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140 West Valley Blvd.
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July 3, 1990

PRELIMINARY ENGINEERING GEOLOGY INVESTIGATION OF SLOPE STABILITY

PYRITE QUARRY RECLAMATION PLAN

GLEN AVON AREA, RIVERSIDE COUNTY. CALIF.

Project No. 2914

GARY S. RASMUSSEN & ASSOCIATES, INC. / *ENGINEERING GEOLOGY*

1811 COMMERCENTER WEST • SAN BERNARDINO, CALIFORNIA 92408 • (714) 888-2422 • 825-9052 • FAX 888-6806

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Prepared For

Paul Hubbs Construction Company
140 West Valley Boulevard
Rialto, California 92376

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140 West Valley Boulevard
Rialto, California 92376

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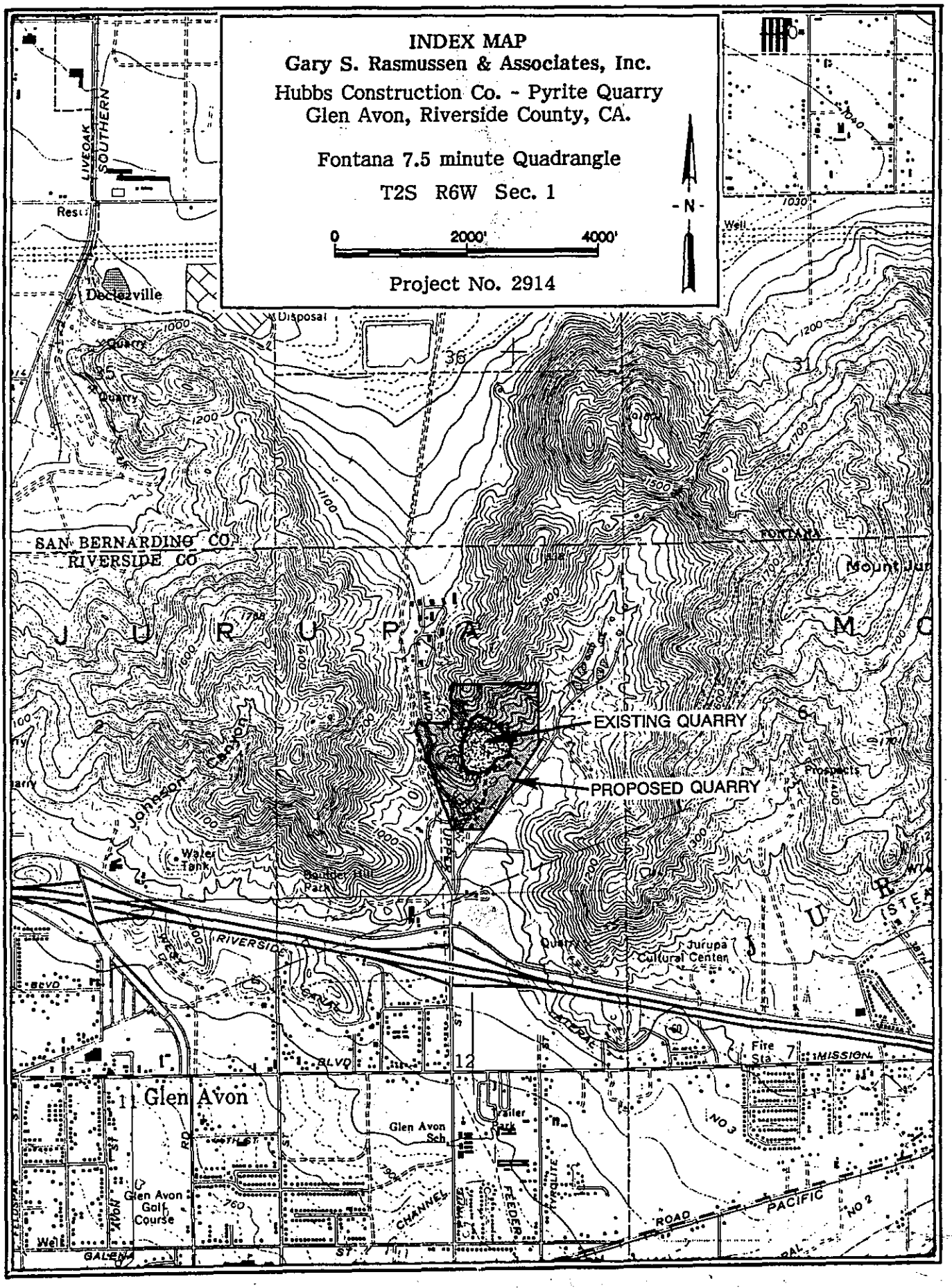
Attention: Jay Hubbs

Subject: Preliminary Engineering Geology Investigation of Slope Stability, Pyrite Quarry Reclamation Plan, Portion of Section 1, T2S, R6W, SBB&M, Pyrite Street, Glen Avon Area, Riverside County, California.

A preliminary engineering geology investigation of slope stability at the Pyrite Quarry has been conducted in accordance with your request. A 100- and 200-scale reclamation plan, dated May, 1990, prepared by Brown & Mullins, Inc., was used in our investigation. The purpose of our investigation was to evaluate the slope stability of the geologic materials at the quarry with respect to the proposed reclamation plan. The approximate location of the existing quarry and the proposed quarry expansion are shown on the index map on page 2.

The reclamation plan indicates that the existing Pyrite Quarry will be expanded to the approximate limits of the property boundary during the next 30 years. We understand that the site will be reclaimed for use as open space and possibly the future placement of human occupancy structures at the completion of mining, estimated to occur in the year 2020. The conclusions and recommendations included in this report are based on eventual human occupancy use of the site.

The reclamation plan shows proposed cut slopes inclined at an overall inclination of 1/2 horizontal to 1 vertical. The highest cut slopes are shown along the northern boundary of the site and are approximately 350 feet in maximum height. Cut slopes up to 250 and 200 feet in maximum height are shown in the western and northeastern portions of the site, respectively. The reclamation plan indicates that the cut slopes will consist of 20-foot wide benches separated by 40-foot high vertical slopes, resulting in an overall cut slope inclination of 1/2 horizontal to 1 vertical.


INDEX MAP
Gary S. Rasmussen & Associates, Inc.
Hubbs Construction Co. - Pyrite Quarry
Glen Avon, Riverside County, CA.
Fontana 7.5 minute Quadrangle
T2S R6W Sec. 1
0 2000' 4000'
N
Project No. 2914
EXISTING QUARRY
PROPOSED QUARRY
SAN BERNARDINO CO
RIVERSIDE CO
Declezville
Glen Avon
Glen Avon Sch
Glen Avon Golf Course
Jurupa Cultural Center
Water Tank
Boulder Hill Park
Prospects
Mount Jur
RIVERSIDE
BLVD
MISSION
PACIFIC
ROAD
CHANNEL
FEEDER
Fire Sta
Disposal
Quarry
Well

SITE INVESTIGATION

A geologic field reconnaissance of the site and surrounding area was conducted on June 14, 1990. In addition, our investigation included review of stereoscopic aerial photographs flown in 1938, 1949, 1953, 1974, 1975, 1980 and 1984; and review of pertinent geologic literature and maps, including reports in our files on nearby projects. A list of aerial photographs reviewed and references cited in this report is included as Enclosure 2.

SITE DESCRIPTION

The approximately 60-acre site is located north of the 60 Freeway and immediately northwest of Pyrite Street in the Glen Avon area of Riverside County, California. The site includes portions of the NE¼ and S½ of Section 1, T2S, R6W, SBB&M. The current operating area of the quarry encompasses approximately 10 acres. Cut slopes associated with the existing quarry are approximately 200 feet in maximum height and their maximum inclination is vertical. The quarry is currently used primarily as a source of riprap for flood control projects. Blasting is the primary excavation method.

At the time of our investigation, the site was occupied by the existing rock quarry and several pieces of heavy machinery used to transport and process the rock. Much of the quarry floor was occupied by stockpiles of large riprap. Rock stockpiles were also observed in the southern portion of the site. Most of the northern portion of the site and the area north of the site includes relatively undisturbed bedrock hillsides covered with a light growth of weeds and brush. An abandoned hazardous waste disposal area (Stringfellow acid pits) exists immediately northeast of the site. A processing plant associated with the hazardous waste exists immediately east of the site. The reclamation plan shows an existing equipment storage area and offices

immediately south of the site, an auto salvage area immediately southwest of the site and an abandoned manufacturing facility immediately northwest of the site.

SITE GEOLOGY

The site is located on the northern portion of a relatively large structural block of land known as the Perris Block. The Perris Block is part of the Peninsular Ranges Geomorphic Province. The Peninsular Ranges Geomorphic Province extends north to the base of the San Gabriel Mountains and south into Mexico to the tip of Baja California. The Perris Block is bounded on the northeast by the San Jacinto fault, on the north by the Cucamonga fault and the San Gabriel Mountains, and on the southwest by the Elsinore fault and the Santa Ana Mountains. The Perris Block is considered to be relatively stable compared to the subsiding San Bernardino Valley Block, which is bounded by the San Andreas and San Jacinto faults. Bedrock hills of moderate relief, such as those that characterize the quarry area, are typical geomorphic and geologic features of the Perris Block.

Geologic materials at the site consist almost entirely of granitic bedrock of the Peninsular Ranges batholith. The granitic bedrock materials mapped on the site include quartz diorite and granodiorite (Morton, 1978, Enclosure 1). Morton mapped quartz diorite in the extreme northeast portion of the property and granodiorite within the existing quarry area and across most of the site.

Metamorphic rocks described as interlayered schist and quartzite of pre-Cretaceous age have also been mapped in the southwestern and extreme northern portions of the property (Morton, 1978). The metamorphic rocks are derived from sediments that predate emplacement of the Peninsular Ranges batholith.

Geologic field reconnaissance and examination of the bedrock types indicates that most of the existing quarry area is within dark, medium to coarse-grained quartz

diorite. The northern, relatively undisturbed portion of the property is underlain by pink, fine to coarse-grained granodiorite. Both of these units are generally very dense and hard. Based on review of aerial photographs and inspection of natural and artificial exposures, the contact between the quartz diorite and granodiorite is nearly vertical and trends in a northwest-southeast direction approximately coincident with the existing northeast quarry wall. The contact between the two units appears to be gradational.

The upper few feet of natural ground in the undisturbed areas of granitic bedrock are characterized by a well developed reddish-brown argillic soil horizon. Bedrock associated with the argillic soil horizon is highly weathered.

Much of the southwest quarry wall exposes metamorphic rocks consisting primarily of slightly to moderately foliated quartzite. Although Morton (1978) showed metamorphic rocks in the extreme northern portion of the site, no metamorphic rocks were observed in the northern portion of the site during the geologic field reconnaissance. All of the materials in the northern portion of the site are expected to consist of fine to coarse-grained granitic bedrock.

Alluvial materials exist in the eastern and southeastern portions of the site associated with a drainage coincident with Pyrite Street. Surficial fill materials associated with the quarrying operations exist at scattered locations across the site. Neither the existing fill materials nor the alluvial materials are considered to be significant to the stability of the proposed cut slopes.

SEISMICITY AND FAULTING

No evidence of faulting through the site or the immediate vicinity was observed during the geologic field reconnaissance or on the aerial photographs reviewed. Numerous northwest-trending lineaments are visible through the site on aerial

photographs that probably represent northwest-trending intrusive contacts, fractures and joints.

Probably the most significant fault to the site from a seismic shaking standpoint is the San Jacinto fault. The San Jacinto fault, located approximately 9 miles northeast of the site, is generally considered to be the most active fault in southern California (Allen, *et al.*, 1965). The San Jacinto fault has been the most seismically active fault in southern California (Allen *et al.*, 1965). Between 1899 and 1990, eight earthquakes of Richter magnitude 6.0 or greater have occurred somewhere along the San Jacinto fault between the San Gabriel Mountains and Mexico (Lamar *et al.*, 1973; Kahle *et al.*, 1988). Other active or potentially active faults are located within the general region, but because of their greater distance from the site and/or lower expected maximum probable earthquake, they are less important to the site.

Based on information available at this time, it is our opinion that a maximum probable earthquake of Richter magnitude 7.0 along the San Jacinto fault may occur. Large earthquakes could occur on other faults in the general area, but because of their greater distance and/or lower probability of occurrence, they are less important to the site from a seismic shaking standpoint.

Seed and Idriss (1983) presented data that showed a relationship between the distance from a causative fault and peak horizontal ground accelerations in bedrock. Based on the data of Seed and Idriss for a Richter magnitude 7.0 earthquake along the San Jacinto fault, approximately 9 miles northeast of the site, a maximum ground acceleration at the site would be approximately 0.38g. This acceleration should not be used as a design value for insertion in the Uniform Building Code formula; rather, it should be considered as an aid in the evaluation of the structural design of any human occupancy structures to be placed on the site in the future.

SLOPE STABILITY

No landslides were observed on or adjacent to the site during the geologic field reconnaissance or on the aerial photographs reviewed. Dense granitic bedrock such as exists on the site is not considered to be susceptible to deep-seated landsliding. However, shallow slope failures may occur within the upper soils mantling the natural slopes and/or associated with oversteepened cut slopes, especially when runoff is concentrated onto slopes.

Probably the most significant structural features in the on-site bedrock that influence the stability of cut slopes is the occurrence, spacing and orientation of fractures (breaks in rock) and foliation (planar alignment of mineral grains).

A moderately developed foliation was observed within the quartz diorite and granodiorite on a localized basis and within most of the metamorphic bedrock. Foliations observed within the granitic and metamorphic bedrock generally trend to the northwest and dip at a steep angle (greater than 55 degrees) towards the northeast. Due to the orientation and localized occurrence of foliation in the granitic bedrock, significant slope stability hazards associated with out-of-slope foliation with respect to the proposed cut slopes are not anticipated. However, in the metamorphic rock foliation is relatively well developed and exhibits greater variability. Slope stability hazards associated with out-of-slope foliation in the metamorphic bedrock may occur.

Significant fracturing was observed within most of the on-site bedrock. Fracture attitudes were obtained from natural bedrock exposures and along the accessible (lower) portion of the quarry face to determine if the fracturing may present a hazard to proposed cut slopes.

Metamorphic bedrock consisting primarily of quartzite is expected to be exposed in the southern portion of the proposed cut slopes along the southwest property

boundary. The quartzite is moderately to highly fractured and moderately weathered. The overall orientation of fracturing in the quartzite is near vertical with a northwest strike. Due to the relatively weathered character and locally intense fracturing of the metamorphic rock, slope raveling and shallow failures should be anticipated in any cut slopes steeper than 1 1/2 horizontal to 1 vertical.

The predominant trend of fracturing in the quartz diorite and granodiorite is to the northwest with a steep to vertical dip. This northwest-trending, steeply dipping fracturing is consistent with the orientation of fracturing in much of the Peninsular Ranges batholith, and is consistent with lineaments visible on the aerial photographs. A less well developed system of fractures strikes to the northeast and dips steeply to vertically. Proposed cut slopes in the granitic bedrock face toward the west, east and south. Due to the orientation of the proposed cuts and the orientation of the predominant trend of fracturing, the fractures observed in the granitic bedrock are not considered to be a significant hazard to proposed cut slopes. A few northwest-trending fractures with a relatively shallow dip to the southwest (30 degrees) were observed in areas of the quarry that appeared to have been heavily blasted. The shallow dipping fractures may be a result of blasting.

CONCLUSIONS

No evidence for large-scale landsliding was observed on the site in the field or on the aerial photographs reviewed. Most of the proposed cut slopes are expected to expose relatively dense granitic bedrock with steeply dipping fractures trending to the northwest and northeast. Due to the general lack of out-of-slope jointing or fracturing relative to the proposed cut slopes, the potential for large rock failures is considered to be low. Cut slopes steeper than 1 horizontal to 1 vertical overall in the granitic bedrock may be subject to large rock falls and rock topples, especially during a significant earthquake in the region.

Due to the foliation, fracturing and weathering in the metamorphic bedrock expected to be exposed in the southern portion of the proposed cut slope along the southwest property boundary, slope raveling and shallow failures should be anticipated in any cut slopes steeper than 1 1/2 horizontal to 1 vertical.

No known faults cross the site and no indicators of fault movement on the site were observed during the geologic field reconnaissance or on the aerial photographs reviewed. Ground rupture due to surface faulting is not expected.

Moderate seismic shaking of the site can be expected within the next 100 years.

RECOMMENDATIONS

Based on the current plans for development at the completion of mining activities (open space and/or industrial park), a maximum overall inclination of 1 horizontal to 1 vertical is recommended for cut slopes in the granitic bedrock. Vertical slopes associated with benches in the granitic bedrock should be no higher than 30 feet. To obtain a 1:1 or flatter overall slope inclination, benches in the granitic bedrock should be at least as wide as the height of the associated vertical slopes.

We recommend a maximum inclination for cut slopes within the metamorphic bedrock (southwest portion of the property) to be 1 1/2 horizontal to 1 vertical overall. Cut slopes inclined at 1:1 overall within the metamorphic bedrock may be feasible based on geologic in-grading inspections conducted by the engineering geologist. Vertical slopes associated with benches in the metamorphic bedrock should be a maximum of 20 feet in height. To obtain a 1 1/2:1 or flatter overall slope inclination, benches on the metamorphic bedrock should be at least 1 1/2 times as wide as the height of the associated vertical slopes.

The proposed quarry operations will include blasting for rock removal; therefore, an inspection of all cut slopes should be conducted by an engineering geologist at the termination of quarry operations. The engineering geologist should evaluate the fracture frequency and orientation of natural or blast-induced fracturing with respect to the bedrock stability evaluation of the slopes. Potentially unstable rock masses may need to be removed or stabilized.

Setbacks for human occupancy structures from the base of the final slopes should be recommended by the engineering geologist based on geologic inspection of the final slopes and the intended use of the structures.

The proposed cut slope inclinations shown on the reclamation plan do not conform to the recommendations made in this report. The final reclamation plan should be reviewed and approved by the engineering geologist.

A maximum probable earthquake of Richter magnitude 7.0 may occur along the San Jacinto fault, which is located approximately 9 miles northeast of the site; therefore, we recommend that human occupancy structures be designed accordingly.

Respectfully submitted,

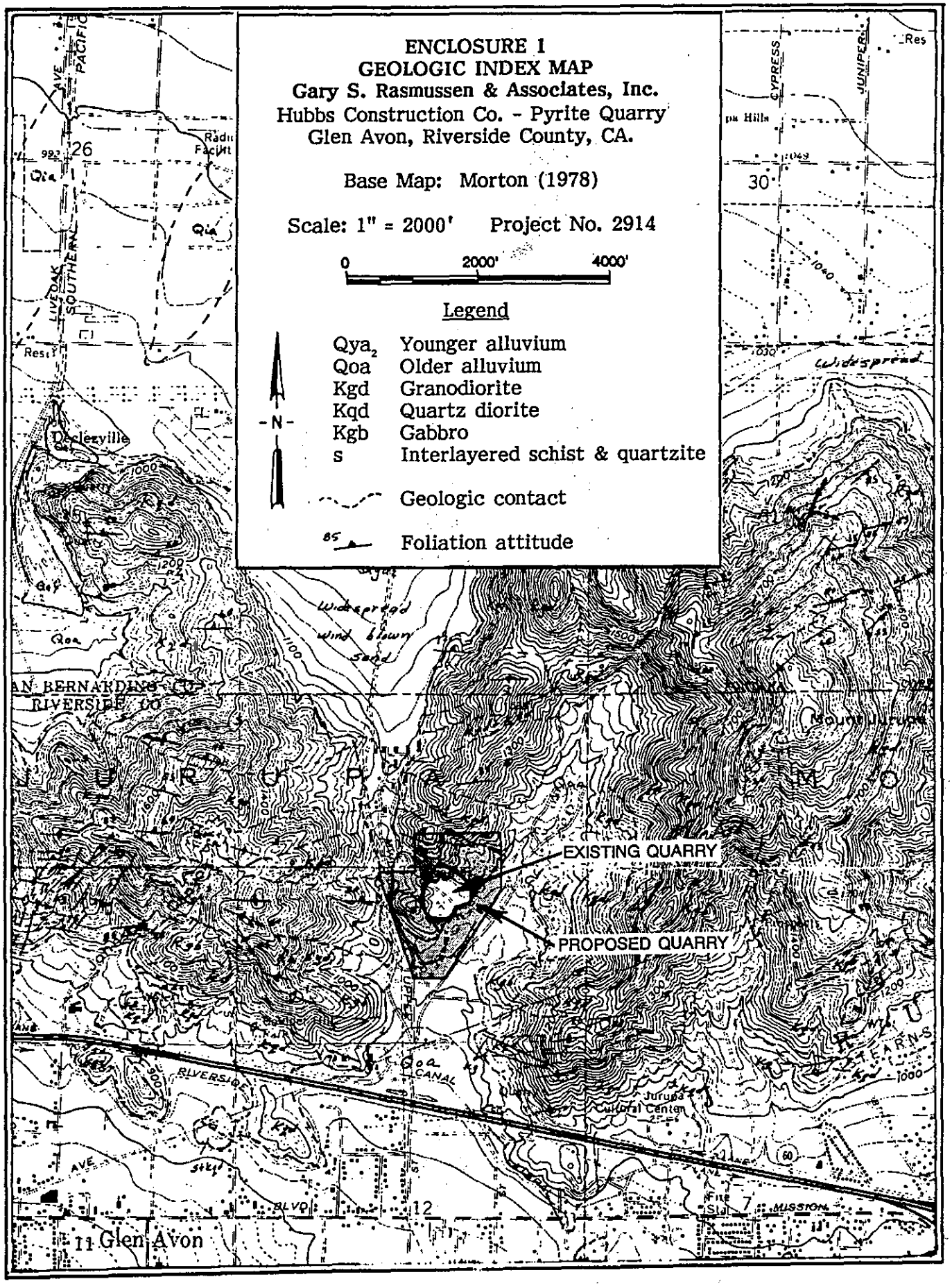
GARY S. RASMUSSEN & ASSOCIATES, INC.

Jay J. Martin
Engineering Geologist, EG 1529

JJM/pg

Enclosure 1: Geologic Index Map
Enclosure 2: References

Distribution: Paul Hubbs Construction Company (6)


ENCLOSURE 1
GEOLOGIC INDEX MAP
Gary S. Rasmussen & Associates, Inc.
Hubbs Construction Co. - Pyrite Quarry
Glen Avon, Riverside County, CA.
Base Map: Morton (1978)
Scale: 1" = 2000' Project No. 2914
0 2000' 4000'
Legend
Qya2 Younger alluvium
Qoa Older alluvium
Kgd Granodiorite
Kqd Quartz diorite
Kgb Gabbro
s Interlayered schist & quartzite
Geologic contact
Foliation attitude
N
EXISTING QUARRY
PROPOSED QUARRY
Declezville
Glen Avon
Jurupa Cultural Center
RIVERSIDE
CANAL
CYPRESS
JUNIPER
Widespread wind blown sand
Widespread
SAN BERNARDINO CO
RIVERSIDE CO
26
30
11
12
7

REFERENCES

Morton, D.M., 1978, Geologic map of the Fontana quadrangle, San Bernardino and Riverside Counties, California: U.S. Geological Survey Open-File Report 78-19.

Riverside County Flood Control and Water Conservation District, January 7, 1949, Black and white aerial photograph numbers 1 and 2.

Riverside County Flood Control and Water Conservation District, May 24, 1974, Black and white aerial photograph numbers 6, 7 and 8.

Riverside County Flood Control and Water Conservation District, August 23, 1975, Black and white aerial photograph numbers 34-36.

Riverside County Flood Control and Water Conservation District, January 23, 1980, Black and white aerial photograph numbers 7 and 8.

Riverside County Flood Control and Water Conservation District, February 27, 1984, Black and white aerial photograph numbers 1784 and 1785.

Seed, H.B. and Idriss, I.M., 1983, Ground motions and soil liquefaction during earthquakes: Earthquake Engineering Research Institute, Monograph Series, Monograph No. 5.

United States Department of Agriculture, June 3, 1938, Black and white aerial photographs, Flight No. AXM-41, photograph numbers 71 and 72.

United States Department of Agriculture, January 31, 1953, Black and white aerial photographs, Flight No. AXL-34K, photograph numbers 59 and 60.