

## 4.2 Geology, Soils and Mineral Resources

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### SIGNIFICANCE CRITERIA

Impacts related to geological resources are considered significant if:

- Risk to human health and safety from geologic hazards is increased
- The impact leads to other adverse impacts
- Unique geological or paleontological features or sites are impacted
- Subsidence, erosion or siltation are substantial
- The recovery of other geological resources is impeded.

### METHODOLOGY

This analysis was performed by evaluating available data, information, and reports. These references are provided in the References Section. No additional data collection or field investigations were performed.

### IMPACT OVERVIEW

The proposed project includes limited surface disturbance, occurs in a relatively flat valley, and has low seismic and volcanic activity; the potential effects related to geological conditions are less than significant.

### EFFECTS OF PROPOSED ACTION

Potential geologic hazards include seismic and volcanic activity, ground subsidence, liquefaction, slope instability and landslides. The effects of these hazards are discussed below.

#### Seismicity

The project is located in an area of low seismic activity with no recent faulting and low topographic relief. There are no seismic epicenters located in Modoc County (USGS 1984). Any ground shaking, settlement, or seismically induced earth movement are not expected to pose a risk to human health and safety.

Although severe ground shaking could potentially rupture a pipeline, the low level of seismic activity is unlikely to produce enough ground movement to cause rupture of the 4-inch PVC pipeline. If a pipeline ruptured, the fluid spilled would probably either seep into the ground in the vicinity of the pipeline (pasture and border of the county road), or flow into the Pit River. The fluids that would spill would likely occur after the carbon treatment. No other project structures are vulnerable to rupture due to seismic shaking. Modoc County requires that facilities be constructed according to the most recent accepted building standards for earthquakes.. No additional mitigation measures are required.

#### Liquefaction

Although the Pit Series soil in the project area along the Pit River is frequently saturated, the soils in the project area are fine-grained and well consolidated and a seismic event is not likely. Therefore, the combination of the three conditions that can produce liquefactions (see Section 3.2 Geology, Soils and Seismicity) are highly unlikely and the potential for liquefaction in the project area is less than significant.

### **Volcanism**

A natural volcanic event is unlikely to be close enough to present a significant risk to human health & safety, or to trigger landslides or slope instability. However, potentially active volcanic centers to the northwest and southwest (Mount Shasta and Mount Lassen) could produce airborne ash that could fall at the site, but it is unlikely to affect the project. Potential eruptions at Medicine Lake Highlands are unlikely and in any case are not expected to be sufficiently violent to generate airborne material. Therefore the risks of adverse impacts to the project or from the proposed action related to volcanism are not significant.

### **Subsidence**

Ground subsidence is not expected to occur as a result of geothermal fluid withdrawal because of the competent nature of the rocks overlying the geothermal aquifer and the low volume of fluid withdrawal. No other action related to the project might cause subsidence; therefore, the project would not cause significant impacts related to subsidence.

### **Slope Instability/Landslides**

The proposed action is located in an area with low topographic relief, relatively competent rocks, and little surface disturbance is proposed. It is unlikely that the project would produce or be affected by slope instability or landslides.

### **Unique Geologic Features**

There are no unique geological or paleontological resources in the project area; consequently, construction and operation of the proposed project would have no impact on these types of features.

### **Erosion**

The prominent soil type in the project area, the Pit Series, has low erosion potential. The project area is flat to gently sloping with little surface disturbance and relatively competent soils. The project is not expected to produce erosion or be adversely affected by erosion.

### **Topography**

Topography would not be affected, as construction is limited to installation of piping, a pipeline, and two small buildings. No grading or other civil work is proposed. Therefore the project would have no significant effect on topography in the area.

### **Expansive Soils**

Expansive soils can have an adverse effect on facility foundations when moisture causes the soil to swell and soften. The two proposed buildings would be constructed on Barnard gravelly loam, which has low expansivity. The discharge pipeline would be laid primarily in the Pit Series soil type, which has higher expansivity than Barnard gravelly loam. Linear structures such as the discharge pipeline are not significantly affected by the shrink-well potential of soils with high expansivity. Engineering controls accommodate these soil properties, for example, by lining the pipe with gravel. Gravel has low shrink-swell potential and adjusts to accommodate the soil around it, keeping the contained pipe intact. The project would not be affected by expansive soils.

### **Mineral Resources**

No aspect of the proposed action would take place in the vicinity of the volcanic cinders identified in Section 3.2 (Geology, Soils and Seismicity). No other mineral resources were identified in the project vicinity. There would be no impact to mineral resources.

### **MITIGATION MEASURES**

No further mitigation measures are required.

### **EFFECTS OF ALTERNATIVE B (NO ACTION)**

If the project were not constructed due to lack of DOE funding, there would be no adverse effects to geology, soils, or mineral resources from Alternative B, the "No Action" alternative; however, the project could proceed without DOE funding contingent upon alternative funding, with effects from Alternative A potentially worse without DOE participation because no mitigation would be required (except NPDES required items). Without funding by DOE, I'SOT would not be reimbursed for costs resulting from permitting efforts, engineering consultation, and system installation costs. No data gathering system would be installed for DOE research and development (R&D) purposes.