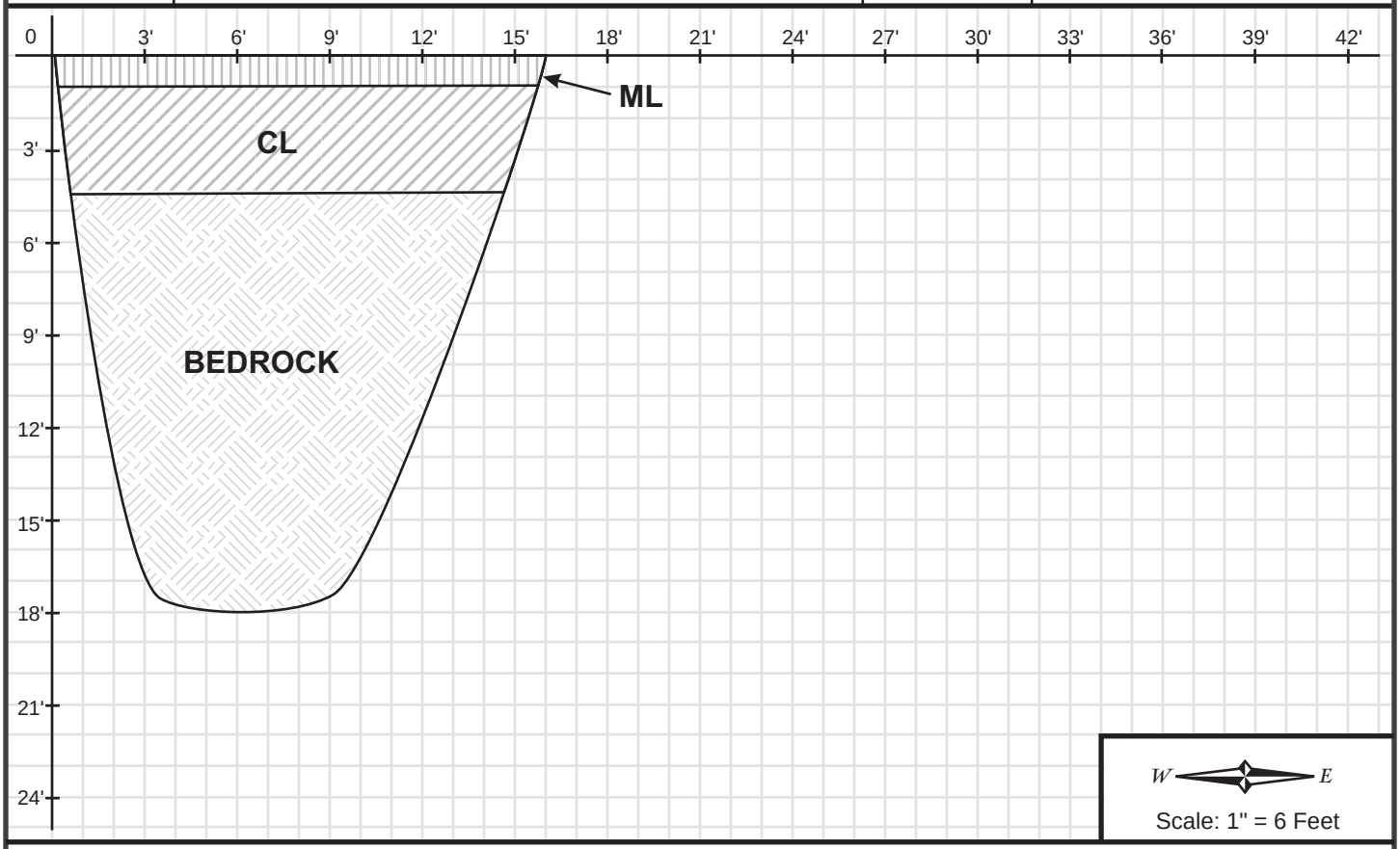


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-21**

Logged By: **KEM**	Date: **26 April 2002**	Elevation:	Pit No.
Equipment: **Komatsu PC400 with 28" bucket**		Pit Orientation: **W - E**	**TP-20**

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0 - 1'	Red brown sandy **SILT (ML)** with gravel and cobbles, stiff, slightly moist		
@ 1' - 4.5'	Yellow brown sandy **CLAY (CL)**, with gravel and cobbles, very stiff, slightly moist		
@ 4.5' - 6.5'	Yellow brown metavolcanic **BEDROCK**, highly to completely weathered, indurated, closely jointed, joints closed with black staining to open ¼" with clay filling		
@ 6.5' - 18'	*Grades moderately to highly weathered, indurated to well indurated, gray on fresh surfaces*		
	Test pit terminated at 18' (practical refusal) No free water encountered No caving noted		



Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

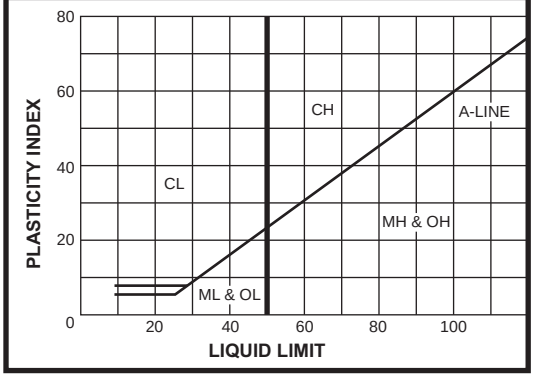
YOUNGDAHL CONSULTING GROUP, INC. GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING	Project No.: 02215 **May 2002**	**EXPLORATORY TEST PIT LOG** **Broadstone 3 Retail Center** Folsom, California	**FIGURE** **A-22**

UNIFIED SOIL CLASSIFICATION SYSTEMS

MAJOR DIVISION			SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS Over 50% > #200 sieve	**GRAVELS** Over 50% > #4 sieve	Clean **GRAVELS** With Little Or No Fines	GW	Well graded **GRAVELS**, **GRAVEL-SAND** mixtures
			GP	Poorly graded **GRAVELS**, **GRAVEL-SAND** mixtures
		GRAVELS With Over 12% Fines	GM	Silty **GRAVELS**, poorly graded **GRAVEL-SAND-SILT** mixtures
			GC	Clayey **GRAVELS**, poorly graded **GRAVEL-SAND-CLAY** mixtures
	SANDS Over 50% < #4 sieve	Clean **SANDS** With Little Or No Fines	SW	Well graded **SANDS**, gravelly **SANDS**
			SP	Poorly graded **SANDS**, gravelly **SANDS**
		SANDS With Over 12% Fines	SM	Silty **SANDS**, poorly graded **SAND-SILT** mixtures
			SC	Clayey **SANDS**, poorly graded **SAND-CLAY** mixtures
FINE GRAINED SOILS Over 50% < #200 sieve	**SILTS & CLAYS** Liquid Limit < 50		ML	Inorganic **SILTS**, silty or clayey fine **SANDS**, or clayey **SILTS** with plasticity
			CL	Inorganic **CLAYS** of low to medium plasticity, gravelly, sandy, or silty **CLAYS**, lean **CLAYS**
			OL	Organic **CLAYS** and organic silty **CLAYS** of low plasticity
	SILTS & CLAYS Liquid Limit > 50		MH	Inorganic **SILTS**, micaceous or diamacious fine sandy or silty soils, elastic **SILTS**
			CH	Inorganic **CLAYS** of high plasticity, fat **CLAYS**
			OH	Organic **CLAYS** of medium to high plasticity, organic **SILTS**
HIGHLY ORGANIC CLAYS			PT	PEAT & other highly organic soils

PLASTICITY CHART

USED FOR CLASSIFICATION OF FINE GRAINED SOILS



SAMPLE DRIVING RECORD

BLOWS PER FOOT	DESCRIPTION
25	25 Blows drove sampler 12 inches, after initial 6 inches of seating
50/7"	50 Blows drove sampler 7 inches, after initial 6 inches of seating
50/3"	50 Blows drove sampler 3 inches during or after initial 6 inches of seating

Note: To avoid damage to sampling tools, driving is limited to 50 blows per 6 inches during or after seating interval.

SOIL GRAIN SIZE

U.S. STANDARD SIEVE	6"	3"	¾"	4	10	40	200	
	BOULDER	COBBLE	GRAVEL		SAND			SILT / CLAY
			COARSE	FINE	COARSE	MEDIUM	FINE	
SOIL GRAIN SIZE IN MILLIMETERS	150	75	19	4.75	2.0	.425	0.075	0.002

KEY TO TEST DATA

- Standard Penetration test
- 2.5" O.D. Modified California Sampler
- 3" O.D. Modified California Sampler
- Shelby Tube Sampler
- 2.5" Hand Driven Liner
- Bulk Sample
- Water Level At Time Of Drilling
- Water Level After Time Of Drilling
- P — Perched Water

KEY TO TEST DATA

- Water Seepage
- MD — Moisture Density Test

NFWE	No Free Water Encountered
FWE	Free Water Encountered
REF	Sampling Refusal
DD	Dry Density (pcf)
MC	Moisture Content (%)
LL	Liquid Limit
PI	Plasticity Index
PP	Pocket Penetrometer
UCC	Unconfined Compression (ASTM D2166)
TVS	Pocket Torvane Shear
EI	Expansion Index (ASTM D4829)
Su	Undrained Shear Strength

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Project No.: 02215

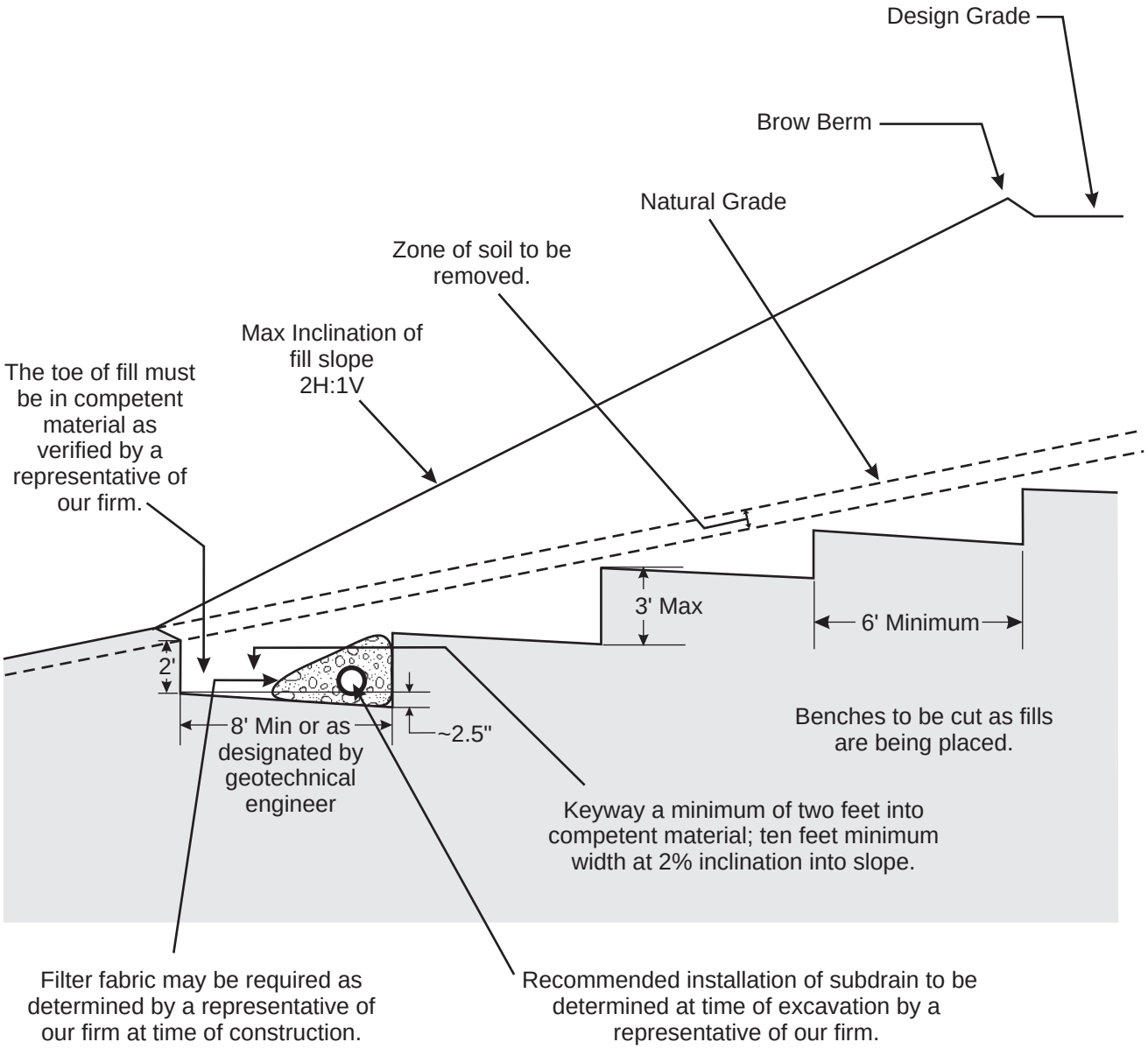
May 2002

SOIL CLASSIFICATION CHART & LOG EXPLANATION
Broadstone 3 Retail Center
Folsom, California

FIGURE A-23

PLACEMENT OF FILL ON NATURAL SLOPE

All keyways should be observed and approved prior to placement of fill.
A keyway is required by UBC for fills on natural slopes of 5H:1V or steeper.



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Project No.: 02215

May 2002

KEYWAY DETAIL - TYPICAL
Broadstone 3 Retail Center
Folsom, California

FIGURE
A-24

APPENDIX B

Laboratory Testing

Direct Shear Test
Atterberg Limit Test
Modified Proctor Tests
R-Value Test

Introduction

Our laboratory testing program for this evaluation included numerous visual classifications, Direct Shear, Atterberg Limit, Modified Proctor, and Resistence Value tests. The following paragraphs describe our procedures associated with each type of test. Graphical results of certain laboratory tests are enclosed in this appendix. The contents of this appendix shall be integrated with the geotechnical engineering study of which it is a part. They shall not be used in whole or in part as a sole source for information or recommendations regarding the subject site.

Laboratory Testing

Visual Classification Procedures

Visual soil classifications were conducted on all samples in the field and on selected samples in our laboratory. All soils were classified in general accordance with the United Soil Classification System, which includes color, relative moisture content, primary soil type (based on grain size), and any accessory soil types. The resulting soil classifications are presented on the exploration logs in Appendix A.

Soil Strength Determination Procedures

The strength parameters of the foundation soils were based on direct shear tests (ASTM D3080-90) performed on a representative remolded sample of the near-surface soils. The results of these tests are presented on Figure B-1, this Appendix.

Atterberg Limit Determination Procedures

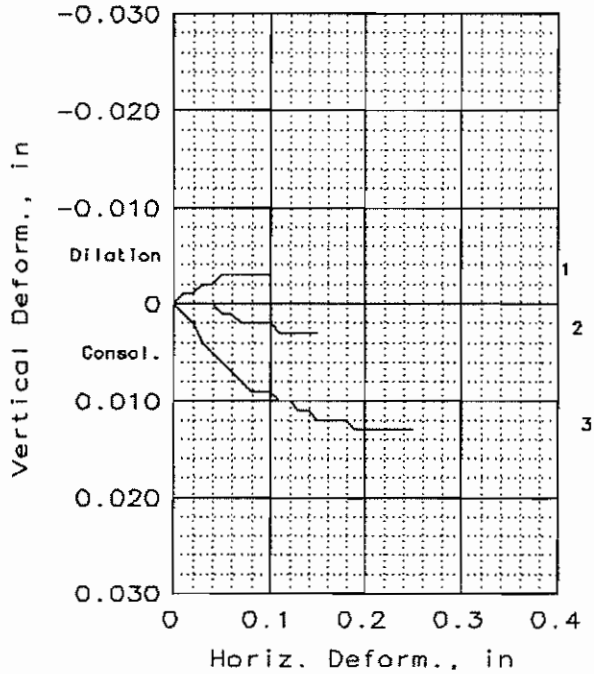
Atterberg limits are used primarily for classifying and indexing cohesive soils. The liquid and plastic limits, which are defined as the moisture contents of a cohesive soil at arbitrarily established limits for liquid and plastic behavior, respectively, were determined for a selected sample in general accordance with ASTM D-423 and ASTM D-414. The results of this test is presented on the enclosed Atterberg limit graphs Figures B-2, this Appendix.

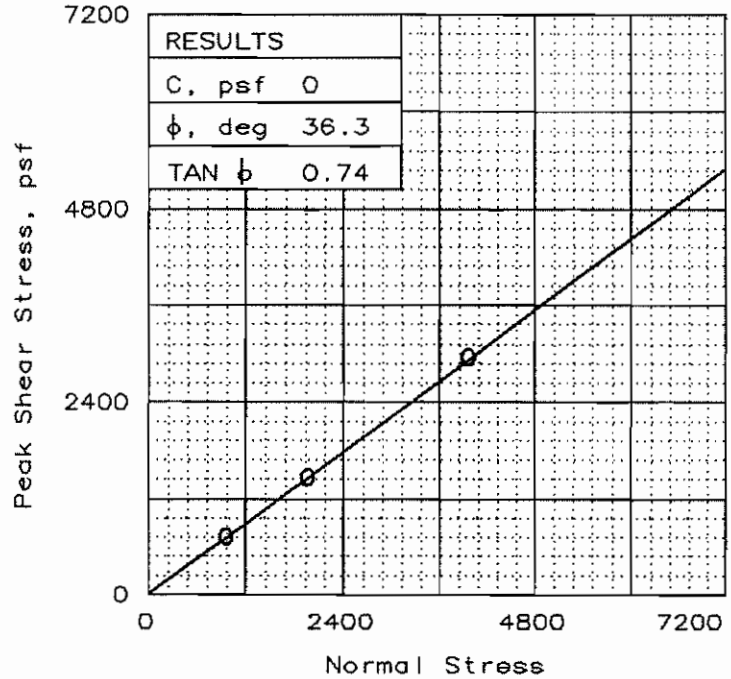
Maximum Dry Density Determination Procedures

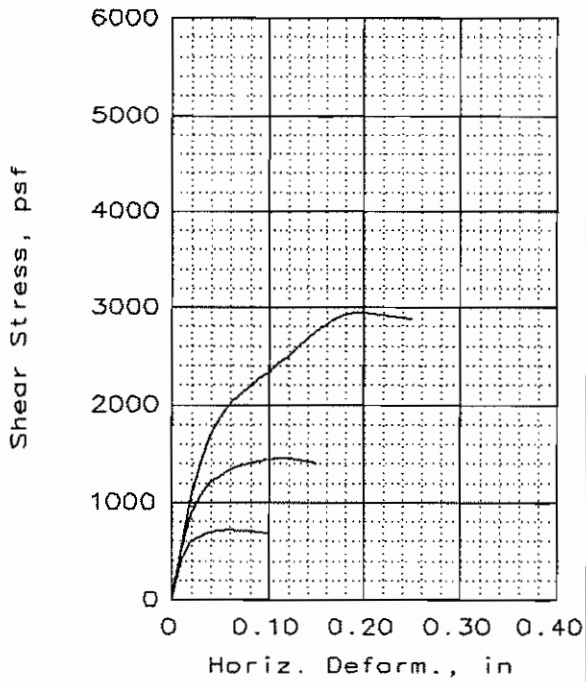
A modified Proctor Test (ASTM D1557-91A) was conducted to provide the optimum moisture and maximum dry density on the near surface material. The results of this test is presented on Figures B-3 through B-9, this Appendix.

Resistance Value Determination Procedures

R-Value tests (California Test Method 301 - F) were performed to obtain asphalt concrete pavement design parameters. The results of this test is presented on Figure B-10, this Appendix







SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	11.1	11.1	11.1
	DRY DENSITY, pcf	116.5	116.5	116.5
	SATURATION, %	65.6	65.6	65.6
	VOID RATIO	0.463	0.463	0.463
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	1.00	1.00	1.00
AT TEST	WATER CONTENT, %	17.0	16.6	15.8
	DRY DENSITY, pcf	116.4	117.2	119.0
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.464	0.454	0.432
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	1.00	0.99	0.98
NORMAL STRESS, psf		1000	2000	4000
MAXIMUM SHEAR, psf		726	1459	2950
RESIDUAL SHEAR, psf				
Strain rate, %/min		0.001	0.001	0.001

SAMPLE DATA

SAMPLE TYPE: REMOLDED

DESCRIPTION: Red Brn Sandy SILT w/trace clay & little gravel

LL= PL= PI=

SPECIFIC GRAVITY= 2.73

REMARKS:

CLIENT:

PROJECT: BROADSTONE 3 RETAIL CENTER

SAMPLE LOCATION: BULK 1 & 2

PROJ. NO.: 02215 DATE: 5/1/02

DIRECT SHEAR TEST REPORT

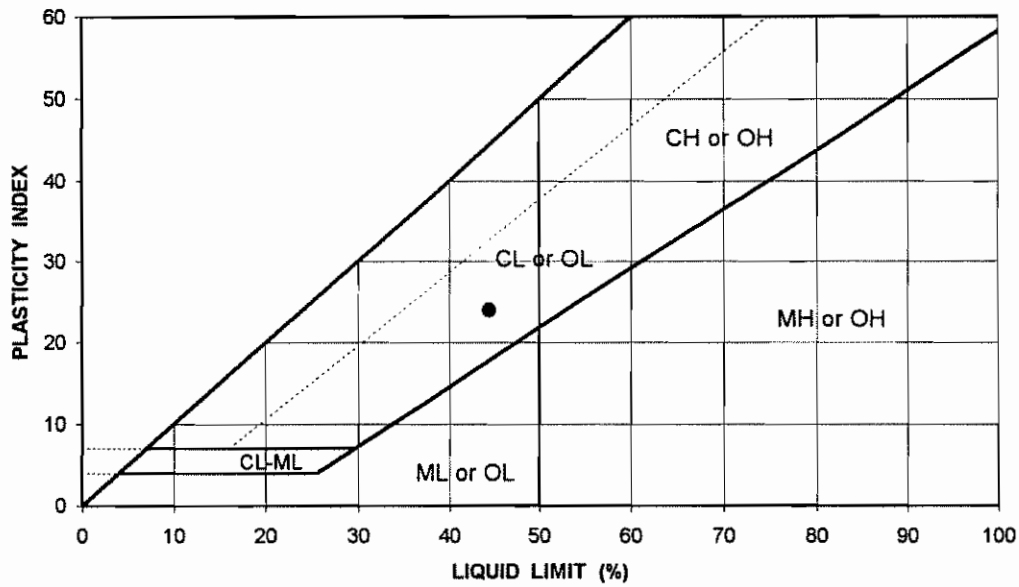
YOUNGDAHL & ASSOCIATES, INC.

FIG. NO. B-1

ATTERBERG LIMIT TEST (ASTM D4318)

SAMPLE NO.: TP-7, BULK 3 DEPTH:

SAMPLE DESCRIPTION: Yellow Brown Silty CLAY



LIQUID LIMIT (%):	44
PLASTIC LIMIT (%):	20
PLASTICITY INDEX:	24
CLASSIFICATION:	CL

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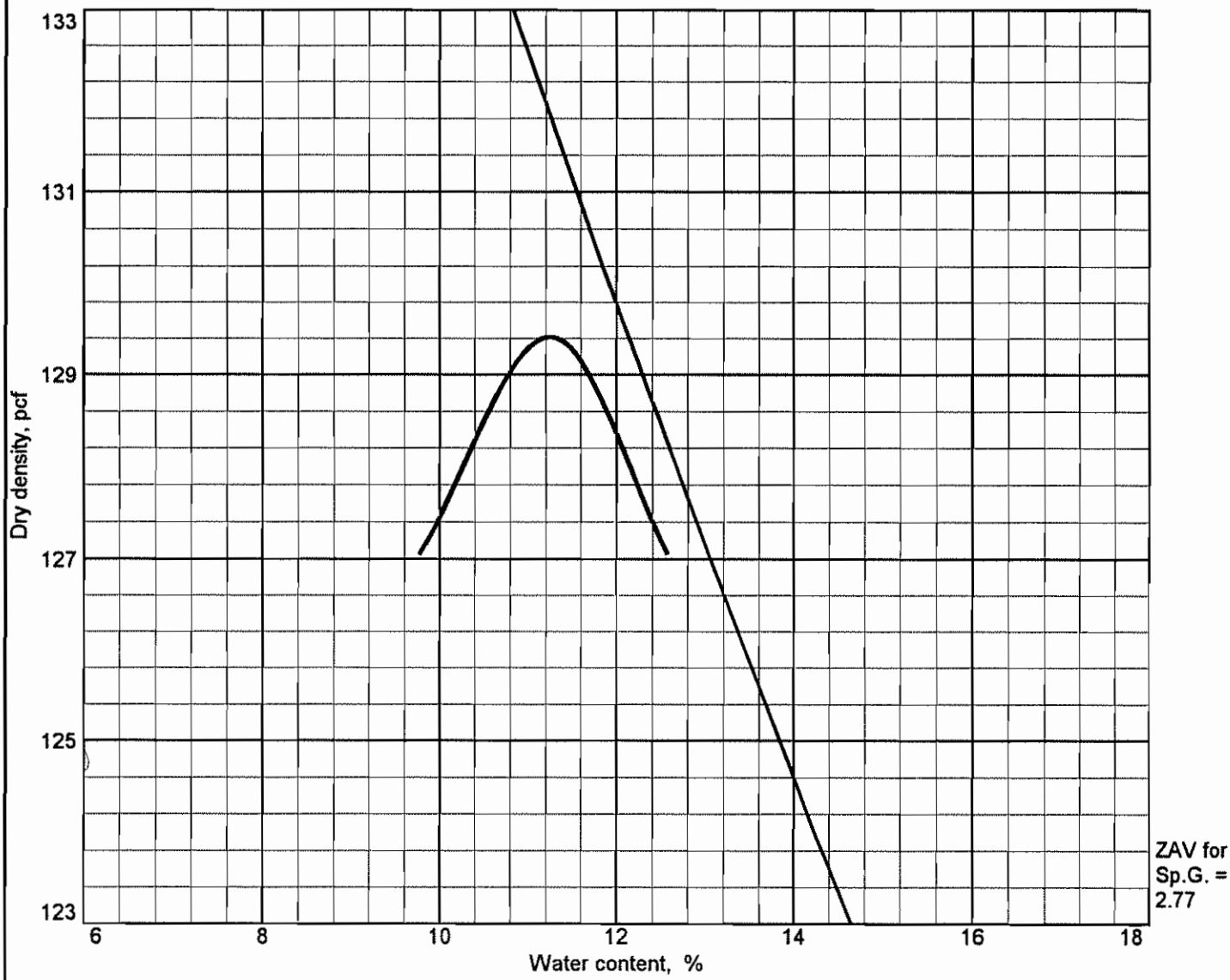
BROADSTONE 3 RETAIL CENTER
Folsom, California

PROJECT NO	DATE
02215	May 2002

FIGURE NO
B-2

COMPACTION CURVE REPORT



Test specification: ASTM D 1557-91 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	ML			2.73				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 129.4 pcf Optimum moisture = 11.3 %	Red Brown Sandy SILT w/trace clay & little gravel

Project No. 02215 **Client:**

Project: BROADSTONE 3 RETAIL CENTER

● **Source:** NATIVE MAT'L **Sample No.:** BK 1 & 2

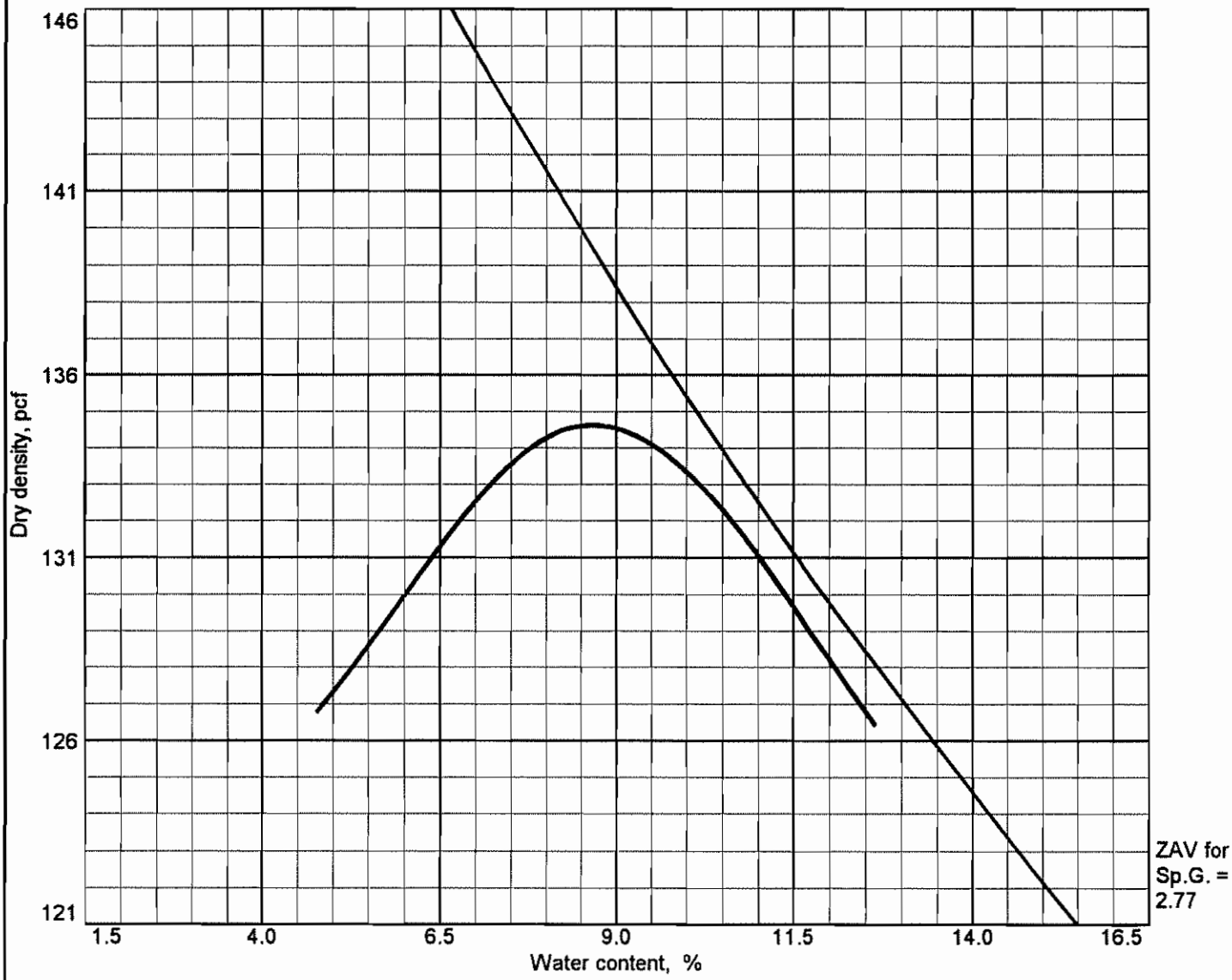
Remarks:

COMPACTION CURVE REPORT

YOUNGDAHL CONSULTING GROUP, INC.

Figure Number B-3

COMPACTION CURVE REPORT



Test specification: ASTM D 1557-91 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
10'	GM			2.73				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 134.6 pcf Optimum moisture = 8.7 %	Yellow Brown Silty GRAVEL w/sand

Project No. **Client:**

Project: BROADSTONE 3 RETAIL CENTER

● **Source:** NATIVE MAT'L **Sample No.:** TP-1 @ 10' **Elev./Depth:** 10'

Remarks:

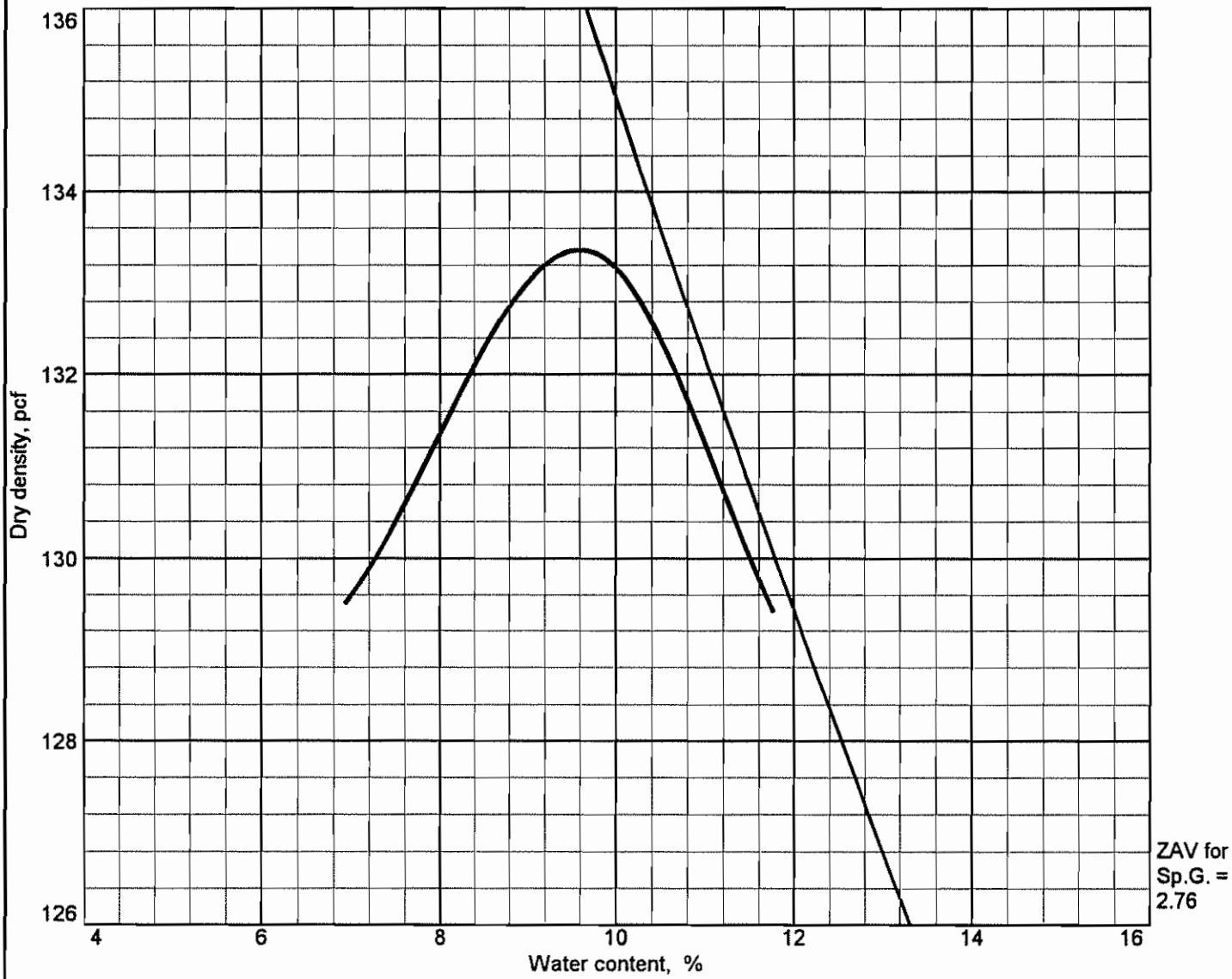
ROCK UNIT WEIGHT = 162.8 PCF
PLUS #4 MAT'L = 72.9%
MINUS #4 MAT'L = 27.1%

COMPACTION CURVE REPORT

YOUNGDAHL CONSULTING GROUP, INC.

Figure Number B-4

COMPACTION CURVE REPORT



Test specification: ASTM D 1557-91 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
20'	GM			2.72				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 133.4 pcf Optimum moisture = 9.6 %	Yellow Brown Silty GRAVEL w/sand

Project No. 02215 **Client:**

Project: BROADSTONE 3 RETAIL CENTER

● **Source:** NATIVE MAT'L **Sample No.:** TP-1 @ 20' **Elev./Depth:** 20'

Remarks:

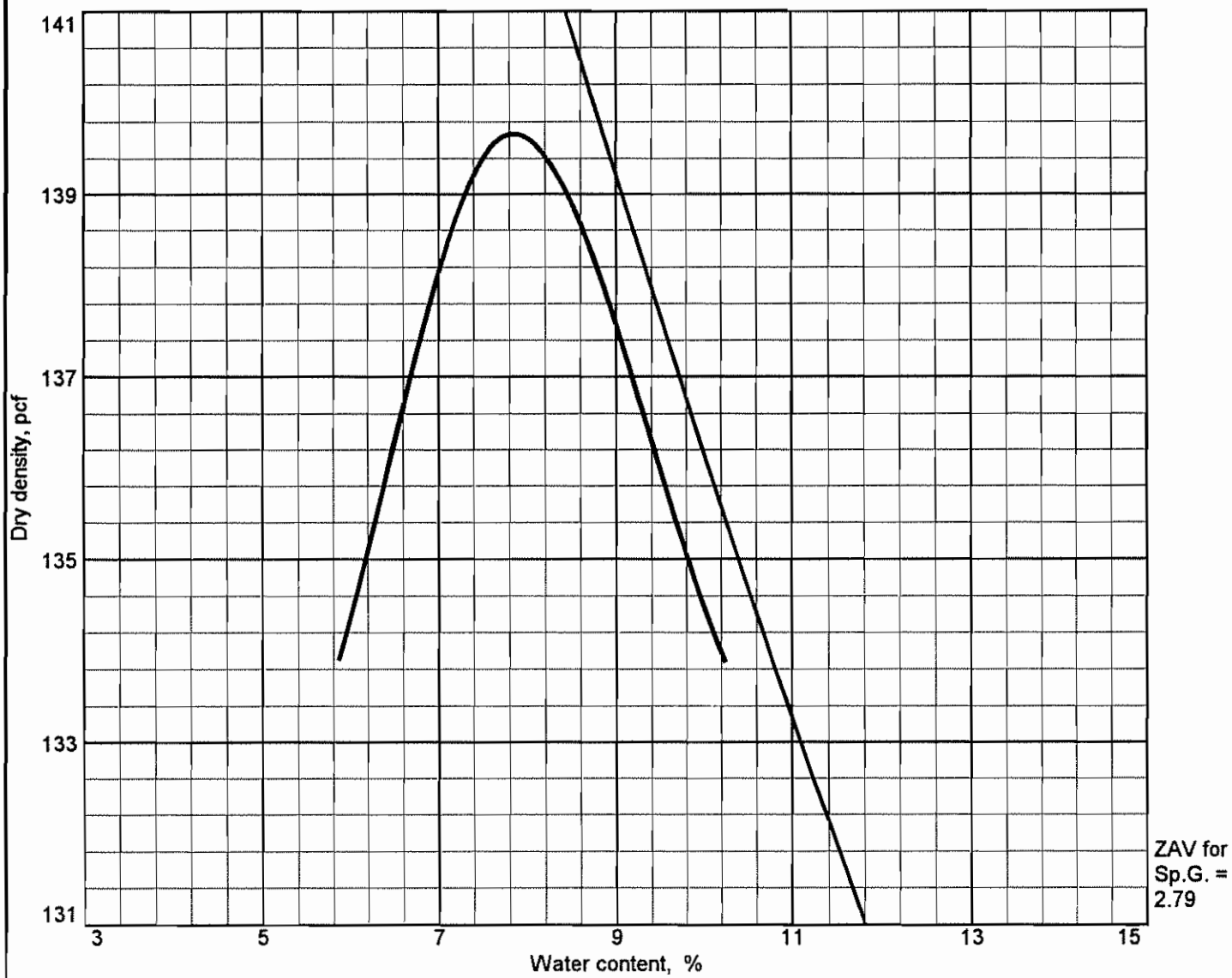
ROCK UNIT WEIGHT = 172.5 PCF
PLUS #4 MAT'L = 78.0%
MINUS #4 MAT'L = 22.0%

COMPACTION CURVE REPORT

YOUNGDAHL CONSULTING GROUP, INC.

Figure Number B-5

COMPACTION CURVE REPORT



Test specification: ASTM D 1557-91 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
10'	SM			2.75				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 139.7 pcf Optimum moisture = 7.9 %	Yellow Brown Silty SAND w/gravel

Project No. 02215 **Client:**

Project: BROADSTONE 3 RETAIL CENTER

● **Source:** NATIVE MAT'L **Sample No.:** TP-2 @ 10' **Elev./Depth:** 10'

Remarks:

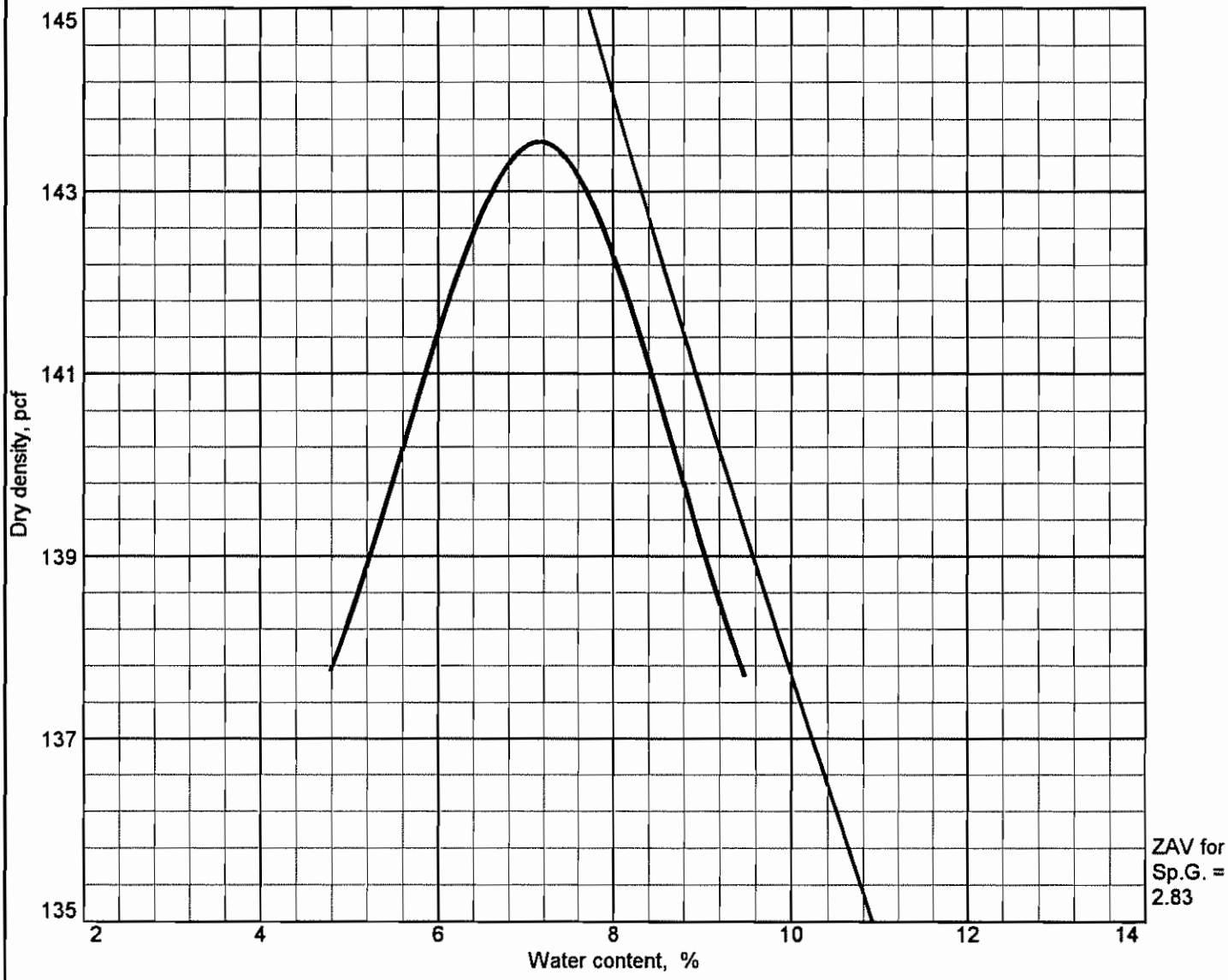
ROCK UNIT WEIGHT = 160.0 PCF
PLUS #4 MAT'L = 45.2%
MINUS #4 MAT'L = 54.8%

COMPACTION CURVE REPORT

YOUNGDAHL CONSULTING GROUP, INC.

Figure Number B-6

COMPACTION CURVE REPORT



Test specification: ASTM D 1557-91 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
20'	GM			2.79				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 143.6 pcf Optimum moisture = 7.2 %	Dk Yellow Brown Silty GRAVEL w/sand

Project No. 02215 **Client:**

Project: BROADSTONE 3 RETAIL CENTER

● **Source:** NATIVE MAT'L **Sample No.:** TP-2 @ 20' **Elev./Depth:** 20'

Remarks:

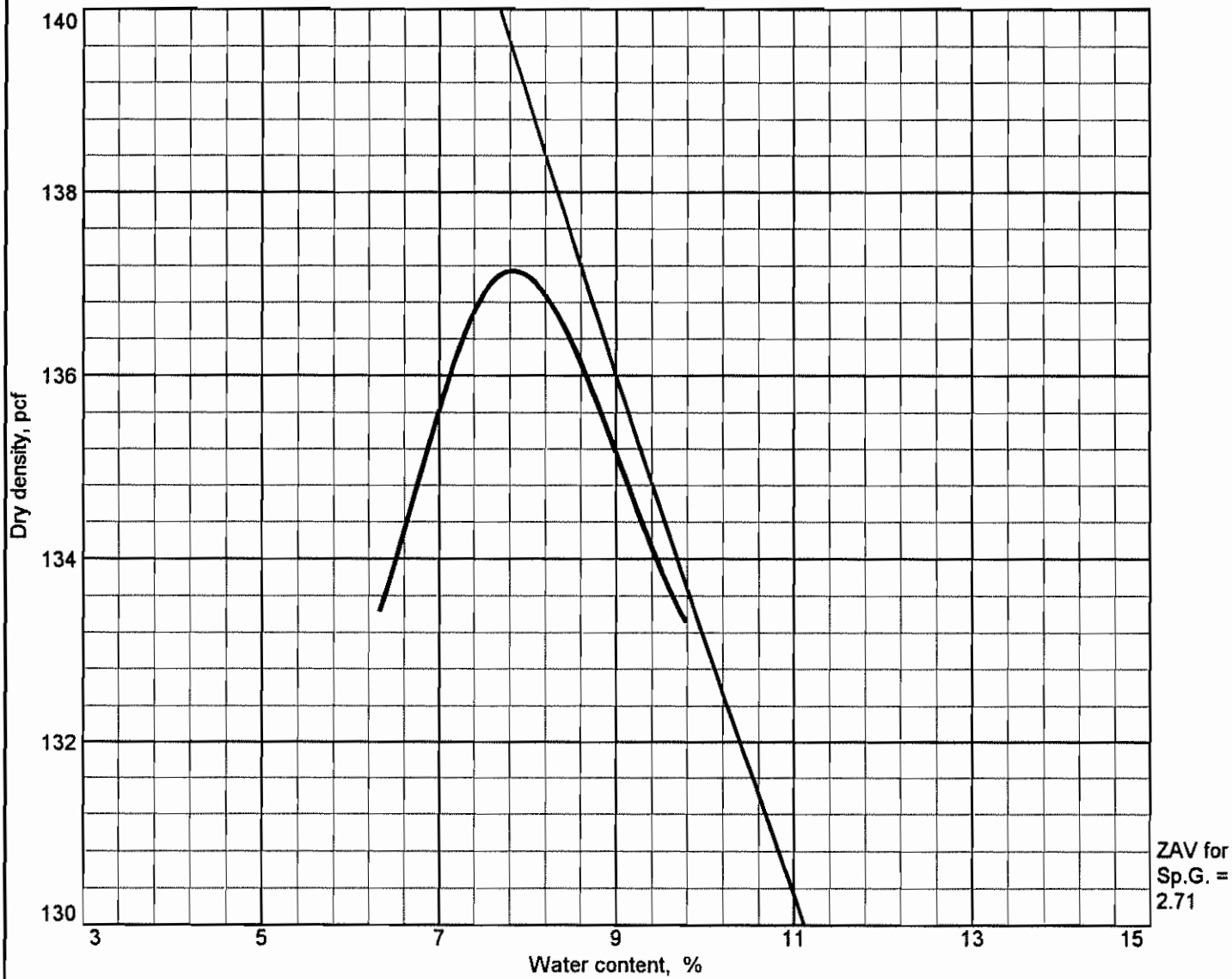
UNIT WEIGHT OF ROCK = 184.4 PCF
PLUS #4 MAT'L = 58.8%
MINUS #4 MAT'L = 41.2%

COMPACTION CURVE REPORT

YOUNGDAHL CONSULTING GROUP, INC.

Figure Number B-7

COMPACTION CURVE REPORT



Test specification: ASTM D 1557-91 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
10'	GM			2.67				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 137.1 pcf Optimum moisture = 7.8 %	Yellow Brown Silty GRAVEL w/sand

Project No. 02215 **Client:**

Project: BROADSTONE 3 RETAIL CENTER

● **Source:** NATIVE MAT'L **Sample No.:** TP-3 @ 10' **Elev./Depth:** 10'

Remarks:

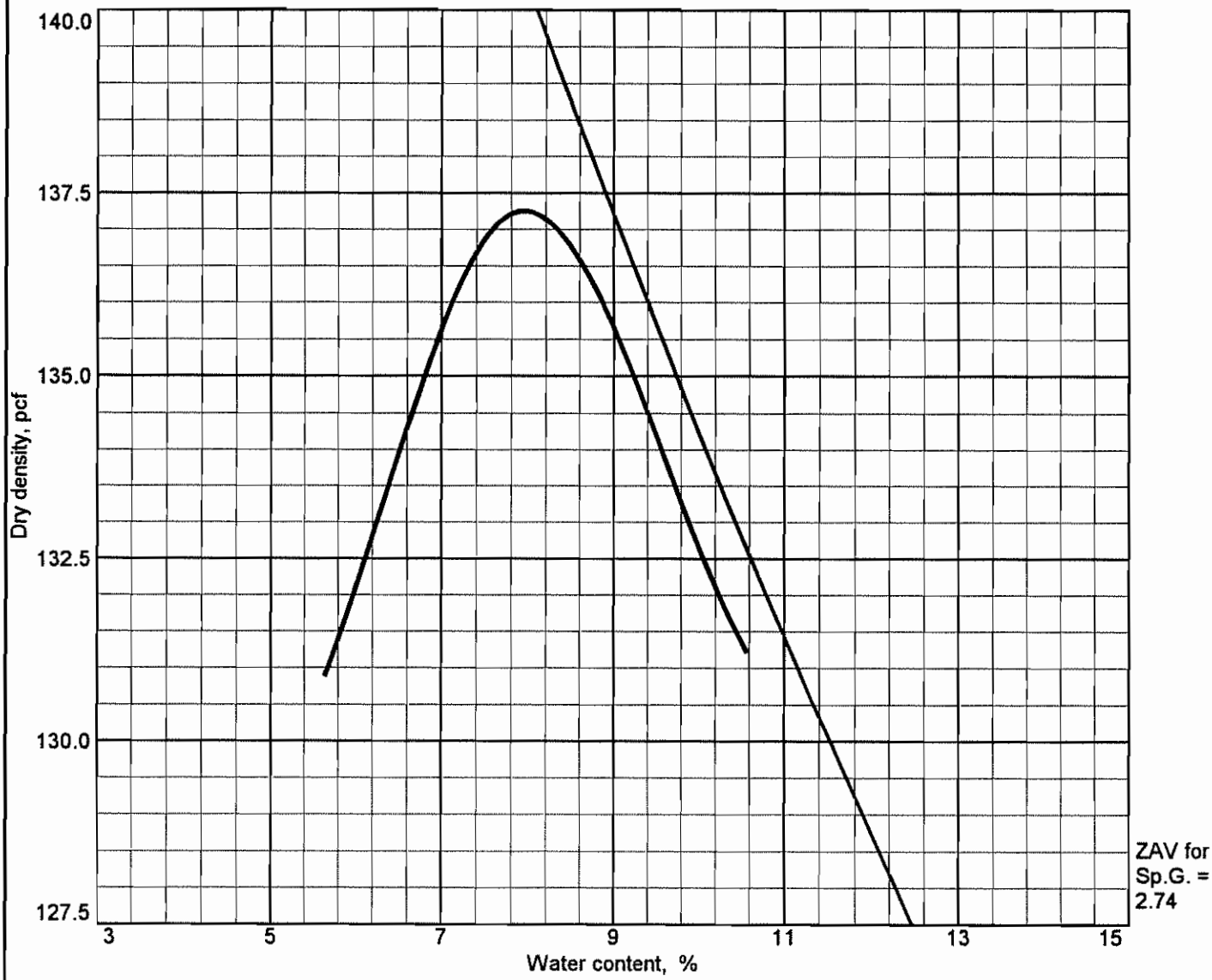
ROCK UNIT WEIGHT = 163.0 PCF
PLUS #4 MAT'L = 66.8%
MINUS #4 MAT'L = 33.2%

COMPACTION CURVE REPORT

YOUNGDAHL CONSULTING GROUP, INC.

Figure Number B-8

COMPACTION CURVE REPORT



Test specification: ASTM D 1557-91 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
20'	GM			2.7				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 137.3 pcf Optimum moisture = 8.0 %	Yellow Brown Silty GRAVEL w/sand

Project No. 02215 **Client:**

Project: BROADSTONE 3 RETAIL CENTER

● **Source:** NATIVE MAT'L **Sample No.:** TP-3 @ 20' **Elev./Depth:** 20'

Remarks:

ROCK UNIT WEIGHT = 183.8 PCF
PLUS #4 MAT'L = 71.4%
MINUS #4 MAT'L = 28.6%

COMPACTION CURVE REPORT

YOUNGDAHL CONSULTING GROUP, INC.

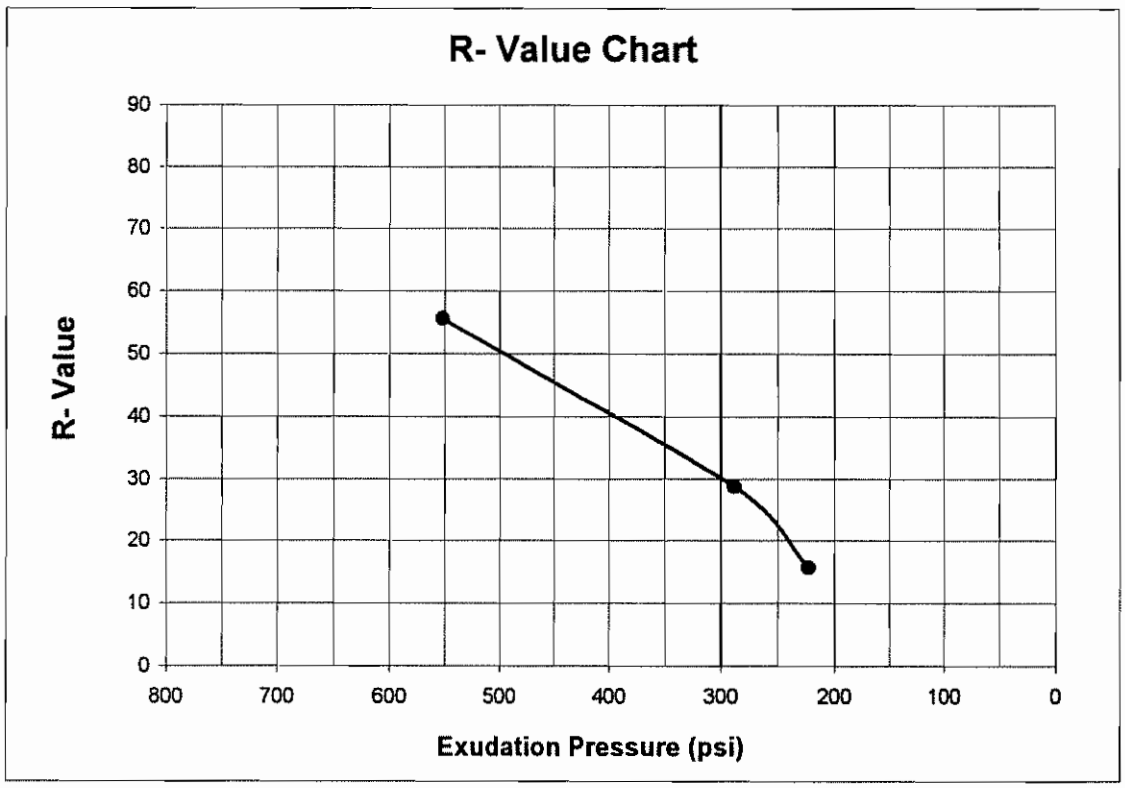
Figure Number B-9

RESISTANCE VALUE TEST (California Test 301, 1978)

Sample I.D.: BULK 1 & 2 Date: 5/2/02

Description: Red Brown Sandy SILT w/trace clay & little gravel

Test Specimen	H	E	K
Moisture Content (%)	16.0	14.9	13.8
Dry Density (pcf)	119.6	121.5	126.1
Expansion Dial (0.0001")	11	21	59
Expansion Pressure (psf)	47.6	90.9	255.5
Exudation Pressure (psi)	221.9	287.9	551.8
Resistance Value "R"	16	29	56
R Value at 300 psi Exudation Pressure:			**30**



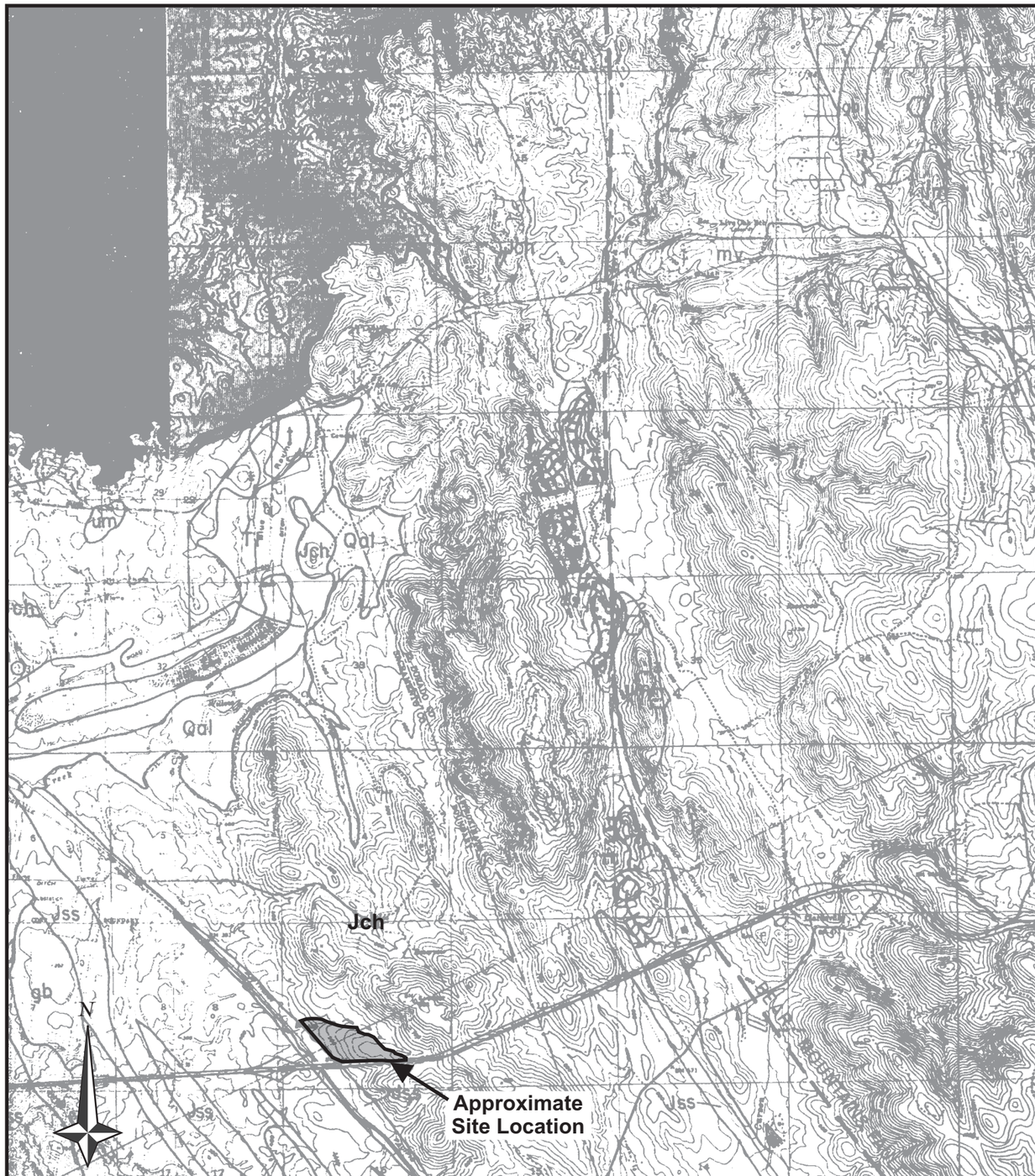
YOUNGDAHL CONSULTING GROUP, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING

BROADSTONE 3 RETAIL CENTER
Folsom, CA

PROJECT NO	DATE
02215	May 2002

FIGURE NO
B-10

APPENDIX C



½ 0 1 2 3 Mile

2000 0 2000 4000 6000 8000 10000 Feet

MINERAL DEPOSITS

- Chromite
- Copper
- Gold, Lode
- Gold, Placer
- Manganese
- Tungsten
- Limestone
- Slate
- Clay
- Silica
- Iron

MAP SYMBOLS

- Water Well Location
- Geologic Contact
- Fault
- Shear Zone
- Strike & Dip Of Foliation
- Mine & Prospect Location
- Quartz Vein
- Orientation Of Deposit
- Mine Index Number

CENOZOIC	t	Dredge Tailings
	Q	Alluvium
	Qal	Quarternary Alluvium
	Tl	Alluvial Sand, Silt, & Conglomerate
	Tm	Mehrten Formation
	Tvd	Rhyodacite Domes
	Tvs	Valley Springs Formation
	Tg	Auriferous Gravels (Tertiary river channel deposits)
	Ti	Ione Formation
MESOZOIC	Kc	Chico Formation
	Jm	Mariposa Formation
	Jmb	Brower Creek Volcanics
	Jlr	Logtown Ridge Formation
	Mzg	Mesozoic Granitic Intrusive Rocks
	Mzd	Mesozoic Dioritic Intrusive Rocks
	Jch	Copper Hill Volcanics (Mesozoic Volcanic Island Arc Terrane)
	Jss	Salt Springs Slate
	Jgo	Gopher Ridge Volcanics
	,msv	Metasedimentary Rocks (Melange Zone)
	ms	Metasedimentry Rocks (Melange Zone)
	ls	Limestone (Melange Zone)
	mv	Metavolcanic Rocks (Melange Zone)
	gb	Gabbro (Melange Zone)
	um	Ultramafic Rocks (Melange Zone)
	mvs	Undifferentiated Metavolcanic & Metasedimentary Rock (Melange Zone)
	Pzmz	Metamorphic Rocks
PALEOZOIC	Pzcc	Calaveras Complex (Metasedimentary Rocks - argillite & chert)
	Pzls	Calaveras Complex (Metasiltstone & Lenses of Carbonate Rock)
	Pzcv	Calaveras Complex (Metavolcanic Rocks)
	Pzct	Calaveras Complex (Talc)
	Pzsf	Shoofly Complex

BASE MAP REF: Adapted from USGS General Geology of the Folsom 15 - Minute Quadrangle, DMG Open File Report 84-50

YOUNGDAHL CONSULTING GROUP, INC.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS TESTING

Project No.: 02215

May 2002

GEOLOGY MAP

Broadstone 3 Retail Center
Folsom, California

FIGURE
C-1

TABLE C-1
DETERMINISTIC SEISMICITY TABLE

SITE NAME & LOCATION:
BROADSTONE 3 RETAIL CENTER
LATITUDE: 38.65 DEGREES
LONGITUDE: 121.11 DEGREES

SITE CLASS* = A-B
Vs= 900

PROJECT NUMBER: 02215
DATE: May-02

SITE CLASSES* :

	Vs 30 (avg.)
A - HARD ROCK	1300 m/s
B - SOFT ROCK/TERRACE	550
C - ALLUVIUM	270
D - BAY MUDS, PEAT	175

LOWER LEVEL EARTHQUAKE (LLE) and UPPER LEVEL EARTHQUAKE (ULE)
PEAK HORIZONTAL GROUND ACCELERATION (PHGA) ESTIMATE
(PREDICTIVE PHGA EQUATION FROM BOORE, JOYNER AND FUMAL, 1994a; 1997*)

FAULT ZONE/ ACTIVITY LEVEL	LLE MOMENT MAGNITUDE (Mw)	ULE MOMENT MAGNITUDE (Mw)	DISTANCE TO SITE (km)	DIRECTION FROM SITE (COMPASS)	MAX. DURATION OF SHAKING** (seconds)	LLE PHGA* (g)	ULE PHGA* (g)
Dunnigan Hills [H]	6.5	7.0	65	NW	23	0.06	0.08
North Tahoe [H]	6.25	6.5	99	E	22	0.04	0.04
Bear Mountain Fault Zone [Q]							
- West Branch:	6.25	6.5	2.5	E-NE	10	0.26	0.29
- East Branch:	6.25	6.5	16	E	12	0.14	0.16
Melones Fault Zone [Q]	6.25	6.5	23	E	12	0.11	0.13
Mormon Island Shear Zone [LQ]	6.25	6.5	1.3	E	10	0.26	0.30
Midland [Q]	6.25	7.0	67	W-SW	23	0.05	0.07
Coast Range S.B. [Q]	6.5	7.0	83	W	25	0.05	0.06
Antioch [Q]	6.25	6.8	96	SW	26	0.04	0.05
Eastern Frontal Sierra Nevada [Q]	6.5	7.5	98	E	33	0.04	0.07

S.B. = SIERRA BLOCK

* BOORE, JOYNER AND FUMAL, 1994a: U.S.G.S. OPEN-FILE REPORT 94-127; 1997: SEISMOLOGICAL RESEARCH LETTERS, VOL. 68, No. 1

** ABRAHAMSON, N.A. & SILVA, W.J., 1996: EMPIRICAL GROUND MOTION MODELS: REPORT PREPARED FOR BROOKHAVEN NATIONAL LABORATORY, USA.

Mw BASED ON PUBLISHED SLIP RATE DATA, WHERE AVAILABLE AND BRACKETED, i.e.

PETERSEN AND WESNOUSKY, 1994, BULLETIN OF THE SEISMOLOGICAL SOCIETY OF AMERICA, VOL 84, No. 5, pp. 1608 - 1649

PETERSEN AND OTHERS, 1996, CALIF. DIV. OF MINES & GEOLOGY, OFR 96-08 // U.S. GEOLOGICAL SURVEY OFR 96-706

WORKING GROUP ON CALIF. EARTHQUAKE PROBABILITIES, 1995, BULL. OF SEISMO. SOC. OF AM., VOL. 85, No. 2, pp. 379 - 439.

INTERNAT'L CONGRESS OF BUILDING OFFICIALS, 1998, MAPS OF KNOWN ACTIVE FAULT NEAR-SOURCE ZONES IN CALIF. & ADJ. PORTIONS OF NEVADA

ALTERNATELY, WHEN SLIP RATE DATA IS ABSENT OR NON-BRACKETED Mw BASED ON:

(1) A POSTULATED RUPTURE L (M/ULE) OR L/seg (M/LLE) AND ASSOCIATED SLIP RATE, WHERE L IS TOTAL FAULT LENGTH (ALL SEGMENTS);

OR

(2) A PUBLISHED SOURCE CATALOG OF ESTIMATED LLE OR ULE EVENTS, i.e.:

MUALCHIN AND JONES, 1996, CALTRANS TECHNICAL REPORT TO ACCOMPANY CALIFORNIA SEISMIC HAZARD MAP 1996.

JENNINGS, 1994, FAULT ACTIVITY MAP OF CALIFORNIA & ADJACENT AREAS, CDMG GEOLOGIC DATA MAP NO. 6 & TEXT

SCHWARTZ, 1994, ATC 35-1 SEMINAR PROCEEDINGS, pp. 4-1 to 4-9.

MUALCHIN AND JONES, 1992, C.D.M.G. OPEN-FILE REPORT 92-1.

LLE = 10% EXCEEDENCE IN 50 YEARS **ULE = Mmax [PETERSEN: CDMG OFR 96-08]**

[Q] = QUATERNARY/POTENTIALLY ACTIVE; [LQ]= LATE QUATERNARY/POTENTIALLY ACTIVE; [H]= HOLOCENE/ACTIVE

RECENCY OF MOVEMENT: [H]<10,000 YRS B.P. ; [LQ]<700,000 YRS B.P. ; [Q]<1,600,000 YRS B.P.

References

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- Harwood, D.S. and Helley, E.J., (1982): "Preliminary Structure Contour Map of the Sacramento Valley, California", United States Geological Survey, Open File Report OFR 82-737.

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- International Congress of Building Officials [I.C.B.O.], (1997): "Uniform Building Code, Volume 2", Chapter 16, Division IV - Earthquake Regulations, pp 2-9 to 2-38.

- Loyd, R.C., (1984): "Mineral Land Classification of the Folsom 15-Minute Quadrangle, Sacramento, El Dorado, Placer, and Amador Counties, California", California Department of Conservation, Division of Mines and Geology, Open-File Report 84-50.

- Mualchin, L. and Jones, A.L., (1992) "Peak Acceleration from Maximum Credible Earthquakes in California", California Department of Conservation, Division of Mines and Geology, Open File Report 92-1.

- Mualchin, L., (1996) "Caltrans California Seismic Hazard Map 1996 & Accompanying Technical Report", California Department of Transportation.

- Petersen, M.D., and others, (1996), "Probabilistic Seismic Hazard Assessment for the State of California", California Division of Mines and Geology and U.S. Geological Survey, CDMG OFR 96-08//USGS OFR 96-706.

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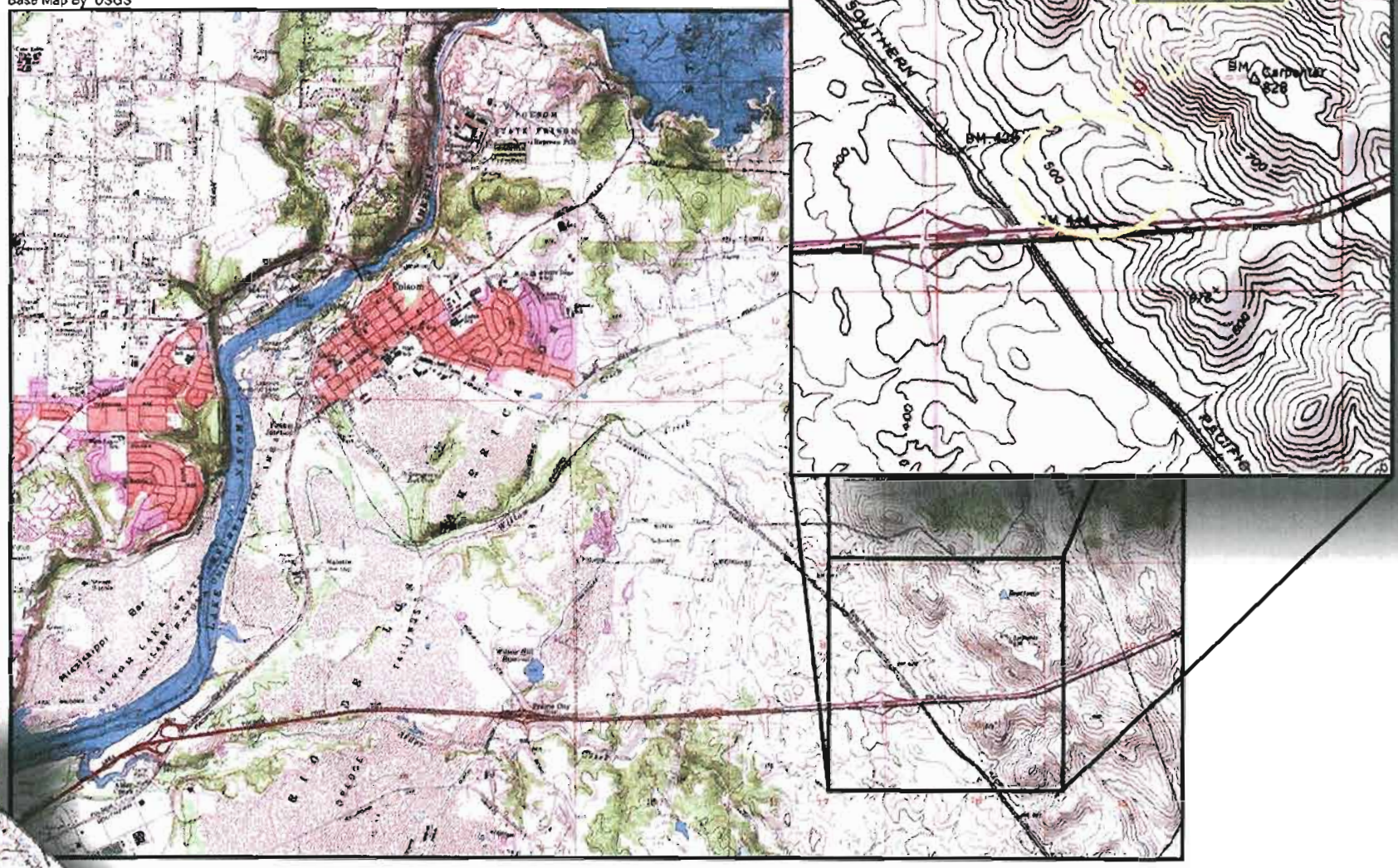
- U.S. Department of Agriculture (USDA) Soil Conservation Service: "Soil Survey of Sacramento County, California" (1991).

APPENDIX D

Site Location Map

Base Map By: USGS



0 2 Miles

Scale: 1" = 1 Mile

North

Figure 1

CONSULTANTS IN GEOPHYSICS AND GEOLOGY FOR THE ENGINEERING, GEOTECHNICAL ENVIRONMENTAL and LEGAL PROFESSIONS
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www.geogasch.com

Broadstone Unit 3:
Seismic Refraction Investigation

Prepared for: **Youngdahl Consulting Group**

Project Number: 2002-13.01 Date: April, 2002

Line Location Map

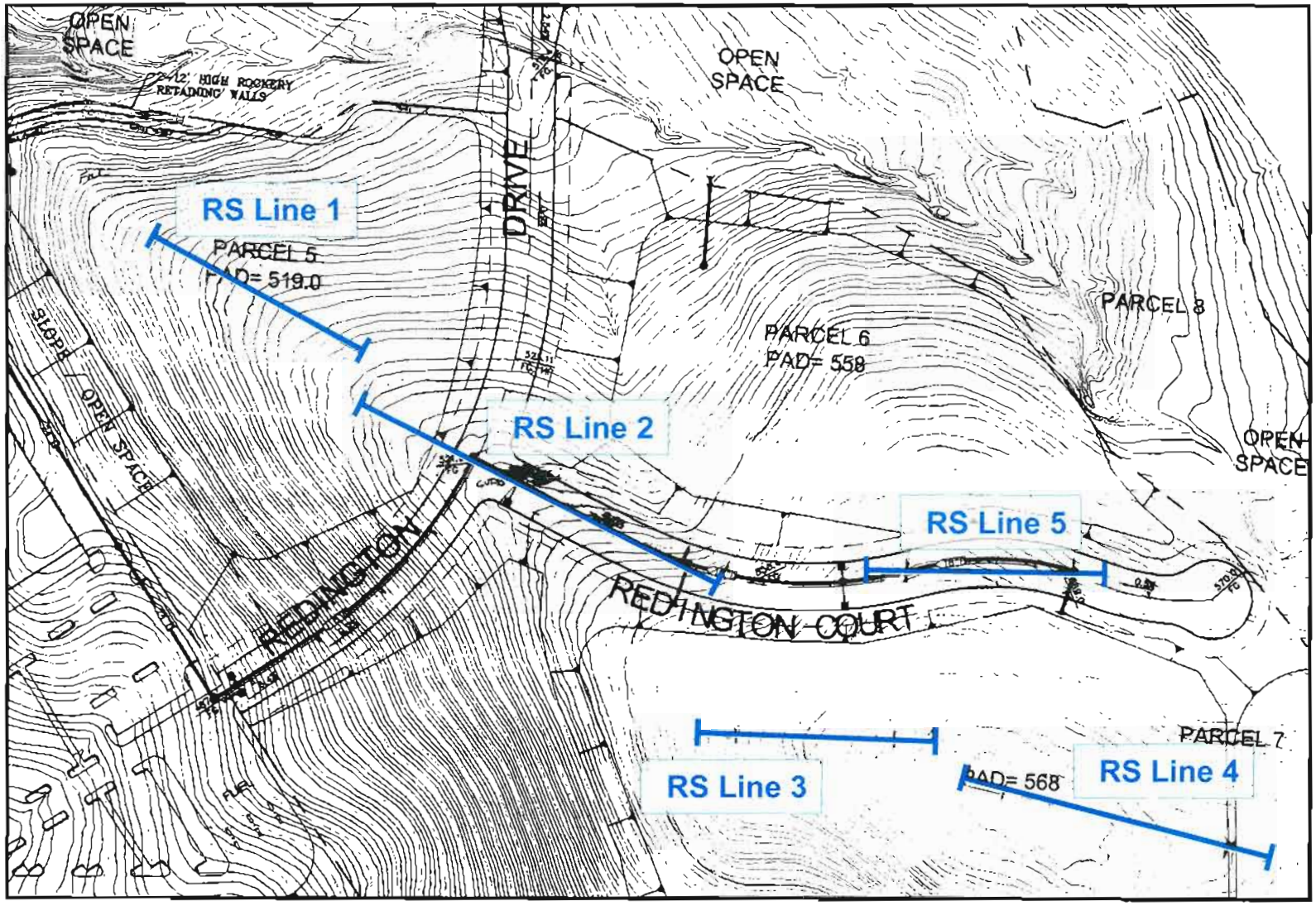

Figure 2

0 400 Feet

Scale: 1" = 200 Feet

North

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Prepared for: Youngdahl Consulting Group

Project Number: 2002-13.01 **Date:** April, 2002

Seismic Velocity Section • RS Line 1

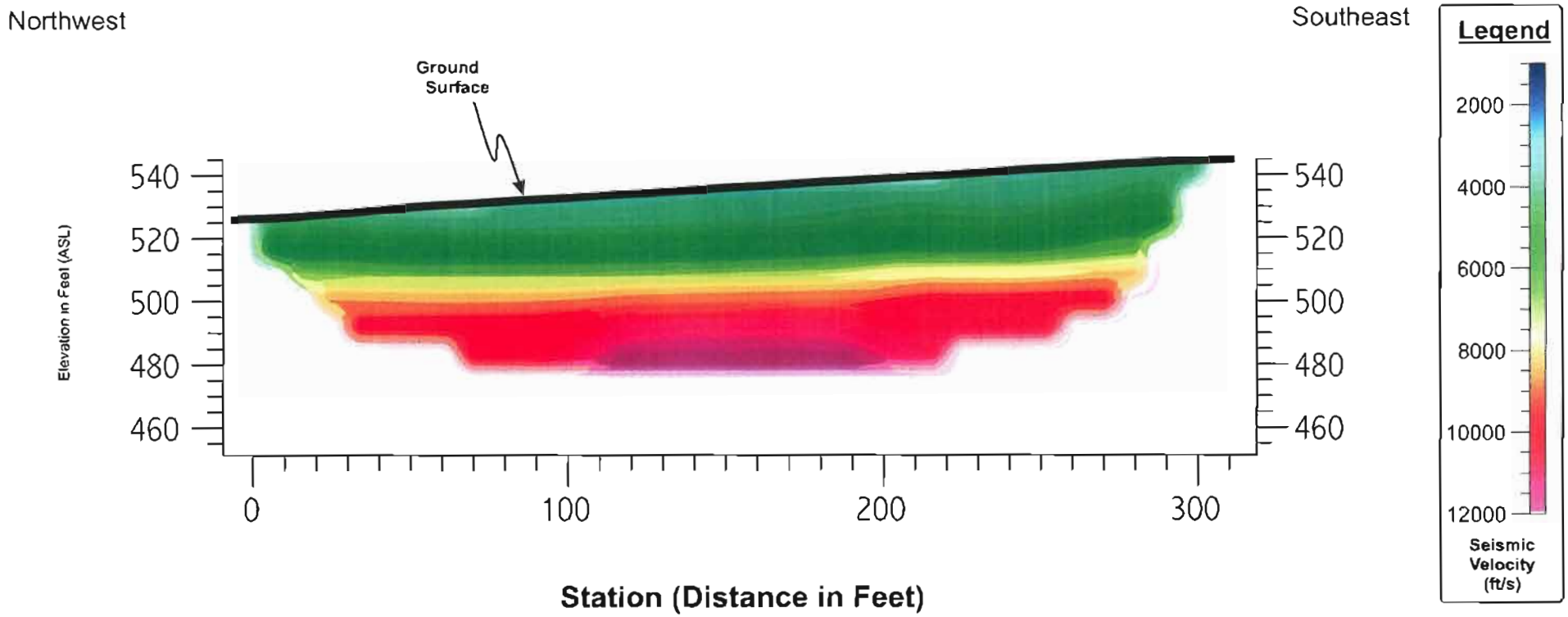

Figure 3

Scale: 1" = 50'
Geophone Station Interval = 25 feet

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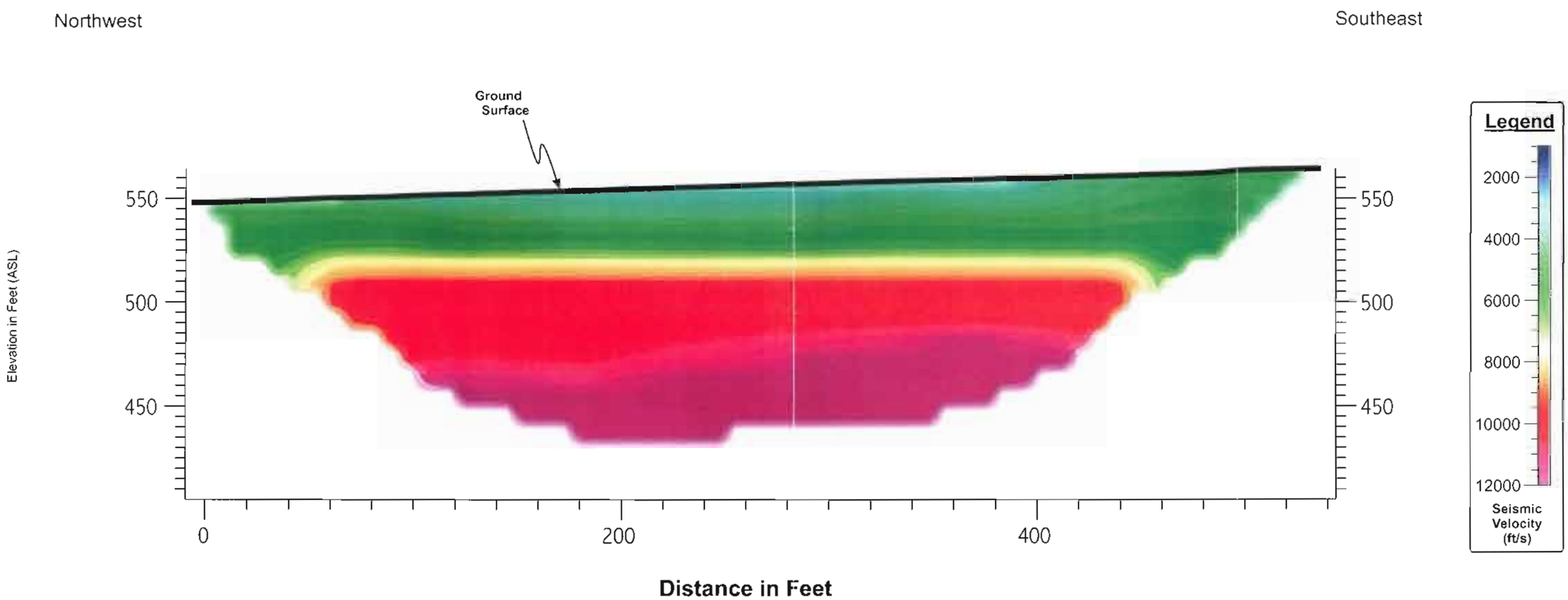
Prepared for: Youngdahl Consulting Group

Project Number: 2002-13.01 **Date:** April, 2002

Seismic Velocity Section • RS Line 2



Scale: 1" = 50'
Geophone Station Interval = 25 feet

Figure 4

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Seismic Refraction Investigation

Prepared for: Youngdahl Consulting Group

Project Number: 2002-13.01 Date: April, 2002

Seismic Velocity Section • RS Line 3

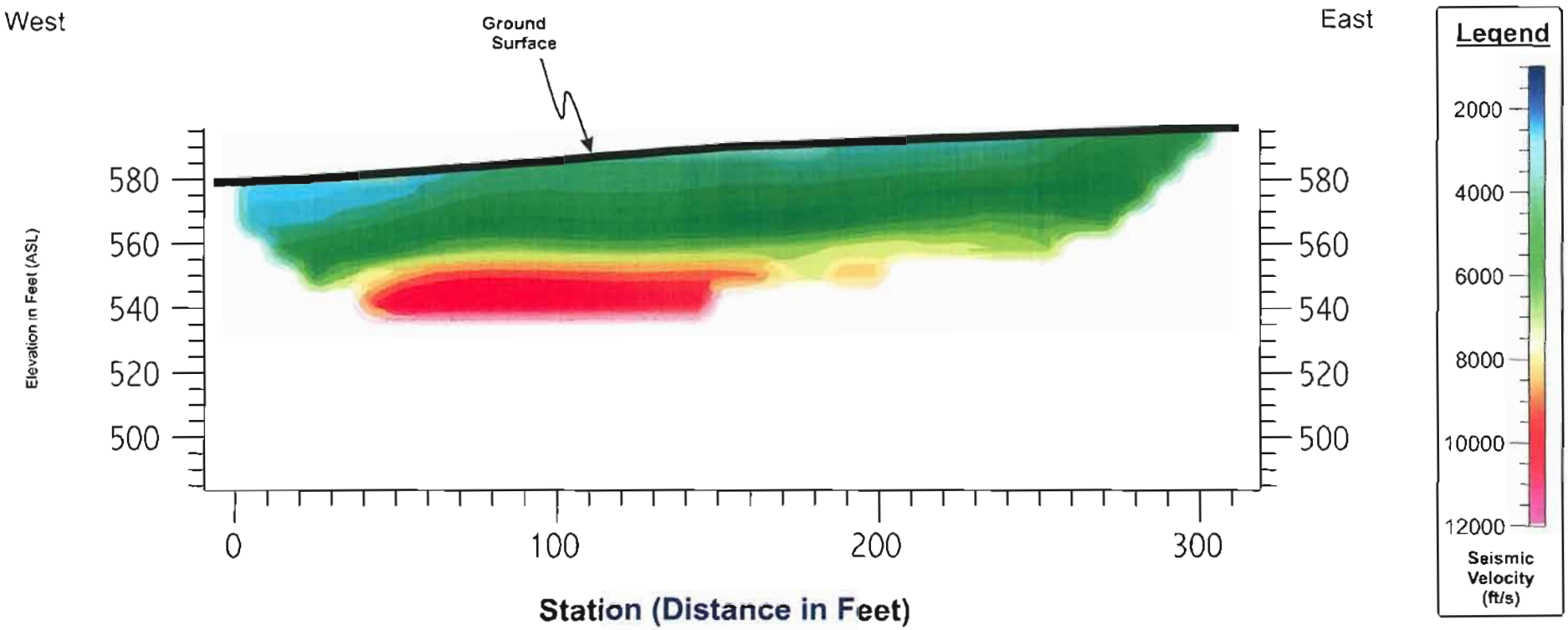

Figure 5

Scale: 1" = 50'
Geophone Station Interval = 25 feet

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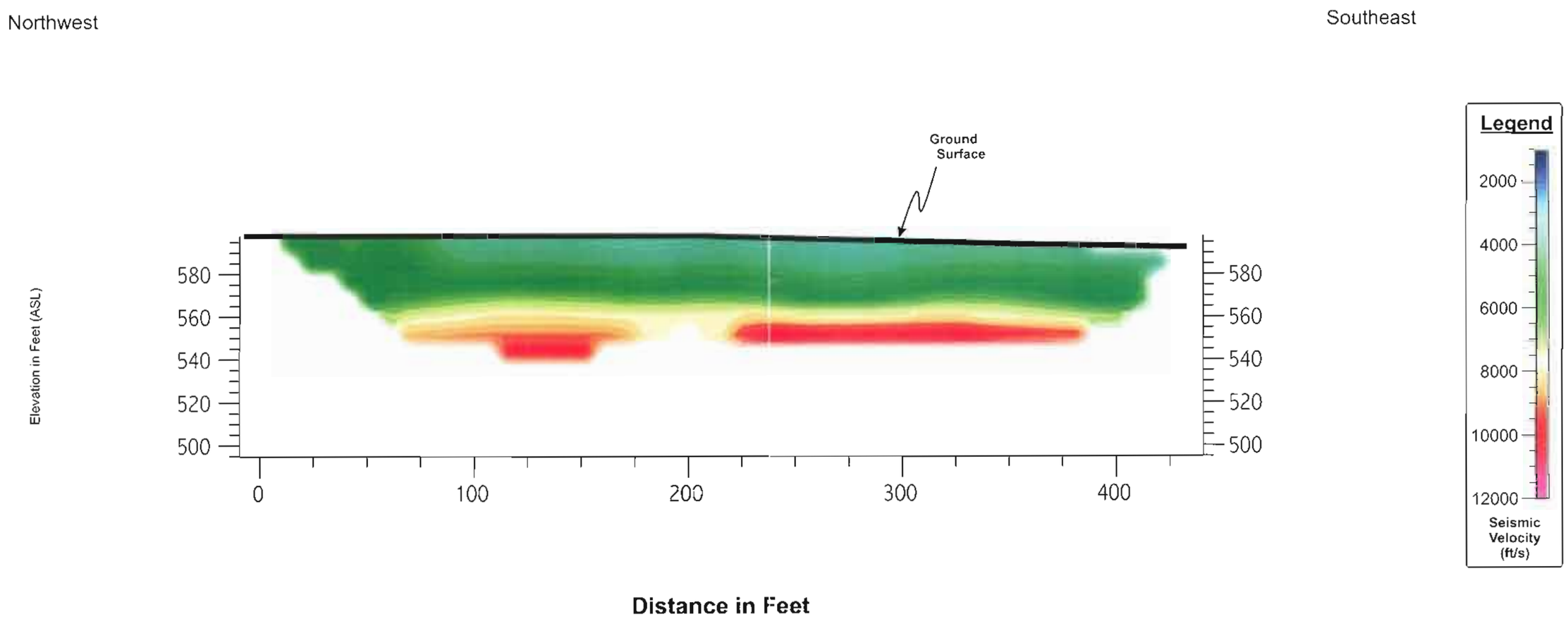
Seismic Refraction Investigation

Prepared for: Youngdahl Consulting Group

Project Number: 2002-13.01 **Date:** April, 2002

Seismic Velocity Section • RS Line 4



Scale: 1" = 50'
Geophone Station Interval = 25 feet

Figure 6

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Prepared for: Youngdahl Consulting Group

Project Number: 2002-13.01 Date: April, 2002

Seismic Velocity Section • RS Line 5

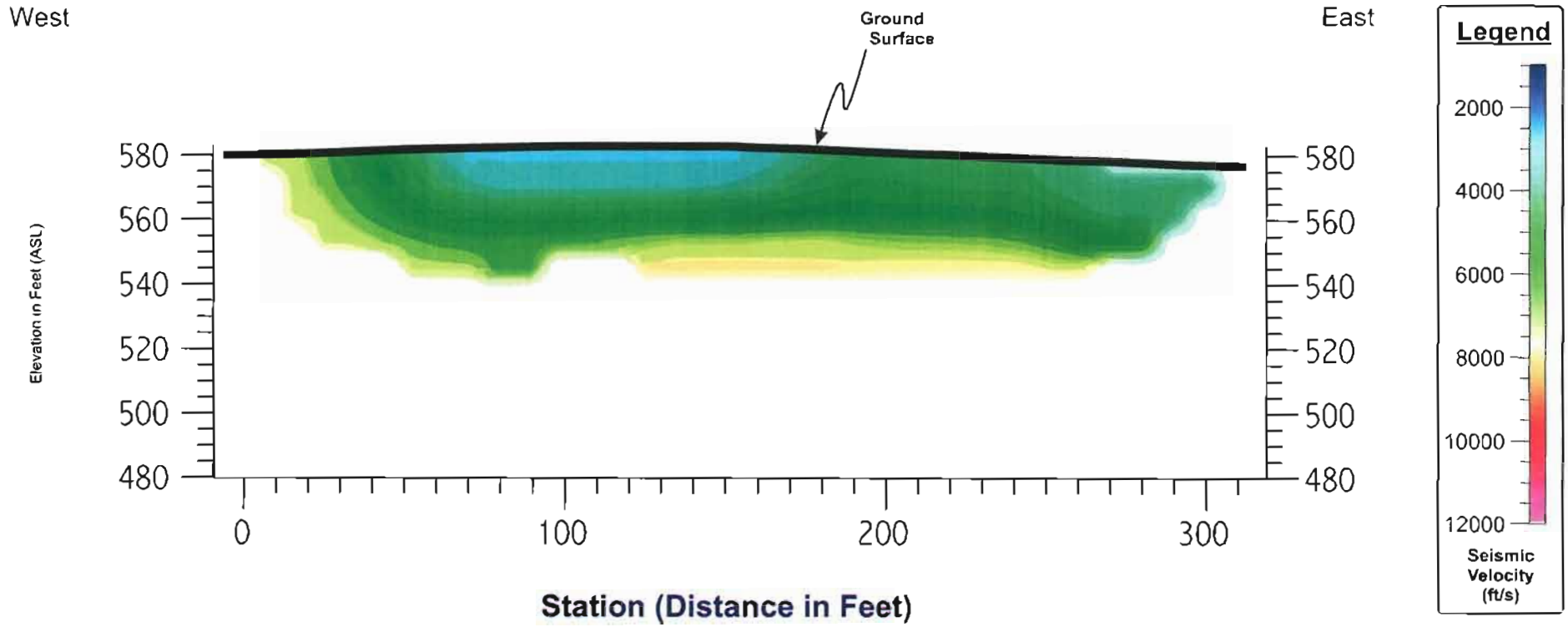

Figure 7

Scale: 1" = 50'
Geophone Station Interval = 25 feet

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Broadstone Unit 3:
Seismic Refraction Investigation

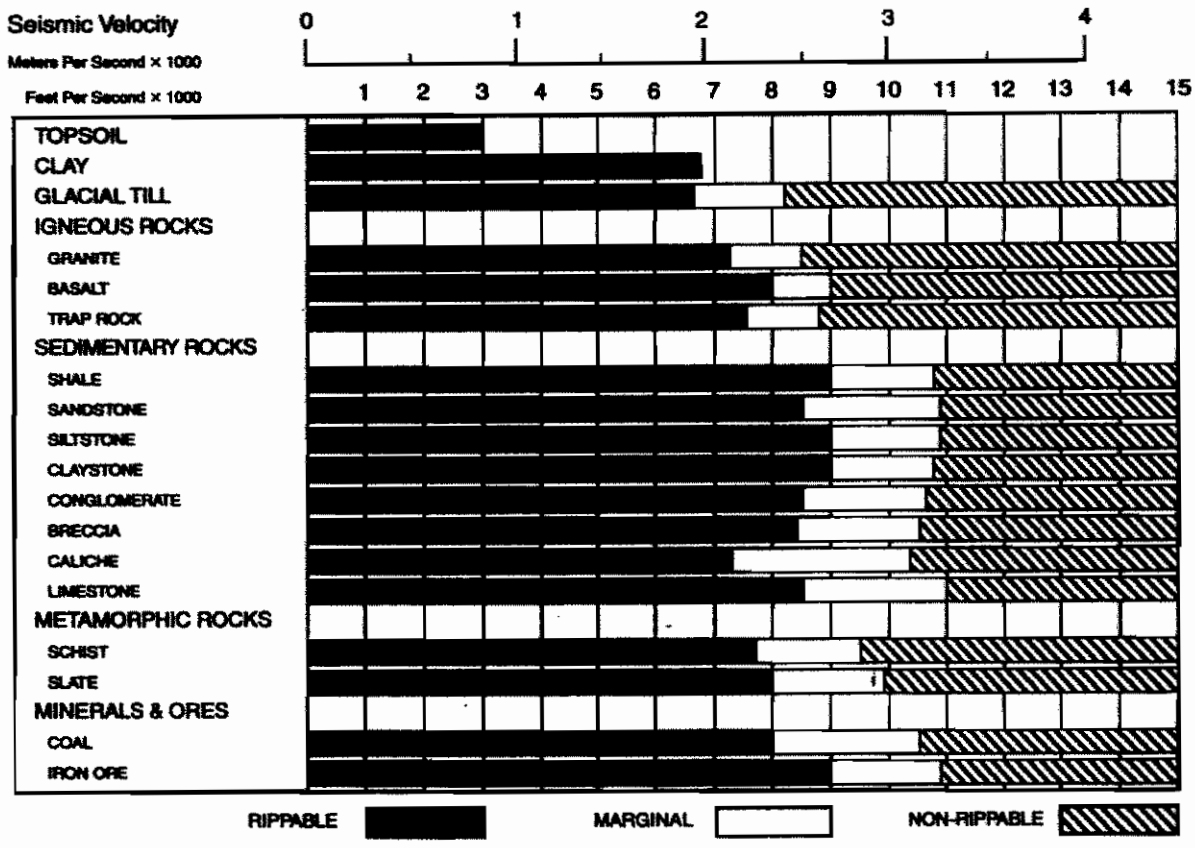
Prepared for: Youngdahl Consulting Group

Project Number: 2002-13.01 **Date:** April, 2002

Caterpillar D10R Ripper Performance Chart*

Rippers | Ripper Performance
• D10R

D10R
- **Multi or Single Shank No. 10 Ripper**
- **Estimated by Seismic Wave Velocities**



* Based on the Caterpillar Performance Handbook Edition 29

Figure 8

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Broadstone Unit 3:
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