GEOTECHNICAL REPORT UPDATE
LOT 7 OF PROPOSED 7-LOT SUBDIVISION
AND NEW ROAD IMPROVEMENTS
WHEELER PROPERTY
1985 LÁS LOMAS
VISTA, CALIFORNIA

January 18, 2022

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Project No. GI-22-01-103

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GEOTECHNICAL REPORT UPDATE, LOT 7 OF PROPOSED 7-LOT SUBDIVISION AND NEW ROAD IMPROVEMENTS, WHEELER PROPERTY, 1985 LAS LOMAS, VISTA, CALIFORNIA

Pursuant to your request, ***SMS*** Geotechnical Solutions, Inc. has completed the attached Geotechnical Report Update report for Lot 7 of the proposed 7-lot residential subdivision and proposed roadway improvements at the above-referenced property.

The following report summarizes the results of our reach and review of previous documents, reports, current development plans and provides site specific updated or amended conclusions and recommendations for Lot 7 and associated roadway improvements consistent with the project grading plan, as understood. From a geotechnical engineering standpoint, it is our opinion that development of Lot 7 and associated Las Lomas roadway improvements remains feasible, provided the recommendations presented in this report are incorporated into the design and construction of the project.

If you have any questions or need clarification, please do not hesitate to contact this office. Reference to our **Project No. GI-22-01-103** will help to expedite our response to your inquiries.

We appreciate this opportunity to be of service to you.

SMS **Geotechnical Solutions, Inc.**

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I. INTRODUCTION

Grading plan for Lot 7 of the proposed 7-lot residential subdivision and associated roadway improvements prepared by ACAL Engineering & Surveying, Inc., is now available and was provided to us for review and preparation of a site-specific geotechnical report update. A copy of Lot 7 grading/road improvement plan is reproduced herein as a Geotechnical Map, Figure 1.

Lot 7 was previously studied as a part of a larger residential subdivision with respect to surface and subsurface geotechnical conditions by this office. Our efforts resulted in the following pertinent technical reports:

A. "Geotechnical Plan Review Update, Proposed 7-Lot Subdivision, Wheeler Property, 1985 Las Lomas, Vista, California, (APN 174-260-25)," Project No. GI-18-08-143, dated December 3, 2021.

B. "Geotechnical Investigation, Proposed 8-Parcel Lot Split For Future Residential Developments, Las Lomas, Vista, California (APN 174-260-25)," Project No. GI-18-08-143, dated September 24, 2018

The referenced reports are on file with our firm and copies can be obtained upon request. Pertinent geotechnical information and technical data are reproduced and incorporated into this work, where appropriate and as applicable. Adequate subsurface explorations as well as laboratory testing were also completed during the previous studies, as presented in the referenced reports, and additional field explorations/laboratory testing were not deemed necessary for completing this update report.

The purpose of this effort was to provide site-specific development recommendations for Lot 7 considering the proposed grading and building pad construction scheme (Figure 1), and to ensure plan conformance with the site indicated geotechnical conditions. Updated and revised/amended recommendations provided in the following sections, and will supplement or supercede those given in the referenced reports, where applicable.

II. SITE DESCRIPTION

Details of topographic site conditions and proposed development are shown on the attached Geotechnical Map, Figure 1. As shown, Lot 7 is located on the western flank of north-south trending ridge, on the south/east side of Las Lomas. There is nearly 70 feet of vertical relief from the lower western property margins near Las Lomas to the upper eastern ridge line areas. More details of overall site description are provided in the attached Enclosure reports.

Tierra Del Cielo and Las Lomas are existing asphalt roads that provides access to the planned 7-lot subdivision including Lot 7. Roadway profiles are variable and locally approach 20%.

III. PROPOSED DEVELOPMENT

A large residential building with a detached additional dwelling unit (ADU) and associated RV/garage is planned in the upper northeastern reaches of Lot 7 at 880.5 feet pad elevation (MSL), as shown on the attached Geotechnical Maps, Figure 1. Modest to relatively major cut-fill grading and wall backfilling ground modifications on the order of 15 feet deep, and utilizing large terraced retaining walls on the order of 8 feet high maximum, are proposed for achieving final design grades. Associated eastern perimeter graded cut slopes are planned at 1.5:1 (horizontal to vertical) maximum gradients and are supported with terraced toe retaining walls at the base. Fill slopes are not planned and ground transitions along the western pad margins will be achieved with terraced retaining walls. Building foundation plans and details are not yet completed. However, future buildings are expected to consist of a conventional wood frame structure with exterior stucco supported on shallow stiff continuous strip and spread pad footings, and slab-on-grade floor foundations.

Lot 7 development will also include improvements and widening of the Tierra Del Cielo and Las Lomas, as shown on attached Figure 1. Las Lomas road improvements propose widening by minor cutting into the hillside resulting in 1.5:1 cut embankments in the southern pavement edge, while transition retaining walls on the order of 6 feet high are proposed on the eastern pavement side to widen Tierra Del Cielo. The northern side of Las Lomas will also be widened by placing fills and construction of new 2:1 roadway fill embankments. Roadways longitudinal profile will remain unchanged. Existing asphalt pavement edges will be sawcut and new asphalt concrete (HMA) pavement sections will be used for in the roadway widening areas.

IV. FIELD INVESTIGATION

A detailed field investigation was completed by this office in connection with the preparation of our original study (Reference B). The approximate location of exploratory test pits and the distribution of the underlying geologic units were transferred and depicted on updated Geotechnical Maps, included as Figures 1 and 2 in the Geotechnical Plan Review Update report, dated December 3, 2021 (Reference A). The updated Geotechnical Maps (Figures 1 and 2 of the Reference A) are reproduced herein as Figures 2 and 3. Logs of the test pits are also reproduced and included herein as Figures 4 through 9. New site-specific Geologic Cross-Sections A-A', B-B' and C-C' illustrating general subsurface conditions underlying Lot 7 based on the existing topography, proposed grades and subsoil profiles, are enclosed as Figures 10 and 11. Pertinent excerpts of laboratory testing, geotechnical data and engineering properties of the underlying soils are included in the following sections.

V. REGIONAL GEOLOGY / GEOLOGIC SETTING

Regional geology and geologic setting were throughly discussed in the referenced reports (see Page 3, Section V of Referenced B) and remains the same as provided therein. Pertinent Geologic Map showing mapped units at and nearby the study property is reproduced herein as Figure 12.

VI. GEOTECHNICAL CONDITIONS

Geotechnical conditions at the project site remain the same as provided in the referenced reports. In general Lot 7 is situated on the western characterized by western flank of a significant north-south trending ridge line. The property is underlain by crystalline bedrock units which are prevalent in surrounding areas. Local outcrops and exposures indicate largely massive rocks which are modestly impacted by joint and shear surfaces. Joint and shear features typically represent poorly developed structures that are characteristically discontinuous and steeply dipping.

Much of the study property is mantled by a relatively shallow to a modest mantle of sandy to clay natural topsoil, which is expected to thicken within the lower areas of the property. Significant fill soils are not present, except along the Las Lomas northern/western pavement edge where modest fill deposits were placed during the roadway development. Existing roadway fill embankments generally occur at 2:1 in overall gradients and reach nearly 10 feet in vertical height. Records of engineering observations and compaction testing control for the existing road embankment/fills are not available. The approximate distribution of earth deposits at the site are shown on the enclosed Geotechnical Maps, Figures 1, 2 and 3.

Subsurface water was not encountered in our test pits to the depths explored and is not expected to impact site grading or performance of the future development. However, sensitive site improvements at the base of cut slope should be protected by the installation of toe drains, as discussed in the referenced reports. Drainage berms shall be provided along the top of graded slopes and a well-constructed back drainage system will be required for all site and building basement type retaining walls. Surface and storm water should be directed away from the building, and irrigation water should not be excessive.

VII. RIPPIBILITY AND ROCK EXCAVATIONS

Modest to major cutting are planned for developing a level building pad in upper northeastern portions of Lot 7, as shown on Figure 1. Performing a seismic survey and rock rippibility was not a part of our original studies or this update effort. General hard rock excavation characteristics are discussed in details in the referenced reports. Roughly, all cuts deeper than 10 feet into the underlying bedrock are expected to encounter very hard units. Based on our knowledge of the site, upper weathered rocks may be anticipated to excavate with light to moderate efforts and local heavy ripping utilizing large bulldozers (Caterpillar D-9 or equal). More concentrated single-shank ripping efforts and specialized excavation techniques including the use of larger trackhoes and large rock beakers should be anticipated for deeper cuts/undercuts and corestone floater removals. Blasting and/or "popping" of very hard units, rock clusters and corestone floaters should also be anticipated. Harder rocks and corestones are also expected to generate larger oversize rock debris creating disposal and handling problems. Blasting ("popping") efforts and the use of larger grading equipments will help to increase production levels and generate better quality fills.

VIII. SITE CLASS AND SEISMIC DESIGN VALUES

Site soils are classified based on the upper 100 feet maximum of site subsoil profile. In the absence of sufficient or specific site data, appropriate soil properties are permitted to be estimated by the project geotechnical consultant based on known geotechnical conditions, and Site Class D is typically used as a "default," unless otherwise noted. Site Classes A and B shall not be assigned to a site, if there is more than 10 feet of soil (or fill) between the top of the underlying rock surface and bottom of the foundation.

Site Classes A and B are most commonly supported by shear wave velocity determination (υ_s, ft/s). Site Class F, which may require a site response analysis, consists of liquefiable or collapsible soils and highly sensitive clayey soil profile. Site Classes C, D, and E soils may be classified using an average field Standard Penetration Resistance ($\tilde{N}$) method for soil layers based on Section 20.4.2 of ASCE 7-16. Where refusal is met for a rock layer (blow counts of 50 or greater for 6 inches or less penetration), Ni is taken as 100 blows per foot. Site Classification is then established based on Table 20.3-1 of ASCE 7-16.

Requirements provided below are also applicable and should be incorporated in the project designs where appropriate:

1. Site specific hazard analysis is required (see Section 11.4.8) in accordance with Chapter 21.2 of ASCE 7-16 for structures on Site Class E sites with values of Ss greater than or equal to 1.0g, and structures on Site Class D and E sites with values of S1 greater than or equal to 0.2g. However, the following three exceptions are permitted for Equivalent Lateral Force design (ELF) using conservative values of seismic design parameters in lieu of performing a site specific ground motion analysis:

* Structures on Site Class E sites with Ss greater than or equal to 1.0, provided the site coefficient Fa is taken as equal to that of Site Class C.

* For structures on Site Class D sites with S1 greater than or equal to 0.2, a long period coefficient (Fv) of 1.7 may be utilized for calculation of Ts, provided that the value of Seismic Response Coefficient (Cs) is determined by Equation (12.8-2) for values of the fundamental period of the building (T) less than or equal to 1.5Ts, and taken as 1.5 times the value computed in accordance with either Equation 12.8-3 for T greater than 1.5 Ts and less than or equal to T_L or Equation 12.8-4 for T greater than T_L.

* Structures on Site Class E sites with S1 greater than or equal to 0.2, provided that T is less than or equal to Ts and the equivalent static force procedure is used for the design.

2. Where Site Class B is recommended, and a site specific measurement is not provided, the site coefficients Fa, Fv, and F_{PGA} shall be taken as unity (1.0) in accordance to Section 11.4.3 of ASCE 7-16.

3. Where Site Class D is selected as the default site class per Section 11.4.3 of ASCE 7-16, the value of Fa shall not be less than 1.2. Where the simplified procedure of Section 12.4 is used, the value of Fa shall be determined in accordance with Section 12.14.8.1, and the values of Fv, S_{MS} and S_{M1} need not to be determined.

Based on our reevaluation, planned construction method and past experience with similar project, Site Class C (Very Dense Soil and Soft Rock) may be conservatively considered for the project site subsoil profile.

Seismic design values are presented in the enclosed Attachment A, prepared in accordance with Chapter 16, Section 1613 of the 2019 California Building Code (CBC) and ASCE 7-16 Standard. Presented values are generated using ASCE developed web interface that uses the United States Geological Survey (USGS) web services and retrieves the seismic design data in a report format.

IX. SLOPE STABILITY

Project natural terrain is underlain by competent crystalline bedrock units, which typically perform well in natural and graded slope conditions. Landslides or other forms of slope instability are not indicated within the project natural hillside areas.

Cut slopes exposing crystalline bedrock are expected to be grossly stable at 1.5:1 gradients to anticipated design maximum vertical heights. However, in order to further evaluate 1.5:1 cut slope stability, a typical 1.5:1 graded cut slope with a short 4 feet high retaining wall at the toe was modeled and analyzed as part of our previous update report (Reference A, dated December 3, 2021).

Trial analyses were perform based on the assumed boundary and loading conditions, and geometry of the most critical section developed from the project plans. The overall gross stability was estimated using the GSTABL7 with STED Win Slope Stability Analysis System for both static and pseudo-static (seismic) conditions utilizing selected method of analysis (Bishop). A 0.20g ($\frac{2}{3}S_{DS}/2.5$) horizontal ground acceleration (a_h) was assumed for the pseudo-static conditions. Stability was then evaluated by choosing selected limits which identify failure trail surfaces. Graphical illustrations summary of the slope stability analysis results with the minimum factor of safety for the most critical failure plane are reproduced and included with this report as Attachment B.

Based on our assumptions and analysis, and considering a typical 1.5:1 cut slope with a maximum 4 feet high vertical exposure at the toe (the toe retaining wall at the base of the cut slope was ignored in our analyses), minimum factors of safety of 1.5 and 1.1 were indicated for deep-seated global stability trail surfaces for static and pseudo-static (seismic) conditions, respectively. The minimum generally accepted safety factors for the static and pseudo-static (seismic) conditions are 1.5 and 1.1 respectively.

However, all graded cut slopes shall require special geologic inspection and mapping for potential adverse or unfavorable joint structures and shear features, and confirming stability at the time of grading operations. Added stability recommendations should be provided at time if necessary and should be anticipated. Rock and debris fencing shall be required for the project larger cut slopes greater that 10 feet in maximum vertical height. Toe retaining walls shall also be expected at the base of the planned cut slopes, unless otherwise approved by the project geologist at the time of grading inspections based on the final exposures and actual rock joint structures and shear features. The upper portions of cut slopes are also expected to expose a section of loose topsoil that may require in-place moisture conditioning and track walking with heavy construction equipments, or removal and reconstruction as a stabilized fill over cut slope with an adequately wide keyway at the base developed into the natural hillside, as schematically shown on the attached Figure 13.

New graded roadway fill embankment slopes should be programmed for 2:1 maximum gradients, properly benched into the competent undisturbed natural hillside terrain and neatly contour blended into surrounding areas to provide a smooth transition as recommended in the referenced reports. The existing roadway embankment/fills, where they occur, shall also be removed and recompacted/reconstructed as a part of the new roadway fills, as specified. Graded slopes more than 30 feet high should be provided with drainage terraces at the mid-height, as recommended in the referenced reports.

Runoff shall not be allowed to flow over the top of slopes or occur in a concentrated flow condition over the finish slope faces. All graded slopes should be provided with well-developed brow ditches along the top.

X. LABORATORY TESTING

Adequate sampling and laboratory testing were performed by this office in support of previous site study (Reference B), and added sampling and testing were not deemed warranted at this time. Laboratory test results excerpts are reproduced below:

A. **Representative Soil Types:** Earth deposits at the project property were closely examined. Representative near surface soils were sampled for laboratory testing. Based upon our limited test pit and field exposures, site soils have been grouped into the following soil types:

TABLE 1

Soil Type	Description
1	Red brown to brown silty clayey sand with rock fragments (Topsoil)
2	Red brown to tan gray rocks in a fine to coarse sand matrix (Weathered Bedrock)
3	Dark brown locally rocky silty to sandy clay (Topsoil)

B. **Grain Size Analysis:** Grain size analyses were performed on selected samples of Soil Types 1 and 3. The test results are tabulated in Table 2 below.

TABLE 2

Sieve Size		6"	3"	2"	1½"	1"	¾"	½"	#4	#10	#20	#40	#100	#200
Location	Soil Type	Percent Passing												
TP-101 @ 1.5'	2*	100	98	88	79	70	64	58	47	37	29	23	16	13
TP-102 @ 1'	3					100	99	98	97	96	95	93	85	73

* Selective sampling. May not be representative of actual soil-rock fill mixture. Excludes larger rock sizes.

C. **Maximum Dry Density and Optimum Moisture Content:** The maximum dry density and optimum moisture content of Soil Types 1 and 3 were determined in accordance with ASTM D1557. The maximum dry densities and optimum moisture contents were corrected for rock contents, where applicable. The test results are presented in Table 3.

TABLE 3

Sample Location	Soil Type (ST)	Max. Dry Density (pcf)	Opt. Moist. Content (%)	Corrected Max. Dry Density (pcf)	Corrected Opt. Moist. Content (%)
TP-101 @ 0.5'	1	117.0	16	127.5	12
TP-103 @ 2.5'	3	111.0	19	-	-

D. **Unit Weight & Moisture Content Tests:** In-place dry density and moisture content of collected representative soil samples were determined from relatively undisturbed chunk samples using the Water Displacement method (Method A) in accordance with ASTM D7263, and Water Content of Soil and Rock by Mass test method in accordance with ASTM D2216. The test results are presented in Table 4.

TABLE 4

Sample Location	Soil Type	Field Moisture Content (ω-%)	Field Dry Density (ϒd-pcf)	Max. Dry Density (ϒm-pcf)	In-Place Relative Compaction	Degree of Saturation S (%)
TP-101@ 1.5'	2	2	134.5	-	-	18
TP-102 @ 1'	3	2	91.2	111.0	82	6
TP-102 @ 3.5'	2	6	127.9	-	-	45
TP-103 @ 1'	1	2	93.4	117.0	80	6
TP-103 @ 2.5'	3	15	95.5	111.0	82	51
TP-103 @ 4'	2	4	129.0	-	-	33
TP-104 @ 1'	1	1	98.8	117.0	84	4
TP-104 @ 3'	3	12	97.7	111.0	88	43
TP-104 @ 4.5'	2	11	110.5	-	-	54
TP-105 @ 1'	3	9	95.0	111.0	86	30
TP-105 @ 5.5'	2	11	112.5	-	-	57
TP-106 @ 5'	2	10	111.4	-	-	51

Assumptions and Relationships:
In-place Relative Compaction = (ϒd ÷ ϒm) X100
Gs = 2.80
e = (Gs ϒω ÷ ϒd) - 1
S = (ω Gs) ÷ e

E. **Expansion Index Test:** Two expansion index (EI) tests were performed on representative samples of Soil Type 3 in accordance with the ASTM D4829. The test results are presented in Table 5.

TABLE 5

Sample Location	Soil Type	Molded ω (%)	Degree of Saturation (%)	Final ω (%)	Initial Dry Density (PCF)	Measured EI	EI 50% Saturation
TP-102 @ 1'	3	14	50	33	97.8	68	68
TP-103 @ 2.5'	3	17	50	37	89.1	84	84

(ω) = moisture content in percent.

$EI_{50} = EI_{meas} - (50 - S_{meas})((65 + EI_{meas}) \div (220 - S_{meas}))$

Expansion Index (EI)	Expansion Potential
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
〉130	Very High

F. **Direct Shear Test:** One direct shear test was performed on a representative sample of Soil Type 1 in accordance with ASTM D3080. The prepared specimen was soaked overnight, loaded with normal loads of 1, 2, and 4 kips per square foot respectively, and sheared to failure in an undrained condition. The test result is presented in Table 6.

TABLE 6

Sample Location	Soil Type	Sample Condition	Unit Weight (Ɣw-pcf)	Angle of Int. Fric. (Φ-Deg.)	Apparent Cohesion (c-psf)
TP-101 @ 0.5'	1	Remolded to 90% of Y_m @ % ω_{opt}	121.3	30	200

G. **pH and Resistivity Test:** pH and resistivity of a representative sample of Soil Type 3 was determined using "Method for Estimating the Service Life of Steel Culverts," in accordance with the California Test Method (CTM) 643. The test result is tabulated in Table 7.

TABLE7

Sample Location	Soil Type	Minimum Resistivity (OHM-CM)	pH
TP-103 @ 2.5'	3	350	8.3

H. **Sulfate Test:** A sulfate test was performed on a representative sample of Soil Type 3 in accordance with the California Test Method (CTM) 417. The test result is presented in Table 8.

TABLE 8

Sample Location	Soil Type	Amount of Water Soluble Sulfate In Soil (% by Weight)
TP-103 @ 2.5'	3	0.010

I. **Chloride Test:** A chloride test was performed on a representative sample of Soil Type 3 in accordance with the California Test Method (CTM) 422. The test result is presented in Table 9.

TABLE 9

Sample Location	Soil Type	Amount of Water Soluble Chloride In Soil (% by Weight)
TP-103 @ 2.5'	3	0.036

XI. SITE CORROSION ASSESSMENT

A site is considered to be corrosive to foundation elements, walls and drainage structures if one or more of the following conditions exist:

* Sulfate concentration is greater than or equal to 2000 ppm (0.2% by weight).
* Chloride concentration is greater than or equal to 500 ppm (0.05 % by weight).
* pH is less than 5.5.

For structural elements, the minimum resistivity of soil (or water) indicates the relative quantity of soluble salts present in the soil (or water). In general, a minimum resistivity value for soil (or water) less than 1000 ohm-cm indicates a potential for presence of high quantities of soluble salts and a higher propensity for corrosion. Appropriate corrosion mitigation measures for corrosive conditions should be selected depending on the service environment, amount of aggressive ion salts (chloride or sulfate), pH levels and the desired service life of the structure.

Results of limited laboratory tests performed on selected representative of site soil samples indicated that the minimum resistivity is less than 1000 ohm-cm suggesting presence of high quantities of soluble salts. However, test results further indicated that pH levels are greater than 5.5, sulfate concentrations are less than 2000 ppm and chloride concentration levels are less than 500 ppm. Based on the results of the available limited corrosion analyses, the project site is considered non-corrosive.

SMS Geotechnical Solutions, Inc. does not consult in the field of corrosion engineering and the client, project architect or structural engineer should agree on the required level of corrosion protection, or consult a corrosion engineer as warranted. However, based on the result of the tested soil sample, the amount of water soluble sulfate (SO4) was found to be 0.01percent by weight (100 ppm) which is considered negligible according to ACI 318 (S0 Exposure Class with Not Applicable severity). Water soluble chloride (CL) was found 0.036 percent by weight (360 ppm), and concrete is expected to be dry or protected from moisture. The project site is also not located within 1000 feet of salt or brackish water. Consequently, exposures to chloride may also be considered negligible (C0 Exposure Class with Not Applicable severity). In our opinion and as a minimum concrete consisting of Portland cement Type II (ASTM C150) with minimum 28 days compressive strength (f'_c) of 2500 psi and maximum 0.50 water-cement ratio is considered typically adequate for S0 and C0 Class exposures, unless otherwise specified, or noted on the project plans.

Table 10 below is appropriate based on the pH-Resistivity test results. Adequate protective measures against corrosion should be considered for all buried metal pipes, connections, elbows, conduits, improvements and structures, as necessary and appropriate. Buried metal pipes and conduits should be wrapped and provided with appropriate protective cover, as necessary and wherever applicable.

TABLE 10

Design Soil Type	Gauge	16	14	12	10	8
3	Years to Perforation of Metal Culverts	20	26	36	46	56

XII. STORMWATER BMPs

Stormwater BMP facilities, if required or considered in connection with the project development, should be designed and constructed considering the site indicated geotechnical conditions. The implemented management and water treatment control practices shall have no short and long term impacts on the new building pads and improvement surfaces, graded and natural slopes, fills and backfills, structures and onsite and nearby offsite improvements.

Testing for site infiltration feasibility condition was not a part of this study. However, based on the geotechnical data collected during this work, native gabbroic rocks, underlying the site at shallow depths, chiefly consist of very hard bedrock units which may be characterized as Hydrologic Soil Group D (based on San Diego Hydrology Manual classification). Consequently, bio-retention/detention systems typically consisting of a suitably sized excavated basin(s) with specially engineered sand filter media and a perforated pipe(s) underdrain surrounded with ¾-inch crushed rocks and impervious liner on the bottom and sides of the basin may be considered. Captured water should be filtered and slowly discharge via a storm drain pipe to and approved storm drain facility. A Typical BMP Swale and a Typical Bio-Detention Detail are attached herein as Figures 14 and 15. Actual designs should be provided by the project design consultant.

The bio-retention/detention basin(s) should be suitably sized for adequate storage capacity with filtrations completed not more than 72 hours and vegetation carefully managed to prevent creating mosquito and other vector habitats. Additional and more specific recommendations should be provided by the project geotechnical consultant at the final plans review phase, if necessary

XIII. CONCLUSIONS

Based on our review of the referenced reports and from a geotechnical viewpoint, development of Lot 7 substantially as proposed (see Figure 1), is feasible from a geotechnical viewpoint. The project site is underlain by crystalline bedrock units at shallow depths, mantled by a section of thin to moderate soil cover. Local undocumented roadway fills are also present along Las Lomas northern/western pavement edge.

Geotechnical conditions and engineering properties of onsite earth materials presented in the referenced reports remain substantially unchanged. All conclusions provided in the referenced reports remain valid and should be considered in the final designs, except where specifically superseded or amended below. The following also are appropriate:

A. Landslides, faults or significant shear zones are not present at the project site and are not considered a geotechnical factor in the planned development. The study site is not located near or within the Alquist-Priolo earthquake fault zone established by the State of California. The most significant long-term geologic hazard likely to impact the property is periodic ground shaking associated with earthquake activity along nearby or distant active faults. The project shall be designed and constructed in accordance with the seismic design requirements of the 2019 California Building Code (CBC) and ASCE 7-16 Standard.

B. Based on the current plans, modest to relatively major cut excavations, on the order of 15 vertical feet, are planned for the developing a level building pad. Associated eastern perimeter cut slopes are planned at 1.5:1 gradients, supported with terraced toe retaining walls and combined vertical heights approaching nearly 23 feet. New fill slopes are not planned in connection with the building pad development and ground elevation transitions along the western pad margins will be achieved with terraced retaining walls. Planned building pad perimeter terraced transition retaining walls will on the order of 8 feet high.

C. Proposed Las Lomas roadway widening cut slopes will be mostly minor features planned for 1.5:1 maximum gradients. Transition retaining walls, on the order of 6 feet high, are also planned for accommodating Las Lomas roadway widening in the southern portions.

D. Based on our analyses, the planned 1.5:1 cut slopes are expected to be grossly stable provided our grading and mitigation recommendation provided in the following sections are followed. Toe retaining walls shall be required at the base of the planned 1.5:1 cut slopes, unless otherwise specifically approved by the project geologist based on special geologic inspections of actual exposures at the time of grading operations. Rock and debris fencing shall be required for 1.5:1 cut slopes greater that 10 feet in maximum vertical height and the upper slope portions exposing loose topsoil require in-place compaction by track walking or removal and reconstruction as a stabilized fill over cut slope.

E. Permanent vertical cut exposures developed into the site natural hillside shall not be allowed, unless otherwise specifically approved by the project geotechnical consultant. Vertical cut exposures, where they become necessary, shall be supported by retaining walls designed based on the soils parameters provided herein and in the referenced report. However, locally, minor vertical cuts less than 4 feet high maximum exposing massive unfractured/unjointed rocks may be allowed, only if approved in the field by special geologic inspections performed by the project geologist.

F. New roadway embankment fills, programmed at 2:1 maximum gradients, will also be grossly stable with respect to deep seated and surficial failures, provided our grading recommendations are followed.

G. A seismic survey and rock rippibility study was not a part of our prior studies and this update effort. However, roughly, all cut excavations deeper than 10 feet into the underlying bedrock are expected to encounter very hard units. Based on limited available exploratory trenching exposures and our field observation and, upper weathered rocks may be anticipated to excavate with light to moderate efforts and local heavy ripping utilizing large bulldozers (Caterpillar D-9 or equal). More concentrated single-shank ripping efforts, special excavation techniques and use of larger track hoes and rock beakers should be anticipated for deeper cuts/undercuts and corestone floater removals. Blasting and/or local "popping" of very hard units, rock clusters and corestone floaters should also be anticipated. Blasting efforts and the use of larger grading equipments will help to increase production levels and generate better quality fills.

H. Harder rocks and corestones are expected to generate larger oversize rock debris creating disposal and handling problems. Larger rocks should be selectively removed and separated from the fill mixture, however, burial of smaller rock sizes may be allowed in deeper fills, as specified in the referenced report. Manufactured fill mixture should consist of minus 6-inch particles and maintain a minimum of 40 percent fines (smaller than #4 sieve). Wall backfill should consist of minus 3-inch particle sizes and maintain the same minimum fines to rock ratio. Rocky to gravelly fills typically require added processing and moisture conditioning efforts by the grading contractor in order to manufacture a uniform mixture suitable for reuse as project compacted fills.

I. Surficial soil mantle and all existing roadway fills, where they occur, shall be removed to the underlying competent bedrock and recompacted using remedial grading techniques, as specified. Existing roadway fills shall also be removed and incorporated into the new roadway compacted fills by developing a proper toe keyway and benching into the competent natural hillside, as approved in the field.

J. Site surficial topsoils range from sandy to plastic clayey deposits with medium expansive potential, and also locally include some rock debris. Potentially expansive soils, however, are expected to be minor in the project overall earthwork quantities. Potentially expansive clayey soils, where encountered, should be selectively buried in deeper fills or thoroughly mixed with an abundance of good quality sandy soils generated from the site weathered bedrock excavations to manufacture a very low expansive mixture.

   Based on our investigation and select grading recommendations provided herein, expansive soils are not expected to be a major geotechnical factor in the site development. Final bearing soil mixtures are expected to consist chiefly of silty sandy gravel to gravelly silty sand (GM/GP) with very low expansion potential (expansion index less than 20) based on ASTM D4829 classification. Actual classification and expansion characteristics of the finished grade soil can only be provided in the final as-graded compaction report based on proper testing of foundation bearing and subgrade soils.

K. Temporary excavations and wall backcut slopes are expected to mostly expose a mantle of topsoils over competent bedrock and should be developed as specified in the following sections.

L. Natural groundwater is not expected to impact project grading or the long term stability of the individual developed lots. The proper control of uphill surface run-off and storm waters are important factors in the continued stability of the graded building pad, embankments and associated perimeter transition retaining walls. Cut slopes that expose fractured bedrock may transmit irrigation or meteoric water creating excessive moisture conditions. Moisture sensitive improvements located near the toe of impacted cut slopes can be protected by subsurface drains constructed along the base of graded cut slopes. All retaining walls should be provided with an adequate back drainage system as specified in the following sections. Storm water and drainage control facilities should be designed and installed for proper control and disposal of surface water as shown on the approved grading or drainage improvements.

M. Post construction settlements after completion of remedial grading work as specified herein, are expected to be within acceptable construction tolerances. Post construction foundation bearing soil settlements are expected to be less than approximately 1-inch and should occur below the heaviest loaded footing(s). The magnitude of post construction differential settlements, as expressed in terms of angular distortion, is not anticipated to exceed ½-inch in a distance between similarly loaded adjacent structural elements, or a maximum distance of 20 feet.

N. Soil collapse, liquefaction and seismically induced settlements will not be a factor in the planned site development provided our remedial grading recommendations are followed.

O. Buildings, structures and improvements constructed on or near the top of descending slopes shall maintain an adequate setback from the top of slope or provided with a deepened footing/thickened edge to satisfy the minimum horizontal setback from daylight, as specified below.

XIV. RECOMMENDATIONS

All development recommendations provided in the referenced reports (see References) remain valid and should be considered in the final project designs and implemented during the construction phase, except where specifically superseded or amended below. The following site-specific recommendations are also appropriate based on the Lot-7 proposed development plans:

A. Applicable Codes, Standards and Project Specifications: All designs and construction works including excavations and earthwork, fill/backfill materials and processing, placement and compaction procedures, and foundations shall be completed in accordance with Chapter 18 (Soils and Foundations) and Appendix "J" (Grading) of the 2019 California Building Code (CBC), ASCE 7-16, the Standard Specifications for Public Works Construction, City of Vista ordinances, applicable local codes and engineering standards, the requirements of the governing agencies and recommendations of the referenced reports and this update study, as applicable.

B. Grading and Earthwork: Modest to relatively major cut and fill/wall backfill grading will be required for development level building pad surfaces and achieving final grades. Modest grading and construction of new roadway fill embankment slopes will also be necessary for the planned Las Lomas roadway widening. Earthwork and remedial grading operations, including removals and over-excavations, undercutting, rock disposal and fill/backfill materials and manufacturing, and fill/backfill placement and compaction procedures stay unchanged, and should be completed as specified in the referenced reports (see References).

1. **Existing Underground Utilities and Buried Structures:** All existing underground waterlines, sewer lines, pipes, storm drains, utilities, tanks, structures and improvements at or nearby the project site and planned roadway improvement areas should be thoroughly potholed, identified and marked prior to the initiation of the actual grading and earthworks. Specific geotechnical engineering recommendations may be required based on the actual field locations and invert elevations, backfill conditions and proposed grades in the event of a grading conflict.

Utility lines may need to be temporarily redirected, if necessary, prior to earthwork operations and reinstalled upon completion of earthwork operations. Alternatively, permanent relocations may be appropriate as shown on the approved plans.

Abandoned irrigation lines, pipes and conduits should be properly removed, capped or sealed off to prevent any potential for future water infiltrations into the foundation bearing and subgrade soils. Voids created by the removals of the abandoned underground pipes, tanks and structures should be properly backfilled with compacted fills in accordance with the requirements of this report.

2. **Clearing and Grubbing:** Remove all existing surface and subsurface structures, abandoned concrete slabs/foundations, tanks, vaults, pipes, improvements, vegetation, roots, stumps, large boulders, and all other unsuitable materials and deleterious matter from all areas proposed for new fills, embankments, improvements, and structures plus a minimum of 10 horizontal feet outside the perimeter, where possible and as approved in the field.

   All debris generated from the site demolitions, clearing, trash, and unsuitable materials should also be properly removed and disposed of. Trash, vegetation and construction debris should not be allowed to occur or contaminate new site fills and backfills.

   The prepared grounds should be observed and approved by the project geotechnical consultant or his designated field representative prior to grading and earthworks.

3. **Over-Excavations and Removals:** Uniform and stable bearing soil conditions should be constructed under the planned new buildings, retaining walls, structures and improvements. For this purpose, over-excavations (removals) and recompaction of site topsoils and highly weathered bedrock residuum, and existing roadway/fills where they occur, will be required in the areas planned to receive new fills, structures, and improvements. Over-excavations and remedial grading should extend a minimum of 10 horizontal feet outside the planned new fills, building and improvement envelops, where possible and unless otherwise approved in the field.

   Removal depths should be extended to the underlying dense and competent bedrock units, as approved in the field. Actual stripping depths are expected to vary throughout the project site and should be established in the field by the project geotechnical consultant or his designated field representative. Approximate stripping depths, as currently established based on the limited available exploratory test pit sites and our site observations are anticipated to range from 1.5 to 5 feet below the existing ground surfaces (BGS). In the planned roadway widening improvement areas removals should be extended to competent bedrock or a minimum of 12 inches below the rough finish subgrade whichever is more, and include all existing roadway fills expected to ranging to nearly 10 feet thick. Locally deeper removals may be necessary based on the actual field exposures and should be anticipated.

Bottom of all removals should also be adequately prepared, ripped and recompacted to a minimum depth of 6 inches as a part of initial fill lift placement. Preparations of bottom of removals and over-excavations shall construct neat, level surfaces free of uneven large outcropping adequately benched, keyed-in and heeled back into the natural hillside exposing competent bedrock, as directed in the field. All ground steeper than 5:1 receiving fills/backfills should be properly benched and keyed as directed in the field.

4. **Excavation Characteristics:** Based on the current plans (Figure 1) total cut/undercut depths on the order of 25 feet maximum are anticipated. In General, all cuts deeper than nearly 10 feet into the project bedrock may be expected to encounter very hard bedrock units. A seismic survey for determining depth(s) of rippable rock and help quantify the amount of very hard (blasting) rocks in deeper cut areas was not a part of our prior studies and this update effort.

   Based on our current site studies and experience with similar projects, weathered near surface rocks may be expected to be excavated with light to moderate efforts utilizing larger bulldozers (Caterpillar D-9 or equal) to a relatively modest depth on the order of 10 feet. Deeper cuts/undercuts should be expected to encounter very hard rocks and potential corestone floaters requiring more concentrated single-shank ripping and specialized excavation efforts including the use of large trackhoes and rock beakers. Blasting and/or local "popping" of very hard units, rock clusters and corestones should also be anticipated. Blasting efforts will also aid to increase production levels and improve quality of the generated fill materials.

   Earth materials generated from the removals and excavations of site corestones, boulders, rock floaters and harder units are expected to generate poor quality rocky fill materials with little to inadequate fines, and include oversize rock debris creating handling and disposal difficulties.

5. **Cut-Fill Transitions and Undercutting:** Ground transition from excavated cut to compacted fills shall not be permitted underneath the proposed new structures and site improvements. Building foundations, retaining walls and site structural as well as on-grade pavements/improvements should be supported entirely on well-compacted fills or uniformly founded on undisturbed competent bedrock units, as approved by the project geotechnical consultant.

   Cut-fill transition pads will require special treatment. The cut portion of the cut-fill pads plus 10 feet outside the perimeter, where possible and as directed in the field, should be undercut to a sufficient depth to provide for a minimum 3 feet of compacted fill mat below rough finish grades (RFG), or at least 12 inches of well-compacted fill below the bottom of deepest footing(s), whichever is more. In the roadways, driveway, parking and on-grade slabs/improvement transition areas there should be a minimum 12 inches of compacted soils below rough finish subgrade.

Undercutting the cut portions of the project cut-fill transition pads, will also accommodate foundation and underground utility trenching in an otherwise very hard bedrock units. In the case of deeper utility trenches, undercutting to a minimum 8 inches below the proposed inverts may be considered. Cut-fill transition mitigation and undercutting should be carried out in substantial accordance with the enclosed Typical Undercutting Detail, Figure 16.

6. **Temporary Excavations and Backcut Slopes:** Undermining existing nearby improvements, structures and adjacent public and private properties by the site excavations and removal operations shall not be allowed. For this purpose, adequate excavation set backs shall be maintained and excavation slopes laid back at safe gradients as appropriate.

   Trenching, wall backcuts and temporary excavation slopes, or portions thereof, developed into site existing road fills/topsoils should be laid back at 1:1 maximum gradients. Excavation slopes, wall backcuts and trenching exposing competent bedrock may be development at near vertical gradients to a maximum of 5 feet high, unless otherwise approved or directed in the field. Larger backcuts and temporary excavation slopes may be development at near vertical gradients within the lower 5 feet where exposing competent bedrock and laid back at 1:1 maximum gradients within the upper portions. The laid back slope should then be properly benched out and new fills/backfills tightly keyed-in as the backfilling progresses.

   All wall backcuts and temporary slopes require geotechnical observations during the excavation operations. More specific recommendations should be given in the field by the project geotechnical consultant based on actual exposures. Revised temporary construction/backcut slope and trenching recommendations including flatter slope gradients, larger setbacks and the need for temporary shoring/trench shield support may also become necessary and should be anticipated.

   The project contractor shall also obtain appropriate permits, as needed, and conform to Cal-OSHA and local governing agencies' requirements for trenching/open excavations and safety of the workmen during construction. Appropriate permits for offsite grading or excavation encroachments into neighboring private properties and/or public right-of-ways, if any required or necessary, should also be obtained as appropriate from respective owners and agencies.

7. **Soil Properties and Fill/Backfill Materials:** Excavations of site existing surficial topsoil mantle will include local rock debris and clayey soils ranging to medium expansion potential. Excavations of site weathered bedrock units will predominantly generate gravelly to sandy materials. Generated expansive clayey soil, however, is expected to be minor in overall earthwork quantities and should be buried in deeper fills

at least 4 feet below rough finish pad grades using select grading techniques, or throughly mixed with an abundance of gravelly to sandy soils generated from the weathered bedrock excavations to manufacture a very low expansive mixture.

Excavations of harder bedrock units, floater rocks and corestones are expected to generate poor quality rock fills with little to inadequate fines and include larger oversize rock debris. Rock fills will create mixing and compaction difficulties, while oversize rock debris result in handling and disposal problems. Rocks up to 12 inches in maximum diameter may be allowed in compacted fills provided they are individually placed, surrounded with compacted fills and buried a minimum of 5 feet below the rough finish pad grades. The upper 5 feet in the building pad grades, and 10 feet in the areas of public right-of-way and easements should consist of minus 6-inch materials. In the absence of very deep fills or large fill slopes, rocks larger than 12 inches in maximum diameter should be properly removed and disposed of.

Project fills shall be clean deposits free of trash, debris, roots, stumps, organic matter and deleterious materials consisting of minus 6-inch particles and include at least 40% finer than #4 sieve materials by weight. Trench and wall backfills shall consist of a minimum of 3-inch particles and maintain the minimum specified fines to rock ratio. In order to improve the quality of the generated rocky fills and generate adequate fines, additional rock breaking efforts with heavy equipments, screening and/or the use of a skeleton bucket should be anticipated. Gravelly to rocky materials will also require added processing and mixing efforts in order to manufacture a uniform mixture suitable for reuse as site new fills and backfills.

Import soils, if necessary to improve the quality of the generated rock fills and meet the minimum fines to rock fill ratio, or used for wall and trench backfills, should be good quality sandy granular non-corrosive deposits (SM/SW) with very low expansion potential (100% passing 1-inch sieve, more than 50% passing #4 sieve and less than 18% passing #200 sieve with expansion index less than 20). Import source/borrow site(s) shall be a "clean" natural site (i.e. no contamination & no toxic/hazards substance) or manufactured (D.G. or Class 2 base) import materials from a sand/materials plant. Source/borrow sites with land use activities where there could be potential contaminants and toxic substance health risks such as industrial and agricultural sites, fuel storage and gas stations, dry cleaners, photographic processing facilities, paint stores, auto repairs/painting facilities, manufacturing and metal processing shops, waist treatment, aerospace facilities, etc. as well as those sites currently undergoing remediation, corrective action, closure activities overseen by the California Department of Toxic Substance Control (DTSC) or other regulatory agencies shall not be allowed. Import fills obtained from construction projects and from demolition debris, asphalt, broken concrete, shall also not be allowed. Import soils should be observed, tested as necessary, and approved by the project geotechnical engineer prior to delivery to the site. Import soils should also meet or exceed engineering characteristic and soil design parameters as specified in the following sections.

8. **Fill/Backfill Soil Placement, Spreading and Compaction:** Uniform bearing and subgrade soil conditions should be constructed at the site by the project cut-fill and remedial grading operations. New fills and backfills should be adequately processed, thoroughly mixed, moisture conditioned to slightly (2%) above the optimum moisture levels, or as directed in the field, placed in thin (8 inches maximum) uniform horizontal lifts and mechanically compacted with heavy construction equipments to a minimum of 90% of the corresponding laboratory maximum dry density per ASTM D1557, unless otherwise specified. The upper 12 inches of subgrade soils (including trench backfills) under the asphalt pavement base layer should be compacted to minimum 95% compaction levels.

9. **Shrinkage and Bulking:** Based on our estimates, existing loose surficial road fills/topsoils may be expected to shrink, on average, approximately 5% to 15%, and soils generated from the excavations of onsite bedrock may be anticipated to bulk nearly 10% to 20% on a volume basis when compacted as specified herein.

10. **Permanent Graded Slopes:** Large fill slopes are not planned in connection with the building pad development on Lot 7.

    Associated eastern perimeter graded cut slopes are planned at 1.5:1 maximum gradient with terraced toe retaining wall at the base. Based on our analysis and evaluations, the planned graded cut slopes as currently planned, are expected to be stable for the indicated maximum vertical heights and gradients. However, special geologic observations and mapping of the exposed cut face during the grading operations by the project geotechnical consultant shall be required to evaluate potential adverse rock fracturing and jointing structures, and confirm stability. Added stability or revised recommendation including but not limited to flatter than 1.5:1 slope gradients, providing a larger toe retaining walls with an adequate free board, or terraced slope type construction may become required and will be provided at that time, if unfavorable geologic conditions are noted. Rock debris fencing shall be required along the toe of cut slopes based on the actual exposures, and larger cut slopes 10 feet or greater in maximum vertical height.

    Cut slopes exposing site surficial residual topsoils may also require to be moisture conditioned and track-walked with heavy construction equipments to enhance surficial slope face stability, as directed in the field. Thicker loose and unstable residual topsoils exposures may require removal and reconstruction as a stabilized fill over cut slope with an adequately wide keyway as directed in the field and in substantial accordance with the attached typical Stabilization Fill For Unstable Material Exposed In Cut Slopes, Figure 13.

Permanent vertical cuts shall not be allowed, unless otherwise specifically approved by the project geotechnical consultant. In general, locally very minor vertical cuts less than 3 feet high maximum exposing massive stable and unfractured/unjointed rocks may be allowed, only if approved in field by special geologic observations. Unless otherwise specifically approved all vertical cuts shall be supported by properly designed retaining walls suitable to the actual site condition. For grading design purposes, retaining wall supports should be shown on the project plans for all vertical cuts. Then, locally minor unsupported vertical cuts less than 3 feet high maximum, where they may be allowed as observed and approved in the field, can be shown on the final as-built grading plans. Subsurface toe drainage system may also be appropriate for the protection of the lower nearby improvements at the base of cut slopes which can transmit up-slope water, as determined in the field, and may be anticipated.

Project new roadway embankment fill slopes should be constructed at 2:1 maximum gradients, provided with an adequate toe keyway at the base and properly benched into the natural hillside. New roadway slope construction should include the removals of the existing road fills. A minimum 15-foot wide toe keyway should be developed at the base of new embankment slope, extended a minimum of 2 feet into the underlying dense and competent bedrock, as approved in the field. Bottom of the toe keyway should be heeled back a minimum of 2% into the hillside. Temporary backcuts should then be developed at 1:1 maximum within the existing road fills, where they occur, unless otherwise specified or directed in the field. Temporary 1:1 backcut development should effectively remove the majority of existing road fills and construct level benches into the backcut slopes throughout. The level benches should be a minimum of 4 feet wide and developed in a manner that there is a minimum of 10 feet (horizontally) of new compacted fill from the outside edge (front) of the bench to the finish slope face, unless otherwise directed or approved in the field. Attached Typical Fill Over Natural Hillside Detail, Figure 17, depicts general details for developing the project graded slopes, where applicable.

The new roadway embankment fill slope should be constructed by placing minimum 90% compacted fills in thin, horizontal lifts upon approved keyway excavations and the level benches to achieve maximum 2:1 gradients and neatly contour blended into the surrounding slope areas to provide a smooth transition. The fill slope should also be compacted to minimum 90% compaction levels out to the finish slope face. Back rolling at a minimum of 4-foot vertical increments and trackwalking the completed slope, or over-building the slope and cutting back to design configurations, is recommended. Field density tests should be performed to confirm adequate compaction levels within the slope face.

11. **Retaining Wall Back Drainage System:** Project perimeter transition retaining walls should be provided with a well developed back drainage system consisting of a minimum 4-inch diameter, Schedule 40 (SDR 35) perforated pipe surrounded with a minimum of 1½ cubic feet per foot of ¾-inch crushed rocks (12 inches wide by 18 inches deep) installed at the depths of the wall foundation level and wrapped in filter fabric (Mirafi 140-N). If Caltrans Class 2 permeable aggregate is used in lieu of the crushed rocks, the filter fabric can be deleted. The wall back drain should be installed at suitable elevations to allow for adequate fall via a non-perforated solid pipe (Schedule 40 or SDR 35) to an approved outlet. All wall back drain pipes and outlets should be shown on the final as-build plans.

    Adequate waterproofing and the use of special water-tight type concrete (hycrete or similar) are also recommended for the project perimeter retaining walls. Project wall designs should also consider to include a bentonite waterproofing layer with absorbency quality to mitigate any potential or concerns for subsurface water impacts.

    A wall back drain system schematic is depicted on the enclosed Typical Retaining Wall Back Drainage, Figure 18.

12. **Surface Drainage and Erosion Control:** A critical element to the continued stability of the building pads and slopes is an adequate storm water and surface drainage control system and protection of the slope faces. Surface and storm water shall not be allowed to impact the developed construction and improvement sites. This can most effectively be achieved by appropriate vegetation cover and the installation of the following systems:

    * Concentrated surface run-off or overflow of water from the top of slopes should be avoided. Drainage swales should be constructed at the top and toe of the slopes as shown on the approved drawings.

    * Building pad surface run-off should be collected and directed away from the planned buildings and improvements to a selected location in a controlled manner. Area drains should be installed.

    * The finished slope faces should be planted soon after completion of grading. Unprotected slope faces will be subject to severe erosion and should not be allowed. Over-watering of the slope faces should also not be allowed. Only the amount of water to sustain vegetation should be provided.

    * Temporary erosion control facilities and silt fences should be installed during the construction phase periods and until landscaping is fully established as indicated and specified on the approved project grading/erosion plans.

13. **Engineering Observations and Compaction Testing:** All earthwork operations including excavations, removals/over-excavations, suitability of earth deposits used as compacted fills and backfills, and fill/backfill compaction procedures should be continuously observed and tested by the project geotechnical consultant and presented in a final report. Engineering properties of finished bearing and subgrade soils should be confirmed in the final rough pad grading compaction report.

    Geotechnical engineering observations and testing should include but are not limited to the following:

    * Initial observation - After clearing and grading limits have been staked but before brushing/excavation starts.

    * Over-excavation, removals and bottom excavation observation - After dense and competent bedrock units are exposed and prepared to receive fill or backfill, but before fill or backfill is placed.

    * Temporary excavations, wall backcuts and trenching observations - After the excavation is started but before the vertical depth of excavation is more than 5 feet. Local and Cal-OSHA safety requirements for open excavations apply.

    * Fill/backfill observation - After the fill/backfill placement is started but before the vertical height of fill/backfill exceeds 2 feet. A minimum of one test shall be required for each 100 lineal feet maximum in every 2 feet vertical gain, with the exception of wall backfills where a minimum of one test shall be required for each 30 lineal feet maximum. Wall backfills should consist of minus 3-inch maximum particle sizes, maintain the specified minimum fines to rock ratio, and mechanically compacted to a minimum of 90% compaction levels, unless otherwise specified or directed in the field. Finish rough and final pad grade tests shall be required regardless of fill thickness.

    * Foundation trench and subgrade soils observation - After the foundation trench excavations and prior to the placement of steel reinforcing for proper moisture and specified compaction levels.

    * Geotechnical foundation/slab steel observation - After the steel placement is completed but before the scheduled concrete pour.

    * Underground utility, plumbing and storm drain trench observation - After the trench excavations but before placement of pipe bedding or installation of the underground facilities. Local and Cal-OSHA safety requirements for open excavations apply.

Observations and testing of pipe bedding may also be required by the project geotechnical engineer.

* Underground utility, plumbing and storm drain trench backfill observation - After the backfill placement is started above the pipe zone but before the vertical height of backfill exceeds 2 feet. Testing of the backfill within the pipe zone may also be required by the governing agencies. Pipe bedding and backfill materials shall conform to the governing agencies' requirements and project soils report if applicable. All trench backfills should consist of minus 3-inch maximum particles sizes, maintain the specified minimum fines to rock ratio and mechanically compacted to a minimum of 90% compaction levels, unless otherwise specified. Plumbing trenches more than 12 inches deep maximum under the floor slabs should also be mechanically compacted and tested for a minimum of 90% compaction levels. Flooding or jetting techniques as a means of compaction method should not be allowed.

* Pavement/improvements base and subgrade observation - Prior to the placement of concrete or asphalt for proper moisture and specified compaction levels.

C. Foundations and Floor Slabs

Future residential buildings on the new graded building pads may be supported on shallow stiff concrete footings and slab-on-grade floor type foundations consistent the anticipated silty sandy gravel to gravelly silty sand (GM/GP) with very low expansion potential (expansion index less than 20 based on ASTM D4829 classification). Added or modified recommendations may also be necessary and should be given at the plan review phase. All foundations and floor slab recommendations should be further confirmed and/or revised as necessary at the completion of rough grading based on the as-graded site geotechnical conditions.

1. All footings should be supported on well-compacted fills placed in accordance with the requirements of this report, or competent undisturbed bedrock, as approved in the field. The cut portions of graded daylight pad should be undercut and reconstructed to design grades with compacted fills, as specified herein.

2. Perimeter and interior continuous strip foundations should be sized at least 15 inches wide and 18 inches deep for single and two-story structures. Spread pad footings, if any, should be at least 24 inches square and 12 inches deep. Footing depths are measured from the lowest adjacent ground surface, not including the sand/gravel layer beneath the floor slabs. Exterior continuous footings should enclose the entire building perimeter.

Continuous interior and exterior foundations should be reinforced with a minimum of four #5 reinforcing bars. Place 2-#5 bars 3 inches above the bottom of the footing and 2-#5 bars 3 inches below the top of the footing. Reinforcement details for spread pad footings should be provided by the project architect/structural engineer.

3. Interior slabs should be a minimum 5 inches in thickness, reinforced with #4 reinforcing bars spaced 15 inches on center each way, placed mid-height in the slab. Interior slabs should be underlain by 4 inches of clean sand (SE 30 or greater) which is provided with a well performing moisture barrier/vapor retardant (minimum 10-mil Stego) placed mid-height in the sand. Alternatively, a 4-inch thick base of compacted ½-inch clean aggregate provided with the vapor barrier (minimum 15-mil Stego) in direct contact with (beneath) the concrete may also be considered only if a concrete mix which can address bleeding, shrinkage and curling is used.

   Provide "softcut" contraction/control joints consisting of sawcuts spaced 10 feet on centers each way for all interior slabs. Cut as soon as the slab will support the weight of the saw and operate without disturbing the final finish which is normally within 2 hours after final finish at each control joint location or 150 psi to 800 psi. The sawcuts should be minimum 1-inch in depth but should not exceed 1¼-inches deep maximum. Anti-ravel skid plates should be used and replaced with each blade to avoid spalling and raveling. Avoid wheeled equipment across cuts for at least 24 hours.

   Provide re-entrant corner (270 degrees corners) reinforcement for all interior slabs consisting of minimum two, 6 feet long #3 bars at 12 inches on center with the first bar placed 3 inches from the re-entrant corner. Re-entrant corners will depend on slab geometry and/or interior column locations. The enclosed Typical Isolation Joints And Re-Entrant Corner Reinforcement, Figure 19 may be used as a general guideline.

4. Adequate setbacks or deepened foundations shall be required for all foundations and improvements constructed on or near the top of descending slopes to maintain minimum horizontal distances to daylight or adjacent slope face. There should be a minimum of 7 feet or ⅓ of slope height, whichever is more, horizontal setback from the bottom outside edge of the footing to daylight for foundations. Larger setbacks (minimum 10 feet to daylight) shall be required for more sensitive structures and improvements (such as swimming pools) which cannot tolerate minor movements. Concrete flat woks and site improvements near the top of descending slopes should be provided with a thickened edge to satisfy this requirement, unless otherwise specified or approved.

5. Foundations can only be constructed on level surfaces and shall be stepped based on the natural slope topography. Step foundations should maintain the minimum widths, depths and reinforcement, as specified. Individual steps in continuous footings shall not exceed 18 inches in height and the slope of a series of such steps shall not exceed 1 unit vertical to 2 units horizontal (50%) unless otherwise approved. The steps shall be detailed on the project foundation plans. The local effects due to the discontinuity of the steps shall also be considered in the design of foundations as appropriate and applicable. A Typical Stepped Footing Detail is attached to this report as Figure 20.

6. Foundation trenching efforts are expected to cause disturbed bottom of trenches and may result in uneven/unsmooth trench sidewalls. Disturbed bottom of trenches should be recompacted in-place using a wacker and disturbed trench side walls, if developed, should be neatly removed (widened areas should be filled with concrete as a part of the footing pour) prior to steel placement.

7. Foundation trenches and slab subgrade soils should be observed and tested for proper moisture and specified compaction levels and approved by the project geotechnical consultant prior to the placement of steel reinforcement or concrete pour.

D. Soil Design Parameters

The following soil design parameters are based upon tested representative samples of earth deposits and our experience with similar earth deposits in the vicinity of the project site. All parameters should be re-evaluated when the characteristics of the final as-graded soils have been specifically determined:

1. Design unit weight = 122 pcf.
2. Design angle of internal friction = 30 degrees.
3. Design active pressure for retaining structures = 40 pcf (EFP), level backfill, cantilever, unrestrained walls.
4. Design active pressure for retaining structures = 67 pcf (EFP), 2:1 sloping backfill, cantilever, unrestrained walls.
5. Design active pressure of for retaining structures = 79 pcf (EFP), 1.5:1 sloping backfill, cantilever, unrestrained walls.
6. Design static at-rest pressure for retaining structures = 61 pcf (EFP), non-yielding, restrained walls.
7. Design passive resistance for retaining structures = 368 pcf (EFP), level surface at the toe (soil mass on the toe side extends a minimum of 10 feet or 3 times the height of the surface generating passive resistance).
8. Design passive resistance for retaining structures = 140 pcf (EFP), 2:1 sloping down ground surface at the toe
9. Design coefficient of friction for concrete on soils = 0.36.

10. Design net allowable bearing pressure for compacted fills = 2000 psf.
11. Design net allowable bearing pressure for competent undisturbed bed rock = 2500 psf.
12. Allowable lateral bearing pressure (all structures except retaining walls) = 200 psf/ft.

Notes:

- Added lateral pressures caused by nearby foundations, embankments, improvements and surcharge loading should also be considered in the project wall designs, as applicable and appropriate.

- In case of terraced wall conditions, the upper retaining walls foundation pressure should not be allowed to surcharge the lower retaining walls, unless otherwise considered in the wall designs. For this purpose, the upper wall should be adequately set back from the top of the lower wall a minimum clear distance equal to the height of the lower wall. Alternatively, upper wall foundation should be adequately depended so that the lower wall is above a projected imaginary plane having a downward slope of 1-unit vertical to 2-units horizontal (50%) from a line 9 inches above the bottom edge of the upper wall footing. A combination of setback and deepened foundations may also be considered.

- The passive pressure for the upper terraced retaining wall should be considered as an additional active pressure on the lower wall, unless otherwise noted or approved.

- An additional seismic force due to seismic increments of earth pressure should also be considered in the project designs, if appropriate and where applicable. A seismic lateral inverted triangular earth pressure of 18 pcf (EFP), acting at 0.6H (H is the retained height) above the base of the wall should be considered. Alternatively, seismic loading based on Mononobe-Okake (M-O) coefficients may be considered for seismic force due to seismic increments of earth pressure. The following relationships and design values are appropriate:

TABLE 11

Wall Condition	Total Lateral Pressure	Seismic Lateral Pressure	K_A	K_O	K_h	K_{AE}	K_{OE}	Υ (pcf)
Unrestrained	$P_{AE}=P_A + P_{AE}$	$\Delta P_{AE}=\frac{3}{8}K_h\Upsilon H^2$	0.33	-	0.15	0.48	-	122
Restrained	$P_{OE}=P_O + P_{OE}$	$\Delta P_{OE}=K_h\Upsilon H^2$	-	0.50	0.15	-	0.65	122

- Use a minimum safety factor of 1.5 for wall over-turning and sliding stability. However, because large movements must take place before maximum passive resistance can be developed, a safety factor of 2 may be considered for sliding stability where sensitive structures and improvements are planned near or on top of retaining walls.

- When combining passive pressure and frictional resistance the passive component should be reduced by one-third. The upper 9 inches of ground surfaces should not be included in the design for passive soil resistance, unless otherwise noted or specified.

- The net allowable foundation pressure provided herein was determined based on minimum 12 inches wide by 12 inches deep footings. The indicated value may be increased by 20% for each additional foot of depth and 20% for each additional foot of width to a maximum of 5500 psf, if needed. The allowable foundation pressures provided herein also applies to dead plus live loads and may be increased by one-third for wind and seismic loading.

- The allowable lateral bearing earth pressures may be increased by the amount of the designated value for each additional foot of depth to a maximum of 1500 pounds per square foot.

E. Exterior Concrete Slabs, Sidewalks and Flatworks

1. All exterior slabs should be a minimum of 4 inches in thickness, reinforced with #3 bars at 18 inches on centers in both directions placed mid-height in the slab. Subgrade soils underneath the exterior slabs should be moisture reconditioned and recompacted to minimum 90% compaction levels at the time of fine grading and before placing the slab reinforcement.

2. Reinforcements lying on subgrade will be ineffective and shortly corrode due to lack of adequate concrete cover. Reinforcing bars should be correctly placed extending through the construction joints tying the slab panels. In construction practices where the reinforcements are discontinued or cut at the construction joints, slab panels should be tied together with minimum 18 inches long #3 dowels at 18 inches on centers placed mid-height in the slab (9 inches on either side of the joint).

3. Provide "tool joint" or "softcut" contraction/control joints spaced 10 feet on center (not to exceed 12 feet maximum) each way. The larger dimension of any panel shall not exceed 125% of the smaller dimension. Tool or cut as soon as slab will support weight, and can be operated without disturbing the final finish which is normally within 2 hours after final finish at each control joint location or 150 psi to 800 psi. Tool or softcuts should be a minimum of ¾-inch but should not exceed 1-inch deep maximum. In case of softcut joints, anti-ravel skid plates should be used and replaced with each blade to avoid spalling and raveling. Avoid wheeled equipments across cuts for at least 24 hours.

   Joints shall intersect free-edges at a 90° angle and shall extend straight for a minimum of 1½ feet from the edge. The minimum angle between any two intersecting joints shall be 80°. Align joints of adjacent panels. Also, align joints in attached curbs with joints in slab panels. Provide adequate curing using approved methods (curing compound maximum coverage rate = 200 sq. ft./gal.).

4. All exterior slab designs should be confirmed in the final as-graded compaction report.

5. Subgrade soils should be tested for proper moisture and specified compaction levels and approved by the project geotechnical consultant prior to the placement of concrete.

F. Pavement Design

1. **Asphalt Concrete (HMA) Paving:** Specific pavement designs can best be provided at the completion of rough grading based on R-value tests of the actual finish subgrade soils; however, the following structural sections may be considered for initial planning phase and cost estimating purposes only (not for construction):

   * A minimum section of 4 inches HMA (AC) on 6 inches of Class 2 aggregate base (AB), or the minimum structural section required by City of Vista, whichever is more, may be considered for the onsite asphalt paving surfaces. Actual designs will depend on final subgrade R-value and design TI, and the approval of the City of Vista.

   * In the areas where the longitudinal grades exceed 10%, 0.3-inch asphalt concrete should be added to the design asphalt concrete thickness for each 1% increase in grade or portion thereof. PCC paving should be considered for longitudinal grades over 15%.

* Maximum lift for HMA (AC) shall not exceed 3 inches. The 4-inch asphalt concrete layer, where required, should consist of 2.5 inches of a binder/base course (¾-inch aggregate) and 1.5 inches of finish top course (½-inch aggregate) topcoat, placed in accordance with the applicable local and regional codes and standards.

* The Class 2 aggregate or recycled base (AB) shall meet or exceed the requirements set forth in the current California Standard Specification (Caltrans Section 26-1.02). Base materials should be compacted to a minimum 95% of the corresponding maximum dry density (ASTM D1557). Subgrade soils beneath the asphalt paving surfaces should also be compacted to a minimum 95% of the corresponding maximum dry density within the upper 12 inches. Base materials and subgrade soils should be tested for proper moisture and minimum 95% compaction levels and approved by the project geotechnical consultant prior to the placement of the base or asphalt layers.

2. **Roadway Widening, Asphalt Overlay and Resurfacing:** Sawcutting, cold milling, grinding and overlay of selected pavement surfaces for creating a smooth transition between the new and existing asphalt are expected. For this purpose, the designated asphalt pavement surfaces in the transition areas, as shown on the project improvement plans, should be grinded to a depth of 2 inches, for at least 2 feet from the sawcut edge(s), unless otherwise specified or noted. Upon completion of grinding, exposed surfaces receiving overlay should be examined for pavement evaluation and the need for application of pavement fabric to disallow potential reflective cracking. Pavement fabric (Petromat or approved equal), if and where necessary, should then be properly placed over the exposed pavement cracks prior to resurfacing in accordance with the manufacturer's recommendations and project specifications.

   The surface of existing pavements should be prepared to the satisfaction of the geotechnical engineer or project inspector prior to the placement of the tack coat and/or pavement fabric. Asphalt placement should then be carried out to neatly construct a sooth transition.

   In the asphalt overlay areas, asphalt overlay thickness shall not be less than 1½ inches, unless otherwise noted or approved. All materials, and construction procedures should comply with the applicable codes and standards and the County of San Diego Ordinances and Standard Specifications For Public Works Construction (Green Book).

3. **PCC Pavings:** Residential PCC pavings on very low expansive subgrade soils should be a minimum 5 inches in thickness, reinforced with #3 reinforcing bars at 16 inches on centers each way placed at mid-height in the slab. In the areas where longitudinal grades exceed 15%, PCC pavings should also be provided with minimum 8 inches wide by 8 inches deep pavement anchors perpendicular to the pavement longitudinal profile excavated into the approved subgrade at each 15-foot interval maximum. Pavement anchors should be poured monolithically with the concrete paving surfaces. As a minimum, use Green Book (Standard Specifications For Public Works Construction) 520-A-2500 Concrete Class for PCC pavings (not integral with curb). Subgrade soils beneath the PCC pavings should also be moisture reconditioned and recompacted to minimum 90% compaction levels at the time of fine grading and before placing the slab reinforcement.

   Reinforcing bars should be correctly placed extending through the construction (cold) joints tying the slab panels. In construction practices where the reinforcements are discontinued or cut at the construction joints, slab panels should be tied together with minimum 18-inch long (9 inches on either side of the joint) similar size dowels, placed at the same spacing as the slab reinforcement.

   Provide "tool joint" or "softcut" contraction/control joints spaced 10 feet on center (not to exceed 15 feet maximum) each way. The larger dimension of any panel shall not exceed 125% of the smaller dimension. Tool or cut as soon as the slab will support the weight and can be operated without disturbing the final finish which is normally within 2 hours after final finish at each control joint location or 150 psi to 800 psi. Tool or softcuts should be a minimum of 1-inch in depth but should not exceed 1¼-inches deep maximum. In case of softcut joints, anti-ravel skid plates should be used and replaced with each blade to avoid spalling and ravelings. Avoid wheeled equipment across cuts for at least 24 hours.

   Joints shall intersect free edges at a 90° angle and shall extend straight for a minimum of 1½ feet from the edge. The minimum angle between any two intersecting joints shall be 80°. Align joints of adjacent panels. Also, align joints in attached curbs with joints in slab panels. Provide adequate curing using approved method (curing compound maximum coverage rate = 200 sq. ft./gal.).

4. **Permeable (Pervious) Interlocking Concrete Pavers (PICP):** Permeable (Pervious) Interlocking Concrete Pavers (PICP), if considered as a part of the project stormwater quality treatment BMPs should consist of a self-contained system disallowing saturation of adjacent foundation bearing and subgrade soils, wall backfills and site improvements. In general, PICP pavements should maintain a minimum clear distance of 5 feet from the building foundations with finish subgrade sloped away at a minimum 2% onto a 12 inches wide collector trench along the low edge provided with a 4-inch diameter (Sch. 40 or SDR 35) underdrain pipe surrounded with ¾-inch crushed rocks, as conceptually

shown in the enclosed Typical Permeable Paver Detail, Figure 21. In case of nearby fill embankments and wall backfills, a minimum 10 feet clear setback should be considered. The perforated underdrain pipe should discharge collected water into an appropriate storm drainage facility Deepened foundations, perimeter cut-off walls and curb restraints should also be provided as appropriate, and bottom and sides of the system lined with an impervious liner, as shown. More specific recommendations should be provided by the project geotechnical engineer at the plan review phase.

PICP pavement structural section should consist of 3⅛-inch, PICP over a minimum of 2 inches of ASTM No. 8 bedding course/choke stone over a minimum 8 inches of ASTM No. 57 stone base course over a minimum of 12 inches of 95% compacted subgrade (per ASTM D1557), unless otherwise noted or specified. Bedding course/choke stone and base course stone should also be well compacted, consolidated and interlocked (avoid crushing the underdrain pipes) with heavy construction equipments. ASTM No. 8, No. 9 or No. 89 should be used for joint materials depending on the joint size and per manufacturer recommendations.

Gradation requirements for ASTM No. 57, No. 8, No. 89 and No. 9 are as follows:

TABLE 12

Sieve Size	Percent Passing			
	No. 57	No. 8	No. 89	No. 9
1½"	100			
1"	95 to 100			
½"	25 to 60	100	100	
⅜"		85 to 100	90 to 100	100
No. 4	0 to 10	10 to 30	20 to 55	85 to 100
No. 8	0 to 5	0 to 10	5 to 30	10 to 40
No. 16		0 to 5	0 to 10	0 to 10
No. 50			0 to 5	0 to 5

5. **General Paving:** In the roadway improvement areas, edge of existing pavement should be neatly sawcut, as shown on the approved improvements plans, and removed prior to the preparation of adjacent subgrade soils. Pavement subgrade soils preparations and compaction should then be carried out as specified herein. There should be a minimum of 12 inches of 95% compacted subgrade underneath the pavements base coarse for all asphalt pavement sections.

Base section and subgrade preparations per structural section design, will be required for all surfaces subject to traffic including roadways, travelways, drive lanes, driveway approaches and ribbon (cross) gutters. Driveway approaches within the public right-of-way should have 12 inches subgrade compacted to a minimum of 95% compaction levels and provided with a 95% compacted Class 2 base section per the structural section design. Base layer may not be required under sidewalks in case of very low expansive (expansion index less than 20) subgrade soils, unless otherwise noted.

Base layer under curb and gutters should be compacted to a minimum 95%, while subgrade soils under curb and gutters, and base and subgrade under sidewalks should be compacted to a minimum 90% compaction levels. More specific recommendations should be given at the time of plan review phase and confirmed in the final as-graded compaction report.

Base and subgrade soils should be tested for proper moisture and specified compaction levels, and approved by the project geotechnical consultant prior to the placement of the base or asphalt/PCC/PICP finish surface.

Concrete curb and gutters with longitudinal profiles of 15% or greater should be reinforced with a minimum 2-#3 continuous bar. Concrete curbs, sidewalks, flatwork and site improvements constructed at or near the top of the descending slopes should also be provided with a thickened edge to provide a minimum of 7 feet horizontal setback from the bottom outside edge to face of slope (daylight). Use minimum 520-C-2500 Concrete Class for concrete curbs and gutters.

G. General Recommendations

1. The minimum foundation design and steel reinforcement provided herein are based on soil characteristics and are not intended to be in lieu of reinforcement necessary for structural consideration.

2. Adequate staking and grading control is a critical factor in properly completing the recommended remedial and site grading operations. Grading control and staking should be provided by the project grading contractor or surveyor/civil engineer, and is beyond the geotechnical engineering services. Staking should apply the required setbacks shown on the approved plans and conform to setback requirements established by the governing agencies and applicable codes for off-site private and public properties and property lines, utility easements, right-of-ways, nearby structures and improvements, leach fields and septic systems, and graded embankments. Inadequate staking and/or lack of grading control may result in illegal encroachments or unnecessary additional grading which will increase construction costs.

3. Open or backfilled trenches parallel with a footing shall not be below a projected plane having a downward slope of 1-unit vertical to 2 units horizontal (50%) from a line 9 inches above the bottom edge of the footing, and not closer than 18 inches from the face of such footing. The Typical Trench Adjacent to Foundation is provided in the enclosed Figure 22 and may be used as a general guideline.

4. Where pipes cross under-footings, the footings shall be specially designed. Pipe sleeves shall be provided where pipes cross through footings or footing walls, and sleeve clearances shall provide for possible footing settlement, but not less than 1-inch all around the pipe. A schematic detail entailed Pipes Through or Below Foundation is included on the Figure 22.

5. Foundations where the surface of the ground slopes more than 1 unit vertical in 10 units horizontal (10% slope) shall be level or shall be stepped so that both top and bottom of such foundations are level. Individual steps in continuous footings shall not exceed 18 inches in height and the slope of a series of such steps shall not exceed 1 unit vertical to 2 units horizontal (50%) unless otherwise specified. The steps shall be detailed on the structural drawings. The local effects due to the discontinuity of the steps shall also be considered in the design of foundations as appropriate and applicable.

6. Adequate horizontal setbacks or deepened foundations shall be required for all foundations and on-grade improvements constructed on or near the top of descending slopes to maintain the minimum required setbacks to daylight as specified.

7. Future swimming pools, if any are planned, will require special design considerations consistent of the as-graded building pad geotechnical conditions and final underlying fill total and differential thicknesses. Future swimming pools should only be considered in coordination, review and approval of the project geotechnical consultant.

8. Expansive clayey soils shall not be used for backfilling of any retaining structure. All retaining walls should be provided with a 1:1 wedge of granular, compacted backfill measured from the base of the wall footing to the finished surface and a well-constructed back drain system as shown on the enclosed Figure 16. Planting large trees behind site retaining walls should be avoided.

9. All underground utility and plumbing trenches should be mechanically compacted to a minimum of 90% of the maximum dry density of the soil unless otherwise required or specified. Care should be taken not to crush the utilities or pipes during the compaction of the soil. Trench backfill materials and compaction beneath pavements within the public right-of-way shall conform to the requirements of governing agencies.

10. Site drainage over the finished pad surfaces should flow away from structures in a positive manner. Care should be taken during the construction, improvements, and fine grading phases not to disrupt the designed drainage patterns. Roof lines of the buildings should be provided with roof gutters. Roof water should be collected and directed away from the buildings and structures to a suitable location.

11. Final plans should reflect preliminary recommendations given in this report. Final grading and foundation plans should also be reviewed by the project geotechnical consultant for conformance with the requirements of the geotechnical investigation report outlined herein. More specific recommendations may be necessary and should be given when final grading and architectural/structural drawings are available.

12. All foundation trenches should be observed by the project geotechnical consultant to ensure adequate footing embedment and confirm competent bearing soils. Foundation and slab reinforcements should also be observed and approved by the project geotechnical consultant.

13. The amount of shrinkage and related cracks that occur in the concrete slabs, flatwork and driveways depend on many factors, the most important of which is the amount of water in the concrete mix. The purpose of the slab reinforcement is to keep normal concrete shrinkage cracks closed tightly. The amount of concrete shrinkage can be minimized by reducing the amount of water in the mix. To keep shrinkage to a minimum the following should be considered:

    * Use the stiffest mix that can be handled and consolidated satisfactorily.

    * Use the largest maximum size of aggregate that is practical. For example, concrete made with ⅜-inch maximum size aggregate usually requires about 40-lbs. more (nearly 5-gal.) water per cubic yard than concrete with 1-inch aggregate.

    * Cure the concrete as long as practical.

    The amount of slab reinforcement provided for conventional slab-on-grade construction considers that good quality concrete materials, proportioning, craftsmanship, and control tests where appropriate and applicable are provided.

14. A preconstruction meeting between representatives of this office, the property owner or planner, city inspector as well as the grading contractor/builder is recommended in order to discuss grading and construction details associated with site development.

XV. GEOTECHNICAL ENGINEER OF RECORD (GER)

SMS Geotechnical Solutions, Inc. is the geotechnical engineer of record (GER) for providing a specific scope of work or professional service under a contractual agreement unless it is terminated or canceled by either the client or our firm. In the event a new geotechnical consultant or soils engineering firm is hired to provide added engineering services, professional consultations, engineering observations and compaction testing, ***SMS*** Geotechnical Solutions, Inc. will no longer be the geotechnical engineer of the record. Project transfer should be completed in accordance with the California Geotechnical Engineering Association (CGEA) Recommended Practice for Transfer of Jobs Between Consultants.

The new geotechnical consultant or soils engineering firm should review all previous geotechnical documents, conduct an independent study, and provide appropriate confirmations, revisions or design modifications to his own satisfaction. The new geotechnical consultant or soils engineering firm should also notify in writing ***SMS*** Geotechnical Solutions, Inc. and submit proper notification to the City of Vista for the assumption of responsibility in accordance with the applicable codes and standards (1997 UBC Section 3317.8).

XVI. LIMITATIONS

This report is issued with the understanding that the owner or his representative is responsible to ensure that the information and recommendations are provided to the project architect and civil/structural engineer so that they can be incorporated into the plans. Necessary steps shall be taken to ensure that the project general contractor and subcontractors carry out such recommendations during construction.

The geotechnical consultant should be provided the opportunity for a general review of the projects final grading/improvements and foundation plans in order to ensure that the recommendations provided in original and subsequent plan review reports (Enclosure) as well as this update report are properly interpreted and implemented. The project geotechnical engineer should also be provided the opportunity to field verify all site grading operations and foundation constructions. If the project geotechnical engineer is not provided the opportunity of making these reviews, he can assume no responsibility for misinterpretation of his recommendations.

This report should be considered valid for permit purposes for a period of 12 months and is subject to review by our firm following that time. In case of plan revisions including changes in the final grades, profiles, pad sizes, and actual building and improvement locations, this report should be reviewed and updated by this office for additional recommendations based on the plan changes, as appropriate.

Should any questions arise concerning this report, please do not hesitate to contact this office. Reference to our **Project No. GI-22-01-103** will help to expedite our response to your inquiries.

We appreciate this opportunity to be of service to you.

SMS **Geotechnical Solutions, Inc.**

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