LGC GEO-ENVIRONMENTAL, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING • SWPPP

December 28, 2018 Project No. G18-1691-10

Mr. Patrick Diaz
CRESTWOOD CORPORATION
510 Citrus Edge Street
Glendora, California 91740

Subject: ***Summary of Geotechnical/Geologic Feasibility Investigation, Proposed 42 Lot Residential Project, 5553 Mission Boulevard, Montclair Area, County of San Bernardino, California.***

LGC Geo-Environmental, Inc. (LGC) is pleased to submit our summary report of the in progress geotechnical/geologic investigation for the proposed 42-lot residential development project, 5553 Mission Boulevard, in the Montclair Area of the County of San Bernardino, California. This summary report presents the tentative results of our research of published geologic/geotechnical reports and/or maps, review of aerial photographs, field exploration, geologic mapping, and laboratory testing; as well as our geotechnical and geologic judgment, opinions, conclusions and preliminary recommendations pertaining to geotechnical/geologic issues and constraints associated with the geotechnical/geologic feasibility aspects of proposed residential development.

Based on the results of our field exploration, geologic mapping, laboratory testing, geologic and geotechnical engineering evaluations, along with review of published literature and aerial photographs for the site area, it is our opinion that the subject site is suitable for proposed residential development, provided the preliminary recommendations presented in this geotechnical/geologic summary the future detailed geotechnical/geologic investigation are utilized during the design, grading, and construction. LGC should review any grading plan, as well as any foundation/structural plans when they become available, and revise the recommendations presented herein, if necessary.

It has been a pleasure to be of service to you on the feasibility aspects of this project. Should you have any questions regarding the content of this report or should you require additional information, please do not hesitate to contact this office at your earliest convenience.

Respectfully submitted,

LGC Geo-Environmental, Inc.

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Certified Engineering Geologist

RS/RLG

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1.0 INTRODUCTION

1.1 Purpose and Scope of Services

The main purpose of our in progress geotechnical/geologic investigation was to evaluate the pertinent geologic and geotechnical conditions at the site and to provide opinions, conclusions and preliminary recommendations pertaining to geotechnical/geologic issues and constraints associated with the geotechnical/geologic feasibility aspects of the proposed residential development.

Our scope of services included:

- Review of available previous geotechnical/geologic reports, geologic maps, and aerial photographs pertinent to the site.
- Subsurface investigation including the excavation, sampling, and logging of four (4) borings, to depths ranging from about 16.5 feet to 26.5 feet below the existing ground surface, utilizing a hollow stem auger drill rig. The borings were excavated to evaluate the general characteristics of the subsurface geotechnical/geologic conditions on the site including classification of site soils, determination of depth to groundwater (if present), and to obtain representative soil samples.
- Geologic mapping of the site.
- Laboratory testing of representative soil samples obtained during our subsurface exploration.
- Geotechnical engineering and geologic analysis of the data with respect to the proposed residential development.
- Preparation of this summary report presenting our preliminary findings, conclusions and geotechnical recommendations for the proposed development.

1.2 Location and Site Description

The subject site is roughly rectangular in shape and is about 4.81 acres in size and is located at 5553 Mission Boulevard, in the Montclair Area of the County of San Bernardino, California. The site is bounded on the north by Mission Boulevard on the east by residential development and vacant property, on the south by residential development, and on the west by residential development and a car wash.

The topography of the site is relatively level. Drainage appears to flow to the southwest and south, with elevations ranging from approximately 931 feet above mean sea level (msl) in the northeast portion of the site to approximately 923 feet msl in the southwestern portion of the site.

The site is currently vacant with storage containers currently on site and a light growth of annual weeds and grasses as well as some trees. In the northern portion of the site pieces of concrete, piles of topsoil, and debris exist from the former nursery.

1.3 Proposed Development and Grading

Based on the referenced 40-scale conceptual site plan, provided to LGC, the proposed use at site will consist of a 42-lot residential development. No other plans have not been developed at this time, indicating grading, structures or improvements.

1.4 Previous Geotechnical Reports

To the best of our knowledge no previous geotechnical reports or plans are available for the development of the site at this time.

1.5 Aerial Photograph Review

Relevant Google Earth satellite photographs from 1994 through 2014 were reviewed. A summary table of the photos reviewed is presented in Appendix A.

1.6 Subsurface Exploration

Our subsurface exploration was performed on November 26, 2018 consisted of four (4) borings, to depths ranging from about 16.5 feet to 26.5 feet below the existing ground surface, utilizing a hollow-stem auger drill rig. Prior to the subsurface work, an underground utilities clearance was obtained from Underground Service Alert of Southern California. At the conclusion of the subsurface exploration, all the borings were backfilled with native materials with some compactive effort. Minor settlement of the backfill soils may occur over time.

During our subsurface exploration, representative relatively undisturbed and bulk samples were retained for laboratory testing. Laboratory testing was performed on representative soil samples and included in-situ density and moisture content, maximum dry density and optimum moisture content, expansion, chloride, sulfate content and consolidation.

2.0 GEOTECHNICAL CONDITIONS

2.1 Regional Geology

The subject site is located in the Peninsular Ranges Geomorphic Province in California on the central portions of a broad alluvial apron created by the coalescence of several large alluvial fans that extend southward into the Chino Basin from the flanks of the San Gabriel Mountains. The apron is composed of Quaternary alluvium and alluvial fan deposits that extend to a depth of roughly 950 feet.

The site is situated in the central portion of the Perris Block, which is a relatively stable structural block that is located between the San Jacinto Fault Zone to the east, the Elsinore Fault Zone to the west and the Cucamonga Fault Zone to the north. In general, the Perris Block consists of Quaternary to Pleistocene aged alluvium that overlies Paleozoic metamorphic bedrock and Cretaceous granitic bedrock.

In close proximity, the subject site is located approximately 4 miles northeast of the Chino Hills, approximately 6 miles south of the San Gabriel Mountains and approximately 11 miles west of the Jurupa Mountains.

2.2 Local Geology

Based on our review of the available geological and geotechnical literature and exploratory borings conducted at the site, it is our understanding that the site is primarily underlain by a thin mantle of surficial topsoil, which were generally underlain by alluvial fan deposits and older alluvial fan deposits. Undocumented artificial fill was not encountered in the exploratory borings but could still be present in local areas within the site.

Topsoil: Topsoil was encountered within all of the exploratory borings, at the surface to depths of about 0.5 foot to 1.0 feet. These materials were generally consisted of silty sand, sand, which was fine to medium grained, dark brown, dry to damp and loose to with some gravel. Some roots were also observed.

Alluvial Fan Deposits: Holocene age alluvial fan deposits were present below the undocumented artificial fill and topsoil, at depths of about 0.5 foot to 1.0 feet. These materials were alternating layers of gravelly sand, sandy gravel, sand, silty sand and sandy silt, which are generally very fine to coarse grained, various shades of gray, olive, orange and brown, dry to very moist and firm to very stiff and medium dense to dense, micaceous with some cobbles. Portions of the upper 1.5 feet to 3.0 feet of these materials are weathered and lower in density. Based on the exploration these materials are approximately 14.0 feet to 19.5 feet thick.

Older Alluvial Fan Deposits: Pleistocene age older alluvial fan deposits was present below the alluvial fan deposits, at depths of about 14.0 feet to 20.0 feet. These materials were alternating layers of silty sand, sandy silt, silty clay and clayey silt, which are generally are very fine to fine grained, various shades of olive, orange, olive and brown, damp to very moist, dense and firm to very stiff, mottled and slightly desiccated with caliche.

2.3 Landslides

Review of geologic literature does not indicate the presence of landslides on or directly adjacent to the site.

2.4 Groundwater

Groundwater was not encountered during the current subsurface investigation up to 26.5 feet below the existing surface. A review of the Chino Basin Watermaster "Depth to Groundwater Contour Map, Summer 2016", indicates groundwater in the general site area is about 300 feet to 325 feet below the existing ground surface.

2.5 Surface Water

Based on our review of the USGS topographic maps and Google Earth satellite photographs, existing drainage is roughly to the southwest and south. Surface water runoff relative to project design is the purview of the project civil engineer and should be designed to be directed away from the proposed structures.

2.6 Faulting

The subject site is not located within an Alquist-Priolo Earthquake Fault Zone and there are no known faults (active, potentially active, or inactive) onsite. The possibility of damage due to ground rupture is considered negligible since active faults are not known to cross the site.

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the southern California region, which may affect the site, include soil liquefaction and dynamic settlement. Other secondary seismic effects include shallow ground rupture, and seiches and tsunamis. In general, these secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependant on the distance between the site and causative fault and the onsite geology. The closet known active fault to the site is the San Jose Fault, which is about 3.9 mile away. Other major active faults,

within 20 miles of the subject site that could produce these secondary effects are the Chino-Central Avenue Fault, Sierra Madre Fault, Cucamonga Fault, Whittier Fault, Elysian Park Thrust Fault, San Jacinto-San Bernardino Fault, Clamshell-Sawpit and the San Andreas Fault among others. A risk assessment of these secondary effects is provided in the following sections.

2.6.1 Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose to medium dense, near surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential.

Due to the presence of historic high groundwater level in excess of 50 feet below the existing ground surface, the potential for liquefaction is considered remote at the site.

2.6.2 Shallow Ground Rupture

Ground rupture due to active faulting is not likely to occur on site due to the absence of known active fault traces. Cracking due to shaking from distant seismic events is not considered a significant hazard, although it is a possibility at any site.

2.6.3 Tsunamis and Seiches

Based on the elevation of the proposed development at the site with respect to sea level and its distance from large open bodes of water, the potential of seiche and/or tsunami is considered to be negligible.

2.7 Slope Stability

Proposed cut and fill slopes constructed at a 2:1 horizontal to vertical (h:v) should be grossly stable.

Portions of the proposed cut slopes may expose low-density topsoil as well as significant layers of relatively non-cohesive alluvial fan deposits which will likely require stabilization by overexcavation and replacement with compacted fill. During detailed geotechnical investigation and/or grading plan review stages a detailed slope stability analyses is warranted.

2.8 Settlement

Any undocumented artificial fill, topsoil, or weathered alluvial fan deposits exhibit the potential to settle or hydro-consolidate under the surcharge of the future proposed structural and fill loads.

2.9 Laboratory Testing

Laboratory testing of the onsite soils was performed on representative samples obtained from the borings and included in-situ density and moisture content, maximum dry density and optimum moisture content, expansion, sulfate content and consolidation. These results should be confirmed at the completion of site development.

Sulfate testing of representative soils indicated negligible amount of soluble sulfate ("Negligible" per ACI 318R-05 Table 4.3.1).

3.0 CONCLUSIONS

Based on the results of our in-progress preliminary geotechnical/geologic feasibility investigation, it is our opinion that the subject site is suitable for proposed residential development, provided the preliminary recommendations presented in this geotechnical/geologic feasibility evaluation and future detailed geotechnical/geologic investigations are considered and incorporated into the project design process and construction. The following is a summary of the primary geotechnical and geologic factors determined from our preliminary geotechnical/geologic evaluation.

- Based on our subsurface exploration and review of pertinent geologic maps and reports, the site is underlain by surficial topsoil Holocene age alluvial fan deposits and Pleistocene age older alluvial deposits.
- There are no known landslides impacting the site.
- Groundwater is not considered a constraint for the proposed development.
- The potential for liquefaction is considered nil.
- Active or potentially active faults are not known to exist on the site.
- Laboratory test results of the upper soils (topsoil and alluvial fan deposits) indicate a very low expansion potential and negligible potential for soluble sulfate effects on normal concrete.
- The majority of the site is underlain by up to about 2.0 feet to 4.0 feet of potentially compressible topsoil and weathered alluvial fan deposits which may be prone to potential post-grading settlement and/or hydro-consolidation, under the surcharge of future proposed structural loads and fill loads.
- From a geotechnical perspective, the existing onsite soils appear to be suitable material for use as fill, provided they are relatively free from rocks (larger than 8 inches in maximum dimension), construction debris, and organic material. It is anticipated that the onsite soils may be excavated with conventional heavy-duty construction equipment.
- It is anticipated that the onsite soils may be excavated with conventional heavy-duty construction equipment.

4.0 RECOMMENDATIONS

4.1 Site Earthwork

We anticipate that earthwork at the site will consist of site preparation and remedial grading followed by construction of slab-on-grade type foundations. All earthwork and grading should be performed in accordance with all applicable requirements of the appropriate reviewing agency and LGC's General Earthwork and Grading Specifications for Rough Grading. In case of conflict, the following recommendations shall supersede those included in as part of LGC's General Earthwork and Grading Specifications for Rough Grading.

4.1.1 Site Preparation

Prior to remedial grading of areas to receive structural fill, structures or other improvements, the areas should be cleared of surface obstructions any existing debris and stripped of any vegetation.

Vegetation and debris should be removed and properly disposed of offsite. Holes resulting from the removal of buried tree root systems, obstructions, structures or utilities, should be replaced with suitable compacted fill material. Areas to receive fill and/or other surface improvements should be scarified to a minimum depth of 6 inches, brought to a near-optimum moisture condition, and recompacted to at least 90 percent relative compaction (based on American Standard of Testing and Materials [ASTM] Test Method D1557).

4.1.2 Private Sewage System Abandonment

Any existing seepage pit and other private sewage systems, and/or other subsurface structures that may be encountered, should be located, removed and/or properly abandoned from a geotechnical standpoint. Abandonment and/or removal of septic systems that may exist should be in accordance with local codes and recommendations by LGC. Seepage pits, if abandoned in-place, should be pumped clean, backfilled with gravel or clean sand jetted into place, and then capped with a minimum of 2 feet or more of a 2-sack or greater slurry or concrete for a distance of 2 feet or more outside the edge of the seepage pit. The top of the slurry or concrete cap should be at a minimum 10 feet below proposed grade.

4.1.3 Overexcavation and Recompaction

The site is generally underlain by approximately 2.0 feet to 4.0 feet of potentially compressible soils (topsoil and weathered alluvial fan deposits which may be prone to future settlement under the surcharge of foundation and/or fill loads. These materials should be overexcavated to competent alluvial fan deposits or older alluvium and replaced with compacted fill soils. Within the level portions of the lots overexcavations should extend at least 4.0 feet below proposed pad grade or 2.0 feet below the lowest proposed footings for structures or walls, whichever is deeper. Overexcavation within roadway area can be limited to approximately 1.0 foot to 2.0 feet. However, localized, deeper overexcavation should be anticipated where deemed necessary by the geotechnical consultant based on observations during grading.

4.1.4 Cut and Shallow Fill Lots

All cut and shallow fill lots should be capped with a minimum of 4.0 feet of engineered structural fill, so that all footings are founded into engineered fill with a minimum of 2.0 feet of fill below the footings. Overexcavation should extend to the entire level portions of the lot.

4.1.5 Cut/Fill Transition and Fill Differentials

To mitigate distress to structures related to the potential adverse effects of excessive differential settlement, cut/fill transitions should be eliminated from all lots. The entire structure should be founded on a uniform bearing material. This should be accomplished by overexcavating the "cut" portions of the entire level portion of the lot and replacing the excavated materials as properly compacted fill. Recommended depths of overexcavation are provided in the following table:

DEPTH OF FILL ("fill" portion)	*DEPTH OF OVEREXCAVATION ("cut" portion)*
Up to 12 feet	4 feet
Greater than 12 feet	One-third the maximum thickness of fill placed on the "fill" portion (15 feet maximum)

4.1.6 *Import Soils for Grading*

In the event import soils are needed to achieve final design grades, all potential import materials should be free of deleterious/oversize materials, very low in expansion, and approved by the project geotechnical consultant prior to commencement of delivery onsite.

4.1.7 *Fill Placement and Compaction*

The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts generally not exceeding 8 inches in compacted thickness, brought to at least optimum-moisture content, and compacted to at least 90 percent relative compaction (based on ASTM Test Method D1557). Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of the geotechnical consultant. In general, oversized material shall not be placed within any fills during grading.

4.1.8 *Benching*

Where compacted fills are to be placed on natural slope surfaces inclining at 5:1 (h:v) or greater, the ground should be excavated to create a series of level benches, which are a minimum height of 4 feet, excavated into competent materials

4.2 *Foundations*

4.2.1 *General*

Given that the expansion index of the onsite soils is less than 20, as well as the recommended overexcavation and the anticipated settlement, conventional foundations may be considered and recommendations to mitigate the effects of expansive soils or excessive settlement should not be required. Preliminary recommendations for foundation design and construction will be presented at a later date upon completion of the geotechnical/geologic investigation. When the final structural loads for the proposed structures are known they should be provided to our office, in order to determine actual geotechnical foundation design parameters. All footing excavations should be cut square and level, and should be free of sloughed materials. Footing excavation soils should be at least at optimum moisture content prior to pouring concrete.

4.3 *Structural Setbacks*

Structural setbacks, in addition to those required per the current CBC, are not required due to geologic or geotechnical conditions within the site.

4.4 *Corrosivity to Concrete*

In general, soil environments that are detrimental to concrete have high concentrations of soluble sulfates. ACI 318R-05 Table 4.3.1 provides specific guidelines for the concrete mix design based on different amount of soluble sulfate content.

Based on testing performed during this investigation within the project site, the onsite soils are classified

as having a negligible sulfate exposure condition in accordance with ACI 318R-05 Table 4.3.1.

4.5 Future Plan Reviews, Construction Observation and Testing

Future plan reviews are necessary to ensure that recommendations and conclusions from LGC's preliminary studies have been incorporated into the plans. Modifications to the plan or additional subsurface exploration/laboratory testing may be required based upon our review; therefore our review should be performed as soon as practical. Such reviews should include, but are not limited to:

- Rough Grading Plans
- Precise Grading Plans
- Foundation Plans
- Utility Plans

Plans should be forwarded to the project geotechnical engineer and/or engineering geologist for LGC for review and comments, as deemed necessary.

The preliminary conclusions and recommendations provided in this summary report are based on subsurface explorations, laboratory testing and geotechnical/geologic analyses to date. A representative of LGC should observe the interpolated subsurface conditions in the field during construction.

Construction observation and testing should also be performed by the geotechnical consultant during future grading, foundation excavations, backfill of utility trenches, or when an unusual soil condition is encountered at the site. Future grading plans, foundation plans, and final project drawings should be reviewed by this office prior to construction.

5.0 LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report. The samples taken and submitted for laboratory testing, the observations made and the in-situ field testing performed are believed representative of the entire project; however, soil and geologic conditions revealed by excavation may be different than our preliminary findings. If this occurs, the changed conditions must be evaluated by the project geotechnical engineer and engineering geologist and design(s) adjusted as required or alternate design(s) recommended.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and/or project engineer and incorporated into the plans, and the necessary steps are taken to see that the contractor and/or subcontractor properly implements the recommendations in the field. The contractor and/or subcontractor should notify the owner if they consider any of the recommendations presented herein to be unsafe.

The findings of this report may be modified upon completion of the detailed preliminary geotechnical/geologic investigation. However, changes in the conditions of a property can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties.

In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the

broadening of knowledge. Accordingly, the findings of this summary report may be invalidated wholly or partially by changes outside our control.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience.

APPENDIX A

References

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Aerial Photographs Reviewed

SOURCE	*FLIGHT*	*FRAME(S)*	*FLIGHT DATE*	*SCALE*
Google Earth	N/A	N/A	5/31/94	N/A
Google Earth	N/A	N/A	6/4/02	N/A
Google Earth	N/A	N/A	11/30/03	N/A
Google Earth	N/A	N/A	3/6/04	N/A
Google Earth	N/A	N/A	12/31/05	N/A
Google Earth	N/A	N/A	6/17/07	N/A
Google Earth	N/A	N/A	11/14/09	N/A
Google Earth	N/A	N/A	3/7/11	N/A
Google Earth	N/A	N/A	3/15/13	N/A
Google Earth	N/A	N/A	4/23/14	N/A