Appendix K Geotechnical Investigation Report and Addendum

Appendices

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AGI
Aragón Geotechnical, Inc.
Consultants In The Earth & Material Sciences
CALIFORNIA ● MEXICO

July 1, 2015
Project No. 4306-PR

City of Banning
99 East Ramsey Street
Banning, California 92220

Subject: Summary of Geotechnical Document Reviews & Feasibility Assessment
Rancho San Gorgonio Project
City of Banning, Riverside County, California

Gentlemen:

In accordance with your authorization of services under City purchase order, Aragón Geotechnical Inc. (AGI) has completed technical critiques of City-supplied project exhibits and reports concerning the proposed Rancho San Gorgonio master-planned community. AGI's services scope also included limited independent background research, primarily for purposes of confirming the completeness or veracity of site findings. Review tasks included air photo interpretations of Internet-available imagery, geological literature reviews, checks of proprietary AGI geotechnical reports for nearby projects, online searches of various City, Riverside County, State, and Federal websites, and a half-day-long site reconnaissance visit. Technical documents and key figures we examined are listed below. Documents were supplied as electronic .pdf files.

- *Geotechnical Investigation for Proposed Rancho San Gorgonio Master Planned Community, Banning, California*: RMA GeoScience, Rancho Cucamonga, California, dated November 8, 2012 (RMA No. 12-G02-01).
- *Addendum to Geotechnical Investigation, Additional Parcels, Proposed Rancho San Gorgonio Master Planned Community, Banning, California*: RMA GeoScience, Rancho Cucamonga, California, dated May 21, 2013 (RMA No. 12-G02-01).
- The included electronic file copy of *Figure 3, Conceptual Master Plan Map* from the preceding primary Geotechnical Investigation report.
- The included electronic file copy of *Figure 5, Site Geologic Map* also from the preceding primary Geotechnical Investigation report.

The primary goals of the office and site reviews were to (1) Provide independent professional judgments concerning the site characterization findings and preliminary design conclusions of RMA GeoScience [hereafter "RMA"] reports; (2) Verify that the conceptual master plan appears to be feasible with respect to geological hazards; and (3) Inform and advise the City of Banning about recommended requests for corrections or further information before proceeding with City approval. The project proponent intends to use the documents for multiple jurisdictional and land entitlement actions. There is not a single codified standard used by the City in qualifying submitted geotechnical reports. Accordingly, AGI's self-selected basis for the technical review was derived from various requirements outlined in the Banning Municipal Code, Riverside County Ordinance 457, the California Building Code, California Geological Survey Notes 41 and 48, and our opinions of competent Southern California professional practice.

We expect and encourage circulation of this review report with the project proponent and their engineering consultants. However, AGI's role as a contract reviewer to the City of Banning excludes assumption of any design responsibility for the project or project elements, which shall remain with the engineers-of-record. Furthermore, it is understood that the City of Banning shall retain discretionary authority to formally deny, approve, or approve with modifications the reviewed reports in whole or in part, regardless of the advice or recommendations of this firm.

FINDINGS

Background Information

Development Concept. Rancho San Gorgonio comprises 35 contiguous land parcels per the Riverside County Land Information System, encompassing about 833 acres in aggregate. The irregularly shaped project encompasses portions of surveyed Sections 16 and 17, T.3S. R.1E. (San Bernardino Baseline and Meridian). In gross aspect the site is aligned with the southern half of the San Gorgonio Pass just east of the principal watershed divide between the Santa Ana River Basin and the Whitewater River Region. All site runoff will contribute to the receiving waters of the Whitewater River. Flat to gently rolling terrain interrupted by several incised intermittent watercourses characterizes the majority of the site. A small part of the site intercepts a spur ridge of the San Jacinto Mountains. RMA reports there is about 200 feet of elevation relief within the project limits. Surrounding properties consist of a mix of undeveloped semi-arid natural lands, rural-residential parcels, secondary school properties, and a commercial campground.

RMA stated that the primary investigation report was intended to support a petition for annexation of certain unincorporated Riverside County territory in the project limits to the City of Banning. AGI checks of Riverside County GIS databases indicated the area in question is the southeast quarter of Section 17, i.e., about 160 acres. RMA exhibits lacked labeled City boundary lines. We would speculate that depending upon timing of specific plan approvals *vis à vis* commission actions to approve the annexation, the Riverside County Planning Department may have technical review authority for the unincorporated quarter-section. Project proponents should be aware that County review standards may result in requests for information differing from requests of City staff or AGI as agents for the City, if a County geotechnical review is required.

As envisioned in the referenced conceptual map, Rancho San Gorgonio would comprise approximately 21 development planning areas. Most planning areas would be traditional single-family subdivisions. One part of the project would feature age-restricted seniors housing. Multi-family townhome or apartment sites are indicated for three smaller areas. The development concept suggests the total dwelling count would be close to 3,200 units. Significant acreage would comprise hilly open space, active and passive park site amenities, and permanent easements for stream channels, overhead electric transmission lines, and a buried high-pressure gas transmission pipeline. The gas line and the "El Casco" overhead double-circuit 115kV power-line corridor bisect the site within easements recorded on behalf of Southern California Gas and Southern California Edison.

RMA Site Investigations. As far as is known, all geological and soils engineering studies for the Rancho San Gorgonio project have been completed solely by RMA. The referenced geotechnical investigations constitute *feasibility-level* studies. Although the engineering consultant was aware of the conceptual plan, site explorations were not targeted to any specific proposed improvements. Explorations sites appear to have been selected to encompass the range of expected soil types and geological environments. However, no subsurface work was performed in stream thalwegs subject to Federal jurisdiction, utility easements, or bedrock open-space areas. RMA's reports included data and interpretations from:

- Geological mapping, literature reviews, and stereo-pair aerial images.
- 15 drilled soil borings and 44 backhoe test pits ranging in depth from 3.5 to 51.5 feet.
- Laboratory testing of selected recovered soil samples.
- 2 seismic refraction line spreads at a hypothesized concealed fault location.
- 3 water infiltration tests.

Past & Current Site Conditions. Information indicated the undeveloped project site has historically been used for dry-farmed agriculture, limited orchard cultivation, and open rangeland. Only one structure site has been identified (confirmed by AGI), other than various public improvements constructed at the City-operated A.C. Dysart Equestrian Park. The latter project appendage also includes the sole significant examples of past grading, and exhibits a few small areas of undocumented fill.

The half-day site reconnaissance visit was made on June 11, 2015 by AGI's undersigned geological reviewer. Access was restricted to public thoroughfares inside and around the project. Nonetheless, almost all project areas were readily visible. Observations hinted that no significant changes have occurred since 2012. Described features in the report were easily located. Drought conditions meant that site soils were very dry at the surface, and very little seasonal vegetation cover was present. All stream courses were dry. Scattered trees, mostly mature tamarisk, populated the Montgomery Creek and Pershing Creek stream courses. Dumped trash, inert broken concrete, furniture, tires, and similar wastes were widely scattered along unimproved road alignments.

Engineering Geologic Overview

Local Geologic Setting. The vast majority of the site is underlain by several generations of detrital alluvial sediments. A deeply dissected older alluvial unit forms a number of conspicuous finger-like ridges. Ridges sometimes merge into relatively flat-topped mesa-like surfaces toward the northeast. The older alluvial unit is predominantly dense silty sand with some weathered gravel and cobble clasts. Between the ridges are deposits of younger alluvium consisting of loose to medium dense silty sand, sand, and massive silt. Localized sandy wash sediments occur along stream thalwegs. RMA trench logs usually describe the younger alluvium as visibly porous. We note that featureless churned soils caused by burrowing fauna, open burrows, and visible macro-porosity can be seen in younger alluvium to depths of at least 10 to 12 feet along Pershing Creek. Soil boring data indicate younger alluvium depths can locally exceed 30 feet. AGI's experience from very similar nearby sites would support interpretations that "younger alluvium" in fact constitutes a slightly heterogenous mix of locally derived slopewash, water-laid sheet-flood alluvium [Montgomery Creek watershed], and wind-laid eolian silt and fine sand with markedly low in-place densities. Eolian deposits might be expected to be preferentially located in the wind-protected eastern lee of the finger ridges.

Crystalline bedrock locally borders and in one instance projects into the project along the southeastern specific plan boundary. Mountainous terrain rises uninterrupted to more than 1,400 feet above the site to the south. Bedrock types listed by RMA include a Cretaceous-age quartz diorite ("granite" in colloquial terms), and an older foliated metasedimentary schist. Granitic rock slopes in the general area are usually fairly steep and littered with exhumed corestones (hard residual boulders at one time surrounded by decomposed bedrock). The schist is distinctively dark-colored and tends to form fin-like outcroppings south of the project limits.

Earthquake Fault Hazards. Rancho San Gorgonio lacks any territory placed within official Alquist-Priolo Earthquake Fault Zones. These State-delineated regulatory zones surround active faults deemed to pose threats to structures from surface offset. Riverside County and City of Banning planning documents also indicate the site is free of local-agency fault hazard management zones. However, RMA literature research disclosed undefined hazard potentials for two concealed, buried fault lines identified from groundwater elevation data. Analyses were undertaken to see if the concealed faults met criteria for active faults that would require avoidance.

RMA findings were that neither of the two faults has surface expression in site sedimentary deposits including older, Pleistocene-age alluvium. Accordingly, neither fault was judged active. RMA's broad opinion was that site planning to mitigate surface rupture risks was not needed. Based on the data and analyses presented, this firm would agree that no further work to define or delineate fault rupture hazards appears to be warranted.

Other Geological Hazards. RMA identified several potential threats to the proposed Rancho San Gorgonio improvements. Engineering and design options exist to mitigate these hazards.

- *Strong Ground Motion.* Severe ground shaking was stated as a high-probability event within the design life of new structures. Hazard risks are high due to the project's proximity to active faults, short average recurrence intervals of around 220 years between earthquakes on the local segment of the San Andreas fault, and scientific studies indicating the last San Andreas event in the Coachella Valley was more than 320 years ago. RMA presented recommended prescriptive seismic design criteria based on the 2010 California Building Code (CBC). This code is now out of date.

- *Tsunami, Seiche, Induced Flooding.* The former two phenomena were not deemed to be site threats. RMA indicated some flooding hazard was possible from tank or feed-line rupture of a small reservoir next to City Well C5. The flooding risk would be very localized, however.
- *Erosion.* Intermittent streams in the project locally feature near-vertical gully walls, some approaching 20 feet high. Convex slopes on elevated ridges are covered with loose colluvium and rocks. RMA reports and our site observation findings indicated all site alluvial units are highly erodible. RMA also mentions disturbed bare-soil surfaces will be susceptible to wind erosion.
- *Debris Flows.* Not addressed by the reviewed reports. Requests for information concerning this hazard are discussed later in this letter.
- *Landslides.* RMA indicated that mapped or newly discovered landslides were not found in the project. Older alluvium and crystalline bedrock have high mechanical strengths and would not typically be judged highly susceptible to deep-seated mass movement. However, RMA pointed out that localized slope instability hazards were present where natural or diverted water flows impinge upon incised stream banks. Some bank failures were noted. Future instability risks would presumably be caused by undercutting, or displacement due to strong ground motion.
- *Liquefaction.* RMA listed groundwater well records indicating groundwater to be at least 240 feet deep. Natural springs or seeps were not observed. Based on these findings, liquefaction potential was judged to be nil.
- *Settlement.* AGI deduces that dynamic dry-soil settlements are locally possible in the absence of engineered grading. Risks will vary with soil type. Older, denser soils will have far less susceptibility than loose younger sediments. The reviewed documents lack quantified hazard potentials, however.
- *Flooding.* RMA noted the main stream courses and some other low-relief site areas were in defined flood hazard zones. The relevant FEMA Flood Insurance Rate Maps have not changed (2008 issue). A flood zone exhibit was not provided. RMA recommended that the design civil engineer consider management of flood waters from on- and off-site sources as part of the overall project design.

Geotechnical Engineering Site Characterization

Soils. No unusual soil classifications or chemically aggressive materials appear to have been detected in site alluvial units. All site materials were preliminarily accepted by RMA for use in engineered compacted fills after clearing and grubbing actions. All of the site units, excluding crystalline bedrock, have been judged easily excavatable with typical heavy grading equipment. Laboratory tests indicated engineered soil fills would most likely have favorable high strengths and low expansion potential. Data indicated low soluble sulfate and chloride concentrations, near-neutral pH values, and relatively high measured minimum saturated resistivity values. The benign soil chemistry results indicated special protective measures for in-ground concrete and metal improvements should not be needed.

Grading. The 2012 conceptual master plan exhibit provided no finish grade information or preliminary earthwork quantity estimates. It is naturally presumed that cut-and-fill mass grading is planned. Cuts will most likely involve lowering of knolls and ridges. Most intervening areas mapped as "Qal" will likely receive some depth of fill. All development areas close to or within designated 100-year flood hazard zones will require fill. Perhaps the deepest fill may be proposed for the Montgomery Creek watercourse, which the conceptual plan suggests will be substituted with a buried culvert or large-diameter pipe.

All existing soils close to ground surfaces were deemed unsuitable by RMA for support of building foundations, building slabs, or added compacted fill. Overexcavation and recompaction of shallow soils were recommended. Predicted "removal" depths were:

- Man-made fill: All existing fill soils to the top of competent natural ground; up to 10 feet or so expected in A.C. Dysart Equestrian Park.
- Wash deposits: Undefined (areas were not explored), but stated as "complete removal" to underlying competent native materials.
- Younger alluvium: Minimum 5 feet or so, but with anticipated deeper removals in some areas, "possibly extending up to maximum depth[s] of 20 to 30 feet".
- Older alluvium: Typically ~2 to 5 feet.

Foundations & Slabs-on-Grade. Standard reinforced concrete shallow continuous footings and isolated pad foundations were judged suitable. All foundations would be expected to bear on specified minimum depths of engineered compacted fill below the base of concrete. Said minimum depths would be established in design-phase investigations.

For floor slabs-on-grade, RMA suggested an actual concrete thickness of 4.0 inches. Plain concrete with weakened plane joints, or alternatively reinforcement with 6"x6" 10/10 welded-wire fabric were considered suitable options. AGI presumes these preliminary guidelines apply to single-family homes. Different guidelines could be more appropriate for commercial structures, clubhouses, buildings taller than two stories, and condominium-type development. Special site conditions including expansive subgrade soils or localities where differential settlements are a concern could also require upgrading to deformed bars or selection of post-tensioned slab designs. The reports do point out that slab-on-grade recommendations need further evaluation both after the availability of grading plans, and in the as-built condition. RMA included adequate references to selection and placement of sub-slab vapor retarders applicable to most any type of occupancy construction.

REVIEW CONCLUSIONS, ADVICE, AND RECOMMENDATIONS

RMA concluded that the Rancho San Gorgonio concept was feasible from geotechnical design and geological risk management viewpoints. We concur. RMA's *Geotechnical Investigation* report and addendum report remain in gross conformance with contemporary standards of care and regional guidelines for a feasibility-level inquiry. Importantly, further subsurface work has been explicitly recommended as a prelude to required project engineering design approvals. We believe the City of Banning may accept the documents once certain AGI-recommended updates and clarifications have been received and vetted.

It is the opinion of this firm that *the No. 1 potential hazard and development constraint at Rancho San Gorgonio is differential settlement by the mechanism of hydrocollapse*. Soil collapse potential was not discussed by RMA. The phenomenon is a rapid, irreversible compression of the soil column under the influences of an imposed load and rises in soil water content such as from anthropic irrigation or runoff. Susceptibility to collapse can be expected to be very low in dense, cemented soils (e.g., older alluvium), but potentially very high in loose, dry, and visibly porous soils (e.g., younger alluvium and especially any wind-laid silty sediments). Measured collapse in the few RMA-tested samples ranged from 0.11% to 2.91%. AGI's Banning experience and prediction would be that some younger sediments could have over **2½ times** the maximum measured value. Effects on the built environment could be severe. The site geological model is a near-perfect analogue to localities elsewhere in Riverside County that experienced earth fissuring, surface subsidence, ruptured utility lines, and tilted homes wherever susceptible materials were not mitigated and were later buried under fill.

Recommended Updates, Corrections, and Information Requests

The following numbered paragraphs voiced to the project proponents and their consultants highlight items AGI believes should be mandatory conditions for approval of record geotechnical documents. The 2012 report is approaching 3 years since the date of actual site investigation. Site conditions, regulatory standards, and professional practice all can change. We advise adhering to a regionally observed rule-of-thumb that submitted reports should be less than one year old from date of issuance for lead agency consideration.

Item #1. Please provide a geotechnical update letter indicating that the engineer-of-record has made findings that the conclusions and recommendations of previous reports are still valid. The update letter at a minimum should address the following:

- *Changes to surface conditions (land use; vegetation; grading; export/import of soils or unsuitable materials; new erosion features; etc.).*
- *Whether local, County, State, and Federal agencies have imposed any new hazard or special studies zones involving the project site since 2012.*
- *Descriptions of any significant changes in the local groundwater regime, with reference to updated groundwater elevation data (State WQCB records are current to Spring 2015).*
- *An affirmative statement that the subsurface data in the 2012 report remain representative of today's predicted conditions, in the opinion of the consultant. Data from confirmation soil borings should be supplied if there is reason to believe that significant changes have in fact occurred.*
- *An affirmative statement that preliminary design criteria for site earthwork and structures are still applicable. Provide revised criteria where required. Revise all code references where applicable (e.g., slab-on-grade section, p. 15).*
- *Updated professional signatures/seals indicating current licensure.*

Item #2. Discuss the susceptibility, risks, possible site effects, and mitigation for collapsible soils. Will "all" younger alluvium require excavation and replacement as engineered fill? Indicate whether structural mitigation (e.g., P-T or other stiffened foundation-slab approaches) may be a future recommended option if complete removals are not required. Provide quantified estimates of total vertical collapse-mediated displacement in the absence of any mitigation. What objective criteria may be used to discriminate unsuitable from suitable younger alluvium bottoms at time of construction? Although it is acknowledged that the feasibility report is not intended *to provide specific details, some discussion of how grading methods will mitigate differential settlement risks in the transition zones between older alluvium ridges and future fill ± younger alluvium should be considered.*

Item #3. Indicate whether modified compaction criteria and consolidation settlement monitoring may be needed for deep fill, generally considered to be 50 feet or more. We suspect deep alluvial removals plus raw fills may approach this number.

Item #4. The same Flood Insurance Rate Map is referenced three times in the report (page 8). Revise the reference to include the three correct map sheets [0816G, 0817G, and 0819G]. City and Riverside County safety element maps for flooding are poor – please include scaled exhibits from the FEMA website (FIRMettes) or an assembled map built from digital downloads showing the official flood hazard zones.

Item #5. The potential for debris flow hazard from steep, off-site watersheds adjacent to the southeast part of the project need to be addressed. Will hazard vary with time, e.g., could risks become elevated after wildfire? Indicate whether mitigation needs to be included in project planning.

Item #6. AGI believes the same area called out above may present hazard of rockfall. Findings of absence or presence of unstable corestones should be presented. Can unstable corestones potentially several hundred feet in elevation above Rancho San Gorgonio be mitigated? The bedrock spur ridge in the site appears to have a small number of strewn blocks near the eastern slope toe. The consultant should recommend a suitable preliminary horizontal setback from the slope for structures in the "future use" are shown on the conceptual plan; the recommendation could include a proviso allowing for shortening or eliminating setbacks pending detailed plans and geotechnical design investigations. Suggest mitigation options.

<u>Revised Seismic Design Criteria</u>. As of January 1, 2014, prescriptive design coefficients for mitigating seismic loads in Riverside County and the City of Banning shall conform with the 2013 California Building Code (CBC) and 2013 California Residential Code (CRC). Compared to older codes, the 2013 versions generally result in higher seismic demands in near-source regions. The 2013 CBC relies on a Web-based software tool, using as primary inputs the site's location and the assigned site class. The latter is a measure of

"stiffness" determined by borehole tests or geophysical methods. The 2013 code explicitly incorporates seismic risk calculated from the probabilistic 2008 National Seismic Hazard model and newer attenuation functions.

City officials should be aware that in less than 18 months the code development cycle will renew with the 2016 CBC. We expect that 2013 seismic load criteria will change, and that geotechnical design reports will need to present new updates. The future code will incorporate a new hazard model and refinements to certain structural response coefficients. It is likely to result in slightly higher design loads in the Pass region. Owners are reminded that the 2013 CBC/CRC and related codes define minimum criteria needed to produce acceptable life-safety performance. Code-compliant structures can still suffer damage. Project proponents should be aware that structures can be designed to further limit earthquake damage, sometimes for modest cost premiums.

> *Item #7. The consultant should reconstitute the table in §3.10 of the primary investigation report to reflect 2013 code values. Rancho San Gorgonio is a large site. Accordingly, sensitivity analyses using the closest site-to-source coordinates should be undertaken. The updated table should reflect the most conservative (highest) coefficients to validate feasibility (include the relevant geographic coordinates). Identify the Seismic Design Category for residences (CRC R301.2.2.1.1); more than one SDC may be applicable depending upon geographic location and building design restrictions per CRC §R301.2.2.1.2 (2). Identify SDC for non-residential buildings. Include CBC-required site-modified zero-period* MCE_R *ground motion estimate* PGA_M *and seismic response coefficients* C_{RS} *and* C_{R1} *determined by the software tool from Figures 22-17 and 22-18 of ASCE/SEI 7-10.*
>
> *Item #8. Comment on the source for the reported magnitude of the July 8, 1986 North Palm Springs earthquake (p. 8 and Table 2). Later work by the U.S. Geological Survey raised the magnitude to (variously)* $M_w6.0$ *-* $M_w6.2$ *based on slip area and surface damage effects.*
>
> *Item #9. Quantify dynamic settlement potentials for loose unsaturated soil deposits (Qw, Qal) and dense soil deposits (Qoal) without earthwork mitigation, using a selected event (*PGA_M *or mode-magnitude earthquake from a deaggregation analysis) and known or estimated soil properties.*

> *Item #10. Review and revise if needed the seismic loads on retaining walls calculated according to rigid-plastic methods (M-O or similar). Indicate the percent exceedance frequency and how pga was derived (mode-magnitude, PGA_M, or $S_{DS}/2.5$).*

Infiltration Potential. Stormwater management rules have changed significantly since 2012. Developers are tasked with supplying water quality management plans (WQMPs, based on an agency template and rules of the *Whitewater River Region WQMP Guidance Document* approved on December 31, 2014) as a part of construction entitlement actions. Features and improvements that will filter, detain, and infiltrate nuisance water flows and storm runoff will be required. Goals are protection of water quality, and hydromodification to reduce peak discharges to volumes no higher than the pre-existing condition. WQMPs prepared by the project civil engineer usually require locality-specific subsurface soils investigations and infiltration test data to substantiate suitability for engineered basins and the like. AGI predicts several such infiltration test reports may be required as project phases enter the City's approval process. We do not believe WQMPs with their detailed hydrology calculations are required or even possible at this point; however, we would think that some finding or opinion is needed to show which low impact design (LID) stormwater management options are feasible, and which are not.

Very limited data were presented concerning the site's ability to infiltrate captured stormwater flows. The tests were done at locations we would not expect to be candidate sites for surface basins based on the conceptual master plan. The master plan in fact lacks any depictions of basins. The project's total area would hint that some basins might need to be several acres in size. The Lead Agency may need to investigate whether basins must actually be shown on the concept. Nonetheless, the infiltration data and soils classifications do highlight a generalized AGI interpretation of soil infiltration capability. From worst to best capability:

Older cemented alluvium ⇒ Younger alluvium ⇒ Wash deposits

Wash deposits may of course be unavailable for creation of basins and the like, inasmuch they are in jurisdictional USA waters subject to flood. Younger alluvium could theoretically be retained in some areas as an infiltration medium. Older alluvium will probably almost always exhibit low infiltration velocities. Engineered fill is not suitable or allowed as an infiltration medium in any case.

> *Item #11. Indicate depth bgs for the three completed double-ring tests. Provide stated opinions of infiltration feasibility for site materials classes, in light of knowledge that any basin or treatment control BMP must clear in 48 hours. The consultant shall indicate whether basins could pose unintended risks of slope instability, liquefaction (from perched-water layers), settlement, or soil collapse to on-site development or off-site properties, and if so, suggest alternative management approaches that respect geotechnical conditions. Lastly, if the Lead Agency determines that approximate basin sizes and locations must be disclosed on conceptual plans, the consultant should obtain additional test data from those locations at proposed or estimated bottom depths.*

Site-Specific Investigations. AGI concurs with RMA recommendations that design-phase geotechnical studies will need to be undertaken. These studies will become the basis for grading plan specifications. AGI advises that major non-residential buildings, buildings taller than two stories, buildings with first-floor areas exceeding 5,000 square feet, and condominium/apartment type structures should also be individually investigated once more-detailed plans become available.

FEMA will require one or more so-called "Letters of Map Revision" when flood control infrastructure is contemplated to remove areas from the 100-year flood zones. Engineered dikes, levees, or armored bank protection may be proposed. These should be evaluated by alignment-specific investigations. Foundation design (spread footings or deep foundations) and scour protection would be topics for site-specific geotechnical engineering investigations of proposed bridges.

Closure

The findings and preliminary opinions in this report may require modification as a result of later field observations or subsurface work. Our opinions have been based on the improvements and dimensions illustrated on the referenced plans. Changes in the Rancho San Gorgonio specific plan may alter or add to our recommended supplemental information requests.

This report was prepared for the use of the City of Banning, the project proponent, and their engineering consultants. Our findings, opinions, and recommendations reflect presently accepted scientific and engineering principles, regulatory requirements, and

Southern California professional practice in the disciplines of engineering geology and geotechnical engineering. We make no other warranties either expressed or implied. Environmental or hazardous materials risk assessments were beyond the scope of AGI's review. Current findings can be invalidated in the future on the basis of code changes, new hazard mitigation criteria, or findings made during actual construction.

We appreciate your trust in AGI professional opinions and advice. Please contact the undersigned at our Riverside office at (951) 776-0345 if you have questions.

Respectfully submitted,
Aragón Geotechnical, Inc.

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RMA GeoScience

GEOTECHNICAL CONSULTANTS

GEOTECHNICAL INVESTIGATION
FOR
PROPOSED RANCHO SAN GORGONIO MASTER PLANNED COMMUNITY
BANNING, CA

for

Rancho San Gorgonio, LLC
10621 Civic Center Drive
Rancho Cucamonga, CA 91730

November 8, 2012

12-G02-01

RMA GeoScience

GEOTECHNICAL CONSULTANTS

November 8, 2012

Rancho San Gorgonio, LLC
10621 Civic Center Drive
Rancho Cucamonga, CA 91730

Attention: Mr. Peter J. Pitassi, A.I.A.
Project Manager

Subject: Geotechnical Investigation for
Proposed Rancho San Gorgonio
Master Planned Community
Banning, CA

Dear Mr. Pitassi:

In accordance with your request, a geotechnical investigation has been completed for the above-referenced project. The report addresses both engineering geologic and geotechnical conditions. The results of the investigation are presented in the accompanying report, which includes a description of site conditions, results of our field exploration and laboratory testing, conclusions, and recommendations.

We appreciate this opportunity to be of continued service to you. If you have any questions regarding this report, please do not hesitate to contact us at your convenience.

Respectfully submitted,

RMA Group

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1.00 INTRODUCTION

1.01 Purpose

A geotechnical investigation has been completed for a proposed master planned community known as Rancho San Gorgonio in the City of Banning and County of Riverside, California. The purpose of the investigation is present geotechnical and geologic information to aid in obtaining following entitlement permits and approvals: A General Plan Amendment, Zone Changes, a Specific Plan, a Certified Environmental Impact Report, a Local Agency Formation Commission (LAFCO) Annexation, a Development Agreement, a Master Tract Map, a U.S. Army Corp of Engineers 404 permit, a California Department of Fish and Game 1603 permit, and a Waste Discharge Requirement permit (WDR) from the California Regional Water Quality Control Board (RWQCB).

1.02 Scope of the Investigation

The general scope of this investigation included the following:

- Review of published and unpublished geologic, seismic, groundwater and geotechnical literature.
- Examination of aerial photographs.
- Contacting of underground service alert to locate onsite utility lines.
- Logging, sampling and backfilling of 15 exploratory borings drilled with a CME-75 drill rig.
- Logging and sampling of 41 exploratory trenches excavated and backfilled with a backhoe.
- Three soil infiltration tests using a double ring infiltrometer.
- Two seismic fraction lines.
- Laboratory testing of representative soil samples.
- Geotechnical evaluation of the compiled data.
- Preparation of this report presenting our findings, conclusions and recommendations.

Our scope of work did not include a preliminary site assessment for the potential of hazardous materials onsite.

1.03 Site Location and Description

The site consists of approximately 803 acres of land. The majority of the site is located in the City of Banning, California. The southwest portion of the site is located in an unincorporated portion of the County of Riverside, California.

The property is generally bounded by Sunset Avenue and Turtle Dove Lane on the west, Coyote Trail and Old Idyllwild Road on the south, San Gorgonio Avenue on the east, and Westward Way on the north less several parcels on land south of Westward Way (Figure 1). The approximate geographic position of the center of the site is 33.9106° latitude and -116.8940° longitude.

The property is identified by the following Assessor's Parcel Numbers:

537-150-005
537-150-006
537-150-007
537-170-002
537-170-003
537-190-001
537-190-002
537-190-003
537-190-004
537-190-005
537-190-018
537-190-019
537-190-020
537-190-021
537-190-022
537-200-031
537-200-032
537-200-033
537-200-034
537-200-035
537-200-036
537-200-037
537-200-038
543-020-021
543-030-004
543-040-001
543-040-002
543-050-001
543-050-002
543-050-003

The location of the parcels in illustrated in Figure 2.

The majority of the property consists of gentle rolling hills, valleys and incised drainage courses. Four major drainage courses cross the property: Smith Creek, Pershing Creek, Montgomery Creek and Gilman Home Channel. The locations of these drainage courses are shown on Figure 1. There is a rugged bedrock knob in the southeast corner of the site. Elevations range from approximately 2,400 to 2,200 feet above sea level. At the time of this study, the majority of the site was cover by sparse, low, dry grasses with a few areas of thin to moderately dense brush. There were also scattered trees within larger drainage courses.

Improvements on the site consist of fences to contain livestock, towers for electrical transmission lines, electrical transmission lines which cross the center of the property in an east-west direction, electrical transmission lines which cross the southeast corner of the site, a 36-inch diameter gas transmission pipeline that crosses the center of the property in a east-west direction, an east-west trending water main in the southeast portion of the site, livestock watering troughs, and water supply pipes to some of the watering troughs. Several dirt roads cross the property. The roads are used for property access, for maintenance of utility lines, and access to the gas transmission pipeline. There are no structures on the site.

1.04 Current and Past Land Usage

The property is currently used for rangeland for cattle and horses, and is crossed by a 36-inch diameter gas line and electrical transmission lines. A water main was also installed in the southwest corner of the site, apparently in anticipation of development of that portion of the site with ranch type residences.

Aerial photographs indicate that the site there has been no prior development of the site, with the exceptions of a house at the southeast corner of Westward Way and Lovell Street and the above mentioned improvements. Tonal patterns on aerial photographs suggest the property has been used for cattle grazing back to the 1980's or earlier. Prior to that, it appears that the property was used for dry farming, probably hay alfalfa or grain crops. In the 1940s or earlier, there were orchards (probably citrus) in northern and eastern portions of the site.

1.05 Planned Usage

It is our understanding that the proposed development will consist of a residential master planned community that will included multiple housing types, community facilities, and infrastructure improvements (Figure 3). Our investigation was performed prior to the preparation of grading or foundation plans. To aid in preparation of this report, we utilized the following assumptions:

- Maximum foundation loads of 2 to 3 kips per linear foot for continuous footings and 60 kips for isolated spread footings.

- Cuts and fills will be less than 25 feet.

1.06 Investigation Methods and Limitations

Our investigation consisted of office research, field exploration, laboratory testing, review of the compiled data, and preparation of this report. It has been performed in a manner consistent with generally accepted engineering and geologic principles and practices, and has incorporated applicable requirements of California Buildings Code. Definitions of technical terms and symbols used in this report include those of the ASTM International, the California Building Code, and commonly used geologic nomenclature.

Technical supporting data are presented in the attached appendices. Appendix A presents a description of the methods and equipment used in performing the field exploration and logs of our subsurface exploration. Appendix B presents a description of our laboratory testing and the test results. Standard Grading Specifications and references are presented in Appendices C and D, respectively.

Access to portions of the site was limited due to environmental constraints (burrowing owls and jurisdictional drainages).

2.00 FINDINGS

2.01 Geologic Setting

The site is located in the San Gorgonio Pass, an elongate east-west trending valley situated between the San Bernardino and San Jacinto Mountains. This valley is part of the major drainage divide between the Pacific Ocean and Salton Trough and is filled with multiple generations of alluvial deposits that are mainly derived from the San Bernardino Mountains. The high part of the valley is to the west of the site. From there it slopes downward to the east until it merges with the alluvial filled Coachella Valley. To the west the valley merges with older alluvial soils of the Beaumont Plain.

Sedimentary deposits along the north side of the San Gorgonio Pass are folded and cut by north dipping low-angle thrust and wrench faults of the San Gorgonio Pass fault pass fault zone. Traversing the north side of the San Gorgonio Pass is the Banning fault, a segment of the San Andreas fault zone.

Regional geologic mapping by Dibblee (Figure 4) indicates that the site is underlain by Holocene and Pleistocene age alluvial soils, except for a small hill in the southeast portion of the property that is composed of granitic and metamorphic bedrock.

2.02 Earth Materials

Our field investigation encountered five geologic units: artificial fill, wash deposits, alluvium, older alluvium, and crystalline bedrock. These units are described individually below and where encountered during our subsurface investigation on the accompanying boring and trench logs (Appendix A).

- Artificial Fill (No Map Symbol)

  Artificial fills have been placed along the contours of rolling hills within the site, apparently as an aid to control erosion. These fills appear to have been derived from onsite older alluvial soils composed of silty sands and sandy silts. We found no information regarding the placement and compaction of these fills.

  In addition, backfill was placed over the 36-inch diameter gas pipeline that crosses the center of the site and the water main in the southwest corner of the site. We found no information regarding the placement or compaction of these fills.

- Wash Deposits (Map Symbol Qw)

  Wash deposits occur in active drainage courses within the site, namely Smith Creek, Pershing Creek, Montgomery Creek and Gilman Home Channel. These deposits consist primarily of gray-white fine to coarse grained sands. Exploratory excavations were not made in these drainage courses because of jurisdictional issues.

- Alluvium (Map Symbol Qal)

  Alluvial deposits occur in valley areas and tributary drainage courses within the site. These deposits are typically composed of grayish brown and brown sandy silts, silty sands with some sand layers. At the time of our study, the deposits typically ranged from dry to moist and were found to typically range from loose to medium dense.

- Older Alluvium (Map Symbol Qoal)

  Older alluvial deposits underlie the higher elevations of the site and younger geologic units. This Pleistocene age deposit occurs as rolling hills and flattop mesas within the site. These deposits consist primarily of reddish brown silty sand with some layers of sand. The deposit was typically found to be dense to very dense and moist. The soil profile developed over this unit was found to be clayey in some areas.

- Granitic and Metamorphic Bedrock (Map Symbol Kqd-ms)

  Granitic and metamorphic bedrock underlie the hill in the southeast corner of the site. Dibblee (2003) classified the bedrock as Cretaceous quartz diorite and Paleozoic metasedimentary rocks. He indicates that the foliation of these rocks dips to the east from approximately 50 to 75 degrees (Figure 4). The two rock types are clearly visible within the knob and hillsides to the south. We have not mapped the bedrock in detail because the knob where they occur will not be developed. For simplicity, we have grouped with two bedrock types into a single geologic unit.

A site Geologic Map showing the distribution of the above geologic units and the locations of our borings and trenches is presented as Figure 5. Logs of the borings and trenches are presented in Appendix A.

2.03 Expansive Soils

Expansion testing was performed on three soil samples that were collected within the site. The test results indicate that these soils have a very low expansion potential. Based on visual observation, it appears that some surficial soils overlying older alluvial deposits may be expansive. However, these soils account for only a small portion of the soils that underlie the site and are therefore are expected to have little or no impact on site development upon completion of grading. Results of expansion tests are presented in Appendix B.

Since expansion testing was performed on only a small portion of the soils within the site and since site grading will redistribute soils, additional testing of the expansive properties of soils should be performed during future geotechnical investigations of the property and near the completion of rough grading in each development area.

2.04 Surface and Groundwater Conditions

Springs, seepage and standing water were not present at the time of our study. A wetlands area was present just south of Westward Way in the northwestern portion of the site. The sources of the water in this area are outflow from a storm drain and possibly overflow from an offsite water storage tank. Water seasonally collects in excavations that were made in a hilltop in the northwest portion of the site west of Sunset Avenue. Creek beds within the site were dry at the time of our field investigation. Topographic maps show a standing water body in the east-central part of the site (Figure 1). There is a low concrete wall in that area that is about 3 feet high that apparently ponds seasonal surface runoff. The impounded water is apparently used as a water source for grazing livestock.

Groundwater was not encountered during our subsurface exploration. According to the California Department of Water Resources State Groundwater Elevation Monitoring System, the depth to ground water in the vicinity of the site has ranged from approximately 240 to 560 feet below the ground surface. Data from nearby wells is summarized below:

Well No.	Approximate Distance from Site	Highest Groundwater Level (ft)	Lowest Groundwater Level (ft)	Dates of Reported Groundwater Measurements
03S01E18A001S	0.15 miles to the west	246.0	401.2	1998-2010
03S01E19A001S	0.75 miles to the southwest	244.6	254.0	2007-2010
03S01E10N001S	0.33 miles to the northeast	499.5	557.4	2005-2005

The depth to groundwater in Well C5 located just south of the intersection of Westward Way and Woodland Avenue (east of Sunset Avenue) ranged from approximately 320 to 430 feet below the ground surface between 1997 and 2000 (Geoscience, 2010). The southern portion of the site is identified as an area of significant groundwater decline as a result of outflow into the Colorado River Aqueduct San Jacinto Tunnel, which is located within the San Jacinto Mountains to the south of the site (Bloyd, 1971).

It is possible that shallower perch groundwater may occur seasonally along or near drainage courses.

2.05 Faults

The site is not located within the boundaries of an Earthquake Fault Zone for fault-rupture hazards as defined by the Alquist-Priolo Earthquake Fault Zoning Act. The nearest Earthquake Fault Zone is located more than one mile to the north along the San Gorgonio Pass fault. In addition, the site is not located within a fault rupture hazard zone established by either the City of Banning or the County of Riverside (Figure 6).

Two faults have been mapped through the site, The McMullen fault and the Central Banning Barrier fault. However, within the site these postulated faults have no surface expression and are buried by thick alluvial deposits. The McMullen and Central Banning Barrier faults are not included with the limits of City, County or State fault rupture hazard zones.

San Andreas Fault

The San Andreas fault zone within San Gorgonio pass is complex and remains a topic of research. The San Andreas fault breaks into several different segments, but the relationship of each segment with the entire San Andreas fault is not clear. The southern branch of the San Andreas fault projects into the Banning and San Gorgonio Pass fault zones, which are located more than one mile north of the site. The northern branch of the San Andreas fault passes through the San Bernardino Mountains approximately 6 miles to the north of the site and is known as the Mission Creek fault.

Banning Fault

The Banning fault, which is located about 3 miles to the north of the site at its nearest point, is a strike-slip fault that extends for a distance of about 50 miles from the Indio Hills in the Coachella Valley to the San Jacinto fault in Loma Linda. According to Matti, Morton and Cox (1992) the Banning fault has had a complex history that includes both left- and right-lateral displacements. They report that during middle Miocene time the Banning fault zone may have juxtaposed the Peninsular Ranges block against the San Gabriel Mountains block along a regionally extensive fault system. They also report that during late Miocene time the Banning fault was incorporated into the San Andreas transform system and was probably the eastward continuation of the San Gabriel fault in the San Gabriel Mountains. The Banning fault was apparently abandoned by the San Andreas system in early Pliocene time. Within the San Gorgonio Pass, the Banning fault is obscured by Quaternary age sedimentary deposits and has been modified by Quaternary reverse, thrust, and wrench faults of the San Gorgonio Pass fault zone.

San Gorgonio Pass Fault Zone

The San Gorgonio Pass fault zone consists of a series of reverse, thrust, and wrench faults that extend from Whitewater to Calimesa on the north side of San Gorgonio Pass. In map view, the San Gorgonio Pass fault zone has a distinctive zigzag pattern. Movements the San Gorgonio Pass fault zone have occurred during late Quaternary time. The nearest trace of the San Gorgonio Pass fault zone is located more than one mile north of the site.

McMullen Fault

The McMullen fault was originally mapped by the U.S. Geological Survey (Bloyd, 1971) as a bedrock fault within the crystalline bedrock of the San Jacinto Mountains south of the site. Bloyd did not extend the fault to the north into the San Gorgonio Pass or through the site (Figure 7). Other recent regional maps prepared by the California Geological Survey (Jennings and Bryant, 2010 and Jennings and others, 2010) also show the McMullen fault within the crystalline bedrock south of the site, but do not extend the fault further north into the San Gorgonio Pass or through the site. The McMullen fault is not shown on regional geologic maps prepared by Dibblee (Figure 4) and Rodgers (1965). The City of Banning General Plan (Exhibit V-1) shows the McMullen fault extending from the San Jacinto Mountains northwesterly into the San Gorgonio Pass and through the site (Figure 6). The General Plan map shows that the portion of the McMullen fault within San Gorgonio Pass and the site is concealed by younger and older alluvial deposits. The McMullen fault is not included within the limits of City of Banning or County of Riverside fault hazard rupture zones, and it is not included within the limits of a California Alquist-Priolo Earthquake Fault Zone for fault rupture hazards.

The potential impact of the McMullen fault on site development was further evaluation by analysis of aerial photographs, geologic field mapping and a geophysical survey.

Aerial photographs from Google Earth, Historicaerials.com and the Riverside County Flood Control District were examined for topographic, vegetation and tonal lineaments that might be indicative of near surface faulting. Two tonal lineaments are visible on 1948 aerial photographs from the Riverside County Flood Control District. One of the lineaments occurs in an alluvial area south of the site between the San Jacinto Mountains and Old Idyllwild Road. This lineament is about 450 feet long and was also observed on 1996, 2003, 2004, 2005 and 2011 Google Earth aerial photographs, but not on 2002, 2006, 2009 and 2012 Google Earth aerial photographs. The lineament projects south into rugged mountainous terrain. The lineament does not extend north of Old Idyllwild Road into the site. A flat-top mesa of Pleistocene age older alluvium crosses the projected trend of the lineament to the north. The lineament appears to be the result and land clearing and discing for weed control. A second tonal lineament was observed on the 1948 aerial photograph from the Riverside County Flood Control District. This lineament is about 800 feet long and occurs between two bedrock knobs within the southeast portion of the site, west of the other lineament. This lineament was not observed on any other aerial photographs. It projects to the south into rugged mountainous terrain underlain by granitic bedrock. The lineament does not extend north of Smith Creek.

In the field we did not observe any landforms along lineaments or their projected trends suggestive of faulting such as scarps or offset drainage courses. In addition, we did not observe any vegetation patterns suggestive of faulting along the lineaments or their projected traces.

Seismic refraction lines were run across the projected trend of the eastern lineament and the location of the western lineament by Terra Geosciences. The seismic lines were each 300 feet long and were orientated perpendicular the trend of the lineaments. Two velocity layers were identified Seismic Line No. 1, which was run across the westerly lineament. The upper velocity layer (1,586 ft/sec) is interpreted to be alluvium and the lower velocity layer (6,738 ft/sec) is interpreted to be crystalline bedrock. There were no abrupt changes in the contact between the velocity layers to suggest the presence of faulting. Two velocity layers were identified Seismic Line No. 2, which was run across the projected trend of the easterly lineament. The upper velocity layer (1,487 ft/sec) is interpreted to be alluvium and the lower velocity layer (2,261 ft/sec) is interpreted to be older alluvium. There were no abrupt changes in the contact between the velocity layers to suggest the presence of faulting. Results of the seismic refraction lines and a description of the procedures used are presented in Appendix B.

Based on observations presented above, it is our opinion that the concealed McMullen fault, if present within the site, has no near surface express and it is covered by both younger and older (Pleistocene age) alluvium. Thus it is our opinion that measures to mitigate the potential for future surface fault rupture along the postulated trace of the McMullen fault do not need to be incorporated into planning and development of the site.

Central Banning Barrier Fault

A U.S. Geological Survey groundwater study (Rewis and others, 2006) indicates that there may be multiple buried groundwater barriers in the San Gorgonio pass area that are referred to as the Banning Barrier faults. The study has postulated that these barriers are L-shaped faults, similar to the zigzag fault pattern of the San Gorgonio Pass fault zone. However, their study indicates that Banning Barrier faults have no surface expression and are not an extension of the San Gorgonio Pass faults. The postulated Central Banning Barrier fault has not been zoned as a surface fault rupture hazard by the City of Banning, County of Riverside, or the State of California.

The Rewis study mapped one of these postulated features, the Central Banning Barrier fault, through the northwestern portion of the site (Figure 8). A cross section contained in the study indicates that the Central Banning Barrier fault is overlain by approximately 300 feet of unfaulted older alluvial deposits (Figure 8). Although the Rewis study does not specify the age of the older alluvial soils, multiple regional geologic maps, such as Dibble (Figure 4), indicate that the older alluvial soils are Pleistocene in age. Consequently the fault, if present, would be classified as not active according to current criteria of the State of California, which defines active faults as those displacing Holocene age deposits. The Barriers faults are shown to offset very old (early Pleistocene age) alluvium and therefore are classified as potentially active according to current criteria of the State of California criteria which defines potentially active faults as those that offset Pleistocene age deposits.

We reviewed multiple stereo and non-stereo aerial photographs and performed geologic field mapping to determine if there are any lineaments or geomorphic features that might be indicative of surface expression of the Central Banning Barrier fault. The Rewis study shows one leg of the L-shaped Central Banning Barrier fault trending in a northwest-southeast direction similar to the direction of drainage courses in the south Banning region. The course of these drainages is apparently controlled by regional uplift and tilting, but the possibility of fault control cannot be entirely ruled out. However, the other leg of the L-shaped barrier is perpendicular to the regional drainage pattern and crosses flat-top mesas of older alluvium. Our review of landforms along the northeast-southwest leg of the postulated Central Banning fault revealed no aerial photo lineaments or scarps suggesting the presence of near surface faulting. The absence of such features is in agreement with the conclusions of the Rewis study that the barrier does not have surface expression. The Rewis study further indicates that the groundwater barrier affect ends more than 200 feet below the ground surface.

Therefore, we concur with the Rewis study that the Central Banning Barrier fault, if present, is a deep subsurface the does not reach the ground surface and thus in our opinion it is not a surface fault rupture hazard within the site.

Other Regional Faults

Faults in the San Gorgonio pass region are shown on Figure 6. The distances to notable faults within 100 kilometers of the site are presented on Table 1.

2.06 Historic Seismicity

Four historic strong earthquakes have been epicentered within about 20 miles of the site. The most recent of these events were the magnitude 5.6 North Palm Springs earthquake in 1986 and the magnitude 6.5 Big Bear earthquake in 1992. Both of these events were epicentered about 18 miles from the site. Large earthquakes also occurred in the San Jacinto region in 1899 and near Hemet in 1918. It is estimated that the San Jacinto earthquake had a magnitude of 6.7 and was epicentered about 10 miles from the site. It is estimated that the Hemet earthquake had a magnitude of 6.8 and was epicentered about 13 miles from the site. However, since the San Jacinto and Hemet earthquakes occurred prior to the development of seismic monitoring networks, and their locations and magnitudes are only approximate. Strong earthquakes that have occurred within the region in historic time and their approximate epicentral distances are summarized in Table 2.

2.07 Flooding Potential

According to Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) 06065C0816G, 06065C0816G and 06065C0816G (effective dates August 28, 2008), Smith Creek, Pershing Creek, Montgomery Creek, and Gilman Home Channel, are areas subject to inundation by the 1% annual change flood (Zones A and AE). Zone A designates areas where no base flood elevations have been determined and Zone AE designates areas where base flood levels have been determined. Areas bordering Montgomery Creek and Gilman Home Channel, a drainage between Pershing and Montgomery Creeks, and tributaries of Pershing Creek and Gilman Home Channel were mapped as Stippled Zone X by FEMA. Stippled Zone X is defined as areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. The remainder of the site is located within Zone X which is defined as areas determined to be outside the 0.2% annual chance floodplain.

The locations of Smith Creek, Pershing Creek, Montgomery Creek, and Gilman Home Channel are illustrated on Figure 1. The FEMA flood zones are shown in the City of Banning General Plan. The Riverside County Transportation and Land Management Agency GIS Flood Zone map illustrates the major FEMA flood zones, but not the tributary flood zones.

The design civil engineer should consider these flood zones as well as other surface runoff originating from both within and outside of the site should in design of the project.

2.08 Landslides and Erosion

No large landslides were encountered during our field investigation and none were apparent on aerial photographs. The majority of the site is generally not susceptible to landsliding due its low gradient. Soils along and adjacent to some drainage course have been eroded by water and there have been some failures of channel banks. However, these areas are restricted to the immediate channel areas.

The site is located within an area of high speed winds. Therefore, soils at the site can experience wind erosion if vegetation, buildings, hardscape or other protective covers are absent.

2.09 Regional Land Subsidence

Ground subsidence is a gradual settling or sinking of the ground surface that is typically associated with oil, gas or groundwater extraction. According to the Riverside County General Plan, the site is located in an area that is susceptible to regional land subsidence. However, the City of Banning General Plan indicates that subsidence has not been observed within the City

There are no oil or gas fields within or near the site. Consequently, regional land subsidence due to extraction of oil or gas is not a hazard at the site. Alluvial sediments beneath could be susceptible to land subsidence if proper groundwater management practices are not followed. The City of Banning General Plan indicates that groundwater conservation and recharge activities have been implemented in the Banning to manage ground subsidence due to extraction of groundwater.

2.10 Mineral Resources

No mines or mineral resources are shown to be present within the site on a map showing the locations of mines and mineral resources in Riverside County (Saul and others, 1968). The City of Banning and County of Riverside general plans indicate that the site is located within Mineral Resource Zone MRZ-3, which is defined as an area containing mineral deposits, the significance of which cannot be evaluated from available data. The general plan maps and regional geologic maps do not identify any mineral resources within the site.

3.00 CONCLUSIONS AND RECOMMENDATIONS

3.01 General Conclusion

Based on specific data and information contained in this report, our understanding of the project and our general experience in engineering geology and geotechnical engineering, it is our professional judgment that the proposed development is geologically and geotechnically feasible. This is provided that the recommendations presented below are fully implemented during design, grading and construction.

3.02 General Earthwork and Grading

All grading should be performed in accordance with the General Earthwork and Grading Specifications outlined in Appendix C, unless specifically revised or amended below. Recommendations contained in Appendix C are general specifications for typical grading projects and may not be entirely applicable to this project.

It is also recommended that all earthwork and grading be performed in accordance with Appendix J of the 2010 California Building Code and all applicable governmental agency requirements. In the event of conflicts between this report and Appendix J, this report shall govern.

3.03 Earthwork Shrinkage and Subsidence

Shrinkage is the decrease in volume of soil upon removal and recompaction expressed as a percentage of the original in-place volume. Subsidence occurs as natural ground is densified to receive fill. These factors account for changes in earth volumes that will occur during grading.

Alluvium and existing fills are expected to have fairly high shrinkage, perhaps on the order of 10 to 20 percent. Because of its granular nature, the shrinkage of wash deposits is expected to be less. Based on our experience in similar wash deposits on other sites, shrinkage of wash deposits is expected to be on the order of 5 to 10 percent. Older alluvial soils are fairly dense, thus its shrinkage is expected to be less than alluvium, approximately 5 to 10 percent for surficial older alluvium and 0 to 5 percent for deeper older alluvium. Grading is currently not proposed within bedrock, thus its shrinkage potential is not applicable to the currently proposed project. Excavations in bedrock could result in bulking.

Since alluvial soils that will need to be densified have low in situ densities, subsidence could be on the order of 0.2 feet. Existing fill soils will need to be entirely removed to competent native soils and thus subsidence of fills is not applicable. It is expected that older alluvial soils that will be exposed at the base of removals will be dense, thus a subsidence value of 0.1 foot may be considered in planning. Wash deposits are expected to have a similar subsidence value. Subsidence in areas underlain by bedrock will be nil.

The above estimates of shrinkage and subsidence are based on a small sample size when the size of the property is considered. Shrinkage and subsidence potential should be studied in greater detail to refine these estimates. For initial planning purposes prior to additional testing, use of multiple shrinkage and subsidence scenarios should be considered.

The degree to which fill soils are compacted and variations in the insitu density of existing soils will influence earth volume changes. Consequently, some adjustments in grades near the completion of grading could be required to balance the earthwork.

3.04 Removals and Overexcavation

All vegetation, trash and debris should be cleared from the grading area and removed from the site. Prior to placement of compacted fills, all non-engineered fills and loose, porous, or compressible soils will need to be removed down to competent ground. Depths of removals will be dependent upon the nature of the underlying soils and proposed land use. In general, it is anticipated that the following removals will be need for areas to receive fill or support structures:

- Artificial fills (No Map Symbol): Complete removal of artificial fills to competent natural ground is anticipated.

- Wash deposits (Map Symbol Qw): Complete removal to underlying competent alluvial or older alluvial deposits. Depth of removal should be determined after jurisdictional drainage issues are resolved and anticipated grades have been established.

- Alluvium (Map Symbol Qal): The in situ density of alluvial soils within the site varies laterally and with depth. It is anticipated that removals of alluvium will typically need to extend to a minimum depth of 5 feet with deeper removals in some areas, possibly extending up to maximum depth of 20 to 30 feet. Alluvial removals will need to be evaluated in greater detail when grading plans are developed.

- Older alluvium (Map Symbol Qoal): Removals of older alluvium are expected to typically be on the order of 2 to 5 feet, depending upon the nature of the proposed development and near surface weathering of the older alluvial soils, although deeper removals might be needed in some areas.

- Granitic and Metamorphic Bedrock (Map Symbol Kqd-ms): No grading is currently proposed within the bedrock hill in the southeast corner of the site. Consequently, removal requirements for bedrock are not applicable at this time. Specific recommendations would need to be developed if grading is proposed within the hill at a later date.

More detail evaluation of removals should be developed once grading plans are available. At that time overexcavation recommendations should also be developed. Typically, footing areas that are not in deep fill areas are undercut, moistened, and compacted to a minimum of 90% relative compaction to a depth equal to the width of the footing below the bottom of the footing or to a depth of 3 feet below the bottom of the footing, whichever is less. Footing areas are typically defined as extending from the edge of the footing for a distance of 5 feet. Floor slabs, concrete flatwork and paved areas are typically underlain by a minimum of 12 inches of soil compacted to a minimum of 90% relative compaction. Removal and overexcavation depths will need to be confirmed or adjusted, if necessary, at the time of grading.

3.05 Rippability and Rock Disposal

Our exploratory trenches and borings indicate that soils within the site will be rippable with conventional heavy duty grading equipment and that it is unlikely that oversized materials will be encountered within the onsite soils.

The rippability of the bedrock knob in the southeast portion of the site was not specifically analyzed because no development in that area is currently proposed. Based on our visual field observations and experience with similar bedrock materials in southern California, we expect that heavy ripping and possibly blasting will be necessary to make significant cuts in the bedrock and that such excavations will likely generate oversized materials. Our general guidelines for rock disposal are presented in Appendix C. Implementation of our guidelines will require continuous testing and observation by a member of our staff. Oversized materials should not be placed within 10 feet of finish grade without the prior approval of the geotechnical consultant. Additional investigation of bedrock rippability can be performed, if requested.

3.06 Subdrains

Groundwater was not encountered during the course of our subsurface investigation. Water well data indicates that the depth to groundwater in the region is in excess of 200 feet. Conceptual development plans indicate that several drainage courses within the site will likely be filled. However, since it is anticipated that the permeability of native soils will be greater than soils would likely be placed within filled drainage courses, installation of canyon subdrains may not be necessary. The potential need for installation of canyon subdrains will need to be further evaluated once detailed development and grading plans have been prepared.

3.07 Fill and Cut Slopes

For preliminary planning purposes we recommend that cut and fill slopes be inclined no steeper than 2 horizontal to 1 vertical. More specific evaluation of slope stability should be performed once detailed site development and grading plans are prepared.

3.08 Wind and Water Erosion

High velocity winds occur within the San Gorgonio Pass where the site is located. Consequently, soils lacking vegetation or other cover will be subject to wind erosion. This should be considered in planning of the project and mitigation measures should be implement during and following earthwork.

Major drainages courses within the site have eroded meandering channels. These channels and their banks will be subject to future erosion during periods of high runoff. Mitigation of channel erosion and protection of adjoining areas to be developed will need to be addressed in planning, design and construction.

3.09 Faulting

Regional maps show two concealed faults within the site, the McMullen fault and the Central Banning Barrier fault. These have no known surface expression within the site and none was found during our field investigation. Since both of these faults are overlain by Pleistocene age older alluvium with the site and they are not included within the City, County or State fault rupture hazard zones, it is concluded that the faults do not represent a future surface fault rupture hazard. Other major faults within the regional are potential sources for future earthquakes, but they do not represent a future surface fault rupture hazards within the property because they do not pass through the site.

3.10 Seismic Design Parameters

Seismic design parameters have been developed in accordance with Section 1613 of the 2010 California Building Code (CBC) using the online U.S. Geological Survey Java Ground Motion Parameter Calculator (Version 5.1.0, ASCE 7 Standard) and a site location based on latitude and longitude. The calculator generates probabilistic and deterministic maximum considered earthquake spectral parameters represented by a 5-percent damped acceleration response spectrum having a 2-percent probability of exceedance in 50 years. The deterministic response accelerations are calculated as 150 percent of the largest median 5-percent damped spectral response acceleration computed on active faults within a region, where the deterministic values govern. The calculator does not, however, produce separate probabilistic and deterministic results. The parameters generated for the subject site are presented below:

2010 California Building Code (CBC) Seismic Parameters

Parameter	Value
Site Location	Latitude = 33.9106 degrees Longitude = -116.8940 degrees
Site Class	Site Class = D Soil Profile Name = Stiff soil profile
Mapped Spectral Accelerations (Site Class B)	S_s (0.2- second period) = 1.500g S_1 (1-second period) = 0.600g
Site Coefficients (Site Class D)	$F_a = 1.0$ $F_v = 1.5$
Maximum Considered Earthquake Spectral Accelerations (Site Class D)	S_{MS} (0.2- second period) = 1.500g S_{M1} (1-second period) = 0.900g
Design Earthquake Spectral Accelerations (Site Class D)	S_{DS} (0.2- second period) = 1.000g S_{D1} (1-second period) = 0.600g

The above table shows that $S_1 < 0.75g$, $S_{DS} > 0.50g$ and $S_{D1} > 0.20g$. Therefore, for the Seismic Design Category is D for all Occupancy Categories (CBC Section 1613.5.6). Consequently, as required for Seismic Design Categories D through F by CBC Section 1803.5.12, lateral pressures for earthquake ground motions, liquefaction and soil strength loss have been evaluated (see Sections 3.11 and 3.17).

For preliminary design purposes, we recommend a peak ground acceleration, PGA = $S_{DS}/2.5 = 1.000g/2.5 = 0.40g$.

3.11 Liquefaction and Secondary Earthquake Hazards

Potential secondary seismic hazards that can affect land development projects include liquefaction, tsunamis, seiches, seismically induced settlement, seismically induced flooding and seismically induced landsliding.

Liquefaction

Liquefaction is a phenomenon where earthquake- induced ground vibrations increase the pore pressure in saturated, granular soils until it is equal to the confining, overburden pressure. When this occurs, the soil can completely loose its shear strength and enter a liquefied state. The possibility of liquefaction is dependent upon grain size, relative density, confining pressure, saturation of the soils, and intensity and duration of ground shaking. In order for liquefaction to occur, three criteria must be met: underlying loose, coarse-grained (sandy) soils, a groundwater depth of less than about 50 feet, and a potential for seismic shaking from nearby large-magnitude earthquake.

According to the City of Banning and Riverside County General Plans, with site is located within an area of low to moderate liquefaction potential. However, since the depth to groundwater water within the site is on the order of 240 feet or more, the potential for liquefaction within the site is nil.

It should be noted that the California Geological Survey has not yet prepared a Seismic Hazard Zone Map of potential liquefaction hazards for the quadrangle in which the site is located.

Tsunamis and Seiches

Tsunamis are sea waves that are generated in response to large-magnitude earthquakes. When these waves reach shorelines, they sometimes produce coastal flooding. Seiches are the oscillation of large bodies of standing water, such as lakes, that can occur in response to ground shaking. Tsunamis and seiches do not pose hazards due to the inland location of the site and lack of nearby bodies of standing water.

Seismically Induced Settlement

Seismically induced settlement occurs most frequently in areas underlain by loose, granular sediments. Damage as a result of seismically induced settlement is most dramatic when differential settlement occurs in areas with large variations in the thickness of underlying sediments. Settlement caused by ground shaking is often non-uniformly distributed, which can result in differential settlement. Since it is anticipated that loose soils underlying the site is being removed and replaced with compacted fill, the potential for significant seismically induced settlement appears unlikely. This should be further evaluated by more detailed geotechnical studies upon development of grading plans.

Seismically Induced Flooding

The site is not located directly down-stream from any major reservoirs. Consequently seismically induced flooding at the site is unlikely. There is an offsite water storage tank located on the south side of Westward Way east of Sunset Avenue that could pose a localized flooding hazard should the tank or its connecting pipes fail during an earthquake.

Seismically Induced Landsliding

The City of Banning General Plan indicates that the bedrock knob in the southeast portion of the site has a low to moderate potential for seismically induced landsliding. The landsliding potential is related to the possibility of rock falls and rolling of boulder outcrops. The hazard is expected to be limited areas near the toe of slopes, as not boulders were found in alluvial areas beyond the toes of slopes.

Near vertical banks along drainage course could also be subject to seismically induced landsliding. Such failures, should they occur, are expected to be limited to the immediate vicinity of the channel banks.

It should be noted that the California Geological Survey has not yet prepared a Seismic Hazard Zone Map of potential earthquake-induced landslide hazards for the quadrangle in which the site is located.

3.12 Foundations

For preliminary design purposes, isolated spread footings and/or continuous wall footings are recommended to support of residential structures, retaining walls and other lightly loaded structures associated with residential development. If the recommendations in the section on grading are followed and footings are established in firm native soils or compacted fill materials, preliminary design of footings may use the following allowable soil bearing values:

- Continuous Wall Footings:

  Footings having a minimum width of 12 inches and a minimum depth of 12 inches below the lowest adjacent grade have allowable bearing capacity of 1,500 pounds per square foot (psf). This value may be increased by 20% for each additional foot of width and/or depth to a maximum value of 3,500 psf.

- Isolated Spread Footings:

  Footings having a minimum width of 12 inches and a minimum depth of 18 inches below the lowest adjacent grade have allowable bearing capacity of 2,500 psf. This value may be increased by 20% for each additional foot of width or depth to a maximum value of 3,500 psf.

- Retaining Wall Footings:

  Footings for retaining walls should be founded a minimum depth of 12 inches and have a minimum width of 12 inches. Footings may be designed using the allowable bearing capacity and lateral resistance values recommended for building footings. However, when calculating passive resistance, the upper 6 inches of the footings should be ignored in areas where the footings will not be covered with concrete flatwork. This value may also be increased by 20% for each additional foot of width or depth to a maximum value of 3,500 psf. Reinforcement should be provided for structural considerations as determined by the design engineer.

The above bearing capacities represent an allowable net increase in soil pressure over existing soil pressure and may be increased by one-third for short-term wind or seismic loads. The maximum expected settlement of footings designed with the recommended allowable bearing capacity is expected to be on the order of ½ inch with differential settlement on the order of ¼ inch.

Preliminary testing indicates that soils within the site have a very low expansion potential. Therefore, reinforcement of footings for expansive soil is not required. However, in view of the seismic setting, a nominal reinforcement consisting of one #4 bar placed within 3 inches of the top of footings and another placed within 3 inches of the bottom of footings is recommended. The structural engineer may require heavier reinforcement.

Due to the preliminary nature of the expansion tests performed for this study, we recommend additional testing be performed when detailed development have been prepared and near the completion of rough grading to verify the preliminary expansion test results and recommended foundation design criteria.

3.13 Foundation Setbacks from Slopes

Setbacks for footings adjacent to slopes should conform to the requirements of the California Building Code. Specifically, footings should maintain a horizontal distance or setback between any adjacent slope face and the bottom outer edge of the footing.

For slopes descending away from the foundation, the horizontal distance may be calculated by using h/3, where h is the height of the slope. The horizontal setback should not be less than 5 feet, nor need not be greater than 40 feet per the California Building Code. Where structures encroach within the zone of h/3 from the top of the slope the setback may be maintained by deepening the foundations. Flatwork and utilities within the zone of h/3 from the top of slope may be subject to lateral distortion caused by gradual downslope creep. Walls, fences and landscaping improvements constructed at the top of descending slopes should be designed with consideration of the potential for gradual downslope creep.

For ascending slopes, the horizontal setback required may be calculated by using h/2 where h is the height of the slope. The horizontal setback need not be greater than 15 feet per the California Building Code.

3.14 Slabs on Grade

Testing performed during this investigation indicates that soils on the site have a very low expansion potential. Therefore it is anticipated that reinforcement of slabs on grade to resist forces of expansive soils will not be required. Floor slabs should have a nominal thickness of at least 4 inches and should be are divided into squares or rectangles using weakened plane joints, each with maximum dimensions not exceeding 25 feet. If weakened plane joints are not planned, then the slabs shall be reinforced with at least 6x6-10/10 welded wire fabric placed at mid-height of the slab.

A moisture vapor retarder/barrier is recommended beneath all slabs-on-grade that will be covered by moisture-sensitive flooring materials such as vinyl, linoleum, wood, carpet, rubber, rubber-backed carpet, tile, impermeable floor coatings, adhesives, or where moisture-sensitive equipment, products, or environments will exist. Design and construction of the vapor retarder or barrier should conform to Section 1805 of the 2010 California Building Code (CBC) and pertinent sections of American Concrete Institute (ACI) guidance documents 302.1R-04, 302.2R-06 and 360R-10.

The moisture vapor retarder/barrier should consist of a minimum 10 mils thick polyethylene with a maximum perm rating of 0.3 in accordance with ASTM E 1745. Seams in the moisture vapor retarder/barrier should be overlapped no less than 6 inches or in accordance with the manufacturer's recommendations. Joints and penetrations should be sealed with the manufacturer's recommended adhesives, pressure-sensitive tape, or both. The contractor must avoid damaging or puncturing the vapor retarder/barrier and repair any punctures with additional polyethylene properly lapped and sealed.

ACI guidelines allow for the placement of moisture vapor retarder/barriers either directly beneath floor slabs or below an intermediate granular soil layer.

Placing the moisture retarder/barrier directly beneath the floor slab will provide improved curing of the slab bottom and will eliminate potential problems caused by water being trapped in a granular fill layer. Concrete slabs poured directly on a vapor retarder/barrier can experience shrinkage cracking and curling due to differential rates of curing through the thickness of the slab. Therefore, for concrete placed directly on the vapor retarded, a maximum water cement ratio of 0.45 and the use of water-reducing admixtures to increase workability and decrease bleeding will likely be required.

If granular soil is placed over the vapor retarder/barrier, the layer should be at least 2 inches thick in accordance with traditional practice in southern California. The granular layer should be uniformly compacted and trimmed to provide the full design thickness of the proposed slab, and should not be left exposed to rain or other sources of water such as wet-grinding, power washing, pipe leaks or other processes, and should be dry at the time of concrete placement. Granular fill layers that become saturated should be removed and replaced prior to concrete placement.

An additional layer of sand may be placed beneath the vapor retarder/barrier at the developer's discretion to minimize the potential of the retarder/barrier being punctured by underlying soils.

Slab on grade design recommendations should be further evaluated once grading and foundation plans are prepared and near the completion of rough grading.

3.15 Miscellaneous Concrete Flatwork

For preliminary design purposes, miscellaneous concrete flatwork and walkways may be designed with a minimum thickness of 4 inches. Large slabs should be reinforced with a minimum of 6x6-10/10 welded wire mesh placed at mid-height in the slab. Control joints should be constructed to create squares or rectangles with a maximum spacing of 15 feet.

Walkways may be constructed without reinforcement. Walkways should be separated from foundations with a thick expansion joint filler. Control joints should be constructed into non-reinforced walkways at a maximum of 5 feet spacing.

The subgrade soils beneath all miscellaneous concrete flatwork should be compacted to a minimum of 90 percent relative compaction for a minimum depth of 12 inches. The geotechnical engineer should monitor the compaction of the subgrade soils and perform testing to verify that proper compaction has been obtained.

3.16 Footing Excavation and Slab Preparations

All footing excavations should be observed by the geotechnical consultant to verify that they have been excavated into competent soils. The foundation excavations should be observed prior to the placement of forms, reinforcement steel, or concrete. These excavations should be evenly trimmed and level. Prior to concrete placement, any loose or soft soils should be removed. Excavated soils should not be placed on slab or footing areas unless properly compacted.

Prior to the placement of the moisture barrier, the subgrade soils underlying the slab should be observed by the geotechnical consultant to verify that all under-slab utility trenches have been properly backfilled and compacted, that no loose or soft soils are present, and that the slab subgrade has been properly compacted to a minimum of 90 percent relative compaction within the upper 12 inches.

Footings may experience and overall loss in bearing capacity or an increased potential to settle where located in close proximity to existing or future utility trenches. Furthermore, stresses imposed by the footings on the utility lines may cause cracking, collapse and/or a loss of serviceability. To reduce this risk, footings should extend below a 1:1 plane projected upward from the closest bottom of the trench.

Subgrade soils in area of slabs on grade and walkways should near their optimum moisture content prior to the placement of concrete. The geotechnical consultant should verify that the appropriate moisture content has been achieved a maximum of 24 hours prior to the placement of concrete or moisture barriers.

3.17 Lateral Load Resistance

Lateral loads may be resisted by soil friction and the passive resistance of the soil. The following parameters are recommended.

- Passive Earth Pressure = 375 pcf (equivalent fluid weight).
- Coefficient of Friction (soil to footing) = 0.35
- Retaining structures should be designed to resist the following lateral active earth pressures:

Surface Slope of Retained Materials (Horizontal:Vertical)	Equivalent Fluid Weight (pcf)
Level	42
5:1	44
4:1	46
3:1	50
2:1	67

These active earth pressures are only applicable if the retained earth is allowed to strain sufficiently to achieve the active state. The required minimum horizontal strain to achieve the active state is approximately 0.0025H. Retaining structures should be designed to resist an at-rest lateral earth pressure if this horizontal strain cannot be achieved.

- At-rest Lateral Earth Pressure = 63 pcf (equivalent fluid weight)

The Mononobe-Okabe method is commonly utilized for determining seismically induced active and passive lateral earth pressures and is based on the limit equilibrium Coulomb theory for static stress conditions. This method entails three fundamental assumptions (e.g., Seed and Whitman, 1970): Wall movement is sufficient to ensure either active or passive conditions, the driving soil wedge inducing the lateral earth pressures is formed by a planar failure surface starting at the heel of the wall and extending to the free surface of the backfill, and the driving soil wedge and the retaining structure act as rigid bodies, and therefore, experiences uniform accelerations throughout the respective bodies (U.S. Army Corps of Engineers, 2003, Engineering and Design - Stability Analysis of Concrete Structures).

- Seismic Lateral Earth Pressure = 42 pcf (equivalent fluid weight).

The seismic lateral earth pressure given above is an inverted triangle, and the resultant of this pressure is an increment of force which should be applied to the back of the wall in the upper 1/3 of the wall height and also applied as a reduction of force to the front of the wall in the upper 1/3 of the footing depth.

3.18 Drainage and Moisture Proofing

Surface drainage should be directed away from proposed structures and into suitable drainage devices. Neither excess irrigation nor rainwater should be allowed to collect or pond against building foundations or within low-lying or level areas. Surface waters should be diverted away from the tops of slopes and prevented from draining over the top of slopes and down the slope face.

Walls and portions thereof that retain soil and enclose interior spaces and floors below grade should be waterproofed and dampproofed in accordance with CBC Section 1805.

Retaining structures should be drained to prevent the accumulation of subsurface water behind the walls. Backdrains should be installed behind all retaining walls exceeding 3 feet in height. A typical detail for retaining wall back drains is presented in Appendix C. All backdrains should be outlet to suitable drainage devices. Retaining wall less than 3 feet in height should be provided with backdrains or weep holes. Dampproofing and/or waterproofing should also be provided on all retaining walls.

3.19 Cement Type and Corrosion Potential

Initial soluble sulfate tests indicate that concrete at the subject site will have a negligible exposure to water-soluble sulfate in the soil. Our preliminary recommendations for concrete exposed to sulfate-containing soils are presented in the table below.

Recommendations for Concrete Exposed to Sulfate-Containing Soils

Sulfate Exposure	**Water Soluble Sulfate (SO_4) in Soil (% by Weight)**	**Sulfate (SO_4) in Water (ppm)**	**Cement Type (ASTM C150)**	**Maximum Water-Cement Ratio (by Weight)**	**Minimum Compressive Strength (psi)**
Negligible	0.00 - 0.10	0-150	--	--	2,500
Moderate	0.10 - 0.20	150-1,500	II	0.50	4,000
Severe	0.20 - 2.00	1,500-10,000	V	0.45	4,500
Very Severe	Over 2.00	Over 10,000	V plus pozzolan or slag	0.45	4,500

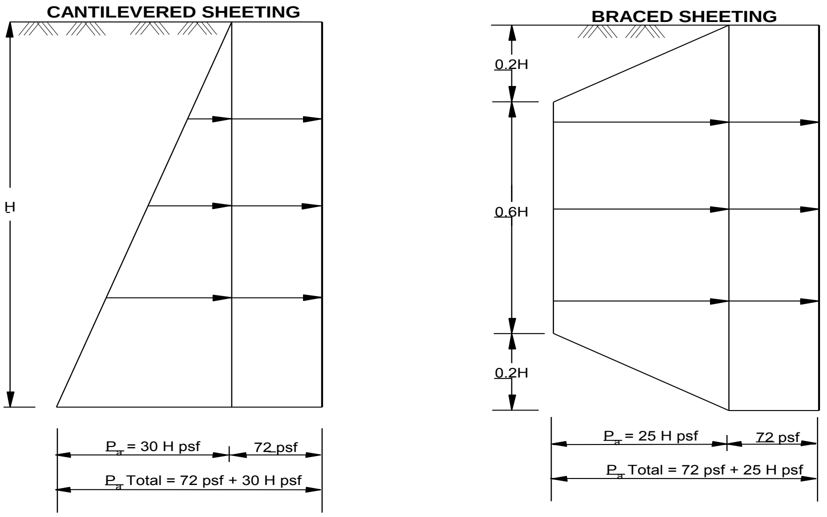
Use of alternate combinations of cementitious materials may be permitted if the combinations meet design recommendations contained in American Concrete Institute guideline ACI 318-11.

The soils were also tested for soil reactivity (pH) and electrical resistivity (ohm-cm). The preliminary test results indicate that the on-site soils have a soil reactivity ranging from 7.0 to 7.4 and an electrical resistivity ranging from 8,600 to 17,000 ohm-cm. A neutral or non-corrosive soil has a value ranging from 5.5 to 8.4. Generally, soils that could be considered moderately corrosive to ferrous metals have resistivityvalues of about 3,000 ohm-cm to 10,000 ohm-cm. Soils with resistivity values less than 3,000 ohm-cm can be considered corrosive and soils with resistivity values less than 1,000 ohm-cm can be considered extremely corrosive.

Based on these test results, it appears that soils underlying the site have a low corrosion potential. However, due to the preliminary nature of the testing performed, it is recommended that additional testing be performed as specific development plans are developed and that specific design recommendations be developed at that time.

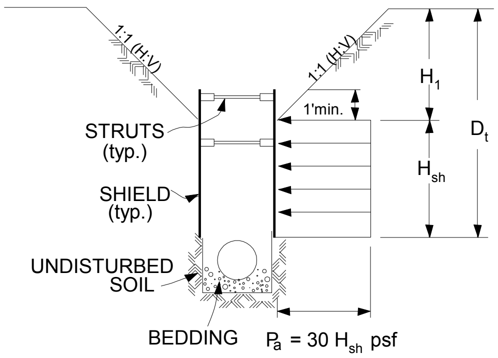
3.20 Temporary Slopes

Excavation of utility trenches will require either temporary sloped excavations or shoring. Temporary excavations in existing alluvial soils may be safely made at an inclination of 1:1 or flatter. If vertical sidewalls are required in excavations greater than 5 feet in depth, the use of cantilevered or braced shoring is recommended. Excavations less than 5 feet in depth may be constructed with vertical sidewalls without shoring or shielding. Our recommendations for lateral earth pressures to be used in the design of cantilevered and/or braced shoring are presented below. These values incorporate a uniform lateral pressure of 72 psf to provide for the normal construction loads imposed by vehicles, equipment, materials, and workmen on the surface adjacent to the trench excavation. However, if vehicles, equipment, materials, etc., are kept a minimum distance equal to the height of the excavation away from the edge of the excavation, this surcharge load need not be applied.



SHORING DESIGN: LATERAL SHORING PRESSURES

Design of the shield struts should be based on a value of 0.65 times the indicated pressure, Pa, for the approximate trench depth. The wales and sheeting can be designed for a value of 2/3 the design strut value.



HEIGHT OF SHIELD, H_{sh} = DEPTH OF TRENCH, D_t , MINUS DEPTH OF SLOPE, H_1

TYPICAL SHORING DETAIL

Placement of the shield may be made after the excavation is completed or driven down as the material is excavated from inside of the shield. If placed after the excavation, some overexcavation may be required to allow for the shield width and advancement of the shield. The shield may be placed at either the top or the bottom of the pipe zone. Due to the anticipated thinness of the shield walls, removal of the shield after construction should have negligible effects on the load factor of pipes. Shields may be successively placed with conventional trenching equipment.

Vehicles, equipment, materials, etc. should be set back away from the edge of temporary excavations a minimum distance of 15 feet from the top edge of the excavation. Surface waters should be diverted away from temporary excavations and prevented from draining over the top of the excavation and down the slope face. During periods of heavy rain, the slope face should be protected with sandbags to prevent drainage over the edge of the slope, and a visqueen liner placed on the slope face to prevent erosion of the slope face.

Periodic observations of the excavations should be made by the geotechnical consultant to verify that the soil conditions have not varied from those anticipated and to monitor the overall condition of the temporary excavations over time. If at any time during construction conditions are encountered which differ from those anticipated, the geotechnical consultant should be contacted and allowed to analyze the field conditions prior to commencing work within the excavation.

Cal/OSHA construction safety orders should be observed during all underground work.

3.21 Soil Infiltration

Three soil infiltration tests were performed using a Double-Ring Infiltrometer (ASTM Test Method D 3385-03). One test was performed in alluvium and two tests were performed in older alluvium. Results of the testing are summarized in the table below.

Soil Infiltration Rates

Test No.	Geologic Unit	Infiltration Rate	
		(cm/hr)	(in/hr)
P-1	Qoal	7.64	2.98
P-2	Qal	1.98	0.77
P-3	Qoal	0.21	0.08

The above infiltration rates are presented for preliminary design purposes only and should not be used for final design. For preliminary design, we recommend use of a soil infiltration rate of 2 cm/hr for areas underlain by alluvial soils and 0.2 cm/hr for areas underlain by older alluvial soils. These rates should not be used for fill soils. Preliminary design of the infiltration systems should include an appropriate factor of safety to account for degradation of soil conditions by fine grained materials carried by runoff, potential growth of vegetation, accumulation of trash and other appropriate considerations. The actual reduction rate cannot be determined because these future factors are not currently known. In some cases, infiltration is reduced by factor ten. Additional infiltration testing will need to be performed when the location and depths of infiltration systems are known.

The test data sheets for the soil infiltration test are presented in Appendix B.

3.22 Utility Trench Backfill

Alluvial and older alluvial soils on the site will not be suitable for use as pipe bedding for buried utilities. All pipes should be bedded in a sand, gravel or crushed aggregate imported material complying with the requirements of the Standard Specifications for Public Works Construction Section 306-1.2.1. Crushed rock products that do not contain appreciable fines should not be utilized as pipe bedding and/or backfill. Bedding materials should be densified to at least 90% relative compaction (ASTM D1557) by mechanical methods. The geotechnical consultant should review and approve of proposed bedding materials prior to use.

The on-site soils are expected to be suitable as trench backfill provided they are screened of organic matter and cobbles over 6 inches in diameter. Backfill may include rocks up to 12 inches when the trench width is greater than 3 feet. Trench backfill should be densified to at least 90% relative compaction (ASTM D1557).

All utility trench backfill within street right of way, utility easements, under or adjacent to sidewalks, driveways, or building pads should be observed and tested by the geotechnical consultant to verify proper compaction. Trenches excavated adjacent to foundations should not extend within the footing influence zone defined as the area within a line projected at a 1:1 drawn from the bottom edge of the footing. Trenches crossing perpendicular to foundations should be excavated and backfilled prior to the construction of the foundations. The excavations should be backfilled in the presence of the geotechnical engineer and tested to verify adequate compaction beneath the proposed footing.

Cal/OSHA construction safety orders should be observed during all underground work.

3.23 Pavement Sections

R-value tests were performed on two soil samples in order to provide information on their soil properties for preliminary pavement structural design. Structural sections were designed using the procedures outlined in Chapter 630 of the California Highway Design Manual (Caltrans, 2012). This procedure uses the principle that the pavement structural section must be of adequate thickness to distribute the load from the design traffic index (TI) to the subgrade soils in such a manner that the stresses from the applied loads do not exceed the strength of the soil (R-value).

Laboratory testing yielded R-value results of 18 and 22 for the selected soil samples. The lower value of 18 was used to calculate preliminary pavement sections. Traffic index values were selected from the Table A of the City of Banning Public Works Specification for minimum street design standards. Calculated pavement sections and City of Banning minimum pavement sections are presented in the table below.

Structural Pavement Sections

	Major Highway	Secondary Highway	General Local Streets	Restricted Local Streets	Alley
Traffic Index	9.5	8 min.	5.5	4.5	--
Calculated Pavement Section	7"AC/16"AB	6"AC/12"AB	4"AC/7"AB	4"AC/4"AB	--
Minimum Pavement Section*	4"AC/6"AB	3"AC/4"AB	3"AC/4"AB	3"AC/4'AB	2½"AC/3"AB

* City of Banning Public Works Specifications
Table A, Minimum Street Design Standards, Page 31 (1983).
AC = Asphaltic concrete
AB = Class II aggregate base

It is anticipated that Portland Cement Concrete (PCC) pavements for areas which are not subject to traffic loads will need to be a minimum thickness of 4 inches thick and may be placed on compacted soils. Where there will be traffic loads it is anticipated that PCC pavement will need to be a minimum thickness of 6 inches of Portland cement concrete and will need to rest on 4 inches of crushed aggregate base.

Prior to paving, the subgrade soils should be scarified and the moisture adjusted to within 2% of the optimum moisture content. The subgrade soils should be compacted to a minimum of 90% relative compaction where base is used and 95% relative compaction where base is not used. All aggregate base courses should be compacted to a minimum of 95% relative compaction.

The above pavement sections have been provided for preliminary planning purposes. Additional testing and analyses of pavement sections will need to be performed when detailed development or grading plans have been developed and near the completion of rough grading of individual development areas.

3.24 Plan Review

Once grading and foundation plans are prepared for the subject property, this office should review the plans from a geotechnical viewpoint. More detail geotechnical investigations and/or analyses will need to be performed at that time.

3.25 Geotechnical Observation and Testing During Rough Grading

The geotechnical engineer should be contacted to provide observation and testing during the following stages of grading:

- During the clearing and grubbing of the site.
- During the demolition of any existing structures, buried utilities or other existing improvements.
- During excavation and overexcavation of compressible soils.
- During all phases of grading including ground preparation and filling operations.
- When any unusual conditions are encountered during grading.

A final geotechnical report summarizing conditions encountered during grading should be submitted upon completion of the rough grading operations.

3.26 Post-Grading Geotechnical Observation and Testing

After the completion of grading the geotechnical engineer should be contacted to provide additional observation and testing during the following construction activities:

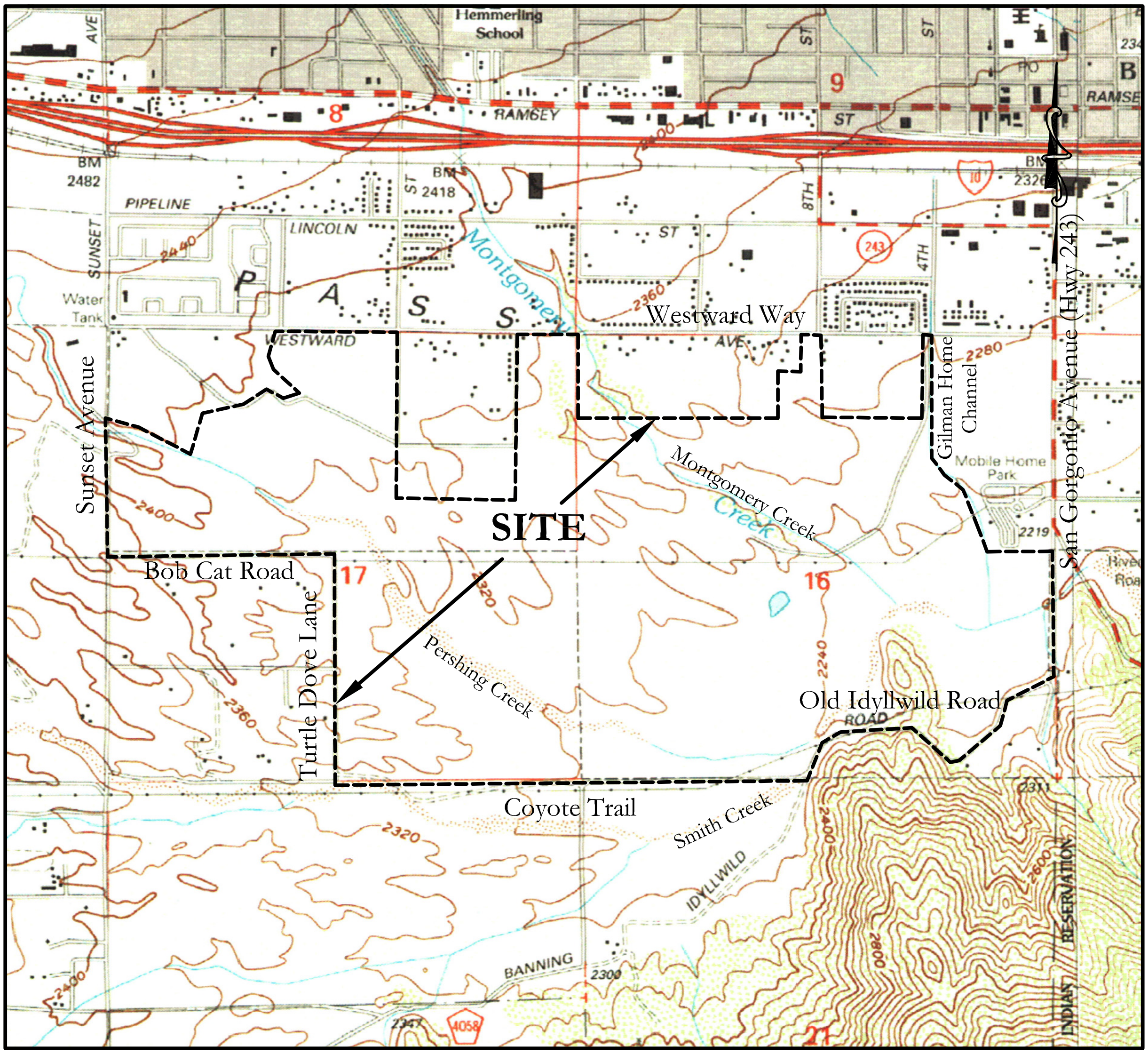
- During trenching and backfilling operations of buried improvements and utilities to verify proper backfill and compaction of the utility trenches.
- After excavation and prior to placement of reinforcing steel or concrete within footing trenches to verify that footings are properly founded in competent materials.
- During fine or precise grading involving the placement of any fills underlying driveways, sidewalks, walkways, or other miscellaneous concrete flatwork to verify proper placement, mixing and compaction of fills.
- When any unusual conditions are encountered during construction.

4.00 CLOSURE

The findings, conclusions and recommendations in this report were prepared in accordance with generally accepted engineering and geologic principles and practices. No other warranty, either expressed or implied, is made. This report has been prepared for Rancho San Gorgonio, LLC to be used solely for design purposes. Anyone using this report for any other purpose must draw their own conclusions regarding required construction procedures and subsurface conditions.

The geotechnical and geologic consultant should be retained during the earthwork and foundation phases of construction to monitor compliance with the design concepts and recommendations and to provide additional recommendations as needed. Should subsurface conditions be encountered during construction that are different from those described in this report, this office should be notified immediately so that our recommendations may be re-evaluated.

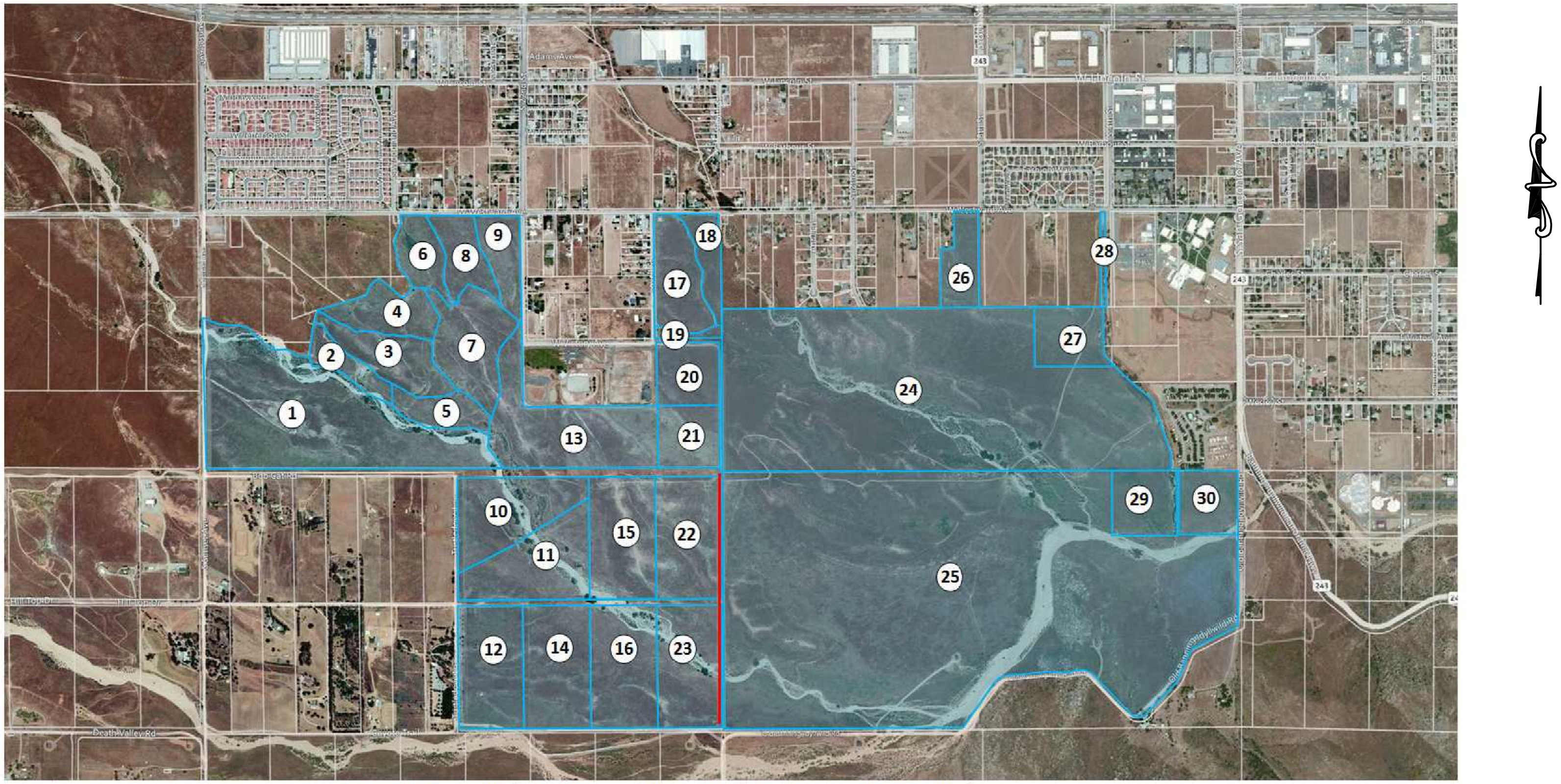
FIGURES AND TABLES



SITE LOCATION MAP

Scale: 1" = 2,000'

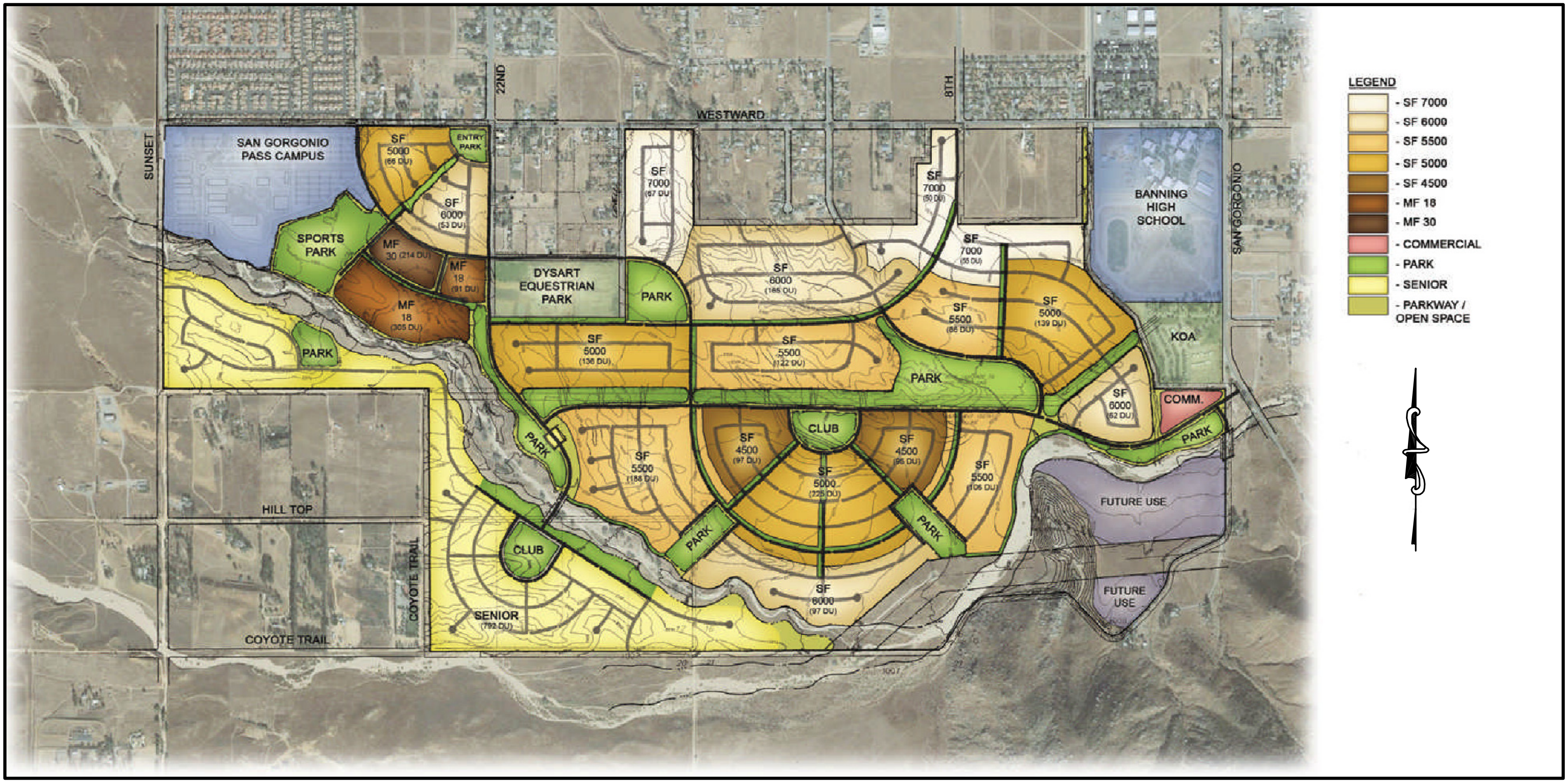
Base Map: U.S. Geological Survey Beaumont Quadrangle, 1996



#	APN	Lot Size
1	537-190-018	2,628,846
2	537-190-004	233,482
3	537-190-003	495,713
4	537-190-001	482,645
5	537-190-005	291,416
6	537-150-005	325,829
7	537-190-002	709,592
8	537-150-006	373,309
9	537-150-007	323,651
10	537-200-031	794,099
11	537-200-032	824,591
12	537-200-035	800,197
13	537-190-019	1,239,282
14	537-200-036	837,659
15	537-200-033	822,848
16	537-200-037	831,996
17	537-170-002	543,629
18	537-170-003	257,440
19	537-190-022	52,272
20	537-190-021	400,752
21	537-190-020	399,881
22	537-200-034	794,534
23	537-200-038	804,118
24	543-040-001	6,550,117
25	543-050-001	11,552,112
26	543-020-021	345,431
27	543-040-002	385,942
28	543-030-004	47,916
29	543-050-002	435,600
30	543-050-003	394,218
	TOTAL Sq. Ft.	***34,979,117***
	TOTAL ACRES	***803.01***

SITE PARCEL MAP

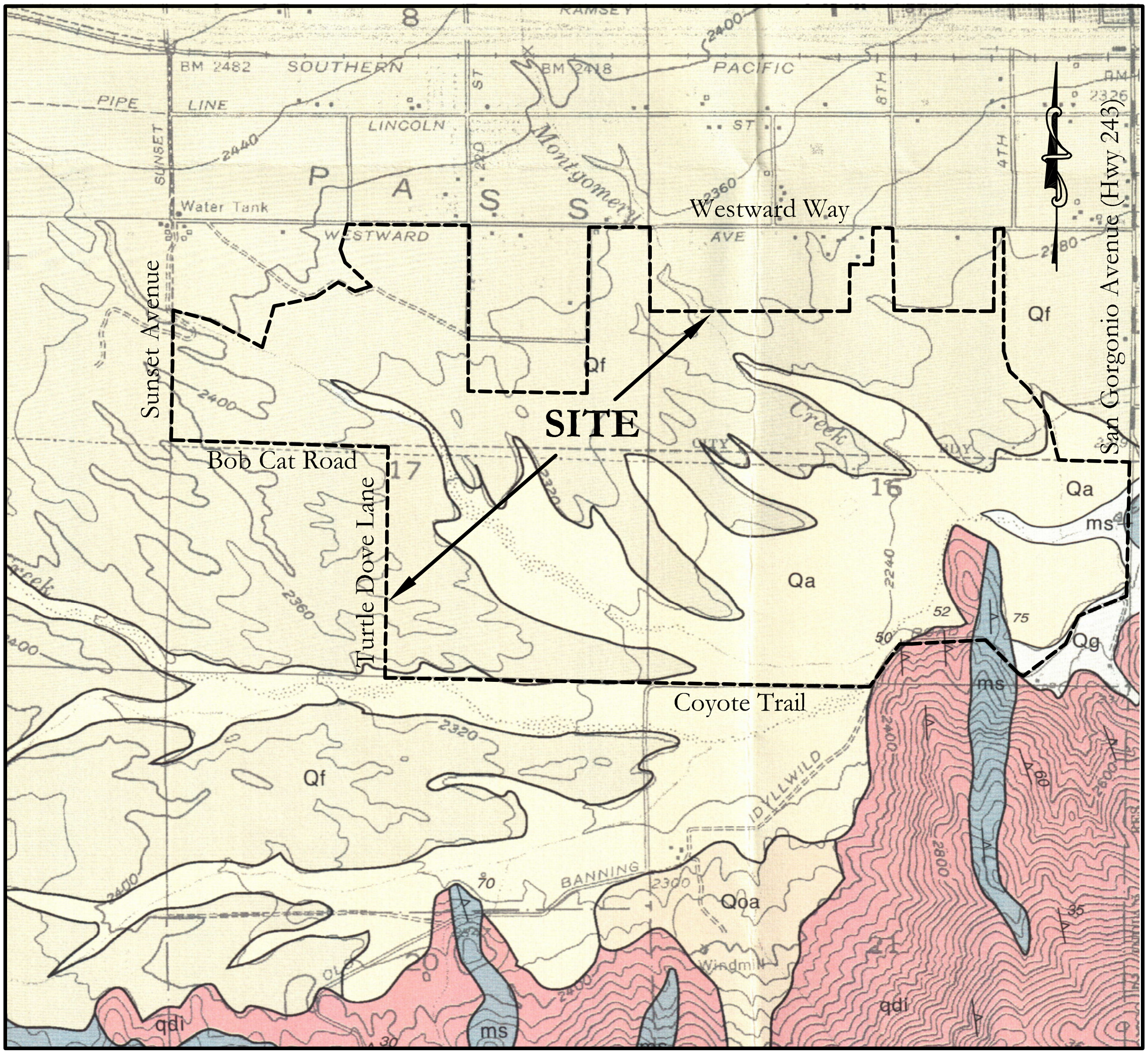
Scale: 1" = 1,600'



CONCEPTUAL MASTER PLAN MAP

Scale: 1" ~ 1,500'

Base Map: Stantec Consulting, Inc.

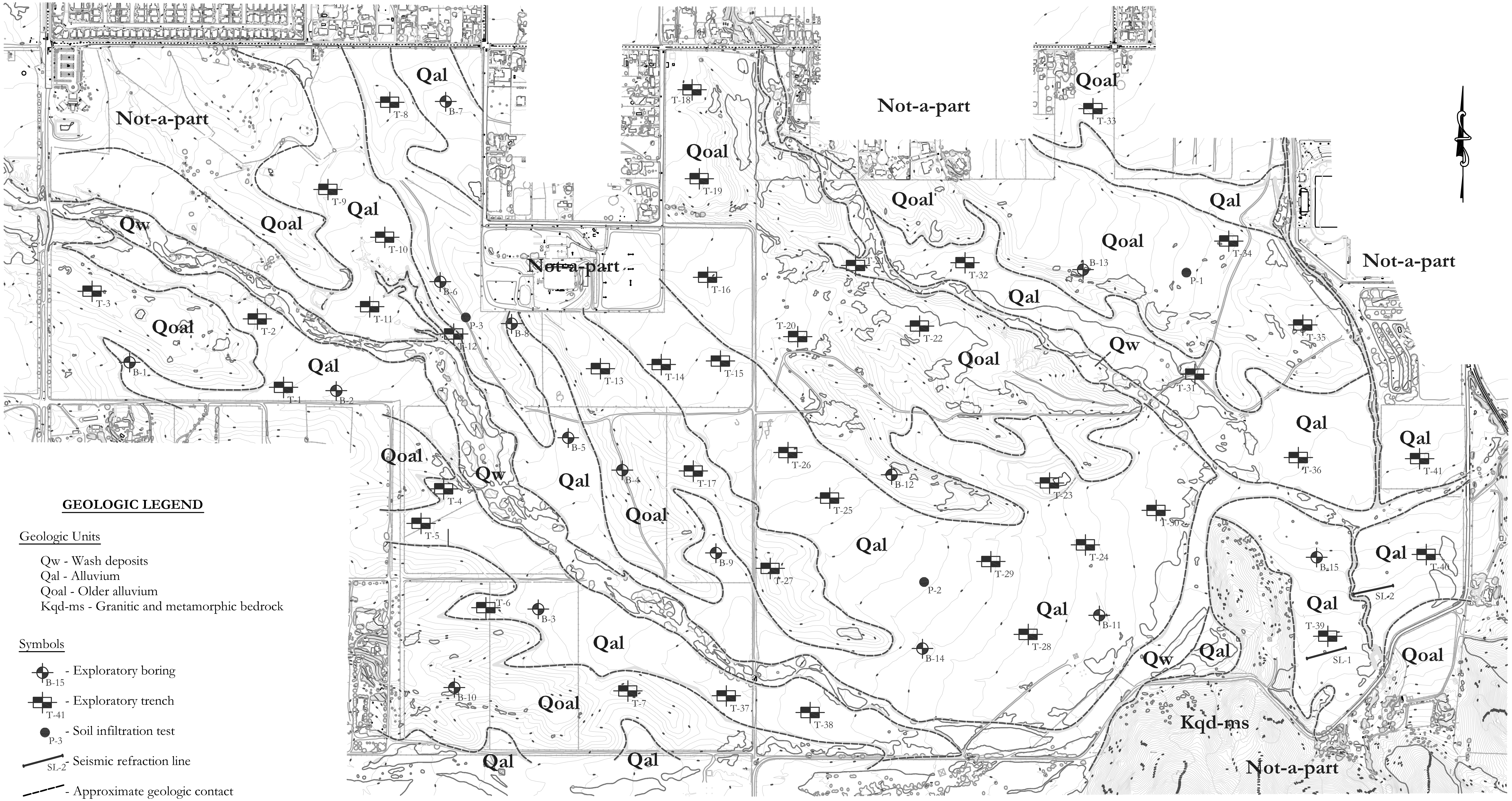


REGIONAL GEOLOGIC MAP
by DIBBLEE
Scale: 1" = 2,000'

Partial Legend

Qg - Stream channel alluvium (Holocene)
Qa - Flood plain alluvium (Holocene)
Qf - Alluvial fan deposits (Pleistocene)
Qoa - Older alluvial fan deposits (Pleistocene)
qdi - Granitic bedrock, mostly tonalite (Cretaceous)
ms - Metasedimentary bedrock, Mica schist-phyllite (Paleozoic)

Source: Dibblee, Geologic Map of the Beaumont Quadrangle, (2003).



GEOLOGIC LEGEND

Geologic Units

Qw - Wash deposits
Qal - Alluvium
Qoal - Older alluvium
Kqd-ms - Granitic and metamorphic bedrock

Symbols

B-15 - Exploratory boring
T-41 - Exploratory trench
P-3 - Soil infiltration test
SL-2 - Seismic refraction line
- Approximate geologic contact

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PLAN CHANGES

ITEM	DESCRIPTION	BY	DATE

Scale in Feet
(1"=750')
0 375' 750' 1,500'

BASE MAP PROVIDED BY: MADOLE & ASSOICATES

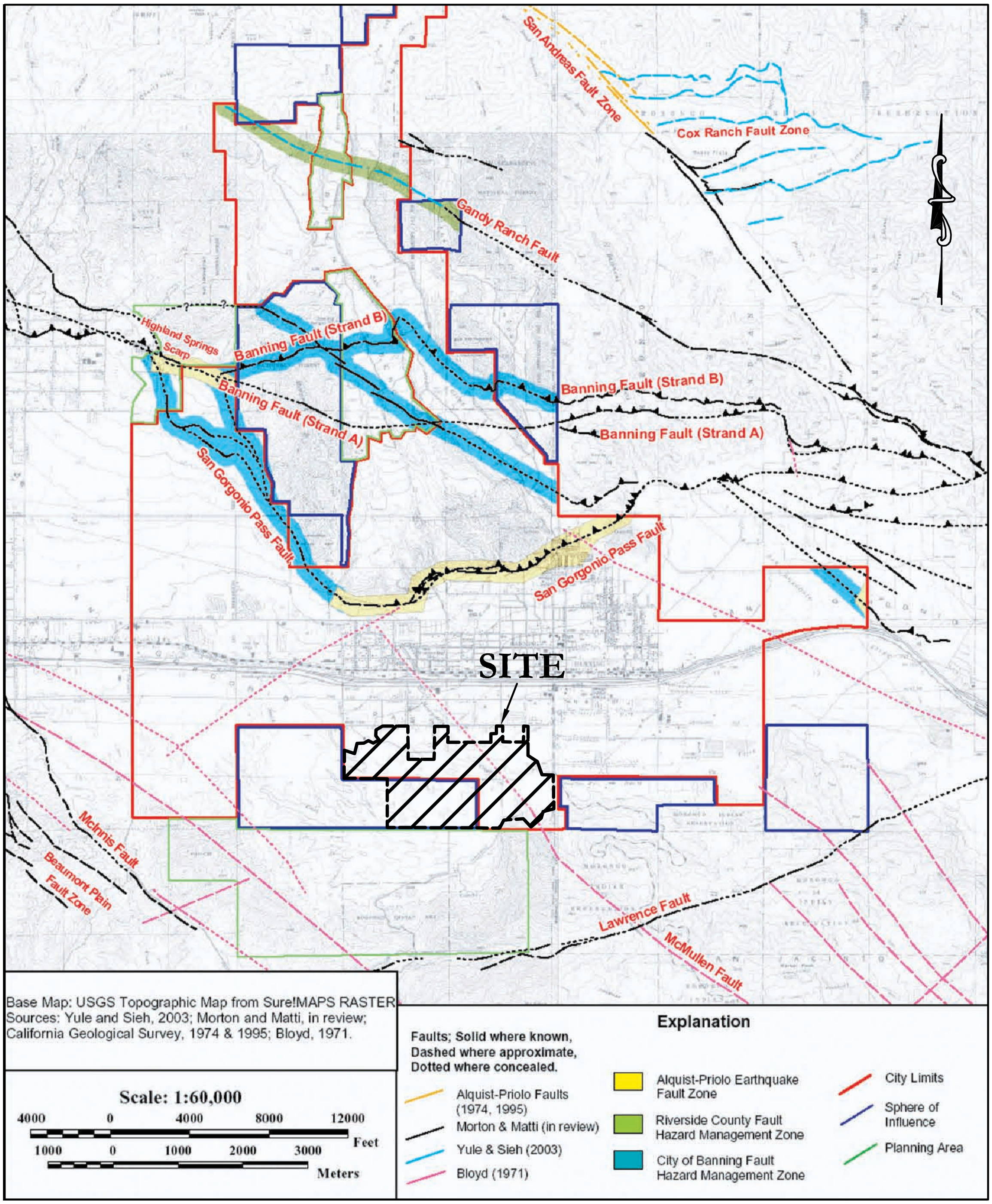
THIS PLAN HAS BEEN PREPARED FOR USE AS A GEOLOGICAL MAP AND IS NOT INTENDED FOR CONSTRUCTION.

RANCHO SAN GORGONIO, LLC
8439 WHITE OAK AVENUE
RANCHO CUCAMONGA, CA

DRAWN BY: GW
CHECKED BY: KD
APPROVED BY: SD
DATE: 11-2012

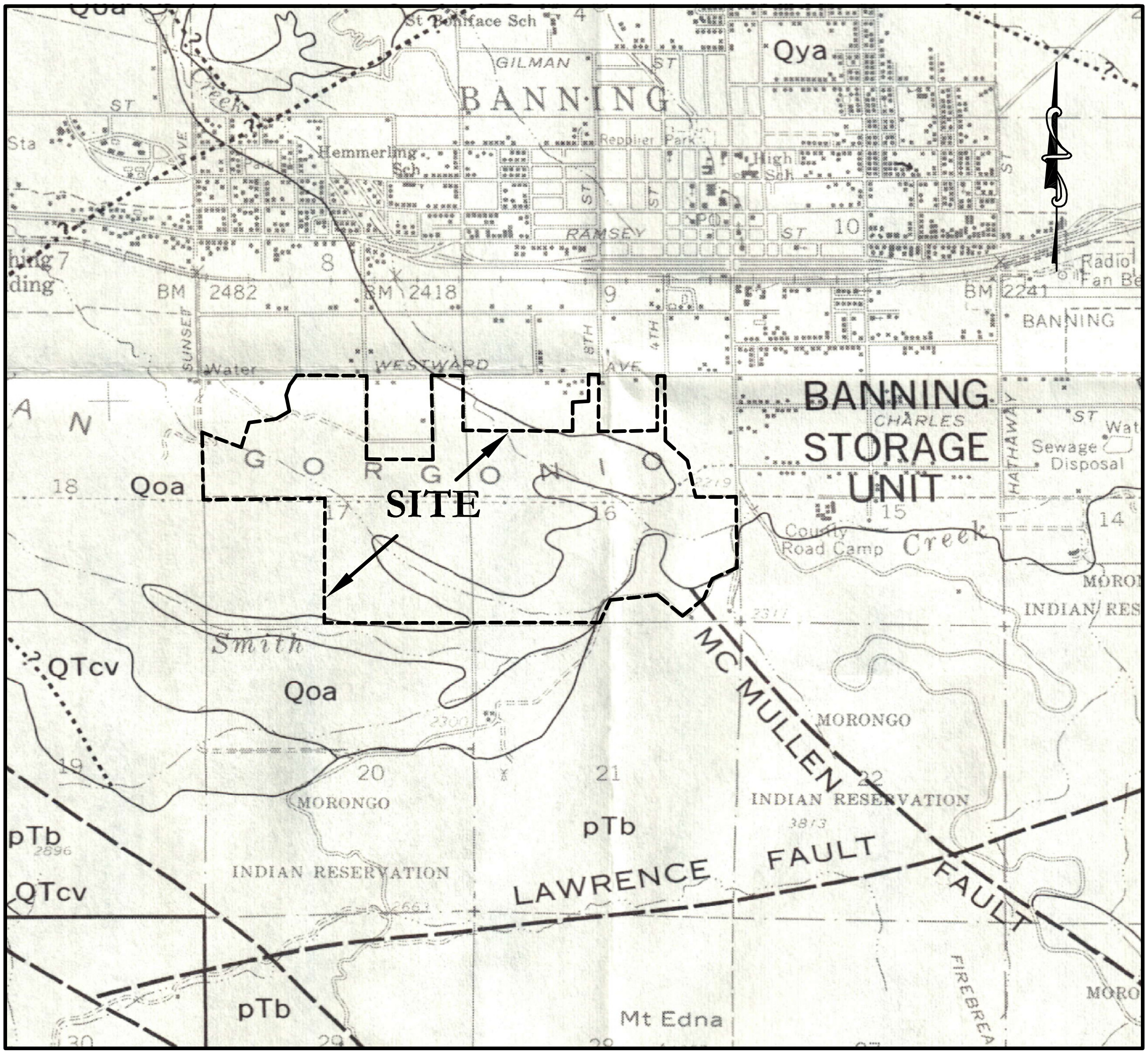
SITE GEOLOGIC MAP
RANCHO SAN GORGONIO
BANNING, CA

RMA JOB NO.: 12-G02-01
SHEET NO.: 1 OF 1
FIGURE NO.: 5



REGIONAL FAULT MAP

Base Map: City of Banning General Plan, Exhibit V-1



REGIONAL GEOLOGIC MAP
by BLOYD
Scale: 1" ~ 0.7 Miles

Partial Legend

Qya - Younger alluvium (Holocene)
Qoa - Older alluvium (Pleistocene)
QTcv - Contintental deposits (Pleistocene to Pliocene)
pTb - Basement complex crystalline bedrock (Pre-Tertiary)

Base Map: U.S. Geological Survey Water-Supply Paper 1999-D (Bloyd, 1971)

NOTABLE FAULTS WITHIN 100 KILOMETERS AND SEISMIC DATA

Fault Zone & geometry	Distance (km)	Distance (mi.)	Maximum Moment Magnitude	Slip Rate (mm/yr)
Burnt Mountain (rl-ss)	47	29	6.5	0.6
Calico-Hidalgo (rl-ss)	77	48	7.3	0.6
Chino-Central Ave. (rl-r-o)	63	39	6.7	1.0
Clamshell-Sawpit (r)	95	59	6.5	0.5
Cleghorn (ll-ss)	50	31	6.5	3.0
Cucamonga (r)	59	37	6.9	5.0
Earthquake Valley (rl-ss)	86	53	6.5	2.0
Elsinore (rl-ss)	51	32	6.8	5.0
Emerson (rl-ss)	68	42	7	0.6
Eureka Peak (rl-ss)	51	32	6.4	0.6
Helendale - S Lockhart (rl-ss)	51	32	7.3	0.6
Holser (r)	99	62	6.5	0.4
Johnson Valley (rl-ss)	60	37	6.7	0.6
Landers (rl-ss)	51	32	7.3	0.6
Lenwood-Lockhart (rl-ss)	55	34	7.5	0.6
Newport-Inglewood (rl-ss)	93	58	6.9	1.5
North Frontal - Western (r)	48	30	7.2	1.0
North Frontal - Eastern (r)	51	0	6.7	0.5
Pinto Mountain (ll-ss)	23	14	7.2	2.5
Pisgah-Bullion Mtn. (rl-ss)	83	52	7.3	0.6
Puente Hills Blind Thrust (r)	90	56	7.1	0.7
San Andreas (rl-ss)	12	7	7.5	24.0
San Jacinto (rl-ss)	15	9	6.7	12.0
San Joaquin Hills (r)	80	50	6.6	0.5
San Jose (ll-r-o)	77	48	6.4	0.5
Sierra Madre (r)	82	51	7.2	2.0
Whittier (rl-ss)	69	43	6.8	2.5

Notes:

Fault geometry - (ss) strike slip, (r) reverse, (n) normal, (rl) right lateral, (ll) left lateral, (o) oblique

Fault and Seismic Data - California Geological Survey (Cao), 2003

HISTORIC STRONG EARTHQUAKES IN SOUTHERN CALIFORNIA SINCE 1812

Date	Event	Causitive Fault	Magnitude	Epicentral Distance (miles)
Dec. 12, 1812	Wrightwood	San Andreas?	7.3	65
Dec. 16, 1858	San Bernardino Area	uncertain	6.0	25
Feb. 9,1890	San Jacinto	uncertain	6.3	49
May 28, 1892	San Jacinto	uncertain	6.3	51
July 30, 1894	Lytle Creek	uncertain	6.0	50
July 22, 1899	Cajon Pass	uncertain	6.4	45
Dec.25, 1899	San Jacinto	San Jacinto	6.7	10
Sept. 20, 1907	San Bernardino Area	uncertain	5.3	23
May 15, 1910	Elsinore	Elsinore	6.0	33
April 21, 1918	Hemet	San Jacinto	6.8	13
July 23, 1923	San Bernardino	San Jacinto	6.0	25
March 11, 1933	Long Beach	Newport-Inglewood	6.4	67
April 10, 1947	Manix	Manix	6.4	77
Dec. 4, 1948	Desert Hot Springs	San Andreas or Banning	6	30
Feb. 9, 1971	San Fernando	San Fernando	6.6	95
July 8, 1986	North Palm Springs	Banning or Garnet Hills	5.6	18
Oct. 1, 1987	Whittier Narrows	Puente Hills Thrust	6.0	71
Feb. 28, 1990	Upland	San Jose	5.5	50
June 28, 1991	Sierra Madre	Clamshell Sawpit	5.8	69
April 22, 1992	Joshua Tree	Eureka Peak	6.1	34
June 28, 1992	Landers	Johnson Valley & others	7.3	35
June 28, 1992	Big Bear	uncertain	6.5	18
Jan. 17, 1994	Northridge	Northridge Thrust	6.7	99
Oct. 16, 1999	Hector Mine	Lavic Lake	7.1	60

Notes:

Earthquake data: U.S. Geological Survey P.P. 1515 & online data, Southern California Earthquake Center & California Geological Survey online data

Magnitudes prior to 1932 are estimated from intensity.

Magnitudes after 1932 are moment, local or surface wave magnitudes.

Attenuation relationship - Boore et al., 1997 (mean values), values at distances > 50 miles are approximate

Site Location:

Site Longitude:	116.894
Site Latitude:	33.911

APPENDIX A

FIELD INVESTIGATION

APPENDIX A

FIELD INVESTIGATION

A-1.00 FIELD EXPLORATION

A-1.01 Number of Borings, Trenches, Infiltration Tests and Seismic Lines

Our subsurface investigation consisted of 15 borings, 41 trenches, 3 soil infiltration tests and 2 seismic refraction lines.

The borings drilled with a CME-75 drill rig equipped with 8-inch diameter hollow stem augers. The trenches were excavated and backfilled with a backhoe equipped with a 24-inch bucket. The infiltration tests were performed using a double ring infiltrometer. The seismic refraction lines were performed by Terra Geosciences using a Geometrics StrataVisor™ NZXP model signal enhancement refraction seismograph.

A-1.02 Location of Borings, Trenches, Infiltration Tests and Seismic Lines

A Site Geologic Map showing the approximate locations of the borings, trenches, infiltration tests and seismic lines is presented as Figure 5.

A-1.03 Boring and Trench Logging

Logs of borings and trenches were prepared by one of our staff and are attached in this appendix. The logs contain factual information and interpretation of subsurface conditions between samples. The strata indicated on these logs represent the approximate boundary between earth units and the transition may be gradual. The logs show subsurface conditions at the dates and locations indicated, and may not be representative of subsurface conditions at other locations and times.

Identification of the soils encountered during the subsurface exploration was made using the field identification procedure of the Unified Soils Classification System (ASTM D2488). A legend indicating the symbols and definitions used in this classification system and a legend defining the terms used in describing the relative compaction, consistency or firmness of the soil are attached in this appendix. Bag samples of the major earth units were obtained for laboratory inspection and testing, and the in-place density of the various strata encountered in the exploration was determined

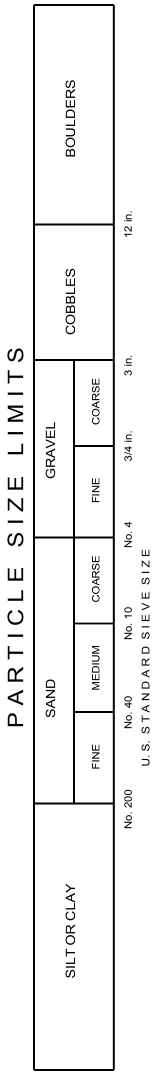
A-1.04 Soil Infiltration Testing

Soil infiltration testing was performed using a double-ring infiltrometer (ASTM Test Method D 3385-03) to determine an infiltration rate of soils at three different locations. Infiltrometer equipment consisted of two calibrated plastic cylinders, two aluminum rings, constant level float values, shutoff values, and plastic tubing to connect the cylinders and aluminum rings. Calibrations were mark directly on the plastic cylinders. The cylinders were connected to special supports to prevent tipping and to maintain proper height. The aluminum rings were 12 and 24 inches in diameter and 20 inches high. The float values were used to maintain a constant water level in the aluminum rings. Infiltration rate of water during the test was determined by monitoring volume changes in the calibrated cylinders. Testing was continued until a relatively uniform infiltration rate was obtained.

A-1.05 Geophysical Survey

A geophysical survey was performed in the southeast portion of the site by Terra Geosciences. The survey consisted of two seismic refraction lines that were run across aerial photo lineaments that approximately correspond to the postulated subsurface trace of the McMullen fault of Bloyd (1971). The seismic refraction lines were each 300 feet in length. A 16-pound sledge-hammer was used as an energy source to produce the seismic waves and twenty-four, 14-Hz geophones (with 70% damping), were spaced at 12-foot intervals along the traverse lines to detect both the direct and refracted waves. The seismic wave arrivals were digitally recorded in SEG-2 format on a Geometrics StrataVisor™ NZXP model signal enhancement refraction seismograph. Seven shot points were utilized along each seismic line spread using forward, reverse, and intermediate locations. The data was acquired using a sampling rate of 0.0625 milliseconds with a record length ranging from 0.15 to 0.20 seconds. No acquisition filters were used. Each geophone and shot location was surveyed using a hand level and ruler for relative topographic correction.

The recorded data were used in the field to analyze the arrival time of the primary seismic "P"-waves at each geophone station. The data was subsequently transferred to an office computer for further processing, analyzing, and printing using the computer programs SIP (Seismic Refraction Interpretation Program) developed by Rimrock Geophysics, Inc. (1995) and Rayfract™ (Intelligent Resources, Inc., 1991-2012). The results of the geophysical survey are presented in this appendix.



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

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

UNIFIED SOIL CLASSIFICATION SYSTEM

I. SOIL STRENGTH/DENSITY

BASED ON STANDARD PENETRATION TESTS

Compactness of sand		Consistency of clay	
Penetration Resistance N (blows/Ft)	Compactness	Penetration Resistance N (blows/ft)	Consistency
0-4	Very Loose	<2	Very Soft
4-10	Loose	2-4	Soft
10-30	Medium Dense	4-8	Medium Stiff
30-50	Dense	8-15	Stiff
>50	Very Dense	15-30	Very Stiff
		>30	Hard

N = Number of blows of 140 lb. weight falling 30 in. to drive 2-in OD sampler 1 ft.

BASED ON RELATIVE COMPACTION

Compactness of sand		Consistency of clay	
% Compaction	Compactness	% Compaction	Consistency
<75	Loose	<80	Soft
75-83	Medium Dense	80-85	Medium Stiff
83-90	Dense	85-90	Stiff
>90	Very Dense	>90	Very Stiff

II. SOIL MOISTURE

Moisture of sands		Moisture of clays	
% Moisture	Description	% Moisture	Description
<5%	Dry	<12%	Dry
5-12%	Moist	12-20%	Moist
>12%	Very Moist	>20%	Very Moist, wet

SOIL DESCRIPTION LEGEND

Exploratory Boring Log

Boring No. B-1

Sheet 1 of 2

Date Drilled: 8-24-12

Logged By: KD

Location: See Geologic Map

Eleveation (ft): 2,386

Drilling Equipment: CME -55

Boring Hole Diameter: 8"

Drive Weights: 140 lbs.

Drop: 30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
	Sample Type	Blows (blows/ft)	Bulk Sample					This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	R	19	▨			SM		Alluvium (Qal): Light brown silty fine to medium grained sand, slightly moist, medium dense.
5	R	15		10.8	123.1			Grades to brown fine to coarse grained silty sand at 5'.
10	R	15		10.8	121.6			Trace of gravel at 10'
15	R	15		10.1	124.6			
20	R	17		12.5	114.1			Trace of gravel and increasing course sand content at 20'.
25	R	67		10.6	125.9	SM		Older Alluvium (Qoal): Olive-yellow silty fine to medium grained silty sand with layers of fine to course grained sand and fine to coarse grained silty and clayey sand, dense, moist.

Sample Types:

R - Ring Sample

▨ - Bulk Sample

▽ - Groundwater

T - Tube Sample

S - SPT Sample

▬ - End of Boring

RMA GeoScience

Exploratory Boring Log

Boring No. B-1

Sheet 2 of 2

Date Drilled:	8-24-12	Drilling Equipment:	CME -75
Logged By:	KD	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Elevation (ft):	2,386	Drop:	30"

Depth (ft)	Samples Sample Type	 Blows (blows/ft)	 Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	S	51		9.3		SP		Olive-yellow silty sand continues.
35	S	52						Trace of clay at 35'.
40	S	79/ 11"						
								Total depth 41.5' No groundwater Hole backfilled with cuttings
45								
50								

Sample Types:

R - Ring Sample	◩ - Bulk Sample	▽ - Groundwater
T - Tube Sample	S - SPT Sample	◣ - End of Boring

Exploratory Boring Log

Boring No. B-2

Sheet 1 of 2

Date Drilled:	8-24-12	Drilling Equipment:	CME -55
Logged By:	GW	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Eleveation (ft):	2,355	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
	Sample Type	Blows (blows/ft)	Bulk Sample					This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
			▨			SM		Alluvium (Qal): Grayish brown silty fine grained sand, dry, medium dense, moist.
	R	21						Slight increase in moisture content with depth.
5	R	22		8.4	106.3			
10	R	27		5.7	106.1			Grades to brown color at 10'.
15	R	29		8.0	101.7			
20	R	35		4.7	108.3			Less silt and a trace of medium grained sand at 20'.
25	S	14				SP		Brown fine grained sand with silt and a few pieces of gravel, medium dense.

Sample Types:

- R - Ring Sample
- ▨ - Bulk Sample
- ▽ - Groundwater
- T - Tube Sample
- S - SPT Sample
- ▬ - End of Boring

RMA GeoScience

Exploratory Boring Log

Boring No. B-2

Sheet 2 of 2

Date Drilled: 8-24-12
Logged By: GW
Location: See Geologic Map
Elevation (ft): 2,355

Drilling Equipment: CME -75
Boring Hole Diameter: 8"
Drive Weights: 140 lbs.
Drop: 30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
	S	10				SM		Light brown silty fine grained sand, loose to medium dense.
35	S	30		3.2		SP		Pinkish gray fine grained sand with gravel and a trace of silt, medium dense to dense, dry.
40	S	33		2.6		SP		Light brown fine to medium grained sand with a trace of coarse sand, dense, dry.
45	S	18		10.6		SM		Brown to dark brown silty fine grained sand, medium dense, moist.
50	S	17		10.5				Increase in silt content at 50'.
								Total depth 51.5' No groundwater Hole backfilled with cuttings

Sample Types:

R - Ring Sample
▨ - Bulk Sample
▽ - Groundwater
T - Tube Sample
S - SPT Sample
▬ - End of Boring

RMA GeoScience

Exploratory Boring Log

Boring No. B-3
Sheet 1 of 2

Date Drilled:	8-24-12	Drilling Equipment:	CME -55
Logged By:	GW	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Eleveation (ft):	2,305	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
			▨			ML		Alluvium (Qal): Light brown sandy silt, fine grained. Grades to brown color with a trace of medium to coarse sand below 3', medium dense, moist. (70% passing #200 sieve)
5	R	25		10.4	96.5			
10	R	42		6.1	102.2			
15	R	33		4.7	100.0			Grades to light brown color with increase in silt content at 15'.
								Pinkish gray fine to coarse grained sand, dense, dry.
20	R	51		1.7	118.2	SP		
								Brown silty fine gained sand, medium dense, moist.
25	S	11		8.8		SM		

Sample Types:

R - Ring Sample	▨ - Bulk Sample	- Groundwater
T - Tube Sample	S - SPT Sample	- End of Boring

Exploratory Boring Log

Boring No. B-3

Sheet 2 of 2

Date Drilled:	8-24-12	Drilling Equipment:	CME -75
Logged By:	GW	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Elevation (ft):	2,305	Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	S	11		16.3		SM		Brown silty fine grained sand continues.
35	S	25		7.6		SM		Older Alluvium (Qoal): Reddish brown silty fine to medium grained sand, medium dense, moist, moderately hard drilling.
40	S	86		5.1				Scattered gravel and very dense at 40'.
45	S	59		7.4				Trace of coarse sand and yellowish red color at 40'.
50	S	80		3.4		SP		Reddish brown fine to coarse grained sand with fine gravel, dry, very dense.
								Total depth 51.5' No groundwater Hole backfilled with cuttings

Sample Types:

R - Ring Sample

◪ - Bulk Sample

▽ - Groundwater

T - Tube Sample

S - SPT Sample

◣ - End of Boring

Exploratory Boring Log

Boring No. B-4

Sheet 1 of 1

Date Drilled:	8-27-12	Drilling Equipment:	CME-75
Logged By:	GW	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Elevation (ft):	2,334	Drop:	30"

Depth (ft)	Samples Sample Type	 Blows (blows/ft)	 Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
			▨			SM		Older Alluvium (Qoal): Strong brown fine to medium grained silty sand with scattered gravel and small cobbles, dense, moist.
5	R	68		5.3	118.6			Grades to very dense fine very to coarse grained silty sand with scattered gravel and cobbles at 5'.
10	R	85/ 11"		7.7	119.7			Grades to brown to dark brown color with slight moisture increase at 10'.
15	S	36		6.6				
20	R	76		7.1	122.9			Grades back to fine to medium grained silty sand at 20'.
25	S	47		6.2				
								Total depth 26.5' No groundwater Hole backfilled with cuttings

Sample Types:

R - Ring Sample

▨ - Bulk Sample

- Groundwater

T - Tube Sample

S - SPT Sample

- End of Boring

Exploratory Boring Log

Boring No. B-5

Sheet 1 of 2

Date Drilled:	8-27-12	Drilling Equipment:	CME -55
Logged By:	GW	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Eleveation (ft):	2,318	Drop:	30"

Depth (ft)	Samples Sample Type	 Blows (blows/ft)	 Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
						SM		Alluvium (Qal): Strong brown silty fine grained sand with a trace of coarse sand and high silt content, loose to medium dense, moist.
5	R	20		9.0	82.2			
						ML		Brown to light brown silty with fine grained sand, moist, loose to medium dense.
10	S	5		15.9				
15	R	17		13.3	94.3			
20	S	9	▨	15.3				
								(79% passing #200)
25	R	20		11.6	92.6			

Sample Types:

R - Ring Sample
▨ - Bulk Sample
▽ - Groundwater
T - Tube Sample
S - SPT Sample
◣ - End of Boring

Exploratory Boring Log

Boring No. B-5

Sheet 2 of 2

Date Drilled:	8-27-12	Drilling Equipment:	CME -75
Logged By:	GW	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Elevation (ft):	2,318	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
	S	11				ML		Brown to light brown silt continues.
						SM		Red fine to coarse grained silty sand, moist, medium dense.
35	R	28		11.3	113.5			
40	S	10		7.7				
45	R	36		11.8	119.5			Grades to dark reddish brown color at 45'.
50	S	14		11.1				
								Total depth 51.5' No groundwater Hole backfilled with cuttings

Sample Types:

R - Ring Sample	▨ - Bulk Sample	▽ - Groundwater	
T - Tube Sample	S - SPT Sample	◣ - End of Boring	

Exploratory Boring Log

Boring No. B-6
Sheet 1 of 1

Date Drilled: 8-27-12
Logged By: GW
Location: See Geologic Map
Elevation (ft): 2,369

Drilling Equipment: CME-75
Boring Hole Diameter: 8"
Drive Weights: 140 lbs.
Drop: 30"

Material Description

This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
	Sample Type	Blows (blows/ft)	Bulk Sample					
			▨			SM		Older Alluvium (Qoal): Reddish brown silty fined to medium grained sand with a trace of coarse sand, gravel and small cobbles, moist, dense to very dense.
5	S	55		8.0				
10	R	70		5.8	116.1			Grades to yellowish red color at 10'.
15	S	47		9.6				
20	R	80		4.1	120.6			Grades back to reddish brown color at 20', decrease in moisture content.
25	S	34		3.9				
								Total depth 26.5' No groundwater Hole backfilled with cuttings

Sample Types:

R - Ring Sample
▨ - Bulk Sample
▽ - Groundwater
T - Tube Sample
S - SPT Sample
◣ - End of Boring

Exploratory Boring Log

Boring No. B-7

Sheet 1 of 2

Date Drilled:	8-27-12	Drilling Equipment:	CME -55
Logged By:	GW	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Eleveation (ft):	2,369	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
						SM		Alluvium (Qal): Light brown fine to medium grained silty sand, dry, loose to medium dense.
5	R	39		3.1	118.0			(35% passing #200)
10	S	9		2.2				Grades to fine to coarse grained silty sand at 10'.
15	R	36		3.4	108.4			Trace of carbonates and fine to medium grained at 15'.
20	S	11		4.4				
						SM		Older Alluvium (Qoal): Yellowish red fine to medium grained silty sand with a trace of coarse sand and gravel, moist, dense to very dense.
25	R	45		4.6	122.0			

Sample Types:

R - Ring Sample
▱ - Bulk Sample
∇ - Groundwater
T - Tube Sample
S - SPT Sample
▬ - End of Boring

RMA GeoScience

Exploratory Boring Log

Boring No. B-7

Sheet 2 of 2

Date Drilled:	8-27-12	Drilling Equipment:	CME -75
Logged By:	GW	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Elevation (ft):	2,337	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
	Sample Type	Blows (blows/ft)	Bulk Sample					This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	S	57		4.9		SM		Yellowish red fine to medium grained silty sand continues.
35								
	R	50/5"		5.0	118.4			
								Total depth 36.5' No groundwater Hole backfilled with cuttings
40								
45								
50								

Sample Types:

- R - Ring Sample
- ▱ - Bulk Sample
- ▽ - Groundwater
- T - Tube Sample
- S - SPT Sample
- ▬ - End of Boring

Exploratory Boring Log

Boring No. B-8

Sheet 1 of 2

Date Drilled:	8-27-12	Drilling Equipment:	CME -55
Logged By:	GW	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Eleveation (ft):	2,337	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
						SM		Alluvium (Qal): Yellowish red fine grained silty sand with a trace of medium to coarse sand, moist, loose.
5	S	4		7.7				
10	R	11		7.5	118.9			
15	S	5		14.9				
20	R	12		14.3	115.1			Grades to reddish brown color at 20'.
25	S	31		6.4				Older alluvium (Qoal): Yellowish red fine to coarse grained silty sand with gravel, less moisture than above, dense, hard drilling, moist.

Sample Types:

R - Ring Sample ◩ - Bulk Sample ▽ - Groundwater

T - Tube Sample S - SPT Sample ▬ - End of Boring

Exploratory Boring Log

Boring No. B-8

Sheet 2 of 2

Date Drilled: 8-27-12
Logged By: GW
Location: See Geologic Map
Elevation (ft): 2,337

Drilling Equipment: CME -75
Boring Hole Diameter: 8"
Drive Weights: 140 lbs.
Drop: 30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
	R	50/6"		6.9	122.8	SM		Yellowish red fine to coarse grained silty sand contiues.
35	S	50/4"						Total depth 35.5' No groundwater Hole backfilled with cuttings
40								
45								
50								

Sample Types:

R - Ring Sample
▨ - Bulk Sample
▽ - Groundwater
T - Tube Sample
S - SPT Sample
▬ - End of Boring

Exploratory Boring Log

Boring No. B-9

Sheet 1 of 2

Date Drilled:	8-27-12	Drilling Equipment:	CME -55
Logged By:	GW	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Eleveation (ft):	2,296	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
	Sample Type	Blows (blows/ft)	Bulk Sample					This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
						SM		Alluvium (Qal): Brown fine grained silty sand with a trace of medium grained sand, loose to medium dense, moist.
5	R	21		4.0	108.8			(31% passing #200)
10	S	3		10.1				Grades to yellowish red color with a trace of medium to coarse sand at 10'.
15	R	12		7.8	122.9			
20	S	5		7.9				
25	R	43		6.7	129.8	SM		Older Alluvium (Qoal): Reddish brown fine to medium grained silty sand with a trace of coarse sand, medium dense to dense, moist.

Sample Types:

R - Ring Sample ◪ - Bulk Sample ▽ - Groundwater

T - Tube Sample S - SPT Sample ▬ - End of Boring

Exploratory Boring Log

Boring No. B-9

Sheet 2 of 2

Date Drilled: 8-27-12

Logged By: GW

Location: See Geologic Map

Elevation (ft): 2,296

Drilling Equipment: CME -75

Boring Hole Diameter: 8"

Drive Weights: 140 lbs.

Drop: 30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
	S	45		6.5		SM		Reddish brown fine to medium grained silty sand continues.
35	R	73/ 10"		7.7	123.7			
								Total depth 36' No groundwater Hole backfilled with cuttings
40								
45								
50								

Sample Types:

R - Ring Sample

◸ - Bulk Sample

∇ - Groundwater

T - Tube Sample

S - SPT Sample

▬ - End of Boring

RMA GeoScience

Exploratory Boring Log

Boring No. B-10
Sheet 1 of 1

Date Drilled:	8-28-12	Drilling Equipment:	CME-75
Logged By:	KD	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Elevation (ft):	2,357	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
			▨			SM		Older Alluvium (Qoal): Reddish brown fine to medium grained silty sand, dry to slightly moist, dry, dense.
5	R	70/ 11"		5.5	101.9			Grades to dark yellow brown with coarse sand and a trace of gravel below 5'.
10	S	41		2.5				
15	R	74		3.8	120.8	SP		Brown fine to medium grained sand, moderately well sorted, very dense, dry.
20	S	50/2"		3.9				
						SM		Reddish brown fine to medium grained silty sand with minor coarse sand, very dense.
25	R	93/ 10"		5.0	119.8	SP		Yellow brown fine to medium grained sand with minor coarse sand, moderately sorted, very dense.
								Total depth 31.5' No groundwater Hole backfilled with cuttings
	S	40		3.8				

Sample Types:

R - Ring Sample	▨ - Bulk Sample	▽ - Groundwater
T - Tube Sample	S - SPT Sample	◣ - End of Boring

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Exploratory Boring Log

Boring No. B-11

Sheet 1 of 2

Date Drilled: 8-28-12

Logged By: KD

Location: See Geologic Map

Eleveation (ft): 2,241

Drilling Equipment: CME -55

Boring Hole Diameter: 8"

Drive Weights: 140 lbs.

Drop: 30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
			▨			ML		Alluvium (Qal): Brown sandy silt, fine grained sand, medium dense, moist (54% passing #200 sieve).
5	R	33		5.4	108.1			
	S	18		6.4				
10	R	27		6.4	107.8			Medium dense with an increase in fine sand content at 10'.
	S	8		4.7				
15	S	12		3.4		SM		Light brown fine grained silty sand, dry to moist, loose to medium dense.
20	S	5		10.0				Increase in moisture and silt content at 20'.
25	R	34		7.4	113.9			Grades to fine to medium grained silty sand at 25'.
	S	7		4.5				

Sample Types:

R - Ring Sample

▨ - Bulk Sample

⊻ - Groundwater

T - Tube Sample

S - SPT Sample

▬ - End of Boring

Exploratory Boring Log

Boring No. B-11

Sheet 2 of 2

Date Drilled:	8-28-12	Drilling Equipment:	CME -75
Logged By:	KD	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Elevation (ft):	2,241	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
	S	18		2.8		SP		Gray brown fine grained sand with minor medium to coarse grained sand and trace to minor silt, dry, well sorted, medium dense.
35	S	12		17.0				Interbedded brown silt and gray brown fined grained sand at 35', very moist.
40	S	22		12.2		SM		Brown fine to medium grained silty sand, moist, medium dense, very moist.
						SP		Light brown fine to medium grained sand, dry, moderately well sorted, medium dense, moist.
45	S	17		6.9				
						ML		Brown silt, moist, slightly cohesive, loose, moist.
50	S	9		16.0				Silt contains fine sand at 50'.
								Total depth 51.5' No groundwater Hole backfilled with cuttings

Sample Types:

R - Ring Sample

▨ - Bulk Sample

▽ - Groundwater

T - Tube Sample

S - SPT Sample

▬ - End of Boring

RMA GeoScience

Exploratory Boring Log

Boring No. B-12
Sheet 1 of 1

Date Drilled:	8-28-12	Drilling Equipment:	CME-75
Logged By:	KD	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Elevation (ft):	2,296	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
	Sample Type	Blows (blows/ft)	Bulk Sample					This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
			▨			SM		Older Alluvium (Qoal): Red fine to coarse grained silty sand with minor fine gravel, dry to slightly moist, dense. (31% passing #200)
5	R	74		5.1	123.6			
								Grades to orange brown color at 7'.
10	S	38		4.5				Thin layer of fine to medium grained sand at 10 to 11'.
15	R	75		7.9	118.5			
20	S	28		7.2		SP		Orange brown fien to medium grained sand with minor silt and coarse sand and trace gravel, medium dense to dense, moist.
25	R	80		5.6	114.3			
								Total depth 26.5' No groundwater Hole backfilled with cuttings

Sample Types:

R - Ring Sample

▨ - Bulk Sample

▽ - Groundwater

T - Tube Sample

S - SPT Sample

◣◢ - End of Boring

RMA GeoScience

Exploratory Boring Log

Boring No. B-13
Sheet 1 of 1

Date Drilled: 8-28-12
Logged By: KD
Location: See Geologic Map
Elevation (ft): 2,294

Drilling Equipment: CME-75
Boring Hole Diameter: 8"
Drive Weights: 140 lbs.
Drop: 30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
						SM		Older Alluvium (Qoal): Red fine to coarse grained silty sand, dry to slightly moist, dense.
5	R	49		5.9	119.4			Grades to light orange brown and light brown color at 5'. (32% passing #200)
10	S	50		5.4		SP		Brown fine to coarse grained sand with silt and minor gravel, dry to moist, poorly sorted, dense.
15	R	80/ 11"		4.5	119.6			
20	S	31		3.6				Grades to fine to medium grained sand with minor silt and coarse sand and trace gravel at 20'.
								Total depth 21.5' No groundwater Hole backfilled with cuttings
25								

Sample Types:

R - Ring Sample
◪ - Bulk Sample
▽ - Groundwater
T - Tube Sample
S - SPT Sample
▬ - End of Boring

RMA GeoScience

Exploratory Boring Log

Boring No. B-14

Sheet 1 of 2

Date Drilled:	8-28-12	Drilling Equipment:	CME -55
Logged By:	KD	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Eleveation (ft):	2,263	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
	Sample Type	Blows (blows/ft)	Bulk Sample					This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
						SM		Alluvium (Qal): Brown fine to medium grained silty sand with minor coarse sand, dry to moist, medium dense to dense.
5	R	58		5.3	122.3			(23% passing #200)
						SP		Dark yellow brown fine to coarse grained sand with silt, poorly to moderately well sorted, medium dense, dry to slightly moist.
10	S	26		5.0				
						SM		Brown fine to coarse grained silty sand, slightly moist, dense.
15	R	85/ 11"		3.1	118.3	SP		Brown fine to coarse grained sand with silt and minor fine gravel, poorly sorted, dense to very dense, dry.
20	S	32		6.8				Decreasing silt content at 20'.
						SM		Brown fine to medium grained silty sand, moist, very dense.
25	R	80/ 11"		7.7	124.0			

Sample Types:

R - Ring Sample

▨ - Bulk Sample

▽ - Groundwater

T - Tube Sample

S - SPT Sample

▬ - End of Boring

Exploratory Boring Log

Boring No. B-14

Sheet 2 of 2

Date Drilled:	8-28-12	Drilling Equipment:	CME -75
Logged By:	KD	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Elevation (ft):	2,263	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
	S	65		4.2		SP	⁘	Brown fine to coarse grained sand with minor silt and trace gravel, poorly sorted, dry, dense to very dense.
35							⁘	
	R	50/5"		3.2	114.1		⁘	
40							⁘	
	S	59		3.1			⁘	
							▬	Total depth 41.5' No groundwater Hole backfilled with cuttings
45								
50								

Sample Types:

R - Ring Sample
◪ - Bulk Sample
▽ - Groundwater

T - Tube Sample
S - SPT Sample
▬ - End of Boring

Exploratory Boring Log

Boring No. B-15

Sheet 1 of 2

Date Drilled:	8-29-12	Drilling Equipment:	CME -55
Logged By:	KD	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Eleveation (ft):	2,215	Drop:	30"

Depth (ft)	Samples Sample Type	 Blows (blows/ft)	 Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
			▨			SM		Alluvium (Qal): Brown to gray brown fine to coarse grained silty sand, loose to medium dense, dry.
5	R	33		1.9	107.9			Becomes dense at 5'.
10	S	18		3.8				Grades to brown color at 10'.
15	R	47		6.7	105.1			Grades to brown to reddish brown fine to medium grained silty sand at 15, moist'.
20	S	6		9.5				Grades to fine grained silty sand at 20'.
						ML		Brown sandy silt, fine grained sand, moist, medium dense.
						SM		Brown to reddish brown fine grained silty sand, medium dense, moist.
25	R	21		8.9	112.6			

Sample Types:

R - Ring Sample	▨ - Bulk Sample	⊽ - Groundwater
T - Tube Sample	S - SPT Sample	◣ - End of Boring

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Exploratory Boring Log

Boring No. B-15

Sheet 2 of 2

Date Drilled:	8-29-12	Drilling Equipment:	CME -75
Logged By:	KD	Boring Hole Diameter:	8"
Location:	See Geologic Map	Drive Weights:	140 lbs.
Elevation (ft):	2,215	Drop:	30"

Depth (ft)	Samples			Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	Sample Type	Blows (blows/ft)	Bulk Sample					
	S	21		5.3		SM/SP		Brown to reddish brown fine to coarse grained sand and fine to coarse grained silty sand, medium dense, moist.
35	R	62/ 11"		11.4	121.8	SM		Older Alluvium (Qoal): Reddish brown fine to medium grained silty sand with trace clay, moist, dense.
40	S	29		19.0		ML		Brown silt, moist, slightly cohesive.
45	R	80		4.2	124.1	SP		Brown fine to coarse grained sand with trace gravel, poorly sorted, medium dense to very dense.
50	S	30		6.6				Alternating fine to coarse grained sand, fine grained sand and silt at 50'.
								Total depth 51.5' No groundwater Hole backfilled with cuttings

Sample Types:

R - Ring Sample ▨ - Bulk Sample ▽ - Groundwater

T - Tube Sample S - SPT Sample ▬ - End of Boring

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,369

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-1
Date Excavated: 8-28-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	▨				SM		Alluvium (Qal): Light brown fine to medium grained silty sand with some coarse sand, porous to bottom of trench, small rootlets from 0 to 1.5', loose.
	▨	7.6	86.1				
	▨	9.7	79.9				
5		8.7	86.6				
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,373

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-2
Date Excavated: 8-28-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	▨				SM		Alluvium (Qal): Light brown fine to medium grained silty sand, porous to bottom of trench, loose.
	▨	7.5	85.1				
		11.5	87.0				
5							
10							Total depth 9.5 feet No groundwater No Caving Trench backfilled
15							

Exploratory Trench Log

Trench No. T-3

Location: See Geologic Map
Elevation (ft.): 2,409
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-28-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Older Alluvium (Qoal): Reddish brown fine to medium grained silty sand with clay and small rootlets in the upper foot and pinhole size pores, moist, dense.
		10.4	106.1				
5		8.8	109.2				
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-4

Location: See Geologic Map
Elevation (ft.): 2,343
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-28-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown fine of medium grained silty sand, ¼" pores to a depth of 4', loose.
		9.7	83.7				
		14.2	84.1				
5							
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-5

Location: See Geologic Map
Elevation (ft.): 2,323
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-28-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM	▨	Alluvium (Qal): Light brown fine grained silty sand with pim-hole to ¼" size pores, loose.
		9.7	83.7				
		14.2	84.1				
5							
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-6

Location: See Geologic Map
Elevation (ft.): 2,356
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-28-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM	▨	Alluvium (Qal): Light brown silty sand with gravel up to 2" in size, rootlets in the upper foot of the trench, pin-hole to 1/8" pores, medium dense
		4.3	106.4				
		7.8	99.8				
5							
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,330

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-7
Date Excavated: 8-28-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM	▨	Older Alluvium (Qoal): Reddish brown silty sand with gravel, moist, medium dense to dense.
		9.0	110.5			▨	
5		9.9	102.4				
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,386

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-8
Date Excavated: 8-29-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
	▨				SC	▨	Older Alluvium (Qoal): Red sandy clay with silt, trace of organics in the upper 6", moist, dense, difficult to excavate, backhoe bucket leaves grooves in bottom of trench.
	▨	16.0	105.4			▨	
5							
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,380

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-9
Date Excavated: 8-29-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown fine grained silty sand with grave, pin-hole size pores to a depth of 2', moist, loose to medium dense.
		9.9	92.8				
		8.7	99.4				
5							
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,370

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-10
Date Excavated: 8-29-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown fine grained silty sand, rootlets in the upper 3", pin-hole to ¼" size pores in the upper 3', easy digging, moist, medium dense to dense.
		6.0	96.0				
		6.4	109.1				
5							Total depth 4 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,360

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-11
Date Excavated: 8-29-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown silty sand with gravel, rootlets in the upper 6", pin-hole to 1/8" s ize pores to a depth of 3 ½', moist, old 10" diameter pipe running in an east-west direction encountered at a depth of 2', medium dense.
		8.3	98.3				
5		9.3	95.9				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,360

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-12
Date Excavated: 8-29-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Reddish brown silty sand with gravel, rootlets and pin-hole size pores to a depth of 1', dry in the upper 2', then becoming moist, medium dense.
		4.2	98.1				
		8.9	101.9				Total depth 4 feet No groundwater No Caving Trench backfilled
5							
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,353

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-13
Date Excavated: 8-29-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Older Alluvium (Qoal): Reddish brown silty sand with gravel and granitic cobbles up to 4" in maximum dimension, moist to very moist, medium dense.
		8.7	103.5				
5		13.9	104.6				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,342

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-14
Date Excavated: 8-29-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown silty sand with gravel, pin-hole to 1/8” size pores to a depth of 2', moist, loose.
		7.5	92.0				
		12.0	88.9				
5							Total depth 4 feet No groundwater No Caving Trench backfilled
10							
15							

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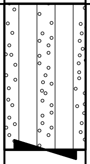
Exploratory Trench Log

Trench No. T-15

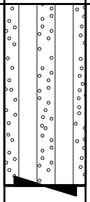
Location: See Geologic Map
Elevation (ft.): 2,324
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-29-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown silty sand with gravel, rottlets and pin-hole to $^1/_8$" size pores to a depth of 1', moist, loose.
		7.9	93.3				
		7.9	92.4				Total depth 4 feet No groundwater No Caving Trench backfilled
5							
10							
15							

Exploratory Trench Log

Trench No. T-16

Location: See Geologic Map
Elevation (ft.): 2,339
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-29-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Older Alluvium (Qoal): Red silty sand with gravel, rootlets and pin-hole to $^1/_8$" size pores to a depth of 1", moist to very moist, medium dense.
		5.7	99.6				
5		14.5	103.2				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-17

Location: See Geologic Map
Elevation (ft.): 2,325
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-29-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Older Alluvium (Qoal): Red medium to coarse grained silty sand with gravel, rootlets and pin-hole to ¼" size pores to a depth of 2', moist, dense.
		6.1	107.4				
		8.0	113.2				Total depth 4 feet No groundwater No Caving Trench backfilled
5							
10							
15							

Exploratory Trench Log

Trench No. T-18

Location: See Geologic Map
Elevation (ft.): 2,368
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-30-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Older Alluvium (Qoal): Red silty sand with gravel and cobbles up to a maximum dimension of 8". Scattered pin-hole size pores to a depth of 1', moist, medium dense.
		8.9	106.8				
5		13.5	97.0				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-19

Location: See Geologic Map
Elevation (ft.): 2,356
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-30-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Older Alluvium (Qoal): Red silty sand with gravel amd cobbles with a maximum dimension of 4", rootlets to a depth of 6", moist to very moist, medium dense.
		6.1	97.2				
5		13.9	105.4				
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-20

Location: See Geologic Map
Elevation (ft.): 2,325
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-30-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Older Alluvium (Qoal): Red silty sand with gravel, pin-hole to $^1/_8$" size pores to a depth of 4', moist to very moist, medium dense.
		16.5	95.0				
5		11.5	104.9				
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,313

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-21
Date Excavated: 8-30-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
		4.8	93.1		SM		Alluvium (Qal): Light brown silty sand with gravel and a hint of red coloring, pin-hole to ½” pores to bottom of trench, moist, loose to medium dense. Ant colony encountered with tunnels up to 1: wide and ¼” high encountered near the bottom of the trench.
5		7.2	95.7				
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,323

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-22
Date Excavated: 8-30-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Older Alluvium (Qoal): .Red silty sand with gravel, pin-hole size pores to a depth of 1.5', rootlets to a depth of 6", medium dense to dense.
		12.7	108.2				
		14.7	100.7				
							Total depth 3.5 feet No groundwater No Caving Trench backfilled
5							
10							
15							

Exploratory Trench Log

Trench No. T-23

Location: See Geologic Map
Elevation (ft.): 2,263

Logged By: CF
Equipment: Backhoe w/24" bucket

Date Excavated: 8-30-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown silty sand with with little to no gravel and a hint of red coloring, rootlet to a depth of 6", pin-hole to $^1/_8$” size pores to bottom of trench, moist to very moist, loose.
		9.8	85.0				
5		14.0	90.8				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-24

Location: See Geologic Map
Elevation (ft.): 2,251

Logged By: CF
Equipment: Backhoe w/24" bucket

Date Excavated: 8-30-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
		5.8	95.1		SM		Alluvium (Qal): Light brown silty sand with intermittent gravel, pin-hole to ½” size pore to bottom of trench, moist, loose.
		8.4	95.2				
5							Total depth 4 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-25

Location: See Geologic Map
Elevation (ft.): 2,277

Logged By: CF
Equipment: Backhoe w/24" bucket

Date Excavated: 8-30-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown silty sand with intermittent gravel and a hint of red coloring, rootlets to a depth of 2', pin-hole to ¼" size pores to bottom of trench, loose to medium dense.
		9.8	92.3				
5		7.4	98.8				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-26

Location: See Geologic Map
Elevation (ft.): 2,283

Logged By: CF
Equipment: Backhoe w/24" bucket

Date Excavated: 8-30-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown silty sand with intermittent gravel and a hint of red coloring, pin-hole to ¼" size pores to the bottom of the trench, moist, loose.
		6.0	85.9				
		7.8	90.9				Total depth 4 feet No groundwater No Caving Trench backfilled
5							
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,288

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-27
Date Excavated: 8-31-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
		8.7	112.3		SM		Older Alluvium (Qoal): Red silty sand with intermittent gravel, rootlets and pin-hole size pores to a depth of 3 feet, moist, medium dense to dense.
5		11.5	103.4				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,260

Logged By: CF
Equipment: Backhoe w/24" bucket

Trench No. T-28
Date Excavated: 8-31-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
		5.4	91.7		SM		Alluvium (Qal): Light brown silty sand with ontermittent gravel and a hint of red color, rootlets to a depth of 6", pin-hole size pores to the bottom of the trench, moist, loose to medium dense.
5		7.0	101.1				Total depth 4.5 feet No groundwater No Caving Trench backfilled
10							
15							

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Exploratory Trench Log

Trench No. T-29

Location: See Geologic Map
Elevation (ft.): 2,266

Logged By: CF
Equipment: Backhoe w/24" bucket

Date Excavated: 8-31-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown silty sand with little to no gravel, rootlets to a depth of 6", very porous to bottom of trench (pin-hole to ¼" size pores), loose to medium dense.
		10.3	95.0				
5		11.5	96.0				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-30

Location: See Geologic Map
Elevation (ft.): 2,242

Logged By: CF
Equipment: Backhoe w/24" bucket

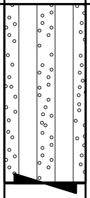
Date Excavated: 8-31-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown silty sand with with little to no gravel and a hint of red coloring, rootlets to a depth of 6", very porous to bottom of trench (pin-hole to ¼" size pores), loose to medium dense.
		7.1	94.3				
		8.5	96.0				Total depth 4 feet No groundwater No Caving Trench backfilled
5							
10							
15							

Exploratory Trench Log

Trench No. T-31

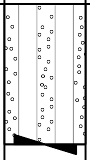
Location: See Geologic Map
Elevation (ft.): 2,245
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-31-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown silty sand with intermittent gravel and a hint of red coloring, rootlets to a depth of 6", pin-hole size pores to bottom of trench, medium dense.
		3.9	100.0				
5		5.0	100.3				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-32

Location: See Geologic Map
Elevation (ft.): 2,288
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-31-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
		3.2	103.1		SM		Alluvium (Qal): Light brown fine to coarse grained silty sand with intermittent gravel and a hint of red coloring, rootlets to a depth of 6", pin-hole to ¼" size pores to bottom of trench, dry to moist, easy digging, medium dense.
		9.1	101.9				Total depth 4 feet No groundwater No Caving Trench backfilled
5							
10							
15							

Exploratory Trench Log

Trench No. T-33

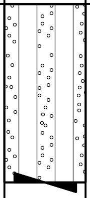
Location: See Geologic Map

Elevation (ft.): 2,298

Logged By: CF

Equipment: Backhoe w/24" bucket

Date Excavated: 8-31-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
		12.1	108.8		SM		Older Alluvium (Qoal): Red silty sand with little or no gravel and clay, rootlets to a depth of 6", pin-hole to ¼" size pores to bottom of trench, moist to very moist, medium dense to dense.
5		9.8	103.0				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-34

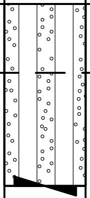
Location: See Geologic Map

Elevation (ft.): 2,266

Logged By: CF

Equipment: Backhoe w/24" bucket

Date Excavated: 8-31-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Older Alluvium (Qoal): Light brown silty sand with intermittent gravel.
		4.4	100.8		SM		Red silty sand with gravel and cobbles with a maximum dimension of 4", rootlets to a depth of 6", pin-hole to ½" size pores to the bottom of the trench, moist, medium dense to dense.
5		10.7	109.6				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-35

Location: See Geologic Map
Elevation (ft.): 2,250
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-31-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
		7.2	113.2		SM		Older alluvium (Qoal): Light brown silty sand with little to no gravel, rootlets to a depth of 1', numerous pin-hole size to ¼" sized pores.
					SM		Red silty sand with gravel, pin-hole size to ¼" sized pores to bottom of trench, moist, dense.
5		10.4	112.0				Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-36

Location: See Geologic Map
Elevation (ft.): 2,227
Logged By: CF
Equipment: Backhoe w/24" bucket
Date Excavated: 8-31-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown silty sand with little to no gravel, rootlets to a depth of 6", pin-hole size pores to bottom of trench, moist, loose.
		7.6	82.4				
		10.0	84.7				Total depth 4 feet No groundwater No Caving Trench backfilled
5							
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,287
Logged By: KD
Equipment: Backhoe w/24" bucket

Trench No. T-37
Date Excavated: 9-4-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Light brown fine to medium grained silty sand, moderately porous with pin-hole to 1/16" size pores, loose. Grades to brown color at 1.5'.
		9.1	94.5				
5		7.4	107.5				Dense at 5'.
							Increased sand content at 7'.
					SP		Gray brown sand with silt and minor gravel, poorly sorted, medium dense to dense.
10							Total depth 10 feet No groundwater No Caving Trench backfilled
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,280
Logged By: KD
Equipment: Backhoe w/24" bucket

Trench No. T-38
Date Excavated: 9-4-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Alluvium (Qal): Brown fine to medium grained silty sand, slightly to moderately porous with pin-hole to 1/16" size pores, blocky structure, dense. Grades to brown to yellow brown color at 2'.
		9.2	114.6				
		7.4	111.6				Only slightly porous with pin-hole size pores at 4'.
5							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-39

Location: See Geologic Map
Elevation (ft.): 2,227

Logged By: KD
Equipment: Backhoe w/24" bucket

Date Excavated: 9-4-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM	▨	Alluvium (Qal): Gray brown fine to coarse grained silty sand with trace gravel, loosed to medium dense to dense, non-porous.
		1.1	109.0			▨	
						▨	6" thick layer of gray fine to coarse grained sand with trace gravel at 3'.
5		1.6	102.4				
							Total depth 5 feet No groundwater Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-40

Location: See Geologic Map
Elevation (ft.): 2,234

Logged By: KD
Equipment: Backhoe w/24" bucket

Date Excavated: 9-4-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM	▨	Alluvium (Qal): Gray brown fine to coarse grained silty sand with trace of gravel, loose to 3', then medium dense, grass rootlets to 4'.
5		1.4	103.1				
							Total depth 5 feet No groundwater Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-41

Location: See Geologic Map

Elevation (ft.): 2,213

Logged By: KD

Equipment: Backhoe w/24" bucket

Date Excavated: 9-4-12

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Brown fine to medium grained silty sand with coarse sand and a slight trace of fine gravel, loose to 12", then medium dense, moderately porous to 4', then slightly porous, pin-hole to 1/32" size pores to 4', pin-hole size pores below 4'.
		5.8	98.6				
5		7.1	106.6				
							Total depth 5 feet No groundwater Trench backfilled
10							
15							

INFILTRATION TEST RESULTS

Project ID 12-495-01
Test Location P-1 (33.913486, -116.883971)
Tested By KD
Date 9/7/12

	Area	Depth of Liq
Constants	(cm^2)	(cm)
Inner Ring	707	11.5
Anlr. Space	2106	9.0

No.	S or E	Date Yr 2011	Time hr (min)	Elpd Time (min)	Flow Readings Inner Ring Rg (cm^3)	Flow Readings Inner Ring Flow (cm^3)	Flow Readings Anlr Space Ring (cm^3)	Flow Readings Anlr Space Flow (cm^3)	Iner Infil Rate Inr (cm/hr)	Iner Infil Rate Anlr (cm/hr)	Iner Infil Rate Inr (in/hr)	Iner Infil Rate Anlr (in/hr)	Remarks
1	S	9/7	8:30:00	0	0	850	0	6,250	4.81	11.87	1.88	4.63	Reddish brown silty sand (SM)
	E	9/7	8:45:00	15	850		6,250						
2	S	9/7	8:45:00	15.0	0	1,250	0	6,200	7.07	11.78	2.76	4.59	Refilled Rings
	E	9/7	9:00:00	30.0	1,250		6,200						
3	S	9/7	9:00:00	15.00	1,250	1,150	6,200	6,300	6.51	11.97	2.54	4.67	
	E	9/7	9:15:00	45.00	2,400		12,500						
4	S	9/7	9:15:00	15.00	0	1,250	0	6,400	7.07	12.16	2.76	4.74	Refilled Rings
	E	9/7	9:30:00	60.00	1,250		6,400						
5	S	9/7	9:30:00	15.00	1,250	1,250	6,400	6,400	7.07	12.16	2.76	4.74	
	E	9/7	9:45:00	75.00	2,500		12,800						
6	S	9/7	9:45:00	10.00	0	1,275	0	5,000	10.82	14.25	4.22	5.56	Refilled Rings
	E	9/7	9:55:00	85.00	1,275		5,000						
7	S	9/7	9:55:00	10.00	1,275	925	5,000	5,000	7.85	14.25	3.06	5.56	
	E	9/7	10:05:00	90.00	2,200		10,000						
8	S	9/7	10:05:00	10.00	2,200	900	0	4,500	7.64	12.82	2.98	5.00	
	E	9/7	10:15:00	105.00	3,100		4,500						
9	S	9/7	10:15:00	10.00	3,100	900	4,500	4,000	7.64	11.40	2.98	4.44	
	E	9/7	10:25:00	115.00	4,000		8,500						
10	S	9/7	10:25:00	10.00	4,000	900	8,500	4,000	7.64	11.40	2.98	4.44	
	E	9/7	10:35:00	125.00	4,900		12,500						
11	S	9/7	10:35:00	10.00	4,900	900	0	4,000	7.64	11.40	2.98	4.44	
	E	9/7	10:45:00	135.00	5,800		4,000						
12	S	9/7	10:45:00	10.00	5,800	900	4,000	3,950	7.64	11.25	2.98	4.39	
	E	9/7	10:55:00	145.00	6,700		7,950						

INFILTRATION TEST RESULTS

Project ID 12-495-01
Test Location P-2 (33.906929, -116.890719)
Tested By KD
Date 9/7/12

Constants	Area (cm^2)	Depth of Liq (cm)
Inner Ring	707	11.5
Anlr. Space	2106	9.0

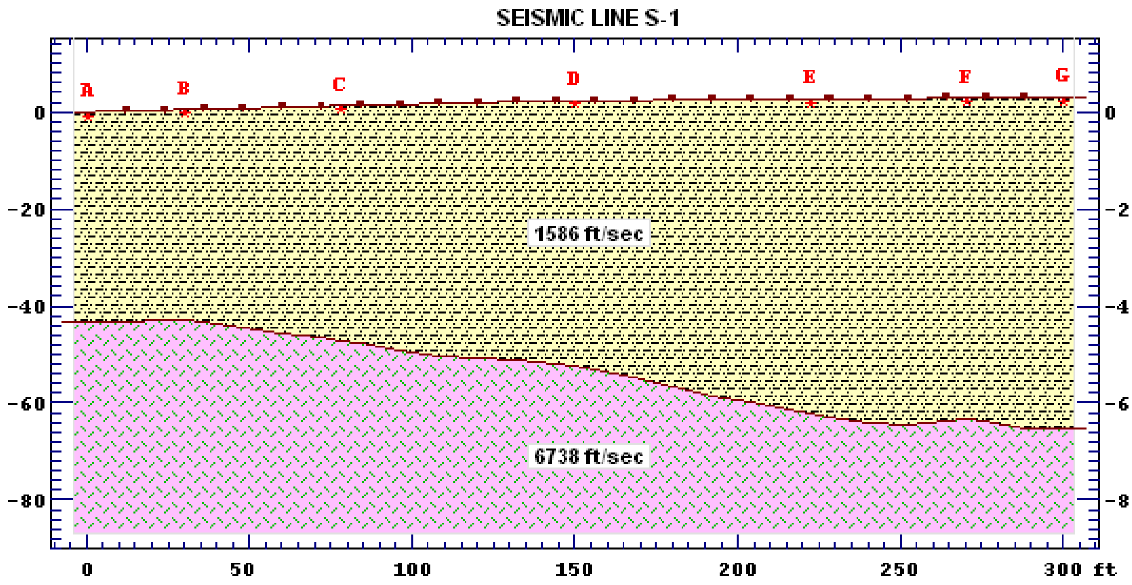
					Flow Readings				Iner Infil Rate		Iner Infil Rate		
					Inner Ring		Anlr Space						
No.	S or E	Date Yr 2011	Time hr (min)	Elpd Time (min)	Rg (cm^3)	Flow (cm^3)	Ring (cm^3)	Flow (cm^3)	Inr (cm/hr)	Anlr (cm/hr)	Inr (in/hr)	Anlr (in/hr)	Remarks
1	S	9/7	12:00:00	0	0	350	0	2,450	1.98	4.65	0.77	1.81	Gray brown silty sand (Qal)
	E	9/7	12:15:00	15	350		2,450						
2	S	9/7	12:15:00	15.0	350	300	2,450	2,250	1.70	4.27	0.66	1.67	
	E	9/7	12:30:00	30.0	650		4,700						
3	S	9/7	12:30:00	15.00	650	400	4,700	2,200	2.26	4.18	0.88	1.63	
	E	9/7	12:45:00	45.00	1,050		6,900						
4	S	9/7	12:45:00	15.00	1,050	350	6,900	2,200	1.98	4.18	0.77	1.63	
	E	9/7	13:00:00	60.00	1,400		9,100						
5	S	9/7	13:00:00	15.00	1,400	400	9,100	2,100	2.26	3.99	0.88	1.56	
	E	9/7	13:15:00	75.00	1,800		11,200						
6	S	9/7	13:15:00	15.00	0	400	0	2,000	2.26	3.80	0.88	1.48	Refilled Rings
	E	9/7	13:30:00	90.00	400		2,000						
7	S	9/7	1:30:00	15.00	400	350	2,000	2,000	1.98	3.80	0.77	1.48	
	E	9/7	1:45:00	105.00	750		4,000						
8	S	9/7	13:45:00	15.00	750	350	4,000	2,000	1.98	3.80	0.77	1.48	
	E	9/7	14:00:00	120.00	1,100		6,000						
9	S	9/7	14:00:00	15.00	1,100	350	6,000	2,000	1.98	3.80	0.77	1.48	
	E	9/7	14:15:00	135.00	1,450		8,000						

INFILTRATION TEST RESULTS

Project ID 12-495-01
Test Location P-3 (xxx)
Tested By KD
Date 9/10/12

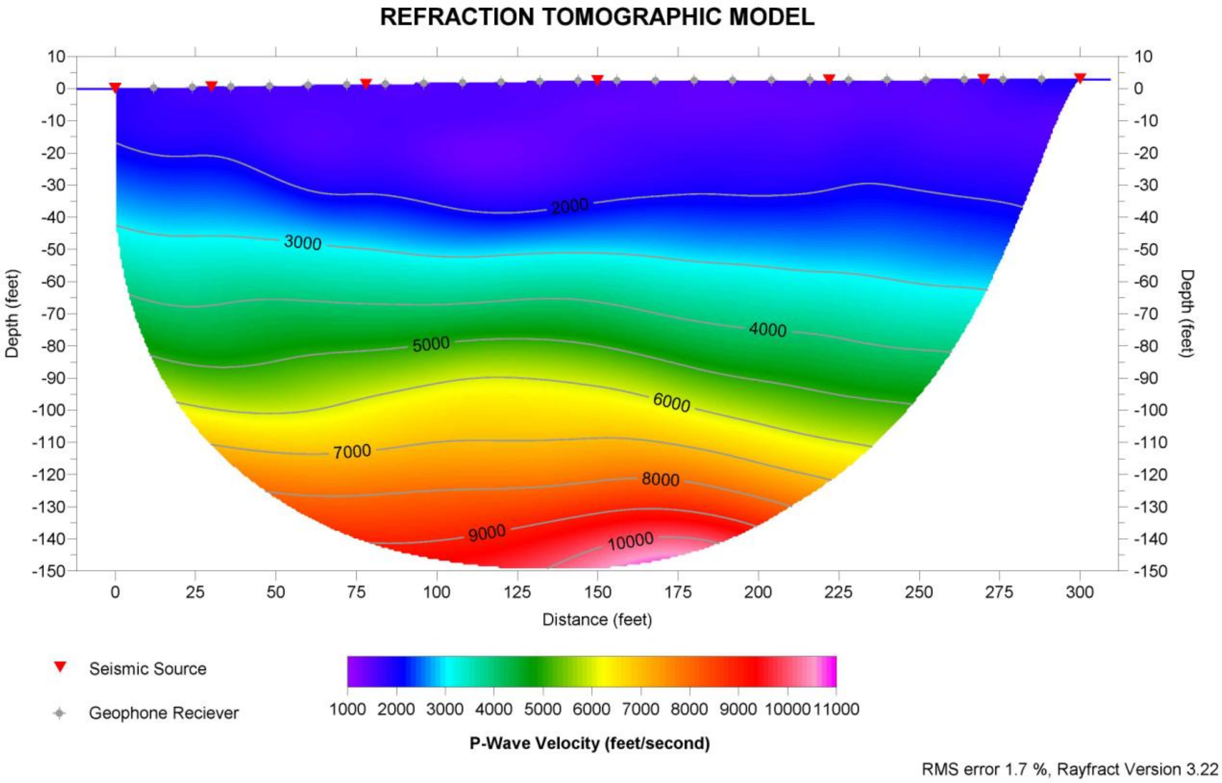
Constants	Area (cm^2)	Depth of Liq (cm)
Inner Ring	707	11.5
Anlr. Space	2106	9.0

No.	S or E	Date Yr 2011	Time hr (min)	Elpd Time (min)	Flow Readings Inner Ring Rg (cm^3)	Flow Readings Inner Ring Flow (cm^3)	Flow Readings Anlr Space Ring (cm^3)	Flow Readings Anlr Space Flow (cm^3)	Iner Infil Rate Inr (cm/hr)	Iner Infil Rate Anlr (cm/hr)	Iner Infil Rate Inr (in/hr)	Iner Infil Rate Anlr (in/hr)	Remarks
1	S	9/10	9:00:00	0	0	250	0	900	1.41	1.71	0.55	0.67	Reddish brown silty sand (Qoal)
	E	9/10	9:15:00	15	250		900						
2	S	9/10	9:15:00	15.0	250	200	900	600	1.13	1.14	0.44	0.44	
	E	9/10	9:30:00	30.0	450		1,500						
3	S	9/10	9:30:00	15.00	450	150	1,500	400	0.85	0.76	0.33	0.30	
	E	9/10	9:45:00	45.00	600		1,900						
4	S	9/10	9:45:00	15.00	600	100	1,900	400	0.57	0.76	0.22	0.30	
	E	9/10	10:00:00	60.00	700		2,300						
5	S	9/10	10:00:00	30.00	700	150	2,300	600	0.42	0.57	0.17	0.22	
	E	9/10	10:30:00	90.00	850		2,900						
6	S	9/10	10:30:00	30.00	850	100	2,900	500	0.28	0.47	0.11	0.19	
	E	9/10	11:00:00	120.00	950		3,400						
7	S	9/10	11:00:00	30.00	950	75	3,400	500	0.21	0.47	0.08	0.19	
	E	9/10	11:30:00	150.00	1,025		3,900						
8	S	9/10	11:30:00	30.00	1,025	75	3,900	450	0.21	0.43	0.08	0.17	
	E	9/10	12:00:00	180.00	1,100		4,350						
9	S	9/10	12:00:00	30.00	1,100	75	4,350	450	0.21	0.43	0.08	0.17	
	E	9/10	12:30:00	210.00	1,175		4,800						

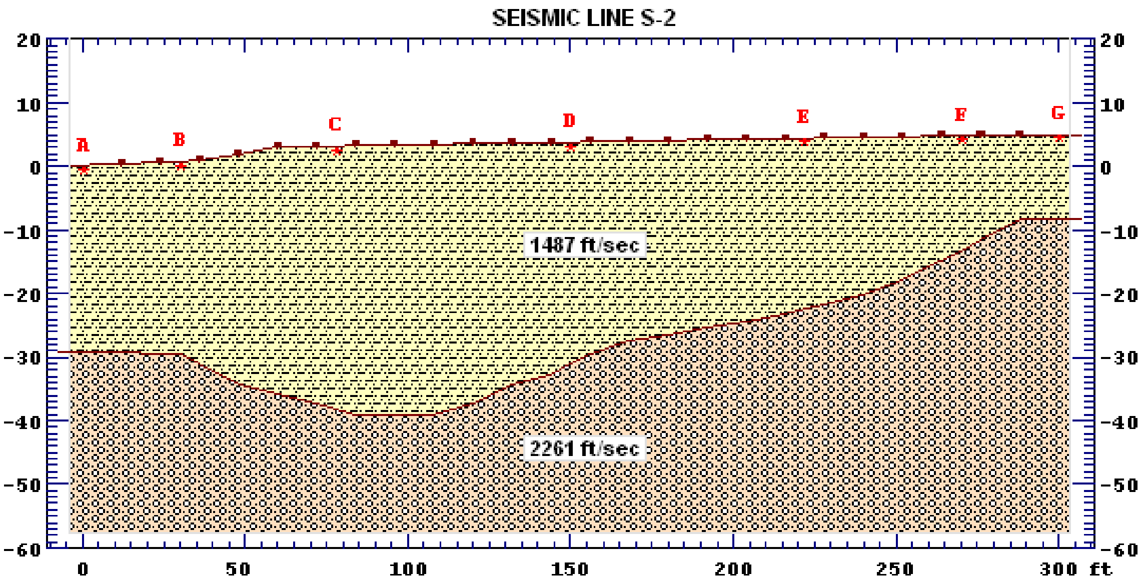


SEISMIC LINE S-1

North 75° East →

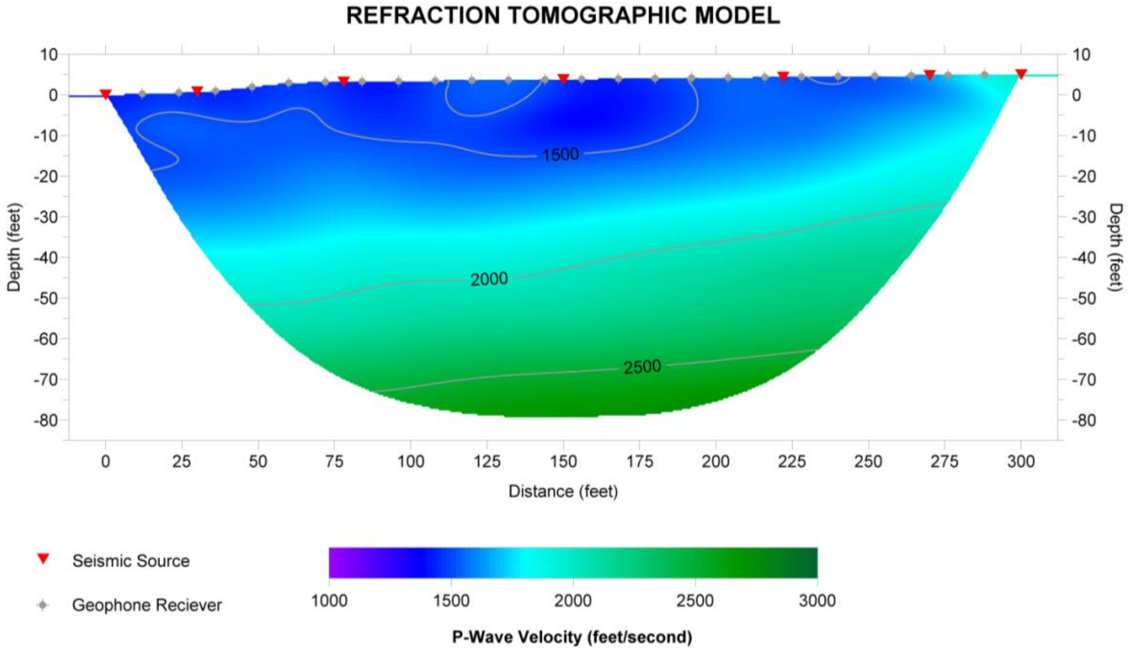


RMS error 1.7 %, Rayfract Version 3.22



SEISMIC LINE S-2

North 78° East →



NOTE: Vertcal Exaggeration 1.5X

RMS error 1.6 %,Rayfract Version 3.22

APPENDIX B

LABORATORY TESTS

APPENDIX B

LABORATORY TESTS

B-1.00 LABORATORY TESTS

B-1.01 Maximum Density

Maximum density - optimum moisture relationships for the major soil types encountered during the field exploration were performed in the laboratory using the standard procedures of ASTM D1557.

B-1.02 Expansion Tests

Expansion index tests were performed on representative samples of the major soil types encountered by the test methods outlined in ASTM D4829.

B-1.03 Soluble Sulfates

Testing was performed on representative samples encountered during the investigation using the HACH DR3 (Calcium Phosphate Extractable) procedures.

B-1.04 Sand Equivalence

Sand Equivalent tests were performed on representative samples of the major soil types encountered by the test methods of ASTM D2419.

B-1.05 Soil Reactivity (pH) and Electrical Conductivity (Ec)

Representative soil samples were tested for soil reactivity (pH) and electrical conductivity (Ec) using the test methods of ASTM D4972. The pH measurement determines the degree of acidity or alkalinity in the soils. The Ec is a measure of the electrical resistivity and is expressed as the reciprocal of the resistivity.

B-1.06 Particle Size Analysis

Particle size analysis was performed on representative samples of the major soils types in accordance to the standard test methods of the ASTM D422. The hydrometer portion of the standard procedure was not performed and the material retained on the #200 screen was washed. Separate testing of soil samples to determine the percentage of soils passing the #200 screen was performed in accordance with the test methods of ASTM D422.

B-1.07 Direct Shear

Direct shear tests were performed on representative samples of the major soil types encountered in the test holes using the standard test method of ASTM D3080 (consolidated and drained). Tests were performed on remolded. Remolded samples were tested at 90 percent relative compaction.

Shear tests were performed on a direct shear machine of the strain-controlled type. To simulate possible adverse field conditions, the samples were saturated prior to shearing. Several samples were sheared at varying normal loads and the results plotted to establish the angle of the internal friction and cohesion of the tested samples.

B-1.08 Consolidation (One-Dimensional)

One-dimensional consolidation tests were performed using the standard test method of ASTM D2435. The rate of consolidation of the tested sample was not determined and the applied test pressure is indicated on the summary of the test results. To simulate possible adverse field conditions, moisture was added to an axial load of 650 or 1250 pounds per square foot.

B-1.09 Resistance Value (R-Value)

Resistance Value tests were performed on representative samples of the major soil types encountered by the test methods outlined in California 301.

B-1.10 Moisture Determination

Moisture content of the soil samples was performed in accordance to standard method for determination of water content of soil by drying oven, ASTM D2216. The mass of material remaining after oven drying is used as the mass of the solid particles.

B-1.11 Density of Split-Barrel Samples

The densities of soil samples obtained by using a split-barrel sampler were determined in accordance to standard method of ASTM D1586.

B-1.12 Test Results

Test results for all laboratory tests performed on the subject project are presented in this appendix.

SAMPLE INFORMATION

Sample Number	Sample Description	Sample Location	
		Boring/Trench No.	Depth (ft)
1	Light brown silty sand (Qal)	B-1	2-4
2	Grayish brown silty sand (Qal)	B-2	1-5
3	Light brown sandy silt (Qal)	B-3	1-5
4	Strong brown silty sand (Qoal)	B-4	1-4
5	Strong brown sandy silt (Qal)	B-5	20-23
6	Reddish brown silty sand (Qoal)	B-6	1-3
7	Reddish brown silty sand (Qoal)	B-10	1-5
8	Brown sandy silt (Qal)	B-11	1-5
9	Red silty sand (Qoal)	B-12	1-5
10	Brown to gray brown silty sand (Qal)	B-15	1-5
11	Light brown silty sand (Qal)	T-1	0-4
12	Light brown silty sand (Qal)	T-2	0-5

MAXIMUM DENSITY - OPTIMUM MOISTURE

(Test Method: ASTM D1557)

Sample Number	Optimum Moisture (Percent)	Maximum Density (lbs/ft^3)
3	11.5	123.5
8	7.5	129.5
9	9.5	128.0
12	10.5	128.0

EXPANSION TEST

Test Method: ASTM D4829

Sample Number	Molding Moisture Content (Percent)	Final Moisture Content (Percent)	Initial Dry Density (lbs/ft³)	Expansion Index	Expansion Classification
1	7.2	12.4	120.5	0	Very low
9	7.5	16.3	117.5	4	Very low
12	7.0	16.8	120.6	15	Very low

SOLUBLE SULFATES

(Test Method: Hach DR3 - Calcium Phosphate Extractable)

Sample Number	Soluble Sulfate (ppm)
3	15
8	19
9	21
12	28

SAND EQUIVALENT

Test Method: ASTM D2419

Sample Number	Sand Equivalent
2	7
6	9

SOIL REACTIVITY (pH) AND ELECTRICAL CONDUCTIVITY

(Test Method: ASTM D4972)

Sample Number	pH	Resistivity (ohm-cm)
3	7.1	8,600
8	7.4	15,000
9	7.2	9,400
12	7.0	17,000

PERCENT PASSING #200 SIEVE

(Test Method: ASTM D422)

Sample Number or Location	Percent Passing #200 Sieve
9	30
B-7 @ 5’	35
B-9 @ 5’	31
B-13 @ 5’	32
B-14 @ 5’	23

PARTICLE SIZE ANALYSIS

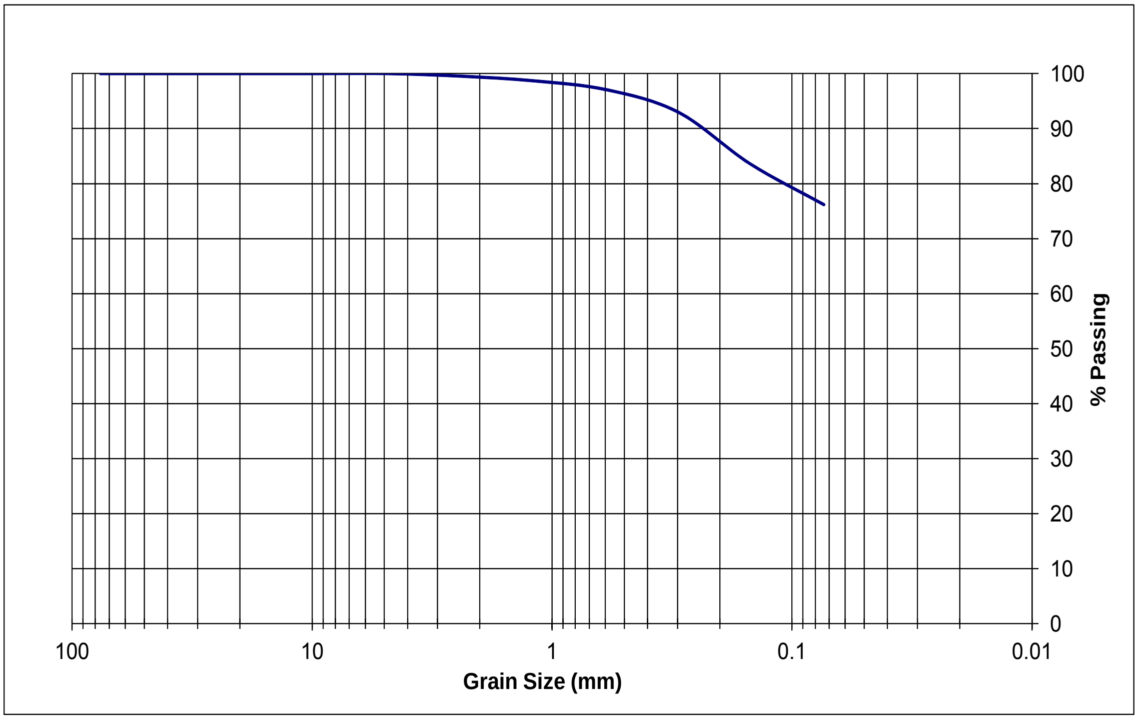
ASTM D422

Sample Id: 3
Location B-3, 1-5'

Dry Net Weight (gms): 480.6

Screen Size	Net Retained Weight (lbs)	Net Passing Weight (lbs)	% Passing
3"	0	480.6	100
1-1/2"	0	480.6	100
3/4"	0	480.6	100
3/8"	0	480.6	100
#4	0	480.6	100
#8	2.3	478.3	100
#16	6.3	474.3	99
#30	14.2	466.4	97
#50	33.8	446.8	93
#100	78.6	402.0	84
#200	114.4	366.2	76

∴USCS Classification: ML - Sandy Silt



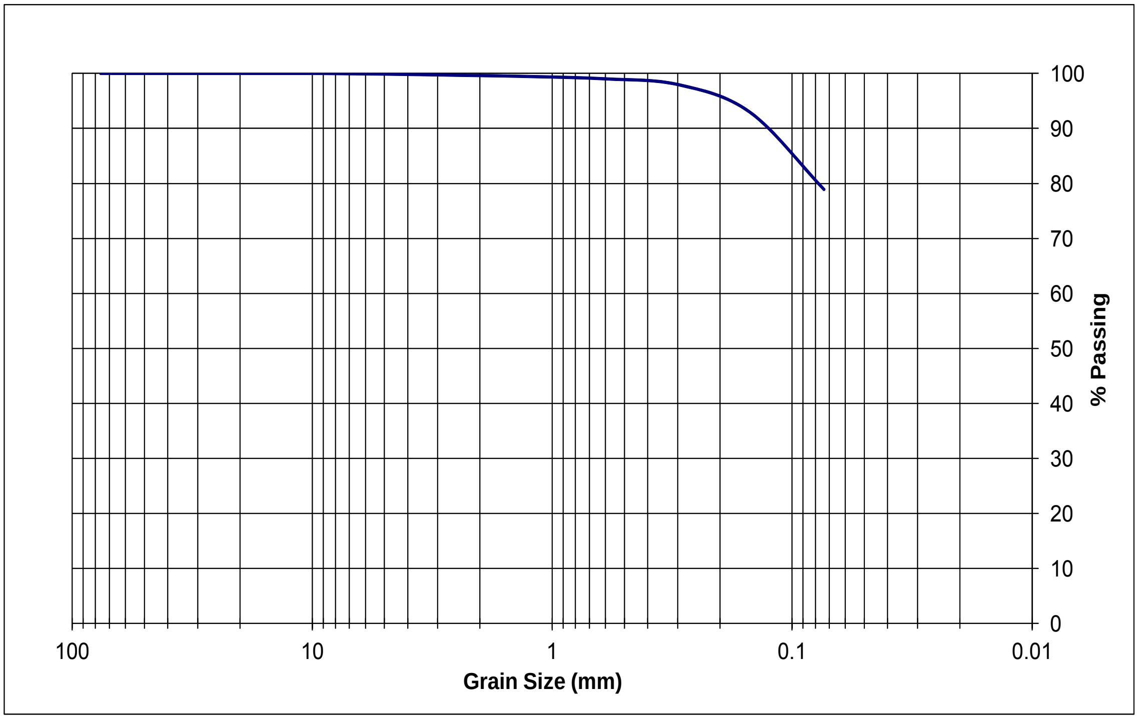
PARTICLE SIZE ANALYSIS
ASTM D422

Sample Id: 5
Location: B-8, 20-23'

Dry Net Weight (gms): 467.1

Screen Size	Net Retained Weight (lbs)	Net Passing Weight (lbs)	% Passing
3"	0	467.1	100
1-1/2"	0	467.1	100
3/4"	0	467.1	100
3/8"	0	467.1	100
#4	0.6	466.5	100
#8	1.6	465.5	100
#16	2.7	464.4	99
#30	4.7	462.4	99
#50	9.6	457.5	98
#100	33.0	434.1	93
#200	98.6	368.5	79

∴USCS Classification: ML - Sandy Silt



PARTICLE SIZE ANALYSIS

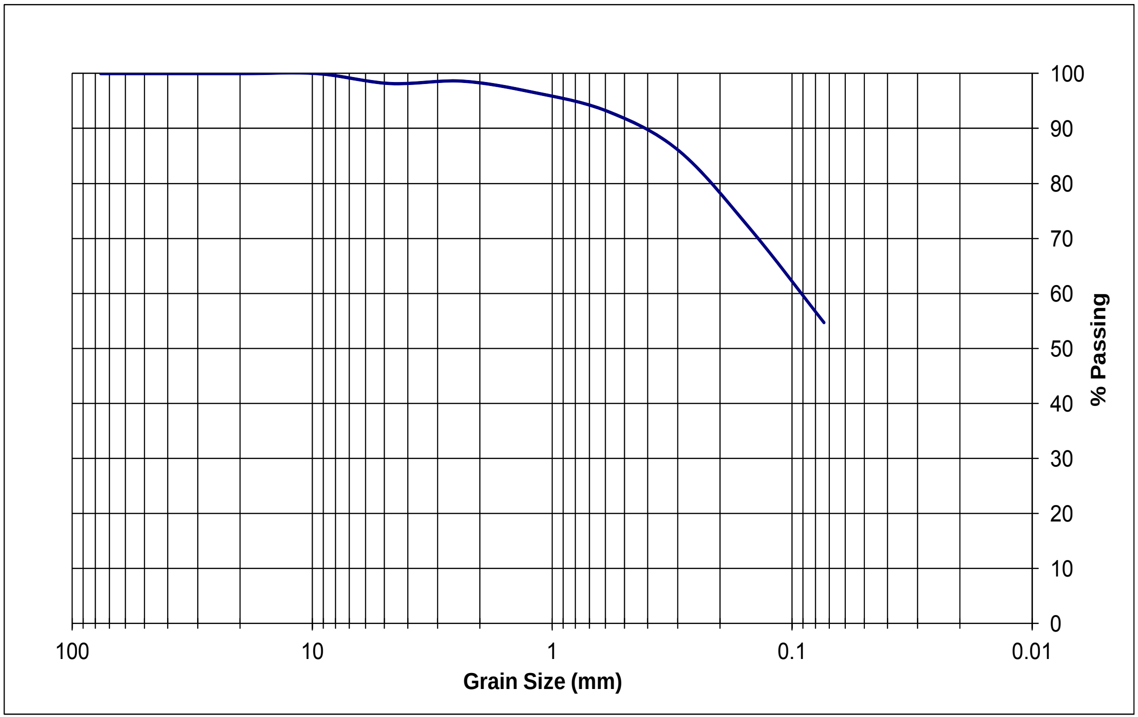
ASTM D422

Sample Id: 8
Location: B-11, 1-5'

Dry Net Weight (gms): 510.1

Screen Size	Net Retained Weight (lbs)	Net Passing Weight (lbs)	% Passing
3"	0	510.1	100
1-1/2"	0	510.1	100
3/4"	0	510.1	100
3/8"	0	510.1	100
#4	9.2	500.9	98
#8	7.0	503.1	99
#16	17.5	492.6	97
#30	34.9	475.2	93
#50	71.4	438.7	86
#100	143.8	366.3	72
#200	231.0	279.1	55

∴USCS Classification: ML - Sandy silt



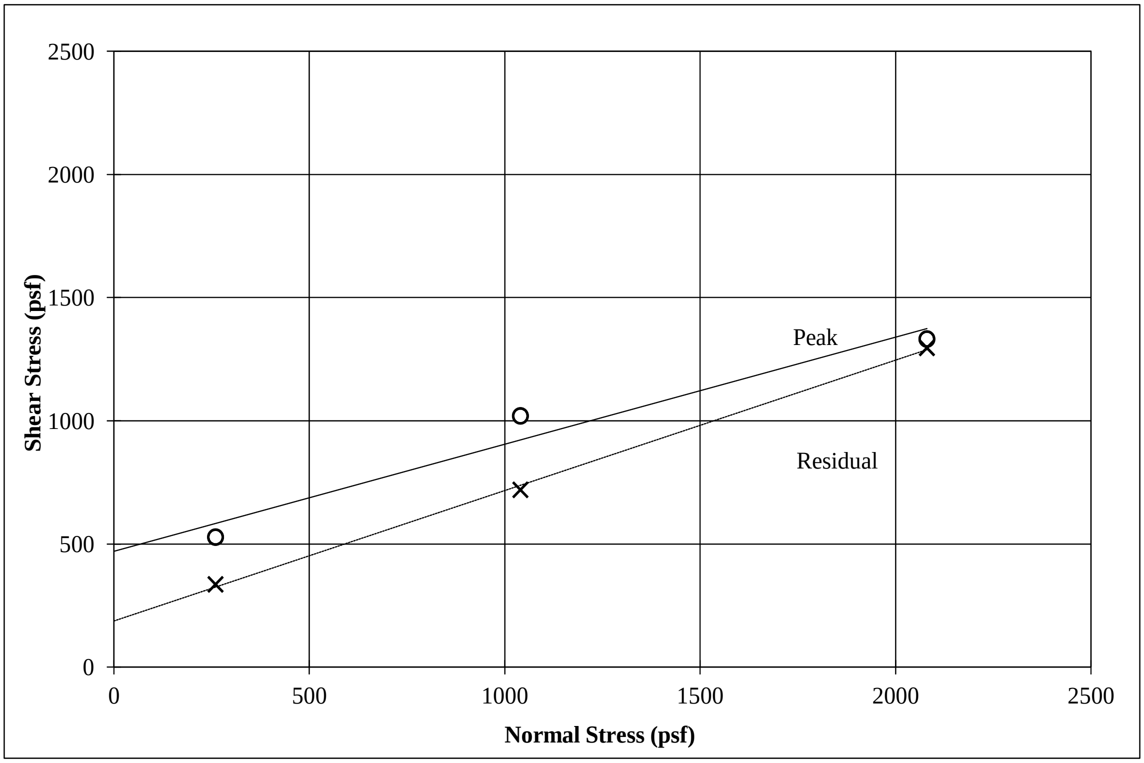
DIRECT SHEAR TEST
ASTM D3080

Sample ID: 3
Location: B-3, 1-5'

Maximum Dry Density (pcf) = 123.5
Optimum Moisture Content (%) = 11.5
Initial Dry Density (pcf) = 111.2
Initial Moisture Content (%) = 11.5
Final Moisture Content (%) = 20.3

Normal Pressure	Peak Shear Resist	Residual Shear Resist
260	528	336
1040	1020	720
2080	1332	1296

	Peak	Residual
Cohesion (psf) =	470	190
Friction Angle (deg) =	23	28



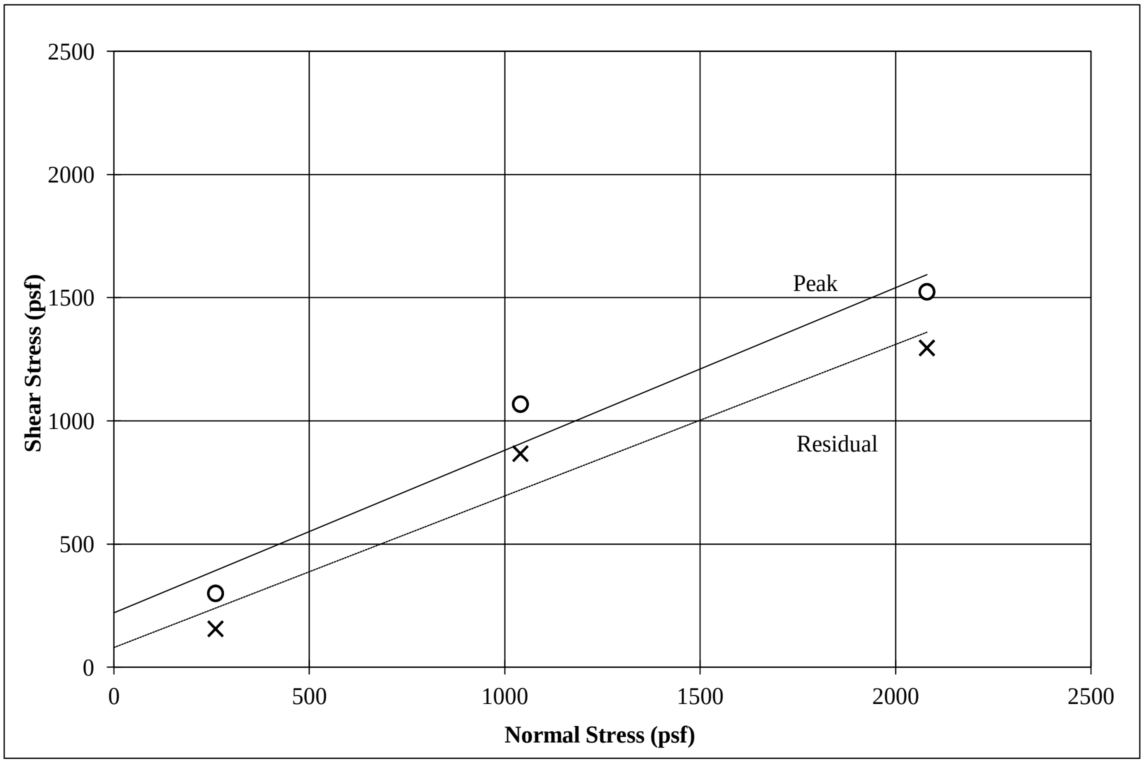
DIRECT SHEAR TEST
ASTM D3080

Sample ID: 8
Location: B-11, 1-5'

Maximum Dry Density (pcf) = 129.5
Optimum Moisture Content (%) = 7.5
Initial Dry Density (pcf) = 115.3
Initial Moisture Content (%) = 7.5
Final Moisture Content (%) = 18.1

Normal Pressure	Peak Shear Resist	Residual Shear Resist
260	300	156
1040	1068	867
2080	1524	1296

	Peak	Residual
Cohesion (psf) =	220	80
Friction Angle (deg) =	33	32



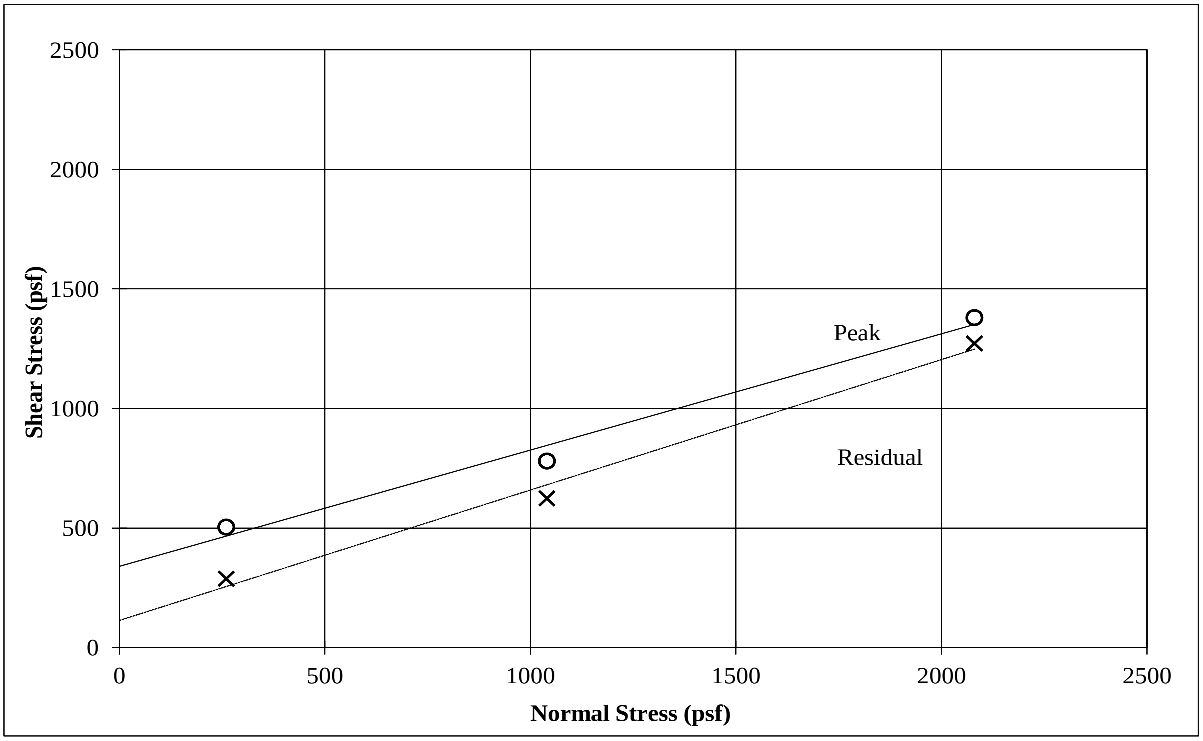
DIRECT SHEAR TEST
ASTM D3080

Sample ID: 9
Location: B-12, 1-5'

Maximum Dry Density (pcf) = 128.0
Optimum Moisture Content (%) = 9.5
Initial Dry Density (pcf) = 114.1
Initial Moisture Content (%) = 9.5
Final Moisture Content (%) = 16.4

Normal Pressure	Peak Shear Resist	Residual Shear Resist
260	504	288
1040	780	624
2080	1380	1272

	Peak	Residual
Cohesion (psf) =	340	110
Friction Angle (deg) =	26	29



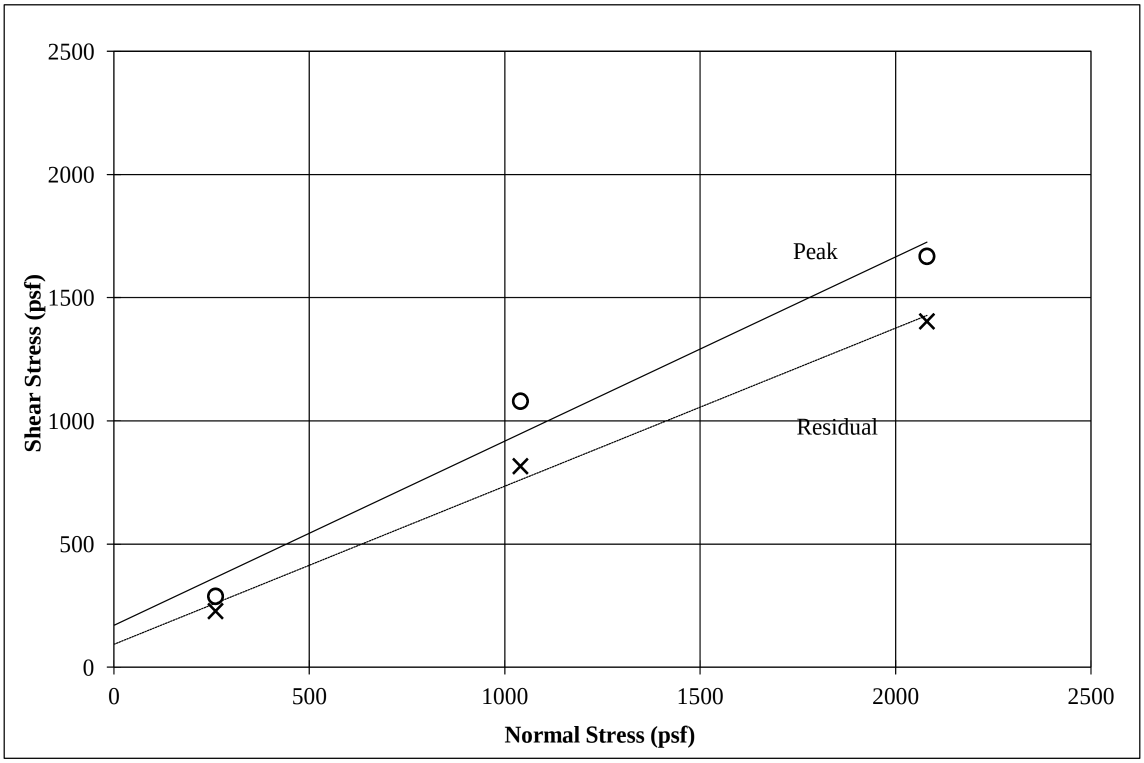
DIRECT SHEAR TEST
ASTM D3080

Sample ID: 12
Location: T-3, 0-5'

Maximum Dry Density (pcf) = 128.0
Optimum Moisture Content (%) = 10.5
Initial Dry Density (pcf) = 115.0
Initial Moisture Content (%) = 10.5
Final Moisture Content (%) = 16.2

Normal Pressure	Peak Shear Resist	Residual Shear Resist
260	288	228
1040	1080	816
2080	1668	1404

	Peak	Residual
Cohesion (psf) =	170	90
Friction Angle (deg) =	37	33

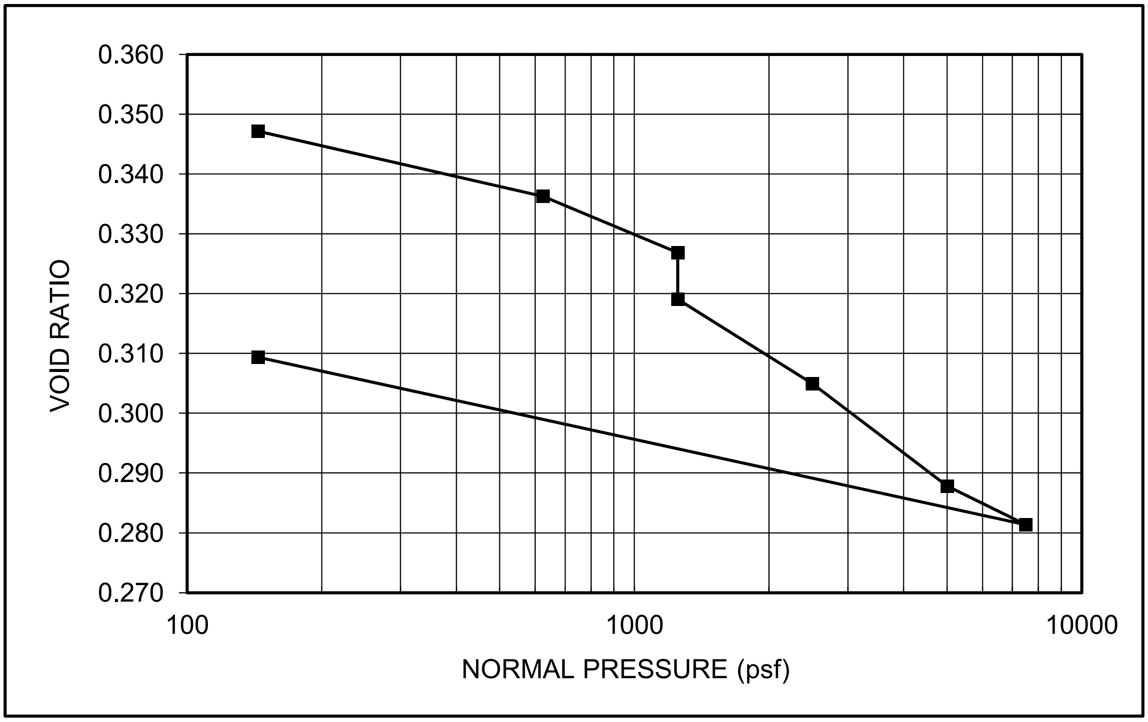


ONE-DIMENSIONAL CONSOLIDATION
ASTM D2435

Location: B-1 @ 5'

Unit Weight (pcf):	120.6	Initial Dial Reading:	0.2461	inch
Initial Moisture:	10.8%	Initial Specimen Height:	1.0000	inch
Final Moisture:	11.6%	Initial Void Ratio:	0.345	
Initial Saturation:	81.3%	Final Void Ratio:	0.309	
Final Saturation:	97.5%	Specific Gravity :	2.60	

Moisture Condition	Load (psf)	Final Dial Reading (inches)	Sample Height (inches)	Void Ratio
In Situ	144	0.2447	1.0014	0.347
	625	0.2528	0.9933	0.336
	1250	0.2598	0.9863	0.327
Add water	1250	0.2656	0.9805	0.319
	2500	0.2761	0.9700	0.305
	5000	0.2888	0.9573	0.288
	7500	0.2936	0.9525	0.281
	144	0.2728	0.9733	0.309



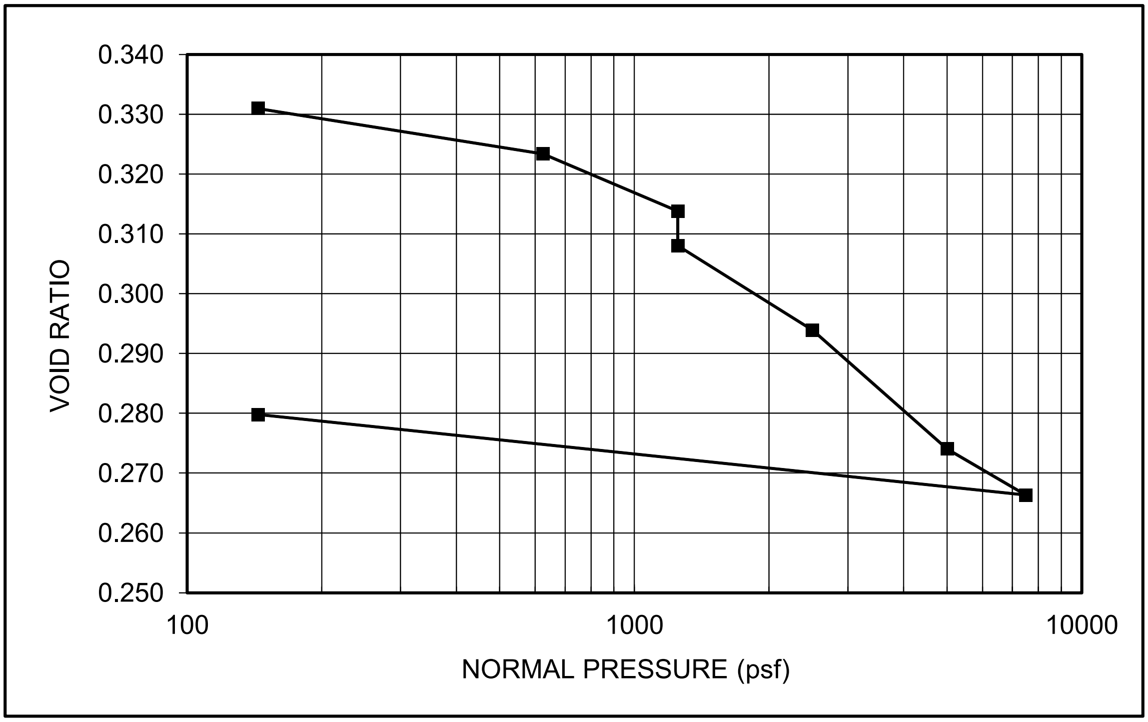
ONE-DIMENSIONAL CONSOLIDATION
ASTM D2435

Location: B-1 @ 10'

Unit Weight (pcf): 121.7
Initial Moisture: 10.8%
Final Moisture: 12.0%
Initial Saturation: 84.3%
Final Saturation: 111.5%

Initial Dial Reading: 0.1932 inch
Initial Specimen Height: 1.0000 inch
Initial Void Ratio: 0.333
Final Void Ratio: 0.280
Specific Gravity : 2.60

Moisture Condition	Load (psf)	Final Dial Reading (inches)	Sample Height (inches)	Void Ratio
In Situ	144	0.1948	0.9984	0.331
	625	0.2005	0.9927	0.323
	1250	0.2077	0.9855	0.314
Add water	1250	0.2120	0.9812	0.308
	2500	0.2226	0.9706	0.294
	5000	0.2375	0.9557	0.274
	7500	0.2433	0.9499	0.266
	144	0.2332	0.9600	0.280

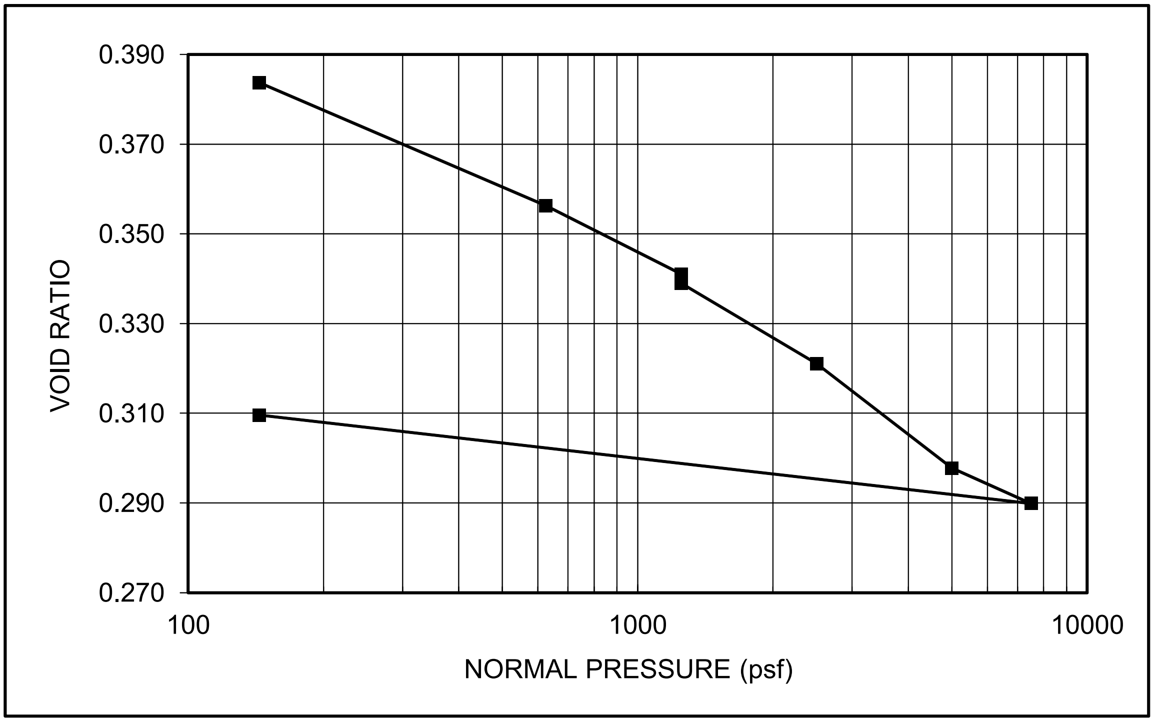


ONE-DIMENSIONAL CONSOLIDATION
ASTM D2435

Location: B-1 @ 15'

Unit Weight (pcf):	117.0	Initial Dial Reading:	0.2469	inch
Initial Moisture:	10.1%	Initial Specimen Height:	1.0000	inch
Final Moisture:	12.8%	Initial Void Ratio:	0.387	
Initial Saturation:	67.9%	Final Void Ratio:	0.310	
Final Saturation:	107.5%	Specific Gravity :	2.60	

Moisture Condition	Load (psf)	Final Dial Reading (inches)	Sample Height (inches)	Void Ratio
In Situ	144	0.2490	0.9979	0.384
	625	0.2688	0.9781	0.356
	1250	0.2798	0.9671	0.341
Add water	1250	0.2813	0.9656	0.339
	2500	0.2942	0.9527	0.321
	5000	0.3110	0.9359	0.298
	7500	0.3167	0.9302	0.290
	144	0.3025	0.9444	0.310



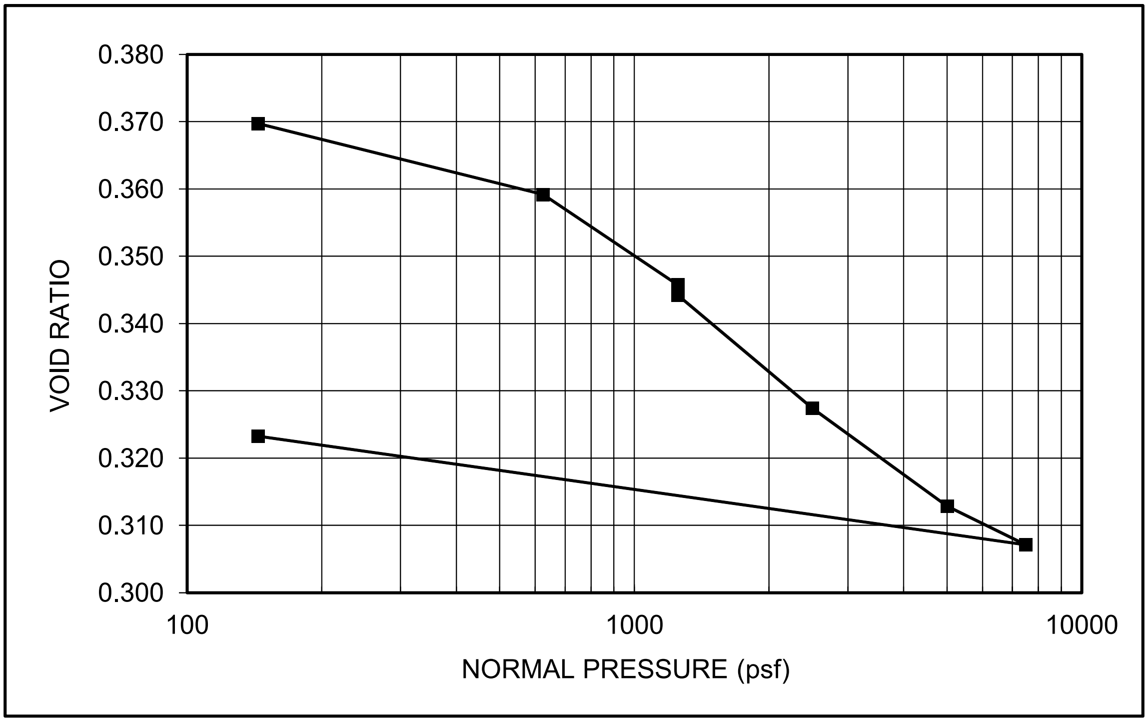
ONE-DIMENSIONAL CONSOLIDATION
ASTM D2435

Location: B-1 @ 20'

Unit Weight (pcf): 118.4
Initial Moisture: 12.5%
Final Moisture: 13.5%
Initial Saturation: 87.8%
Final Saturation: 108.6%

Initial Dial Reading: 0.1874 inch
Initial Specimen Height: 1.0000 inch
Initial Void Ratio: 0.370
Final Void Ratio: 0.323
Specific Gravity : 2.60

Moisture Condition	Load (psf)	Final Dial Reading (inches)	Sample Height (inches)	Void Ratio
In Situ	144	0.1878	0.9996	0.370
	625	0.1955	0.9919	0.359
	1250	0.2053	0.9821	0.346
Add water	1250	0.2064	0.9810	0.344
	2500	0.2187	0.9687	0.327
	5000	0.2293	0.9581	0.313
	7500	0.2335	0.9539	0.307
	144	0.2217	0.9657	0.323

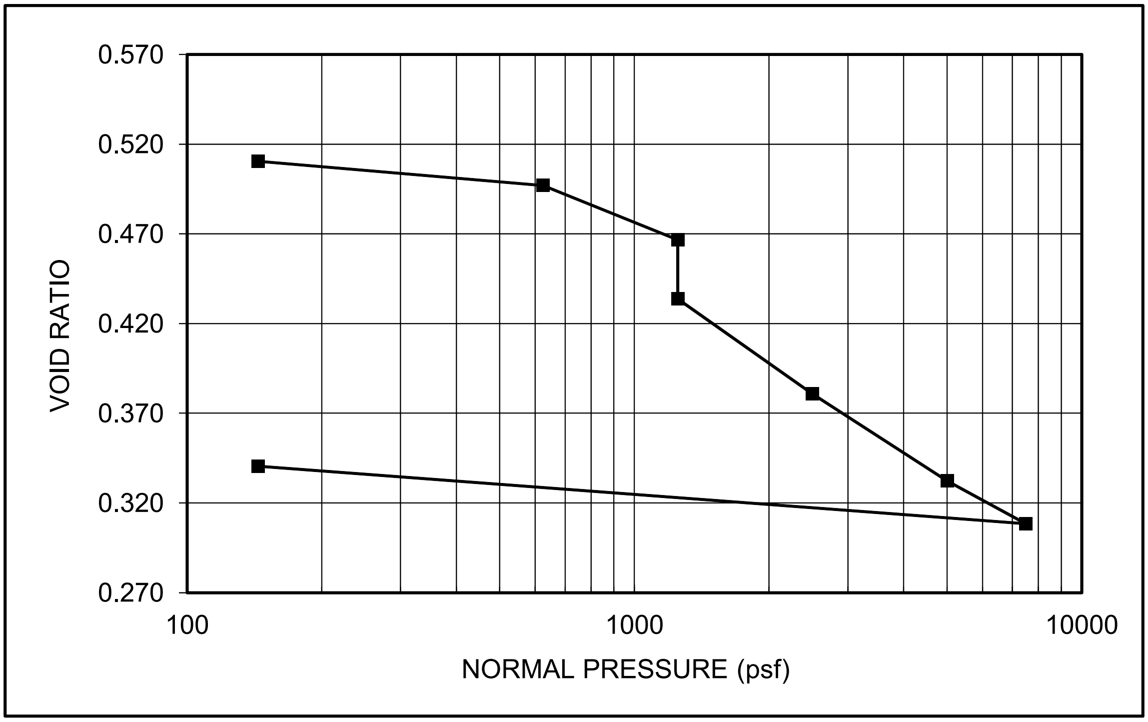


ONE-DIMENSIONAL CONSOLIDATION
ASTM D2435

Location: B-8 @ 10'

Unit Weight (pcf):	107.4	Initial Dial Reading:	0.2181	inch
Initial Moisture:	7.5%	Initial Specimen Height:	1.0000	inch
Final Moisture:	14.1%	Initial Void Ratio:	0.511	
Initial Saturation:	38.2%	Final Void Ratio:	0.341	
Final Saturation:	107.7%	Specific Gravity :	2.60	

Moisture Condition	Load (psf)	Final Dial Reading (inches)	Sample Height (inches)	Void Ratio
In Situ	144	0.2182	0.9999	0.510
	625	0.2271	0.9910	0.497
	1250	0.2472	0.9709	0.467
Add water	1250	0.2690	0.9491	0.434
	2500	0.3040	0.9141	0.381
	5000	0.3361	0.8820	0.332
	7500	0.3519	0.8662	0.308
	144	0.3307	0.8874	0.341

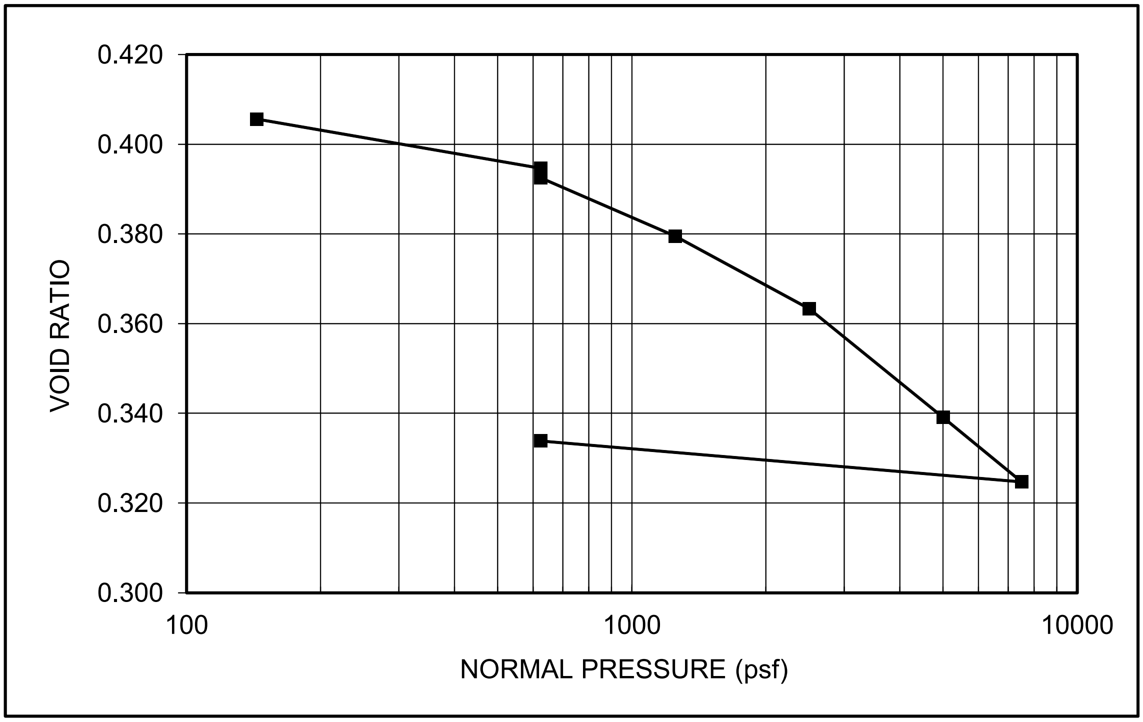


ONE-DIMENSIONAL CONSOLIDATION
ASTM D2435

Location: B-8 @ 20'

Unit Weight (pcf):	115.1	Initial Dial Reading:	0.2671	inch
Initial Moisture:	14.3%	Initial Specimen Height:	1.0000	inch
Final Moisture:	16.4%	Initial Void Ratio:	0.410	
Initial Saturation:	90.8%	Final Void Ratio:	0.334	
Final Saturation:	127.7%	Specific Gravity :	2.60	

Moisture Condition	Load (psf)	Final Dial Reading (inches)	Sample Height (inches)	Void Ratio
In Situ	144	0.2699	0.9972	0.406
	625	0.2777	0.9894	0.395
Add water	625	0.2792	0.9879	0.393
	1250	0.2884	0.9787	0.380
	2500	0.2999	0.9672	0.363
	5000	0.3171	0.9500	0.339
	7500	0.3273	0.9398	0.325
	625	0.3208	0.9463	0.334

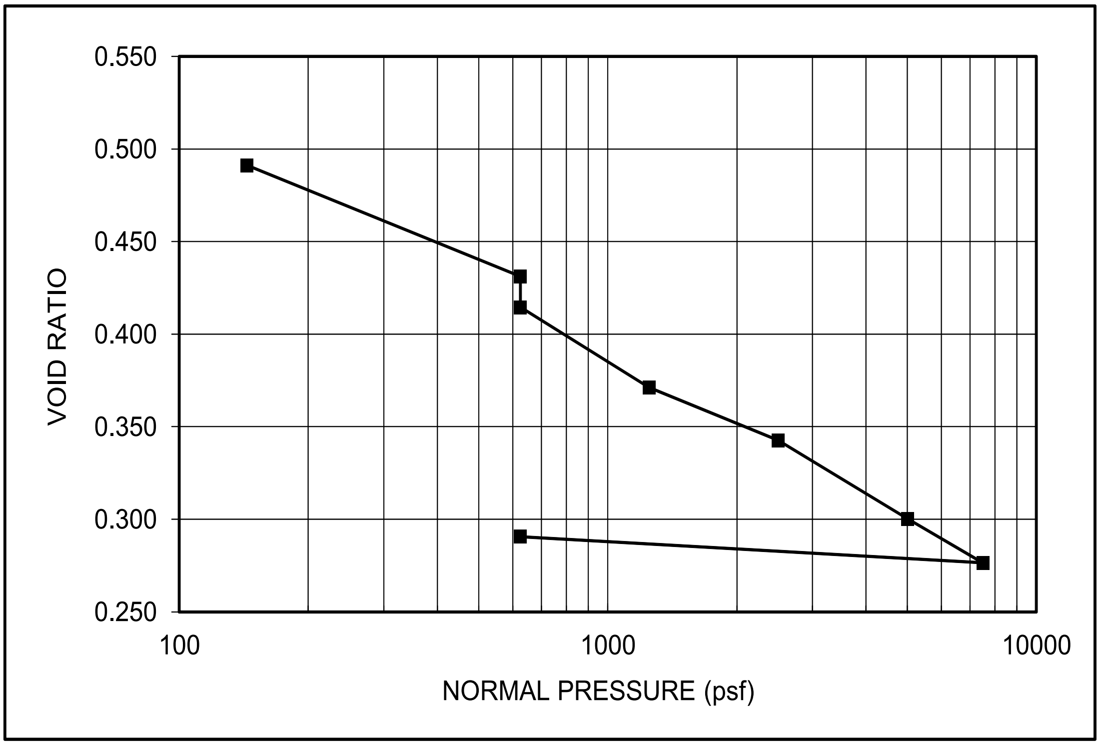


ONE-DIMENSIONAL CONSOLIDATION
ASTM D2435

Location: B-5 @ 5'

Unit Weight (pcf):	108.8	Initial Dial Reading:	0.2245	inch
Initial Moisture:	4.0%	Initial Specimen Height:	1.0000	inch
Final Moisture:	15.7%	Initial Void Ratio:	0.491	
Initial Saturation:	21.2%	Final Void Ratio:	0.291	
Final Saturation:	140.5%	Specific Gravity :	2.60	

Moisture Condition	Load (psf)	Final Dial Reading (inches)	Sample Height (inches)	Void Ratio
In Situ	144	0.2245	1.0000	0.491
	625	0.2648	0.9597	0.431
Add water	625	0.2759	0.9486	0.415
	1250	0.3050	0.9195	0.371
	2500	0.3241	0.9004	0.343
	5000	0.3525	0.8720	0.300
	7500	0.3685	0.8560	0.276
	625	0.3590	0.8655	0.291

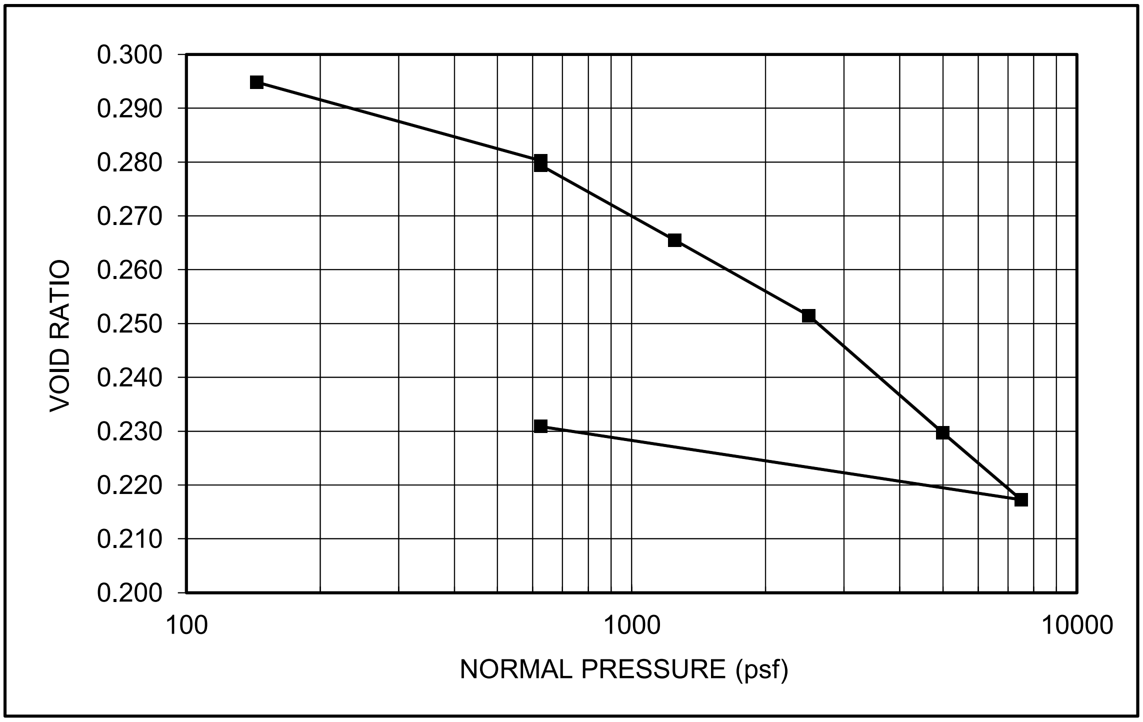


ONE-DIMENSIONAL CONSOLIDATION
ASTM D2435

Location: B-9 @ 15'

Unit Weight (pcf):	125.1	Initial Dial Reading:	0.2411	inch
Initial Moisture:	8.0%	Initial Specimen Height:	1.0000	inch
Final Moisture:	12.0%	Initial Void Ratio:	0.297	
Initial Saturation:	70.1%	Final Void Ratio:	0.231	
Final Saturation:	135.1%	Specific Gravity :	2.60	

Moisture Condition	Load (psf)	Final Dial Reading (inches)	Sample Height (inches)	Void Ratio
In Situ	144	0.2427	0.9984	0.295
	625	0.2539	0.9872	0.280
Add water	625	0.2546	0.9865	0.279
	1250	0.2653	0.9758	0.265
	2500	0.2761	0.9650	0.251
	5000	0.2929	0.9482	0.230
	7500	0.3025	0.9386	0.217
	625	0.2920	0.9491	0.231



CTM 301 - DETERMINATION OF RESISTANCE "R" VALUE OF TREATED AND UNTREATED BASES, SUBBASES, AND BASEMENT SOILS BY THE STABILOMETER

Sample ID: 2

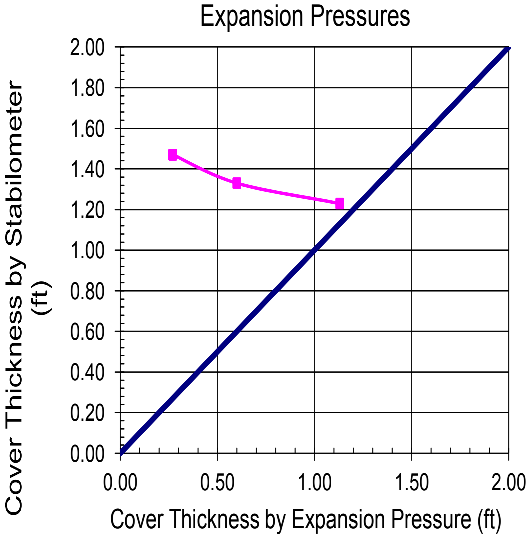
Specimen No	A	B	C
Moisture Content (%)	14.6	13.6	12.5
Dry Density (pcf)	111.8	116.1	117.7
Exudation Pressure (psi)	142	280	442
Stabilometer R Value	8	17	23
Expansion Pressure Dial	8	18	34

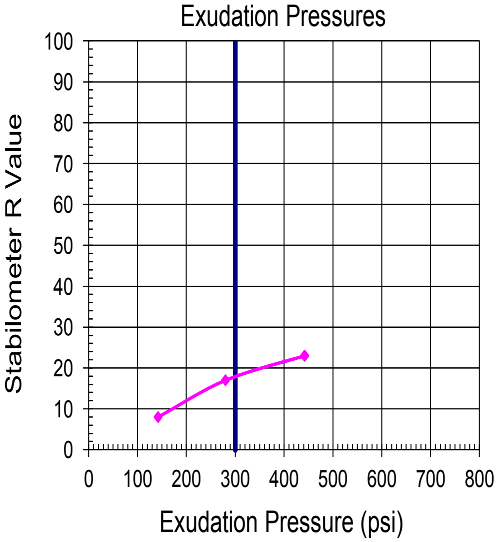
Use: Traffic Index = 5.0 Gravel Factor = 1.00

Thickness by Expansion (ft)	0.27	0.60	1.13
Thickness by Stabilometer (ft)	1.47	1.33	1.23

Equilibrium Thick (ft) 1.20

Equilibrium Pressure R Value	**25**	*Use Exudation R Value*
Exudation Pressure R Value @ 300 psi	**18**	





Expansion Pressure R-Value is based on the following structural section:

Thickness of AC (ft)=	**0.25**	G_f(ac) =	2.50	W(ac) =	145
Thickness of Aggregate Base (ft)=	**0.33**	G_f(base) =	1.10	W(base) =	130
		G_f(avg) =	1.70	W(avg) =	136

CTM 301 - DETERMINATION OF RESISTANCE "R" VALUE OF TREATED AND UNTREATED BASES, SUBBASES, AND BASEMENT SOILS BY THE STABILOMETER

Sample ID: 4

Specimen No	A	B	C
Moisture Content (%)	15.4	14.4	13.4
Dry Density (pcf)	108.8	118.2	118.9
Exudation Pressure (psi)	134	242	573
Stabilometer R Value	9	20	31
Expansion Pressure Dial	13	21	38

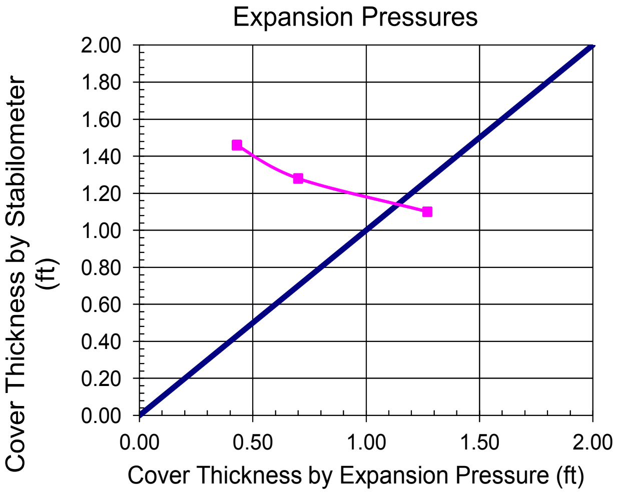
Use: Traffic Index = 5.0 Gravel Factor = 1.00

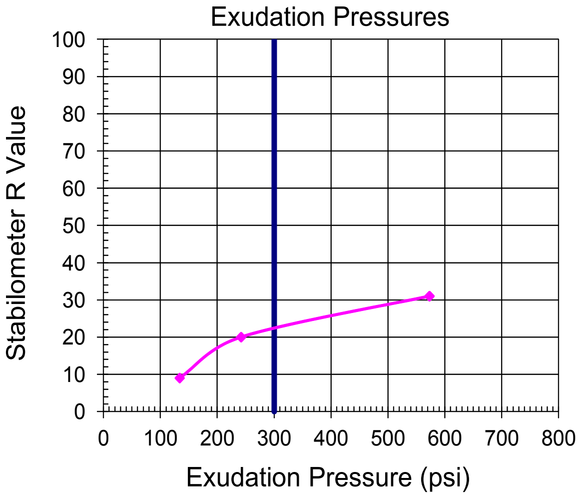
Thickness by Expansion (ft)	0.43	0.70	1.27
Thickness by Stabilometer (ft)	1.46	1.28	1.10

Equilibrium Thick (ft) 1.14

Equilibrium Pressure R Value **29**
Exudation Pressure R Value @ 300 psi **22**

Use Exudation R Value





Expansion Pressure R-Value is based on the following structural section:

Thickness of AC (ft)=	**0.25**	G_f(ac) =	2.50	W(ac) =	145
Thickness of Aggregate Base (ft)=	**0.33**	G_f(base) =	1.10	W(base) =	130
		G_f(avg) =	1.70	W(avg) =	136

APPENDIX C

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

APPENDIX C

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

C-1.00 GENERAL DESCRIPTION

C-1.01 Introduction

These specifications present our general recommendations for earthwork and grading as shown on the approved grading plans for the subject project. These specifications shall cover all clearing and grubbing, removal of existing structures, preparation of land to be filled, filling of the land, spreading, compaction and control of the fill, and all subsidiary work necessary to complete the grading of the filled areas to conform with the lines, grades and slopes as shown on the approved plans.

The recommendations contained in the geotechnical report of which these general specifications are a part of shall supersede the provisions contained hereinafter in case of conflict.

C-1.02 Laboratory Standard and Field Test Methods

The laboratory standard used to establish the maximum density and optimum moisture shall be ASTM D1557.

The insitu density of earth materials (field compaction tests) shall be determined by the sand cone method (ASTM D1556), direct transmission nuclear method (ASTM D2922) or other test methods as considered appropriate by the geotechnical consultant.

Relative compaction is defined, for purposes of these specifications, as the ratio of the in-place density to the maximum density as determined in the previously mentioned laboratory standard.

C-2.00 CLEARING

C-2.01 Surface Clearing

All structures marked for removal, timber, logs, trees, brush and other rubbish shall be removed and disposed of off the site. Any trees to be removed shall be pulled in such a manner so as to remove as much of the root system as possible.

C-2.02 Subsurface Removals

A thorough search should be made for possible underground storage tanks and/or septic tanks and cesspools. If found, tanks should be removed and cesspools pumped dry.

Any concrete irrigation lines shall be crushed in place and all metal underground lines shall be removed from the site.

C-2.03 Backfill of Cavities

All cavities created or exposed during clearing and grubbing operations or by previous use of the site shall be cleared of deleterious material and backfilled with native soils or other materials approved by the soil engineer. Said backfill shall be compacted to a minimum of 90% relative compaction.

C-3.00 ORIGINAL GROUND PREPARATION

C-3.01 Stripping of Vegetation

After the site has been properly cleared, all vegetation and topsoil containing the root systems of former vegetation shall be stripped from areas to be graded. Materials removed in this stripping process may be used as fill in areas designated by the soil engineer, provided the vegetation is mixed with a sufficient amount of soil to assure that no appreciable settlement or other detriment will occur due to decaying of the organic matter. Soil materials containing more than 3% organics shall not be used as structural fill.

C-3.02 Removals of Non-Engineered Fills

Any non-engineered fills encountered during grading shall be completely removed and the underlying ground shall be prepared in accordance to the recommendations for original ground preparation contained in this section. After cleansing of any organic matter the fill material may be used for engineered fill.

C-3.03 Overexcavation of Fill Areas

The existing ground in all areas determined to be satisfactory for the support of fills shall be scarified to a minimum depth of 6 inches. Scarification shall continue until the soils are broken down and free from lumps or clods and until the scarified zone is uniform. The moisture content of the scarified zone shall be adjusted to within 2% of optimum moisture. The scarified zone shall then be uniformly compacted to 90% relative compaction.

Where fill material is to be placed on ground with slopes steeper than 5:1 (H:V) the sloping ground shall be benched. The lowermost bench shall be a minimum of 15 feet wide, shall be a minimum of 2 feet deep, and shall expose firm material as determined by the geotechnical consultant. Other benches shall be excavated to firm material as determined by the geotechnical consultant and shall have a minimum width of 4 feet.

Existing ground that is determined to be unsatisfactory for the support of fills shall be overexcavated in accordance to the recommendations contained in the geotechnical report of which these general specifications are a part.

C-4.00 FILL MATERIALS

C-4.01 General

Materials for the fill shall be free from vegetable matter and other deleterious substances, shall not contain rocks or lumps of a greater dimension than is recommended by the geotechnical consultant, and shall be approved by the geotechnical consultant. Soils of poor gradation, expansion, or strength properties shall be placed in areas designated by the geotechnical consultant or shall be mixed with other soils providing satisfactory fill material.

C-4.02 Oversize Material

Oversize material, rock or other irreducible material with a maximum dimension greater than 12 inches shall not be placed in fills, unless the location, materials, and disposal methods are specifically approved by the geotechnical consultant. Oversize material shall be placed in such a manner that nesting of oversize material does not occur and in such a manner that the oversize material is completely surrounded by fill material compacted to a minimum of 90% relative compaction. Oversize material shall not be placed within 10 feet of finished grade without the approval of the geotechnical consultant.

C-4.03 Import

Material imported to the site shall conform to the requirements of Section 4.01 of these specifications. Potential import material shall be approved by the geotechnical consultant prior to importation to the subject site.

C-5.00 PLACING AND SPREADING OF FILL

C-5.01 Fill Lifts

The selected fill material shall be placed in nearly horizontal layers which when compacted will not exceed approximately 6 inches in thickness. Thicker lifts may be placed if testing indicates the compaction procedures are such that the required compaction is being achieved and the geotechnical consultant approves their use.
Each layer shall be spread evenly and shall be thoroughly blade mixed during the spreading to insure uniformity of material in each layer.

C-5.02 Fill Moisture

When the moisture content of the fill material is below that recommended by the soils engineer, water shall then be added until he moisture content is as specified to assure thorough bonding during the compacting process.

When the moisture content of the fill material is above that recommended by the soils engineer, the fill material shall be aerated by blading or other satisfactory methods until the moisture content is as specified.

C-5.03 Fill Compaction

After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted to not less than 90% relative compaction. Compaction shall be by sheepsfoot rollers, multiple-wheel pneumatic tired rollers, or other types approved by the soil engineer.

Rolling shall be accomplished while the fill material is at the specified moisture content. Rolling of each layer shall be continuous over its entire area and the roller shall make sufficient trips to insure that the desired density has been obtained.

C-5.04 Fill Slopes

Fill slopes shall be compacted by means of sheepsfoot rollers or other suitable equipment. Compacting of the slopes may be done progressively in increments of 3 to 4 feet in fill height. At the completion of grading, the slope face shall be compacted to a minimum of 90% relative compaction. This may require track rolling or rolling with a grid roller attached to a tractor mounted side-boom.

Slopes may be over filled and cut back in such a manner that the exposed slope faces are compacted to a minimum of 90% relative compaction.

The fill operation shall be continued in six inch (6") compacted layers, or as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

C-5.05 Compaction Testing

Field density tests shall be made by the geotechnical consultant of the compaction of each layer of fill. Density tests shall be made at locations selected by the geotechnical consultant.

Frequency of field density tests shall be not less than one test for each 2.0 feet of fill height and at least every one thousand cubic yards of fill. Where fill slopes exceed four feet in height their finished faces shall be tested at a frequency of one test for each 1000 square feet of slope face.

Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density reading shall be taken in the compacted material below the disturbed surface. When these readings indicate that the density of any layer of fill or portion thereof is below the required density, the particular layer or portion shall be reworked until the required density has been obtained.

C-6.00 SUBDRAINS

C-6.01 Subdrain Material

Subdrains shall be constructed of a minimum 4-inch diameter pipe encased in a suitable filter material. The subdrain pipe shall be Schedule 40 Acrylonitrile Butadiene Styrene (ABS) or Schedule 40 Polyvinyl Chloride Plastic (PVC) pipe or approved equivalent. Subdrain pipe shall be installed with perforations down. Filter material shall consist of 3/4" to 1 1/2" clean gravel wrapped in an envelope of filter fabric consisting of Mirafi 140N or approved equivalent.

C-6.02 Subdrain Installation

Subdrain systems, if required, shall be installed in approved ground to conform the approximate alignment and details shown on the plans or herein. The subdrain locations shall not be changed or modified without the approval of the geotechnical consultant. The geotechnical consultant may recommend and direct changes in the subdrain line, grade or material upon approval by the design civil engineer and the appropriate governmental agencies.

C-7.00 EXCAVATIONS

C-7.01 General

Excavations and cut slopes shall be examined by the geotechnical consultant. If determined necessary by the geotechnical consultant, further excavation or overexcavation and refilling of overexcavated areas shall be performed, and/or remedial grading of cut slopes shall be performed.

C-7.02 Fill-Over-Cut Slopes

Where fill-over-cut slopes are to be graded the cut portion of the slope shall be made and approved by the geotechnical consultant prior to placement of materials for construction of the fill portion of the slope.

C-8.00 TRENCH BACKFILL

C-.01 General

Trench backfill within street right of ways shall be compacted to 90% relative compaction as determined by the ASTM D1557 test method. Backfill may be jetted as a means of initial compaction; however, mechanical compaction will be required to obtain the required percentage of relative compaction. If trenches are jetted, there must be a suitable delay for drainage of excess water before mechanical compaction is applied.

C-9.00 SEASONAL LIMITS

C-9.01 General

No fill material shall be placed, spread or rolled while it is frozen or thawing or during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests by the soils engineer indicate that the moisture content and density of the fill are as previously specified.

C-10.00 SUPERVISION

C-10.01 Prior to Grading

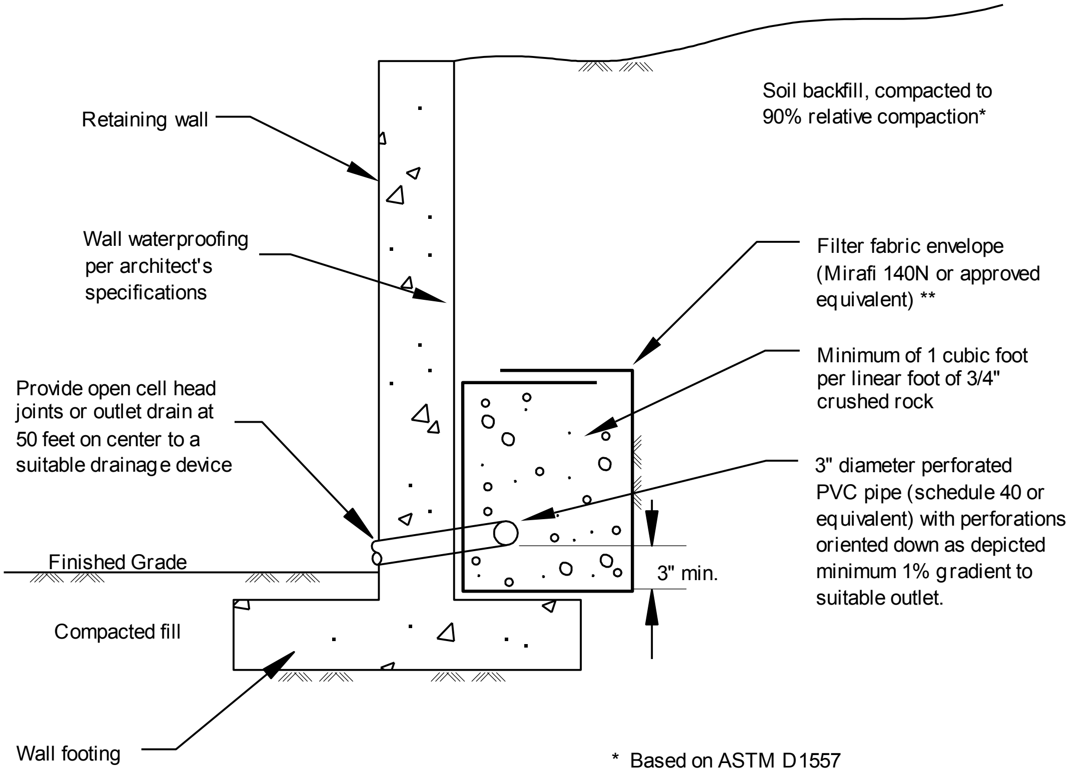
The site shall be observed by the geotechnical consultant upon completion of clearing and grubbing, prior to the preparation of any original ground for preparation of fill.

The supervisor of the grading contractor and the field representative of the geotechnical consultant shall have a meeting and discuss the geotechnical aspects of the earthwork prior to commencement of grading.

C-10.02 During Grading

Site preparation of all areas to receive fill shall be tested and approved by the geotechnical consultant prior to the placement of any fill.

The geotechnical consultant or his representative shall observe the fill and compaction operations so that he can provide an opinion regarding the conformance of the work to the recommendations contained in this report.



* Based on ASTM D1557

** If class 2 permeable material (See gradation to left) is used in place of 3/4" - 1 1/2" gravel. Filter fabric may be deleted. Class 2 permeable material compacted to 90% relative compaction. *

SPECIFICATIONS FOR CLASS 2
PERMEABLE MATERIAL
(CAL TRANS SPECIFICATIONS)

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

RETAINING WALL DRAINAGE DETAIL

APPENDIX D

REFERENCES

APPENDIX D

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RMA GeoScience

GEOTECHNICAL CONSULTANTS

May 31, 2013

Rancho San Gorgonio, LLC
10621 Civic Center Drive
Rancho Cucamonga, CA 91730

Attention: Mr. Peter J. Pitassi, A.I.A.
Project Manager

Subject: Addendum to Geotechnical Investigation
Additional Parcels
Proposed Rancho San Gorgonio Master Planned Community
Banning, CA

Reference: Geotechnical Investigation for Proposed Rancho San Gorgonio – Banning 803 Master Planned Community, Banning, CA prepared by RMA Geoscience dated November 8, 2012 (Job No. 12-G02-01)

Dear Mr. Pitassi:

In accordance with your request and authorization, this addendum to our November 8, 2012 geotechnical report has been prepared to address geotechnical conditions at additional parcels that will be added to the proposed Rancho San Gorgonio Master Planned Community. The scope of our work consisted of review of our prior geotechnical report, review of aerial photographs, field reconnaissance, geologic mapping, logging of three exploratory trenches excavated and backfilled with a backhoe, review of the compiled data, and preparation of this report.

The additional parcels consist of:

- The A.C. Dysart Equestrian Park which is located south of Victory Avenue between South 22nd Street and Lovell Street if they were extended south. The Park is identified as Assessor's Parcel Number 537-190-016.
- A group of four parcels located on the south side of Westward Way approximately 640 to 1,070 feet east of Lovell Street. The parcels are identified as Assessor's Parcel Numbers 543-020-011 & 002, 543-020-23, and 537-170-004.

The approximate locations of the parcels are shown on the accompanying Site Location Map (Figure 1).

SITE CONDITIONS

Prior Land Uses

Review of aerial photographs indicates that the A.C. Dysart Equestrian Park was developed sometime in the late 1980's or early 1990's. Prior to this, the Park was apparently used as rangeland and possibly for dry farming. The eastern portion of the Park was part of a citrus orchard in the 1930's. Two excavations were noted in the northeast part of the site on a 2003 aerial photograph. It appears that the excavations were about 60 feet long, about 10 feet wide and a few feet deep. They were subsequently backfilled.

Aerial photographs show no prior use of the parcels east of Lovell Street, although construction of Westward Way may have altered the direction of surface water following entering a drainage course that crosses the four parcels.

Current Land Uses

The A.C. Dysart Park is an equestrian center. It contains two arenas, grandstands, office trailers, dirt parking lots, a grass field, outdoor stages, picnic areas, concession booths, and other related improvements. The Park also contains a nursery operation with potted plants and community garden. There are several dirt roads within the Park that are covered with asphalt grindings. Asphalt grindings are also stockpiled in the southeast corner of the Park. A few small piles of fill soils and horse manure were also present within the site at the time of our field work. There were roll-away trash bins, trash dumpsters and empty 55-gallon drums in the southwest corner of the site. Transit benches and trash containers were stored in the south-central part of the site.

The parcels east of Lovell Street are cross by Montgomery Creek, a southeast trending drainage course. There is no apparent land use within these parcels.

SOIL AND GEOLOGIC CONDITIONS

Geologic Setting

Regional geologic maps indicate that the two sites are underlain by Pleistocene age alluvial soils (Figure 2).

The Equestrian Park and four parcels east of Lovell Street are not located within a State of California Earthquake Fault Zone or similar City of County fault rupture hazard zone. The Central Banning Barrier fault is mapped near or through the Equestrian Park and four parcels east of Lovell Street. However, as discussed in our prior geotechnical report, the Central Banning Barrier fault is overlain by thick alluvial deposits and the fault has no known surface expression. Therefore, in our opinion, the Central Banning Barrier fault is not a surface rupture hazard within the site.

No large landslides were encountered during our field investigation and none were apparent on aerial photographs. Soils along the drainage course in the four parcels east of Lovell Street have been eroded and there are some channel bank failures.

Dysart Park

Surface geologic mapping, subsurface exploration and regional geologic maps indicate that the Dysart Park is underlain by artificial fill, alluvium and older alluvium.

It appears that fills were cast over the tops of slopes and placed in some drainage courses that crossed the site prior to develop the Park. These fills likely were generated from onsite soils, may not be compacted and are visually estimated to range from a few feet to as much as about 10 feet thick. A few small mounds of fills consisting of soils with man-made debris and horse manure were noted scattered about the property. Minor fills are also likely to be present in dirt parking lot areas. Three exploratory trenches excavated in the eastern part of the site encountered about one foot of fill consisting of brown silty fine sand. The ground surface in that portion of the Park was cracked into polygonal and rectangular patterns. The ground cracks were observed to continue about one foot or less into subsurface fill soils, but not into deeper older alluvial soils. In addition, dirt roads throughout the site are covered by asphalt grindings and asphalt grindings have been stockpiled in the southeast corner of the Park. The stockpile is estimated to be a few feet thick.

Rolling terrain within suggests the presence of alluvial soils in low laying areas. In a nearby boring and trenches excavated during our 2012 geotechnical investigation of the Rancho San Gorgonio site, alluvium was found to consist of light brown silty sand. The alluvium within the Park is expected to be of a similar composition. The alluvium was found to be approximately 21 feet thick to the north of Dysart Park.

Older alluvium in three trenches excavated within Dysart Park was found to consist of reddish brown silty sand and sandy silt, similar in composition to older alluvial soils encountered within the Rancho San Grogonio site.

Parcels East of Lovell Street

Surface mapping and regional geologic maps indicate that the parcels east of Lovell Street are underlain by artificial fill, wash deposits and older alluvium.

The artificial fill was placed within Montgomery Creek to allow construction of Westward Avenue along the northern side of the parcels. The road fill toes-out within or near the northern side of the site. Two large concrete drainage pipes carry runoff within Montgomery Creek beneath the road. Broken slabs of concrete were placed in Montgomery Creek approximately 650 feet south of Westward Avenue, apparently in an effort to control erosion. Wash deposits consisting of gray-white gravelly sand with cobbles have been deposited in the stream bed of Montgomery Creek. These deposits are similar to those encountered within the Rancho San Gorgonio site.

Older alluvial deposits have been exposed along the banks of Montgomery Creek. These deposits consist of reddish brown silty sands similar to the older alluvial deposits encountered within the Rancho San Gorgonio site. Erosion has locally caused small slope failures along the banks of the Creek.

Flood Hazard Zones

According to Federal Emergency Management Agency the course of Montgomery Creek within the parcels east of Lovell Street is identified as Flood Zones AE and Stippled X. A former drainage course that crossed the equestrian Park in a general north-south direction is also identified as Flood Zone Stippled X. The remainders of both areas are located in Flood Zone X. Zone AE designates areas where base flood levels have been determined. Stippled Zone X is defined as areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. Zone X which is defined as areas determined to be outside the 0.2% annual chance floodplain.

CONCLUSIONS AND RECOMMENDATIONS

Soil and geologic conditions within Dysart Park and the four parcels to the east of Lovell Street are similar to those encountered within the Rancho San Gorgonio site, with the exception of artificial fills present within the Park and along Westward Avenue north of the four parcels.

Artificial fills within the Park should be removed to competent native soils and replaced with compacted fills, as needed to reach design grades, when the site is graded. Any miscellaneous artificial fills within the four parcels to the east of Lovell Street should also be removed to competent native ground and replaced with compacted fill as needed to reach design grades. The potential impact of the road fill along the north side of the four parcels east of Lovell Street Based should be further evaluated upon preparation of grading plans. More detailed investigation of the site could better identify the extent and composition of the fills.

Asphalt grindings within Dysart Park should be hauled from the property, recycled or placed beneath roadways in a manner to protect the environment. Asphalt grindings should not be placed fills used to construct lots, greenbelts or other areas to be landscaped.

Concrete slabs within the four parcels east of Lovell Street should be hauled from the site or may be placed in compacted fills provided that it must be broken down to approximately 4 to 8-inch particles and mixed thoroughly with on-site soils. No large and flat pieces may to be used for fill. Concrete generated from demolition of existing improvements within Dysart Park may be similarly handled.

It is our professional opinion that other conclusions and recommendations presented in our November 8, 2012 geotechnical investigation of the Rancho San Gorgonio site are applicable to the additional parcels addressed herein.

CLOSURE

The findings, conclusions and recommendations in this report were prepared in accordance with generally accepted engineering and geologic principles and practices. No other warranty, either expressed or implied, is made. This report has been prepared for Rancho San Gorgonio, LLC to be used solely for design purposes. Anyone using this report for any other purpose must draw their own conclusions regarding required construction procedures and subsurface conditions.

We trust that this letter will serve your needs at this time. In you have any questions or require further assistance, please do not hesitate to contact us.

Respectfully,

RMA Group

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Attachments:
- Figure 1 - Site Location Map
- Figure 2 - Regional Geologic Map
- Figure 3 - Site Geologic Map
- Appendix A - Trench Logs (3)

FIGURES

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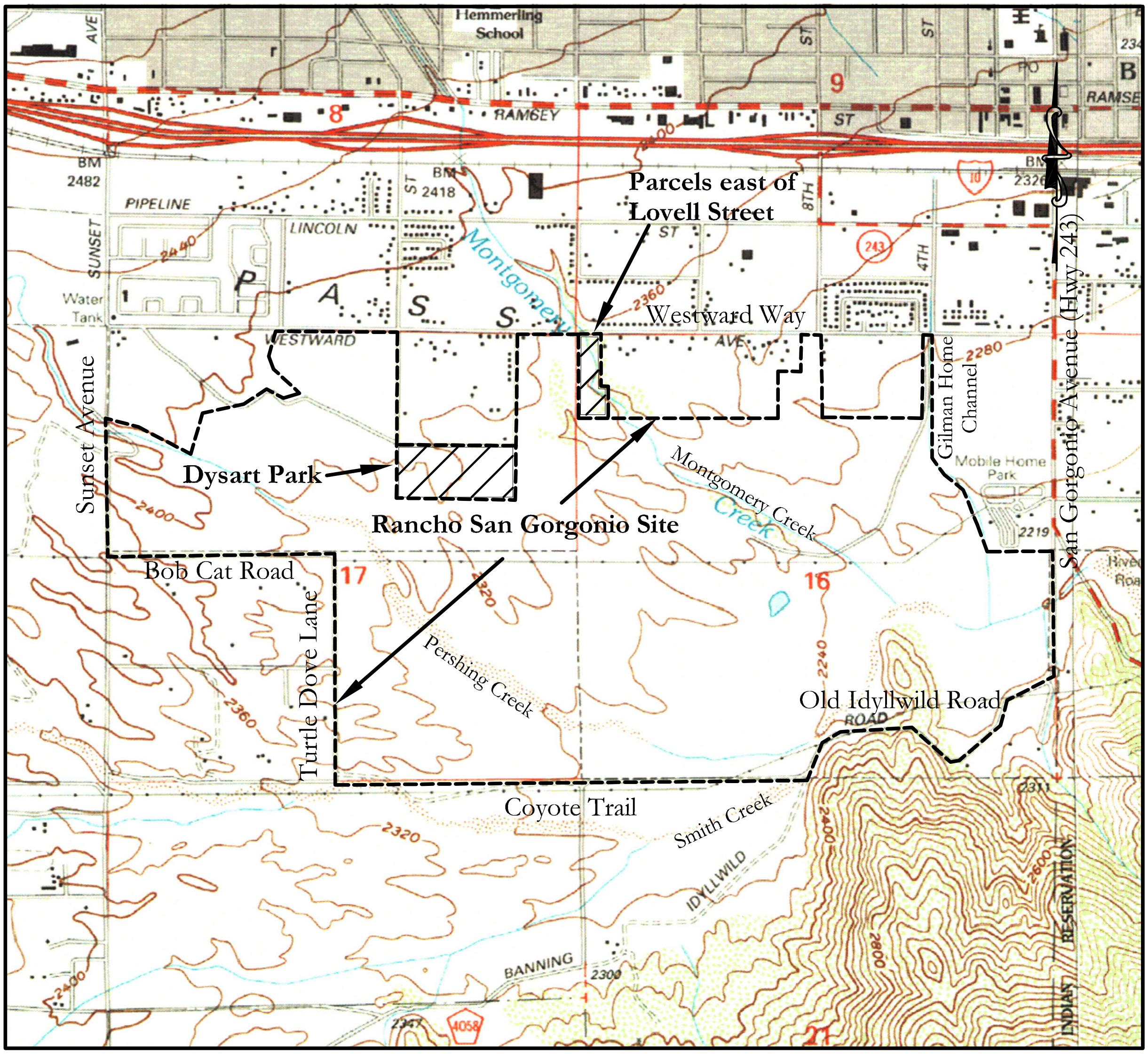
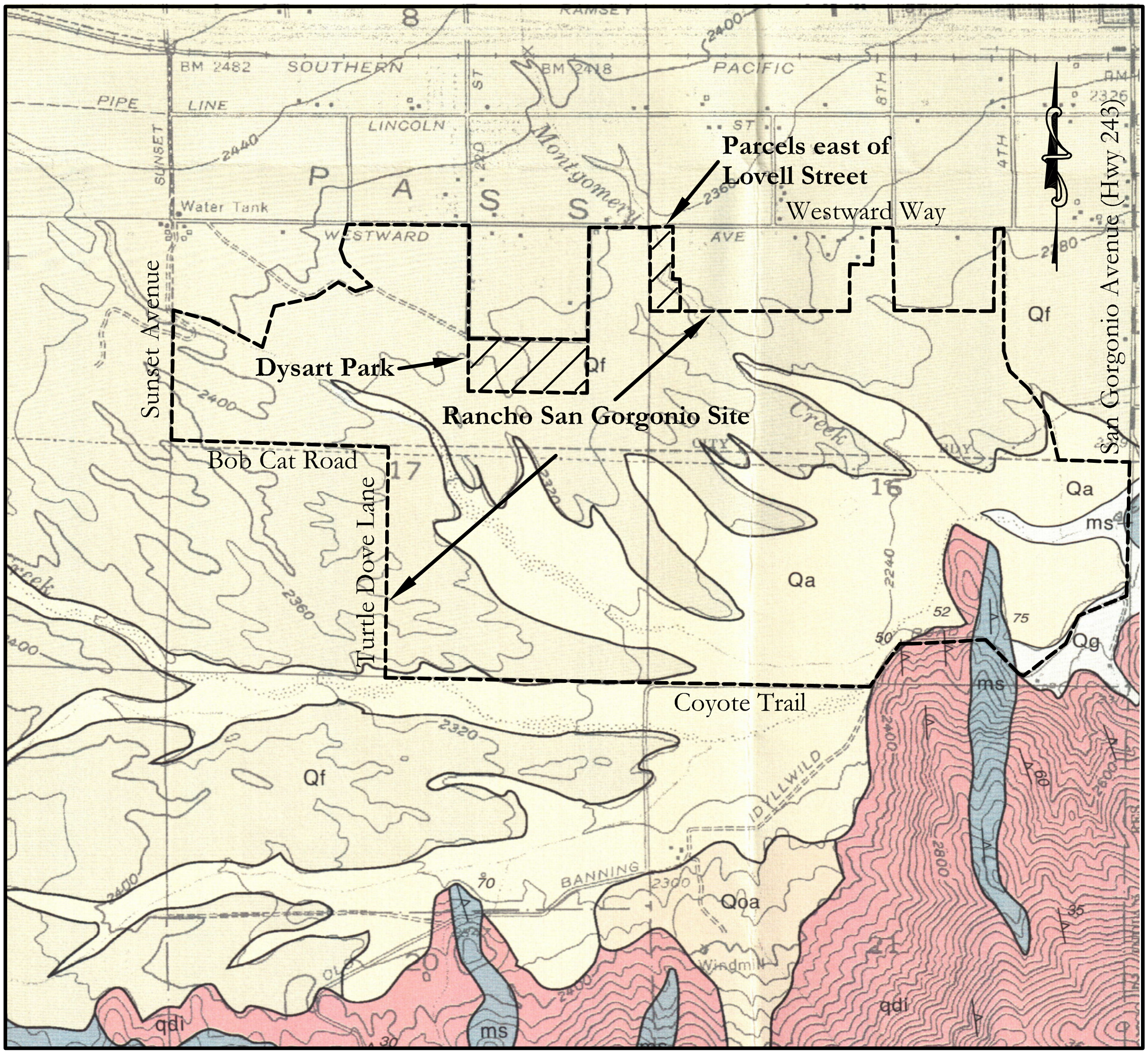
GEOTECHNICAL CONSULTANTS



SITE LOCATION MAP

Scale: 1" = 2,000'

Base Map: U.S. Geological Survey Beaumont Quadrangle, 1996



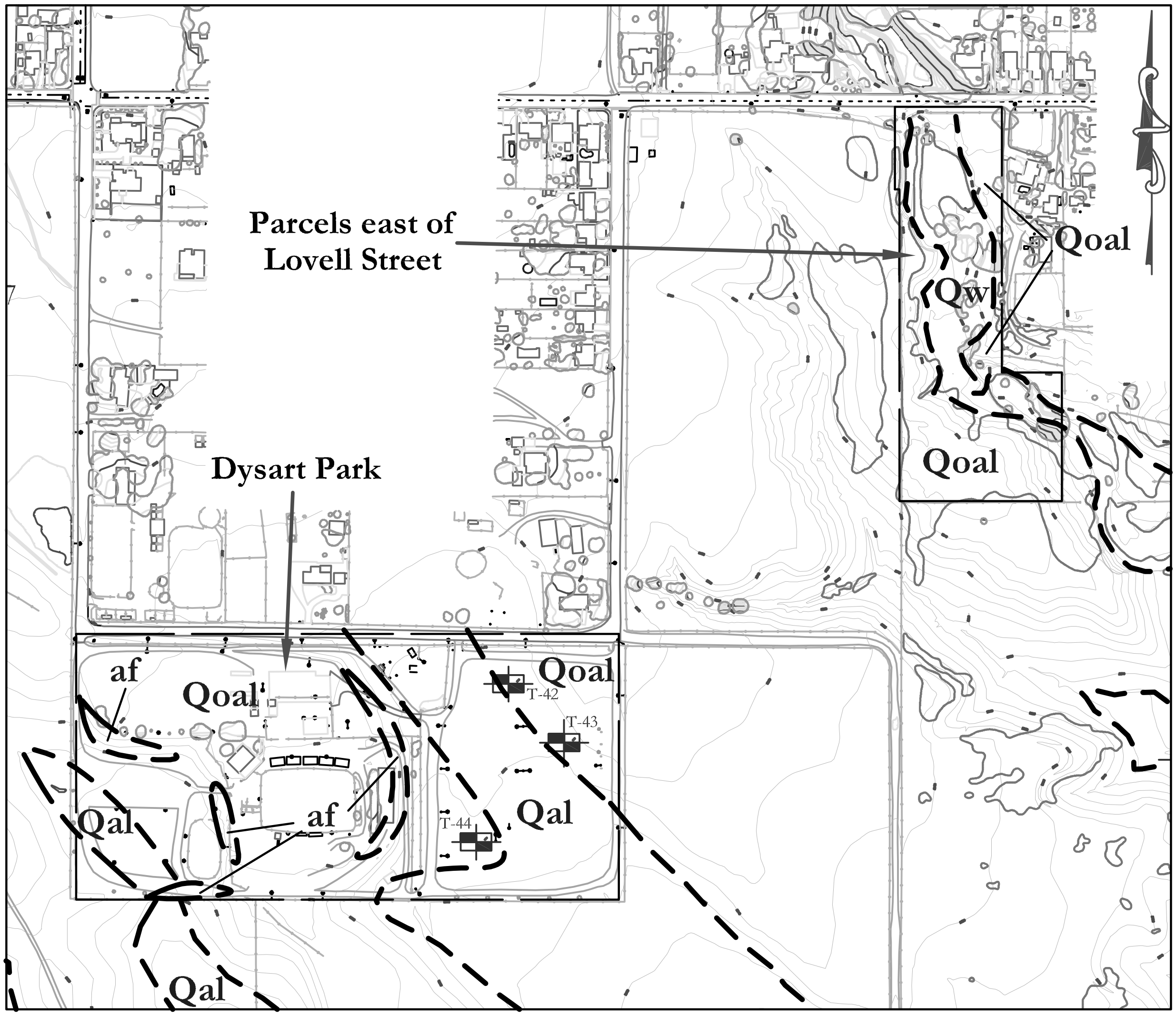
REGIONAL GEOLOGIC MAP
by DIBBLEE

Scale: 1" = 2,000'

Partial Legend

Qg - Stream channel alluvium (Holocene)
Qa - Flood plain alluvium (Holocene)
Qf - Alluvial fan deposits (Pleistocene)
Qoa - Older alluvial fan deposits (Pleistocene)
qdi - Granitic bedrock, mostly tonalite (Cretaceous)
ms - Metasedimentary bedrock, Mica schist-phyllite (Paleozoic)

Source: Dibblee, Geologic Map of the Beaumont Quadrangle, (2003).



SITE GEOLOGIC MAP

Legend

af - Artifical fill
Qw - Wash deposits
Qal - Alluvium
Qoal - Older alluvium
⊞ - Exploratory trench
-- - Approximate geologic contact

Base map by Madole and Associates

APPENDIX A

TRENCH LOGS

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Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,355

Logged By: GW
Equipment: Backhoe w/24" bucket

Trench No. T-42
Date Excavated: 5-13-13

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Artificial fill (af): Brown silty fine sand with surface ground cracks.
					SM		Older alluvium (Qoal): Reddish brown silty sand, fine grained, trace of coarse sand, a few pieces of fine gravel, massive, moderately dense, slightly porous, moist. Surface cracks do not extend into older alluvium.
		6.2	85.9				
5							
							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Location: See Geologic Map
Elevation (ft.): 2,351

Logged By: GW
Equipment: Backhoe w/24" bucket

Trench No. T-43
Date Excavated: 5-13-13

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Artificial fill (af): Moderate brown silty fine sand with surface cracks.
					SM		Older alluvium (Qoal): Reddish brown silty sand, fine grained, trace of coarse sand, a few pieces of fine gravel, massive, moderately dense, slightly porous, moist. Surface cracks do not extend into older alluvium.
		6.1	89.9				
5							Total depth 4.5 feet No groundwater No Caving Trench backfilled
10							
15							

Exploratory Trench Log

Trench No. T-44

Location: See Geologic Map
Elevation (ft.): 2,354

Logged By: GW
Equipment: Backhoe w/24" bucket

Date Excavated: 5-13-13

Depth (ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)		USCS	Graphic Symbol	Material Description This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
					SM		Artificial fill (af): Moderate brown silty fine sand.
					SM		Older Alluvium (Qoal): Reddish brown silty fine sand with scattered fine to coarse gravel, dense, moist.
		10.1	97.0		ML		Reddish brown sandy silt, fine grained sand, trace of coarse sand, slightly porous, moist, dense.
5							Total depth 5 feet No groundwater No Caving Trench backfilled
10							
15							