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Project No. 15142-01

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Placeworks

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Subject: *Geotechnical Summary Regarding the City of Hope Specific Plan, Located in the Cities of Duarte and Irwindale, California*

Introduction

In accordance with your request, LGC Geotechnical, Inc. has prepared this geotechnical summary report regarding the City of Hope Specific Plan located in the Cities of Duarte and Irwindale, California. It is our understanding that an updated specific plan is being prepared in order to provide direction of future development over a 20-year period within the limits of the City of Hope National Medical Center (City of Hope). This report presents our summary of previous geotechnical reports, conclusions, and recommendations regarding geotechnical issues that may need to be addressed during future site development.

The subject site is an approximately 116-acre polygonal shaped area located in the southeastern corner of the City of Duarte and overlaps slightly into the City of Irwindale (Figures 1 & 2). In general, the subject site is bounded to the north by East Duarte Road, to the west by Cinco Robles Drive and Buena Vista Street, and to the east by the Santa Fe Spreading Grounds associated with San Gabriel River flood control. The majority of the subject site is occupied by various medical complexes, parking areas, and other associated improvements. Some undeveloped vacant parcels still remain and are generally located in the southwest portion of the subject site. The site is relatively flat with elevations ranging from approximately 435 feet above mean sea level (msl) in the southern portion of the site to approximately 482 feet above msl in the northeastern portion of the site.

The purpose of our study was to form an opinion on the likely geotechnical conditions and provide preliminary geotechnical conclusions and recommendations relative to the feasibility of future development within the subject site. **No subsurface geotechnical exploration and/or laboratory testing was performed in preparation of this report.** Our services consisted of a review of the four provided geotechnical reports and readily available geotechnical information and published maps. A reference map (Figure 2) has been provided in order to depict the locations of the previous geotechnical reports summarized herein.

Regional Geology

Regionally the San Bernardino Quadrangle is diagonally bisected by the San Andreas Fault zone, separating the San Gabriel and San Bernardino Mountains, which are major elements of the Traverse

Ranges Province (USGS, 2003). The subject site is located in the northern most portion of the Peninsular Ranges Province which is included in the southern portion of the San Bernardino quadrangle. The San Bernardino Basin and area south of the Sierra Madre Fault are underlain by surficial alluvial deposits and San Gabriel Mountains basement bedrock at depth. Alluvial sediments at and around the subject site are associated with sediment deposition from stream channels and alluvial fan outwash from major canyons. In addition, artificial fill associated with flood control construction for the San Gabriel River are present near the subject site.

Groundwater

Historic high groundwater is on the order of approximately 150 feet below existing grades (CDMG, 1998) and was not encountered during subsurface exploration associated with the summarized geotechnical reports below.

Summary and Findings of Mactec, 2005a

Mactec performed a geotechnical evaluation in 2005 for the proposed Transfusion Medicine Center located within the City of Hope National Medical Center. Two borings excavated to depths of approximately 50 feet below existing grade performed by Law/Crandall (LCA) in 1994 and four test pits excavated to depths of approximately 15 feet below existing ground by Hardin Lawson, Inc. (HLA) in 1993 were utilized in their evaluation. Based on their field evaluation and laboratory test results the following major conclusions and recommendations were made by Mactec:

- The site is underlain by native alluvial soils consisting primarily of well graded sand, sandy gravel and gravelly sand. Localized areas of non-engineered artificial fill soils up to approximately 1 to 4.5 feet thick were encountered in one test pit and one boring, respectively. The fill soils generally consisted of dark gray and brown silty sand and were not uniformly well compacted. Larger cobbles and boulders were also encountered during the previous subsurface investigations.
- Groundwater was not encountered to the maximum explored depth of approximately 50 feet below existing ground surface.
- Due to the absence of groundwater, site soils are not considered susceptible to liquefaction potential and liquefaction-induced settlement.
- It was recommended that any existing artificial fill soils be removed to expose natural soils. The exposed soils should be scarified a minimum of 6 inches, brought to near optimum moisture content and compacted to a minimum 95 percent relative compaction.
- Any fill soils with less than 5 percent fines content was to be compacted to a minimum 95 percent relative compaction. Fill soils with greater than 5 percent fines content were to be compacted to a minimum 90 percent relative compaction.
- Laboratory testing indicated an expansion index value of 3 (“Very Low” expansion potential).
- Preliminary testing indicated an R-Value of 40. Preliminary asphalt concrete pavement section was estimated at 3 inches of asphalt concrete over 5 inches of aggregate base for a Traffic Index of 5 or less. For a Traffic Index of 6, preliminary asphalt concrete pavement section was estimated at 4 inches of asphalt concrete over 5 inches of aggregate base.

Summary and Findings of Mactec, 2005b

Mactec performed a geotechnical evaluation in 2005 for the proposed Cancer Immunotherapeutics and Tumor Immunology (CITI) building located within the City of Hope National Medical Center. Building 105, the Helford Building, and a small parking lot previously occupied the site and were to be demolished as part of the construction of the CITI building. Three large diameter borings were excavated to depths ranging from approximately 14 to 15 feet below existing grade. Based on their field evaluation and laboratory test results the following major conclusions and recommendations were made by Mactec:

- The site is underlain by dense native alluvial soils consisting primarily of well graded sand with gravel, cobbles, and boulders. Artificial fill soils approximately 2 feet thick were encountered in the three excavated borings and were most likely placed during previous construction operations. The fill soils generally consisted of well graded sand with silt. In general, the excavated borings experienced significant caving during excavation.
- Samples of the artificial fill and native soils were collected and tested for maximum dry densities and moisture content. Laboratory testing indicated maximum dry densities and optimum moistures of 127.4 at 8.7 percent and 126.0 at 8.1 percent for the existing onsite fill and native soils, respectively.
- Groundwater was not encountered to the maximum explored depth of approximately 15 feet below existing ground surface.
- Due to the absence of groundwater and dense nature of the soils, the potential for liquefaction at the site is considered very low.
- Settlement for the proposed CITI building was estimated to be approximately 3/4-inch and differential settlement was estimated to be 1/4-inch or less across the CITI building.
- It was recommended that any existing artificial fill soils be removed to expose natural soils. The exposed soils should be scarified a minimum of 6 inches, brought to near optimum moisture content and compacted to a minimum 95 percent relative compaction. In addition, any fill soils were to be compacted to a minimum 95 percent relative compaction at near optimum moisture (no more that 2 percent above or below optimum moisture).
- Shoring was recommended in areas where there was not sufficient space for sloped embankments. Difficulty during drilling of recommended soldier piles should be anticipated due to cohesionless soil conditions and the presence of large cobbles and boulders.

Summary and Findings of RTF&A, 2008

R.T. Franklin & Associates Geotechnical Engineering and Engineering Geology (RFT&A) performed a geotechnical foundation investigation for the proposed Gonda building expansion located on Center Drive across from Helford Hospital. The expansion included the construction of a new 4-story, free standing building with a bridge to connect the new building to the current Gonda building. In addition to reviewing nearby previous investigations, RTF&A excavated five backhoe test pits to depths ranging from approximately 5.5 feet to 8 feet below existing grade. Based on their field evaluation and laboratory test results the following major conclusions and recommendations were made by RFT&A:

- The site is underlain by alluvial deposits consisting primarily of tan to light gray, slightly moist sand and gravel. The alluvial deposits encountered were dense with abundant cobbles and some boulders. The approximately 3/4-foot to 2.5 feet of material below existing grades was comprised of old artificial fill and/or topsoil. These materials consisted primarily of light gray to dark brown, loose to dense silty sand with minor to abundant rootlets.

- Groundwater was not encountered to the maximum explored depth below existing ground surface. The historic high groundwater depth is approximately 150 feet below existing grades.
- The subject site is not located in a liquefaction zone as indicated by the State of California Seismic Hazard Zone for the Azusa Quadrangle. Due to the absence of shallow groundwater and dense nature of the existing site soils, the potential for liquefaction at the site is considered very low.
- Significant grading was not planned for the site development, however, vegetation and deleterious debris was recommended to be removed. In addition, areas to receive fill should be removed to competent natural materials and replaced with engineered fill. Removal depths were estimated to extend approximately 1 to 1.5 feet below existing grades. Removal bottoms were to be scarified a minimum of 6 inches and moisture conditioned before the placement of engineered fill.
- Oversize material (greater than 12 inches in diameter) encountered during construction should be disposed of offsite or placed in deep fill areas greater than 4 feet below finish grades. Specialized equipment may be needed in order to properly screen fill for oversized material.
- The site is not located in a State of California Alquist-Priolo Earthquake Fault Zone and no known active or potentially active fault directly underlie the site. The nearest active fault is the Sierra Madre Fault Zone located approximately 1.5 to 2 miles north of the subject site.
- Settlement estimates were anticipated to be less than 1-inch and differential settlements were estimated to be less than ¾-inch over 30 horizontal feet.
- Two samples representative of the onsite materials were collected and tested for maximum dry densities and optimum moisture content. Laboratory testing indicated maximum dry densities and optimum moistures of 114.0 at 13.0 percent and 127.0 at 9.0 percent.
- Laboratory testing indicates an expansion index value of 0 and 35 (“Very Low” and “Low” expansion potential).
- Corrosion testing was performed by Schiff Associates Consulting Corrosion Engineers. Test results indicated minimum resistivity values of 3,160 ohm-cm and 16,000 ohm-cm. Sulfate testing indicated soluble sulfate contents of 197 parts per million (ppm) and 16 ppm. Chloride content testing indicated chloride contents of 47 ppm and 1.5 ppm, and pH values of 6.7 and 7.1. The soil corrosion report stated that the site soils were classified as moderately corrosive to buried metal and aggressive to copper.
- Based on an assumed R-Value of 60, preliminary asphalt concrete pavement section was estimated at 3 inches of asphalt concrete over 4 inches of aggregate base for a Traffic Index of 4, 4 inches of asphalt concrete over 4 inches of aggregate base for a Traffic Index of 6, and 5 inches of asphalt concrete over 4 inches of aggregate base for a Traffic Index of 8.

Summary and Findings of RTF&A, 2009

R.T. Franklin & Associates Geotechnical Engineering and Engineering Geology (RFT&A) performed a geotechnical foundation investigation for the proposed first floor improvements to 2240 Buena Vista Street. In addition to reviewing previous nearby investigations, RTF&A excavated five backhoe test pits to depths ranging from approximately 2.5 to 3 feet below existing grade around the existing building. Based on their field evaluation and laboratory test results the following major conclusions and recommendations were made by RFT&A:

- The site is underlain by alluvial deposits consisting primarily of moist, light brown to brown silty sand and sand. The alluvial deposits encountered were dense with abundant cobbles and some boulders. Approximately 1.5 to 2 feet of artificial fill materials overlie the native alluvial soils. These materials consisted primarily of tan to brown silty sand.
- Groundwater was not encountered to the maximum explored depth of approximately 3 feet below existing ground surface. The historic high groundwater depth is approximately 150 feet below existing grades.

- The subject site is not located in a liquefaction zone as indicated by the State of California Seismic Hazard Zone for the Azusa Quadrangle. Due to the absence of shallow groundwater and dense nature of the existing site soils, the potential for liquefaction at the site is considered very low.
- Significant grading was not planned for the site development, however, vegetation and deleterious debris was recommended to be removed. In addition, areas to receive fill should be removed to competent natural materials and replaced with engineered fill. Removal depths were estimated to extend approximately 0 to 2 feet below existing grades. Removal bottoms were to be scarified a minimum of 6 inches and moisture conditioned before the placement of engineered fill.
- Oversize material (greater than 12 inches in diameter) encountered during construction should be disposed of offsite or may be incorporated into fills if not located in structural areas. Specialized equipment may be needed in order to properly screen fill for oversized material.
- The site is not located in a State of California Alquist-Priolo Earthquake Fault Zone, therefore, the potential for surface fault rupture is considered very low.
- Settlement estimates were anticipated to be less than one inch and differential settlements were estimated to be less than ¾-inch over 30 horizontal feet.
- Corrosion testing was performed by Schiff Associates Consulting Corrosion Engineers. Test results indicated a minimum resistivity value of 5,200 ohm-cm, a soluble sulfate content of 37 parts per million (ppm), a chloride content of 3.7 ppm, and a pH value of 7.8.
- Preliminary testing indicated an R-Value of 71 for the onsite soils and preliminary pavement section designs were based on an R-Value of 60. Asphalt pavement sections and Portland Cement Concrete (PCC) pavement thicknesses were provided for Traffic Indices ranging from 4 to 9.5.

Geotechnical Comments Regarding Future Development

It is anticipated that subsurface geotechnical conditions within the limits of the City of Hope Specific Plan will be similar to those summarized in the geotechnical reports above. However, site specific geotechnical evaluations are anticipated to be necessary on a site by site basis during the planning of future improvements. The onsite geotechnical conditions that should be addressed during site specific evaluations are provided below. Additional geotechnical conditions, not mentioned below, may need to be addressed in the future, depending on the proposed improvements.

- Assessment of the subsurface soil conditions should be addressed in the site specific geotechnical evaluation in order to determine site specific geotechnical recommendations. In general, assessment of site soil conditions is to be accomplished by subsurface field evaluations and laboratory testing of collected samples.
- The site is not located within a mapped zone for liquefaction potential (CGS, 2014). The potential for liquefaction and dry sand seismic settlement should be evaluated with regards to future site development.
- The site is not located in a State of California Alquist-Priolo Earthquake Fault Zone (CGS, 2014) and no known active or potentially active fault directly underlie the site. However, there is the potential for significant ground shaking during a strong seismic event. New improvements will need to be designed for seismic forces in accordance with current building codes and regulations.
- Removal depths shall be determined for unsuitable and/or potentially compressible near surface soils. These materials include, but are not limited to, undocumented fill, topsoil, and colluvium.
- Oversized materials (greater than 12 inches in maximum dimension) were encountered during the previous subsurface investigations. The amount of oversized materials is anticipated to be variable across

the site. Therefore, recommendations for proper handling of oversized materials should be addressed during a site specific geotechnical evaluation.

- If intentional infiltration of storm water is required, onsite field infiltration testing shall be performed in order to determine a design infiltration rate.

Recommendation

Based upon the results of our limited document review (see References), it is our opinion that redevelopment of portions of the subject site appears generally feasible from a geotechnical standpoint. Current geotechnical conditions should be evaluated and addressed on a site by site basis during the planning of future improvements.

Closure

Our proposed services were performed to the general standard of care of geotechnical consulting in Southern California; no other warranty is expressed or implied.

Should you have any questions regarding this letter-report, please do not hesitate to contact our office. We appreciate this opportunity to be of service.

Sincerely,

LGC Geotechnical, Inc.

Dennis Boratyne, GE 2770
Vice President



Kevin Dyekman, CEG 2595
Project Geologist



KAD/DJB/aca

Attachments: Figure 1 – Site Location Map
Figure 2 – Geotechnical Report Index Map
References

Distribution: (2) Addressee

References

- California Department of Transportation (Caltrans), 2012, Corrosion Guidelines, Version 2.0, dated November 2012.
- California Department of Conservation, Division of Mines and Geology (CDMG), 1998, Seismic Hazard Evaluation of the Azusa 7.5-Minute Quadrangle, Los Angeles County, California, Open File Report 98-12, dated 1998.
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- California Geologic Survey, 2014, Earthquake Zones of Required Investigation, Asuza 7.5-Minute Quadrangle, release November 6, 2014.
- Dibblee, Thomas Jr., 1998, Geologic Map of the Mount Wilson and Asuza Quadrangles, Los Angeles County, California, Dibblee Geology Center Map #DF-67, Published 1998.
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- _____, 2015b, Report of Geotechnical Investigation, Proposed Cancer Immunotherapeutics and Tumor Immunology (CITI) Building, City of Hope National Medical Center, 1500 Duarte Road, Duarte, California, Project 4953-05-3351, dated December 28, 2005.
- R.T. Franklin & Associates Geotechnical Engineering and Engineering Geology, 2008, Geotechnical Foundation Investigation, Proposed Gonda Building Expansion, Center Drive, Across from Helford Hospital, Duarte, California, Job No. 2008-201-01, dated September 25, 2008.
- _____, 2009, Geotechnical Foundation Recommendations, Buena Vista First Floor Tenant Improvements, 2240 Buena Vista Street, Irwindale, California 91010, Job No. 2008-203-60, dated March 9, 2009.
- United States Geological Survey (USGS), 2003, Preliminary Geologic Map of the San Bernardino 30' by 60' Quadrangle, California, Version 1.0, compiled by Douglas M. Morton and Fred K. Miller, dated 2003.