3.1 GEOLOGY, MINERALS, AND SOILS

The following analysis has been prepared based on:

- review of the aggregate resource management plan (ARM Plan) from 1994,
- review of *Geomorphic Analysis and Mining Plan for Lower Alexander Valley between Gill Creek and the Jimtown Bridge* (Syar 2005a),
- review of *Hydrologic Impacts of Gravel Mining on The Russian River* (Simons, Li & Associates, Inc. 1991), and
- review of the *Alexander Valley Gravel Bar Skimming Plan* submitted by Syar Industries to Sonoma County (Syar 2005b).

A. Setting

REGIONAL SETTING

The Alexander Valley is one of several northwest-trending intramontane basins located within the northern Coast Ranges of California. The geologic and topographic characteristics of the Coast Range Geomorphic Province are a product of the combination of the tectonic processes, geologic materials, and climate of the region.

The regional bedrock geology consists of complexly folded, faulted, sheared, and altered bedrock that is of the Franciscan Complex of Upper Jurassic to Cretaceous age (65–190 million years old). The Franciscan Complex is composed of a variety of rock types. In the project vicinity and surrounding area, the Franciscan Complex consists of packages or blocks of sheared and unsheared shale and more coherent greywacke sandstone with minor amounts of greenstone, conglomerate, serpentinite, chert, and limestone. Folds are also common within the region's Franciscan Complex.

The geologic province formed at the boundary between the North American and Pacific Crustal plates and from the earlier subduction of the Farallon Tectonic Plate. The contact between these two plates is the San Andreas Fault Zone and subsidiary faults of the San Andreas Fault System. Subsequent compression, uplift, and faulting occurred during the Miocene and Pliocene epochs of the Tertiary Period (between 5 and 15 million years ago). The current tectonic setting is related to the movement along the northwest-southeast trending faults such as the San Andreas and Rodgers Creek–Healdsburg Faults, with movement of the Pacific plate to the north and west relative to the North American Plate.

LOCAL SETTING

The Russian River watershed above the Alexander Valley is uplifting because of compression along the San Andreas Fault Zone and the proximity and geological recent passage of the Mendocino Triple Junction[1]. Because of tectonic uplift and consequent downcutting by river systems, the watershed consists of mostly steep terrain. The terrain is underlain by generally weak rocks and is subject to long intense rainstorms during the winter months. This combination of geologic and climatic factors, combined with land use influences such as timber harvesting,

[1] The Mendocino triple junction is a place where three plates, the Gorda, the North American, and the Pacific, are in contact.

causes high rates of erosion on hill slopes. As a result, the watershed delivers large volumes of sediment to the river network.

Gravels located within the instream alluvial deposits and adjacent terrace deposits of the Russian River have been providing most high-quality construction aggregate produced within the county for many years. The ultimate sources of these aggregate gravels are bedrock formations whose weathering and erosion provides the raw materials from which the gravels are formed. The Franciscan Complex is the principal bedrock formation from which the gravels are derived. The study area consists of alluvial deposits on instream gravel bars of the Russian River. The deposits include sand and gravel originating from weathering and erosion of basaltic rocks and a variety of metamorphosed sandstone and shale. As the bars are repeatedly inundated by the river with deposition of new sediments, there is little or no topsoil on the gravel bars, although dry depressions on or behind bars or areas that are not inundated annually may develop thin topsoil.

The study area is located in an area shown on U.S. Geological Survey (USGS) Map I-909 titled “Mineral Resources of the San Francisco Bay Region, California - Present Availability and Planning for the Future.” The study area is described as gravel, sand and mud deposits of marine and nonmarine origins. This is corroborated by the California Division of Mines and Geology’s Data Map No. 2 titled “Geologic Map of California” (Jennings 1977). Jennings describes the material as Quaternary alluvial, lake, playa, and terrace deposits, unconsolidated and semiconsolidated, mostly nonmarine, and deposited within the last 11,000 years. It is identified as part of Aggregate Resource Sector B-2, shown on plate 3.47 of the California Division of Mines and Geology’s Surface Mining and Reclamation Act (SMARA) Report 146, 1982.

Seismicity and Ground Shaking

The study area is located in a seismically active region of California. The Rodgers Creek–Healdsburg Fault, mapped about 1 mile east of the study area, is the nearest active fault. The active San Andreas Fault lies approximately 30 miles west of the study area. These are northwest-southwest trending faults considered probable extensions of active fault traces paralleling San Francisco Bay. These active faults are not known to cross the study area and thus no fault rupture hazard is present in the study area.

The Modified Mercalli Intensity (MMI) Scale is commonly used to measure earthquake effects caused by ground shaking. Table 3.1-1 defines levels IV, V, VI, and VII of the MMI scale.

Anticipated earthquake shaking intensity maps based on the MMI have been developed for the San Francisco Bay region, including the study area. Weak to strong (MMI IV to VII) ground shaking in the study area could result from a large-magnitude earthquake on the Rodgers Creek–Healdsburg Fault or the San Andreas Fault.

The estimated maximum probable earthquake magnitude for the San Andreas Fault is 8.5, and for the Rodgers Creek–Healdsburg Fault, 7.0 (Sonoma County 1989). Because of the proximity of active faults in the region, the study area would be subject to high ground shaking intensities in the event of an earthquake centered on the San Andreas or Healdsburg–Rodgers Creek Faults. The severity of ground shaking varies considerably over the impacted region depending on the size of the earthquake, the distance from the epicenter of the earthquake, the nature of the soil at the study area, and the nature of the geologic material between the study area and the fault. Ground shaking can cause damage to inadequately designed or improperly constructed structures and foundations

Table 3-1
Ground Shaking Levels of Concern on the Modified Mercalli Intensity Scale

Ground Shaking Level	Definition
IV: No description of shaking severity	No description of shaking severity. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frame creak.
V: Light	Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.
VI: Moderate	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle).
VII: Strong	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments). Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
Source: ABAG 1978	

Liquefaction

Liquefaction is a phenomenon whereby unconsolidated and/or near-saturated soils lose cohesion and are converted to a fluid state because of severe vibratory motion generally associated with earthquake ground shaking. The relatively rapid loss of soil shear strength during strong earthquake shaking results in temporary fluid like behavior of the soil. Soil liquefaction causes ground failure that can damage roads, underground infrastructure, and buildings with shallow foundations. The depth to groundwater influences the potential for liquefaction; the shallower the groundwater, the higher the potential for liquefaction.

Soils

Soils are surface materials derived from the geology that have been modified or acted upon by physical, chemical, or biological agents so that they will support plant life. Characteristics such as depth, permeability, ability to hold water, and fertility vary widely from place to place. Within Sonoma County there are 259 soil types that are classified into 15 major soil associations. Soil associations are divided into six broad groups, and classified A–F based upon color and texture. These groups illustrate the general pattern of soil occurrence in Sonoma County: associations in Groups A–C include soils found primarily in basins, floodplains, terraces, and alluvial fans where instream and terrace production is most likely to occur, while the association in Groups D–F include soils found primarily in high terraces, foothill, upland, and mountain areas generally associated with quarries.

Soils in the vicinity of the proposed mining sites fall under the Yolo-Cortina-Pleasanton Association within Soils Group C. These are well drained to excessively drained, nearly level to moderately sloping, very gravelly sandy loams to clay loams located on floodplains, alluvial fans, and low terraces. This association is found along the Russian River north of Windsor, in the Dry Creek Valley, along the Alexander Valley, north of Cloverdale, and along the Gualala River and is the area where most terrace and instream production takes place.

Gravel bars are "lithic" soils, which mean they do not have a defined profile of horizon development associated with weathering. There is little or no topsoil on the gravel bars, depending on the frequency of inundation; however, the floodplain areas typically contain the same soil profile as the adjoining terraces near the top of the slope, and a thin layer made up of terrace soils and silt trapped by streamside vegetation at the bottom of the slopes.

Landslides

A landslide is a movement of a mass of soil down a slope when the soil loses strength and can no longer support the weight of overlying soil or rocks. Human actions can influence the activity of existing slides or create new slope instability. For example, improperly designed, constructed, and maintained cut slopes and excavation can fail, resulting in physical damage and possibly risk to life. Inappropriate diversion of surface runoff or inadequate subsurface drainage can result in the saturation or weakening of earth materials.

Damaging landslide movements have occurred in Sonoma County. The most widespread and damaging landslides usually occur during years of higher than normal precipitation, particularly in response to intense rainfall. The study area is flat, so substantial landslide hazards do not exist. Collapse of steep riverbanks related to lurching or landslide could occur during an earthquake, but is not expected to pose a substantial hazard.

Expansive Soils

Expansive soil is a fine-grained clay that occurs naturally and is generally found in areas that historically were floodplains or lake areas, but can also occur in hillside areas. Expansive soil is subject to swelling and shrinkage, varying in proportion to the amount of moisture present in the soil. Expansion takes place as water is initially introduced into the soil (by rainfall or watering). The soil will contract if dried out, often leaving small fissures or cracks. Because gravel and sand dominate on the bars, there are no expansive soils within the study area.

B. Regulatory Framework

STATE REGULATORY ISSUES

Alquist-Priolo Earthquake Fault Zoning Act of 1972

The Alquist-Priolo Earthquake Fault Zoning Act required the State Geologist to delineate zones of active faulting in the state and to require studies to be performed for projects located within the delineated Earthquake Fault Zones. The purpose of the act was to prohibit the location of most structures for human occupancy across active fault traces and mitigate the hazard of surface fault rupture. The study area is not located within an Alquist-Priolo Earthquake Fault Zone and no structures are proposed.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (California Geological Survey 2004a) was developed to assist local governments in protecting the public from the hazards of strong seismic ground shaking, liquefaction, landslides, or other ground failure and seismic hazards caused by earthquakes. The act supports a program of mapping areas subject to the secondary effects of earthquake ground shaking, including zones of liquefaction and landslides. Cities and counties require studies to investigate and mitigate the potential seismic hazard zones identified on the maps. To date, mapping efforts have concentrated on the large urban population centers of southern California and the San Francisco Bay Area. No seismic hazard maps have been produced for the study area and vicinity.

The Surface Mining and Reclamation Act of 1975

SMARA provides for reclamation of mined lands and directs the State Geologist to classify land within California according to the presence or likely occurrence of significant mineral deposits (California Geological Survey 2004b). The mineral land classification reports and maps are made available to the appropriate lead agencies, which are required to incorporate the information in their general plans. Since 1975, known and potential mineral deposits have been mapped in about one-third of the state under SMARA. The primary intent of SMARA was to create effective and comprehensive reclamation policies and regulations to reduce the adverse environmental effects and to ensure mined lands are reclaimed to a usable condition. The act also encourages the production and conservation of mineral resources.

LOCAL REGULATORY ISSUES

The Resource Conservation Element of the Sonoma County General Plan addresses soil and mineral resources. The following goals and policies are relevant to the project:

Goal RC-2: Promote and encourage soil conservation and management practice that maintain the productivity of soil resources.

Objective RC-2.1: Ensure that permitted uses are compatible with reducing potential damage due to soil erosion.

Objective RC-2.2: Establish ways to prevent soil erosion and restore areas damaged by erosion.

Policy RC-2a: Design discretionary projects so that structures and roads are not located on slopes of 30 percent or greater. This requirement is not intended to make any existing parcel unbuildable if Health Department and Building Department requirements can be met.

Policy RC-2b: Include erosion control measures for any discretionary project involving construction or grading near waterways or on lands with slopes over 10 percent.

Policy RC-2e: Retain natural vegetation and topography to the extent economically feasible for any discretionary project improvements near waterways or in areas with a high risk of erosion as noted in the Sonoma County Soil Survey.

Policy RC-2f: Prepare and submit to the Board of Supervisors an erosion and sediment control report.

C. Potential Impacts and Mitigation Measures

CRITERIA USED FOR DETERMINING IMPACT SIGNIFICANCE

According to CEQA Guidelines, exposure of people or structures to major geological hazards is considered a significant adverse impact. The potential geologic, soils, and seismic effects of the proposed project can be considered from two points of view: (1) mining operations impacts; and (2) geologic hazards to people. The basic criterion applied to the analysis of mining operations impacts is whether the process of mining operations would create unstable geologic conditions that would last beyond the short-term mining operation period. The analysis of geological hazards is based on the degree that the study area geology could produce hazards to people from earthquakes, ground shaking, ground movement, fault rupture, or other geologic hazards, features or events.

According to Appendix G of the State CEQA Guidelines, a project would typically have a significant impact if it would:

- expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving any of the following:

  a. 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;

  b. strong seismic shaking;

  c. seismic-related ground failure, including liquefaction; or

  d. landslides;

- results in substantial soil erosion or the loss of topsoil;
- be located in 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;
- be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property;
- 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;
- directly or indirectly destroy a unique geologic feature;
- 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; or
- 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.

No structures are proposed as part of the project; therefore, potential impacts on structures are not discussed further.

PROJECT IMPACTS

Findings in the ARM Plan PEIR

Potential impacts on geology and soils were evaluated in Section 8.1, "Geology," and 8.2, "Soils," of the ARM Plan PEIR. The ARM Plan PEIR did not identify any impacts on geology or soils related to instream mining.

Project Impacts

Soil erosion and the loss of topsoil are evaluated in Section 3.2, "Hydrology and Water Quality." No substantial risks to life or property would occur as a result of the project being located on expansive soils because no expansive soils are located within the study area.

The project would not require construction of a new or expanded on-site wastewater disposal system. Therefore, no impacts related to the use of septic tanks or alternative wastewater disposal systems would occur.

No unique geologic features have been identified within the study area. As such, no direct or indirect impacts on unique geologic features would occur.

As described above, the study area is identified by USGS as containing mineral resources, including gravel, sand, and mud deposits. However, because fluvial processes would naturally replace the mined materials within a relatively short time frame (depending on the frequency of large flood events), the project would not result in the loss of availability of a locally important mineral resource. Potentially significant geologic and soil impacts would be limited to the area of seismic risk, landsliding, and unstable slopes, as described below.

Impact 3.1-1 The project would not expose people or structures to potential adverse effects, including the risk of loss, injury, or death involving seismic events.

Although the seismically active San Andreas and Healdsburg–Rodgers Creek Faults are located near the study area, the study area is not located on mapped fault traces or fault zones designated in the Alquist-Priolo Earthquake Fault Zoning Map. As such, the potential to expose people to potential adverse effects, including the risk of loss, injury, or death involving fault rupture, would be less than significant.

Secondary impacts associated with earthquake events include seismically induced ground shaking, liquefaction, bank failure, and landslides. Because of the location of the study area in proximity to the San Andreas and Healdsburg–Rodgers Creek Faults, the study area would be subject to weak to strong ground shaking (MMI IV to VII). The nature of the sand and gravel deposits in the skimming area present a potential for uncontrolled soil movement and liquefaction during an intensive seismic event. However, because heavy equipment is typically operated on flat ground away from excavated slopes, seismic events would not adversely affect skimming operations or subject workers to significant hazard. Because the study area is generally flat, the potential for landslide hazards would not occur. Therefore, workers at the proposed mining area would not be subject to seismic hazards such as loss, injury, or death. Potential impacts would be less than significant.

Mitigation Measures

None.

Impact 3.1-2 The project would not be located in a geologic unit or soil that is unstable. Mining operations, including grading of access roads and skimming activities, have the potential to result in unstable slopes that would expose people or structures to potential adverse effects, including the risk of loss, injury, or death.

Grading of an access road (within the bank to the gravel bars) and skimming activities could result in unstable side slopes. In addition, the removal of riparian vegetation and clearing of the bars could result in slope stability impacts along the channels and banks of the river. As part of the project, cut slopes along the interior sides of the mined areas (for horseshoe and effective discharge stage height techniques) and for areas of river enhancement plan (REP) activities (alcove and oxbow enhancements) would remain at a 2:1 ratio, while the cut slopes at the upper (upstream) end of the skimmed area would be left at a 10:1 ratio. Syar would maintain a setback of 30 feet or 2.5 times the slope height (whichever is greater) from the outer riverbank (top of bank) to the interior edge of skimming areas. In addition, riparian vegetation would be transplanted to the high banks and head of bars to reinforce those areas along the river.

For optional REP activities such as benching, Syar would establish variable slope ratios between 3:1 and 10:1 along the perimeter of the skimmed area; the skimmed floor would have a downstream gradient for this method matching that of the river and a 0.5% cross slope. At the end of the operating season, stockpiled topsoil would be used to resoil the side slopes. These slopes would be revegetated with transplanted vegetation from other skimmed areas and through colonization of native riparian habitat. The middle and bottom of these slopes would also be staked with straw wattles to help retain the soil and establish vegetation.

Although the proposed buffers and transplant of vegetation would generally increase soil stability, the stability of the access road and skimmed area side slopes would need verification by a certified engineering geologist, geotechnical engineer, or civil engineer to ensure that workers are not exposed to the risk of loss, injury, or death from the sudden collapse of cut slopes. All grading in the County must comply with Section 11 of the Sonoma County Code, which impose requirements to ensure slope stability and address other potential impacts. Standard conditions of approval require that grading permits be applied for and approved by the Permit and Resource Management Department's Engineering Section. Such a verification and final grading of the skimmed floor would reduce potential impacts associated with soil instability to less-than-significant levels.

Mitigation Measures

None.