Appendix E: Preliminary Geotechnical Exploration Report


PRELIMINARY GEOTECHNICAL EXPLORATION

SOLANO COUNTY FAIRGROUNDS REDEVELOPMENT PROJECT
VALLEJO, CALIFORNIA

Submitted to:
Mr. Chris Ragan
MacKay & Somps
5142 Franklin Drive, Suite B
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Prepared by:
ENGEO Incorporated

June 30, 2011
Revised November 4, 2011

Project No.
8665.001.000

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GEOTECHNICAL
ENVIRONMENTAL
WATER RESOURCES
CONSTRUCTION SERVICES

Project No.
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Mr. Chris Ragan
MacKay & Somps
5142 Franklin Drive, Suite B
Pleasanton, CA 94588

Subject: Solano County Fairgrounds Redevelopment Project
Vallejo, California

PRELIMINARY GEOTECHNICAL EXPLORATION REPORT

Dear Mr. Ragan:

With your authorization, ENGEO is providing this updated preliminary geotechnical exploration report to be used for the proposed mixed-use redevelopment project of the Solano County Fairgrounds in Vallejo, California. The accompanying report presents the results of our site exploration and planning-level conclusions and recommendations appropriate for site development.

Based on our study and the Solano 360 Specific Plan, it is our opinion that the currently proposed development is feasible from a geotechnical standpoint provided that the recommendations presented in this report are incorporated into plans. Once details regarding building types and layout, structural loads, grading for planned commercial uses at this site have been developed, it is recommended that design-level geotechnical explorations should be performed to address details regarding geotechnical aspects of the planned development.

If you have any questions or comments regarding this report, please call and we will be glad to discuss them with you.

Sincerely,

ENGEO Incorporated

Jacob White
Staff Geologist

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Principal

REGISTERED PROFESSIONAL ENGINEER
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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this geotechnical study update is to characterize geologic hazards and soil conditions at this site and develop planning-level geotechnical conclusions and recommendations for proposed redevelopment at Solano County Fairgrounds in Vallejo, California. This evaluation, based on our preliminary geotechnical exploration and the Solano 360 Specific Plan, included four exploratory borings/standpipe piezometers, and review of available existing geotechnical reports, published geologic maps, historic aerial photographs and construction documents, and topographic maps pertinent to the site.

This report was prepared for the exclusive use of MacKay & Somps and their design team for the project. In the event that any changes in the character, design or layout of the development are made, ENGEO must be contacted to review the conclusions and recommendations contained in this report to determine whether modifications are necessary. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without our express written consent.

1.2 PROJECT LOCATION AND SITE DESCRIPTION

The project site is located at 900 Fairgrounds Drive in Vallejo, California. The approximately 149-acre site is located immediately southwest of the Highway 37 and Interstate 80 junction, situated approximately 2 miles southwest of Sulphur Springs Mountain, and two miles east of the Napa River (Figure 1). In addition, Lake Chabot is located directly west of the subject site, divided from the site by Fairgrounds Drive.

Based on a topographic map by MacKay & Somps, the property has elevations ranging between 82 to 105 feet above mean sea level (msl). The property slopes gently towards the southwest. It is currently developed and used as the Solano County Fairgrounds, golf course, grandstand and horse track, and related improvements.

1.3 PROPOSED DEVELOPMENT

Based on the Solano 360 Specific Plan, the current land development diagram for the property includes construction of entertainment-mixed use, entertainment-commercial, exposition hall, demonstration farm, creek park corridor, transit center, and parking garages and parking lots, (Figure 5).

2.0 BACKGROUND AND PREVIOUS STUDIES

Reportedly, the Solano Fairgrounds property was graded and developed circa 1950. A review of available maps and historic aerial photographs show that at an earlier time, Lake Chabot had extended into the property. Aerial photographs of the site (1957, 1965 and 1970) show that portions of Lake Chabot were in-filled.

A previous preliminary geotechnical study was performed by Treadwell & Rollo dated September 29, 2005, which provided preliminary foundation recommendations. This report was prepared without performing a subsurface investigation and lacked an evaluation of previous fill areas and groundwater conditions at the site. In addition, a phase I environmental site assessment was performed by ENGEO in May 2009 and an update in October 2011.

3.0 GEOLOGY AND SEISMICITY

The site is located within the Coast Ranges geologic province of California, a series of northwest-trending ridges and valleys. Bedrock in the region has been folded and faulted during regional uplift beginning in the Pliocene period, about 4 million years before present. Locally, the site is mapped as Pleistocene alluvial and fluvial deposits to the east consisting of poorly sorted clays, gravels and sands. The western portion of the site is mapped as Holocene alluvial and fluvial fan deposits consisting of sands and gravels and grading upwards to silts and clays. The northwest corner of the site is mapped as Cretaceous Great Valley Sequence consisting of interbedded sandstone and shale (Figure 3, Helley and Graymer, 1997).

The San Francisco Bay Area contains numerous active faults. The site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone, and no known active faults exist within the site. According to the Alquist-Priolo map for the Cordelia Quadrangle the late Pleistocene to Holocene active West Napa Fault is located approximately 1.8 miles to the north west of the project area. According to geologic mapping by Crane (1995) The West Napa Fault is shown trending northwest through the project site. Additionally, the Green Valley Fault is mapped approximately 5 miles to the east of the site and the North Hayward Section of the Hayward Fault is mapped approximately 11.4 miles southwest of the site. An active fault is defined by the State Mining and Geology Board as one that has had surface displacement within Holocene time (about the last 11,000 years) (Hart, 1997). Figure 4 shows the approximate locations of these faults and significant historic earthquakes recorded within the San Francisco Bay Region.

The Working Group on California Earthquake Probabilities (WGCEP, 2007) has evaluated the Bay Area seismicity. In their study, the WGCEP evaluated the probability that a magnitude $M_w = 6.7$ or greater earthquake will occur in the Bay Area within 30 years of the publish date (2007 – 2037). The Hayward-Rogers Creek Fault and North San Andreas Fault systems are estimated to have a 30-year probability of 31 percent and 21 percent, respectively. It should be expected that the site will experience one or more episodes of strong ground shaking during the design life of the proposed redevelopment.

4.0 FIELD EXPLORATION

On April 2, 2009, four exploratory soil borings were drilled extending to a maximum depth of approximately 30½ feet below existing ground surface (bgs). In addition, soil samples were recovered during drilling. The samplers were driven with a 140-pound auto-trip hammer falling a distance of 30 inches. The penetration of the samplers into the native materials was field recorded as the number of blows needed to drive the sampler 18-inches in 6-inch increments. One-inch diameter piezometers were installed in all four borings to monitor groundwater levels. All borings were backfilled with neat cement and capped with a flush-mount monitoring well cover. The boring locations are shown on Figure 2, and the Boring Logs are included in Appendix A.

4.1 SUBSURFACE STRATIGRAHY

The borings encountered deposits of existing "man-made" fills. Along the western and central areas of the site, in areas coinciding with the previous lake area, the borings encountered fills overly soft recent natural alluvial deposits consisting of silts, clays and sands; the combined thickness of man-made fills and soft natural sediments varied from about 23 to 24 feet. Along the eastern side of the site, existing fills combined with soft sediments varied from 10 to 14 feet. Interbedded claystone and siltstone was encountered at depths of 29 feet at B-1, 24 feet at B-2, and 23 feet at B-3.

4.2 GROUNDWATER

During drilling, groundwater was initially encountered in B-1 at 18 feet, B-2 at 14½ feet, B-3 at 14 feet, and B-4 at 19 feet. Several groundwater measurements were taken subsequent to drilling. Table 1 below displays stabilized groundwater measurements and corresponding elevations.

TABLE 1

Location	April 6, 2009		April 13, 2009		March 28, 2011	
	Depth (FT) bgs	EL. (FT) msl	Depth (FT) bgs	EL (FT) msl	Depth (FT) bgs	EL (FT) msl
B-1	6	77	6 ½	76 ½	-	-
B-2	4	80	4	80	2	82
B-3	4 ½	79 ½	4 ½	79 ½	3	81
B-4	10	81	10	81	7	84

4.3 SEISMIC HAZARDS

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. The common secondary seismic hazards include ground shaking, liquefaction, densification, lateral spreading and ground lurching. The following sections present a discussion of these hazards as they apply to the site. Based on topographic and lithologic data, the risk of regional subsidence or uplift, landslides, tsunamis, flooding or seiches is considered low at the site.

4.3.1 Ground Rupture

Since there are no known active faults crossing the property and the site is not located within an Earthquake Fault Special Study Zone, it is our opinion that ground rupture is unlikely at the subject property.

4.3.2 Ground Shaking

An earthquake of moderate to high magnitude generated within the San Francisco Bay Region could cause considerable ground shaking at the site, similar to that which has occurred in the past. To mitigate the shaking effects, all structures should be designed using sound engineering judgment and the 2010 California Building Code (CBC) requirements, as a minimum. Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead-and-live loads. The code-prescribed lateral forces are generally considered to be substantially smaller than the comparable forces that would be associated with a major earthquake. Therefore, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake (SEAOC, 1996).

4.3.3 Liquefaction

Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. Soils most susceptible to liquefaction are clean, loose, saturated, uniformly graded fine-grained sands. Loose sands were encountered in Boring B-2 extending from 18 to 24 feet (bgs). Based on the subsurface exploration and published liquefaction susceptibility maps the site is considered to have a moderate liquefaction potential. We recommend that the design level exploration further explore and evaluate the potential for liquefaction at the site.

4.3.4 Densification Due to Earthquake Shaking

Densification of granular soils and above and below the groundwater table can cause settlement due to earthquake-induced vibrations. We recommend that the design level exploration further explore and evaluate the potential for densification at the site.

4.3.5 Lateral Spreading

Lateral Spreading is a failure within a nearly horizontal soil zone (possibly due to liquefaction), which causes the weaker soils to move toward a free face such as a channel, or down a gentle slope. Based on the soils at the site and proposed development the potential for lateral spreading at the site is considered low. Lateral spreading should be further evaluated during design level exploration.

4.3.6 Ground Lurching

Ground lurching is a result of the rolling motion imparted to the ground surface during energy released by an earthquake. Such rolling motion can cause ground cracks to form in weaker soils. The potential for the formation of these cracks is considered greater at contacts between deep alluvium and bedrock. Such an occurrence is possible at the site as in other locations in the Bay Area Region, but based on the site location, it is our opinion that the offset is expected to be very low.

5.0 PRELIMINARY FINDINGS AND CONSIDERATIONS

Based on our study, it is our opinion that the currently proposed development is feasible from a geotechnical standpoint, provided that the recommendations presented in this report are incorporated into plans. Once final details regarding building types and layout, structural loads, grading for planned commercial uses at this site have been developed, it is recommended that design-level geotechnical explorations should be performed to address details regarding geotechnical aspects of the planned development.

The main geotechnical considerations for the planned development at this site include:

- Presence of undocumented existing fills at the site underlain by soft sediments. The thickness of these deposits is variable and extends to depths of approximately 24 feet in portions of the site.

- Presence of soft sediments (potentially compressible and liquefiable) below the existing fills that may be considered marginally susceptibility to compression and/or seismically induced settlements (i.e., liquefaction) depending on their density, fines content, depth and occurrence.

- Presence of near-surface expansive soils considered susceptible to volume changes, shrink and swell, with fluctuation in moisture content.

- Presence of shallow groundwater levels at the site that may require consideration in design and construction for dewatering, and groundwater mitigation and control.

- Planning related to grading and structures including proposed waterways features, foundation support for structures, etc.

5.1 EXISTING FILL

Exploration borings encountered existing “man-made” undocumented fills, and the thickness of fills generally increases along the western limits of the site, where Lake Chabot was buried. Significant portions of the site are underlain by existing undocumented fills of variable thickness. Existing undocumented fill was encountered at the site in all of our borings, with the thickest portions encountered extending to depths of about 15 feet at B-2 (Figure 6). Undocumented fills may contain debris that is unsuitable for use as engineered fill and may be loosely placed and inadequate for foundation support. In addition, the undocumented fills are considered susceptible to seismic densification, liquefaction, and excessive total and differential settlement that could adversely impact support of planned structures and site improvements. As discussed earlier, areas of uncontrolled existing fills were mapped on the site. Depths and extent of these fills may vary at the site. In general, uncontrolled fills are considered susceptible to excessive total and differential settlements. To reduce settlements resulting from unsuitable fills, where these fills will be located below structures or improvements, they should be completely over-excavated and replaced with engineered fill. The actual extent of the existing unsuitable fills should be determined during grading.

In general, from a geotechnical standpoint, if existing fills are cleared of unsuitable debris and rubble, oversized-rock fragments, and any hazardous or deleterious materials (if encountered), these materials are anticipated to be suitable for reuse as engineered fill.

5.2 SOFT SEDIMENTS (COMPRESSIBLE AND/OR LIQUEFIABLE SOILS)

Underlying the fills are natural soil deposits of variable consistency, and these deposits directly overlie bedrock units (Figure 7). The upper zones of natural soils deposits appear soft, loose, and highly compressible; the soft and loose zones coincide with historic lake areas. Depending on specific variations in fine content, thickness of layers, in situ densities, and groundwater levels, the sandy layers may be considered marginally susceptible to seismically induced deformations, such as liquefaction and even possibly lateral spreading. Potential settlements and related hazards of liquefiable soils could impact foundation support of overlying structures, result in excessive settlement and cause damage to other related site improvements if the on-site soils are liquefiable, depending on its occurrence and level of severity. As such, it is recommended that design-level geotechnical exploration further characterize liquefaction potential for the planned commercial development and potential related seismically induced deformations. Such studies should include appropriate exploratory methods such as rotary wash drilling methods and/or cone penetrometer testing (CPT) to address potential liquefaction to provide appropriate mitigation, as deemed necessary for the planned development.

5.3 EXPANSIVE SOILS

A significant geotechnical concern is the expansive nature of the native soils in the proposed development area. Expansive soils shrink and swell as a result of seasonal fluctuation in moisture content. This can cause heaving and cracking of slabs-on-grade, pavements and structures founded on shallow foundations. Building damage due to volume changes associated with expansive soils can be reduced through proper grading and foundation design.

Successful construction on expansive soils requires special attention during construction. It is imperative that exposed soils be kept moist by watering for several days before placement of concrete. It is extremely difficult to remoisturize clayey soils without excavation, moisture conditioning and recompaction. Mitigation measures should include the prevention of moisture variation. Existing expansive soils may be replaced with non-expansive select fill below constructed slabs. Alternatively, slabs can be designed by the structural engineer to allow for construction on expansive soils. In addition, proper moisture conditioning of expansive soils below slabs prior to placement will reduce the effects of expansion.

The Structural Engineer shall provide final design thickness and additional reinforcement, if necessary, for the intended structural loads. Implementation of Mitigation Measures would reduce the soil expansion potential at the site. Expansive soils within the development site should be further explored during design level studies including laboratory analysis and distribution across the site.

5.4 SHALLOW GROUNDWATER

Groundwater levels were measured as shallow as 2 feet bgs. It is expected that during excavation, groundwater may be encountered and that dewatering operations may be needed. Temporary dewatering during construction should allow for work to be conducted in a relatively dry environment such that the work can be completed to design specifications. Shallow groundwater conditions could also be a foundation design consideration. Groundwater levels should be characterized during design-level geotechnical studies and groundwater quality should also be evaluated to assess the feasibility of discharging to the storm drain system.

5.5 EXISTING UTILITIES, SUBSTRUCTURE AND FOUNDATION REMNANTS

Review of historic air photographs show that the site fairgrounds was developed around 1950 and has since functioned as the Solano County Fairgrounds. Prior to 1950 the site remained undeveloped. Stables and buildings associated with the fairgrounds operation are found across the site. Abandoned utilities and foundation remnants encountered during construction will likely need to be removed.

5.6 2010 CBC SEISMIC DESIGN PARAMETERS

We provide the 2010 California Building Code (CBC) seismic parameters in Table 2 below.

TABLE 2
2010 CBC Seismic Design Parameters

Parameter	Design Value
Site Class	D
0.2 second Spectral Response Acceleration, S_S	1.573
1.0 second Spectral Response Acceleration, S_1	0.600
Site Coefficient, F_A	1.0
Site Coefficient, F_V	1.5
Maximum considered earthquake spectral response accelerations for short periods, S_{MS}	1.573
Maximum considered earthquake spectral response accelerations for 1-second periods, S_{M1}	0.900
Design spectral response acceleration at short periods, S_{DS}	1.049
Design spectral response acceleration at 1-second periods, S_{D1}	0.600

5.7 GRADING CONCEPTS

A number of options may be viable to mitigate the undocumented fills, compressible and/or liquefiable sediments. One measure to reduce risk is to perform remedial grading, including overexcavation of unsuitable fills and soft sediments, and replace these soils in their entirety with properly compacted engineered fill. If this remedial grading measure is successfully completed, then potential risk of settlement would be low; also, with this treatment it is anticipated that structures could be supported on conventional shallow foundations. Other measures that may be considered include partial removal and replacement of soils, in situ ground improvement measures, deep foundations, etc. or combination of various measures to reduce the risk to an acceptable level for the planned development.

For excavations extending below groundwater levels, it is anticipated that temporary dewatering will be necessary. Various temporary dewatering methods such as dewatering wells and pumping within excavations may be suitable. From a geotechnical perspective, the re-use of dewatering for earthwork moisture conditioning and compaction may be suitable.

If existing fills and compressible soils are overexcavated and recompacted, then the densification will result in a volume loss or shrinkage. Based on the materials encountered in our borings and our experience, an average shrinkage factor of 10% may be considered reasonable for recompacted man-made fills and natural soils to be placed as engineered fill. In general, graded slopes should be no steeper than 2:1 (horizontal:vertical). Detailed fill placement recommendations will be provided based on laboratory testing and analysis performed in conjunction with a design-level geotechnical exploration for the project.

Another consideration regarding grading is the creek park water channel feature shown in the Specific Plan. For planning purposes, the sideslope for waterways should be no steeper than 3:1 (horizontal to vertical) and protected from erosion, as deemed necessary. Steeper slope configurations may require earth retention systems. For such a feature to retain water, it may be necessary to construct a low permeability liner along the bottom and sidewalls for water containment; in our experience liners having low permeability (10^{-6} to 10^{-7} cm/sec) or special amendment (such as bentonite) or impermeable geotextile liners may be suitable. An experienced specialty designer should be consulted for design and considerations for the proposed water channels/lake, in concert with recommendations of the project Geotechnical Engineer of Record.

Design-level geotechnical explorations should be performed to further evaluate the geologic conditions described in this report, and characterize the engineering properties of on-site soils. The recommendations presented herein are for planning purposes and will be refined as part of the geotechnical investigation.

5.8 CONCEPTUAL FOUNDATION DESIGN

Several considerations may affect appropriate foundation design for this project. These include risk of settlements, potential expansive soils, building types, footprints and anticipated foundation loads. Several considerations may affect appropriate foundation design for this project.

If compressible materials are remediated through complete removal or in-place remediation within proposed building areas, a shallow foundation system may be constructed consisting of slab on grade with spread footings. Low or non-expansive select material may be considered as a replacement for expansive soils within building areas. Alternatively, depending on local severity and condition of the soils in the building areas, other treatments may be appropriate. With partial soil remediation, deep foundation systems consisting of pier and grade beam, or alternatively, driven piles, with preliminary embedment depths of approximately 30 to 50 feet or greater depending on structural loads may be constructed.

Further studies should characterize risks of settlement to planned development area and acceptable degrees of deflection/settlement to determine whether or not shallow footing systems fall within tolerable ranges for deflection anticipated. If shallow foundations are determined not to be suitable for the planned structure based on estimated deflections, then alternate foundation systems such as stiff reinforced mat foundations or possible deep foundations such as drilled piers or driven piles may be appropriate.

5.9 SLAB-ON-GRADE CONSTRUCTION

Secondary slabs include exterior walkways, access drives and steps. In order to allow slab movement to occur with minimal foundation distress, secondary slabs-on-grade should be constructed structurally independent of the foundation system. Differential movement between secondary slabs and foundation elements should be expected. An expansion joint material should be provided between architectural/structural elements constructed on adjacent secondary and foundation slabs to allow for each element to move independently and with minimal distress to the adjacent element. Where slab-on-grade construction is anticipated, care must be exercised in attaining a near-saturation condition of the subgrade soil before concrete placement.

Secondary slabs-on-grade should be designed specifically for their intended use and loading requirements. Some of the site soils have a moderate expansion potential; therefore, cracking of the slabs should be expected. Frequent control joints should be provided during slab construction for control of cracking.

Exterior slabs may be constructed with thickened edges extending at least 6 inches into compacted soil to minimize water infiltration, and they should slope away from the building to prevent water from flowing toward the structure. In general, secondary slabs-on-grade should have a minimum thickness of 4 inches and should be underlain by a 4-inch-thick layer of clean, crushed rock or gravel. As a minimum requirement, slabs-on-grade should be reinforced with No. 3 bars spaced 16 inches on center each way for control of cracking. The actual slab reinforcement should be designed by the Structural Engineer. In our experience, welded wire mesh may not be sufficient to control slab cracking.

5.10 PRELIMINARY FLEXIBLE PAVEMENT DESIGN

For preliminary estimating purposes, we have calculated flexible pavement design sections for Traffic Indices of 4.5 to 9, considering a minimum R-value of 10. According to methods contained in Topic 608 of Highway Design Manual by Caltrans (revised August 5, 1988), we compute the following:

TABLE 3
Preliminary Pavement Sections

Alternative I			Alternative II		
Traffic Index	AC (inches)	AB (inches)	AC (inches)	AB (inches)	ASB (inches)
4.5	3	7	3	7	-
5.0	3	9	3	6	4
6.0	3½	12	3½	6	7
7.0	4	15	4	6	10
8.0	4½	17	4½	7	11
9.0	5½	22	5½	8	15

Note: AC – Asphalt Concrete
AB – Caltrans Class 2 aggregate base (R-value of 78 or greater)
ASB – Caltrans Class 2 aggregate subbase (R-value of 50 or greater)

The above preliminary pavement section is provided for estimating only. We recommend the actual subgrade material be tested for R-value, and the Traffic Indices and minimum pavement section(s) should be confirmed by the Civil Engineer and the City of Vallejo. Pavement construction and all materials should conform to the specifications and requirements of the Standard Specifications by the Division of Highways, Department of Public Works, State of California, latest edition, City of Vallejo requirements and the following minimum requirements.

- All pavement subgrades should be scarified to a depth of 12 inches below finished subgrade elevation. The subgrade soil should be moisture conditioned to at least 2 percentage points above optimum and compacted to at least 95 percent relative compaction and in accordance with city requirements.
- Subgrade soils should be in a stable, non-pumping condition at the time aggregate base materials are placed and compacted.
- Adequate provisions must be made such that the subgrade soils and aggregate base materials are not allowed to become saturated.
- Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base and should be compacted to at least 95 percent of maximum dry density.
- Asphalt paving materials should meet current Caltrans specifications for asphalt concrete.
- All concrete curbs separating pavement and irrigated, landscaped areas should extend to below the bottom of adjacent aggregate base materials.

5.11 CORROSIVITY

Existing soils should be characterized for corrosivity characteristics. Such characterization should include sulfate testing, which is used to determine if sulfate-resistant concrete is needed for foundation construction, based on the criteria presented in Table 19-A-4 of the 1997 Uniform Building Code (UBC). Sulfate testing should be performed in the future prior to utility installation and foundation construction and may be performed during our detailed exploration.

6.0 DESIGN GEOTECHNICAL REPORT

This report presents preliminary geotechnical findings, conclusions, and recommendations intended for preliminary planning purposes only. A design-level geotechnical exploration and assessment should be performed when development plans are finalized. Design-level exploration should be performed to identify and characterize potential geotechnical constraints such as extents of existing undocumented fill, shallow groundwater, faulting, expansive soils, compressible soils, lateral spreading, inundation, and liquefiable soils, as necessary. Soil samples should be obtained and tested for moisture content, dry unit weight, Plasticity Index, gradation, shear strength, consolidation, and other physical properties as appropriate. A soil corrosion potential analysis including pH, resistivity, sulfate and chloride content tests should also be performed.

7.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report presents preliminary geotechnical recommendations for the proposed development in Vallejo, California. It is the responsibility of the owner to transmit the information and recommendations of this report to the appropriate organizations or people involved in design of the project, including but not limited to developers, owners, buyers, architects, engineers, and designers. The conclusions and recommendations contained in this report are solely professional opinions and are valid for a period of no more than 2 years from the date of report issuance.

We strived to perform our professional services in accordance with generally accepted geotechnical engineering principles and practices currently employed in the area; no warranty is expressed or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our services.

Actual field or other conditions will necessitate clarifications, adjustments, modifications or other changes to ENGEO's documents. Therefore, ENGEO must be engaged to prepare the necessary clarifications, adjustments, modifications or other changes before construction activities commence or further activity proceeds. If ENGEO's scope of services does not include on-site construction observation, or if other persons or entities are retained to provide such services, ENGEO cannot be held responsible for any or all claims arising from or resulting from the performance of such services by other persons or entities, and from any or all claims arising from or resulting from clarifications, adjustments, modifications, discrepancies or other changes necessary to reflect changed field or other conditions.

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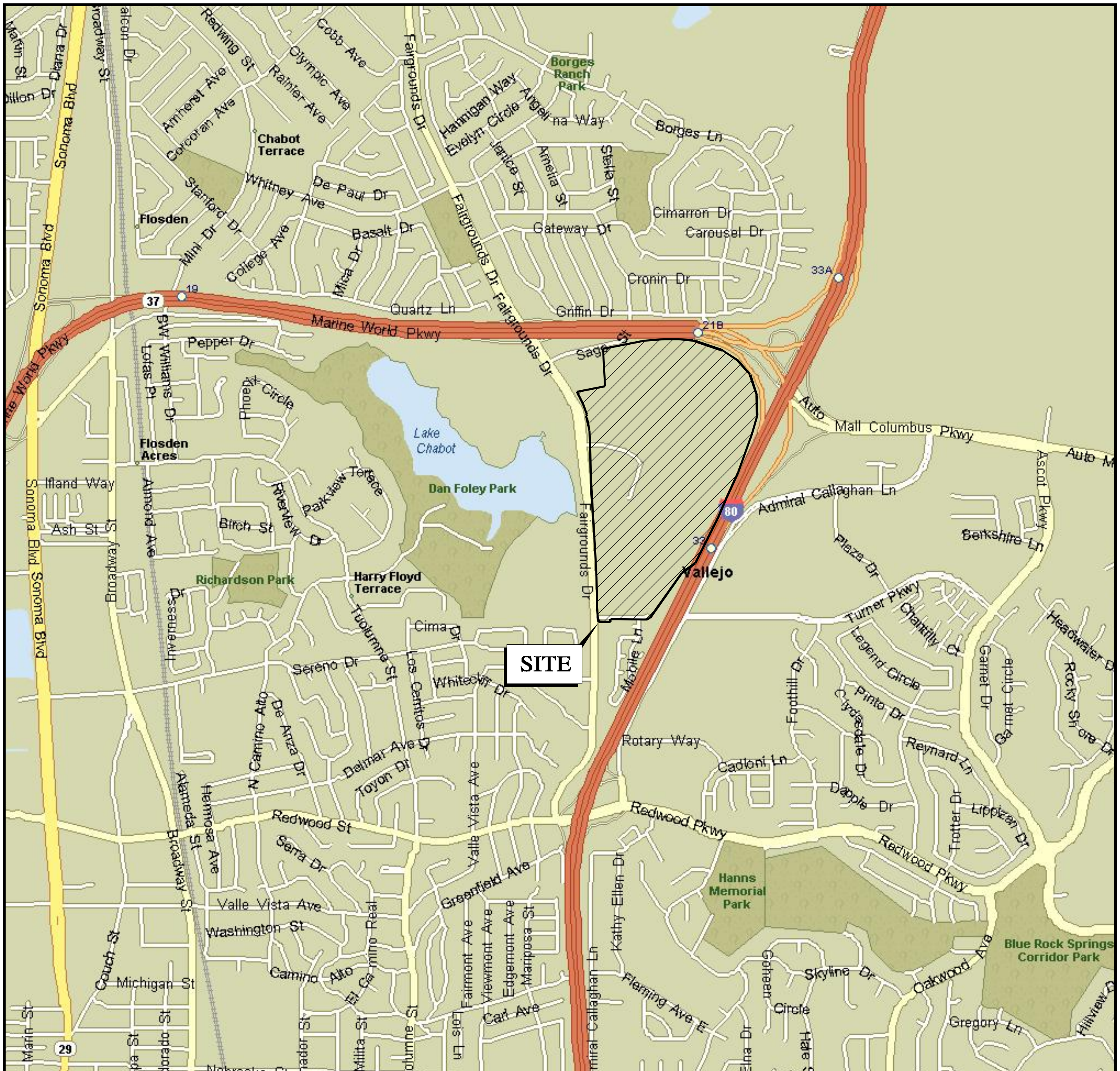
FIGURES



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VICINITY MAP SOLANO COUNTY FAIRGROUNDS VALLEJO, CALIFORNIA	PROJECT NO.: 8665.001.000		FIGURE NO. 1
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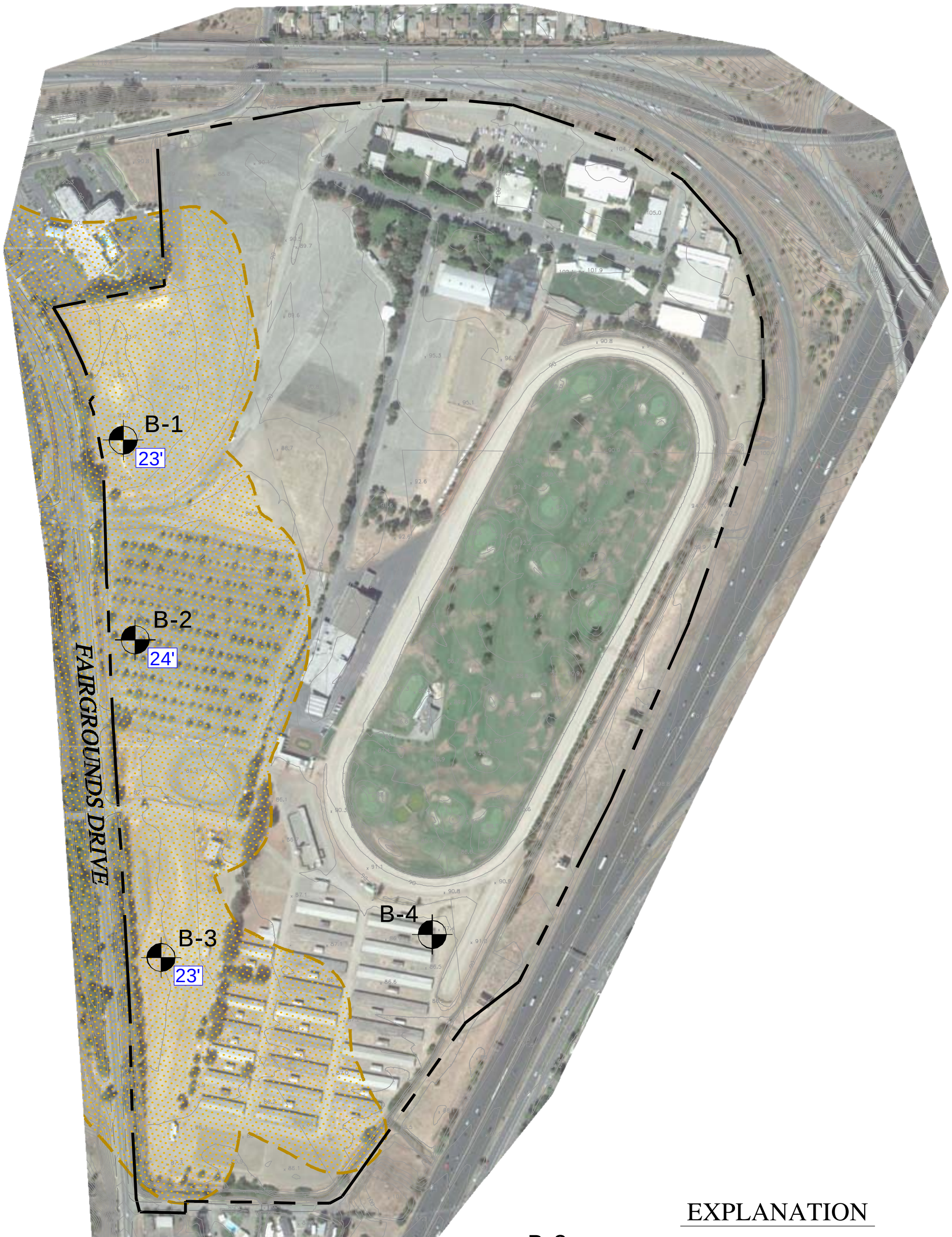


N

EXPLANATION

B-3 23' — APPROXIMATE LOCATION OF EXPLORATORY BORING SHOWING DEPTH TO BEDROCK (ENGEO, APRIL 2, 2009)

APPROXIMATE LIMITS OF HISTORIC LAKE AREA

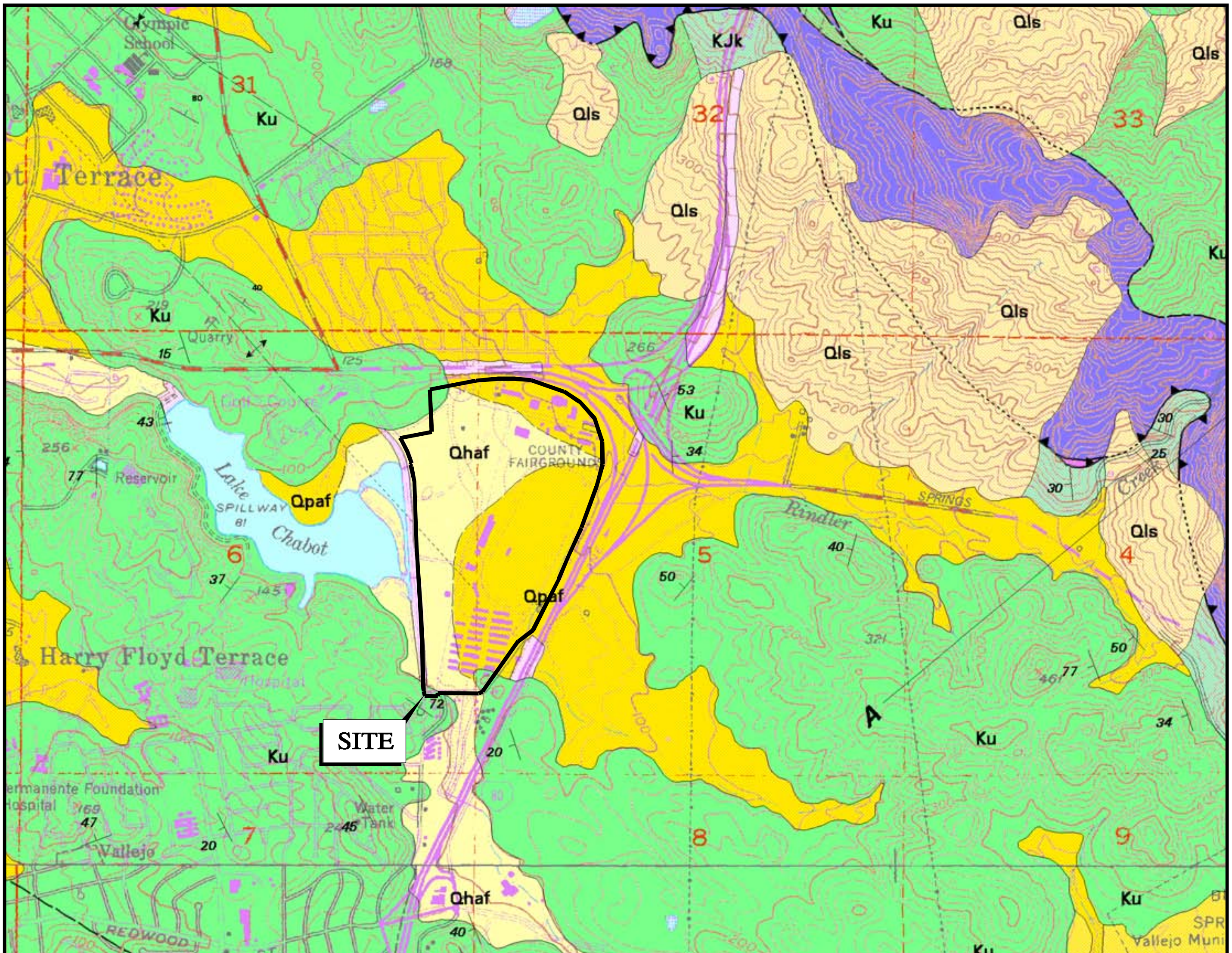
0 FEET 600
0 METERS 300

BASE MAP SOURCE: MACKAY & SOMPS, GOOGLE EARTH

ENGEO Expect Excellence	SITE PLAN SOLANO COUNTY FAIRGROUNDS VALLEJO, CALIFORNIA	PROJECT NO.: 8665.001.000 SCALE: AS SHOWN DRAWN BY: PC / CHECKED BY: DB	FIGURE NO. 2

G:\Drafting\DRAFTING2_Dwg\8665\001\GEX\8665001000-GEX-2-SitePlan-1111.dwg 11-01-11 09:16:54 AM spatters

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

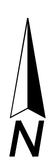
BEDROCK CONTACT-DASHED WHERE GRADATIONAL OR APPROXIMATELY LOCATED

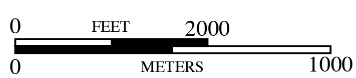
FAULT-DASHED WHERE INFERRED, DOTTED WHERE CONCEALED, QUERIED WHERE EXISTENCE IS DOUBTFUL

STRIKE AND DIP OF STRATA

INCLINED — VERTICAL — OVERTURNED

Qhaf	ALLUVIAL FAN AND DEPOSITS (HOLOCENE)
Qls	LANDSLIDE DEBRIS
Qhap	OLDER ALLUVIUM
Ku	GREAT VALLEY SEQUENCE
KJk	KNOXVILLE FORMATION
sp	SERPENTINITE





BASE MAP SOURCE: USGS, OFR 99-162

ENGEO
Expect Excellence

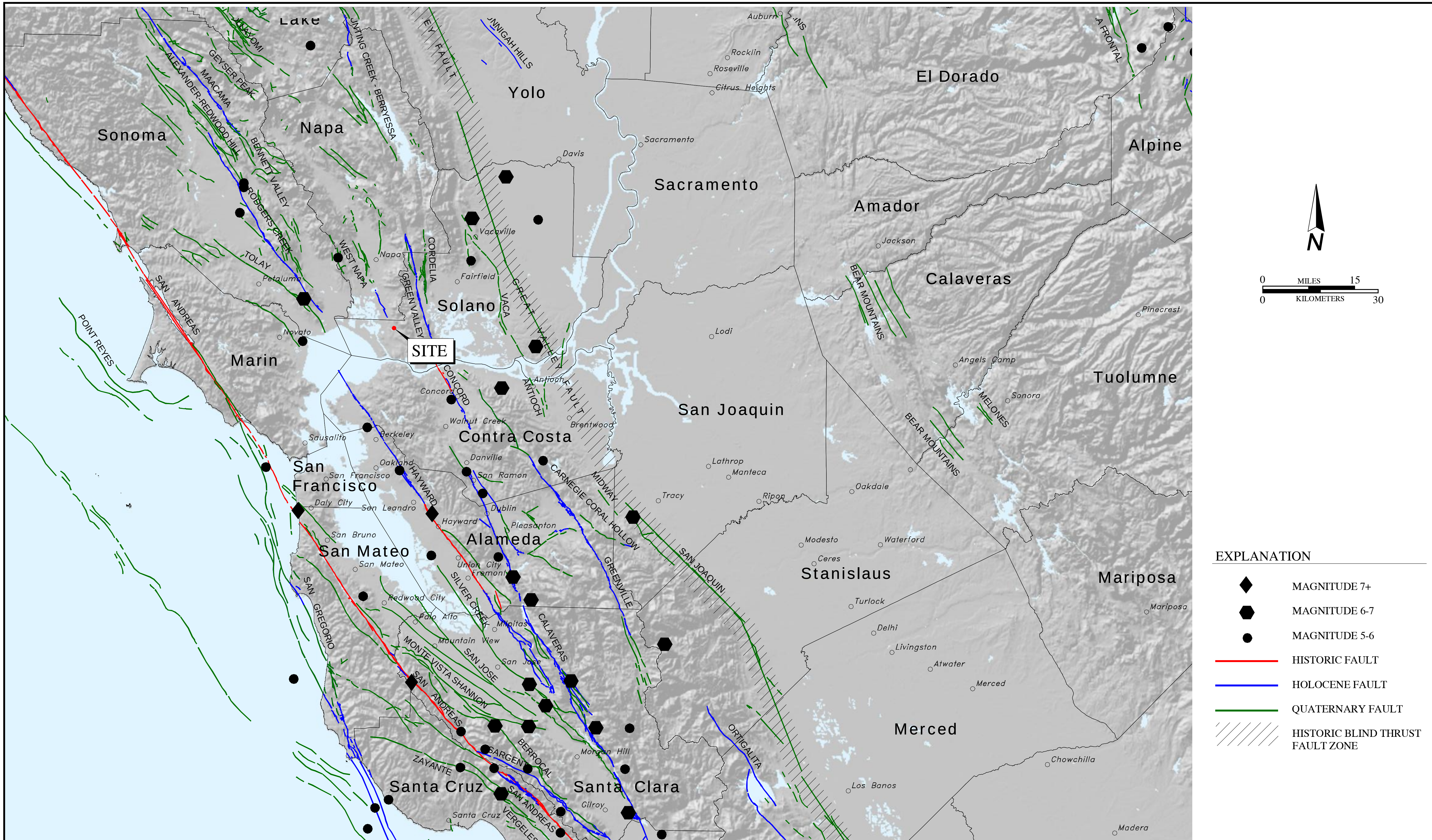
REGIONAL GEOLOGIC MAP
SOLANO COUNTY FAIRGROUNDS
VALLEJO, CALIFORNIA

PROJECT NO.: 8665.001.000	
SCALE: AS SHOWN	
DRAWN BY: PC	CHECKED BY: TB

FIGURE NO. 3

G:\Drafting\DRAFTING2_Dwg\8665\001\GEX\8665001000-GEX-3-RegGeoMap-1111.dwg Plot Date:11-01-11 spatters

ORIGINAL FIGURE PRINTED IN COLOR



BASE MAP SOURCE:
U.S.G.S. 1-ARC SECOND S.R.T.M. DATABASE
U.S.G.S. QUATERNARY FAULT DATABASE, MARCH, 2006
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800-2000)

ENGEO Expect Excellence

REGIONAL FAULTING AND SEISMICITY
SOLANO COUNTY FAIRGROUNDS
VALLEJO, CALIFORNIA

PROJECT NO.: 8665.001.000	FIGURE NO
SCALE: AS SHOWN	4
DRAWN BY: PC	CHECKED BY: TB

G:\Drafting\DRAFTING2_Dwg\8665\001\GEX\8665001000-GEX-4-RegFaultSeismic-1111.dwg Plot Date: 11-01-11 spatters

ORIGINAL FIGURE PRINTED IN COLOR

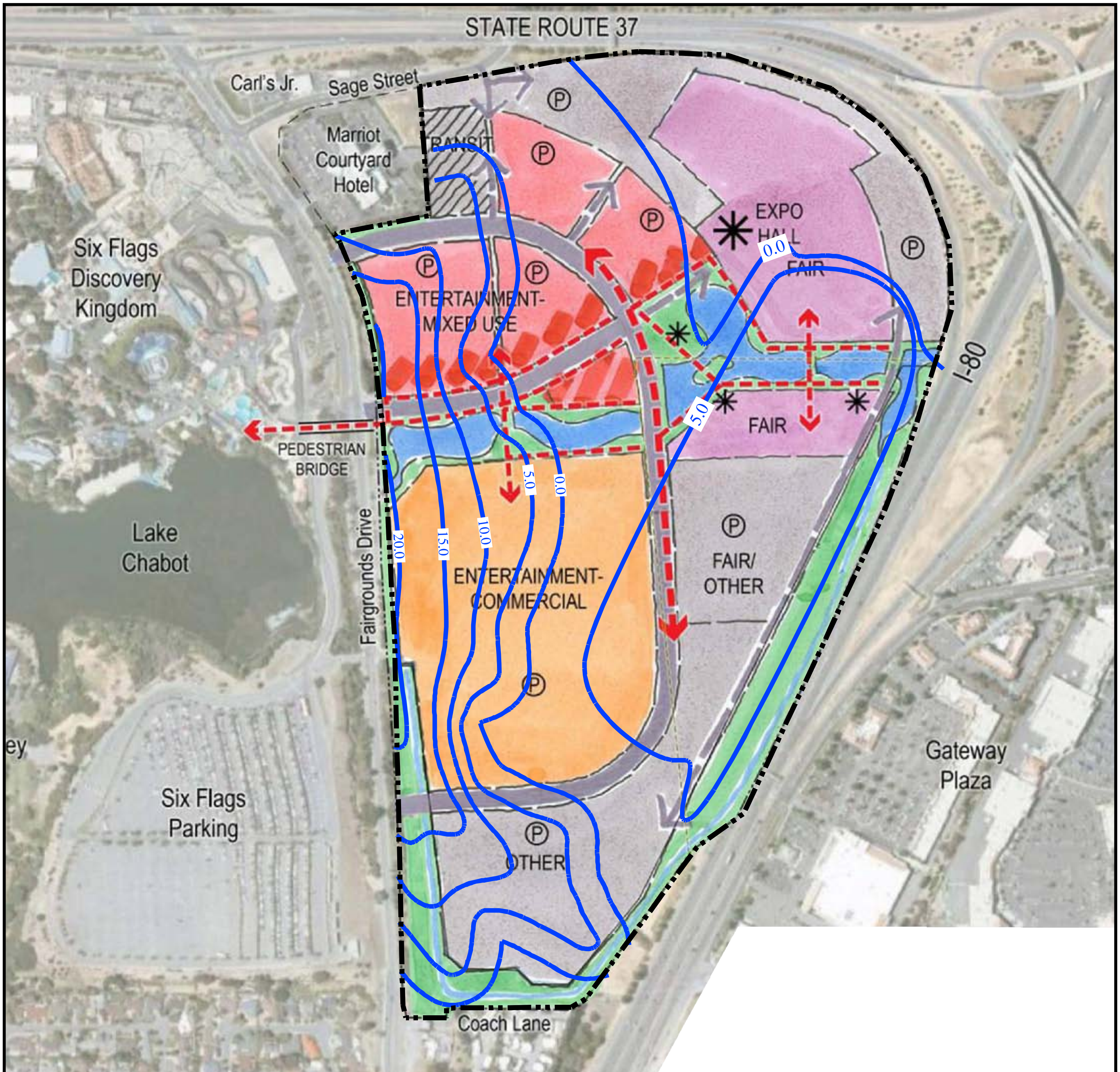
BASE MAP SOURCE: SWA, 360 LAND USE DIAGRAM

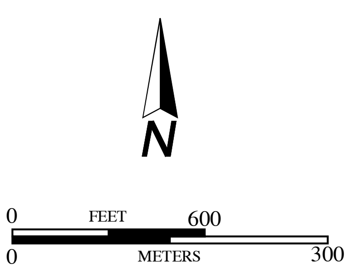
ENGEO
—Expect Excellence—

LAND USE DIAGRAM SOLANO COUNTY FAIRGROUNDS VALLEJO, CALIFORNIA	PROJECT NO.: 8665.001.000		FIGURE NO. 5
	SCALE: AS SHOWN		
	DRAWN BY: JSW	CHECKED BY: TB	

G:\Drafting\DRAFTING2_Dwg\8665\001\GEX\8665001000-GEX-5-Concept J-1111.dwg Plot Date: 11-01-11 spatters

ORIGINAL FIGURE PRINTED IN COLOR





EXPLANATION

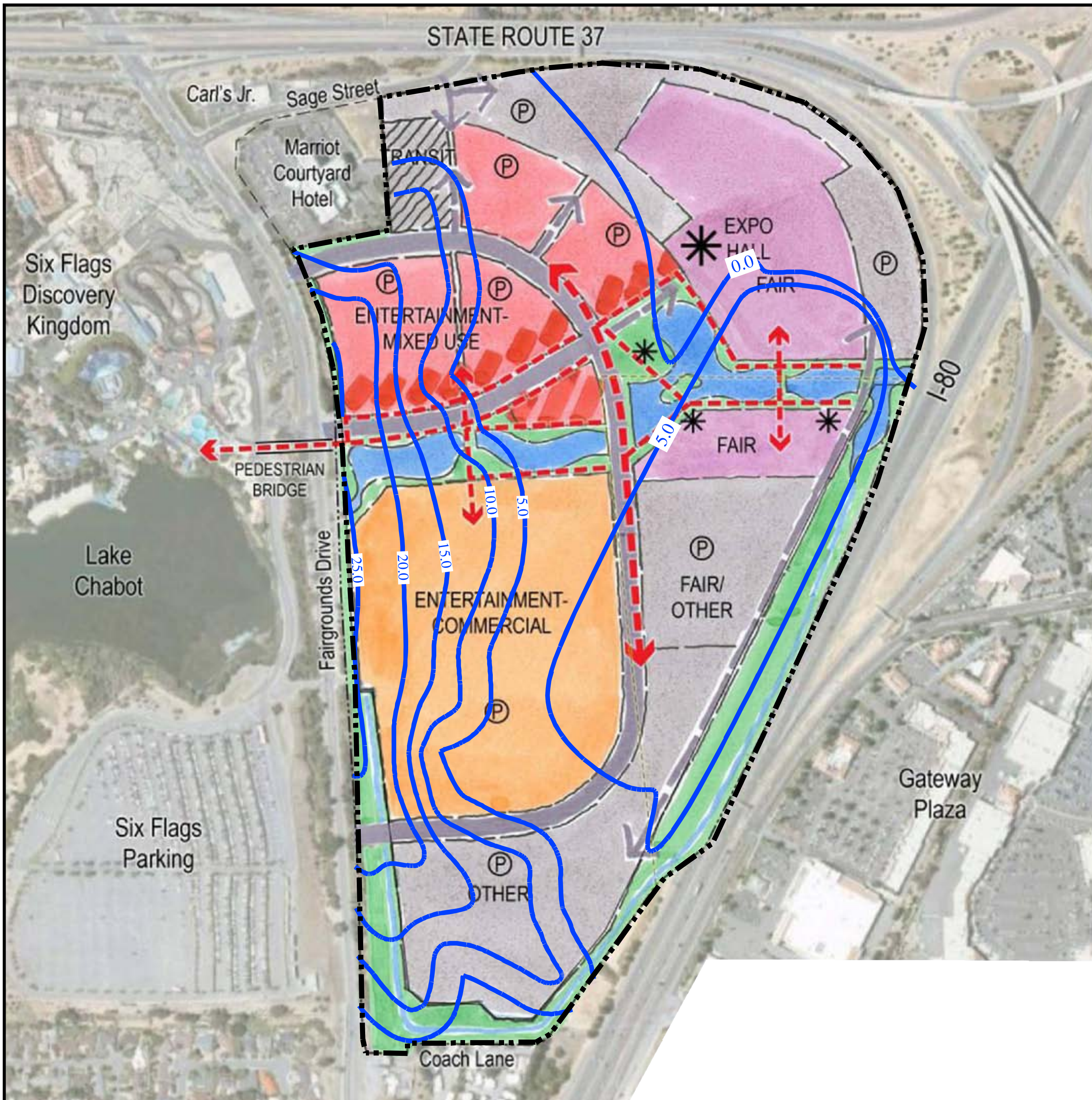
10 — APPROXIMATE ISOPAC CONTOUR LINES OF EXISTING FILL THICKNESS

BASE MAP SOURCE: SWA, 360 LAND USE DIAGRAM

ENGEO Expect Excellence	EXISTING FILL THICKNESS PLAN SOLANO COUNTY FAIRGROUNDS VALLEJO, CALIFORNIA	PROJECT NO.: 8665.001.000 DATE: AS SHOWN DRAWN BY: JSW CHECKED BY: TB	FIGURE NO. 6

G:\Drafting\DRAFTING2_Dwg\8665\001\GEX\8665001000-GEX-6-Fill Thickness-1111.dwg 11-01-11 10:50:54 AM spatters

ORIGINAL FIGURE PRINTED IN COLOR



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EXPLANATION

- - 25 - - APPROXIMATE ISOPAC CONTOUR LINES OF EXISTING FILL PLUS UNDERLYING SOFT SEDIMENT THICKNESS

0 FEET 600
0 METERS 300

BASE MAP SOURCE: SWA, 360 LAND USE DIAGRAM

ENGEO Expect Excellence	EXISTING FILL THICKNESS PLUS SOFT SEDIMENTS SOLANO COUNTY FAIRGROUNDS VALLEJO, CALIFORNIA	PROJECT NO.: 8665.001.000 DATE: AS SHOWN DRAWN BY: JSW CHECKED BY: TB	FIGURE NO. 7

G:\Drafting\DRAFTING2_Dwg\8665\001\GEX\8665001000-GEX-7-MaterialThickness-1111.dwg 11-01-11 10:48:25 AM spatters

ORIGINAL FIGURE PRINTED IN COLOR

APPENDIX A

Key to Boring Logs
Boring Logs

APPENDIX A

KEY TO BORING LOGS

MAJOR TYPES				DESCRIPTION
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LESS THAN 5% FINES		GW - Well graded gravels or gravel-sand mixtures
				GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES		GM - Silty gravels, gravel-sand and silt mixtures
				GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LESS THAN 5% FINES		SW - Well graded sands, or gravelly sand mixtures
				SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES		SM - Silty sand, sand-silt mixtures
				SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS			ML - Inorganic silt with low to medium plasticity
				CL - Inorganic clay with low to medium plasticity
				OL - Low plasticity organic silts and clays
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 %			MH - Elastic silt with high plasticity
				CH - Fat clay with high plasticity
				OH - Highly plastic organic silts and clays
	HIGHLY ORGANIC SOILS			PT - Peat and other highly organic soils

For fine-grained soils with 15 to 29% retained on the #200 sieve, the words "with sand" or "with gravel" (whichever is predominant) are added to the group name.

For fine-grained soil with >30% retained on the #200 sieve, the words "sandy" or "gravelly" (whichever is predominant) are added to the group name.

GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE: 200, 40, 10, 4 — CLEAR SQUARE SIEVE OPENINGS: 3/4 ", 3", 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT (S.P.T.)
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	STRENGTH*
VERY SOFT	0-1/4
SOFT	1/4-1/2
MEDIUM STIFF	1/2-1
STIFF	1-2
VERY STIFF	2-4
HARD	OVER 4

SAMPLER SYMBOLS

- Modified California (3" O.D.) sampler
- California (2.5" O.D.) sampler
- S.P.T. - Split spoon sampler
- Shelby Tube
- Continuous Core
- Bag Samples
- Grab Samples
- NR No Recovery

MOISTURE CONDITION

DRY	Dusty, dry to touch
MOIST	Damp but no visible water
WET	Visible freewater

LINE TYPES

- Solid - Layer Break
- Dashed - Gradational or approximate layer break

GROUND-WATER SYMBOLS

- Groundwater level during drilling
- Stabilized groundwater level

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer

ENGEO INCORPORATED

LOG OF BORING B-1

ENGEO INCORPORATED

Prelim. Geotechnical Exploration
Solano County Fairgrounds
Vallejo, California
8665.001.000

DATE DRILLED: 4/2/2009
HOLE DEPTH: Approx. 29 ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (msl): Approx. 83 ft.

LOGGED / REVIEWED BY: J. White / TPB
DRILLING CONTRACTOR: Britton Exploration
DRILLING METHOD: Hollow Stem Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	DESCRIPTION	Water Level	Blow Count/Foot	Liquid Limit	Plastic Limit	Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
		Seasonal grass and rock fragments at surface. SILTY CLAY (CL), dark brown mottled with dark yellowish brown, stiff, moist to dry, some fine sand and fine gravel, trace rootlets, layering indicative of fill. (fill)									
	1			9							2*
5	2	Becomes SANDY CLAY (CL), mottled with dark bluish gray, fine to coarse gravel. (fill)		10							2.5*
		Pale yellow and orangish red SANDSTONE fragments found in liner and shoe. (fill)		50/2"							
10	3										
	4	SILTY CLAY (CL), very dark gray mottled with dark yellowish brown, stiff, moist, trace fine gravel. (possible fill/soft sediments)		15							1.25*
15	5										
	6	GRAVELLY CLAY to CLAYEY GRAVEL (CL-GC), dark yellowish brown, dense, moist to wet, fine and coarse gravel, some manganese staining, some clay films on gravel. (possible fill/soft sediments)	▽ (18 ft)	25							
20											
	7	Interbedded CLAYSTONE and SILTSTONE, dark gray and dark yellowish brown, weak, thinly bedded, closely fractured, moderately to highly weathered, iron stained fractures. (bedrock)		50/5"							
25	8	Drilling becomes more difficult.									
		SILTSTONE, dark gray, medium strong, closely fractured, slightly weathered. (bedrock)		50/5"							
		Bottom of boring at 29 feet, groundwater encountered at 18 feet.									

ENGEO INCORPORATED

LOG OF BORING B-2

Prelim. Geotechnical Exploration
Solano County Fairgrounds
Vallejo, California
8665.001.000

DATE DRILLED: 4/2/2009
HOLE DEPTH: Approx. 30½ ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (msl): Approx. 84 ft.

LOGGED / REVIEWED BY: J. White / TPB
DRILLING CONTRACTOR: Britton Exploration
DRILLING METHOD: Hollow Stem Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
	1		Seasonal grass and rock fragments at surface. SANDY CLAY (CL), dark gray mottled with dark yellowish brown, stiff, moist, with fine and coarse gravel, layering indicative of fill. (fill)			11							2*
5	2		Same as above.			6							2*
10	3		SILTY CLAY (CL), very dark gray, stiff, moist, trace fine sand. (possible fill/soft sediments)			11							1*
	4		Becomes SILTY CLAY to SANDY CLAY, trace rootlets. (possible fill/soft sediments)										
15	5		SILTY CLAY (CL), dark gray mottled with yellowish brown, stiff, moist to wet, some fine gravel, some manganese staining. (possible fill/ soft sediments)		∇	12							1.25*
20	6		POORLY GRADED SAND (SP), dark brown, loose, wet, with fine gravel, some silt, coarse grained sand. (possible fill/soft sediments)			10							
						3							
	7		SILTY SAND (SM), brown, very loose, wet, with fine gravel, some clay, medium grained sand. (possible fill/soft sediments)										
25	8		Interbedded CLAYSTONE and SILTSTONE, dark yellowish brown and reddish brown, weak, thinly bedded, closely fractured, moderately to highly weathered, iron stained fractures. (bedrock)			39							
	9		SILTSTONE, dark gray, medium strong, closely fractured, slightly weathered. (bedrock)										
30			Same as above.			50/5"							
			Bottom of boring at 30.5 feet, groundwater encountered at 14.5 feet.										

ENGEO INCORPORATED

LOG OF BORING B-3

Prelim. Geotechnical Exploration
Solano County Fairgrounds
Vallejo, California
8665.001.000

DATE DRILLED: 4/2/2009
HOLE DEPTH: Approx. 28 ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (msl): Approx. 84 ft.

LOGGED / REVIEWED BY: J. White / TPB
DRILLING CONTRACTOR: Britton Exploration
DRILLING METHOD: Hollow Stem Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			Seasonal grass at surface. SANDY CLAY (CL), dark yellowish brown, stiff, moist, with fine and coarse gravel. (fill)										
	1		Extremely difficult drilling, possible boulder, moved boring location 3 feet south and continued.										
5			Same as above.			7							
	2		SILTY CLAY (CL), dark gray mottled with dark brown, medium stiff, trace fine gravel and sand. (fill)										1*
			SILTY CLAY (CL), dark bluish gray, stiff, moist, trace fine gravel and rootlets. (possible fill/soft sediments)			17							1.25*
10	3		SILTY CLAY (CL), dark yellowish brown, very stiff, moist, trace fine gravel, iron staining. (possible fill/soft sediments)			18							2.5*
	4				∇								
15	5		CLAYEY GRAVEL (GC), dark yellowish brown, medium dense, wet, with fine to coarse grained sand, fine and coarse angular to subangular gravel. (possible fill/soft sediments)			22							
			Same as above.			29							
20	6		SANDY CLAY (CL), dark yellowish brown, very soft to soft, moist to wet, fine grained sand. (possible fill/soft sediments)			7							0.25*
	7		Drilling becomes more difficult.										
25			SILTSTONE, dark gray interbedded with dark yellowish brown, weak to moderately strong, thinly bedded, closely fractured, moderately weathered. (bedrock)										
	8	NR	No recovery.			44							
			Same as above.			22							
			Bottom of boring at 28 feet, groundwater encountered at 14 feet.										

ENGEO INCORPORATED

LOG OF BORING B-4

Prelim. Geotechnical Exploration
Solano County Fairgrounds
Vallejo, California
8665.001.000

DATE DRILLED: 4/2/2009
HOLE DEPTH: Approx. 26½ ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (msl): Approx. 91 ft.

LOGGED / REVIEWED BY: J. White / TPB
DRILLING CONTRACTOR: Britton Exploration
DRILLING METHOD: Hollow Stem Auger
HAMMER TYPE: 140 lb. Auto Trip

DESCRIPTION	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Plastic Limit	Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
SANDY SILT (ML), brown, medium stiff, dry, trace fine gravel. (fill)									
SILTY CLAY (CL), dark gray, stiff, moist, trace fine gravel and sand. (fill)		50/4"							1.75*
Asphaltic concrete.									
SANDY CLAY (CL), dark yellowish brown mottled with dark gray, very stiff, moist, with fine and coarse gravel. (fill)		15							2.5*
SILTY CLAY (CL), dark bluish gray, very stiff, moist, trace fine gravel. (possible fill/soft sediments)		19							2.5*
SANDY CLAY (CL), yellowish brown, very stiff, moist, trace fine gravel, fine grained sand, some manganese staining. (alluvium)		25							
	▽								
Becomes light gray mottled with yellowish brown, with gravel.		24							
Trace fine and coarse gravel.		21							2.5*
Bottom of boring at 26.5 feet, groundwater encountered at 19 feet.									