Appendix G-1
Response to County of Riverside Review Comments on County Geologic Report No. 1902

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Project No. 68188

Mr. David L. Jones
County of Riverside Planning Department
4080 Lemon Street, 9th Floor
Riverside, California 92502-1409

Subject: **Response to County of Riverside Review Comments**
County Geologic Report No. 1902
Geotechnical Report, Proposed Liberty Quarry
Riverside County, California

Dear Mr. Jones:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this response to the County of Riverside review comments, dated January 15, 2008, as well as comments and questions raised during meetings with the Riverside County Planning Department Transportation and Land Management Agency (TLMA) on January 17, 2008, March 17, 2008, and April 7, 2008, pertaining the Geotechnical Report and Geologic and Hydrologic Evaluation Reports prepared by Kleinfelder for the proposed Liberty Quarry. In the attached document we have restated each County comment (numbers 1 though 23 from the January 15, 2008 letter), and oral questions/comments from the referenced meetings, which are followed by Kleinfelder's response. If you have any questions or require additional information, please do not hesitate to contact our office at your convenience.

Respectfully submitted,

KLEINFELDER WEST, INC.

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Attachments: TMLA Review Comments Letter, January 15, 2008
Plates
Appendix A – Slope Stability Analysis
Appendix B – Controlled Blasting to Improve Slope stability
Appendix C – Mining Impacts on the Elsinore Fault
Appendix D – Rock Mass and Discontinuity Data Tables
Appendix E – Tables

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The following are comments presented in the County of Riverside, Transportation and Land Management Agency letter, *"Review Comments for County Geologic Report No. 1902, Geotechnical Report, Proposed Liberty Quarry, Riverside County, California"*, dated January 15, 2008; followed by Kleinfelder responses.

1. The CD's to be appended to the August 10, 2007 Kleinfelder report were not included with the copy of the report submitted for review. Please provide these CD's.

   Response – Our apologies for the inadvertent oversight. The CDs were provided to TLMA during our first meeting on January 17, 2008.

2. Please provide paper copies of all boring logs and borehole logs as appropriate.

   Response – One set of color paper copies of all the boring logs presented in the geotechnical report were provided at our meeting on January 17, 2008. Because the logs presented in both reports are the same only one set of paper logs have been provided.

3. The consultant should indicate the surface fault rupture potential at this site.

   Response – There is very low potential for surface fault rupture at the site. As indicated on page 9 of 43 of the Geotechnical Report, the dominate fault structure in the region and the closest known active fault is the Elsinore fault zone, which is located approximately two miles northeast of the site. Based on review of published geologic maps and reports for the site and surrounding area, there are no known active faults present within the site or projecting towards the site (Kennedy, 1977; Lamar and Rockwell, 1986; Vaughan et al., 1999; Rockwell et al., 2000). The site is underlain by granitic bedrock of the Rainbow Pluton (Tan and Kennedy, 2000). Based on a fracture trace analysis conducted for the site, linear surface features crossing the area are interpreted to be related to pluton emplacement and are not related to the Elsinore Fault characteristics of a northwesterly trend (pg 14, Kleinfelder, 2007). Therefore, the potential for surface fault rupture on the site is considered to be very low.

   Comment 3 References:

   Kennedy, M.P., 1977, Recency and Character of faulting along the Elsinore Fault Zone in Southern Riverside County, California, California Geological Survey, Special Report 131, p 1 -2.

   Lamar, D.L. and Rockwell, T.K., l986, An overview of the tectonics of the Elsinore fault zone: in Guidebook and Volume on Neotectonics and

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Faulting in Southern California (P. Ehlig, ed.), Cordilleran Section, Geological Society of America, p. 149-158.

Rockwell, T., Bergmann, M., and Kenney, M., 2000, Holocene slip rate of the Elsinore fault in Temecula Valley, Riverside County, California. In Geology and Enology of the Temecula Valley (B. Birnbaum and K. Cato, eds), p. 105-118.

Vaughan, P.R., Thorup, K.M., and Rockwell, T.K., 1999, Paleoseismology of the Elsinore fault at Agua Tibia Mountain, southern California: Bulletin Seismological Society of America, v. 89, no. 6, p. 1447-1457.

4. The consultant should indicate the liquefaction potential at this site.

Response – There is no potential for liquefaction of soils at the site. Seismically induced soil liquefaction generally occurs in loose, saturated, cohesionless soil when pore pressures within the soil increase during ground shaking. The increase in pore pressure transforms the soil to a semi-liquid state. The primary factors affecting the liquefaction potential of a soil deposit are: (1) intensity and duration of earthquake shaking; (2) soil type and relative density; (3) overburden pressures; and (4) depth to groundwater. Soils most susceptible to liquefaction are clean, loose, uniformly graded, fine-grained sands, and non-plastic silts that are saturated. Silty sands have also been shown to be susceptible to liquefaction. These soils typically lose a portion or all of their shear strength and regain strength sometime after shaking stops. Soil movement (both vertical and lateral) has been observed under these conditions because of consolidation of the liquefied soils and the reduced shear resistance of slopes.

The site is underlain by granitic bedrock of the Rainbow Pluton, the thin isolated well-graded veneers of colluvial and alluvial soils will be removed as part of the mining process. It is Kleinfelder's professional opinion that the conditions for liquefaction to occur are not present.

5. Please indicate whether the data obtained from the video and televiewer logs are incorporated into the Boring Logs and, if so, how.

Response – General data from the video and televiewer logs (i.e. joint spacing, thickness of dikes, color/weathering rinds) were incorporated into the boring logs. The boreholes were first continuously downhole logged by the video camera. Based on observations made during the video recording, sections of bore hole were chosen for logging with the downhole televiewer. Boreholes number MW-1 and MW-2 were logged in four separate runs and MW-3 was logged in five runs. The upper and lower depths of the runs were chosen based on discontinuities observed

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in the video, noted changes during drilling, and/or depth that water was encountered.

An initial review of the televiewer logs was completed following drilling and a limited number of joint set attitudes were collected for evaluation/correlation with observed surface lineaments as part of our hydrologic study. These joint attitudes were incorporated into our gINT boring logs and are listed by dip direction and dip angle. Other data incorporated onto the Boring logs included observed weathering/chemical alteration along joints, and where possible, indications of open or closed joints, dikes, general spacing, and relative angle (i.e. high angle, low angle) and depth to water.

Following Kleinfelder's evaluation of the televiewer logs for the hydrological study, the logs were reevaluated for purposes of incorporating the information into our geotechnical report. The attitudes of joints and planar features compiled from the review of the televiewer were not transferred to the gINT logs. The data (over 1,400 attitudes) was compiled by the Televiewer software into tables that could be imported into RocPack III (Watts, 2005) software for evaluation for statistical analysis (Geotechnical Report - Plate 4- Geologic Fracture Trace map and Appendix E). These data were compiled for use in stereonets and analysis of orientations for computer modeling. This additional joint attitude data are presented on the Televiewer logs but were not duplicated onto the gINT boring logs.

6. Please provide the location of the boreholes that were left open for "future testing and/or monitoring activities" and indicate whether these boreholes remain open at this time. Also, please provide a detailed schematic for the completion of these boreholes (collar, seal, locking cover, etc.) and indicate whether appropriate permits were obtained for the construction of these boreholes (wells?).

Response – The locations of the three borings drilled using air rotary methods are indicated on the attached Plate 2, Geologic and Boring Location Map, and Kleinfelder Geotechnical Report Plate 4, Geologic and Fracture Trace Map (Kleinfelder, 2007). Because these borings were drilled into hard granitic bedrock, the holes were not cased, but were left open. A locking, 8-in diameter, by 3 feet tall monument is fixed in place with an approximately 2 feet by 2 feet concrete base at each boring location. A generalized boring cover detail (Plate 1) is attached. In accordance with Riverside County Ordinance No. 682, the borings drilled as part of a Hydrologic Study were drilled as uncased "exploration holes" for the purpose of immediately evaluating the existing geological and/or hydrological conditions. As such the exploration holes are exempt from permit requirements, as per the monitoring well destruction standards of

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Part III, Bulletin 74-90. There has been no subsequent monitoring since the completion of the investigation. As indicated in our report, because the borings were drilled into competent rock, they were not back filled so that subsequent data acquisition could be completed if required. We have also included the location of the off-site Kirkpatrick well on the attached Plates 2, 2c and 3.

7. The consultant should provide greater detail on the nature of the materials expected to be encountered in the proposed quarry faces. Specifically, the discontinuities in the rock mass ultimately result in weaknesses that typically govern the behavior of the rock, hence, special attention should be made to provide complete descriptions and characterization of these features (fractures, joints, fissures, cleavage, schistocity, degree of weathering, infilling materials, etc.).

Response – After compiling the televiewer data, we plotted stereonets to quantify the discontinuity sets within the granitic rock. We used the stereonets to perform slope stability evaluations of the individual benches for the quarry highwall. In addition, the degree of fracturing of the rock mass was accounted for while estimating the overall global stability of the quarry highwalls.

Discontinuity information collected in the borings and estimated from the downhole camera logging is used as part of the estimation for Rock Mass Rating (RMR). Discontinuity spacing, discontinuity aperture, and discontinuity condition (roughness, weathering/alteration, infilling) are input parameters to estimate the RMR, along with the Rock Quality Designation (RQD) (described below) and rock strength. Hoek and Brown (1997) developed a method to relate RMR to the Geologic Strength Index (GSI). The GSI was used in the Hoek-Brown Failure Criterion and global stability analyses for the quarry walls.

Kleinfelder reviewed boring information from 2004 borings completed by Granite Construction (RO04-1 to RO04-8), 2004 access road borings (C-1 and C-2) completed by Kleinfelder, and 2006 quarry borings (MW-1 to MW-3) and downhole televiewer logging completed by Kleinfelder for monitoring well installation.

The 2004 Granite Construction borings (RO04-1 to RO04-8) estimated rock strength, degree of weathering, degree or fracturing, and RQD. In general the granitic rock mass is characterized as fresh to slightly weathered (altered) granitic rock. In addition, there are zones within the rock mass consisting of moderately to highly weathered (altered) rock that typically are less than 10 feet thick. In boring RO04-5, a zone of highly weathered (altered) rock was observed at a depth range of 366 to 400 feet (bottom of boring). The degree of fracturing (jointing) observed in the

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borings ranged from massive rock (joint spacing greater than 3 feet) to moderately jointed (joint spacing 8 inches to 3 feet). Each boring displayed thin zones of moderately to very jointed rock (joint spacing 4 to 8 inches). In boring RO04-1, very jointed to extremely jointed rock (spacing of 2 inches to 4 inches) was observed at a depth range of approximately 135 to 200 feet. Summary Tables are provided in Appendix D.

Borings C-1 and C-2 were completed in 2004 along the proposed alignment of the quarry access road. Rock core was logged by Kleinfelder to describe the condition of the rock mass and the discontinuities. Discontinuity surface roughness ranged from smooth to very rough, with the majority of discontinuities being classified as slightly to very rough. The classification relates to a joint roughness coefficient of 10-20. The majority of discontinuity apertures that were recorded ranged from tight to moderately open. This classification relates to an aperture width of 0.1 mm to 2.5 mm, with an average opening of about 1.0 mm. The surface of the discontinuity apertures ranged from clean to iron stained with some clay infilling. The majority of the discontinuities were iron stained or partially filled with clay. Summary Tables are provided in the attached Appendix D.

Borings MW-1, MW-2 and MW-3 were completed in 2006 as monitoring wells for the quarry hydrologic study. The borings were completed by percussion hammer air rotary drill rig, therefore rock core was not collected. Downhole televiewer logging of the boring sidewalls was performed to map rock discontinuities. Discontinuity information collected included structure, dip, dip direction, and apparent weathering/alteration and aperture. Structures noted included discontinuities, dikes, laminated joints, schistosity, and fracture zones. Apertures of the discontinuities were classified as hairline or open. The table below summarizes the fracture classifications identified in the boring and the number of discontinuities in each classification. As shown in the table, the majority of discontinuities were classified as hairline structures.

Boring	Total Depth	Fracture Classification and Number of Discontinuities							Total
		Hairline	Open	Dike	Laminated	Schistosity	Zone	Unlabeled	
MW-1	710	242	23	3	50	5	15	42	380
MW-2	570	240	110	6	21	1	17	71	466
MW-3	935	195	100	83	16	18	21	23	456

Televiewer data was not collected through the entire length of the borings. Data was collected in runs around areas of apparent higher fracturing. Kleinfelder estimated the fracture spacing for each run for the borings. The spacing is not based on a specific discontinuity set, but for the rock

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mass in general. The following table summarizes the average spacing per run. This information was used to estimate RQD (See comment 8).

Boring	Run		Average Spacing (ft)	Maximum Spacing (ft)	Minimum Spacing (ft)
	No.	Length (ft)			
MW-1	1	242.6	1.1	6.4	0.005
	2	50.3	1.4	7.1	0.005
	3	160.0	1.9	12.3	0.007
	4	56.3	1.5	5.0	0.26
MW-2	1	147.2	0.7	16.7	0.006
	2	58.0	1.6	8.9	0.03
	3	120.1	0.7	5.9	0.006
	4	73.1	1.0	6.1	0.06
MW-3	1	139.0	0.9	4.5	0.007
	2	47.2	1.7	6.5	0.13
	3	68.1	1.6	5.8	0.09
	4	139.9	2.2	15.0	0.01
	5	241.1	1.3	10.0	0.03

8. Rock Quality Designation (RQD) should also be used as a means of evaluating the quality of the rock mass encountered in the recovered rock cores.

Response – Kleinfelder reviewed RQD values logged during the coring activities while characterizing the rock mass for the purpose of performing global stability analyses, as described below. It is our understanding that the purpose of the original Granite Construction rock cores were for evaluation of rock quality as an aggregate source. Kleinfelder was not present during the drilling of these bore holes; this information was provided by Granite as an additional source of subsurface data within the Kleinfelder report. Most of the cores were angle drilled; therefore the orientation of joints weaknesses within the cores are not true dips from the horizontal giving only and apparent dip. The rock cores were reviewed primarily to collect preliminary information on rock types and rough approximations of weaknesses within the rock. The RQD values logged during the coring activities are sufficient for the purpose of performing global stability analyses.

The RQD values logged during the coring activities were reviewed by Kleinfelder for the purpose of performing global stability analyses. Table 1 below summarizes the average RQD for the eight Granite borings from 2004 and two Kleinfelder access road borings from 2004. The average RQD values for the eight Granite borings ranges from 67 to 92 for the granitic rock. These values indicate that the rock mass is typically fair to good quality rock. A more mafic basaltic dike rock was observed in boring RO04-3, which had an average RQD of 78 and aphanitic aplite dikes were

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observed in boring C-1 with an average RQD of 32. These aphanitic aplite dikes observed were less than five feet in thickness.

Boring	Lithology	Average RQD
RO04-1	Granitic Rock	79
RO04-2	Granitic Rock	87
RO04-3	Granitic Rock	67
	Mafic Basaltic Rock	78
RO04-4	Granitic Rock	92
RO04-5	Granitic Rock	90
RO04-6	Granitic Rock	89
RO04-7	Granitic Rock	89
RO04-8	Granitic Rock	92
C-1	Granitic Rock	78
	Aphanitic Aplite Dike	32
C-2	Granitic Rock	71

Additionally, the RQD was estimated based on fracture spacing as summarized by Bieniawski (1989). Bieniawski developed a correlation chart to relate mean fracture spacing to an average RQD value. Based on the fracture spacing for MW-1 through MW-3 (2006) summarized above in TLMA response 7, the average RQD range was 85-90, indicating good quality rock.

This information, along with the fracture information and rock strength is used to estimate the Rock Mass Rating (Bieniawski, 1989). From the RMR, the Geologic Strength Index (GSI) is estimated for Hoek-Brown Failure Criterion and global stability analysis.

9. Detailed geologic cross sections should be prepared for all slope orientations and configurations in the proposed quarry and access road. These cross sections should be based on surface geology, borehole data, and joint/fracture/foliation attitudes, etc. The cross sections should delineate discontinuities in the rock mass, intrusive dikes, depth of weathering, variations in rock types, and other structural features as appropriate.

    Response – Geologic cross-sections have been prepared for critical sections to conduct a preliminary geologic analysis and are attached to this response letter. These cross-sections are appropriate for this geologic analysis. During the course of site development, additional drilling, sampling and testing along with surface geologic mapping will be used to update cross-sections as needed. These cross-sections and/or new cross-sections based on the mining plan will be included in an annual geologic report submitted to the County and the Department of Conservation. These cross-sections will be the basis for updating and analyzing assessments of both static and dynamic stability.

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10. Geologic maps and cross sections should be provided with more detail and at a larger scale (minimum scale of 1”=100’).

    Response – A Geologic and Boring Location Map - Index Map (Plate 2) scale 1-in to 600 feet, four Geologic and Boring Location Maps (Plates 2a, 2b, 2c and 2d) scale 1-in to 100 feet, a Geologic Cross Section Index Map (Plate 3) scale 1-in to 200 feet, and Cross Sections A-A’ to G-G’ (Plates 3a to 3d) scale 1-in to 100 feet are attached to this letter. These maps and cross sections contain the necessary detail and are at the appropriate scale for the purposes of this geologic analysis.

11. Additional subsurface drilling should be performed so as to provide greater coverage over the entire length, width and depth of the proposed quarry. Oriented rock core drilling should be performed for an adequate number of the bore holes.

    Response – The subsurface drilling and rock analysis performed to date is adequate for purposes of establishing the viability of the site for mining purposes and performing initial site stability analysis. A total of 13 borings, with a combined total depth of 4,798 ft., have been drilled at various locations across the site, taking in consideration rock quality, slope configuration and hydrogeologic conditions. See cross-sections A-A’ through G-G’ attached with this response letter.

    Borings drilled in 2004 by Granite collected rock core for aggregate viability and rock quality within the anticipated final quarry walls. Additional rock cores were collected to evaluate rock characteristics for the proposed road way and provide preliminary cut slope recommendations. Drilling was conducted in 2006 to take into consideration the depth to the final quarry floor and hydrogeologic conditions.

    The three deep boring locations (MW-1, MW-2, and MW-3) were selected based on intersecting through-going lineaments, i.e. bedrock weaknesses (Geotechnical Report Plate 4 – Geologic and Fracture Trace Map and attached Plates 2 and 3). These boring locations were selected as part of the hydrologic evaluation but proved to be adequate for compiling subsequent bedrock characteristics. Additional boring locations were not necessary for the purpose of this report. The following summary tables present general borehole information of borings drilled to date as part of this study.

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2004 Boring Summary – Granite

Borehole Number	Approximate Surface Elevation	Dates Drilled	Total Depth (ft)	Hole Size	Angle	Bearing
RO 04-1	1781	3/12/04 to 3/15/04	263	HQ-3	60°	270°
RO 04-2	1952	3/16/04 to 3/17/04	100	HQ-3	90°	0°
RO 04-3	1904	3/18/04 to 3/20/04	300	HQ-3	60°	50°
RO 04-4	1812	3/22/04 to 3/25/04	299	HQ-3	90°	20°
RO 04-5	1737	3/25/04 to 3/30/04	400	HQ-3	60°	55°
RO 04-6	1669	3/30/04 to 4/1/04	200	HQ-3	60°	65°
RO 04-7	1610	4/1/04 to 4/3/04	225	HQ-3	60°	287°
RO 04-8	1742	4/5/04 to 4/9/04	450	HQ-3	60°	275°

2004 Boring Summary – Kleinfelder

Borehole Number	Approximate Surface Elevation	Dates Drilled	Total Depth (ft)	Hole Size	Angle	Bearing
C-1	1600	4/13/04	200	HQ-3	90°	270°
C-2	1415	4/15/04	150	HQ-3	90°	0°

2006 Boring Summary – Kleinfelder

Borehole Number	Approximate Surface Elevation	Dates Drilled	Total Depth (ft)	Diameter (in)	Optical Run No.	Depth Below Surface (ft)	Approximate Run Elevation
MW - 1	1700	7/24/06 to 7/31/06	710	7.5 to 327 ft	1	24.7 to 267.3	1574.3 to 1432.7
				6.5 to 710 ft	2	305.0 to 355.3	1395 to 1344.7
					3	415.3 to 575.3	1284.7 to 1124.7
					4	654.8 to 711.1	1045.2 to 999.9
MW - 2	1914	7/31/06 to 8/02/06	570	6.25 to 570 ft	1	3.9 to 151.1	1910.1 to 1762.9
					2	195.1 to 253.1	1718.9 to 1660.9
					3	345.1 to 465.2	1568.9 to 1448.8
					4	494.8 to 567.9	1419.2 to 1346.1
MW - 3	1930	8/04/06 to 8/10/06	935	6.75 to 327 ft	1	22.1 to 161.1	1907.9 to 1768.9
				6.25 to 710 ft	2	205.0 to 252.2	1725.0 to 1677.8
					3	380.0 to 448.1	1550.0 to 1481.9
					4	495.3 to 635.2	1437.7 to 1294.8
					5	694.8 to 935.9	1235.2 to 994.1

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The borings and rock analysis described above are sufficient in quantity, placement, and depth to establish the viability of the site for mining purposes and for initial site stability analysis. Additional evaluations, described in Geo No. 1902, will be performed during the mining process to continuously evaluate rock stability. These subsequent evaluations of the slope conditions will be conducted as part of detailed monitoring program of each cut bench as mine operations advance. The monitoring program will include continuous field mapping, drilling, preparation of additional cross sections, and conducting additional slope stability analysis. This ongoing review will provide for adjustment in the mining and slope configurations as rock conditions require. These ongoing evaluations will be submitted to the County of Riverside and the State Office of Mine Reclamation for their review. This type of ongoing data collection and analysis is typical of programs for other hard rock mines and provides the most accurate means of assessing result of previous analysis conducted as quarry walls are advanced. The following sections list the minimum mapping and review requirements for the working face and the final high wall evaluation.

Liberty Quarry Geotechnical Stability Quality Assurance

Inspection of the "Working Face"

Mining will be conducted in a top down manner. The working face will be equal to one-half the bench height and range between 20 to 40 feet depending on the local geological conditions, with a flat working bench (at least 30 feet wide) located below the working bench height. This will result in an interim benched slope configuration as mining proceeds downward at 20 to 40 foot intervals. A Certified Engineering Geologist (CEG) or Geotechnical Engineer (GE) will map the exposed rock face on a weekly basis. Inspection and mapping of the mining face may be more frequent, as needed, depending on the field conditions. Each horizontal bench may only be removed following on-site inspection and in accordance with written recommendations of the CEG or GE. No finished slope steeper than 2:1 (horizontal to vertical) shall be established except in compliance with the recommendation of the CEG or GE. The CEG or GE shall record inspections on a form that is satisfactory to the County or Riverside Planning Department.

Inspection of the "Final High Wall"

As the quarry walls reach the planned extent of the quarry, the CEG or GE will conduct a "final survey" of the quarry walls on a weekly basis. In the case that the final bench configuration is deemed not stable by the CEG or GE, wire mesh, benching and/or rock anchors (or other measures recommended by the CEG or GE) may be implemented so that the originally-planned 60-degree

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overall quarry high wall may be maintained. If an evaluation by the CEG or GE considers that the 60-degree overall pit high wall cannot be maintained through wire mesh, benching, rock anchors and/or other measures, the CEG or GE shall recommend options to reduce the pit high wall slope ratio to maintain bench stability. Recommendations regarding stabilization measures will be included in the weekly inspection forms and the CEG or GE will be on-site to ensure that stabilization measures are implemented according to their recommendations.

The CEG or GE will perform an evaluation of the global stability of the final quarry high wall configuration as the quarry proceeds in a downward manner. In addition to assessing the stability of the individual benches, the CEG or GE will submit to County or Riverside Planning Department the results of a global stability analysis detailing the static and pseudo static stability of the high wall to date. No finished high wall slope shall be steeper than 2:1 (horizontal to vertical) unless in compliance with the written recommendation of the CEG or GE.

12. Due to the height and varying orientations of the proposed quarry slopes, multiple rock slope stability analysis methodologies should be used to analyze the stability of the proposed slopes. These analyses must include earthquake effects. The Newmark seismic displacement method, probabilistic analysis, three-dimensional analysis and distinct-element method should be considered.

Response – The final high wall design will be stable and safe based on the studies conducted for this report, and the factor of safety will be suitable and appropriate for an end use as open space. We have conducted a probabilistic analysis of the global stability of the walls of the proposed quarry (Refer to Appendix A of this response letter). In our opinion, this is the most appropriate technique to evaluate large slopes that will be created by the proposed quarry. The probabilistic analysis identifies and quantifies the uncertainty associated with the input data and also the uncertainty associated with the results. Also, we have attempted to select worst-case strength values by standard accepted statistical methods. Refer to Appendix A of this response letter for a discussion on statistically selecting lowest conceivable worst case values suggested by Duncan (2000) for use in the evaluation of the slope stability. Thus, this analysis includes earthquake effects.

We did not conduct the Newmark seismic displacement or distinct element methods of analysis because the results of the pseudostatic analysis demonstrate a factor of safety greater than 1.1. Therefore, the final high wall factor of safety will be suitable and appropriate for end use as open space.

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With respect to performing a three-dimensional evaluation of the overall global stability of the planned reclaimed quarry high walls, it has been shown by numerous authors (Stark, T.D., and Eid, H.T., 2002) that because the three dimensional evaluation considers the side forces associated at the lateral extent of landslides, estimated safety factors are typically greater for the three-dimensional case than for the two dimensional case. Therefore, because the safety factors associated with using averaged assumptions regarding the geometry, water pressures, seismic forces, and shear strength of the materials within the plan quarry high walls are acceptable in all cases that were analyzed. Completing a rigorous three dimensional limit equilibrium analysis for the proposed quarry slopes is not considered relevant at this time.

REFERENCES FOR QUESTION 12

Duncan, J.M., 2000. Factors of Safety and Reliability in Geotechnical Engineering: Journal of Geotechnical and Geoenvironmental Engineering, pp. 307-316

Stark, T. D., and Eid, H. T. 2002. Performance of three-dimensional slope stability methods in practice. Journal of Geotechnical and Geoenvironmental Engineering, Vol 124. No. 11. pg. 1049 - 1060.

13. The stability analyses should consider the worst-case strength values, such as failure along measured shear planes or fractures, in addition to overall global stability and toppling/rockfall.

Response – As stated in our response to Number 12 and in Appendix A of this response letter, we have selected worst-case strength values by standard accepted statistical methods suggested by Duncan (2000), and considered sliding along the discontinuity sets within the rockmass. Using these data, the results indicate acceptable factors of safety are present.

14. The safety factors referred to in GEO No. 1902 range from 1.2 to 1.3. This implies the final slopes could fail and does not meet the County’s minimum requirement for a 1.5 factor of safety. The analysis should be revised to result in a different design and shallower slope gradient that will provide acceptable safety factors (factors that demonstrate a safe, non-failing slope condition).

Response – As in our response to comment 12, a Probabilistic Stability Analysis was conducted (Appendix A of this response letter). The results demonstrate under dry conditions, the deterministic and probabilistic factors of safety are 1.9. The factors of safety range from 1.26 to 2.77. The County’s minimum 1.5 factor of safety is a grading requirement that applies only for cut and fill slopes over 30’ in vertical height, or slopes

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steeper than 2:1, and is therefore not applicable to high wall quarry slope stability analyses. In any event, the Probabilistic Stability Analysis shows that the final slopes will have a factor of safety of greater than 1.5, which is suitable for an end use of open space. In addition, the stability of critical areas will be checked each year based on borings, testing, and geologic field mapping pursuant to the monitoring program described above.

15. The Montana Tech rock strength testing data does not represent the weaker, shear/fractured zones in the rock mass and therefore is not valid for calculating overall slope stability. Actual values for the weaker zones should be obtained and used for the analysis.

Response – The Montana Tech data represents the intact strength of the rock tested. This data alone was not used in calculating overall slope stability, but it was used in conjunction with all of the data to develop a reasonable set of data representative of the entire site. The Montana Tech test report states that because of the highly fractured nature of the rock core near shear zones or in some of the weaker highly jointed rock, tests were completed on some of the more competent rock and that the data do not represent the weaker zones. However, Montana Tech stated that it was their opinion that the rock samples tested were a good representative of the vast majority of the rock that will be exposed in the pit faces (Montana Tech, 2005).

The rock tests performed by Montana Tech demonstrated and average strength of about 325 MPa (R6 or extremely strong rock). However, based on their results of the triaxial compressive tests, the average rock strength was in the neighborhood of 190 MPa, which implies R5, very strong rock. Montana Tech’s focus was to establish if there was sufficient good strong rock for commercial quarrying. Samples were not selected to establish potential stability of the backwalls. These values represent the upper strength spectrum for the rock mass at the proposed quarry.

The slope stability analysis also considered the strength for weaker zones. While completing the rock mass stability analyses (Section 5.1.2 and Appendix E of the Geotechnical Report), we considered a conservative range of rock strengths from moderately strong to very strong rock using proven statistical methods suggested by Duncan (2000) (refer to Appendix A of this response letter). The boring logs in Appendix B (Geotechnical Report: Kleinfelder, 2007) shows the rock mass is primarily characterized as strong to moderately strong rock and very hard to hard. The boring logs show minor zones of weaker rock, but not consistent weak shear zones. Based on the lab data, borings, and field mapping, it is our opinion that the average rock strength values may range from 55 MPa to 160 MPa and we used this range of values as stated in response to No. 12. Thus,

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in our analysis, we appropriately considered the lower conceivable values of strength resulting from weaker shear zones.

16. Geo No. 1902 indicates the data is not adequate for the final quarry high wall design. Additional data should be obtained at this time to confirm the stability of the proposed quarry slopes. This may result in an amendment to the quarry slope design with varying slope gradients in both the horizontal and vertical sense based upon the site specific nature of the rock mass.

    Response – The data analyzed in the slope stability analysis is sufficient for performing initial slope stability analysis. As described previously, the final quarry high wall design is expected to be suitable for end use as open space given the measured rock strengths and calculated safety factors. Furthermore, during the initial phases of the mining operation, the blasting and removal of materials will be conducted well within the boundaries of what ultimately will be the top of slope of the final quarry high wall. Additional data collection is therefore not necessary at this time.

    However, excavation of the quarry would allow a more complete understanding of site geology, rock-engineering characteristics, and slope behavior. Therefore, as stated on Section 5.1.3, page 31 of 43 (Geotechnical Report: Kleinfelder 2007), an ongoing field inspection and slope stability analysis program is recommended. This program will be updated annually and will include detailed mapping of exposed quarry slopes, review of stability history of working faces and benches and detailed study of potential slope failures. Field data will be compiled and analyzed to evaluate current slope conditions. Based on updated data, the assumptions and estimations made for this study will be re-evaluated and, should adverse geomechanical conditions be identified, the final quarry high wall design will be modified to reduce finished slope ratios.

17. It appears the consultant suggests that monitoring of the proposed approximately 0.5:1 quarry slopes will occur during operations and that if monitoring indicates instability, then the slopes would be redesigned to a shallower gradient. This approach seems backwards. Rather, a shallower slope gradient (2:1, 1:1, ?) should be proposed at this time with the limited data accumulated thus far, allowing for the possibility of increasing the slope gradient after continuous monitoring of constructed slopes adequately demonstrates the slopes to be stable.

    Response – As previously described, analysis of the best data available at this time supports the conclusion that the proposed 0.5:1 quarry slopes during operations will be suitable for an end use of open space. There is no need for either additional data gathering at this time, or for a shallower slope gradient design. As indicated in response 16 above, the initial

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mining operation will start from a central portion of the mine boundary. As mining operations proceed outwards, monitoring data will be collected from new core holes and exposed bench faces. This process will allow for ongoing bench rock fall hazard and slope stability analysis based on updated discontinuities data and rock strength parameters. The purpose of this monitoring program is to maintain a safe working environment and to develop an appropriate final high wall slope configuration. If slope monitoring and mapping during mining operations suggest that shallower slope angles may be required because of adverse subsurface conditions, a decrease in mine volume can be accomplished by moving the toe of slope inward towards the center of the quarry, flattening the slope without altering the proposed top of final high wall boundary.

18. The consultant should address the potential benefits and drawbacks from a finished slope surface that includes more benches and/or shorter vertical walls (i.e. stair step design similar to some of the I-15 Caltrans cut slopes in the vicinity of the proposed mine site). This address should include in-mining and post reclamation safety as well as reclamation revegetation and habitat restoration, etc.

Response – We have reviewed potential benefits and drawbacks of constructing the finished slope surfaces with multiple benches and short vertical walls (“stair step” design) similar to some of the slopes designed by Caltrans along I-15.

Benefits for the stair step design follow:

- The stair step design works well in weathered, weak rock slopes where the contractor can rip and grade the steps with mechanical excavators.
- The stair step design provides for a more stable cut face, reduces shallow, surficial rock fall and is safer from a rock fall hazard standpoint.
- The stair step design works well in weathered rock for encouraging vegetative growth by collecting soil that will further stabilize the rock cut.

Drawbacks for the stair step design follow:

- The rock mass within the quarry is at least moderately hard and strong making it very difficult to rip and grade with a mechanical excavator and will require careful detailed controlled blasting.
- The stair step design works poorly in strong rock for encouraging vegetative growth.

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The finished cut-slope surface configuration, (i.e. bench height/width), will be addressed as part of the blasting plan and reclamation plan. Post-reclamation safety as well as reclamation revegetation and habitat restoration will be addressed in detail in a Mine Reclamation Plan, to be developed in accordance with the California Surface Mining and Reclamation Act of 1975.

19. The consultant should address slope stability impacts to and the need for slope setbacks from adjacent properties.

Response – As designed, the final slopes will demonstrate an average factor of safety greater than 1.5 and are expected to maintain stability. As a result, we do not expect the slopes to impact neighboring properties. Due to non-safety related issues, there will be setbacks of at least 50 feet on all sides of the quarry boundary, and more than 50 feet of set back on the eastern, southern and northern portions of the project. Based on the geologic conditions described in the report, these setbacks should be more than adequate to protect adjacent properties in the unlikely event of a slope failure in the project.

20. The consultant should address the effects blasting my have on the proposed slope design and the remaining rock mass (i.e. how might blasting compromise the to-remain-in-place rock mass and what steps will be taken to mitigate these potential impacts?).

Response – Blast induced damage is often surficial and may possibly extend 15 to 30 feet (5 to 10 meters) behind the open face for pit or quarry blasting. The damage can result in rock fall over time as water enters the fractures, freezes, and by expansion opens the cracks and loosens the rock blocks. Blast damage can cause extensive damage where the rock slope contains persistent bedding planes or discontinuities that dip out of the slope face. In this case, explosive gases may travel up the planes resulting in displacement of blocks of rock.

The quarry operator will plan for and mitigate the blast damage to the final walls by implementing a proper production blast design and employing controlled blasting techniques. Production blasting will be designed to limit rock fracturing behind final wall. In addition, controlled blasting techniques such as pre-shearing (presplit) and cushioning blasting techniques should be employed to define the final face. The end result is there is less loose rock on the face from the blasting, which presents a more stable face. Refer to Appendix B of this response letter, which presents a more detailed discussion addressing controlled blasting to improve slope stability.

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21. The consultant should address the potential for seismic events that could be triggered by the removal of the proposed rock mass from the proposed mine as well as the potential seismic events that could be triggered upon filling the resulting mine pit with water.

    Response – We have evaluated the potential for triggered seismic events due to the proposed mining operations as it relates to the Elsinore fault zone. We have presented the results of that evaluation in the attached report in Appendix C. The results of our evaluation lead to the following conclusion: neither the removal of the proposed rock mass from the proposed mine, nor filling the resulting mine pit with water, would create the potential for triggering seismic events.

    For an earthquake to occur on the Elsinore fault, stress has to build up due to tectonic forces resulting from crustal plates moving past one another. Once the forces exceed the strength of the rock, failure occurs along the fault plane, releasing the energy in the form of heat and vibration. This stress build up is generally horizontal to the ground surface, and when the movement occurs along the plate boundary, it forms a near vertical plane (fault surface). Because the weight/force of the rock mass to be removed is a vertical force, and is a relatively small load relative to the rock mass of the crustal plate on which it is riding, the influences of the proposed mining operation on the Elsinore fault are negligible. In addition, because the weight of the water that could be stored in a potential reservoir is a vertical load that is significantly less than the weight of rock removed, the influence on the Elsinore fault will be negligible.

22. A comprehensive hydrogeologic assessment of the site and proposed mining operation should be performed to adequately assess the potential impacts on adjacent watersheds. For example, the assessment should include, at a minimum, the effects of accumulated (phreatic and atmospheric) and/or introduced water from the mine pit entering into adjacent watersheds and how the mine pit could act as a trap for water that might have previously entered the watersheds via fracture flow and/or surface runoff, etc.

    Response – See combined response to Comments 22 and 23, below.

23. A comprehensive hydrogeologic assessment of the site and proposed mining operation should be performed to adequately assess the potential impacts mining could have on existing springs and the associated vegetation/habitat in the vicinity of the mine.

    Response to Comments 22 and 23 – As discussed in the meeting with Riverside County Planning Department on January 17, 2008, Sections 3, 4, and 5 of the report entitled <u>Geologic and Hydrologic Evaluation,</u>

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Proposed Liberty Quarry, Riverside County, California (Kleinfelder, August 10, 2007) are comprehensive assessments of surface water and groundwater conditions at the site, now and in the future. This report was submitted simultaneously with Geo. No. 1902 for consideration by TLMA.

Specific hydrogeologic topics covered by the report are outlined briefly below.

Section 3 addresses Surface Water Hydrology, and includes subsections on site description, regional hydrology, local hydrologic conditions, and evaluation of surface water runoff. Section 4 presents a discussion of the regional hydrogeologic setting, groundwater occurrence and movement, and groundwater production. Local hydrogeologic conditions are discussed in detail in Section 4, including extensive hydrogeologic testing conducted on site. Section 5 specifically addresses potential impacts to groundwater (such as springs and associated vegetation/habitat) and surface water. As discussed, the effects on the habitat for the region are expected to be minimal. As noted in Section 5, operations at the proposed Quarry are not expected to adversely affect local or regional groundwater supplies. Section 5 also addresses the reduction in surface stormwater runoff, and points out how the reduction in runoff would be very small considering that the Quarry footprint would occupy only 0.03 percent of the Santa Margarita Watershed. It points out that imported water would be used for many site operations, and would remain on site, potentially mitigating the difference in what runoff was lost due to quarry operations.

These topics were discussed with the Riverside County Planning Department in a meeting on January 17, 2008.

Oral Comment from January 17, 2008 Meeting with Riverside County Planning Department:

During the meeting with the Riverside County Planning Department on January 17, 2008, an oral comment was made that some additional documentation from the scientific literature was needed, that assessed whether the current situation, with the apparent lack of hydraulic interconnectedness in the granite bedrock, would continue to be the case, once quarrying of the granite commenced.

Response – The following is a summary of pertinent findings of a literature review of the potential effects of blasting and quarrying on existing groundwater conditions. This summary documents that, based on experience at quarry sites, effects of blasting on the bedrock integrity and hydrogeology are expected to be extremely localized to the immediate

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vicinity of the blast zone, in granitic bedrock terrain such as exists at Liberty Quarry.

Extent of Fracturing Caused by Blasting

The effect of blasting and quarrying on bedrock at the proposed Liberty Quarry has been summarized in a report by Vibra-Tech Engineers (2007). Their discussion comes directly from the ISEE Blaster's Handbook (1998), and is reproduced here.

The entire blasting process transpires inside a few hundredths of a second after detonation and takes place within a 20 feet radius of the shot hole (ISEE, 1998). The volume of rock displaced typically resembles an inverted cone, with the depth of the shot hole equal to the height and radius of the base of the cone. Beyond the cone-shaped volume of rock, no permanent deformation of the rock occurs.

This discussion indicates that the permanent effects of blasting are limited to a small area around the blast, with a radius of approximately 20 feet. Beyond this zone, there appears to be no effect on opening of fractures. This effect is borne out by hydrogeologic field studies in granitic terrain, as presented below.

Hydrogeologic Studies on the Effects of Blasting

Field studies of the effects of blasting and quarrying on groundwater conditions indicate that there are substantial differences in the effects, depending on the type of bedrock present at a site. Most studies reported in the hydrogeologic literature on the effects of blasting and quarrying of bedrock on groundwater have focused on sedimentary bedrock, such as in coal mining regions. For example, Eychaner (2000) reported some effects of coal mining on water levels in adjacent wells. Berger et al. (1982) reported that there were no observable effects on groundwater quality in the stratified sedimentary rock, but that some lowering of static water level occurred in a test well, as a coal strip mine operation approached a well site over time, from distances of 2,000 feet to 15 feet.

In another report on groundwater capture in shale bedrock, Forbes et al. (1995) found that deliberate fracturing of a bedrock trench in an attempt to increase the capture of contaminated groundwater at a shale bedrock site in New York resulted in a limited zone of influence in the sedimentary rock strata, that extended up to approximately 300 feet around the trench.

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However, these stratified sedimentary bedrock settings contain sedimentary bedrock, and are substantially different from the hydrogeologic setting in granitic terrain such as occurs at the proposed Liberty Quarry site. In a comprehensive hydrogeologic study of the effects of quarrying in granitic bedrock at Edwards Air Force Base in California (Henkes, et. al., 2007) found that groundwater occurred only in discrete, limited water-bearing zones, and yielded very low amounts of water (less than 0.3 gallons per minute) to test wells and boreholes, similar to the situation at the proposed Liberty Quarry site. Blasting in 31 boreholes was conducted in a concerted attempt to create a fractured granite bedrock zone and increase the interconnectivity of fractures and well yield. Pumping tests conducted after the blast fracturing indicated that, despite their best efforts, “the blast fracturing did not achieve any significant increase in well yield or pumping radius of influence” (Henkes, et. al., 2007). The report indicated no greater hydraulic connectivity to wells was experienced either inside or outside the fracture zone.

Hydrogeologic studies in granite bedrock are rare, because of the extremely limited amount of water that can be found in discrete openings in the bedrock. The following is a summary of a hydrogeologic study in metamorphic schist bedrock, which can have some similar hydraulic characteristics to granite, with low permeability and poorly connected discrete water pockets. In an attempt to capture contaminated groundwater in fractured bedrock schist in southern Maine, Gehl (1994) used closely-spaced blasting (5-foot spacing) to create a permeable fractured bedrock trench from which groundwater was extracted. However, the zone of capture only extended to within approximately 60 feet of the trench, demonstrating the limited effects of the blasting on groundwater. Even in schist, which is stratified but modified by metamorphism, blasting effects on hydrogeologic conditions were found to be extremely limited.

In summary, the hydrogeologic conceptual model for the proposed Liberty Quarry site appears to be characteristic of hydrogeologic conditions at similar sites in granitic terrain: water is encountered in discrete fractures that are disconnected, and blasting effects are expected to extremely limited to the immediate vicinity of the blasting. In fact, the granite bedrock blasting program conducted by Henkes, et. al., 2007 indicated no increase in permeability and interconnectedness of fractures was achieved even when blasting was employed for that purpose. The potential for blasting or quarrying creating a connection between the proposed Liberty Quarry, located on a mountaintop, and outside groundwater in a

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permeable aquifer located thousands of feet distant from the quarry, appears to be highly unlikely.

REFERENCES FOR QUESTIONS 22 AND 23

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Eychaner, J., 2000. Effects of Mountaintop Coal Mining on Ground Water. Workshop on Mountaintop Mining Effects on Ground Water, Charleston, West Virginia, May 9, 2000.

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Gehl, R., 1994. Controlled Blasting And Variable-Rate Pumping For Effective Ground Water Capture. In Fractured Bedrock Issues, October 3-5, 1994, Burlington, Vermont; P265-273.

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ISEE, 1998, Vibration and Airblast, Blasters' Handbook, 17th Edition, International Society of Explosives Engineers, pp. 591-634

Vibra-Tech Engineers, Inc, 2007, *Blasting Plan and Impact Analysis, Liberty Quarry, County of Riverside, California,* Prepared for

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Granite Construction Company, 38000 Monroe Street, Indio, CA 92203-9500, July 25, 2007.

Oral comments from April 7, 2008, Meeting with Riverside County Planning Department:

During a meeting with Galen Kenoyer with Kleinfelder and Dave Jones with TLMA on April 7, 2008, additional oral comments/questions were provided in reference to the County of Riverside -Review Comments Letter, dated January 15, 2008 of the review of Geologic and Hydrologic Evaluation, County Geologic Report No. 1902. The following TLMA comments are followed by Kleinfelders response.

1. Fig. 2.5 – label faults and zones on the figure. Eliminate “Seaward projection of zone” in the Key if it is not pertinent. –

   Response - Figure 2.5 (Geologic and Hydraulic Report: Kleinfelder, 2007) has been revised and is attached for your review.

2. Fig. 3.2 – See drainage boundaries – may help refer to those in discussions re: watersheds, flow to springs, well, etc.

   Response - Figure 3.2 (Geologic and Hydraulic Report: Kleinfelder, 2007) will be used where appropriate in responses.

3. Table F-4. Average pump rate – two rates are given here, and they are significantly different. Why? Explain.

   Response - The Summary of Field Data at the end of Table F-4 (Geologic and Hydraulic Report: Kleinfelder, 2007) calls out two numbers; “Total Gallons Pumped” and “Total Gallons Recharged”. The “Total Gallons Pumped” refers to the volume of water evacuated from the borehole based on a cylindrical volume calculation with the pump operating. The “Total Gallons Recharged” refers to the volume of water recharging into the borehole based on a cylindrical volume calculation with the pump not operating. These have been revised to “Total Water Volume Change in Borehole During Pumping (gallons)” and “Total Water Volume in Borehole During Recovery (gallons)”, respectively. The “Average Pump Rate” refers to the average rate of change in water within the cylindrical volume of the borehole during pumping and has been revised to read “Average Rate of Change in Water Volume Stored in Borehole During Pumping”. The “Average Rate of Recharge” refers to the average rate of change in water within the cylindrical volume of the borehole during recovery and has been revised to read “Average Rate of Change in Water Volume Stored in Borehole During Recovery”.

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Additionally, the column labeled “Change in Volume” was re-calculated to include “+” or “–“ values of water volume change depending on whether water level rose or fell. The previous calculations considered every value as an absolute or positive change regardless if the water level rose or fell. Revised Tables are presented in Appendix E of this response letter.

4. Table F-3 – same comment as above.

   Response – Tables F-2 and F-3 (Geologic and Hydraulic Report: Kleinfelder, 2007) have been revised in a similar manner as Table F-4. Revised Tables F-2 and F-3 are also presented in Appendix E to this letter.

5. Consider adding a cross-section conceptual model that shows the fractures, their limited extent, and the limited amount of groundwater they have in them, such that once they are drained, their ability to yield water is extremely limited.

   Response - The data collected from three boreholes within the 72.7 acres of the proposed quarry footprint does not provide sufficient geologic information to draft a cross section that shows the areal extent of the fractures at depth. The minimum distance between the boreholes is approximately 1,140 feet, which leaves considerable distances for geologic interpretation for fracture lengths.

   However, evidence for the limited water storage in the fractures is demonstrated by the pumping test results conducted on the property. The data obtained indicates the specific capacity or the water yielding character of the boring and by extension, the granitic bedrock, is very low based on the range of values calculated, which were 0.9 gpm per foot (gpm/ft) at the start of the test, and declined to 0.01 gpm/ft near the end of the test. The calculated specific capacities resulting from the constant rate tests performed at MW-2 and MW-3 were also very low, at 0.06 and 0.04 gpm/ft, respectively.

   Translation of calculated specific capacity values to potential groundwater production are as follows, for each gallon of groundwater pumped per minute: for a specific capacity of 0.01 gpm/ft, the drawdown would be 100 feet for every one gpm of groundwater production. For the highest specific capacity reported, 0.9 gpm/ft, the drawdown would be 1.1 foot for every one gpm of groundwater production. However, it should be noted that specific capacity decreases as the length of time increases, and long-term specific capacity rates would be expected to be closer to 0.01 gpm/ft, or less.

   The step-drawdown and constant rate tests revealed the variable and limited extent of groundwater within the joints and fracture of the underlying granitic bedrock. As indicated above and in Table F-3 (Appendix E of this response letter), pumping at discharge rates of 4 to 10 gpm at MW-1 would most likely temporarily drain or dewater the joints and fractures containing water at this

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location within a relative short time span. Likewise, dewatering of MW-2 and MW-3 was also observed to occur within a few hours in the step-drawdown and constant rate tests at relatively low discharge rates. Also observed during the pumping tests was a lack of communication or connectivity between borings and fractures. Specifically, when a given “well” was undergoing either test, the remaining on-site wells and Kirkpatrick Well were monitored as “observation wells” for changes in groundwater elevation; no change was observed. Therefore, it appears there is very little, if any, hydraulic continuity between the fractures and joint sets encountered in the three borings advanced for this evaluation, nor with the Kirkpatrick Well.

Rates of flow in mountainous granitic terrain are dependent on the amount of groundwater contained in fractures and joint sets, the hydraulic continuity of those joints and fractures to yield water, and most importantly, precipitation (Fetter, 1994). In wet years, more groundwater from deep percolation may recharge joint sets and fractures. Conversely, in dry years, less groundwater would be present due to the lower amount of deep percolation. The results of the pumping tests indicate the factures and jointing encountered in the three borings contain limited, readily exhaustible amounts of water and did not demonstrate continuity between boring locations. These results also suggest:

(A) The lack of fracture and jointing continuity is considered indicative of a lack of hydraulic communication between the proposed quarry’s upland topography and surrounding lowlands.

(B) There is insufficient water present in fractures and jointing at the proposed Liberty Quarry property to be considered an extractable resource for consumptive or industrial uses.

(C) The water present in fractures and jointing at the proposed Liberty Quarry property should not present an unacceptable engineering challenge to quarry operations.

6. What other monitoring of groundwater conditions will be done, e.g., during mine operation?

Response – As discussed in Section 4.0 (Geologic and Hydrologic Evaluation; Kleinfelder, 2007), the proposed Liberty Quarry property is a hydrologically isolated topographic highland. Groundwater in the classic sense does not exist on site, but water was encountered exploratory borings advanced on the property (Section 4.2, Geologic and Hydrologic Evaluation; Kleinfelder, 2007). Pumping tests performed in borings demonstrated encountered water was constrained to factures and joint sets, and that dewatering of the borings, and by extension the fractures and joint sets, was readily accomplished (Section 4.3, Geologic and Hydrologic Evaluation; Kleinfelder, 2007). It is not anticipated that “groundwater conditions” will be

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encountered during mining operations. However, as mining activities are advanced, it is expected that fractures and joint sets will be encountered where water may flow under gravity drainage for finite periods of time until they are dewatered.

As noted in other responses to TLMA questions, mine sequencing is performed in a logical sequence of drilling test borings and blast holes, which will be logged by licensed professionals and indications of fractures and joint sets with water will be noted during this process. The presence/absence of water will be factored into mine sequencing plans, evaluated for geotechnical considerations, and its presence and potential flow monitored during and after blasting activities. Encountering finite amounts of water flow in hard-rock quarry operations is not uncommon, and as noted in Section 4.3, Geologic and Hydrologic Evaluation (Kleinfelder, 2007), this water should not present an unacceptable engineering challenge for quarry operations.

7. Ephemeral Springs: how can we assess how much the mine will affect the spring flow? Is the decrease in overland runoff, and its effect on the springs, significant? How does it compare with the year to year variability in precipitation that ultimately feeds the ephemeral springs?

   Response – Based on geologic field investigations within the property, two seasonal seeps were identified. On further visits to the property, these seeps were dry. Additional information concerning ephemeral springs and seeps in the general vicinity of the proposed Liberty Quarry was sought from the USGS Water Resources and the U.S. Fish & Wildlife Service National Wetlands Inventory (NWI) GIS databases. These database searched revealed no information concerning ephemeral springs or seeps within several miles of the proposed quarry location.

   With respect to the two ephemeral seeps/springs encountered within the proposed quarry operational area, it is anticipated water flow from them will progressively decrease to no flow as mining operation progress. The apparent absence of additional ephemeral seeps/springs in the vicinity of proposed Liberty Quarry further suggests there is a lack of structural and hydraulic connection within observed factures and joint sets at this topographic highland with surrounding lowlands. Therefore, the information reviewed to date leads to the conclusion that quarry operations will affect only the ephemeral seeps/springs observed within the quarry property.

   As discussed in Section 3.2, Regional Hydrology (Geologic and Hydrologic Evaluation; Kleinfelder, 2007), the proposed Liberty Quarry resides in two sub-watersheds of the Santa Margarita River Watershed, the Gavilan and Vallecitos. Table 3.2-1 (Geologic and Hydrologic Evaluation; Kleinfelder, 2007) demonstrates the portion of the Gavilan sub-watershed affected by the proposed quarry (i.e., removed from contributing surface flow off the property)

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is 72.7 acres, or approximately 0.25 percent of the sub-watershed. Similarly, 1.38 percent of the Vallecitos sub-watershed is affected by the proposed quarry operations. With year-to-year variability in annual precipitation conservatively ranging to 50 percent, reductions of available overland runoff from the proposed quarry property of between 0.25 and 1.38 percent would be too small in comparison with seasonal precipitation fluctuations to differentiate.

8. Domestic wells: How do we assess what the potential effect of the mine will be on wells in the area?

   Response – Two domestic wells were identified as closest to the proposed quarry location: (1) The Kirkpatrick well, located near the northwest portion of the proposed quarry; and (2) The Jurkoski well, located west of the southwest portion of the propose quarry. The Kirkpatrick well was the only off-site well for which property access for sampling and monitoring was granted during field investigations associated with the proposed Liberty Quarry. Therefore, direct information concerning the Kirkpatrick well was used in prior investigations (Geologic and Hydrologic Evaluation; Kleinfelder, 2007); an evaluation of the Jurkoski well is based on surface area potentially contributing recharge for the well is presented below.

   As discussed in Section 4.5.4 of the Geologic and Hydrologic Evaluation (Kleinfelder, 2007), there appears to be no effects on the Kirkpatrick well from the proposed Liberty Quarry; the quarry property is geologically, hydraulically, and topographically distinct from surrounding lowlands. The Kirkpatrick well is located in a local channel of alluvium in a structurally controlled basin that is considered isolated from the hydrologic conditions within the proposed quarry footprint. Also, the Kirkpatrick well is located northwest and outside of the G-4 sub-basin (refer to attached Revised Figure 3.2); such that the surface runoff area that drains toward the well remains undisturbed.

   Because direct information concerning the Jurkoski well is not available, a conservative evaluation of the potential surface area available for recharge of groundwater at the Jurkoski well is being performed. For the purposes of this evaluation, it is assumed that all precipitation falling on the surface area of the drainages potentially associated with recharging groundwater at the Jurkoski well is available for use at the well. Specifically, any loss of surface area in these drainages will be considered a loss of groundwater at the Jurkoski well.

   Surface drainage on the west side of the proposed quarry property that could contribute recharge water to the Jurkoski well includes sub-basins G-1, G-2, G-3, G-4, G-5, and G-6 (refer to attached Revised Figure 3.2). The pre-quarry combined area of these sub-basins is approximately 112 acres (attached Table 3.4-2). The post-quarry combined area of these drainages is approximately 42 acres, or a reduction of 63 percent. However, the Jurkoski

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well also receives potential recharge from other surface runoff drainage areas other than the Royal Oak Draw; which have an area of approximately 389 acres (approximately 70 percent of potential recharge for the Jurkoski well is derived from areas other than the proposed quarry). Therefore, the overall surface area potentially providing recharge to the Jurkoski well affected by the proposed quarry is approximately 71 acres out of 549 acres of total surface runoff drainage area, or an approximately 13 percent reduction of surface runoff area potentially providing recharge to the Jurkoski Well.

As noted above, a 13 percent reduction is considered a conservative estimate. In reality, not all precipitation falling on a given drainage is available for groundwater recharge, a significant portion is lost to overland flow and evaporation and some is lost to vegetation uptake. Therefore, the actual potential reduction in recharge to the Jurkoski well is expected to be much less than 13 percent. Also, as discussed on the preceding question concerning ephemeral springs, year-to-year variability in annual precipitation conservatively ranges to 50 percent; the small reduction in potential recharge to the Jurkoski well due to the proposed Liberty Quarry would be too small in comparison with seasonal precipitation fluctuations to differentiate.

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