SECTION 4.5
GEOLOGY AND SOILS

This section evaluates the potential impacts of the project as they relate to geology and soils. The main concern is the possibility of ground failure due to seismic activity. The impact analysis is based upon previous geologic studies pertaining to the project site, and a peer review of these studies conducted by Kleinfelder, Inc. The studies and the peer review are included in this document as Appendix E and G.

4.5.1 SETTING

LOCAL GEOLOGY AND SOILS

The project site is located in Burney Valley, which is in the southern portion of the Cascade Range and Modoc Plateau geomorphic provinces. The Cascade Range is a chain of Quaternary volcanoes that overlies slightly older Tertiary volcanic rocks. Erupted volcanic debris blankets the Cascade Range geomorphic province within Shasta County. The Modoc Plateau in northeastern Shasta County is characterized as a large, undulating highland, drained by the Pit River and composed of assorted Miocene to Holocene volcanic rocks principally basaltic in composition (Dupras, 1997). The Burney Valley is bounded by two faults. A western member of the Hat Creek Fault, which runs along the eastern boundary of the project site, forms the eastern boundary of the valley. Approximately three miles west of the project site, another normal fault along an east-facing escarpment known as Rocky Ledge forms the western boundary (Kleinfelder, Inc., 2000).

The site itself is underlain by Pleistocene volcanic rock, composed mainly of basalt (Division of Mines and Geology, 1962). The basalt is black to blue-black in color, and it is vesicular in character, meaning that it contains small cavities formed by entrapment of gas bubbles during solidification of the rock. A vertical fault scarp with a height from 60 to 80 feet runs along the eastern edge. The bluff is composed of black to blue-black vesicular basalt that is Pleistocene in age. The faulted basalt form a west-facing hummocky and blocky cliff, built up of successive layered flows that exhibit well-developed columnar jointing (Dupras, 1997). The bluff facing is covered with basalt talus varying in size from 6 inches to over 6 feet. The talus slope angle ranges from 1.25:1 to 1.5:1 (Kleinfelder, Inc., 2000).

The *Soil and Vegetation Survey-Burney Area, Shasta County* (1992) mapped the soils in the area covered by the proposed reclamation plan. Soil in this area has been identified as the Ricketts-Orhood Complex. Both Ricketts and Orhood soils have moderately slow permeability, slow to medium surface runoff, and low to moderate water erosion hazard. The shrink-swell potential of this soil is low. The other portions of the project site contain Malinda extremely gravelly sandy loam, 15 to 30 percent slopes. This is a well-drained soil derived from slope alluvium from extrusive igneous rock. Permeability is moderately slow, and surface runoff is rapid. Erosion hazard in bare areas is low to moderate (Glazner, 1999). The portion of the site where the plants are proposed contain Willibulli loam. A bulldozed cut at the top of the bluff near the southeastern property corner revealed a 4-foot thick layer of colluvial soil consisting of gravelly clay with cobbles (Kleinfelder, Inc., 2000).

MINERAL RESOURCES

In 1975, the State passed the Surface Mining and Reclamation Act (SMARA) partly in response to the loss of significant mineral resources to urban expansion. Under SMARA guidelines adopted by the State Mining and Geology Board, the State geologist is required to classify specified areas into Mineral Resource Zones (MRZs), based solely upon geologic factors and without regard to present land use or ownership. Based upon a mineral land classification conducted by the State Division of Mines and Geology in 1997, the portion of the project site above the basalt bluff has been classified as MRZ-2a for crushed stone (**Figure 4.5-1**). A MRZ-2a area is underlain by mineral deposits where geologic data indicate that significant measured or indicated resources are present. Land included in the MRZ-2a category is of prime importance because it contains known economic mineral deposits. The project site below the bluff has been classified as MRZ-2b for crushed stone. A MRZ-2b area is underlain by mineral deposits where geologic data indicate that significant inferred resources are present. These resources are inferred by their lateral extension from proven deposits or by their similarity to proven deposits. For both classifications on the project site, the crushed stone is considered to be suitable for use as AC-grade aggregate, or aggregate that can be used in asphaltic concrete.

GEOLOGIC HAZARDS

Seismicity

Northeastern Shasta County has several faults which have been active in Holocene times, that is, within the last 11,000 years. The Hat Creek Fault is located approximately 8 miles southeast of the project site, and the McArthur Fault is located approximately 14 miles to the east. None of the faults in the vicinity of the project site have been recorded as active in historical times.

The project site contains a fault along the base of the bluff. According to the 1994 *Fault Activity Map of California*, this fault has experienced activity within the last 11,000 years. Fault displacement at the project site is about 40 feet. No significant activity in historical times has been recorded. A site inspection by an engineering geologist in 1995 revealed no evidence of geologically recent movement along the bluff (Cooksley Geophysics, 1995). Nevertheless, this fault has been designated by the State Geologist as an Alquist-Priolo Earthquake Fault Zone. The Alquist-Priolo Earthquake Fault Zoning Act is discussed later in this section.

Volcanoes

The project site is located within the southern end of the Cascade Range. The nearest volcano to the project site that has been active in recent history is Lassen Peak, approximately 35 miles to the south. Lassen Peak experienced eruptions from 1914 to 1917. The characteristics of these eruptions included ash clouds, mudflows and pyroclastic flows. The damage caused by these eruptions was limited to the area now encompassed by Lassen Volcanic National Park. Mt. Shasta, which last erupted in 1786, is located approximately 42 miles northwest of the project site. Another recently

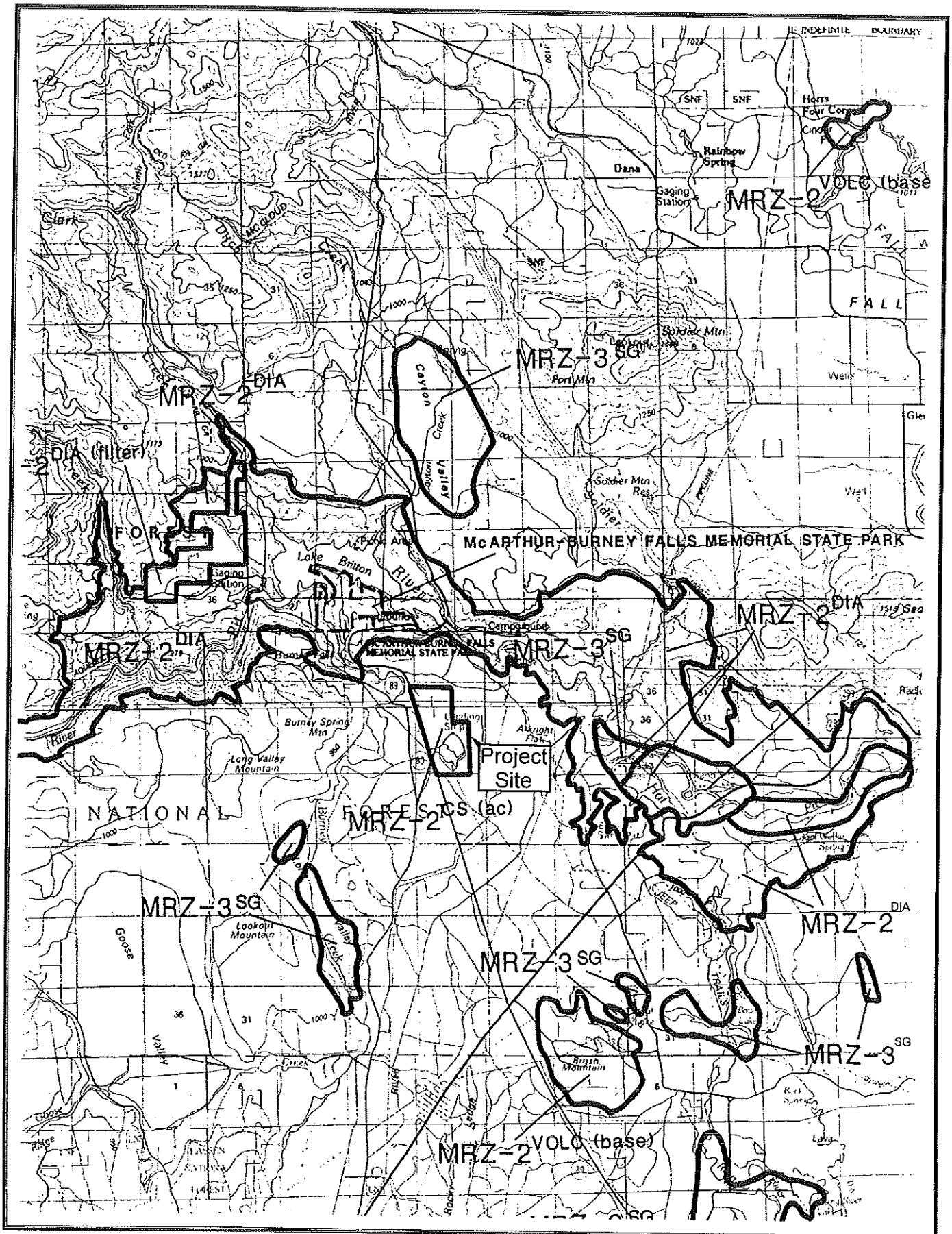

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FIGURE 4.5-1
MINERAL RESOURCE ZONES

active volcanic site is the Medicine Lake area in Siskiyou County, approximately 42 miles to the north. A burnt lava flow in the area was estimated to have occurred in 1750.

Slope Stability

The bluff on the project site, along with the existence of a fault that has been active in recent geologic times, raises the issue of the stability of the bluff. A site inspection by an engineering geologist in 1995 indicated that the rock on the bluff is massive and should remain stable at a slope of 0.75:1 (Cooksley, 1996). No other major slopes are located within or in the vicinity of the project site.

4.5.2 REGULATORY FRAMEWORK

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT

The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code Section 2621 *et seq.*) went into effect in 1973. The purpose of this Act is to prohibit the location of most structures built for human occupancy across the traces of active faults, thereby mitigating the hazard of fault rupture (Public Resources Code Section 2621.5). Under the Act, the State Geologist is required to delineate "Earthquake Fault Zones' (EFZs) along known active faults in California. The State Mining and Geology Board, for the purposes of this Act, defines an "active fault" as one that has had surface displacement within Holocene times, meaning within the last 11,000 years. Cities and counties affected by an EFZ must regulate certain development projects within the zone. As defined in Public Resources Code Section 2621.6(a), a "project" means either of the following:

1) Any subdivision of land which is subject to the Subdivision Map Act, and which contemplates the eventual construction of structures for human occupancy.

2) Structures for human occupancy, with the exception of either of the following:

   - Single-family wood-frame or steel-frame dwellings to be built on parcels of land for which geologic reports have been approved.
   - A single-family wood-frame or steel-frame dwelling not exceeding two stories when that dwelling is not part of a development of four or more dwellings.

Under this Act, cities and counties must withhold development permits for sites within an EFZ until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting. Under current State policy, the boundaries of an EFZ are positioned approximately 500 feet away from a major active fault and approximately 200 to 300 feet from well-defined, minor faults. The Official Map of Earthquake Fault Zones for the project site depicts a 300-foot EFZ. Under guidelines established by the State Mining and Geology Board, no structure for human occupancy shall be permitted on the trace of an active fault. **Figure 4.5-2** depicts the Alquist-Priolo zones in the project vicinity, with illustrations of the 300-foot buffer on each side of the faults.

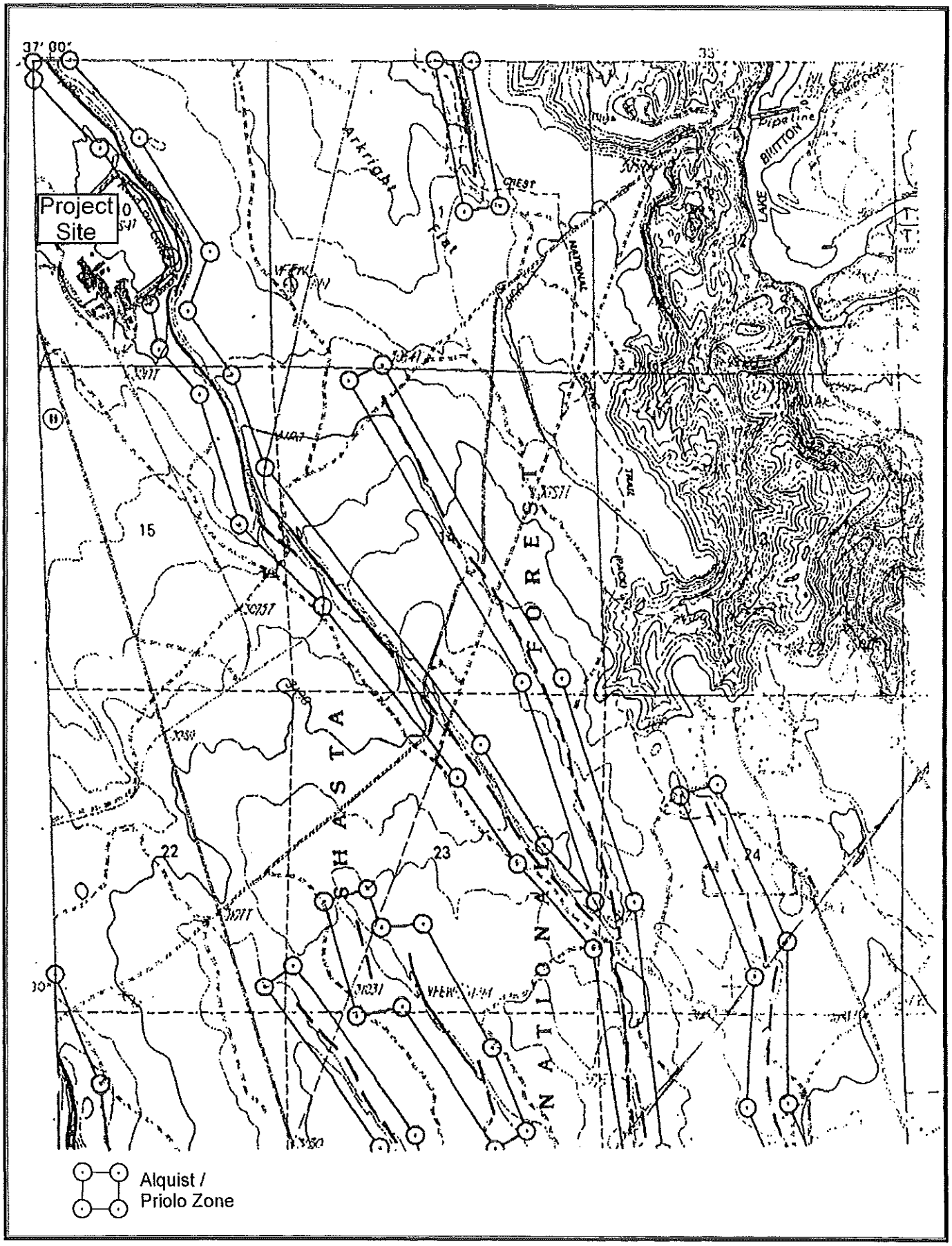

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FIGURE 4.5-2
ALQUIST-PRIOLO EARTHQUAKE FAULT ZONES

UNIFORM BUILDING CODE

The Uniform Building Code (UBC) regulates the construction of structures within the state. The UBC places the project site in Seismic Zone 3, defined as an area of potentially major damage from earthquakes corresponding to intensity VII and higher on the Modified Mercalli Scale. Such areas are subject to strict building regulations designed to enhance the ability of a structure to withstand potential earthquakes. **Table 4.5-1** depicts the Modified Mercalli Scale.

TABLE 4.5-1
MODIFIED MERCALLI INTENSITY SCALE FOR EARTHQUAKES

Richter Magnitude Scale	Modified Mercalli Scale	Effects of Intensity
0.1-0.9	I	Earthquake shaking not felt.
1.0-2.9	II	Shaking felt by those at rest.
3.0-3.9	III	Felt by most people indoors, some can estimate duration of shaking.
4.0-4.5	IV	Felt by most people indoors. Hanging objects rattle, wooden walls and frames creak.
4.6-4.9	V	Felt by everyone indoors, many can estimate duration of shaking. Standing autos rock. Crockery clashes, dishes rattle and glasses clink. Doors open, close and swing.
5.0-5.5	VI	Felt by all who estimate duration of shaking. Sleepers awaken, liquids spill, objects are displaced, weak materials crack.
5.6-6.4	VII	People frightened and walls unsteady. Pictures and books thrown, dishes and glass are broken. Weak chimneys break. Plaster, loose bricks and parapets fall.
6.5-6.9	VIII	Difficult to stand. Waves on ponds, cohesionless soils slump. Stucco and masonry walls fall. Chimneys, stacks, towers and elevated tanks twist and fall.
7.0-7.4	IX	General fright as people are thrown down, hard to drive. Trees broken, damage to foundations and frames. Reservoirs damaged, underground pipes broken.
7.5-7.9	X	General panic. Ground cracks, masonry and frame buildings destroyed. Bridges destroyed, railroads bent slightly. Dams, dikes and embankments damaged.
8.0-8.4	XI	Large landslides, water thrown, general destruction of buildings. Pipelines destroyed, railroads bent.
8.5+	XII	Total nearby damage, rock masses displaced. Lines of sight/level distorted. Objects thrown into air.

Source: California Division of Mines and Geology.

SHASTA COUNTY GRADING ORDINANCE

Shasta County Code Chapter 12.12 sets forth regulations concerning grading, excavating and filling. The County Code prohibits any grading without a grading permit from the County. The grading permit must include an approved grading plan provided by the project applicant, and it shall set forth terms and conditions of grading operations that conform to the County's grading standards. The permit also requires the project applicant to provide a permanent erosion plan which would be implemented upon completion of the project, and which must be approved prior to the start of any work. Each permit shall require approval of a plan for ongoing maintenance of erosion control measures for the duration of the project and for three years after completion of the project, unless the project is released earlier by the enforcing officer designated by the County Board of Supervisors.

SHASTA COUNTY GENERAL PLAN

The County General Plan contains the following objectives and policies concerning geology and soils that pertain to the project:

Minerals

Objectives

MR-2 To encourage the production and conservation of minerals while giving consideration to values relating to recreation, watersheds, wildlife, range, forage, timberlands and aesthetics.

MR-3 To ensure that mining operations are conducted in such a manner as to protect the public health, safety and welfare; to minimize impacts on adjacent land uses; and to mitigate other potential adverse environmental impacts.

MR-4 To ensure that mined lands are reclaimed to minimize adverse impacts on the environment, to protect the public health and safety, and to restore mined lands sites to a usable condition which is readily adaptable to alternative land uses.

Policies

MR-i All new and expanded mining operations shall have a use permit to ensure that they are conducted in a manner to protect the public health, safety and welfare, and to minimize adverse impacts on adjacent land uses and the environment.

MR-j On-site processing, including crushing, washing, screening, sorting and stockpiling, should be allowed as much as possible at all mineral resource sites, subject to consideration of potential conflicts with adjacent and nearby land uses, and to mitigation of potential adverse environmental effects. However, concrete plants and

asphalt plants should only be permitted in the Mineral Resource (MR) and General Industrial (M) zone districts, subject to approval of a use permit.

MR-n An operating term shall be required for each mining use permit. This would set a defined length of time during which mining may occur. Any extensions beyond the permit expiration would require further environmental review and discretionary approval. The term of mining should be balanced so as to allow sufficient time for the operator to amortize investments, without sacrificing regulatory effectiveness. The maximum length of time for which any mining permit maybe approved is 30 years.

MR-o Aggregate recycling facilities should be included as a permitted use subject to a use permit in General Industrial and Mineral Resource zone districts.

MR-q The County should maintain a Surface Mining and Reclamation Act regulatory program to provide current information on mineral resources and mining operations, to review applications for mining permits and reclamation plans, to review mine reclamation financial assurances, to perform annual mine inspections and file inspection reports, to monitor reclamation of mine sites, and to enforce compliance with State and County mining regulations.

Seismic and Geologic Hazards

Objectives

SG-1 Protection of all development from seismic hazards by developing standards for the location of development relative to these hazards; and protection of essential or critical structures, such as schools, public meeting facilities, emergency services, high-rise and high-density structures, by developing standards appropriate for such protection.

SG-3 Protection of development from other geologic hazards, such as volcanoes, erosion and expansive soils.

Policies

SG-c Shasta County shall coordinate with State and Federal agencies monitoring volcanic activity and shall periodically review and update the *Shasta County Emergency Plan* with respect to volcanic hazards.

SG-d Shasta County shall develop and maintain standards for erosion and sediment control plans for development. Special attention shall be provided to erosion prone hillside areas, including extremely erodible soils types such as those evolved from

decomposed granite.

SG-e When soil tests reveal the presence of expansive soils, engineering design measures designed to eliminate or mitigate their impacts shall be employed.

4.5.3 IMPACTS AND MITIGATION MEASURES

SIGNIFICANCE CRITERIA

Appendix G of the CEQA Guidelines indicates that a project may have significant impacts on geology and soils if it does any of the following:

1) Exposes 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.
   ii) Strong seismic ground shaking.
   iii) Seismic-related ground failure, including liquefaction.
   iv) Landslides.

2) Results in substantial soil erosion or the loss of topsoil.

3) Is located on a 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.

4) Is located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.

5) Has 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.

METHODOLOGY

PMC staff reviewed pertinent documents with information on the geology and soils of the area. Several documents published by the State Division of Mines and Geology were reviewed. A list of reviewed documents is provided in the References portion of this section.

PROJECT IMPACTS AND MITIGATION MEASURES

Impact 4.5.1 **The project is located adjacent to an Alquist-Priolo Earthquake Fault Zone, which may subject the project to seismic hazards. [SM]**

As shown in **Figure 4.5-2**, a portion of the project site is located within an Alquist-Priolo EFZ. According to the *Fault Activity Map of California*, the fault has experienced some activity within the last 11,000 years, but not in historical times. Under the Alquist-Priolo Act, no commercial or industrial structures may be located within an EFZ delineated on an official map unless geological investigations are conducted on the site. Even if they are not located within the EFZ, structures on the project site could remain subject to a potential ground shaking hazard, caused by potential activity on the fault. Therefore, seismic hazard impacts are considered ***significant and subject to mitigation***.

Mitigation Measures

The following mitigation measures were provided by the Initial Study for the project:

MM 4.5.1a Under the proposed project and the recommended conditions of the use permit, no permanent or fixed structures shall be located within the boundaries of the Earthquake Fault Zone as shown on the Earthquake Fault Zones map, Cassel Quadrangle, prepared by the State Geologist.

Timing/Implementation: During project implementation and thereafter as part of an annual mine inspection program.
Enforcement/Monitoring: Shasta County Department of Resource Management - Planning Division, Building Division.

MM 4.5.1b The construction of structures and the installation of equipment, including the aggregate processing plant, the asphalt plant and the concrete plant, shall be in compliance with all State and local seismic safety regulations and building codes.

Timing/Implementation: During building construction and equipment installation.
Enforcement/Monitoring: Shasta County Department of Resource Management - Building Division.

Implementation of these mitigation measures would reduce the potential severity of damage to structures on the project site, which would also increase the safety of people on the project site during a seismic event. Impacts after mitigation would be ***less than significant.***

Impact 4.5.2 **A possibility of seismic-related ground failure may occur on the project site. [LS]**

Seismic-related ground failure includes lateral spreading, lurch cracking and liquefaction. Lateral spreading is a secondary result of severe shaking and includes the actual horizontal movement of unconfined alluvium toward lower areas. Severe ground shaking also can induce near-surface cracks in alluvium, or lurch cracking. Liquefaction occurs when loose, saturated granular soil deposits lose their strength due to a sudden excess in water pressure. This buildup is induced by an earthquake. Liquefaction tends to occur in areas near water or within shallow groundwater.

The project site is located on a valley floor underlain by basalt, with no alluvium. Therefore, it is unlikely to experience lateral spreading or lurch cracking. The most likely places where liquefaction would occur is around the pond located south of the former log ponds. Liquefaction at the pond, if it occurs, would likely be confined to its edges. No structures are planned to be constructed near the pond. Ground failure impacts, therefore, are ***less than significant.***

Impact 4.5.3 **Quarry operations could induce slope instability at the bluff. [PSM]**

Mining of the bluff could increase the slope on portions of the bluff, increasing the potential for landslides. The Initial Study for the project indicates that quarry operations would leave a slope of 1:1 (a 45-degree angle). This slope could become unstable during an earthquake causing landslides. The State Office of Mine Reclamation recommends that a setback of 50 feet from the bluff be maintained. However, MM 4.5.1a would require structures on the site to be set back 300 feet, since an Alquist-Priolo EFZ is located along a fault at the bottom of the bluff. This setback would ensure the safety of structures from potential landslides caused by seismic activity.

In a peer review of previous geologic studies conducted on the project site, Kleinfelder, Inc. noted the observation of one study that bedrock on the site is horizontally and vertically jointed, resulting in block-shaped units. Kleinfelder stated that the potential for localized slope instabilities due to the heavily jointed bedrock needed further investigation by an engineering geologist (Kleinfelder, Inc., 2000). Since there was apparently no such investigation, landslide impacts are considered ***potentially significant and subject to mitigation.***

Mitigation Measures

The following mitigation measure was recommended by Kleinfelder, Inc.:

MM 4.5.3a Slope stability conditions of rock and soil slopes on the quarry site shall be evaluated periodically by a qualified professional engineer or a certified engineering geologist as the mining operation progresses. Although there is no set time on when such an evaluation will be conducted, the frequency shall be no less than one time per year. The Planning Division may request additional evaluations if it determines that circumstances warrant them. If a

potential slope stability problem is discovered, the engineer or engineering geologist preparing the evaluation shall make recommendations to reduce or eliminate the problem or its potential results, which the project applicant shall implement.

Timing/Implementation: During project implementation and thereafter as part of an annual mine inspection program.
Enforcement/Monitoring: Shasta County Department of Resource Management - Planning Division.

Implementation of the recommended mitigation would lead to the discovery of any potential slope stability problems and put in place a mechanism for dealing with these problems. Impacts after mitigation would be ***less than significant.***

Impact 4.5.4 **The project would result in the loss of some topsoil and the compaction of other soils. [SM]**

The project would result in various portions of the site being graded for eventual industrial use. The portion of the project site below the bluff is already relatively level and has been used previously as an industrial site. Much of the surface of the site is already compacted. Additional compaction would be in conformance with a grading and drainage plan as part of the preparation of the site for additional industrial uses. A grading and drainage plan, which conforms to adopted County standards, is required by County ordinance.

Most of the project site has been disturbed by previous industrial development, and the topsoil has either been removed or covered over. Some topsoil does remain on the flat area at the top of the bluff. This topsoil would be removed during quarry operations. This impact is ***significant and subject to mitigation.***

Mitigation Measures

The following mitigation measures were provided by previous Initial Studies:

MM 4.5.4a The project applicant shall submit and receive approval of a grading plan, with which all project grading and construction work shall be in compliance. The Building Division shall review the grading plan and shall inspect the project site at the time grading work is performed and completed. The Planning Division shall conduct ongoing monitoring to ensure that the objectives of the grading plan have been met.

Timing/Implementation: Grading plan to be submitted and approved prior to issuance of grading permit. Monitoring to be conducted during project implementation and thereafter as part of an annual mine inspection program.

Enforcement/Monitoring: Shasta County Department of Resource Management - Planning Division, Building Division.

MM 4.5.4b Soil that is removed from the top of the bluff as excavation of the bluff progresses shall be removed as a separate layer from areas to be disturbed by mining operations. Topsoil and vegetation removal shall not precede surface mining activities by more than one year. Topsoil and suitable growth media shall be maintained in separate stockpiles. Test plots are required to determine the suitability of growth media for revegetation purposes. Topsoil and suitable growth media that cannot be utilized immediately for reclamation shall be stockpiled in an area where they will not be disturbed until needed for reclamation. Topsoil and suitable growth media stockpiles shall be clearly identified to distinguish them from mine waste dumps. Topsoil and suitable growth media stockpiles shall be planted with a vegetative cover or shall be protected by other equally effective measures to prevent water and wind erosion and to discourage weeds.

Timing/Implementation: During project implementation and thereafter as part of an annual mine inspection program.
Enforcement/Monitoring: Shasta County Department of Resource Management - Planning Division.

Implementation of the mitigation measures would minimize the loss of remaining topsoil on the project site by ensuring its use during reclamation. Impacts after mitigation would be ***less than significant.***

Impact 4.5.5 Structures associated with the project may be constructed on potentially expansive soils. [PSM]

The proposed truck repair shop would be located on Burney-Arkright complex soil, which has a low shrink-swell. However, the crushing and screening operation, the asphalt plant and the concrete batch plant would be located on Willibulli loam, which has a moderate shrink-swell potential. Although it is not known if this potential could actually lead to structural damage, this impact is considered ***potentially significant and subject to mitigation***.

Mitigation Measures

Potential problems with expansive soils would be mitigated by compliance with the construction requirements of the currently adopted version of the Uniform Building Code. In addition, the following mitigation measure is proposed:

MM 4.5.5a For portions of the project site where structures would be placed, the project applicant shall submit a report from a qualified engineer or soils specialist

that identifies the location of expansive soils and demonstrates how the potential negative impacts of these soils would be minimized or avoided, in accordance with Policy SG-e of the Shasta County General Plan.

Timing/Implementation: Prior to issuance of building permit.
Enforcement/Monitoring: Shasta County Department of Resource Management - Planning Division, Building Division.

Implementation of this mitigation measure would minimize or eliminate the negative effects expansive soils on the site may have on structures. Impacts after mitigation would be ***less than significant.***

CUMULATIVE IMPACTS AND MITIGATION MEASURES

Impact 4.5.6 **Geologic and soil impacts are site-specific and are generally not affected by cumulative development in the region. [LS]**

In general, impacts on geology and soils are generally confined to a specific project area. The overall geology and soil composition of a region are not significantly affected by development. For this project, this typical situation is reinforced by the complex nature of the geology of the County. Thus, cumulative impacts of the project on geology and soils are ***less than significant.***

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