Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

PRELIMINARY GEOTECHNICAL EVALUATION
COLTON REGIONAL SOCCER COMPLEX AND
GUYAUX LANDFILL REDEVELOPMENT
COLTON, CALIFORNIA

PREPARED FOR:
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May 18, 2016
Project No. 209667002

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Mr. Phil Martin
Phil Martin & Associates
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Subject: Preliminary Geotechnical Evaluation
Colton Regional Soccer Complex and
Guyaux Landfill Redevelopment
Colton, California

Dear Mr. Martin:

In accordance with your request and authorization, Ninyo & Moore has performed a preliminary geotechnical evaluation for the Colton Regional Soccer Complex and Guyaux Landfill Redevelopment project in Colton, California. This report presents our findings and conclusions regarding the site geologic conditions and the impacts associated with potential geologic and seismic hazards at the subject site.

We appreciate the opportunity to provide geotechnical consulting services for this project.

Sincerely,
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1. INTRODUCTION

In accordance with your request and authorization, we have performed a preliminary geotechnical evaluation for the Colton Regional Soccer Complex and Guyaux Landfill Redevelopment project located in Colton, California (Figure 1). This evaluation addresses the site geologic conditions and the impacts associated with potential geologic and seismic hazards for inclusion in the environmental planning documents for the project. Our geotechnical evaluation was based on review of readily available geologic and seismic data, published geotechnical literature pertinent to the project site, and a site reconnaissance.

The purpose of this evaluation was to assess the geologic conditions at the site and develop preliminary conclusions regarding potential geologic and seismic impacts associated with the project in accordance with the California Environmental Quality Act (CEQA). Where appropriate, recommendations to mitigate potential geologic hazards, as noted in this report, have been provided.

2. SCOPE OF SERVICES

Our scope of services performed for this evaluation included the following:

- Review of readily available topographic and geologic maps, published geotechnical literature, geologic and seismic data, soil data, groundwater data, aerial photographs, previous reports provided by the client, and in-house information.
- Geotechnical site reconnaissance by a representative from Ninyo & Moore conducted on April 26, 2016, to observe and document the existing surface conditions at the project site.
- Compilation and analysis of geotechnical data pertaining to the site.
- Assessment of the general geologic conditions and seismic hazards affecting the area and evaluation of their potential impacts on the project.
- Preparation of this report presenting the results of our study, as well as our conclusions regarding the project's geologic and seismic impacts, and recommendations to address the impacts to be included in the environmental planning documents.

3. PROJECT DESCRIPTION

The City of Colton (City) is proposing to construct a regional soccer complex and community park in an approximately 29-acre undeveloped area in South Colton (Figure 1). The City intends to develop the site to meet the community's demand for soccer fields, community park amenities, and a site to host regional tournaments that will benefit community sports groups and promote economic development. The City also intends to use the site to provide active facilities and programs to help keep residents fit and healthy and to restore and develop natural education areas for preservation of sensitive environments. Proposed improvements include synthetic turf regulation size soccer fields and natural turf youth soccer fields to accommodate soccer leagues and tournaments for age groups U5 through U18. The community park portion of the project will also include approximately 370 parking stalls, rest room facilities, a concession building, a children's play area, a dog park, multipurpose trails, donor recognition areas, field and parking lot lighting, security fencing, and an entertainment area for community festivals and events. The conceptual design for the proposed soccer complex and community park proposes three tiers of elevation in the site design with retaining walls between each level for donor recognition and spectator seating.

4. SITE DESCRIPTION AND OBSERVATIONS

The proposed new park and soccer complex is located in a mixed residential and industrial area in the City of Colton and will be accessible from East Congress, South Florez, and South Fernando Streets (Figure 2). The proposed park will generally be bounded by single-family residences to the north, vacant land and an industrial property to the west, and vacant land and the Santa Ana River to the south and to the east. An approximately 4- to 6-acre portion of the proposed park property located at the southern terminus of South Florez and South Fernando Streets contains an unlined waste disposal site referred to as the Guyaux Landfill (Figure 2). The landfill has historically been used for waste disposal of construction debris, such as used bricks, concrete, iron waste (slag), plaster molds, rubber, steel, wood, and other deleterious materials.

On April 26, 2016, a representative of Ninyo & Moore conducted a geologic reconnaissance of the site. The site, including the landfill, is sparsely vegetated with grass, brush, and a few trees. The site is irregularly shaped and slopes gently from north to south with an abrupt elevation difference at the landfill boundary and at a relatively small triangular portion of land on the northern boundary of the site that extends east from Pine Street approximately 550 feet and south from East Congress Street approximately 600 feet. The northeast corner of the site near the Santa Ana River is at an elevation of approximately 940 feet above mean sea level (MSL) and the southwest corner of the site is at an elevation of approximately 915 feet above MSL (PIC, 2016). The landfill portion of the site is a relatively flat and roughly circular-shaped plateau extending from the southern terminus of South Florez and South Fernando Streets. Recent preliminary survey data provided by PBLA Engineering indicates that the top of the landfill is at an elevation of approximately 929 to 933 feet above MSL (PBLA Engineering, 2016). The slope face of the landfill is approximately 10 to 12 feet high in relation to the adjacent undeveloped property to the south and the east. However, the high elevation on the landfill is approximately 15 feet higher than the adjacent natural ground. The elevated triangular-shaped piece of land on the north side of the site is also approximately 10 to 15 feet above the adjacent undeveloped property to the south and the east.

Overhead utility lines transect the undeveloped property in a generally east to west direction near the base of the landfill, and continue northeast across the site. Unpaved roads and natural drainage channels meander through the undeveloped property and generally bound the south and east sides of the landfill. An accessible monitoring well was observed at the base of the landfill on the south and locked or abandoned monitoring wells were observed at various locations across the site.

Solid waste and debris, including concrete, brick, wood, and iron slag were visible on the landfill surface and along the face of the southern and eastern descending slopes of the landfill. The surface and slope faces of the landfill were characterized by erosional gullies and numerous rodent burrows. At the time of our site visit, two new homes were in construction just north of, or on the northern boundary of, the landfill site. Large piles of concrete and brick debris up to approximately 7 feet high were observed on the site behind the new residential homes.

5. GEOLOGIC CONDITIONS

5.1. Regional Geology

The project area is located within the Peninsular Ranges Geomorphic Province of southern California. This geomorphic province encompasses an area that extends approximately 125 miles from the Transverse Ranges and the Los Angeles Basin south to the Mexican border, and beyond another approximately 775 miles to the tip of Baja California. The Peninsular

Ranges province varies in width from approximately 30 to 100 miles and is characterized by northwest-trending mountain range blocks separated by similarly trending northwest-trending faults (Norris and Webb, 1990).

The predominant rock type that underlies the Peninsular Ranges province is a Cretaceous-age igneous rock (granitic rock) referred to as the Southern California batholith. Older Jurassic-age metavolcanic and metasedimentary rocks and older Paleozoic limestone, altered schist, and gneiss are present within the province. Cretaceous-age marine sedimentary rocks and younger Tertiary-age rocks comprised of volcanic, marine, and non-marine sediments overlie the older rocks (Norris and Webb, 1990). More recent Quaternary sediments, primarily of alluvial origin, comprise the low-lying valley and drainage areas within the region, including the area where the site is located.

Active northwest-trending fault zones in the Peninsular Ranges province include the San Jacinto fault zone, Elsinore fault zone (Whittier fault), and Newport-Inglewood fault zone. The northern boundary of the Province is formed by the Transverse Ranges Southern Boundary fault system. The active San Andreas fault zone is located northeast of the province within the adjacent Colorado Desert Geomorphic Province. The predominant major tectonic activity associated with these and other faults within this regional tectonic framework is right-lateral, strike-slip movement (Norris and Webb, 1990).

5.2. Site Geology

The site is located within a flood plain of an active wash area north and west of the Santa Ana River (San Bernardino County, 2010b). Regional geologic mapping indicates that the near-surface earth materials underlying the project area consist primarily of late-Holocene unconsolidated deposits of sand, gravel, and boulders (Morton and Miller, 2006). A regional geologic map of the site vicinity is shown on Figure 3. Surface soils observed at the site during our reconnaissance generally consisted of silt, sand, and gravel. Uncompacted and undocumented fill materials were observed at the landfill portion of the site with intermixed cobble- and boulder-sized pieces of debris. The undocumented fill may also contain lead impacted soil (EEC, 2010). Based on review of the site topography, historic aerial photographs, and our site reconnaissance, the landfill materials are anticipated to be on the order of 15 feet thick.

5.3. Groundwater

This site is located in the Upper Santa Ana Valley Groundwater Basin near the boundary of the Rialto-Colton, Bunker Hill, and San Timoteo Groundwater Subbasins of the Upper Santa Ana River Hydrologic Area. Groundwater monitoring well data from the State of California Department of Water Resources Water Data Library (2016) was reviewed for wells in the vicinity of the project site. The data from monitoring wells located in the vicinity of the proposed future soccer complex, indicate historic depths to groundwater as shallow as approximately 13 feet below the ground surface.

According to an Expanded Site Inspection document by Bechtel, a 1989 hydrogeological study conducted by the Santa Ana Watershed Project Authority in the site vicinity indicated a perched groundwater table from approximately 40 to 80 feet below the ground surface (Bechtel, 1996). Additionally, a Work Plan for Remediation of Lead Impacted Soils prepared by Environmental Engineering and Contracting, Inc. (EEC, 2010), indicates that four groundwater monitoring wells were installed in the vicinity of the site in 2009. The depth to groundwater in these wells ranged from approximately 85 to 94 feet below the ground surface. During Ninyo & Moore's site reconnaissance conducted on April 26, 2016, the depth to groundwater measured in a well located at the base of the southern limits of the landfill was approximately 92½ feet below the ground surface.

It should be noted that fluctuations in the level of groundwater at the site may occur due to variations in ground surface topography, subsurface stratification, rainfall, irrigation practices, and other factors which may not have been evident at the time of our evaluation.

6. FAULTING AND SEISMICITY

The project site is located in a seismically active area, as is the majority of southern California, and the potential for strong ground motion at the site is considered significant. Table 1 lists selected principal known active faults within approximately 40 miles of the project area and the maximum moment magnitude (M_{max}) as published by the United States Geological Survey

(USGS, 2008) in general accordance with the Uniform California Earthquake Rupture Forecast, version 3 (UCERF) (Field, et al., 2013).

Figure 4 shows the approximate site location relative to the principal faults in the region. The active San Jacinto fault is located approximately 2.1 miles northeast of the approximate center of the Guyaux landfill area. Blind thrust faults are low-angle faults at depths that do not break the surface and are, therefore, not shown on Figure 4. Although blind thrust faults do not have a surface trace, they can be capable of generating damaging earthquakes and are included in Table 1.

Table 1 – Principal Regional Active Faults

Fault	Approximate Fault-to-Site Distance miles (kilometers) [1]	Maximum Moment Magnitude (M_{max}) [1]
San Jacinto	2.1 (3.3)	7.9
San Andreas	8.6 (13.9)	8.1
Cucamonga	11.2 (18.0)	6.7
Cleghorn	15.5 (24.9)	6.8
North Frontal (West)	18.5 (29.8)	7.2
Chino	21.0 (33.6)	6.8
Elsinore	21.0 (33.8)	7.9
San Jose	21.6 (34.7)	6.7
Whittier	21.8 (35.1)	7.0
Sierra Madre	24.5 (39.5)	7.3
Clamshell-Sawpit	32.7 (52.7)	6.7
Puente Hills Blind Thrust	33.1 (53.3)	6.9
Helendale-South Lockhart	34.3 (55.2)	7.4
Pinto Mountain	34.5 (55.5)	7.3
North Frontal East	35.7 (57.5)	7.0
San Joaquin Hills	36.7 (59.1)	7.1
Raymond	39.1 (62.9)	6.8

Notes:
[1] United States Geological Survey (USGS), 2008.

7. METHODOLOGY FOR GEOLOGIC IMPACT AND HAZARD ANALYSES

As outlined by the CEQA, the proposed project has been evaluated with respect to potential geologic and seismic impacts associated with the project. Evaluation of impacts due to potential geologic and seismic hazards is based on our review of readily available published geotechnical literature and geologic and seismic data pertinent to the proposed project, and site reconnaissance. The references and data reviewed include, but are not limited to, the following:

- Geologic maps and fault maps from the California Geological Survey (CGS) and United States Geological Survey (USGS).
- Topographic maps from the USGS.
- State of California Earthquake Fault Zone Maps.
- County of San Bernardino Hazard and Geologic Hazard Overlay Maps.
- Aerial photographs.
- Seismic data from the CGS and USGS.
- Geotechnical publications by the CGS and USGS.

8. THRESHOLDS OF SIGNIFICANCE

According to Appendix G of the CEQA guidelines (California Natural Resources Agency [CNRA], 2016a and 2016b), a project is considered to have a geologic impact if its implementation would result in or expose people/structures to potential substantial adverse effects, including the risk of loss, injury, or death involving hazards involving one or more of the geologic conditions presented in Table 2. Table 2 also presents the impact potential as defined by CEQA associated with each of the geologic conditions discussed in the following sections.

Table 2 – Summary of Potential Geologic Impacts/Hazards

Geologic Condition	Impact Potential[1]			
	Potentially Significant Impact	Less than Significant with Mitigation Incorporation	Less than Significant Impact	No Impact
Earthquake Fault Rupture			x	
Strong Seismic Ground Shaking		x		
Seismically Related Ground Failure, Including Liquefaction and Dynamic Compaction		x		
Landslides				x
Substantial Soil Erosion		x		
Subsidence			x	
Compressible/Collapsible Soils		x		
Expansive Soils		x		
Groundwater and Excavations		x		

Note:
[1]Reference: CNRA, 2016b

9. CONCLUSIONS AND RECOMMENDATIONS FOR POTENTIAL GEOLOGIC AND SEISMIC IMPACTS/HAZARDS

Based on our review of geologic and seismic background information, implementation of the proposed project is not anticipated to have a significant impact on the geologic environment. However, development of the proposed project improvements may be subjected to potential impacts from geologic and seismic hazards. Potential impacts on the proposed project based on our evaluation are provided in the following sections.

The potential geologic and seismic hazards described below may be addressed by employing sound engineering practice in the design and construction of the proposed project elements. This practice includes the implementation of appropriate geotechnical recommendations prior to the design and construction of the facilities at the project site. Typical methods to reduce potential hazards that may be encountered during the construction of improvements are described in the following sections. Where appropriate, recommendations to mitigate potential geologic hazards are provided. Prior to design of planned improvements, detailed subsurface geotechnical evaluation should be performed to address the site-specific conditions at the locations of the planned improvements and to provide detailed recommendations for design and construction.

9.1. Surface Fault Rupture

Surface fault rupture is the offset or rupturing of the ground surface by relative displacement across a fault during an earthquake. Based on our review of referenced geologic and fault hazard data, the project site is not transected by known active or potentially active faults. The active San Jacinto fault is located approximately 2.1 miles northeast of the landfill. The site is not located within a State of California Earthquake Fault Zone (State of California, 1977). Therefore, the potential for surface rupture is relatively low. However, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

9.2. Seismic Ground Shaking

Earthquake events from one of the regional active or potentially active faults near the project area could result in strong ground shaking which could affect the project area. The level of ground shaking at a given location depends on many factors, including the size and type of earthquake, distance from the earthquake, and subsurface geologic conditions. The type of construction also affects how particular structures and improvements perform during ground shaking.

The 2013 California Building Code recommends that the design of structures be based on spectral response accelerations in the direction of maximum horizontal response (5 percent damped) having a 1 percent probability of collapse in 50 years. Such spectral response accelerations represent the Risk-Targeted Maximum Considered Earthquake (MCE_R) ground motion.

The horizontal peak ground acceleration (PGA) that corresponds to the MCE_R for the project site was calculated as 0.83g using the USGS (2016) seismic design tool (web-based). The mapped PGA (PGA_M) which is defined as the Maximum Considered Earthquake Geometric Mean (MCE_G) PGA with adjustment for site class effects in accordance with the American Society of Civil Engineers 7-10 Standard was estimated to be 0.81g using the USGS (2016) seismic design tool. These estimates of ground motion do not include near-source factors that may be applicable to the design of structures on site.

This potential level of ground shaking could have high impacts on project improvements without appropriate design mitigation, and should be considered during the detailed design phase of the project. Mitigation of the potential impacts of seismic ground shaking can be achieved through project structural design. Structural elements of planned improvements can be designed to resist or accommodate appropriate site-specific ground motions and to conform to the current seismic design standards. Appropriate structural design and mitigation techniques would reduce the impacts related to seismic ground shaking to low levels.

9.3. Liquefaction and Seismically Induced Settlement

Liquefaction is the phenomenon in which loosely deposited granular soils located below the water table undergo rapid loss of shear strength due to excess pore pressure generation when subjected to strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to rapid rise in pore water pressure, causing the soil to behave as a fluid for a short period of time. Liquefaction is known generally to occur in saturated or near-saturated cohesionless soils at depths shallower than 50 feet. Factors known to influence liquefaction potential include composition and thickness of soil layers, grain size, relative density, groundwater level, degree of saturation, and both intensity and duration of ground shaking. The potential damaging effects of liquefaction include differential settlement, loss of ground support for foundations, ground cracking, heaving and cracking of slabs due to sand boiling, buckling of deep foundations due to liquefaction-induced ground settlement.

The State of California Seismic Hazards Mapping Program produces maps showing areas of the state that are susceptible to liquefaction, but has not yet produced maps within the project area. The County of San Bernardino has evaluated generalized areas of liquefaction susceptibility based on areas where potentially loose alluvial soils and shallow groundwater (generally within 50 feet of the ground surface) exist. Based on the Geologic Hazard Overlays of the San Bernardino County Land Use Plan (2010a), the project is located in an area considered to have a medium susceptibility for liquefaction.

Further assessment of the liquefaction potential would be performed prior to detailed design and construction of future improvements in the project area and incorporated into the design, as appropriate. Structural design and mitigation techniques would be developed, as appropriate, to reduce the impacts related to liquefaction to low levels. Therefore, the potential impacts due to liquefaction are considered to be minimal with incorporation of mitigation techniques.

Methods for construction in areas with potential liquefaction hazard may include in-situ ground modification, removal of liquefiable layers and replacement with compacted fill, or support of project improvements with piles at depths designed specifically for liquefaction. Pile foundations can be designed for liquefaction hazard by supporting the piles in dense soil or bedrock below the liquefiable zone or other appropriate methods as evaluated during the site-specific evaluation. Additional recommendations for mitigation of liquefaction may include densification by installation of stone columns, vibration, deep dynamic compaction, and/or compaction grouting.

9.4. Landslides

Landslides and mudflows of earth materials generally occur where slopes are steep and/or the earth materials are too weak to support themselves. Earthquake-induced landslides may also occur due to seismic ground shaking. The San Bernardino County Land Use Plan Geologic Hazards Overlay does not indicate areas susceptible to a landslide within the proposed park site (Figure 5). Additionally, the project site is relatively flat with some minor slopes up to approximately 12 feet high at the landfill and in the northern portion of the site. Accordingly, landslides are not a constraint for development.

9.5. Soil Erosion

Soil erosion refers to the process by which soil or earth material is loosened or dissolved and removed from its original location. Erosion can occur by varying processes and may occur in the project area where bare soil is exposed to wind or moving water (both rainfall and surface runoff). The processes of erosion are generally a function of material type, terrain steepness, rainfall or irrigation levels, surface drainage conditions, and general land uses.

Regional geologic mapping at the site and our observations during our site reconnaissance indicate that the site soils generally consist of sandy materials. Sandy soils typically have low cohesion, and have a relatively higher potential for erosion from surface runoff when exposed in excavations. Surface soils with higher amounts of clay tend to be less erodible as the clay acts as a binder to hold the soil particles together.

The planned construction at the project site would result in ground surface disruption during excavation, grading, and trenching that would create the potential for erosion to occur. However, a Storm Water Pollution Prevention Program (SWPPP) incorporating Best Management Practices (BMPs) for erosion control would be prepared prior to the start of construction in accordance with City of Colton guidelines.

With the implementation of BMPs incorporated in the project SWPPP during planned construction, water- and wind-related soil erosion can be limited within construction site boundaries. Examples of these procedures could include surface drainage measures for erosion due to water, such as the use of erosion-deterrent mats or geofabrics, silt fencing, sandbags and plastic sheeting, and temporary drainage devices. Positive surface drainage should be accommodated at project construction sites to allow surface runoff to flow away from site improvements or areas susceptible to erosion. To reduce wind-related erosion, wetting of soil surfaces and/or covering exposed ground areas and soil stockpiles could be considered during construction operations, as appropriate.

During long-term operation of planned improvement at the site, soil erosion in landscaping areas can be mitigated through site drainage design and maintenance practices. Design procedures can be performed to reduce soil erosion such as appropriate surface drainage design of roadways and facilities to provide for positive surface runoff. These design procedures would address reducing concentrated run-off conditions that could cause erosion and affect the stability of project improvements.

9.6. Subsidence

Subsidence is characterized as a sinking of the ground surface relative to surrounding areas, and can generally occur where deep soil deposits are present. Subsidence in areas of deep soil deposits is typically associated with regional groundwater withdrawal or other fluid withdrawal from the ground such as oil and natural gas. Subsidence can result in the development of ground cracks and damage to subsurface vaults, pipelines and other improvements.

According to the USGS, the project site and vicinity have been subject to historic, early 20th century subsidence due to groundwater pumping (Figure 6) (USGS, 2015). However, current groundwater practices have improved over the years to better manage land subsidence due to groundwater pumping. Management strategies are used by governing agencies to store water for future use and to meet water demands reliably. Due to current practices, subsidence is not a constraint for site development.

9.7. Compressible and Collapsible Soils

Compressible soils are generally comprised of soils that undergo consolidation when exposed to new loading, such as fill or foundation loads. Soil collapse is a phenomenon where the soils undergo a significant decrease in volume upon increase in moisture content, with or without an increase in external loads. Buildings, structures, and other improvements may be subject to excessive settlement-related distress when compressible soils or collapsible soils are present.

The undocumented fill soils associated with the landfill are potentially compressible and/or collapsible and are not suitable for support of settlement-sensitive structures without taking adequate mitigation measures. Mitigation of the landfill materials at the site would generally involve one of two typical alternatives commonly employed to allow construction where such conditions exist: 1) excavation and offsite disposal of the landfill materials and replacement with engineered, compacted fill, or 2) support of new structures on deep pile foundations that extend through the landfill materials and gain support from competent alluvial materials beneath the landfill deposits. The presence of oversize material and debris in the landfill should be anticipated when evaluating these alternatives. Further improvements such as pavements, hardscape, and utilities that are not placed on piles and bearing on landfill materials may be subject to distress due to long-term settlement.

Conceptual project plans provided in the Colton Regional Soccer Complex Concept Design document show the landfill area will generally be open space with non-structural improvements (ICG, 2014). From a geotechnical perspective, it may be feasible to leave the landfill materials in place in an open space area of the park without structural improvements, with the understanding that periodic re-grading will be needed in areas of the landfill that have settled. Additional maintenance activities may include repair of cracks and offset of pavements and hardscapes. The amount of anticipated settlement should be evaluated during the design phase.

Regional geologic mapping indicates that the remainder of the site is underlain by alluvial soils. The alluvial soils underlying the project site are generally unconsolidated, reflecting a depositional history without substantial loading, and may be subject to collapse. Due to the presence of potentially compressible and/or collapsible soils at the site, there is a potential for differential settlement to affect project improvements.

Since planned development within the project area will involve construction of new improvements that would be constructed upon the existing alluvial soils, potential settlement and/or collapsible soils will be a consideration in the detailed design and construction of project improvements. Assessment of the potential for soils prone to settlement would be evaluated prior to detailed design and construction of project improvements and mitigation techniques would be developed, as appropriate, to reduce the impacts related to settlement to low levels.

To evaluate the potential for settlement to affect planned project components, surface reconnaissance and subsurface evaluation would be performed. During the detailed design phase of the project, site-specific geotechnical evaluations would be performed to assess the settlement potential of the on-site natural soils. This may include detailed surface reconnaissance to evaluate site conditions, and drilling of exploratory borings or test pits and laboratory testing of soils, where appropriate, to evaluate site conditions.

Examples of possible mitigation measures for soils with the potential for settlement include removal of the compressible and/or collapsible soil layers and replacement with compacted fill, surcharging to induce settlement prior to construction of improvements, allowing for a settlement period after or during construction of new fills, and specialized foundation design, including the use of deep foundation systems to support structures. Varieties of in-situ soil improvement techniques are also available, such as dynamic compaction (heavy tamping) or compaction grouting.

9.8. Expansive Soils

Expansive soils include clay minerals that are characterized by their ability to undergo significant volume change (shrink or swell) due to variations in moisture content. Sandy soils are generally not expansive. Changes in soil moisture content can result from rainfall, irrigation, pipeline leakage, surface drainage, perched groundwater, drought, or other factors. Volumetric change of expansive soil may cause excessive cracking and heaving of structures with shallow foundations, concrete slabs-on-grade, or pavements supported on these materials.

Regional geologic mapping indicates that the site soils generally consist of sandy materials. In general, the observed granular soils on the ground surface and the sandy alluvial soils mapped at the project site are considered to possess a low expansion potential and would not present significant impacts to the proposed site improvements.

Clayey fill soils may be present in the alluvium and the undocumented fill at the site. Detailed assessment of the potential for expansive soils would be evaluated during the design phase of the project through subsurface exploration and mitigation techniques would be developed, as appropriate, to reduce the impacts related to expansive soils to low levels. Therefore, the potential impacts due to expansive soils would be reduced to low levels with incorporation of techniques such as overexcavation and replacement with non-expansive soil, soil treatment, moisture management, and/or specific structural design for expansive soil conditions developed during design of the project.

9.9. Groundwater and Excavations

Recorded depths to groundwater in monitoring wells in the vicinity of the proposed soccer complex and community park are as shallow as approximately 13 feet below the ground surface. Planned improvements at the project sites are anticipated to consist of excavations and site grading for the fields and other proposed structures. Areas of shallow or perched groundwater or seepage may be encountered during grading and excavations, and, if encountered, could have an impact on the construction activities at the sites.

Wet or saturated soil conditions encountered in excavations during construction for the project can cause instability of the excavations, and present a constraint to construction activities. Excavations in areas with shallow or perched groundwater may need to be cased/shored and/or dewatered to maintain stability of the excavations and adjacent improvements and provide access for construction.

Groundwater levels may be influenced by seasonal variations, precipitation, irrigation, soil/rock types, groundwater pumping, and other factors, and are subject to fluctuations. On-site infiltration of stormwater related to low impact development guidelines, if used, may have an impact on planned site improvements and should be evaluated during the detailed design phase of the project.

Further study, including subsurface exploration, would be performed during the detailed design phase of planned improvements to evaluate the presence of seepage and/or perched groundwater, and to evaluate the potential for stormwater infiltration at the site, and the potential impacts on design and construction of project improvements. Mitigation techniques would be developed, as appropriate, to reduce the impacts related to groundwater to low levels.

10. LIMITATIONS

The purpose of this study was to evaluate geotechnical conditions and potential geologic and seismic hazards at the site by reviewing readily available geotechnical data, to provide a preliminary geotechnical evaluation which can be utilized in the preparation of environmental documents for the project.

The geotechnical analyses presented in this report have been conducted in accordance with current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No other warranty, implied or expressed, is made regarding the conclusions, recommendations, and professional opinions expressed in this report. Our preliminary conclusions and recommendations are based on a review of readily available geotechnical literature, geologic and seismic data, and an analysis of the observed conditions. Variations may exist and conditions not observed or described in this report may be encountered.

11. REFERENCES

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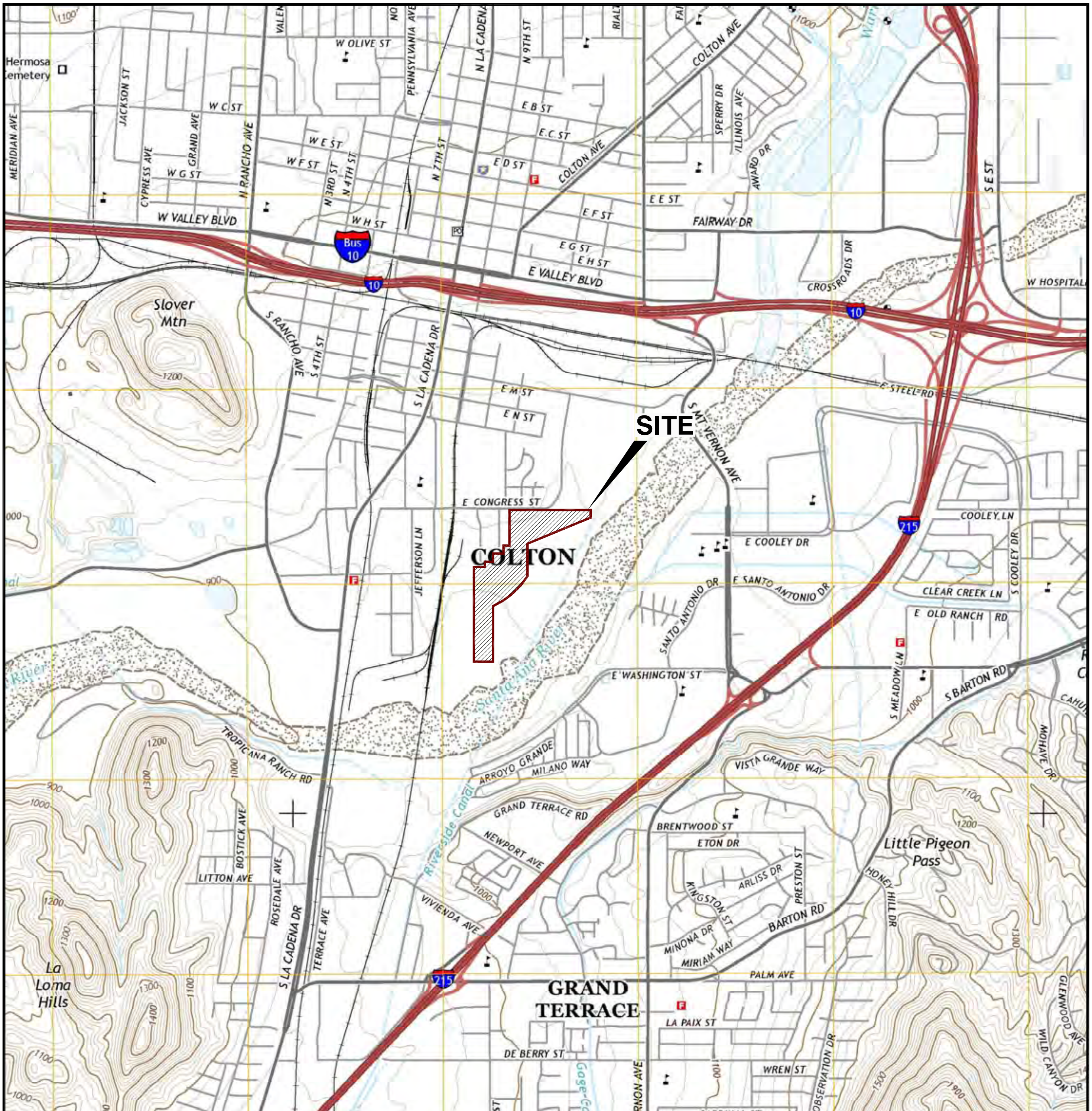
AERIAL PHOTOGRAPHS

Source	Scale	Date	Flight	Numbers
USDA	1:20,000	1-23-53	AXL-30K	59 and 60



REFERENCE: 7.5 MINUTE USGS TOPOGRAPHIC MAP OF SAN BERNARDINO SOUTH, CALIFORNIA QUADRANGLE, DATED 2015, SCALE 1:24000.

N

SCALE IN FEET

0 2,400 4,800

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore

SITE LOCATION

COLTON REGIONAL SOCCER COMPLEX AND
GUYAUX LANDFILL REDEVELOPMENT
COLTON, CALIFORNIA

PROJECT NO.	DATE
209667002	5/16

FIGURE
1

209667002_SL.dwg 15:27:04 05/04/2016 GK

LEGEND

SITE BOUNDARY

LANDFILL BOUNDARY

N

SCALE IN FEET

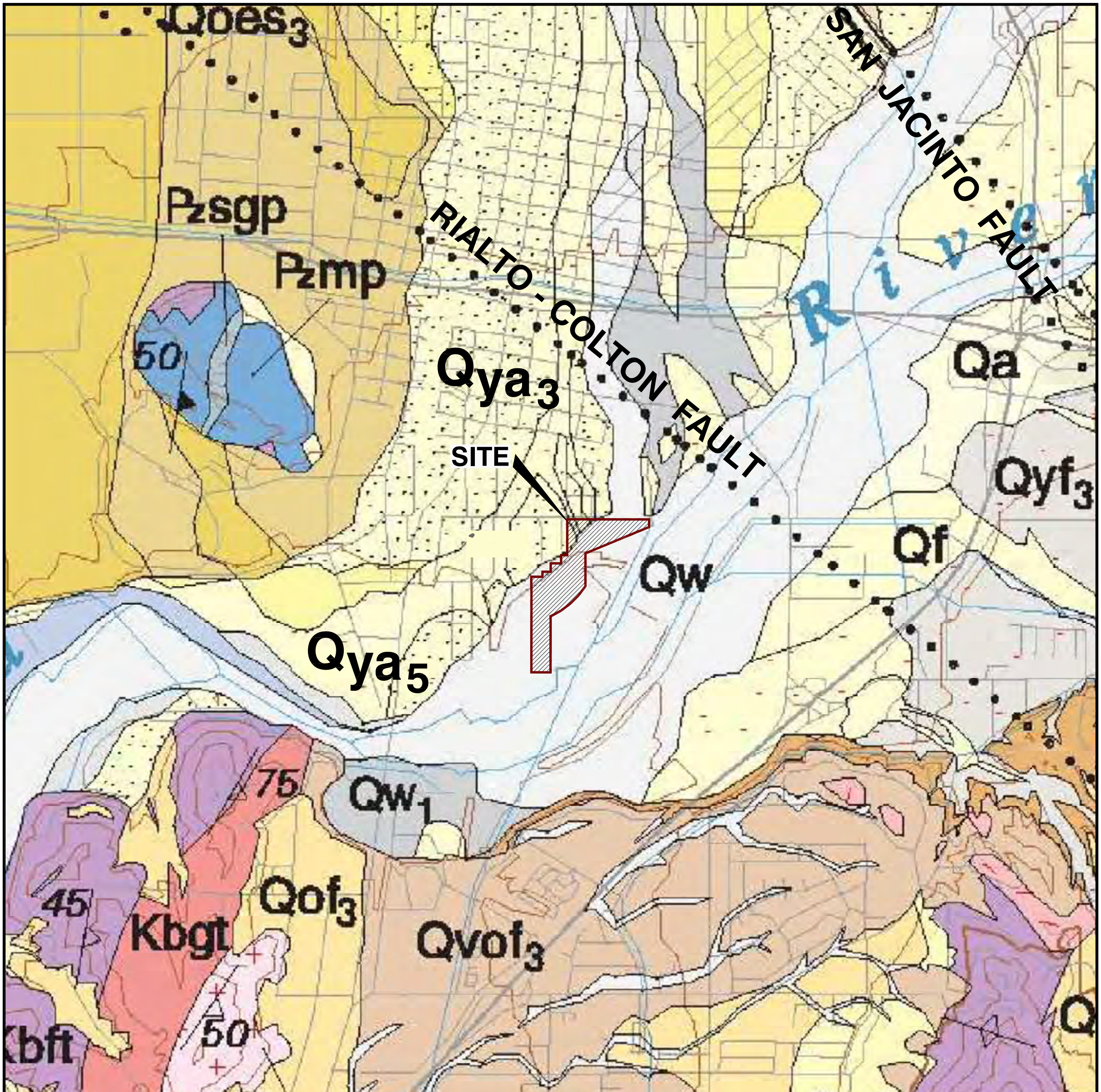
0 500 1,000

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

REFERENCE: GOOGLE EARTH AERIAL PHOTO, 2016.

Ninyo & Moore		SITE PLAN	FIGURE
PROJECT NO.	DATE	COLTON REGIONAL SOCCER COMPLEX AND GUYAUX LANDFILL REDEVELOPMENT COLTON, CALIFORNIA	2
209667002	5/16		

209667002_SP.dwg 10:52:18 05/18/2016 GK



REFERENCE: MORTON, D.M. AND MILLER, F.K., 2006, GEOLOGIC MAP OF THE SAN BERBNARDINO AND SANTA ANA 30'X60' QUADRANGLE, CALIFORNIA.

N

SCALE IN FEET

0 2,400 4,800

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

LEGEND

Qw	VERY YOUNG WASH DEPOSITS
Qf	VERY YOUNG ALLUVIAL FAN DEPOSITS
Qya	YOUNG AXIAL CHANNEL DEPOSITS
Qvof	VERY OLD ALLUVIAL FAN DEPOSITS
	GEOLOGIC CONTACT
• • • • • •	FAULT

Ninyo & Moore

PROJECT NO.	DATE
209667002	5/16

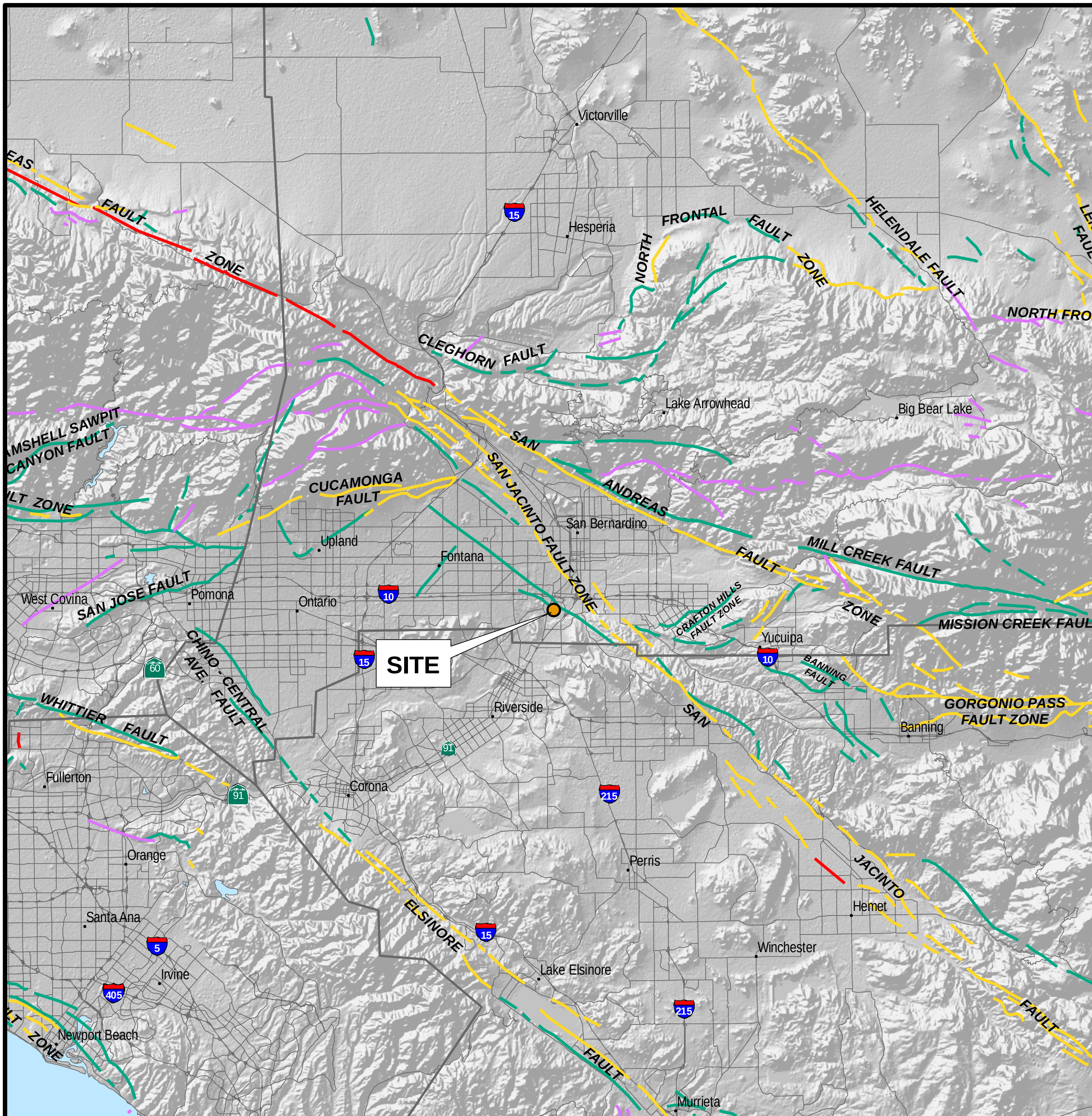
REGIONAL GEOLOGY

COLTON REGIONAL SOCCER COMPLEX AND
GUYAUX LANDFILL REDEVELOPMENT
COLTON, CALIFORNIA

FIGURE

3

209667002_RG.dwg 08:45:17 05/17/2016 GK



GIS DATA SOURCE: CALIFORNIA GEOLOGICAL SURVEY (CGS); ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI)
REFERENCE: JENNINGS, 2010, FAULT ACTIVITY MAP OF CALIFORNIA AND ADJACENT AREAS

LEGEND

FAULT ACTIVITY:

- HISTORICALLY ACTIVE
- HOLOCENE ACTIVE
- LATE QUATERNARY
- QUATERNARY
- COUNTY BOUNDARIES

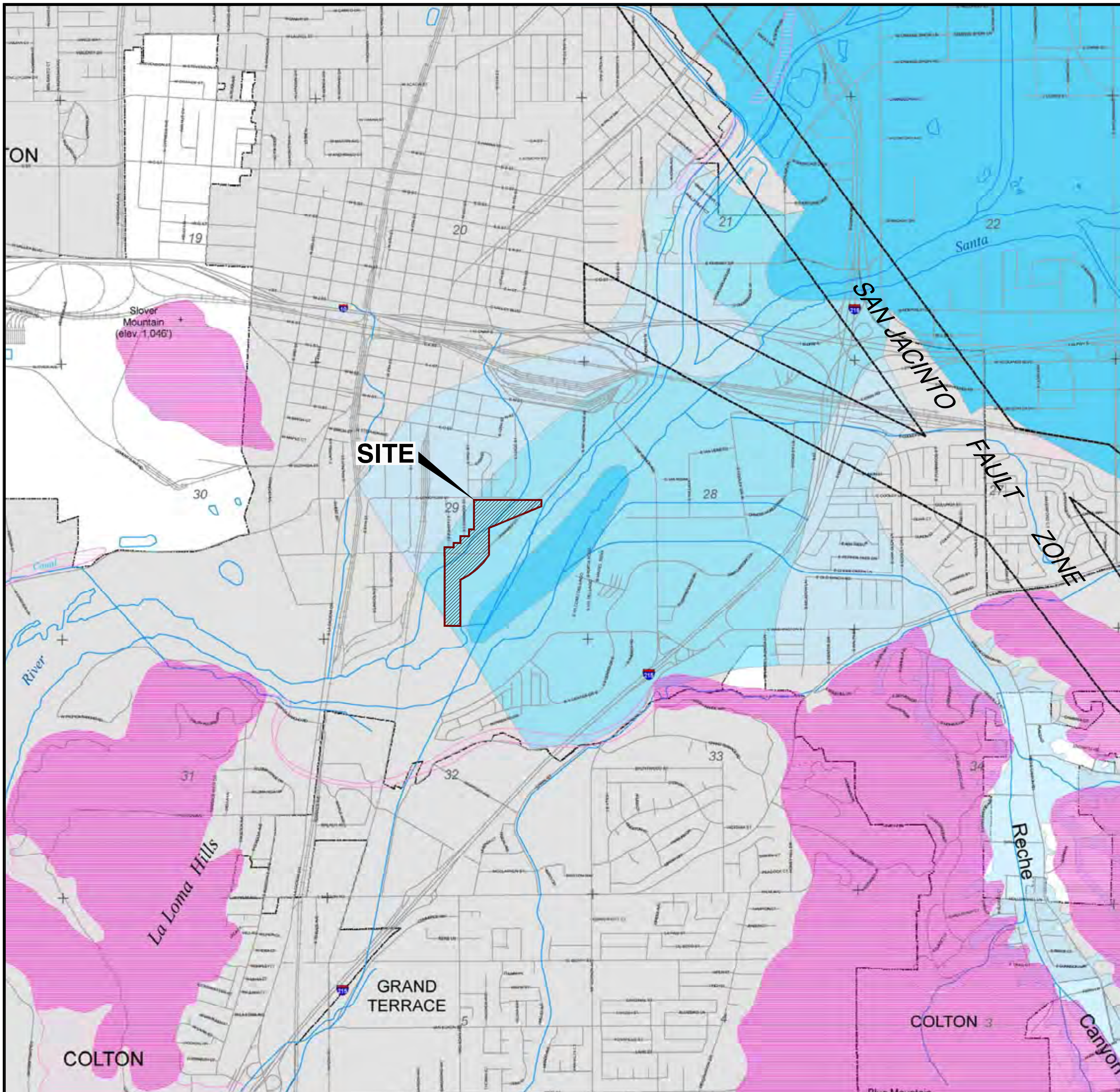
N

0 5 10 20 Miles

NOTE: DIMENSIONS, DIRECTIONS, AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	FAULT LOCATIONS	FIGURE
PROJECT NO. / 209667002	DATE / 5/16	COLTON REGIONAL SOCCER COMPLEX AND GUYAUX LANDFILL REDEVELOPMENT COLTON, CALIFORNIA	4

209667002_Fault loc.gis



REFERENCE: SAN BERNARDINO COUNTY LAND USE PLAN, GENERAL PLAN, GEOLOGIC HAZARD OVERLAYS.

N

SCALE IN FEET

0 3,000 6,000

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

LEGEND

Generalized Landslide Susceptibility
- Low to moderate
- Moderate to high
- Mapped, Existing Landslide
- Rockfall/Debris-Flow Hazard Area

Generalized Liquefaction Susceptibility
- Low
- Medium
- High

Earthquake Fault Zones
- Earthquake Fault Zone Boundary
- County Designated Fault Zones

Ninyo & Moore

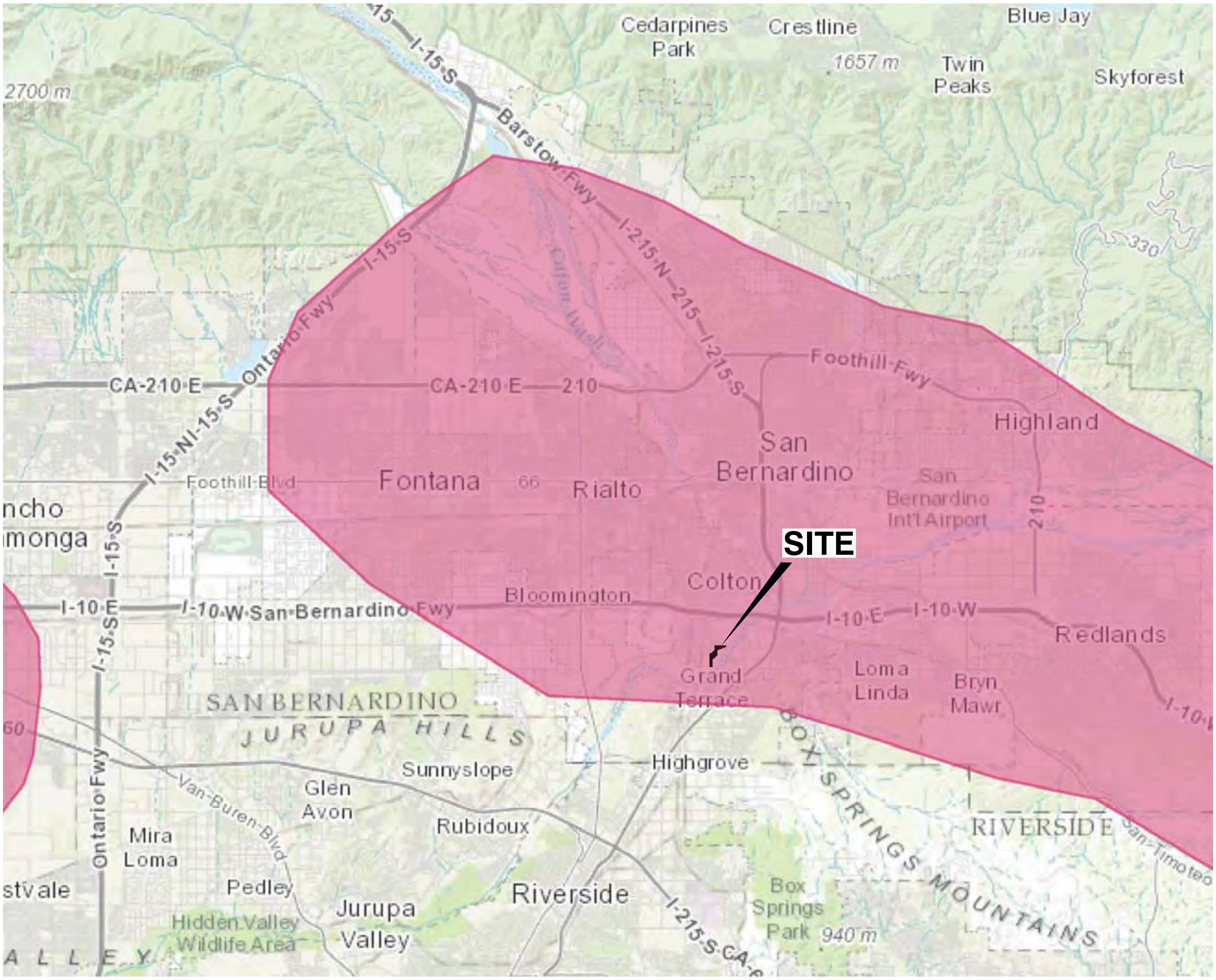
PROJECT NO.	DATE
209667002	5/16

SEISMIC HAZARDS

COLTON REGIONAL SOCCER COMPLEX AND
GUYAUX LANDFILL REDEVELOPMENT
COLTON, CALIFORNIA

FIGURE
5

209667002_SH.dwg 16:12:16 05/16/2016 GK



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WEBSITE: HTTP://CA.WATER.USGS.GOV/LAND_SUBSIDENCE/CALIFORNIA-SUBSIDENCE-AREAS.HTML

N

SCALE IN MILES

0 4 8

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

LEGEND

AREAS OF LAND SUBSIDENCE

Ninyo & Moore		REGIONAL SUBSIDENCE	FIGURE
PROJECT NO.	DATE	COLTON REGIONAL SOCCER COMPLEX AND GUYAUX LANDFILL REDEVELOPMENT COLTON, CALIFORNIA	6
209667002	5/16		

209667002_RS.dwg 15:30:16 05/16/2016 GK