May 15, 2017

EnviroMine, Inc.  
3511 Camino Del Rio South, Suite 403  
San Diego, California  92108  
Attention:  Mr. Dennis Fransway

Dear Mr. Fransway:

This letter transmits two copies of our report of slope stability investigation, prepared for the All American Asphalt Quarry (SMP 95-1), located in the City of Corona, California.

We appreciate this opportunity to provide geotechnical services for this project.  If you have questions or comments concerning this report, please contact us at your convenience.

Respectfully submitted,

CHJ CONSULTANTS, a Terracon Company

[Signature]

Jay J. Martin, E.G.  
Principal Geologist

JJM:lb  
Distribution:  EnviroMine (2 and electronic)
SLOPE STABILITY INVESTIGATION
AMENDED RECLAMATION OF ALL AMERICAN ASPHALT QUARRY
SMP 95-1
CITY OF CORONA, CALIFORNIA
PREPARED FOR
ENVIROMINE INC.
JOB NO. CB175119
Dear Mr. Fransway:

Attached herewith is the report of slope stability investigation, prepared for the All American Asphalt Quarry (SMP 95-1), located in the City of Corona, California.

This report was based upon a scope of services generally outlined in our proposal dated January 15, 2017, and other written and verbal communications.

We appreciate this opportunity to provide geotechnical services for this project. If you have questions or comments concerning this report, please contact us at your convenience.

Respectfully submitted,

CHJ CONSULTANTS, a Terracon Company

Jay J. Martin, E.G.
Principal Geologist

JMJ:lb
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APPENDIX E—SITE PHOTOGRAPHS
INTRODUCTION

During March and April of 2017, this firm conducted document review, geologic mapping, laboratory testing, and slope stability analysis for the All American Quarry in Corona, California. The purposes of this study were to characterize the engineering geologic conditions at the subject mine and evaluate suitable slope configurations for proposed amendments to the mining and reclamation plan.

To orient our investigation, several documents and maps were provided for our use. These include the following:

- Comprehensive Mining Plan (sheet nos. 1 and 2 of 2), Amendment No. 1 dated July 2001
- Comprehensive Mining Plan (sheet nos. 1-5 of 5), Amendment No. 2 dated November 2016

The approximate location of the site is shown on the attached Location Map (Enclosure A-1). A Site Plan and Geologic Map is included as Enclosure A-2.1.
The results of our investigation, together with our conclusions and recommendations, are presented in this report.

**SCOPE OF SERVICES**

The scope of services provided during this investigation included the following:

- Examination of the Comprehensive Mining Plan
- Review of studies, including groundwater condition investigations, by prior consultants
- Structural and geologic mapping of the quarry area
- Collection of representative rock samples
- Laboratory tests including Unconfined Compressive Strength and Specific Gravity
- Evaluation of site seismic conditions
- Kinematic evaluation of the proposed rock slopes
- Slope stability calculations (limit equilibrium) for the proposed slopes under static and seismic conditions
- Consideration of final bench configurations using 50-foot-high by 40-foot-wide benches
- Preparation of this report

**PROJECT CONSIDERATIONS**

This study was performed to evaluate the geotechnical slope stability of proposed reclaimed mine slopes as described in the Comprehensive Mining Plan (Amendment No. 2) dated November 2016. It is proposed to extend the mined and reclaimed slopes eastward from the existing east pit wall to
access resource within the eastern property limits and increase the area and volume of future landfill capacity. The mine produces construction aggregate from a granodiorite source.

The 2016 Mining Plan (Amendment No. 2) shows (Phase 1) a final mined depth to the 400-foot elevation in the western and central final pit bottom with a small portion of the eastern pit bottom between Elevations 500 and 600. Phase 2 consists of a partial backfill operation to bring the reclaimed bottom to between Elevations 500 to 538. Phase 2 backfill operations are not within the scope of this investigation; however, consideration of the fill will be included in calculation of the final reclaimed slope configurations. Phase 3 includes relocation of the processing plant to the central site area and mining to the 400-foot elevation in the area of the existing processing plant in the western portion of the site. Phase 5 includes mining to the 400-foot elevation in a small area in the northwest portion of the property. Mining is not planned in alluvial sediments beneath the plant areas.

Slope configurations for temporary (mining) and reclaimed slopes are depicted on the Mining Plan as follows:

- Maximum inclination of bench faces to be 80 degrees \([0.2(h) to 1(v)]\).
- Finished bench faces to be inclined between 80 degrees (maximum) and 60 degrees (typical based on site conditions).
- Bench height = 25 feet and width = 15 feet where sloped.
- Bench width depicted as 30 feet where temporary vertical slopes are to be utilized below elevation of backfill.
- A 50-foot lateral setback from the brow of the uppermost slope to the property line.
- The overall cut slope angle resulting from the depicted bench geometry is approximately 45 degrees \([1(h) to 1(v)]\).
- Fill slopes are proposed at an angle of 2(h) to 1(v) or flatter.
The tallest cut slope depicted on the 2016 Mining Plan is approximately 920 feet tall and is located along the southern mine boundary. Several slope aspects and heights are depicted including northeast-facing, northwest-facing, north-facing, west-facing, south-facing and southwest-facing slopes.

This investigation provides recommendations for slope and bench geometries that provide suitably stable slopes for final reclamation. Our slope stability evaluation considered the existing 50-foot-tall bench faces with 40-foot-wide benches as are now utilized in mining based on equipment reach capabilities.

Terminology used in this report includes the following as depicted on Enclosure D-1.0.

- Bench height – vertical distance between benches
- Bench width – lateral distance from the toe of bench face to top of next bench face
- Bench face angle – inclination of the slope between two benches
- Haul road (ramp) – road (ramp) provided for access by mining equipment to selected pit levels or pit bottom
- Interramp angle – slope angle formed by a series of uninterrupted benches
- Overall slope – slope formed by a series of interramp slopes separated by haul roads or pit top/bottom

**SITE DESCRIPTION**

The site includes approximately 298 acres with 233 acres in mining. The site is located east of Interstate Highway 15 in the City of Corona in Riverside County, California. Temescal Wash is located west of the site, and an open-pit mining operation is located south of the site. The eastern portion of the site consists of undeveloped hillside terrain formed in granitic bedrock. The site pit is open toward the west-northwest. The site is accessed from Magnolia Avenue and All American Way. Various access roads, haul roads and ramps provide access to the active mine pit and adjacent
areas. Site relief rises from west to east and is formed in several bedrock units of the Perris Structural Block. Natural slopes generally slope at angles less than 30 degrees; however locally steep slopes are present where headward-cutting drainages reach harder bedrock. The Perris Block includes intrusive granitic, metasedimentary and metavolcanic rocks of Cretaceous age in the site area.

Native bedrock exposures are generally limited to the eastern portion of the site and consist of isolated outcrops surrounded by slopes with a mantle of colluvium and a growth of grass (photograph no. 1, Appendix E). The eastern portion of the site consists of a dissected highland with ephemeral northward drainage. Outcrop patterns visible in aerial imagery suggest two roughly east-west and north-south trending structural orientations.

The active pit lacks significant vegetation. Some recently active mine slopes include a mantle of slough concealing underlying benched slopes (photograph no. 2). Reclaimed slopes in the southern portion of the pit are locally vegetated with shrub-type plants. Low grasses and weedy shrubs comprise the primary vegetative cover across the undisturbed portions of the site. Surface water was not present in the pit bottom at the time of our site examinations.

The proposed site configurations, including Phase 1 mining and Phase 2 landfill, are depicted on Enclosure A-2.1. A Geologic Map is included as Enclosure A-2.2. Slope Stability cross sections are presented on Enclosures A-2.3a-c. Ground-based photographs of the site and selected features are included in Appendix E.

**PREVIOUS INVESTIGATIONS**

A series of prior reports addressing slope stability in the mine were reviewed for information pertinent to the current investigation. These include reports by Morhol, Inc. (2002), Fox/Roberts (2001), and Rasmussen (2002).
The Morhol report documents geologic mapping, use of pole plots of measured structural data, preparation of cross sections, geotechnical stability analyses of representative critical slopes, and discussion of general groundwater conditions. Morhol reported the following:

- Groundwater as seepage along fractures and clay-lined fault zones in site bedrock with variable depth and dry conditions in the pit bottom.
- Presence of faults and joints as discontinuities in site bedrock. Faults with clay gouge zones from several inches to one foot in width. Orientation of a "West fault" as N15W, 46NE and an "East fault" as N36W, 34NE.
- Diagrams of joint set orientations for each of five mine benches. Identification of four predominant joint sets that influence quarry stability. These are: N59-83E, 65-80NW; N26-66W, 50-78NE; N10-30W, 75-82SW; and N64-80E, 45-65SE.
- Published values for rock shear strength characterized as cohesion (20 ksf) and friction angle (25 degrees). Factors of safety in two cross sections of 2.48 and 2.12 (static) and 1.99 and 1.70 (seismic). Suitable calculated stability for the planned mine configuration analyzed.
- Gross stability of final mined slopes cut a 40-45 degrees to a maximum height of 700 feet.

A report was prepared by Fox/Roberts Consulting Engineering and Groundwater Geologists (2001), which describes test hole drilling and evaluation of a hydrologic model regarding the potential connectivity of the quarry pit with Temescal Wash. Fox/Roberts reported the following:

- Geologic materials that include young alluvium (recent sediments), older alluvial fan deposits, Puente Formation marine siltstone (black shale and gumbo clay in driller’s logs), and granitic basement rocks.
- Two owner-installed wells within or near the site. These are designated as "3S/6W-32H01" and a "second located well west of the first well and closer to the center of the wash." Driller's logs for the first well documented sand and gravel to 108 feet below the existing ground surface (bgs) and gumbo blue clay from 130 to 180 feet bgs. Driller's logs for the second well documented sand and gravel to 175 feet bgs and blue-gray clayey shale from 175 to 300 feet bgs.
- Seasonal fluctuations of groundwater in Temescal Wash from 5 to 15 feet bgs.
- Two test holes were drilled within the floor of the quarry. Test Hole No. 1 was located in the southeast corner of the pit at elevation 605 feet. Test Hole No. 2 was located in the northwest corner of the pit at elevation 603 feet. Both holes were drilled to 105 feet bgs. Test hole summaries are provided in the subject report.

- Elevation of the water table in the Temescal Basin adjacent to the quarry 625 to 630 feet amsl.

- Static water level in Test Hole No. 1 at 595 feet amsl. Test Hole No. 2 was dry.

- No hydraulic continuity between the granitics in the floor of the quarry and the aquifer in Temescal Wash.

A report was prepared by Gary S. Rasmussen and Associates, Inc. (2002) addresses the engineering geologic conditions and their effect on proposed reclaimed slope configurations. Rasmussen reported the following:

- The general geologic units and nomenclature of bedrock within the site.

- Aerial photograph examination that suggested deep-seated landsliding in the granitic materials. Planned mining would remove this feature if it is present. Landsliding was unconfirmed.

- Colluvium mantling slopes.

- Evidence for faults within the quarry cuts.

- Wedge failure in temporary cuts.

- Summary of groundwater and slope stability findings from the Fox/Roberts and Morhol reports, respectively.

- Recommended cut faces at 60 to 80 degrees between benches in accordance with joint orientation. A 25-foot limit to cut face height. Overall final cut slopes at 1(h) to 1(v) or flatter.

- Alluvium and fill slopes to be cut/constructed at 2(h) to 1(v) or flatter.

- A minimum setback distance of 50 feet from the top of final cut slopes and the site boundary.

- Recommendations for treatment of loose boulders on slopes, on site fills, building locations, and abandonment of unused water wells.
FIELD INVESTIGATION

A certified engineering geologist conducted geologic mapping of the site on April 18 and 20, 2017. Geologic structure was measured, including joint and fault orientations, using a Brunton compass and clinometer. Structural mapping was focused toward existing high walls and quarry exposures. Exposures are sparse in the eastern portion of the proposed mine area as that portion is covered by grass and mantled by a weathered profile that includes thick soil accumulations. The field mapping focus included geologic contacts and rock fabric in proposed slope areas and on features that might affect kinematic stability of local slope faces.

Structural data were augmented by data from a prior study by Morhol (2002). The structural data are summarized in Appendix C. A Geologic Map depicting the recent mine configuration, topography, roads, facilities, and locations of mapping areas and features is provided as Enclosure A-2.2.

SITE GEOLOGY

The site is situated in an uplifted and dissected bedrock terrain in the northern Peninsular Ranges geomorphic province. The Peninsular Ranges include plutonic and metamorphic crystalline rocks of Cretaceous and older age. The crystalline basement rocks are locally mantled by residual soils and capped by isolated alluvial/sedimentary remnants. Geologic units in the site area include intrusive rocks associated with Santiago volcanics (Kvspi), intrusive granitics (Kcg), and alluvium of the adjacent valley area. The mine produces aggregate from the intrusive rock units.

GEOLOGIC UNITS:

As mapped by Gray (1961), Gray and others (2002), and Morton and Miller (2006), the site is underlain by granitic bedrock units that include monzogranite (Kcg), undifferentiated granite (Kgu) and intrusive rocks associated with Santiago Peak volcanics (Kvspi). Estelle Mountain volcanics (Kvem) are mapped adjacent to the southeastern site boundary. The nomenclature of these units
varies by author and date of mapping. The bedrock is mantled by a soil residuum derived from weathering and alteration of bedrock material on flats, accumulation of colluvium on slopes and deposition of alluvium in drainages. The units designated for this investigation are described below.

**Fill (f)**
Fill associated with roadways, processing pads, material stockpiles and ongoing mining operations in the pit is present throughout the mine area. All of these materials are considered undocumented and unsuitable for support of engineered improvements.

**Young Alluvial Channel Deposits (Qya)**
Alluvial channel deposits consisting of poorly sorted, unconsolidated sand, silt and gravel are anticipated in the Temescal Wash channel west of the site. As encountered in driller's logs, these are reported as sand and gravel to 175 feet bgs. The alluvium is underlain by Puente Formation bedrock logged as blue-gray clayey shale.

**Old Alluvial Fan Deposits (Qof)**
Old alluvial fan deposits are mapped along the western site boundary in contact with granitic rocks. These are expected to have soil profiles in the upper portion where undisturbed. This unit is not included within the proposed mining area.

**Monzogranite (Kcg)**
Medium- to coarse-grained tan granitics occur as an intrusive mass that trends roughly north-south across the western portion of the pit (photograph no. 3). As observed in mine exposures, these are locally in fault contact with unit Kvspi. Kcg weathers to a tan color, forms a friable residuum where highly weathered, and exhibits brownish staining on fracture surfaces. Fresh Kcg is hard to very hard based on examination of hand samples. Dark mineral enclaves occur locally where unit Kcg is in contact with Kvspi.
**Intrusive Rocks Associated with Santiago Peak Volcanics (Kvspi)**

Hard to very hard, dark gray, intrusive rocks associated with Santiago Peak Volcanics form the majority of the mine resource (photograph no. 4). This unit is primarily a fine-grained, dark gray rock composed of a suite of mafic minerals with quartz. A porphyritic phase occurs locally and is characterized by euhedral plagioclase crystals up to 6 millimeters in size in a dark gray aphanitic groundmass. The porphyritic phase often, but not always, occurs near the contact with unit Kcg.

**GEOLOGIC STRUCTURE:**

The intrusive rock units of the mine resource are jointed and mildly fractured, forming blocky high wall cuts with a relatively regular pattern of joints, fractures, faults (photograph no. 5). Several inactive faults are exposed in the south high wall. These typically dip eastward at moderate angles and are neutral to north-facing slope faces (photograph no. 6). Some form a contact between the granitic and intrusive units (photograph no. 7). One west-dipping fault was observed. An inactive bedrock fault is mapped by Gray and others (2002) as forming and offsetting a contact along the northeast pit margin. The contact fault is not currently exposed as mapped by Gray and others; however, a smaller fault was observed near the Location 1. We interpret the smaller fault to be a conjugate of and related to the larger mapped fault. The potential for faults to influence slope geometry is addressed in the "Kinematic Evaluation" section of this report.

Unit Kvspi forms few outcrops in the undisturbed eastern portion of the site; however, it is well exposed along a series of high walls near the southern mine boundary. Unit Kcg is exposed at the south and north ends of the mine pit. The more continuous joints in both units dip steeply to the north-northwest, northeast and west-northwest, defining three major joint sets. These joint sets are cut by orthogonal low-angle joints. A similar joint structure was recognized by prior investigators. A variety of less-continuous joints is superimposed on the major joint fabric and represents a more random jointing process and blast-induced fracturing of the high wall mass.

An inactive bedrock fault mapped by Gray and others (2002) projects along the northeast portion of the mine pit. This fault is discussed in the following section.
FAULTING AND SEISMICITY

Regional seismic sources and historic earthquakes were assessed to determine ground motion conditions for evaluation of potential seismic effects on stability of proposed finished slopes. We calculated deterministic peak ground accelerations for the regional seismic sources. These data are presented in the following sections:

REGIONAL FAULTS:
The tectonics of Southern California are dominated by the interaction of the North American and Pacific tectonic plates, which slide past each other in transform motion. Although some motion may be accommodated by rotation of crustal blocks such as the western Transverse Ranges (Dickinson, 1996), the San Andreas fault zone is the major surface expression of the tectonic boundary and accommodates most transform slip between the Pacific and North American Plates. Some slip is accommodated by other northwest-trending strike-slip faults related to the San Andreas system, such as the San Jacinto and the Elsinore faults. Local compressional or extensional strain resulting from the transform motion along this boundary is accommodated by left-lateral, normal and reverse faults such as the Cucamonga fault. Enclosure A-4 depicts faults and their relative activity within the site region. The site is not located within or immediately adjacent to an Alquist-Priolo Earthquake Fault Zone (APZ) designated by the State of California or fault hazard zones designated by the County of Riverside to include traces of suspected active faulting.

Elsinore Fault Zone
The Glen Ivy segment of the Elsinore fault zone is the nearest major active fault, about 6.3 kilometers southwest of the site. The Elsinore fault zone is typified by multiple en echelon and diverging faults. To the north, it splays into the Whittier and Chino faults. The Elsinore is primarily a strike-slip fault zone; however, transtentional features such as the graben of the Elsinore and Temecula Valleys also occur. Most Elsinore fault traces are demonstrably active (Holocene) as documented by Saul (1978), Rockwell and others (1986) and Wills (1988).
The southern segment of the northwest-trending Chino-Central Avenue fault, a northern splay of the Elsinore fault zone, is approximately 10 kilometers miles west of the site and is assigned a 6.8 magnitude by Petersen and others (2008).

The west-to-northwest-trending Whittier fault is approximately 16 kilometers west of the site. The Whittier fault exhibits almost pure right-lateral strike slip (Rockwell and others, 1986). Evidence for activity includes offset of Holocene sediments (Hannan and Lung, 1979) and historic microseismicity (Yerkes, 1985).

**San Jacinto Fault Zone**
The San Jacinto fault zone (SJFZ) is a system of northwest-trending, right-lateral, strike-slip faults approximately 30 kilometers northeast of the site. More large historic earthquakes have occurred on the San Jacinto fault than any other fault in Southern California (Working Group on California Earthquake Probabilities, 1988). The North Clark strand of the SJFZ is suggested to have ruptured twice in the past 300 years during events in 1800 and 1918 (Salisbury and others, 2017).

Based on the data of Matti and others (1992), a portion of the San Jacinto fault may accommodate most of the slip between the Pacific and the North American Plates. Matti and others (1992) suggest this motion is transferred to the San Andreas fault in the Cajon Pass region by "stepping over" to parallel fault strands that include the Glen Helen fault.

**San Andreas Fault Zone**
The San Andreas fault zone is located along the southwest margin of the San Bernardino Mountains, approximately 41 kilometers northeast of the site. The mountain front in the San Bernardino area approximately marks the active trace of the San Andreas fault, here characterized by youthful fault scarps, vegetation lineaments, springs and offset drainages.
**Blind Thrust Faults**

The San Joaquin Hills fault is an inferred blind thrust beneath the San Joaquin Hills in coastal Orange County, southern California. The vertical surface projection of the San Joaquin Hills blind thrust (SJHT) is approximately 32 kilometers southwest of the site. The SJHT is southwest dipping and presumably gave rise to uplift of the San Joaquin Hills. Measurement of uplifted back-bay shorelines and fossil dating suggests an uplift rate of 0.24 meter per 1,000 years and an average earthquake recurrence of 2,500 years on the SJHT (Grant and others, 1999). The SJHT has a postulated potential to produce earthquakes with magnitudes up to Mw 7.3. A latest large event may have occurred in 1769 A.D. based on radiocarbon dating of uplifted marsh sediments (Grant and others, 1999).

**LOCAL FAULTS:**

Several bedrock faults were reported by prior investigators in quarry excavations. As observed during our site mapping these consist of east-, northeast- and lesser southwest-dipping inactive structures related to emplacement of the intrusive bodies at depth. No active faults were identified within the site area during our review of published and unpublished literature and maps, stereoscopic aerial photographs or field mapping. Accordingly, ground fault rupture in the quarry area is not anticipated.

As shown on Enclosures A-2.2 and A-3, an unnamed west-northwest-trending bedrock fault cuts the Kcg and Kvspi units (Gray and others, 2002) and offsets their eastern contact. There are, however, no manifestations of youthful activity along this feature such as scarps or offset drainages. We have observed no indications or evidence of this feature along its southeastward projection in the site exposures. The potential for fault rupture or seismic activity along this fault or other minor shear zones mapped within the quarry is considered very low.
REGIONAL SEISMICITY:
A map of recorded earthquake epicenters is included as Enclosure A-5. The epicenters and magnitudes are plotted using Google Earth from a USGS database of California earthquake catalogs. This enclosure presents yellow circles as epicenters of earthquakes with magnitude equal to or greater than magnitude 4.0 recorded from 1918 through 2016. Red icons are included for named and larger historic earthquakes in the southern California region.

From a ground-shaking standpoint the most significant fault for the site is the Elsinore fault, about 4 miles to the southwest. The potential for ground shaking generated by the Elsinore fault and other regional faults is discussed in the following section.

GROUND-SHAKING HAZARD

The ground-shaking hazard at the site was evaluated from a deterministic standpoint for use as a guide to formulate an appropriate seismic coefficient for use in slope stability analyses.

A deterministic evaluation of seismic hazard was performed for the Elsinore fault and other regional faults using the attenuation relations of Boore and Atkinson (2008), Campbell and Bozorgnia (2008) and Chiou and Youngs (2008). These data are summarized in the following table.

<table>
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<th>Fault (segments)</th>
<th>Magnitude</th>
<th>Distance (km)</th>
<th>Peak Ground Acceleration (g)</th>
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<td>Elsinore (W+GI)</td>
<td>7.3</td>
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<tr>
<td>San Jacinto (SBV+SJV)</td>
<td>7.4</td>
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<td>0.16</td>
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<tr>
<td>Cucamonga</td>
<td>6.7</td>
<td>33</td>
<td>0.11</td>
</tr>
<tr>
<td>San Andreas (SM+NSB+SSB)</td>
<td>7.6</td>
<td>41</td>
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<td>San Joaquin Hills</td>
<td>7.1</td>
<td>32</td>
<td>0.13</td>
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W=Whittier, GI=Glen Ivy, SBV=San Bernardino Valley, SJV=San Jacinto Valley, SM=South Mojave, NSB=North San Bernardino, SSB=South San Bernardino
We utilized \( Kh = 0.2 \) to model the pseudostatic condition for slope stability calculations, consistent with conservative application of methods described by Seed (1979). Seed (1979) considered the size of the sliding mass and earthquake magnitude in selection of \( Kh \). For large slopes, Seed suggested \( Kh = 0.15 \) for sites near faults capable of generating magnitude 8.5 earthquakes. The closest fault to the site, the Elsinore fault, is assigned a characteristic magnitude of 7.3 for the Whittier and Glen Ivy segments. Based on the method of Seed (1979) and the seismic setting of the site, our selection of \( Kh = 0.20 \) is conservative and appropriate for evaluation of existing and future site slopes.

**GROUNDWATER**

The site is located in Sections 32 and 33 of Township 3 South, Range 6 West adjacent to the Temescal sub-basin of the Temescal Valley groundwater basin (Wildermuth, 2007). Groundwater data compiled by Western Municipal Water District (2017) indicates that groundwater occurs along the Temescal Wash channel at shallow depth. Temescal Wash is located near the western site boundary where the channel has an elevation of approximately 640 feet. Static groundwater was reported at 595 feet amsl in a test hole drilled in the "southeastern corner" of the mine pit in 2001. A second test hole No. 2 located in the "northwestern corner" of the pit was dry. A groundwater study investigation by Mr. Mark Roberts (2017), conducted concurrent with our slope stability investigation, included drilling of four test holes to depths ranging from 88 to 135 feet bgs. Information from the test holes indicates static groundwater at elevations from 496.5 feet amsl to 643 feet amsl. The locations of test holes is shown on Enclosure A-2.2. The lowest portion of the pit is currently mined to an elevation near 500 feet amsl. A maximum pit depth of 400 feet amsl is proposed with a lowest outlet elevation (pit rim) of 660 amsl. The following table summarizes groundwater data for the site.
Table 2: Summary of Groundwater Data

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<td>38</td>
<td>626</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12-8-2014</td>
<td>67.4</td>
<td>596.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T3S/R6W-32G01 All American Well No. 2</td>
<td>5-13-2016</td>
<td>66.6</td>
<td>593.4</td>
<td>660</td>
<td>NW portion</td>
</tr>
<tr>
<td></td>
<td>10-30-2001</td>
<td>43</td>
<td>617</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-14-2003</td>
<td>41</td>
<td>619</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>6-10-2005</td>
<td>31.3</td>
<td>628.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11-20-2011</td>
<td>37.3</td>
<td>622.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4-19-2014</td>
<td>53.5</td>
<td>606.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mark Roberts TH-1</td>
<td>4-4-2017</td>
<td>5.5</td>
<td>497.5</td>
<td>503</td>
<td>Pit</td>
</tr>
<tr>
<td>Mark Roberts TH-2</td>
<td>4-4-2017</td>
<td>8.5</td>
<td>496.5</td>
<td>505</td>
<td>Pit</td>
</tr>
<tr>
<td>Mark Roberts TH-3</td>
<td>4/13/2017</td>
<td>39.8*</td>
<td>631.2</td>
<td>671</td>
<td>West portion</td>
</tr>
<tr>
<td>Mark Roberts TH-4</td>
<td>4/13/2017</td>
<td>41</td>
<td>643</td>
<td>684</td>
<td>West portion</td>
</tr>
</tbody>
</table>

*initial reading – hole collapsed prior to 24-hour reading.

Recent groundwater elevation measurements indicate that groundwater levels within the pit area are at 495 feet amsl - approximately 95 feet higher than the planned pit bottom (400 feet amsl). Mark Roberts concluded that groundwater beneath the pit is not hydraulically connected to the Temescal Wash (basin) and that no deleterious effects are anticipated with the deepened mining plan.
For purposes of slope stability modeling, we assumed a conservative pit-full condition with a static water table established at elevation 650 feet amsl; however, this condition is not anticipated.

We observed slight seepage and enhanced plant growth along bedrock faults in the southern portion of the site. An adjacent mine operator reportedly releases surface flow to a ravine adjacent to the south access road above the south high wall. The seepage occurs in an unconfined state as a result of overland flow and local infiltration. Evidence of a groundwater table was not observed in the pit, and no standing water was present. The western portion of the site, near Temescal Wash, is within an area of "low" liquefaction susceptibility according to the Riverside County Integrated Project (2013). This area of the site is outside of quarry boundary and is not anticipated to be affected by mining activities.

Based on the presence of non-liquefiable bedrock, the potential for liquefaction and other shallow groundwater-related hazards at the site is considered to be very low. The quarry bottom may be exposed to periodic ponding of surface water after locally heavy precipitation. However, such ponding is anticipated to be shallow and short-lived—lasting only as long as evaporation/infiltration occurs; therefore, this transient water is not considered in slope stability calculations. Groundwater is not anticipated to significantly affect the stability of the proposed slopes; therefore, our evaluation considered dry conditions in the slope stability calculations.

**SLOPE STABILITY**

The term "landslide", as used in this report, refers to deep-seated slope failures that involve mine pit-scale features that have the potential to reduce the long-term stability of finished quarry reclamation slopes. Landslides in rock are typically related to structure in the parent material. Surficial failures refer to shallow failures that affect limited bench faces and may result in localized raveling of rock material.
Surficial failures or raveling, typically involving surface soils or the disturbed rock zone mantle, are considered a slope management/maintenance issue during mining.

The susceptibility of a geologic unit to landsliding depends on various factors, primarily: 1) the presence and orientation of weak structures, such as fractures, faults or clay beds; 2) the height and steepness of the natural or cut slope; 3) the presence and quantity of groundwater and 4) the occurrence of strong seismic shaking. Primary influences on the stability of final mine slopes are anticipated to be interaction between slope geometry and geologic structure including joints and bedrock faults within the final pit margin.

Typical bench face heights in hard rock mines range from 40 to 50 feet, the expected (and existing) range for the All American Asphalt mine. The modified Ritchie Criteria (MRC), where bench width is equal to 0.2 x height + 15 feet, provides a guide for selection of bench width to mitigate rock fall (Ryan and Pryor, 2000). The minimum recommended bench widths for 40-foot-tall and 50-foot-tall slopes is 23 feet and 25 feet, respectively. A bench configuration of 50 feet (H) x 40 feet (W) was evaluated that utilizes an interramp slope with an angle of 51 degrees. Bench faces will be approximately 80 degrees based on examination of existing conditions. Consideration of backbreak results in an effective bench width of approximately 31 feet measured from the toe of the bench face to the outside of the bench. This effective bench width is considered suitable for mitigation of rockfall for the subject mine. A diagram of this bench configuration is provided as Enclosure C-7. Additional discussion of slope geometries and recommendations for design benching and an overall slope angle is provided in following sections.

**GEOLOGIC STRUCTURE:**

Geologic structural observations included measuring the orientation of bedrock structures (discontinuities) in outcrop exposures during field mapping. The orientations of discontinuities were recorded in tabular format (Appendix C - Table C-1). Structural data were listed according to location.
The majority of more-continuous bedrock discontinuities consist of steeply-dipping joints that dip more steeply than or control the bench face angle (photograph no. 8). At the bench/face scale, discontinuities are primarily block-forming, random fractures developed as a result of blast fracture. Unit contacts consist of sharp intrusive and fault contacts between the Kcg and Kvspi units. Based on these observations and the results of our investigation, deep-seated landsliding is not anticipated in the proposed slopes. Analyses of the proposed reclamation slopes are presented in the following section as kinematic analysis and slope stability calculations.

**SLOPE STABILITY EVALUATION**

We evaluated the kinematic and global slope stability of the proposed slopes for representative configurations and material types. Stereographic analyses were conducted on the discontinuity orientation data (Table C-1) to identify the kinematically-possible failure modes in bench faces. Typically, it is not cost effective to eliminate all potentially unstable blocks, and a certain percentage of bench face failure and/or multiple bench instabilities is acceptable. Most of the smaller unstable features are removed during mining by scaling of the bench faces. Limit equilibrium analyses (global stability) of the proposed rock slopes were performed to compute the overall factors of safety against large-scale, multi-bench failures through the rock mass. Slope heights were determined from the Mine Plan, and overall slope angle and bench geometry were modeled according to the steepest/tallest slope/face anticipated for the final mine configuration.

Rock strength properties for global stability calculations were modeled using Hoek Brown criteria and the ultimate mining depths (highest slopes) anticipated in the mine pit. Discussion and summary of these analyses are presented below. Slope stability data and calculations are presented in Appendices C and D.

**KINEMATIC ANALYSIS:**

Kinematic analysis involves the evaluation of geometrically feasible failure modes in bedrock based on the orientation of structural discontinuities including joints, faults and shear zones. Kinematic
analysis does not consider mass or force as in a limit-equilibrium analysis. The presence of bonded contacts and rough surfaces along joints between adjacent blocks and scaling practices makes the mined slope condition more stable than is inferred by kinematic statistics. Structurally controlled kinematic failure modes include planar, wedge and topple failures. The potential for circular failure of highly fractured rock masses is addressed by the global stability analysis. The angles evaluated in the kinematic analysis are selected to represent maximum or worst-case conditions to capture the potential for daylighted features in bench faces and overall slopes. Bench face angles are determined by field conditions. Due to the inclusion of ramps or haul roads in the overall slopes, final overall slope angles determined by global limit equilibrium analysis are typically flatter than the kinematic models.

Stereonet analysis (Rocscience, 2016) for selected representative slope/bench aspects was performed utilizing the data compiled from mapping and measurement of geologic structures within the site (Appendix C – Table C-1). A maximum bench face angle of 80 degrees was used to represent the existing high wall faces along the southern pit margin and expected final bench faces that are controlled by major joint orientations. A 50-degree overall slope angle (representing slopes extending from the pit rim to pit floor and including benches, ramps and intervening slopes) was evaluated for large-scale faults and shears.

The bench face angle was evaluated for a suite of representative slope azimuths (facing directions) based on the Mine Plan. The slope orientations are listed in Table 3. A plot of major structural trends identified by prior investigators was also created (Enclosure C-2.4). The major joint sets defined by our investigation (Enclosure C-2.2) are consistent with those of the prior investigators. The dominant joint sets exhibit steeply-dipping northeast, north-northwest, and northwest dip directions. Faults and shears exhibit a similar bias to the major joint sets with the addition of a moderate southwest-dipping trend for a fault observed on the 850 Bench and a shear at Location 5.

Planar sliding analysis considers dip vectors of measured data points. Planar sliding requires a releasing surface—a joint or tension crack—to allow sliding to occur. Kinematic analysis does not
consider the geometry of releasing surfaces or the presence/strength of bonded contacts along the sliding plane; therefore actual conditions are typically more stable than indicated by kinematic results. The potential for planar sliding or wedge failure suggested by stereonet analysis should be considered a conservative estimate of probability subject to mitigation by mining practices such as scaling and adjustment of slope face angles to the geometry and conditions encountered during mining. Wedge analysis generates dip vectors for the intersections of all planes; therefore, wedge analysis generates a large number of vectors to evaluate. Topple analysis identifies the potential for columns to form along steeply dipping joint systems or contacts to tilt out of the excavated face along separation surfaces. The stereonet data plots are presented in Appendix C. Table 3 summarizes the results of kinematic evaluation.

<table>
<thead>
<tr>
<th>Slope Aspect</th>
<th>Planar</th>
<th>Wedge</th>
<th>Topple</th>
</tr>
</thead>
<tbody>
<tr>
<td>065</td>
<td>8.05</td>
<td>24.64</td>
<td>13.42</td>
</tr>
<tr>
<td>180</td>
<td>2.01</td>
<td>23.50</td>
<td>8.72</td>
</tr>
<tr>
<td>195</td>
<td>6.71</td>
<td>26.83</td>
<td>6.71</td>
</tr>
<tr>
<td>275</td>
<td>7.38</td>
<td>26.78</td>
<td>6.71</td>
</tr>
<tr>
<td>320</td>
<td>9.40</td>
<td>24.99</td>
<td>10.07</td>
</tr>
<tr>
<td>360</td>
<td>6.71</td>
<td>24.73</td>
<td>4.70</td>
</tr>
</tbody>
</table>

The stereonet evaluation provides results as a percentage of points in a data set with a geometrically feasible orientation to undergo a particular failure mode. In general, the percentage value relates to geometric probability of a particular failure mode. Probabilities below 5 percent suggest low failure potential, 5 percent to 20 percent a low to moderate potential, and values above 20 percent a moderate or higher potential. The sensitivity of slope aspect as a percentage of the total
discontinuities (intersections for wedge analysis) for the three failure modes is presented as series of graphs in Enclosures C-3.1 through C-3.3.

**80-Degree Bench Faces**

For 80-degree bench faces, low to moderate planar sliding potential is indicated. Northwest-facing slopes exhibit a moderate potential for planar sliding (Enclosure C-4.5) along discontinuities consisting of joints with low continuity (Enclosure C-2.2). Based on the steep dip of northwest-facing joints in the global data set and a lack of faults or major joints with daylighted northwest-facing geometries (Enclosure C-2.3), the effective potential for planar sliding is low for all slope aspects. Existing slopes with a northwest aspect exhibit suitable performance with regard to planar stability; future benched slopes with this aspect are expected to perform similarly.

Topple potential is low to moderate for all slope azimuths based on the sensitivity plot for 80-degree faces (Enclosure C-3.2). The steep joint orientations observed in existing cuts provide potential for flexural topple, the expected topple condition for rough joint surfaces, where rock condition is poor and dilation has occurred from production blasting; however, scaling during mining has eliminated topple features. The effective potential for topple is considered low for effectively managed and scaled bench faces.

The sensitivity plot of wedge potential versus slope aspect suggests a moderate to strong potential for wedge failure geometries to form in all slopes, with aspects from 210 to 250 degrees having the highest potential (Enclosure C-3.3). However, the bench faces examined during this investigation did not exhibit problematic wedge failures. The wall scaling and mining practices conducted thus far, including of unstable blocks, appear to produce bench faces with stable conditions relative to wedge geometries. It appears that the effect of joint roughness and strong contact/incomplete separation between blocks mitigates the wedge geometry. The effective potential for problematic, multi-bench-scale wedge failures is considered low. Wedge blocks are expected to be bench-scale features mitigatable during mining.
Recommendations for mitigation of bench-scale raveling due to kinematically-possible slope failures are provided in the "Recommendations" section. The benching plan presented in the Mine Plan is considered feasible with regard to the performance of the proposed rock faces provided that the recommendations presented herein are considered in mine planning and operation. Bench design should allow for adjustments due to areas of raveling on wall faces.

**50-Degree Overall Slopes**

We considered a 50-degree slope to evaluate the potential for faults or shears— the most continuous structures—to affect large-scale kinematic stability. The sensitivity plot for planar sliding in 50-degree slopes is shown as Enclosure 3.4. A moderate to high potential is suggested for sliding in the southwest direction. Southwest-facing reclamation slopes are not planned where mapped faults or shears have adverse orientations. In addition, existing southwest-facing slopes appear uniformly stable and lack large-scale structures with adverse southwest-dipping orientations (photograph no. 9). For future southwest-facing excavations in unexplored areas of the site, geologic mapping can identify faults or large-scale structures with the potential to cause instability. The remaining slopes aspects show low potential for large-scale kinematic planar instabilities.

**GLOBAL STABILITY CALCULATIONS:**

The global stability for the steepest anticipated overall mine and reclamation slopes, as depicted on the Mining Plan, was analyzed using Spencer's method under both static and seismic conditions for rotational and composite failure surfaces using the SLIDE computer program, version 6.039 (Rocscience, Inc., 2016). Selection of the slope configurations for the analysis, which include the tallest anticipated excavated slope proposed and maximum recommended overall slope angle, is based on a most-conservative approach and is applicable to all reclaimed slopes throughout the mine. The final haul road alignments/locations are not determined at this time, but inclusion of haul roads will result in flatter overall slopes angles. Therefore, we modeled the tallest slope (920 feet measured perpendicular to the slope near Section D with an overall slope angle of 49 degrees) as a benched slope with a haul road to demonstrate the stability of the steepest allowable overall slope angle.
We modeled several additional overall slopes using a smoothed, un-benched model with an angle of 49 degrees. The overall angle for slopes that include haul roads and safety benches may be flatter than 49 degrees. Individual structural features are addressed in the kinematic evaluation and are not considered in the global, whole-rock analysis. In addition, faults with a potential to produce whole-slope instabilities of a global type were not present. Table 4 summarizes the slope configuration evaluated for this study.

<table>
<thead>
<tr>
<th>Section</th>
<th>Height (feet)</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>460</td>
<td>Smooth slope at overall 49° angle</td>
</tr>
<tr>
<td>B</td>
<td>290</td>
<td>Smooth slope at overall 49° slope</td>
</tr>
<tr>
<td>C</td>
<td>540</td>
<td>Smooth slope at overall 49° slope</td>
</tr>
<tr>
<td>D (modified)</td>
<td>920</td>
<td>50' (H) - vertical face x 40' (W) benches forming a slope with overall angle at 49°</td>
</tr>
<tr>
<td>F</td>
<td>320</td>
<td>Smooth slope at overall 49° slope</td>
</tr>
</tbody>
</table>

The seismic stability calculations were performed using a lateral pseudostatic coefficient "Kh" of 0.20, consistent with the seismic conditions of the site region. Groundwater was modeled at an elevation of 650 feet amsl to consider a conservative condition. The whole rock strength of the geologic units was determined in part by unconfined compressive strength (UCS) tests using block samples from the mine. Laboratory tests are summarized below.
The rock strength was modeled utilizing the Generalized Hoek-Brown criteria (Hoek, 2000 and Hoek, Carranza-Torres & Corkum, 2002) and the program's built-in parameter calculator with the following input values:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Unconfined Compressive Strength (UCS)</th>
<th>Specific Gravity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PSI</td>
<td>PSF</td>
<td></td>
</tr>
<tr>
<td>Kcg</td>
<td>27,490</td>
<td>3.96 x 10^6</td>
<td>2.623</td>
</tr>
<tr>
<td>Kvspi</td>
<td>24,816</td>
<td>3.57 x 10^6</td>
<td>2.782</td>
</tr>
<tr>
<td>Kvspi (porphyritic)</td>
<td>29,678</td>
<td>4.27 x 10^6</td>
<td>2.743</td>
</tr>
</tbody>
</table>

Table 6.1: Granitic Unit (Kcg) Rock Strength Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Weight (pcf*)</td>
<td>163.7</td>
<td>Measured</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>2.623</td>
<td>Measured</td>
</tr>
<tr>
<td>Intact UCS(^1) (psf**)</td>
<td>3.958 x 10^6</td>
<td>Measured by UCS Test</td>
</tr>
<tr>
<td>Geological Strength Index</td>
<td>55</td>
<td>Blocky with Fair Surface Conditions</td>
</tr>
<tr>
<td>Intact Rock Constant (mi(**)</td>
<td>29</td>
<td>Granodiorite</td>
</tr>
<tr>
<td>Disturbance Factor</td>
<td>1</td>
<td>Production Blasting</td>
</tr>
</tbody>
</table>

\(^1\) Uniaxial Compressive Strength test result
\(^*\) pcf = pounds per cubic foot
\(\text{**}\) psf = pounds per square foot
\(\text{***}\) mi = unitless constant
Table 6.2: Intrusive Units (Kvspi)  
Rock Strength Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Weight (pcf*)</td>
<td>173.6</td>
<td>Measured</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>2.782</td>
<td>Measured</td>
</tr>
<tr>
<td>Intact UCS(^1) (psf(^{**}))</td>
<td>3.573 x 10(^6)</td>
<td>Measured by UCS Test</td>
</tr>
<tr>
<td>Geological Strength Index</td>
<td>54</td>
<td>Blocky with Fair Surface Conditions</td>
</tr>
<tr>
<td>Intact Rock Constant (mi(^{***}))</td>
<td>27</td>
<td>Gabbro</td>
</tr>
<tr>
<td>Disturbance Factor</td>
<td>1</td>
<td>Production Blasting</td>
</tr>
</tbody>
</table>

\(^1\) Uniaxial Compressive Strength test result  
\(^{**}\) pcf = pounds per cubic foot  
\(^{***}\) psf = pounds per square foot  
mi = unitless constant

The results of the global slope stability analyses are summarized below in Table 7. Details of stability calculations including material type boundaries, strength parameters utilized and the minimum factor of safety and critical slip surface are included in Enclosures D-1.1 through D-5.2.

Table 7: Summary of Global Slope Stability

<table>
<thead>
<tr>
<th>Cross Section</th>
<th>Slope Configuration</th>
<th>Static F.S.</th>
<th>Seismic F.S. (Kh=0.20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>460H</td>
<td>3.62</td>
<td>2.60</td>
</tr>
<tr>
<td>B</td>
<td>290H</td>
<td>4.39</td>
<td>3.00</td>
</tr>
<tr>
<td>C</td>
<td>550H</td>
<td>3.10</td>
<td>2.26</td>
</tr>
<tr>
<td>D</td>
<td>920H benched at 49° overall angle</td>
<td>2.53</td>
<td>1.87</td>
</tr>
<tr>
<td>F</td>
<td>370H</td>
<td>3.71</td>
<td>2.81</td>
</tr>
</tbody>
</table>
As indicated by calculation, sufficient static factors of safety in excess of 1.5 and seismic factors of safety in excess of 1.1 were indicated for the modeled proposed rock slope configurations and satisfy Office of Mine Reclamation criteria. The global rock slope configurations appear suitably stable for reclamation of the proposed slopes according to regulatory requirements.

**CONCLUSIONS**

On the basis of our field investigation and slope stability analyses, it is the opinion of this firm that the proposed slope excavations and reclamation of the proposed mine slopes are feasible from geotechnical engineering and engineering geologic standpoints, provided the recommendations contained in this report are implemented during mining.

In general, it appears that the whole rock strength of aggregate resource is sufficient to accommodate the proposed overall slope angles.

Based on our analyses, overall approximate 49-degree mine cut-slopes up to approximately 920 feet in height are suitably stable by calculation against gross failure for the anticipated long-term conditions, including the effects of seismic shaking.

Surficial debris is anticipated to be removed during site development.

Subsequent to blasting of the final rock slope walls, quarry operations may include the use of a scaling chain or mechanical equipment to assist in removal of loose or precarious blocks during removal of the resource. Adherence to the slope benching plan and consideration of newly exposed adverse structural features (if present) during future quarry work can result in stable slopes after completion of reclamation.
Evidence of active faulting was not observed on the site during this investigation. An inactive fault is mapped in the northeast portion of the mine area. The potential for liquefaction and other shallow groundwater hazards within the reclamation/development areas is considered to be low.

Moderate to severe seismic shaking of the site can be expected to occur during the lifetime of the proposed mining and reclamation. This potential has been considered in our analyses and evaluation of slope stability.

Raveling processes during and after quarry operation, with time, will result in deposition of talus on benches. Talus left on the benches can facilitate revegetation and lend a more natural appearance to the reclaimed slopes. It is anticipated that rock fragments will be angular and relatively resistant to rolling. Therefore, rockfall hazard is not anticipated for properly excavated and scaled rock slopes.

Groundwater measurements in onsite wells and drilled test holes indicates static groundwater at elevations from 496.5 feet amsl to 643 feet amsl. The lowest portion of the pit is currently mined to an elevation near 500 feet amsl. A maximum pit depth of 400 feet amsl is proposed with a lowest outlet elevation (pit rim) of 660 amsl. We conservatively modeled static water at the proposed pit outflow elevation for purposes of slope calculation; however, this condition is not anticipated for the reclaimed project. The presence of groundwater in the pit is not considered problematic from a slope stability standpoint.
RECOMMENDATIONS

Final reclaimed overall slopes in competent rock materials within the pit should be designed equal to or flatter than, 49 degrees) up to the maximum height evaluated (920 feet). Inclusion of haul roads or ramps will decrease the overall slope angle. Benching with 40-foot-wide benches every 50 vertical feet, 80-degree bench faces, and 50-degree interramp slopes is suitable by calculation for mining and reclamation. Benching configurations that provide a similar interramp angle and bench width are allowable. Allowance for a final maximum 49-degree overall slope angle should be provided by addition of haul roads or locally wider benches where needed. Haul roads and ramps should be designed in accordance with accepted mining standards. The prevalent joint systems will influence the final geometry of pit walls. The occurrence of back break and kinematic influence on face angles may result in flatter interramp slope angles.

Visual inspection of rock excavations and mine slopes/benches should be performed to address the potential for unknown or newly exposed discontinuities/geologic conditions. If raveling or instability is evident due to features in the geologic structure, the bench width should be increased to provide a suitable buffer to daylighted or unstable features and a sufficient area to mitigate rockfall. Geologic mapping of final slopes should be performed during excavation of reclamation slopes. Preparation of the final benched slope faces may include scaling to ensure removal of loose or potentially unstable blocks.

Blasting practices should be adjusted to reduce damage to rock to be left in reclaimed bench faces. This may require transition from production blasts to pit-wall blasts as mining approaches the designed pit wall (Hagan and Bulow, 2000). Several techniques are available to aid in producing design pit walls that meet reclamation needs. These should be considered and tested prior to reaching final design pit walls as it is often expensive or impossible to correct adverse conditions near pit margins. A blasting consultant experienced with design pit blasting techniques may be consulted if final slope and bench conditions become unsatisfactory.
Unstable or rounded boulders/blocks should be removed or stabilized where accessible. Mine areas below loose rock, if left in place during mining, should be restricted from casual access and indicated by means of signage or fencing.

Based on anticipated reclamation conditions, use of steel netting or other structural installations to mitigate toppling or rock fall is not considered necessary if suitable design pit wall benches are produced; however, these measures can be considered if warranted by future observations or conditions.

Geotechnical evaluation and design, management of mine bench geometry based on encountered conditions, or use of mechanical support systems can enhance the safety of or mitigate hazards in mining; however, monitoring of slope conditions for failure warning signs is the most important means for protecting mine workers (Girard and McHugh, 2000) as it can prevent exposure of personnel to potentially hazardous conditions. As is typical for any surface mining operation, we recommend periodic observation of mine benches above working areas for indications of potential instability during mine operations.

Mine slopes should be protected with berms and/or levees as necessary to prevent slope erosion in the areas where natural slopes drain onto the reclaimed slopes.

**LIMITATIONS**

CHJ Consultants, a Terracon Company, has striven to perform our services within the limits prescribed by our client, and in a manner consistent with the usual thoroughness and competence of reputable geotechnical engineers and engineering geologists practicing under similar circumstances. No other representation, express or implied, and no warranty or guarantee is included or intended by virtue of the services performed or reports, opinion, documents, or otherwise supplied.
This report reflects the testing conducted on the site as the site existed during the study, which is the subject of this report. However, changes in the conditions of a property can occur with the passage of time, due to natural processes or the works of man on this or adjacent properties. Changes in applicable or appropriate standards may also occur whether as a result of legislation, application, or the broadening of knowledge. Therefore, this report is indicative of only those conditions tested at the time of the subject study, and the findings of this report may be invalidated fully or partially by changes outside of the control of CHJ Consultants. This report is therefore subject to review and should not be relied upon after a period of one year.

The conclusions and recommendations in this report are based upon observations performed and data collected at separate locations, and interpolation between these locations, carried out for the project and the scope of services described. It is assumed and expected that the conditions between locations observed and/or sampled are similar to those encountered at the individual locations where observation and sampling was performed. However, conditions between these locations may vary significantly. Should conditions that appear different than those described herein be encountered in the field by the client, any firm performing services for the client or the client's assign, this firm should be contacted immediately in order that we might evaluate their effect.

If this report or portions thereof are provided to contractors or included in specifications, it should be understood by all parties that they are provided for information only and should be used as such.

The report and its contents resulting from this study are not intended or represented to be suitable for reuse on extensions or modifications of the project, or for use on any other project.
CLOSURE

We appreciate this opportunity to be of service and trust this report provides the information desired at this time. Should questions arise, please do not hesitate to contact this office.

Respectfully submitted,

CHJ CONSULTANTS, a Terracon Company

John S. McKeown, E.G. 2396
Senior Geologist

Jay J. Martin, E.G. 1529
Principal Geologist

JSM/JJM:lb
REFERENCES


Campbell, K. W., and Y Bozorgnia, 2008, NGA ground motion model for the geometric mean horizontal component of PGA, PGV, PGD and 5% damped linear elastic response spectra for periods ranging from 0.01 to 10 s, Earthquake Spectra, Vol. 24, No. 1, p. 139-171.


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Hannan, D. L., and Lung, R., 1979, Probable Holocene faulting on the Whittier fault, Yorba Linda, Orange County, California (abs.): Geological Society of America, Abstracts with programs, v. 11, No. 3.


Morhol, Inc., Geoscience Consulting, 2002, Slope Stability Analysis, Proposed Mining and Reclamation Slopes, Amendment to Surface Mining Permit 95-1, All American Asphalt Quarry, City of Corona, California.


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Rocscience, Inc., 2017, SLIDE computer software program, ver. 7.023: 2D Limit equilibrium slope stability for soil and rock slopes.


Saul, R., 1978, Elsinore Fault Zone (South Riverside County Segment) with Description of the Murrieta Hot Springs Fault: California Division of Mines and Geology Fault Evaluation Report 76.


Western Municipal Water District, 2017, Cooperative Well Measuring Program, Covering the Upper Santa Ana River Watershed, the San Jacinto Watershed and the Upper Santa Margarita Watershed, spreadsheet application, project organized by Steve Mains, Watermaster Support Services and Mark T. Copeland, Copeland Consulting.
REFERENCES


AERIAL PHOTOGRAPHS EXAMINED


Riverside County Flood Control District, black and white aerial photograph dated May 5, 1949, photograph no. AXM-4F-179.

Riverside County Flood Control District, black and white aerial imagery dated May 24, 1974, photograph no. 294.

Riverside County Flood Control District, black and white aerial imagery dated April 10, 1980, photograph no. 309.

Riverside County Flood Control District, black and white aerial imagery dated January 30, 1985, photograph no. 6-10.

Riverside County Flood Control District, black and white aerial imagery dated January 23, 1990 photograph nos. 6-10, -13, and -14.

Riverside County Flood Control District, black and white aerial imagery dated January 30, 1995, photograph nos. 7-10 and 7-11.

Riverside County Flood Control District, black and white aerial imagery dated March 11, 2000, photograph nos. 7-10 and 7-11.

Source not determined, black and white aerial imagery dated May 7, 1997, photograph no. 1-1, -2, -3; and 2-1 and 2-2scale: 1" = 500 feet.

Source not determined, black and white aerial imagery dated January 31, 1991, photograph no. 2-1; scale: 1" = 550 feet.

Source not determined, black and white aerial imagery dated April 30, 2004, photograph nos. 1-1 and 1-2; scale: 1" = 600 feet.

Source not determined, black and white aerial imagery dated April 30, 2004, photograph nos. 1-1 through 1-5; scale: 1" = 300 feet.
APPENDIX A

MAPS AND CROSS SECTIONS
GEOLOGIC UNITS:

Qof - fill (from Gray and others, 2002)
Qof - Old alluvial fan deposits (from Gray and others, 2002)

Kog - Monogerocata of Cajuse plume of Morton (1999) (Eratrassic) - Mostly biotite and biotite-hornblende monogerocrate rapping to granodiorite. Medium grained equigranular to subphyllitic. Body is composite, shallow-level intrusion emplaced by magnetic shaping within large volcanic and extrusive rocks. It was tilted eastward and eroded to progressively greater depths from west to east.

Kvopl - Invasive rocks associated with Santiago Peak Volcanics (Eratrassic) - Porphyry. Invasive rocks principally of intermediate composition predates emplaced at shallow depths. Component of plagioclase, clinopyroxene and altered orthopyroxene. Includes ulitic porphyres composed of plagioclase, quartz, and altered pyroxene and biotite.

Geologic Contact, dotted where concealed
Fault
Skate Stability Section (also appears on A-21 Mining Plan)

Reference Location for Mapping
750B Bench Designation
Test Hole Location (Mark Roberts, 2017)
1000P Working Pad
Strike and dip of fault

LIMIT OF MINING
Notes: Proposed grade depicted herein for illustration & approximates overall final benched slope angle. Haul roads not determined at this time. Inclusion of haul roads will result in flatter overall slopes. Proposed fill to be contained within final quarry walls. Existing fill & colluvium not shown.
Note: Proposed grade depicted herein for illustration & approximates overall final benched slope angle. Haul roads not determined at this time. Inclusion of haul roads will result in flatter overall slopes. Proposed fill to be contained within final quarry walls. Existing fill & colluvium not shown.
Note: Proposed grade depicted herein for illustration & approximates overall final benched slope angle. Haul roads not determined at this time. Inclusion of haul roads will result in flatter overall slopes. Proposed fill to be contained within final quarry walls. Existing fill & colluvium not shown.
APPENDIX B

LABORATORY TEST RESULTS
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* C1 - discontinuous (less than 3 ft.); C2 - slightly continuous (3 to 10 feet); C3 - moderately continuous (10 to 30 feet); C4 - highly continuous (30 to 100 feet); C5 - very continuous (greater than 100 feet).

Based on Department of the Interior - Bureau of Reclamation, Engineering Geology Field Manual (2nd edition 1998)
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Based on Department of the Interior - Bureau of Reclamation, Engineering Geology Field Manual (2nd edition 1998)
Joint Sets by Morhol (2002)
South Benches Area
Planar Sliding: Critical Percentage vs. Slope Dip Direction

Mean Values

| Slope Dip = 80 | Slope Dip Direction = 0 | Friction Angle = 34 | Lateral Limit = 20 |

Critical Percentage vs. Slope Dip Direction

Slope Dip = 80  Slope Dip Direction = 0  Friction Angle = 34  Lateral Limit = 20

Drawn By: JMc
Company: CHJ-Terracon
File Name: AAA 360 global data planar.dips7
Date: 3/18/2015, 3:19:29 PM
Project: AAA Corona
Direct Toppling: Critical Percentage vs. Slope Dip Direction

Mean Values

Slope Dip = 80  Slope Dip Direction = 0  Friction Angle = 34  Lateral Limit = 20

Critical Percentage vs. Slope Dip Direction

Project: AAA Corona
Analysis Description: Kinematic
Drawn By: JMc
Company: CHJ-Terracon
Date: 3/18/2015, 3:19:29 PM
Enclosure: C-3.2
Wedge Sliding: Critical Percentage vs. Slope Dip Direction

Mean Values

Slope Dip = 80  Slope Dip Direction = 0  Friction Angle = 34  Lateral Limit = 20

Project
AAA Corona

Analysis Description
Kinematic

Drawn By
JMc

Company
CHJ-Terracon

Date
3/18/2015, 3:19:29 PM

File Name
Enclosure

C-3.3
Planar Sliding: Critical Percentage vs. Slope Dip Direction

Mean Values

- Slope Dip = 50
- Slope Dip Direction = 359
- Friction Angle = 34
- Lateral Limit = 20

Project: AAA Corona
Analysis Description: Kinematic Evaluation
Drawn By: JMc
Company: CHJ-Terracon
Date: 3/18/2015, 3:19:29 PM
Enclosure: C-3.4
Global Data Set

Project: AAA Corona

Analysis Description: Kinematic

Drawn By: JMc

Company: CHJ-Terracon

File Name: All American Data planar 80 195.dips7

Date: 3/18/2015, 3:19:29 PM

Enclosure: C-4.3
**Symbol** | **Type** | **Quantity**
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F |  | 7
J |  | 141
S |  | 1

**Color** | **Density Concentrations**
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0.00 - 0.70
0.70 - 1.40
1.40 - 2.10
2.10 - 2.80
2.80 - 3.50
3.50 - 4.20
4.20 - 4.90
4.90 - 5.60
5.60 - 6.30
6.30 - 7.00

**Contour Data**
- **Pole Vectors**
- **Maximum Density** 6.77%
- **Contour Distribution** Fisher
- **Counting Circle Size** 1.0%

**Kinematic Analysis**
- **Flexural Toppling**
- **Slope Dip** 80°
- **Slope Dip Direction** 65°
- **Friction Angle** 34°
- **Lateral Limits** 20°

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**Plot Mode**
- **Pole Vectors**

**Vector Count**
- 149 (149 Entries)

**Hemisphere**
- **Lower**

**Projection**
- **Equal Angle**

**Global Data Set**
### Global Data Set

- **Symbol**
  - F: 7
  - J: 141
  - S: 1

- **Color**
  - Density Concentrations:
    - 0.00 - 0.70
    - 0.70 - 1.40
    - 1.40 - 2.10
    - 2.10 - 2.80
    - 2.80 - 3.50
    - 3.50 - 4.20
    - 4.20 - 4.90
    - 4.90 - 5.60
    - 5.60 - 6.30
    - 6.30 - 7.00

- **Contour Data**
  - Pole Vectors: 6.77%
  - Contour Distribution: Fisher
  - Counting Circle Size: 1.0%

- **Kinematic Analysis**
  - Flexural Toppling
  - Slope Dip: 80°
  - Slope Dip Direction: 180°
  - Friction Angle: 34°
  - Lateral Limits: 20°

- **Flexural Toppling**
  - Critical: 13
  - Total: 149
  - %: 8.72%

- **Plot Mode**
  - Pole Vectors
  - Vector Count: 149 (149 Entries)
  - Hemisphere: Lower
  - Projection: Equal Angle

### Project Information
- **Project**: AAA Corona
- **Analysis Description**: Kinematic
- **Drawn By**: JMc
- **Company**: CHJ-Terracon
- **File Name**: All American Data topple 80 dins 180.dips7
- **Date**: 3/18/2015, 3:19:29 PM
- **Enclosure**: C-5.2
Symbol | TYPE | Quantity
--- | --- | ---
F | 7
J | 141
S | 1

Color | Density Concentrations
--- | ---
0.00 | 0.70
0.70 | 1.40
1.40 | 2.10
2.10 | 2.80
2.80 | 3.50
3.50 | 4.20
4.20 | 4.90
4.90 | 5.60
5.60 | 6.30
6.30 | 7.00

Maximum Density: 6.77%
Contour Distribution: Fisher
Counting Circle Size: 1.0%

Kinematic Analysis
- Flexural Toppling
- Slope Dip: 80°
- Slope Dip Direction: 195°
- Friction Angle: 34°
- Lateral Limits: 20°

Critical Total %
Flexural Toppling (All): 10 / 149 = 6.67%

Plot Mode
- Pole Vectors
- Vector Count: 149 (149 Entries)
- Hemisphere: Lower
- Projection: Equal Angle

Global Data Set

Project
AAA Corona

Analysis Description
Kinematic

Drawn By
J Mc

Company
CHJ-Terracon

File Name
All American Data topple 8u 195 dips7

Enclosure
C-5.3
### Contour Data
- **Pole Vectors**
- **Maximum Density**: 6.77%
- **Contour Distribution**: Fisher
- **Counting Circle Size**: 1.0%

### Kinematic Analysis
- **Flexural Toppling**
- **Slope Dip**: 80°
- **Slope Dip Direction**: 275°
- **Friction Angle**: 34°
- **Lateral Limits**: 20°

### Flexural Toppling (All)
- **Critical**: 10
- **Total**: 149
- **%**: 6.71%

### Plot Mode
- **Pole Vectors**

### Vector Count
- **149 (149 Entries)**

### Hemisphere
- **Lower**

### Projection
- **Equal Angle**

---

**Global Data Set**

---

**Project**
- **AAA Corona**

**Analysis Description**
- **Kinematic**

**Drawn By**
- **JMc**

**Company**
- **CHJ-Terracon**

**Date**
- **3/18/2015, 3:19:29 PM**

---

**Enclosure**
- **C-5.4**
### Symbol, Type, Quantity

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<td>141</td>
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<td>S</td>
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### Contour Data

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<td>3.60 - 5.40</td>
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<td>5.40 - 7.20</td>
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<td>7.20 - 9.00</td>
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<td>14.40 - 16.20</td>
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<tr>
<td>16.20 - 18.00</td>
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### Critical Intersection

- **Density Concentrations**
  - Critical Intersection: 17.19%

### Kinematic Analysis

- **Wedge Sliding**
  - Maximum Density: 17.19%
  - Contour Distribution: Fisher
  - Counting Circle Size: 1.0%
  - Friction Angle: 34°
  - Critical Total %: 26.78%

### Global Data Set

- **Plot Mode**: Dip Vectors
- **Vector Count**: 149 (149 Entries)
- **Intersection Mode**: Grid Data Planes
- **Intersections Count**: 11025
- **Hemisphere**: Lower

### Analysis Description

- **Project**: AAA Corona
- **Analysis Description**: Kinematic
- **Drawn By**: JMc
- **Company**: CHJ-Terracon
- **File Name**: All American Data wedge 80 275.dips7
- **Enclosure**: C-6.4
- **Date**: 3/18/2015, 3:19:29 PM
### Density Concentrations

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### Analysis Description

**Project:** AAA Corona

**Analysis Description:** Kinematic

**Drawn By:** JMc

**Company:** CHJ-Terracon

**Date:** 3/18/2015, 3:19:29 PM

**File Name:** All American Data wedge 80 320.dips7

**Enclosure:** C-6.5
APPENDIX D

GLOBAL STABILITY CALCULATIONS
Material Name | Color | Unit Weight (lbs/ft³) | Sat. Unit Weight (lbs/ft³) | Strength Type | UCS (psf) | m | s | a | Water Surface | Hu Type | Hu
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
Kc | □ | 163.7 | 170 | Generalised Hook-Brown | 3.958e+006 | 1.16534 | 0.0005553084 | 0.504048 | Water Surface | Custom | 1
Knp | □ | 173.6 | 180 | Generalised Hook-Brown | 3.573e+006 | 1.01017 | 0.000468176 | 0.504342 | Water Surface | Custom | 1

Global Minimums
Method: spencer
FS: 3.620640
Center: 124.638, 1186.445
Radius: 817.813
Left Slip Surface Endpoint: 349.012, 400.014
Right Slip Surface Endpoint: 867.675, 844.811
Left Slope Intercept: 349.012 650.000
Right Slope Intercept: 867.675 844.811
Resisting Moment=1.74848e+10 lb-ft
Driving Moment=4.8292e+09 lb-ft
Resisting Horizontal Force=1.61084e+07 lb
Driving Horizontal Force=4.44905e+06 lb
Total Slice Area=92172.1 ft²

Fault contact
<table>
<thead>
<tr>
<th>Material Name</th>
<th>Color</th>
<th>Unit Weight (lbs/ft³)</th>
<th>Sat. Unit Weight (lbs/ft³)</th>
<th>Strength Type</th>
<th>UCS (psf)</th>
<th>m</th>
<th>s</th>
<th>a</th>
<th>Water Surface</th>
<th>Hu Type</th>
<th>Hu</th>
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<tr>
<td>Kg</td>
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<td>163.7</td>
<td>170</td>
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<td>3.958e+06</td>
<td>1.1634</td>
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<td>Water Surface</td>
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<td>Kspk</td>
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<td>1.0107</td>
<td>0.00468176</td>
<td>0.504342</td>
<td>Water Surface</td>
<td>Custom</td>
<td>1</td>
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</table>

Global Minimums
Method: spencer
FS: 2.603470
Center: 120.586, 1186.422
Radius: 818.888
Left Slip Surface Endpoint: 349.041, 400.047
Right Slip Surface Endpoint: 865.124, 845.481
Left Slope Intercept: 349.041 650.000
Right Slope Intercept: 865.124 845.481
Resisting Moment=6.94646e+009 b·ft
Driving Moment=5.94646e+009 b·ft
Resisting Horizontal Force=1.4531e+007 lb
Driving Horizontal Force=5.58141e+006 lb
Total Slice Area=91131.1 ft²

Diagrams and analysis details are also provided, including Global Minimums and various safety factors. The diagrams show the slide interpretation with specific parameters and calculations.
Material Name | Color | Unit Weight (lb/ft³) | Sat. Unit Weight (lb/ft³) | Strength Type | UCS (psf) | m | s | a | Water Surface | Hu Type | Hu
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
Kcg | 163.7 | 170 | Generalised Hoek-Brown | 3.958e+006 | 1.16534 | 0.0000553084 | 0.504048 | Water Surface | Custom | 1
Knap | 173.6 | 180 | Generalised Hoek-Brown | 3.573e+006 | 1.01017 | 0.0008488176 | 0.504342 | Water Surface | Custom | 1

Global Minimums
Method: spencer
FS: 2.996800
Center: 645.767, 911.617
Radius: 527.273
Left Slip Surface Endpoint: 169.204, 685.997
Right Slip Surface Endpoint: 517.933, 400.075
Left Slope Intercept: 169.204 685.997
Right Slope Intercept: 517.933 651.779
Resisting Moment=4.71025e+009 lb-ft
Driving Moment=1.57176e+009 lb-ft
Resisting Horizontal Force=7.05444e+006 lb
Driving Horizontal Force=2.35399e+006 lb
Total Slice Area=57354.9 ft²

Fault contact to remain

Bedrock septum to remain
<table>
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<tr>
<th>Material Name</th>
<th>Color</th>
<th>Unit Weight (lbs/ft³)</th>
<th>Sat. Unit Weight (lbs/ft³)</th>
<th>Strength Type</th>
<th>UCS (psf)</th>
<th>m</th>
<th>s</th>
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<td>Krip</td>
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<td>173.6</td>
<td>180</td>
<td>Generalised Hook-Brown</td>
<td>3.573e+006</td>
<td>1.0117</td>
<td>0.000468176</td>
<td>0.504342</td>
<td>Water Surface</td>
<td>Custom</td>
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Global Minimums
Method: spencer
FS: 3.097680
Center: 821.409, 1228.828
Radius: 965.203
Left Slip Surface Endpoint: 0.095, 956.764
Right Slip Surface Endpoint: 572.938, 400.071
Left Slope Intercept: 0.095 956.764
Right Slope Intercept: 572.938 649.364
Resisting Moment=2.07554e+010 lb-ft
Driving Moment=6.70029e+009 lb-ft
Resisting Horizontal Force=1.72762e+007 lb
Driving Horizontal Force=5.57715e+006 lb
Total Slice Area=102725 ft²

Safety Factor
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
3.25
3.50
3.75
4.00
4.25
4.50
4.75
5.00
5.25
5.50
5.75
6.00+

Analys
Section C

Drawn By: JMc
Scale: 1:1600
Company: CHJ - Terracon

Date: 4/27/2017, 1:58:32 PM
File Name: Section C.slim
Enclosure: D-3.1

Project: AAA Mine
Analysis Description: Section C

CHJ Consultants
### Material Properties

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<th>Material Name</th>
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<th>Sat. Unit Weight (lbs/ft³)</th>
<th>Strength Type</th>
<th>UCS (psf)</th>
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<th>s</th>
<th>a</th>
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<tbody>
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<td>Generalised Hook-Brown</td>
<td>3.573e+006</td>
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<td>0.504342</td>
<td>Water Surface</td>
<td>Custom</td>
<td>1</td>
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</tbody>
</table>

### Global Minima
- Method: spencer
- FS: 2.262160
- Center: 821.473, 1228.870
- Radius: 865.308
- Left Slip Surface Endpoint: 0.063, 956.763
- Right Slip Surface Endpoint: 572.994, 400.007
- Left Slope Intercept: 0.063, 956.763
- Right Slope Intercept: 572.994, 649.364
- Resisting Moment: 1.84491e+10 lb-ft
- Driving Moment: 8.15549e+09 lb-ft
- Resisting Horizontal Force: 1.57709e+07 lb
- Driving Horizontal Force: 6.97161e+06 lb
- Total Slice Area: 102765 ft²
Global Minimums
Method: spencer
FS: 3.706160
Center: 150.068, 1065.553
Radius: 484.533
Left Slip Surface Endpoint: 264.099, 594.629
Right Slip Surface Endpoint: 607.642, 906.184
Left Slope Intercept: 264.099 650.539
Right Slope Intercept: 607.642 906.184
Resisting Moment=5.81055e+009 lb-ft
Driving Moment=1.56781e+009 lb-ft
Resisting Horizontal Force=8.95775e+006 lb
Driving Horizontal Force=2.41699e+006 lb
Total Slice Area=31191.6 ft²

### Material properties

<table>
<thead>
<tr>
<th>Material Name</th>
<th>Color</th>
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<th>Sat. Unit Weight (lbs/ft³)</th>
<th>Strength Type</th>
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<th>m</th>
<th>a</th>
<th>Water Surface</th>
<th>Hu Type</th>
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### Analysis Description

**Project:** AAA Mine

**Analysis Description:**

**Drawn by:** JMc

**Date:** 4/27/2017, 1:58:32 PM

**File Name:** Section F.slim

**Company:** CHJ - Terracon

**Scale:** 1:750

**D-5.1**
APPENDIX E

SITE PHOTOGRAPHS
Photo 1: Native bedrock outcrop. View east.
Photo 2: Mine slopes with slough over benches.

Photo 3: Granitics (Kcg) exposed in cut at north end of mine pit.
Photo 4: Intrusives associated with Santiago Volcanics (Kvspi).
Photo 5: Typical joint controlled, blocky bench faces – south high wall.
Photo 6: East-dipping fault with gouge and zones of seepage – south high wall.
Photo 7: Steeply-dipping fault contact between porphyritic phase of Kvspi (left) and Kcg (right).
Photo 8: Steeply-dipping, joint-controlled bench faces – south high wall.
Photo 9: Southwest-facing slope along northeast pit margin. View toward Location 1.