4.6 Geology, Soils, Seismicity, and Mineral Resources

Issues (and Supporting Information Sources):		*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
6.	**GEOLOGY, SOILS, AND SEISMICITY— Would the project:**				
a)	Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
	i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? (Refer to Division of Mines and Geology Special Publication 42.)	☐	☐	☐	☒
	ii) Strong seismic ground shaking?	☐	☐	☒	☐
	iii) Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐
	iv) Landslides?	☐	☐	☒	☐
b)	Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c)	Be located on geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☒	☐	☐	☐
d)	Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☒	☐
e)	Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒
f)	Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
g)	Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒

4.6.1 Setting

Geology

The Idaho-Maryland Mine is located within the distinct geologic region of California known as the Sierra Nevada geomorphic province, which includes the Sierra Nevada mountain range and the gold-bearing veins of the Sierra Nevada Foothills Gold Belt. The gold belt averages 50 miles in width, and extends for 320 miles in a north-northwest orientation along the western slope of the Sierra Nevada range. Rocks in this region were formed over millions of years as tectonic plates collided with and slid under the North American Plate. Basement rocks are composed of ancient sea floor deposits, volcanic rocks, and sedimentary rocks that have been altered by pressure and heat (a process geologists refer to as metamorphism) and igneous rocks (rocks formed from solidified molten magma). The rocks in the project area show evidence of having been faulted multiple times, metamorphosed during the emplacement of the Sierra Nevada batholith (massive granite body), and elevated during more recent geologic history. The individual rock units are separated by a series of inactive fault structures that represent suture zones reaching deep within the earth.

Distinct geologic formations underlie the vicinity of the Idaho-Maryland Mine and the project sites. The Mehrten Formation is the youngest of these deposits and consists of rock deposited through a series of volcanic events about 25 million years ago. Older rock types include metamorphic sedimentary rocks of the Fiddle Creek Complex situated east of the Weimar Fault, volcanic and basement rocks of the Lake Combie Complex Formation and a zone of rock, referred to as mélange (chaotic jumble of different rocks). The mélange consists of a matrix of well foliated (parallel segregation of minerals), highly deformed serpentinite, which large tectonic clasts or "slabs" of rocks. These "slabs" vary in character and consist of metamorphosed volcanic flows, fine grained metamorphosed sedimentary units (e.g., cherts, slates), diabase (fine-grained intrusive, igneous rock), and gabbro (coarse grained plutonic rock).[1] The large Brunswick Slab, the largest and most important of the slabs, borders the Idaho-Maryland Mine to the south and extends eastward for 1.5 miles defining the southern boundary of the high-strain zone for nearly its entire length.

The Idaho-Maryland site is located on a gold deposit. The shape of the Idaho-Maryland ore deposit is controlled by the Weimar Fault, and the Idaho Deformation Corridor. The Idaho Deformation Corridor is a fault zone in high strain that extends along the entire northern side of the Idaho-Maryland ore deposit. The geologic structure is controlled by the Morehouse Fault, the Idaho Deformation Corridor and the Weimar Fault. Another associated fault, the Wolf Creek Fault Zone, extend through the region and ranges from 500 ft to 2,000 ft wide in the Grass Valley area.

Topographic and Geomorphic Site Conditions

The primary data source for the following discussion of topography and geomorphic site conditions was obtained from the preliminary geotechnical evaluation conducted by Holdrege & Kull (H&K), in October, 2004. In their geotechnical evaluation, H&K considered topography, geologic conditions, and geotechnical engineering constraints at the Idaho-Maryland site, the New Brunswick site, and the Round Hole site.

1 Intrusive igneous rocks are made from magma that when molten, penetrates into or between other rocks but solidifies before reaching the surface. Plutonic rocks are made from magma that cool and solidifies below the surface.

Idaho-Maryland Site

The Idaho-Maryland site can be divided into the main area, southern area, and the southeastern area. The main area is located in the northwest part of the Idaho-Maryland site and occupies the largest portion. This area would contain the ceramics plant and the majority of the other proposed facilities. The topography of the main area slopes gently to the northwest with slopes ranging from less than 5 percent along the perimeter of the main area to about 25 percent beneath the ceramics plant. The gently sloping areas (<5%) appeared to have been previously graded with surfaces covered with waste rock, presumably associated with past hard rock mining. The steeper slope in the vicinity of the proposed ceramics plant was covered with piles of waste rock up to 10-feet in height. Existing slopes and other site features are shown on the Constraints Map, **Figure 2-1**. A ditch also crossed this slope in the vicinity of the proposed ceramics plant. The western part of the central area was relatively flat lying and contained patchy areas of sandy material on the surface. Site elevations ranged from approximately 2,490 feet above mean sea level (MSL) near the concrete towers to 2,560 feet above MSL in the northeastern part of the main area (H&K, 2004).

The western end of a small, west-trending ridge dominates the topography in the southern area. The native soil had been cut from the ridge top and deposited along the edges of the newly formed plateau. A short timber crib wall retained less than 5 feet of fill on the southern edge of the previously graded area, immediately north of a dirt access road. The remainder of the property appeared to consist primarily of undisturbed native soil. Elevations ranged from approximately 2,620 feet above MSL on the ridge near the eastern property boundary to approximately 2,530 feet above MSL near the southwest property corner. Slope gradients ranged from approximately 2 to 8 percent on the previously graded ridge top and from approximately 2:1, horizontal to vertical (H:V) on the land sloping away from the ridge (H&K, 2004).

The southeastern area contains the previously graded area, cut slopes, and a steep natural slope along the eastern boundary. The southeastern area was relatively flat-lying and characterized by extensive cut and fill associated with past lumber milling activities. Several relic foundations, apparently associated with the past lumber mill, as well as a concrete slab-on-grade and a pile of large concrete fragments, were observed by H&K within the previously graded area. Cut slopes on the east side of the graded area approached 30 feet in height, and slope gradients ranged from approximately 1:1, horizontal to vertical (H:V), to near vertical. Significant residual rock structure was observed in the soil exposed in the cut slope faces. Elevations in this area ranged from approximately 2,590 feet above MSL on the graded area at the toe of the cut slope to approximately 2,730 feet above MSL near the eastern site boundary. Slope gradients were generally less than 10 percent, excluding the natural slope, the cut slope, and a relatively steep fill slope located on the southern end of the historic mill area (H&K, 2004).

New Brunswick Site

The New Brunswick site is situated in a valley created by the South Fork Wolf Creek. The site is bounded by Bennett Road to the north, a pond and associated dam to the east, and a steep slope 60 percent to the south. Elevations across the site ranged from 2,680 feet above MSL at the western site boundary to roughly 2,760 feet above MSL around the New Brunswick Mine area. The site consisted of the generally flat lying surfaces around the New Brunswick Mine, gently sloping open fields and tree covered areas extending downstream of the dam, and steep slopes along the southern part of the site. Deep fill was apparent in the vicinity of the New Brunswick Mine workings. This area also contains a mine silo, concrete slabs-on-grade, and the covered New Brunswick shaft. The gently sloping surfaces along the valley floor were covered with thick vegetation. Concrete walls and waste rock piles associated with the Union Hill shaft are located in the northwestern part of the site as well as numerous waste rock piles on the northeast facing slopes across from the Union Hill shaft. The Constraints Map, **Figure 2-2**, shows locations of major topographic features such as rock piles and former mine workings. These piles approached 10 feet in height and were likely associated with mining from the Cambridge shaft and nearby exploration (H&K, 2004).

Round Hole Site

The Round Hole site lies on the slope immediately north of Whispering Pines Lane. The proposed site consists of a 300-foot long access road and 300-foot diameter circular area. H&K observed a north facing 25 percent slope along the access road and a shallower northeast facing 15 percent slope in the circular area. Elevations across the site ranged from 2,705 feet above MSL at the top of the access road to 2,640 feet above MSL at the lowest part of the site. H&K also observed the remains of a concrete structure and waste rocks piles in the northern part of the site. These features were likely associated with the Round Hole shaft (H&K, 2004).

Soils

Information on site soil conditions was obtained for this MEA from the preliminary geotechnical engineering investigation conducted by H&K in October 2004. The investigation included a cursory surface reconnaissance at the site, review of selected geologic, soil survey and historical references, review of previous reports for the property; and our experience with subsurface conditions in the area. H&K used the *Soil Survey of the Nevada County Area, California* (USDA Soil Conservation Service, reissued August 1993) as the primary source for information regarding soil type and occurrence.

Idaho-Maryland Site

Undisturbed soil in portions of the southwestern part of the Idaho-Maryland site is underlain by Secca-Rock Outcrop complex. The soils drain moderately well and are underlain by metamorphic rock, which is approximately 45 inches beneath the surface. Outcropping rock typically occupies between 10 and 40 percent of the surface area mapped as Seccca–Rock Outcrop. Undisturbed soils on the eastern side of the site is underlain by] Sites loam, a well drained soil overlying metamorphic sedimentary rocks at a depth of approximately 78 inches. Permeability (the rate that surface water runs through soil) is slow in the Sites Loam. The soil survey identifies soil in the southern central portion of the site as cut and fill land, which has been altered by methods other than mining. The survey states that deep accumulations of bark may be present at locations previously used as logging deck yards or lumber stack yards. According to the soil survey, the

Placer diggings underlie the northwestern portion of the site. This soil type occurs along drainage ways that have been placer mined and typically consist of gravel with little fines.

New Brunswick Site

The southwestern part of the New Brunswick is underlain by Aiken Loam, a well-drained soil that forms on the sides of volcanic flows within the Mehrton Formation. Permeability of the Aiken Loam soil type is moderately slow. Weathered volcanic bedrock is commonly encountered at a depth of about 64 inches below the soil surface. Surface material in the central portion of the Brunswick site is characterized as Placer diggings. The northeastern portion is underlain by "Alluvial Land," which the soil survey describes as a miscellaneous land type consisting of narrow areas of alluvial deposits. These soils can range in their ability to drain and the permeability varies from moderately slow to very slow depending on the soil characteristics.

Round Hole Site

The Round Hole site is entirely underlain by Secca-Rock outcrop complex. The characteristics of this soil type are described above under the Idaho-Maryland site.

Seismicity

The state of California has been seismically active throughout geologic history because the contact boundary of major tectonic plates extends the entire west coast of North America. The seismic activity in the Central Valley and the Sierra Nevada is attributable to complex regional tectonic processes such as movement along major crustal plates and uplift and volcanism in the Sierra Nevada mountain range. The Foothills fault system, which extends along the western flank of the Sierra Nevada Range, is a major fault zone that was formed 225 to 65 million years ago in response to tectonic deformation within the Sierra Nevada. The Foothills Fault System includes the Melones and Bear Mountain Fault Zones. The 1975 Oroville earthquake on the Cleveland Hill segment suggests that faults within the Foothills Fault System might be active. Faults within the system have been active in the past 100,000 years and activity within the last 10,000 years cannot be precluded; nevertheless, the Foothills Fault System has not been included within the Alquist-Priolo Earthquake Fault Zoning Act (Hart, 1990).

The western half of Nevada County contains relatively inactive faults. These inactive fault structures are defined by the California Geological Survey (CGS) as fractures that may have been active several million years ago but have not experienced any relative movement along their structure within the past 2 million years (Nevada County, 1995). In the project area, the three primary fault structures, defined above as sutures between rock masses, are the Idaho fault, the Weimer fault (6-3 fault), and the Morehouse fault. The Morehouse Fault branches from the Idaho Deformation Corridor in an arc shape and forms the southern contact of the Brunswick Slab. The fault extends in a southeasterly direction to the Weimar Fault.

Earthquake Measurement and Intensity

Earthquakes can cause strong ground shaking that may damage property and infrastructure. The severity of ground shaking at any particular point is referred to as intensity, which is a subjective measure of ground shaking effects felt by people and experienced by structures and earth materials. The intensity of shaking generally decreases with distance away from the source of an earthquake. The level of intensity is commonly defined by comparison to the Modified Mercalli Scale, which categorizes the intensity on the basis of observed effects of seismic shaking on people and objects (**Table 4.6-1**). The MMI scale has a range of values from I (lowest, not felt by humans) to XII (total damage to manmade improvements and the ability to see seismic waves on the ground surface).

Quantitative measurements of the level of ground motion during an earthquake are recorded by strong-motion seismographs that measure the ground surface acceleration of objects due to seismic shaking. Strong ground motion is described as motion of sufficient strength to affect people and their environment or any ground movement recorded on a strong motion instrument or seismograph. The common way to describe ground motion during an earthquake is with the motion parameters of acceleration and velocity in addition to the duration of the shaking. A common measure of ground motion is the peak ground acceleration (PGA). The PGA for a given component of motion is the largest value of horizontal acceleration obtained from a seismograph.

The project sites are situated in a region that has experienced at least VII on the Modified Mercalli Intensity (MMI) scale. Areas experiencing this intensity of seismic activity typically experience slight to moderate damage on older (masonry) buildings and considerable damage in poorly build or inadequately designed structures. Since 1887, Nevada County and the surrounding area have experienced 25 earthquakes. These events were assigned a Modified Mercalli Scale intensity ranging from minor to moderate. Eleven of the earthquakes were measured at VI and fourteen at VII. Richter scale magnitudes recorded since 1937 ranged between 4.0 and 5.3 (Nevada County, 1995). In 1909, two seismic event with a Richter magnitude of 5 to 6 occurred 9 miles northeast of Nevada City or 15 miles from the project site. If similar seismic events were to occur in the future, the expected ground accelerations could range between 0.09g to 0.34g within the study area (Nevada County, 1995).

Considering that the Foothills Fault System and Melones Fault Zone are located within the region, it is possible that the project sites will experience a seismic event capable of shaking the ground surface. The Foothills Fault zone and Melones Fault zone are capable of producing a maximum credible earthquake of 6 ½ magnitude (CGS, 1992). If a seismic event were to occur along the Foothills Fault zone, this event could generate 0.4g to 0.5g PGA in the area surrounding the project sites.

A probabilistic seismic hazard (PSH) map shows the predicted level of hazard from earthquakes that seismologists and geologists believe could occur. The PSH analysis takes into consideration uncertainties in the size and location of earthquakes and the resulting ground motions that can

TABLE 4.6-1
MODIFIED MERCALLI INTENSITY SCALE

Intensity Value	Intensity Description	Average Peak Acceleration
I	Not felt except by a very few persons under especially favorable circumstances.	< 0.0017 g[a]
II	Felt only by a few persons at rest, especially on upper floors on buildings. Delicately suspended objects may swing.	< 0.014 g
III	Felt noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly, vibration similar to a passing truck. Duration estimated.	< 0.014 g
IV	During the day felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.	0.014–0.04 g
V	Felt by nearly everyone, many awakened. Some dishes and windows broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles may be noticed. Pendulum clocks may stop.	0.04–0.09 g
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; and fallen plaster or damaged chimneys. Damage slight.	0.09–0.18 g
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.	0.18–0.34 g
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motor cars disturbed.	0.34–0.65 g
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.	0.65–1.24 g
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.	> 1.24 g
XI	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.	> 1.24 g
XII	Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.	> 1.24 g

[a] g (gravity) = 980 centimeters per second squared. 1.0 g of acceleration is a rate of increase in speed equivalent to a car traveling 328 feet from rest in 4.5 seconds.

SOURCE: California Geological Survey, Note 32 (CDMG, 1997b) affect a particular site. Probabilistic seismic hazard maps indicate that peak ground acceleration in the project area could reach or exceed 0.1 to 0.2g PGA (CGS, 2005).[2]

The seismic risk in Nevada County is considered low because large earthquakes have not occurred in Nevada County and the county is located adjacent to the more tectonically stable northeastern section of California. Nevertheless, Nevada County is located in one of the most seismically active states in the country and therefore, providing the county with a "no seismic risk" status is not possible (Nevada County, 1995). Future sources of seismic activity might be related to the stresses of plate tectonics, volcanic activity within the southern Cascade Range and from regional tectonic activity within the Basin Range province to the east.

Mineral Resources

The surface Mining and Reclamation Act of 1975 (SMARA) and its recent amendments require the State of California to inventory and classify selected mineral resources within California. The intent of the Act is to classify the absence or presence of mineral resources within a region, identify the market area of the commodity and estimate future need of the commodity within a geographic area. Areas are classified into Mineral Resource Zones (MRZ) depending on the occurrence and availability of the mineral resource. Classification of these mineral lands does not consider current land use. Once classified, the State Geologist is required to designate those mineral deposits that are significant on a regional and statewide level. Overall, the information is intended to inform local agencies and decision makers regarding the planning and development of lands that contain significant mineral resources (Nevada County, 1995).

The CGS provides the guidance for MRZ identification; the criteria for establishing the zones are based on four general categories, as discussed below.

> MRZ-1 are areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
>
> MRZ-2 are areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood exists for their presence. This zone shall be applied to (a) known mineral deposits or (b) where well developed lines of reasoning, based upon economic geologic principles and adequate data, demonstrate that the likelihood for occurrence of significant mineral deposits is high.
>
> MRZ-3 are areas containing mineral deposits, the significance of which cannot be evaluated.
>
> MRZ-4 are areas where available information is inadequate for assignment to any other MRZ zone.

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2 The PSH maps are typically expressed in terms of probability of exceeding a certain ground motion. These maps depict a 10% probability of being exceeded in 50 years. There is a 90% chance that these ground motions will NOT be exceeded. This probability level allows engineers to design buildings for larger ground motions that seismologists think will occur during a 50-year interval, making buildings safer than if there were only designed for the ground motions that are expected to occur in the 50 years. Seismic shaking maps are prepared using consensus information on historical earthquakes and faults. These levels of ground shaking are used primarily for formulating building codes and for designing buildings.

Information and data regarding the mineral classification in the project area is contained in the CGS Special Report 164, Mineral Land Classification of Nevada County, California. The project area is classified by the CGS as MRZ-2b and is located within the Grass Valley Northeast Area (lode gold). The Northeast Area gold deposits are contained within quartz veins that occupy a network of faults and fissures. Although many veins have been mined to considerable depth, significant quantities of gold likely exist. Significant gold resources also likely exist along some sections of the veins system which were previously not economically feasible or remained unexplored. A total of 64 gold veins have been discovered – of those, 62 have been explored. The veins contain native gold in a quartz matrix with minor amounts of other minerals (Nevada County, 1995)

4.6.2 Regulatory Context

Federal

Mine Safety and Health Administration

Mine Safety and Health Administration (MSHA), a division of the U.S. Department of Labor, administers the provisions of the Federal Mine Safety and Health Act of 1977. MSHA develops and enforces mandatory safety and health regulations pursuant to the Code of Federal Regulations (CFR) 30 that apply to all surface and underground mines located in the U.S. through inspections, rigorous training, and providing educational programs for employers and employees in the mining industry. The ultimate purpose is to eliminate fatal accidents, reduce the frequency and severity of nonfatal accidents, minimize health hazards, and promote improved safety and health conditions in mines of the United States. Project operations would be regulated by MSHA, and periodic inspections would be performed under MSHA regulations to ensure maximum worker safety during project operation. The Idaho-Maryland Mine mining operations are subject to periodic safety inspections by MSHA.

State

California Building Code

The California Building Code (CBC) is another name for the body of regulations found in the California Code of Regulations (CCR), Title 24, Part 2, which is a portion of the California Building Standards Code (CBSC, 2001). Title 24 is assigned to the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. Under state law, all building standards must be centralized in Title 24 or they are not enforceable. The purpose of the CBC is to provide minimum standards to safeguard life or limb, health, property and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all building and structures within its jurisdiction. Published by the International Conference of Building Officials, the Uniform Building Code is a widely adopted model building code in the United States. The CBC incorporates by reference the Uniform Building Code (UBC) with necessary California amendments. These amendments include significant building design criteria that have been tailored for California earthquake conditions (CBSC, 2001).

Because of its high seismic potential the regions of the State have been classified by the Uniform Building Code into either Seismic Zones 3 or 4 (GeoSolutions, 2005). The project is within Seismic Zone 3. Zone 3 is expected to experience moderate effects from earthquake ground shaking. The national model code standards adopted into Title 24 apply to all occupancies in California except for modifications adopted by state agencies and local governing bodies.

Local

Nevada County General Plan[3]

The Nevada County General Plan contains the following objectives and policies that would be applicable to the proposed project:

- Policy 10.13: Continue to cooperate with the State Division of Mines and Geology, the State Office of Emergency Services and other appropriate Federal, State and local agencies and incorporate the most current data concerning the following as the basis for the County's Site Development Standards, and project site plan review:

  a. geologic hazards; and

  b. seismic hazard data for sensitive land uses such as schools, medical facilities, high-density residential uses, and intensive commercial uses. The project review shall consider the need to mitigate development in such areas in accordance with Federal, State and local standards.

     As part of the project site review process, require sufficient soils and geologic investigations to identify and evaluate the various geologic and seismic hazards that may exist for all proposed development, including subdivisions**.** Such investigations shall be required within an area determined to be seismically active by the State Division of Mines and Geology or within an area having potential geologic hazards, including slope instability and excessive erosion.

- Goal 17.1: Recognize and protect valuable mineral resources for current and future generations in a manner that does not create land use conflicts.

- Objective 17.1: Protect valuable mineral deposits from intrusion by incompatible land uses that will impede or preclude mineral extraction or processing. Promote the proper management of all mineral resource activities in the County and minimize the impact of extraction and processing on neighboring activities and the environment in general

- Policy 17.2: Exploration is conditionally permitted in compatible General Plan designations. A conditional use permit shall be required if:

  a. Overburden or mineral deposits in excess of 1,000 cubic yards are disturbed, or

  b. The operation in any one location exceeds one acre in size, or

3 Under the proposed project, Nevada County plans and policies would only apply to the New Brunswick site, which would not be annexed into the City of Grass Valley as part of this proposed project.

c. De-watering will occur or water will be discharged from the site as a result of the operation.

Exploration is conditionally permitted in incompatible General Plan designations providing:

a. Methods of geological survey, geophysical, or geochemical prospecting are used,

or

b. Bore holes and trial pits not exceeding 100 cubic yards of overburden or other mineral disturbance per acre may be done.

c. No explosives may be used other than geophysical; there may be no drifting or tunneling and de-watering or water discharge is not allowed.

- Policy 17.3: All exploratory operations shall require a reclamation plan unless:

a. Less than 1,000 cubic yards of overburden are disturbed, and

b. The size of the operation in any one location is one acre or less.

In those instances where a reclamation plan is not required, an erosion control plan, approved by the Nevada County Planning Department, and a grading permit shall be required for those operations in which 50 cubic yards or more of overburden are disturbed.

- Policy 17.5: Nevada County hereby recognizes, accepts, and adopts by reference those State Classification Reports as found in Appendix A of this Chapter providing information on the location of significant mineral deposits within the County.

The General Plan land use map shall include a Significant Mineral Deposit identification reflecting MRZ-2 areas as determined in the Reports and similar studies. At any time a Classification Report is presented to the County, said map shall be amended to reflect the Report within 12 months. When it is necessary, due to the lack of specificity, to clarify the exact location of this identification, said Reports shall be used.

- Policy 17.6: Encourage extraction of mineral resources in compatible areas prior to intensified urbanization or conversion to other incompatible land use development.

- Policy 17.8: A reclamation plan, consistent with the State Surface Mining and Reclamation Act standards, is required for all mining operations. Reclamation shall

1. Prevent, mitigate, or minimize adverse effects on the environment.
2. Encourage the production and conservation of minerals.
3. Provide for the protection and subsequent beneficial use of mined and reclaimed land.
4. Eliminate residual hazards to the public health and safety.
5. Ensure that mined lands are reclaimed on a timely basis to a usable condition that is readily adaptable for alternative land uses.
6. Avoid the environmental and legal problems created by improperly abandoned mines.

- Policy 17.9: Encourage the mining of previously mined land, if such land still contains economically mineable minerals, so the land can be reclaimed for alternative uses.

- Policy 17.24: Regardless of the General Plan designation, subsurface mining shall be conditionally permitted throughout the County. Said mining shall be allowed only after impacts on the environment and affected surface land uses have been adequately reviewed and found to be in compliance with CEQA. Of particular importance shall be the impact of the operation on surface land uses, water quantity and quality, noise and vibration, land subsidence, and traffic associated with surface access. All other related impacts shall also be addressed.

- Policy 17.25: Surface access to subsurface mining is conditionally permitted only in compatible General Plan designations as defined herein. However, vent and escape shafts are conditionally permitted in incompatible General Plan designations where surface disturbance is minimal.

- Policy 17.26: Surface plants for underground mines differ greatly in complexity and areal extent so evaluation on an individual project basis is required to assess impact on the environment. The simplest case is a mine portal or shaft collar from which ore and waste are removed from the site for treatment and disposal elsewhere. As a result, the impact on the environment could be minimal. The most complex cases involve stockpiles, crushing and grinding facilities, concentrators and other processing units, shops, warehouses and offices, waste disposal areas, tailings ponds and extended infrastructure. Such operations shall receive the same evaluation as large surface mines.

(Nevada County, 1995).

City of Grass Valley General Plan

The City of Grass Valley General Plan Safety Element provides the following Goals (SG), Objectives (SO), Policies (SP), and Safety Implementation Actions and Strategies (SI) that would applicable to the proposed project:

- Goal 1-SG: Reduce the potential risk of death, injury, property damage, and economic and social dislocation from hazards.

- Objective 1-SO: Assurance of a high level of protection from geologic and seismic hazards for all residents, structures, and vital services.

- Policy 1-SP: Adopt current uniform codes for new construction.

- Policy 2-SP: Ensure seismic safety and structural integrity in housing and commercial/industrial facilities through code enforcement.

- Policy 4-SP: Based on location or probable need, require development plans in mined areas to include in-depth assessments of potential safety, including mining-related excavations, and health hazards and accompanying mitigation measures.

- Safety Implementation Action 6-SI: Establish a mine-related hazards program, to include the following specific actions. Initiate and maintain a mine hazard database, incorporating maps, technical studies, and other germane information. To the extent practical and possible, map and describe identifies hazards. Coordinate with Nevada County and the

California Geological Survey in mine hazard research and information collection and dissemination. Provide technical assistance and advice to property owners in identifying and mitigating mine-related hazards on their properties. Determine the appropriate extent of geotechnical field investigations and other research required to determine the presence or absence of potentially hazardous mine-related features. Require appropriate field investigation and other research as part of the approval process for new developments, including individual new structures.

- Safety Implementation Action 11-SI: Incorporate into City construction codes appropriate provisions and revisions of the Uniform Building Code regarding seismic safety.

The City of Grass Valley General Plan Conservation and Open Space Element provides the following goals and objectives that would be applicable to the proposed project:

- Policy 1-COSP: Continue to identify mineral resources and to develop policies addressing their protection from competing land uses, minimizing impacts on mining activities, in compliance with State law.
- Policy 2-COSP: Establish an active program of land/development rights acquisition in order to protect sensitive environmental areas and features.
- Policy 5-COSP: Carefully regulate development on steep slopes.
- Policy 6-COSP: Prevent excessive alteration of the natural topography.

(City of Grass Valley, 2005).

4.6.3 Impacts Discussion

Methods

This section considers the potential impacts of the proposed project associated with geologic conditions, soils, seismicity, and mineral resources. Establishing the setting and analysis of the geologic and seismic impacts associated with the proposed project required review of existing unpublished and published data, in addition to a site reconnaissance and discussions with professionals familiar with the geology and seismic history of the region. Information on the geology was, in part, gleaned from the 1995 IMM Dewatering and Exploration Project EIR. This document provided a comprehensive understanding of the type of bedrock and the geologic structures underlying the site. Data provided by IMM included logs of rock coring and a preliminary geotechnical report completed by Holdrege & Kull in 2005. The core logs, documenting several rock borings completed throughout the IMM property, were useful to verify the geologic conditions and confirm our understanding of bedrock groundwater flow. The Holdrege and Kull preliminary geotechnical report prepared for the proposed project provided an essential tool for analyzing the geotechnical impacts of the property. Holdrege and Kull discussed existing conditions, investigated the geotechnical and geological constraints at each of the project sites, and provided geotechnical recommendations to reduce adverse conditions upon development.

Published maps prepared by the U.S. Geological Survey and California Geological Survey (CGS) were consulted to verify regional geologic structure and seismic conditions and to interpret geologic descriptions provided by IMM. These included the USGS Professional Paper 194, *The Gold Quartz Veins of Grass Valley, California* and the 1992 Geologic Map of the Chico Quadrangle, published by the CGS. A site reconnaissance conducted with GeoSolutions staff provided an opportunity to ground truth geotechnical and geologic conditions and contributed to a more comprehensive understanding of the relationship to topography and the configuration of the proposed project with consideration of the geology and location of mine workings. The geologic analysis included consultation with GeoSolutions regarding the geologic conditions and the history of mining at IMM. The geologic analysis used the technical memorandum prepared by Geosolutions, which outlined some key geologic considerations. Other sources accessed by GeoSolutions included the May 1991 Technical Assessment Report on the Idaho-Maryland Mining prepared by James Askew Associates, Inc. and the 1992 IMM Application For Conditional Use & Reclamation.

Results

The general issue areas are outlined in the checklist table at the beginning of this chapter. Various issues identified in the checklist are considered to have no impact to the proposed project and are discussed briefly below.

Fault Rupture Hazards

Seismically-induced ground rupture is defined as the physical displacement of surface deposits in response to an earthquake's seismic waves. The magnitude, sense, and nature of fault rupture can vary for different faults or even along different strands of the same fault. Ground rupture is considered more likely along active faults. The project sites are not underlain or in the vicinity of an active fault capable of surface rupture. No faults in the area are zoned by the State of California under the Alquist-Priolo Earthquake Fault Zoning act as active and susceptible to fault rupture. Fault rupture is not considered an impact to the proposed project.

Inadequate Soils for Wastewater Disposal

The soils covering the proposed project sites are relatively thin and overlie bedrock. Surface drainage and wastewater disposal under the soil conditions could be problematic. However, the proposed project would require a septic system only on the New Brunswick site to serve the restrooms for the hoist operation personnel. Soils at the proposed restroom location can accommodate a septic system and leachfield. Stormwater would either flow to Wolf Creek or be discharged through municipal sanitary and the storm sewer systems available to IMM from the City of Grass Valley. Inadequate soils to accommodate disposal of wastewater to the surface or through a septic system is not considered an impact to the proposed project.

Loss of Availability of a Known Mineral Resource

The proposed project involves reactivation of a once operating subsurface gold mine for the extraction and gold ore and overburden. The project also includes processing the gold ore and manufacturing of ceramics. Considering the project components, loss of mineral resource availability is not an impact of the proposed project.

Loss of Availability of a Locally-Important Mineral Resource Recovery Site

As stated above, the project involves reactivation of a mineral resource area. The project would reestablish mining and therefore, loss of a mineral recovery site is not an impact of the proposed project.

Impact 4.6-1: In the event of a regional earthquake on one of the active fault zones in the region, the project sites would experience ground shaking. Strong ground shaking could cause injury, damage property, and disrupt utility service. Although ground shaking could occur, it is not expected to produce strong ground motion and the use modern seismic design criteria and construction techniques would reduce injury and damage to buildings and mine workings. This would be a less than significant impact.

A primary seismic hazard for the project sites and vicinity is the secondary effects of ground shaking during a regional earthquake. In populated areas, the greatest potential for injury and property damage is a result of ground shaking from a regional earthquake. The degree of damage depends on many interrelated factors including earthquake depth, distance from the causative fault, source mechanism, duration of shaking, and type of surface deposits or bedrock. In the project area, ground shaking from an earthquake could reach 0.5 g or equivalently, a Modified Mercalli intensity of VII to VIII. Ground shaking from an event of this magnitude would be felt by people but the damage to newer buildings designed with modern seismic criteria and under current building codes would be minor. However, ground shaking from a regional earthquake could damage some older buildings in Grass Valley, cause some injuries, overwhelm emergency services, temporarily disrupt utility service, and temporarily close essential businesses services. The 1995 *IMM Dewatering and Mine Exploration EIR* (Nevada County, 1995), identified seismically induced ground failure and secondary hazards associated with subsidence or settlement as notable seismic hazards. Seismically-induced settlement or subsidence can be caused by compaction of soil or collapse of underground voids near the surface (Nevada County, 1995).

Earthquakes are an unavoidable hazard and the proposed project would not increase the potential risks. Although the project would attract additional people to the Idaho-Maryland Mine and City of Grass Valley, the potential for injury during an earthquake is the same or less than it would be elsewhere in the county. The project proposes new manufacturing facilities, which would be designed and constructed using appropriate seismic criteria to withstand ground shaking effects. In the event of an earthquake, ground shaking would not be expected to greatly impact subsurface mine workings and the potential threat of injury to workers is low. A regional earthquake would be generated from a considerable distance from the mine exposure and the seismic waves would travel through the massive bedrock and around the excavations. Bedrock tends to attenuate seismic waves as opposed to soft soils which can amplify seismic waves. Damage to deep-seated mine workings is usually limited to minor fracturing of thinly bedded, exposed rock because of the massive bedrock conditions at depth. However, nearer to the surface where is there is less rock mass between the surface and the tunnel, rock failure could occur. Such a failure could cause collapse of the thin layer of rock above the excavation and cause subsidence at the ground surface (Nevada County, 1995). If such a subsidence incident occurs, the failure area would be expected to be localized and not result in significant injury.

Given the limited history of earthquakes in this region, the presence of stable bedrock geology, and the distances to regional faults, the potential for strong ground shaking to cause injury and excessive damage to structures and mine workings is low, this would be a less than significant impact.

Impact 4.6-2: In the event of an earthquake ground failures due to liquefaction and landslides could be triggered on the project site. Such failures could cause localized damage to structures and engineered fills but is not likely to cause injury. This would be a less than significant impact.

Violent ground shaking can lead to ground failure due to liquefaction. Liquefaction is a phenomenon whereby unconsolidated and/or near saturated soils lose cohesion and are converted to a fluid state as a result of severe vibratory motion. The relatively rapid loss of soil shear strength during strong earthquake shaking results in the temporary fluid-like behavior of the soil. Liquefaction can damage building foundations, break underground utilities, and cause differential settlement. In order for liquefaction to occur, there must be a sudden large decrease of shearing resistance in cohesionless soil (sand or small gravel) caused by a shock, such as an earthquake, and associated increase in pore water pressure. Typical soils that can liquefy include low-density soils that, when saturated and concurrently subjected to high intensity ground shaking, dilate due to excessive water forces and behave as a liquid rather than a soil matrix.

As discussed, the project area could experience ground shaking during an earthquake but considering the location of the project, the ground shaking intensity is not expected to be significantly high. Because of this, the potential for liquefaction and seismically-induced landslides is low. The threat of damage to future improvements due to liquefaction appears to be minimal for the 101-acre Idaho-Maryland site because subsurface materials beneath the property are mostly lacking in the combination of soil types and groundwater conditions needed for this type of failure. Alluvial soils within main drainage channels of Wolf Creek and its tributary the South Fork may be liquefiable given adequate seismic loading. However, these alluvial soils are generally outside of the areas of development and are also considered compressible under seismic conditions and thus would require mitigation for other reasons. However, in the rare situation that localized ground failure due to liquefaction do occur in areas with unconsolidated, saturated fill materials, the effects would not impact a large area and liquefaction ground failures would not cause injury or serious structural damage in buildings. The most likely location for liquefaction failures to occur would be in the saturated sediments adjacent to and beneath the mine water settling pond and the stormwater detention pond. However, considering the low earthquake intensities that could be generated by a regional earthquake, the potential that liquefaction could damage these structures is low. Some small slope failures may occur due to seismic shaking but the potential for these incidents to cause injury or damage is low. Considering the low potential for seismically-induced ground shaking and landslides, this impact would be less than significant.

Impact 4.6-3: Construction activities including grading, removal of concrete and vegetative cover could result in substantial soil erosion by wind and water. Once developed, the project site areas, especially the Idaho-Maryland site, should be adequately protected from effects of water and wind erosion. This would be a less than significant impact.

Water and wind erosion of soils during construction can be problematic due to the large areas of exposed soil and unprotected cut and fill slopes. The H&K geotechnical evaluation provided preliminary recommendations to address construction erosion, especially for cut and fill slopes. These recommendations include seeding graded portions of the site following grading, hydro-seeding slopes, using of netting and binding agents to keep seeds and straw intact, installing drainage ditches, and proper conveyance of overland flow. The H&K recommendations are standard engineering Best Management Practices that have been proven to control erosion. Implementation of these preliminary measures and additional measures at the design-level geotechnical design stage would ensure that impacts associated with soil erosion remain less than significant.

Impact 4.6-4: Mining activities associated with the project may be impacted by or contribute to subsidence hazards associated with existing subsurface mine works. Sudden subsidence due to collapsed mine portals and tunnels present a hazard to people, mine workers, and property. This would be a potentially significant impact.

Subsidence can be caused by natural geologic phenomenon and by the failure of manmade features such as mine shafts. The Old Brunswick shaft of the Idaho-Maryland mine collapsed during a storm in 1998 causing a sink hole that engulfed property and undercut the foundation of a private home. Mine related hazards include open holes at the ground surface, poorly covered or shored up shafts and subsurface tunnels (Nevada County, 1995). Collapse and surface subsidence could potentially be triggered by project activities such as mine dewatering, re-establishment and reconditioning of mine workings, blasting, or surface construction. Uncontrollable natural occurrences such as earthquake related rock falls, storm runoff, or cave-in can lead to tunnel collapse and subsidence. Former mine features are shown on the Constraints Map, **Figure 2-1** through **Figure 2-3**.

Impact 4.6-5: The geotechnical condition of the earthen berm separating the Milco property and the Idaho-Maryland site has not been directly investigated. The applicant reports that this earthen structure has been in place for 70 years and does not show signs of deterioration. The proposed project does not include use of this berm to support structural improvements or roadways. In the event of an earthquake, small slope failures, subsidence,

or settlement could occur in localized sections of the berm but this condition is unlikely to cause serious damage or injury. This is a less than significant impact.

The earthen berm (also referred to as a levee) that extends along part of the eastern boundary of the IMM property and adjacent Milco site is reportedly a 70-year old earthen structure constructed of soil and rock, presumably a heterogeneous distribution of mine tailing materials (as shown on the Constraints map, **Figure 2-1**). Currently, a gravel access road runs along the top of this structure. IMMC reports that the condition of the levees is good and that no signs of deterioration, such as slope failure or settlement have been identified. The proposed project would not change the current condition of this earthen berm nor would new structures be placed on or near it. The proposed project would include an access road to the west and along the northern end of the levee from the corner of Centennial Road and Whispering Pines Lane. Also, west of the levee and along the southern end of the levee, IMMC proposes to construct a storm water cut-off ditch. The proposed road and the stormwater ditch would not require grading (i.e. slope cut) that would affect the integrity of the levee. The pond located on the Milco property acts as a storm water retention pond, catching runoff from adjacent properties during the winter and spring months, but is reportedly dry during the summer and fall. During the wet seasons, surface water from the Milco pond passes through an existing buried culvert at the base of the levee and allows water to pass through onto IMMC property.

In the event of an earthquake of considerable magnitude, soil and rock material within the earthen berm may become dislodged from the side slope, subside around the culvert passing underneath the berm, or settle differentially in areas of heterogeneous materials. In addition, heavy rains or static forces (those driven by gravity) may cause portions of the berm slopes to fail over time. If these failures were to occur, the damage would be localized and effects to the overall integrity of the berm would be minor and not likely to cause injury or damage to existing structures or structures proposed as part of the project.

Impact 4.6-6: Areas of the project sites contain fill material that is unsuitable to support structural improvements. This would be a potentially significant impact.

Following their geotechnical investigation, H&K stated that their primary concern is the presence of fill in portions of the previously graded areas of the Idaho-Maryland site and New Brunswick site. Much of the fill encountered during a previous subsurface investigation at the Idaho-Maryland site reportedly contained organic material that would not be suitable to support structural improvements. Areas containing soils that may not be suitable for construction, as shown on the Constraints Map, **Figure 2-1**, would be expected to occur in the areas of young quaternary alluvium. H&K anticipates that the relatively shallow fill across much of the southern area would be able to be removed or, if deemed suitable for the purpose, used for compacted fill. However, the deeper fill encountered by others in the southeastern area would likely require extensive excavation and would not likely be reused due the reported abundance of organic materials. The disturbed material and waste rock identified in the northwestern part of the Idaho-Maryland site and at the New Brunswick site may not be suitable to support structural improvements. Waste rock piles cover portions of the Idaho-Maryland, New Brunswick, and Round Hole sites. In general, these piles are not suitable to support structural improvements. The waste rock piles in the area of the proposed ceramic plant would likely have to be removed prior to construction.

Impact 4.6-7: Expansive clay soils may be present in some areas of the site above relatively shallow bedrock. Expansive soils can damage foundations, pavement and roadways. Expansive soils conditions can be corrected by standard engineering practices. This impact would be a less than significant impact.

The H&K geotechnical investigation anticipates that expansive clay soils may be present at some locations of the site. If expansive soils are present and not properly mitigated through standard engineering remedies, the shrink-swell nature of the clay can, over time, gradually compromise the integrity of structural elements such as foundations and pavement. The result of unmanaged expansive soils can include cracks in concrete, heaved asphalt pavement, and misaligned underground utilities. Preliminary recommendations are provided by H&K in their October 2004 investigation and additional recommendations for handling these soils when encountered would be included in the design-level geotechnical investigations. Although expansive soils may exist at certain locations on the project site, the presence of these soils can be verified during a design-level geotechnical investigation and adequately mitigated using standard geotechnical engineering practices. Therefore, this impact would be less than significant.

4.6.4 Data Gaps

1. In order to adequately assess project impacts of unsuitable fill materials, the applicant should provide an additional assessment on how they propose to mitigate the areas reported by H&K as containing fill material that are unsuitable and incapable of supporting structures.

2. H&K did not conduct a seismic evaluation in their preliminary geotechnical evaluation nor did they discuss seismic risk. It is understood that earthquake ground shaking could occur but the shaking intensity will likely be low. Nevertheless, it would assist our analysis if the applicant, through H&K, provided results of a site seismic characterization. Such an evaluation should include a summary of earthquake related risks, estimated ground motions, an assessment of the likelihood of seismically induced ground failure, potential discussion of the likely earthquake sources, and distances from the site to causative faults.

3. Additional information is needed to fully assess the potential for subsidence due to collapse of mine workings. This analysis is necessary to demonstrate that reactivation of the Idaho-Maryland Mine and the proposed development would not lead to subsidence hazards that could affect people of property. The MEA team requests that IMMC provide information on past or present failures of mine workings, at the Idaho-Maryland Mine, if any, that have led to surface subsidence, settlement, or structural damage. Of primary interest are failures in the mine workings that occurred near the ground surface (i.e., entrances to declines or shallow tunnels) and resulted in subsurface collapse noticeable at the surface.

4. Our geotechnical analysis would benefit from additional information on the structural competence of the stormwater detention pond and basic design features of other proposed or existing water retention facilities, slated to be used for the project. Useful information

would include size, depth, liner material, spillway design and underlying geologic materials.

References – Geology, Soils, Seismicity, and Mineral Resources

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