3.3. Geology, Fluvial Geomorphology, and Soils

This section addresses geologic, fluvial geomorphic, and soils issues related to implementation of the Proposed Action. The following evaluation is based on review of existing literature and data, along with information obtained in conjunction with the wetland delineation, reconnaissance-level assessment of the local geologic and geomorphic conditions, and detailed geomorphic mapping provided by the TRRP. Hydrology, groundwater, and water resource issues are evaluated in Section 3.4 and water quality issues are evaluated in Section 3.5.

3.3.1. Affected Environment/Environmental Setting

Regional Geology

The Trinity River basin occupies portions of two parallel but distinct geologic provinces: the Coast Ranges Province and the inland Klamath Mountains Province. The Coast Ranges Province, which consists chiefly of the well-known Franciscan Assemblage and its associated basal unit, the South Fork Mountain Schist, is composed of highly disrupted and generally unstable rocks of sedimentary and volcanic origin. It occupies a limited area (approximately 56,000 acres, or less than 3 percent of the basin) at the northwestern extremity of the watershed downriver from any proposed TRRP projects. The Coast Ranges of northern California represent recent and contemporary accretion and uplift of geologic materials associated with the development of the Cascadia Subduction Zone, which is also responsible for the formation of the Cascade Range of volcanoes to the north and east of the Trinity River basin, including Mt. Shasta and Mt. Lassen.

East of the Coast Ranges, the Klamath Mountains were assembled from older metamorphic and igneous intrusive or *plutonic* rocks. The majority of the Trinity River basin lies within the Klamath Mountains Province. This province is divided into the Eastern Klamath, Central Metamorphic, Western Paleozoic and Triassic, and Western Jurassic sub-provinces or *terranes*. These terranes were successively accreted against the western margin of North America over an approximately 300-million-year period of convergent motion of lithospheric plates. The Klamath Mountains represent one of the most complete records of the westward growth of the North American continent.

Plutonic intrusions into metamorphic rocks are distributed across the watershed. These are often informally termed *granitic* rocks or granite. Some of the larger intrusions include the Shasta Bally Batholith at the headwaters of Grass Valley Creek, and numerous plutons that form the granitic core of the Salmon-Trinity Alps. Granitic rocks are highly erodible; they weather into individual sand-size grains and are a chronic source of fine sediment to streams and rivers. Grass Valley Creek is a classic example of a tributary source of fine sediment to the Trinity River downstream of the TRD.

Several distinct sedimentary units occur within the watershed. The Weaverville Formation, a series of non-marine deposits, is exposed in fault-bounded valleys across the southeastern portion of the watershed. Younger terraces and floodplains occur in the largest river valleys in the watershed, and some older alluvial deposits are located in higher topographic positions where uplift has occurred since their deposition. These deposition materials were the focus of large-scale placer gold mines that have shaped the landscapes of the Trinity River since the 1850s. Glacially eroded materials, largely of granitic origin, add to the sediment input to the Trinity River system, particularly from streams that emanate from the Salmon-Trinity Alps (e.g., Rush and Canyon creeks).

Mines and Mineral Resources

The geologic properties of many of the terranes, related to their origins as oceanic crust and/or their intrusion by plutonic bodies, have resulted in mineralization that is widely distributed across the watershed. Many minerals of economic importance, including gold, copper, zinc, chromite, manganese, platinum, silver, and mercury, are present, and have been mined by a variety of methods from the advent of European settlement to the present. Historically, the principal mineral of economic importance was gold, and the Trinity River watershed had the greatest concentration of gold mines in California outside of the Sierra Nevada. Both hardrock (lode) mines and placer (alluvial gravel) mines are present in the watershed, with activity from 1848 to the present. The tailing deposits associated with large-scale placer mining provide a substantial source of aggregate required in various construction projects.

Local Geology

The Proposed Action is located downstream of the confluence of Canyon Creek with the mainstem Trinity River and upstream of the confluence of the North Fork Trinity River with the mainstem Trinity River. The proposed rehabilitation sites are situated between Junction City, a small community 2 miles upstream of the project, and Helena, a small community downstream from the project. The geologic setting of each rehabilitation site differs from that of its neighbors; the differences are related to the complex variety of terranes within the Klamath Mountains Province and surficial alluvial deposits that form the bed and banks of the Trinity River.

Rocks of the Salmon Hornblende Schist unit of the Central Metamorphic Belt underlie the Conner Creek site and are exposed in outcrops along SR 299. These rocks are very hard and durable, and weather to large, angular cobbles and boulders. Surficial deposits blanket the proposed rehabilitation sites, and consist of recent and modern alluvial floodplain and terrace deposits and historic hydraulic and dredge tailings. Glacial outwash from Canyon Creek, originating in the Trinity Alps, contributes additional alluvial materials on a recurring basis. Schistose rocks of the Central Metamorphic Belt are the other major component of the unconsolidated sediments at the Conner Creek site, with lesser amounts of other granitic and metamorphic rocks transported from upstream.

Road cuts along SR 299 and Red Hill Road suggest that the Valdor Gulch site is underlain by Salmon Hornblende Schist on the left side of the river and by rocks of the North Fork unit of the Sawyers Bar terrane on the right side of the river. The North Fork unit consists of metavolcanic and metasedimentary rocks. The Valdor Gulch site occupies an extensive terrace deposit on either side of the Trinity River, including the area known as Cooper's Bar on the left side of the river. Dredge tailings are a prominent component of the overburden at the site.

The Elkhorn site is underlain by diabase and gabbro of the Salmon River unit exposed in the road cuts of SR 299. Less extensive terrace deposits are present, and a sandy point bar occupies the alluvial floodplain at the downstream end of the site.

The Pear Tree Gulch site is underlain by Salmon River rocks in its eastern extremity, and by metasediments of the Western Hayfork terrane of the Western Paleozoic and Triassic Belt in its western portion. Alluvial sand and gravel bars and tailings deposits constitute the overburden.

Mines and Mineral Resources

Modern and ancient alluvial gravels were mined until the 1940s using a variety of techniques. Hydraulic mining, using high water pressures to erode and mobilize large quantities of unconsolidated overburden from gold-bearing areas, was conducted at a large scale in the general vicinity of the Conner Creek and Valdor Gulch sites. Evidence of this activity can be seen from SR 299 and Red Hill Road within the site boundary (e.g., exposed banks and erosional features). Large-scale bucket-line dredge operations were also common between 1930 and 1950. These activities have resulted in tailing deposits that continue to influence the form and function of the Trinity River. Examples of these tailing deposits can be observed at the Conner Creek and Valdor Gulch sites.

Since World War II, mineral extraction activities have focused on aggregate resources, although some gold mining activity has occurred on private lands and mining claims in the general vicinity of the rehabilitation sites. Over time, aggregate mining of alluvial deposits and reworking of hydraulic tailings have resulted in additional channel modification and changes in sediment supply.

Active Mining Claims

The General Mining Law of 1872 is one of the major statutes that direct the federal government's land management policy. The law grants free access to individuals and corporations to prospect for minerals in public domain lands, and allows them, upon making a discovery, to stake (or "locate") a claim on that deposit. Those sections of the Trinity River that are under federal jurisdiction are therefore open to prospecting.

A number of placer mining claims exist within the boundaries of and adjacent to the rehabilitation sites. Proposed rehabilitation activities have the potential to disturb materials within these claims, and to potentially disrupt any ongoing mine developments and activities at the sites. Placer claims are established with the intent to sort unconsolidated alluvial materials for precious metals (i.e., gold, platinum). Suction dredging is the principal mining method used for these claims, typically during low-flow periods when alluvial features are exposed or accessible.

There are currently no approved mining activities operating under a Federal Operating Plan or a County Surface Mining and Reclamation Act (SMARA) permit in the near vicinity of the rehabilitation sites that would conflict with the Proposed Action. There are, however, three active aggregate mining claims near Junction City operating under SMARA permits. A sand and gravel extraction company is currently operating at the site of the historic La Grange Hydraulic Gold Mine, upstream of Junction City, and there are two active sand and gravel extraction sites associated with the Hocker Flat project. In fact, the Hocker Flat project included the reclamation of one of these sites.

Regional Fluvial Geomorphology

Fluvial geomorphology was fundamental in the evaluation and selection of the preferred alternative for the FEIS/EIR. Addressing the relationships between flow, sediment, and vegetation formed the basis for the Implementation Plan (Appendix C of the FEIS/EIR). This plan identified the key ROD components and suggested actions that would support implementation of these. ROD components and supporting actions include:

- variable instream release volumes to the Trinity River (dam releases, storage, timing)
- mechanical rehabilitation (high flow and channel projects)
- coarse and fine sediment management program (coarse augmentation, fine control)
- infrastructure modifications (bridges, structure relocations)
- watershed protection program
- adaptive environmental assessment and management

River channels form and are maintained by the dynamic interaction of three primary building blocks: sediment of various size classes, varying quantities and ages of vegetation, and varying amounts of water. Individual rivers are composed of a unique combination of these building blocks, which are determined by soils, climate, and geology. Complex interactions between these three components define the geomorphic environment and provide a diversity of physical structures, such as point bars and riffle-pool sequences that perform a variety of environmental functions. The resulting geomorphic environment typically supports a unique ecosystem that depends on geomorphic processes to maintain its fundamental structure. A change in one or more of the building blocks would change the geomorphic environment (U.S. Fish and Wildlife Service et al. 2000).

Generally, a highly variable flow regime in an alluvial river system results in a physically complex river that provides substantial ecological benefits. This complexity provides a variety of riverine and riparian habitats that can be used by different species under a range of flows. Varying flows impart varying amounts of energy throughout a river channel and elicit varying responses in the river channel. Flows can mobilize and deposit a wide range of sediment particle sizes (ranging from fine material to large boulders during peak events). This movement and deposition of sediment particles in turn scour and shape the river channel, creating river bars, pools, and riffles, and can force the main channel to shift its position in the floodplain (Figure 3.3-1). Within the scour zone, vegetation on gravel bars is inhibited by the depth and duration of flow.

The construction of the TRD replaced the Trinity River's pre-dam hydrology with a greatly reduced, near-constant flow schedule (Figure 3.3-2). This reduction in water and associated energy has directly affected the character of the channel (Figure 3.3-3). The new, lower flows allowed woody riparian vegetation (e.g., willows, alders) along the channel to become established and to mature. Sediment berms developed along the channel margins. These berms further anchored the sides of the channel and resulted in the loss of many broad, gently sloping point bars, thereby converting the pool-riffle-run sequences created by alternate bar sequences to a largely monotypic run habitat. The loss of these bars has substantially reduced the complexity and diversity of riparian and riverine habitats (McBain and Trush 1997). These changes in geomorphic processes and channel geomorphology have decreased the quantity and quality of these habitats.

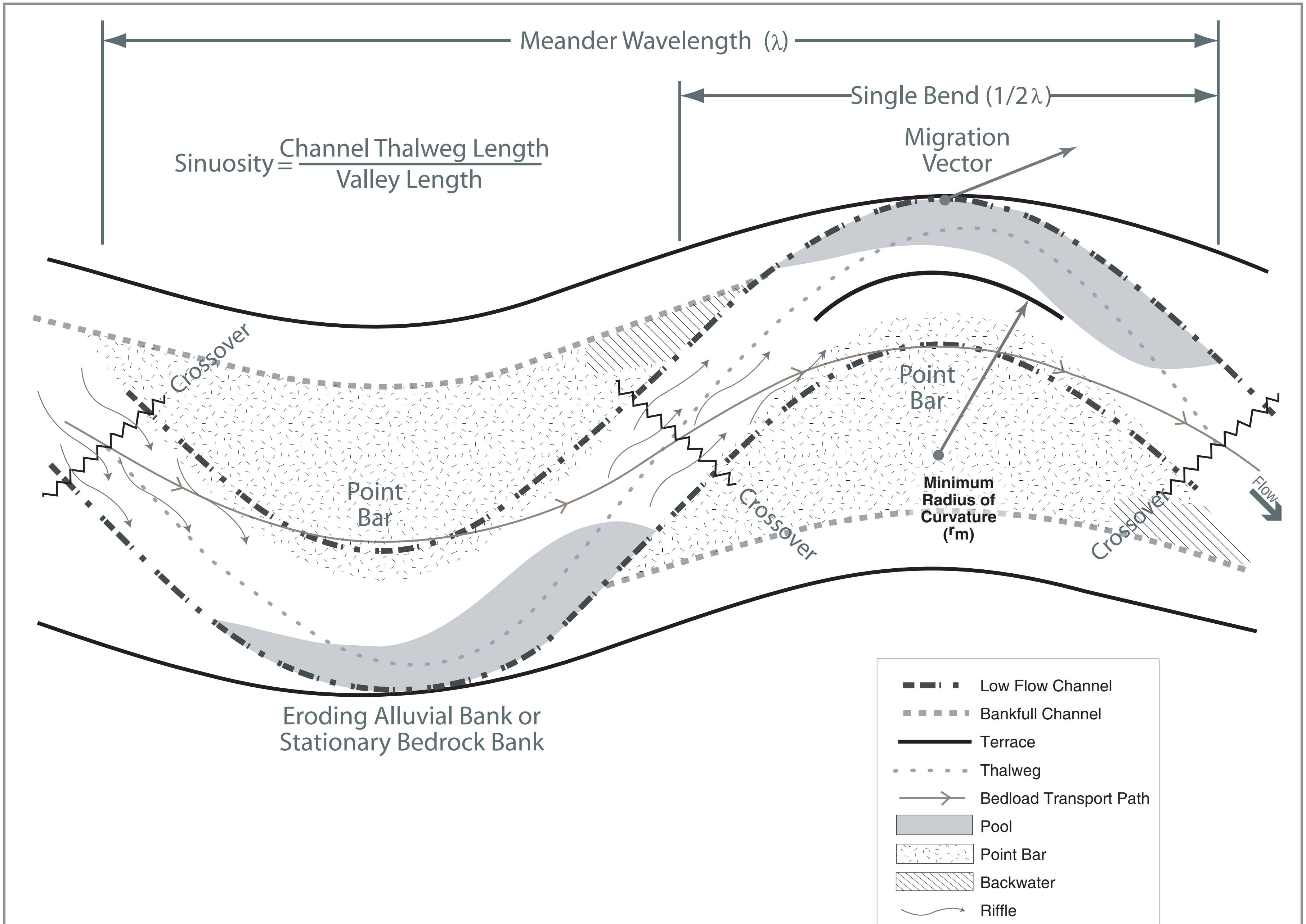
Ten attributes were identified in the Trinity River Flow Evaluation Report (U.S. Fish and Wildlife Service and Hoopa Valley Tribe 1999) and used in the FEIS/EIR to describe the geomorphic environment and processes of a healthy alluvial river. These attributes were developed specifically for the Trinity River based on an in-depth historical and literature search (McBain and Trush 1997) and a comparison of pre- and post-dam conditions in the watershed. The comparison was largely based on aerial photographs taken before and after dam construction. The healthy river attributes provide a foundation for understanding the dynamic equilibrium of the river, and were used to develop recommendations to meet rehabilitation objectives. The “healthy river” attributes described in the FEIS/EIR provide a benchmark for evaluating potential strategies for improving the fishery within the mainstem Trinity River. The methodology used in the FEIS/EIR assumed that if all 10 of these attributes were present, the Trinity River would have the physical characteristics to support a healthy alluvial river ecosystem. These attributes are listed below:

- Attribute 1: Spatially complex channel geomorphology
- Attribute 2: Flows and water quality are predictably unpredictable
- Attribute 3: Frequently mobilized channel bed surface
- Attribute 4: Periodic channel bed scour and fill
- Attribute 5: Balanced fine and coarse sediment budgets
- Attribute 6: Periodic channel migration
- Attribute 7: A functional floodplain
- Attribute 8: Infrequent channel resetting floods
- Attribute 9: Self-sustaining diverse riparian plant community
- Attribute 10: Naturally fluctuating groundwater table

Local Fluvial Geomorphology

The geomorphic environments of the four rehabilitation sites are directly affected by the hydrology, channel bed composition and sediment regimes, and riparian vegetation at their respective locations. Each site has a number of distinct morphological features. These features support habitat components that depend on a variety of physical processes to maintain their fundamental structure. Modification of the channel and floodplain configurations at the sites has altered and simplified the natural diversity of geomorphic processes and energy regimes available for maintenance of a variety of channel forms, habitats, and vegetation structures.

Figure 3.3-2 and Figure 3.3-3 illustrate the generalized geomorphic setting of a typical channel segment similar to the Proposed Action. Figures 3.3-4a-d characterize geomorphic features at the sites. Extensive modification of channel forms and other alluvial landforms is evident based on the distribution of natural and human-caused features observed. Review of 1948 photographs indicates channel straightening associated with dredge operations, resulting in the excavation of alluvial materials and the deposition of tailings piles, thereby confining the river and modifying the floodplain.



Source: Trinity River Flow Evaluation Report, 1999

Figure 3.3-1.
Alternate Bar Formation

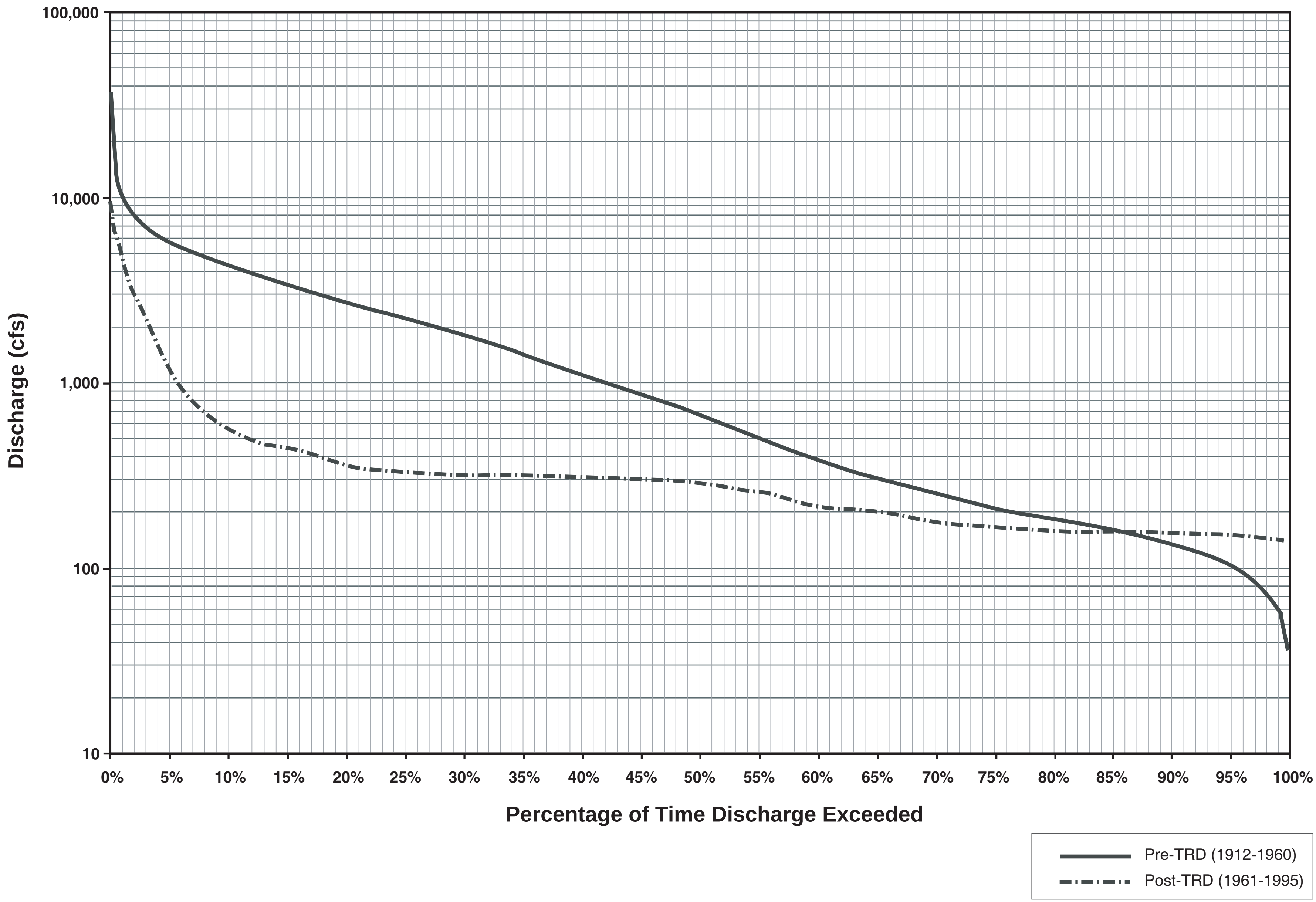
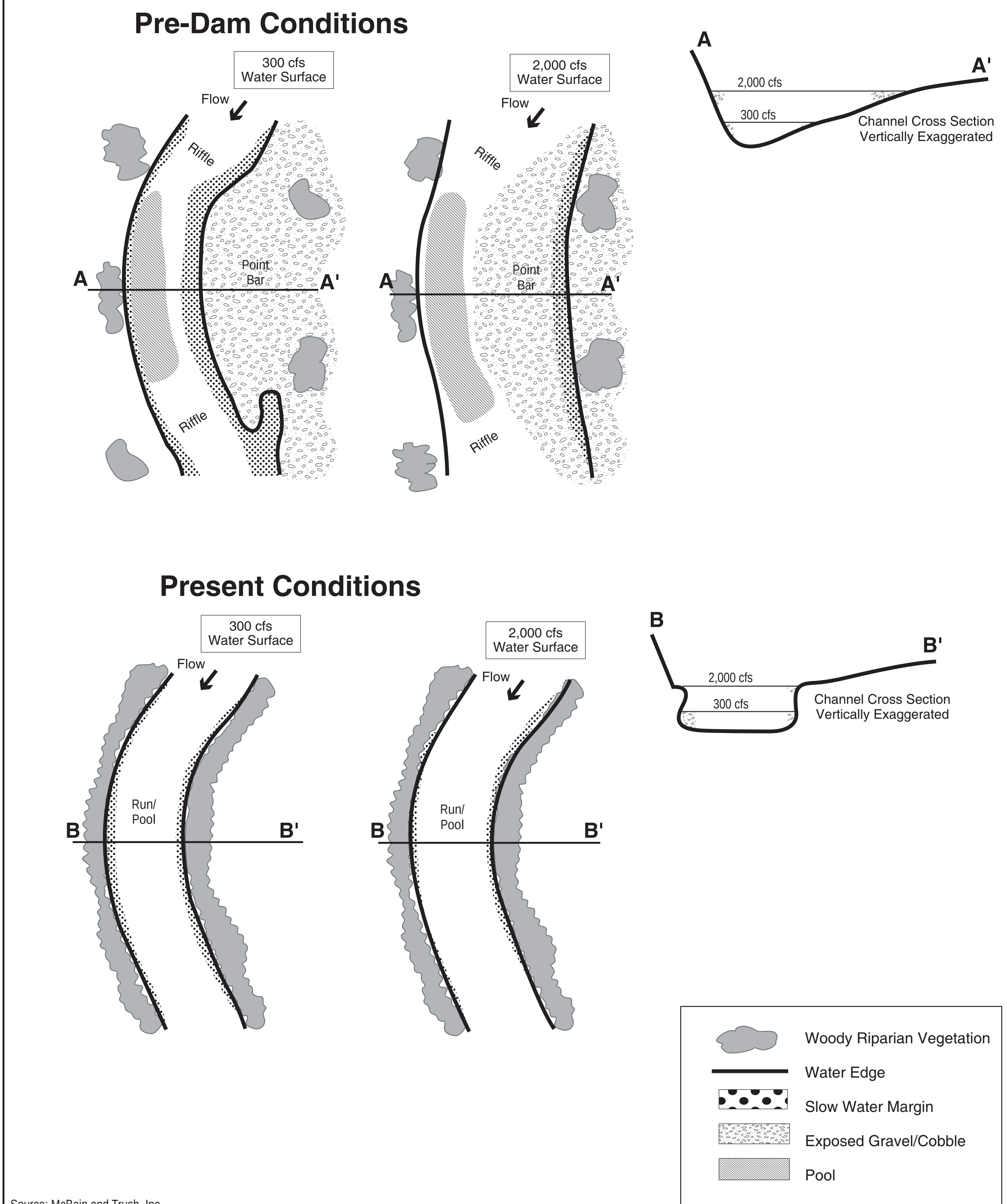


Figure 3.3-2
Pre- and Post-dam Hydrology



Source: McBain and Trush, Inc.

Figure 3.3-3
Simplified Geomorphology

More recently, riparian berms have formed along the channel margins. This has occurred in response to the establishment of persistent stands of riparian vegetation due to the elimination of scour by high seasonal flows, following the commencement of operation of the TRD. These berms have effectively reduced the sinuosity of the channel, and inhibited the development and migration of alternate point bars. While floodplain features persist, the presence of the tailings deposits and the riparian berms has reduced access to the floodplain for the most frequently recurring floods and diminished the river's ability to regulate overbank flows during higher flow events.

Geologic Hazards

Seismicity and Seismic Hazards

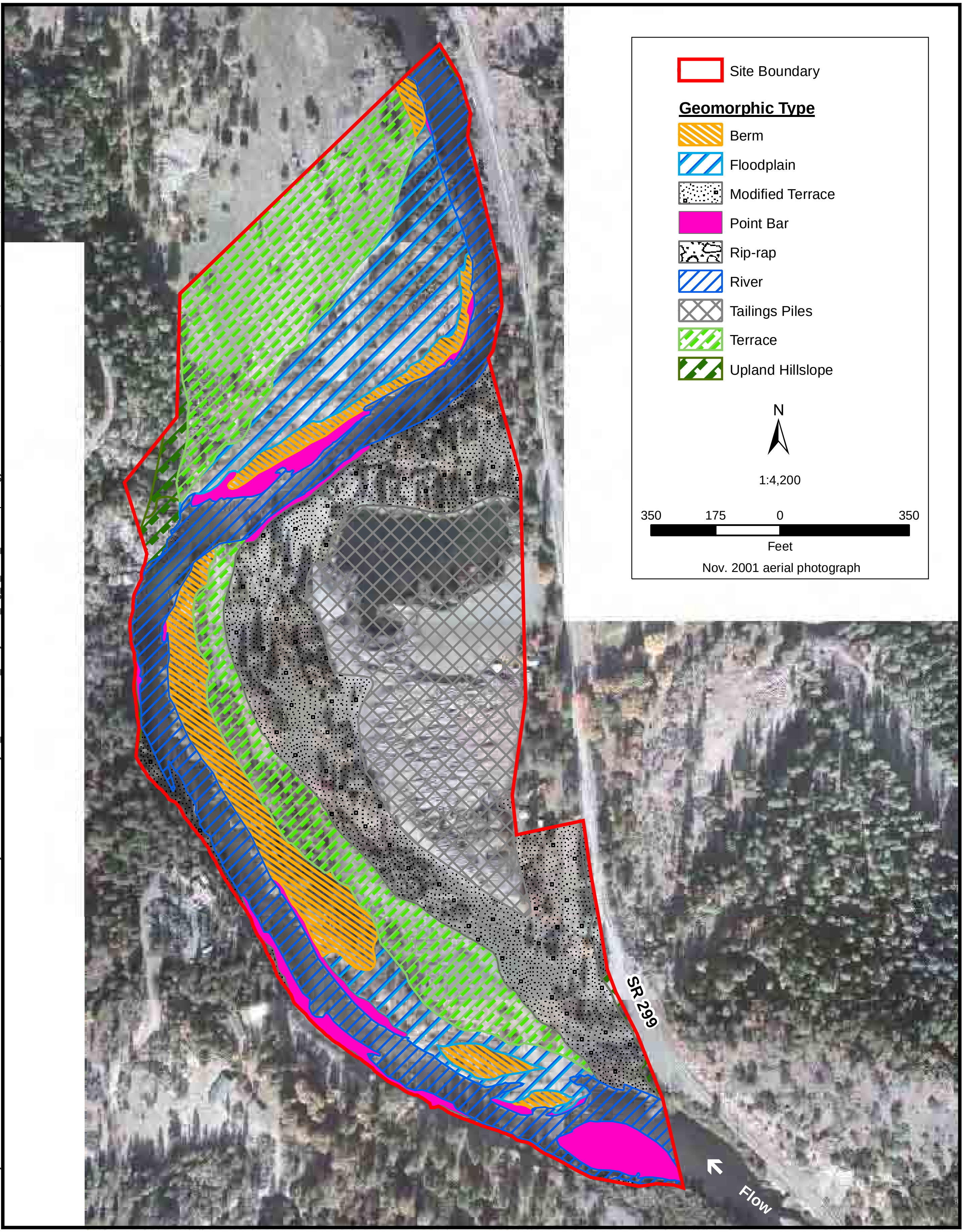
Seismicity refers to the geographic and historical distribution of earthquakes, while seismic hazards refer to the risk of loss from damaging earthquakes. According to the Reclamation Dataweb (http://www.usbr.gov/dataweb/dams/ca10196.htm), the infrastructure of the TRD (e.g., dams, tunnels, powerhouses) is located in a region of low historical seismicity and few known Quaternary faults. The region may, however, be subject to low to moderate levels of ground shaking from nearby or distant earthquakes.

The most recent (2003) Probabilistic Seismic Hazards Assessment Model for California (California Geological Survey/USGS, (http://www.consrv.ca.gov/cgs/rghm/pshamap/pshamain.html), describes the peak ground acceleration with an exceedance probability of 10 percent in 50 years as falling in the range of 0.1-0.2 peak ground acceleration (pga) on firm rock for the two upstream sites (Conner Creek and Valdor Gulch) as well as for upstream areas that include the TRD facilities, and in the range of 0.2-0.3 pga for the two downstream sites (Elkhorn and Pear Tree Gulch).

Peak ground accelerations on soft rock and alluvium, which would be applicable to most areas within the rehabilitation sites, fall within the 0.2-0.3 pga range for all four sites. Seismic hazard ratings increase markedly westward from the rehabilitation sites, due to the presence of numerous active seismic structures in the north coastal region of California. Peak ground accelerations of 0.3-0.4 pga are forecast under the seismic hazards model for the downstream portions of the Trinity River watershed. A de-aggregated seismic hazard map of California (Peterson et al. 1996) can be found at http://www.consrv.ca.gov/cgs/rghm/psha/ofr9608/index.htm. This reference indicates that west-central Trinity County falls within the categories of furthest or second-furthest distance from earthquakes causing the dominant hazard for peak ground acceleration (50-200 km).. These identified hazard ratings are related to the possibility of seismicity on the northern portion of the San Andreas Fault Zone and related fault splays in the northern Coast Ranges, and, more importantly, along the Cascadia Subduction Zone along the western Humboldt and Del Norte County coast.

No local Quaternary faults have been identified, although little detailed mapping of Quaternary geologic features has been conducted in the area. Historic earthquake activity in the area has been very low. No

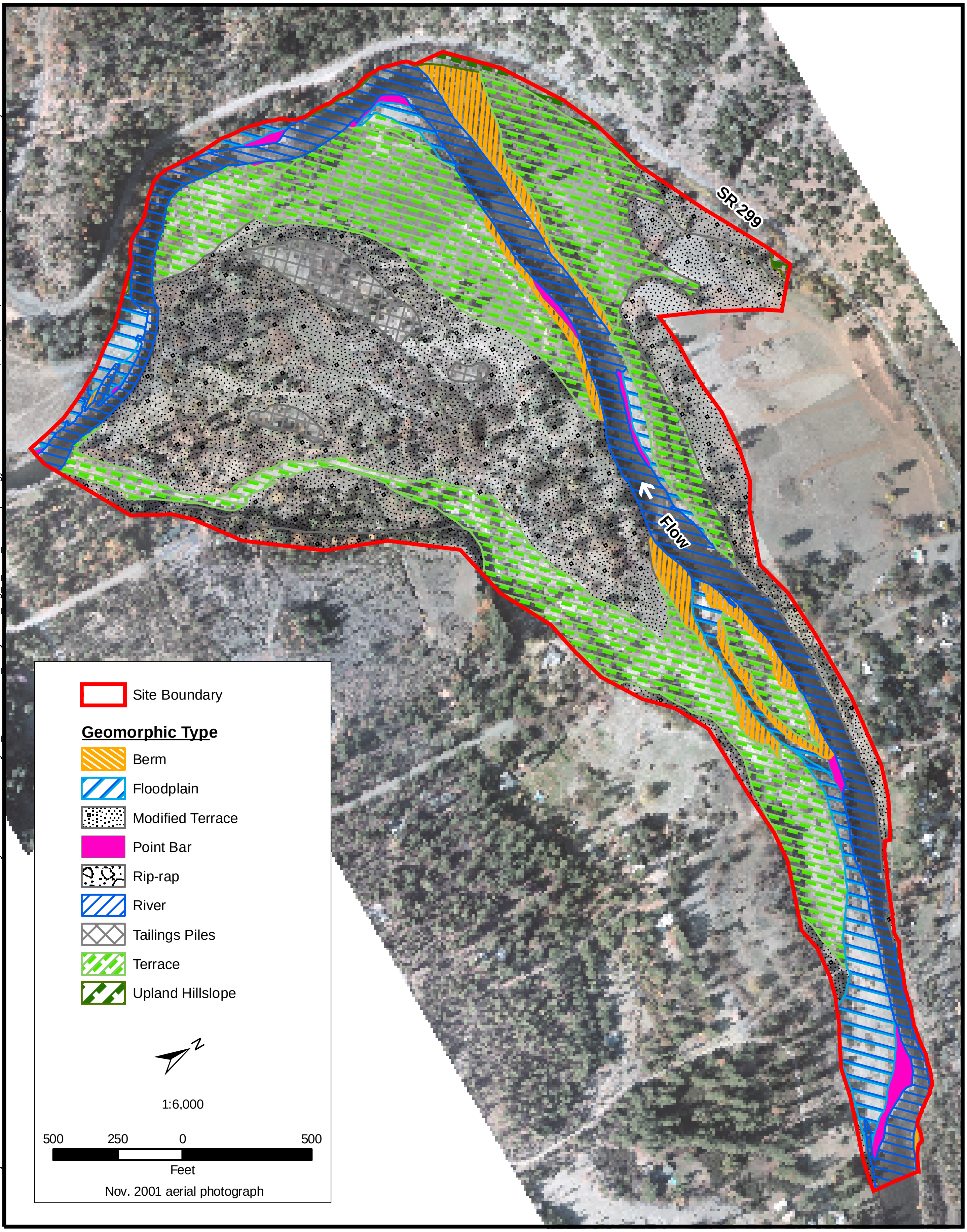
Path: R:\Projects\10010 Mechanical Channel Rehab Sites on Mainstem Trinity River\GIS\Site-Canyon Creek\10010_CanyonCrk_Fig_3_3-4a_Geomorphology.mxd   Source: NSR, Inc.; USBR; McBain and Trush, Inc.   12-01-05   bmoore



North State Resources, Inc.

Canyon Creek Suite of Rehabilitation Sites: Trinity River Mile 73 to 78

Figure 3.3-4a
Conner Creek Geomorphology



Path: R:\Projects\10010 Mechanical Channel Rehab Sites on Mainstem Trinity River\GIS\Site-Canyon Creek\10010 CanyonCrk Fig 3 3-4b Geomorphology.mxd Source: NSR, Inc.; USBR; McBain and Trush, Inc. 11-07-05 bjm

Figure 3.3-4b
Valdor Gulch Geomorphology

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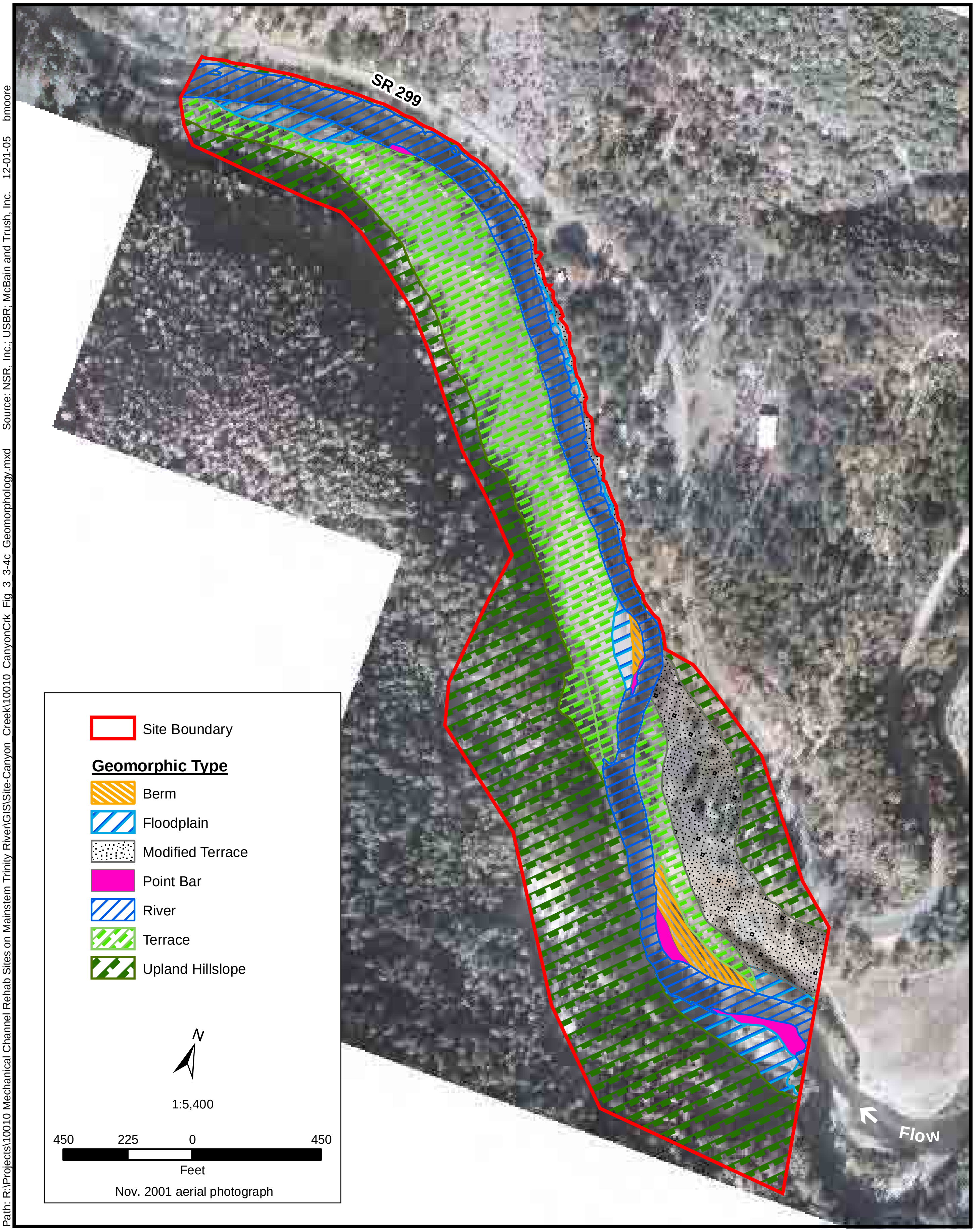

Figure 3.3-4c
Elkhorn Geomorphology

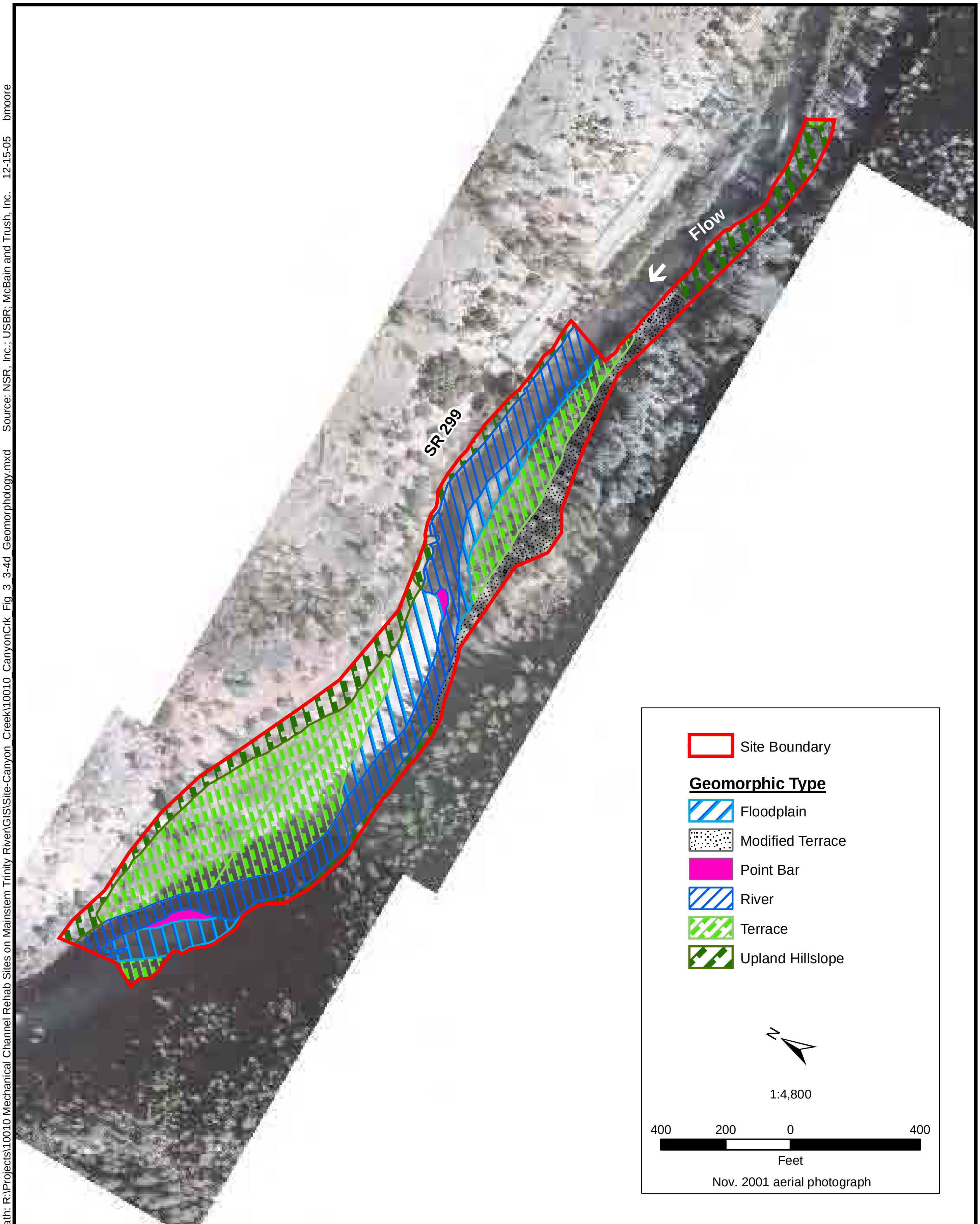

Figure 3.3-4d
Pear Tree Geomorphology

areas of Trinity County are described or mapped as Fault-Rupture Hazard Zones under the Alquist-Priolo Earthquake Fault Zoning Act (California Department of Conservation Division of Mines and Geology 1999).

Maximum credible earthquakes (MCEs) were determined for potentially significant faults, including Likely, Hat Creek, Freshwater, Mendocino, and San Andreas. These MCEs have projected surface wave magnitudes that range from 7 to 8.5. A maximum Modified Mercalli level of VI to VII was also estimated for local seismicity (Trinity County 2001). The Modified Mercalli scale describes the intensity of an earthquake's effects at a given locality. The Mercalli level described above generally equates to a widely felt, often frightening, but only minimally to moderately damaging earthquake.

Liquefaction

Liquefaction is a process whereby water-saturated granular soils are transformed to a liquid state during ground shaking. Loose to medium dense sands, gravels, and silts occurring below the water table are prone to liquefaction. The soils bordering the Trinity River in immediate proximity to the rehabilitation sites are predominantly alluvial in nature. These soils have the potential to experience liquefaction; however, no detailed analysis was conducted because the type of activities described in Chapter 2 of the EA/DEIR would not affect the potential for liquefaction or be affected by liquefaction were it to occur.

Landslides

The potential for landslides triggered by seismic events is not considered significant at the rehabilitation sites or upstream in the vicinity of the TRD, due to the low historical seismicity of the region. There is a potential for downstream areas with higher seismic risk and unstable geologic materials to experience slope failures during seismic events. Possible effects of large downstream landslides could include temporary damming of the mainstem Trinity River, depending on the volume of failed material and the flow regime at the time of the event. It is unlikely that effects of such an event would persist for a sufficient period to affect the rehabilitation sites.

Slope stability within the rehabilitation sites is dependent on the underlying geology. The bedrock units underlying the sites are prone to rock fall and shallow debris slides associated with road cuts and other oversteepened slopes. Soils developed on these rock types are shallow and prone to surficial erosion. Although landslides are a common occurrence along SR 299, these features are typically intercepted by the highway and rarely contribute material to the river in the reach that includes the rehabilitation sites.

Seiches

Seiches could occur upstream at TRD facilities as result of seismic, meteorologic, or geologic activities. A seiche is an oscillation or standing wave in a body of water confined in a basin. Seiches commonly arise from a sudden local change in atmospheric pressure, accompanied by wind and, occasionally, tidal currents. They can also occur as the result of ground shaking caused by earthquakes, or by the force of large landslides or debris flows entering a water body. Local water bodies capable of generating a large-scale seiche include Trinity Lake, Lewiston Lake, and Grass Valley Creek Reservoir. The hazards associated with a seiche involve the overtopping or possible failure of these dams, with resultant modifications to the flow regime of the Trinity River (i.e., flooding). However, the likelihood of such an event is considered minimal.

Volcanic Activity

Volcanic hazards in the general vicinity of the Proposed Action are limited primarily to ash fall and minor seiches in Trinity and Lewiston lakes. There are three large active volcanoes in the Cascade Range in California—Lassen Peak, Mount Shasta, and the Medicine Lake Volcano—as well as numerous smaller vents. The distance (75 to 100 miles) from these volcanic centers suggests that the rehabilitation projects proposed by the TRRP would not likely be significantly affected by a volcanic eruption (Trinity County 2001).

Soils

The majority of the soils at the rehabilitation sites are described in the *Soil Survey of Trinity County, California, Weaverville Area* (U.S. Department of Agriculture 1998). The entire area of the Conner Creek and Valdor Gulch site is covered by this survey. A small portion of the Elkhorn site and most of the Pear Tree Gulch site are outside the map area of this survey. The remaining portion of the Elkhorn site is described in *Land Resource Regions and Major Land Resource Areas of the United States* (USDA Soil Conservation Service 1981). The majority of the Pear Tree Gulch site lies outside the boundary of both surveys. Detailed soil descriptions and soil survey maps of the study area are presented in *Trinity River Mechanical Channel Rehabilitation Project, Canyon Creek Suite Delineation of Waters of the United States, Including Wetlands* (North State Resources 2004).

3.3.2. Regulatory Framework

Local

Trinity County General Plan Goals and Objectives

The Trinity County General Plan contains goals and policies designed to guide the future physical development of the county, based on current conditions. The General Plan contains all the state-required elements, including community development and design, transportation, natural resources, health and safety, noise, housing, recreation, economic development, public facilities and services, and air quality. The following goals and policies, relative to geology issues associated with the Proposed Action, were taken from the applicable elements of the General Plan (Trinity County 2001). The General Plan includes the Junction City Community Plan (Trinity County 1987).

County Wide Goals and Objectives

Environmental

To strive to conserve those resources of the county that are important to its character and economic well-being:

- By assuring that developments occurring on these lands are compatible with the resources.

Conservation Element

The following goals and objectives and policies are applicable to the Proposed Action.

To conserve, preserve and maintain the habitat for wildlife species, plant life and the environment:

- By planning for mineral production and performance so as to avoid destruction, pollution or degradation of surrounding land and of water and air resources. After mineral extraction has been completed, land used for mineral production should be revegetated and restored to its natural condition.
- By identifying all geologic and soil areas and developing standards for restricted development of any hazard areas.

Safety Element

The following goals and objectives and policies are applicable to the Proposed Action.

Seismic Safety Goal

A. Reduce the threat to life and property from seismic and geologic hazards.

B. Promote safety from seismic and geologic hazards

- Geologic hazards and seismic safety shall be considered in the preparation of environmental documents as required by CEQA.
- The County shall confirm that all construction and grading activities done will not adversely affect the stability of any slope.

Trinity County Zoning Ordinance

Section 12. Mining (Ordinance. No. 315-230, Ordinance. No. 315-596)

Purpose: To provide for the extraction of minerals, essential to the continued economic well-being of the County, while ensuring that mined lands are reclaimed to prevent or minimize adverse effects on the environment and to protect the public health and safety.

Section 30. General Provisions and Exceptions

Use: All of the uses listed in this Section [Section 30], and all matters related directly thereto are declared to be uses possessing characteristics of such unique and special classification as making practical their inclusion in any class of use set forth in the various districts defined herein, and therefore the authority for and location of any of the uses designated shall be subject to the issuance of a Use Permit in accordance with the provisions of Section 32 hereof.

Junction City Community Plan

The Junction City Community Plan (Trinity County 1987) covers approximately 42 square miles (27,000 acres) centered on the Trinity River from Maxwell Creek to slightly downstream of Helena.

Natural Resources

This element of the Plan is intended to identify and protect the various natural resources found within the Plan area by implementing the following goal:

Goal: To encourage the continued use of resource lands for resource production purposes. Objectives consistent with this goal include:

- Encouraging the sound use of mineral resources, especially sand and gravel operations, which also reduce sedimentation of the Trinity River.

Hazards

This element of the Plan is intended to minimize or preclude the occurrence of erosion, landslide, and/or the effects of other geologic events within a project area by identifying potential problem areas and implementing the following goal:

Goal: To deter development on unstable slopes or soils. Objectives consistent with this goal include:

- the discouragement of development activities on fault zones and landslide areas
- assurance that existing development activities in unstable areas are monitored and stabilized
- coordinating review of private and public developments with the Natural Resources Conservation Service

Project Consistency with the Trinity County General Plan and Community Plans

This section compares the goals and objectives of the Proposed Action to the relevant local planning policies (i.e., Trinity County General Plan, Junction City Community Plan) to determine if there are any inconsistencies.

The goals and objectives described in Chapter 1 are generally compatible with the applicable General Plan goals and policies summarized above. The overall goal of the Proposed Action is to rehabilitate the sites so that they function in a manner that is closer to historic conditions (e.g., pre-Lewiston Dam).

3.3.3. Environmental Consequences/Impacts and Mitigation Measures

Methodology

Data for the following analysis were taken from existing reports on local and site-specific geology as well as on-site assessments during field reviews. These reports include the following documents: Soil Survey of Trinity County, California, Weaverville Area (U.S. Department of Agriculture 1998); Trinity River Mechanical Channel Rehabilitation Pilot Project, Wetland Delineation (U.S. Bureau of Reclamation 2003); FEIS/EIR; SEIS/EIR; Trinity River Maintenance Flow Study Final Report (McBain and Trush 1997); Trinity County General Plan; and previously cited online and Geographic Information Systems (GIS) data sources.

Criteria for Determining Significance

A project would have a significant impact related to geology, geomorphology, and soils if it could subject people, structures, or other resources to geologic or seismic hazards or disrupt, eliminate, or otherwise render unusable geologic or soil resources. Significant impacts would occur if the Proposed Action would:

- expose people, structures, or critical utility facilities to major geologic hazards (including seismicity, landslides, seiches, and liquefaction);
- involve changes in topography that would result in unstable soil conditions;
- increase erosion rates to a level at which associated sedimentation levels could affect streams, rivers, or other water bodies;
- interfere with existing, proposed, or potential development of mineral resources; and/or
- be inconsistent with the 10 Trinity River healthy alluvial river attributes.

Impacts and Mitigation Measures

Table 3.3-1 summarizes the potential geology, fluvial geomorphology, and soils impacts resulting from construction and operation of the Proposed Action.

TABLE 3.3-1.
SUMMARY OF GEOLOGY AND SOILS IMPACTS FOR THE PROJECT

Impact	Action Site	No-Action Alternative	Proposed Action	Alternative 1	Proposed Action with Mitigation	Alternative 1 with Mitigation
1. Implementation of the project could result in the exposure of structures and people to geologic hazards, including ground shaking and liquefaction.	All sites	NI	NI	NI	NI	NI

TABLE 3.3-1.
SUMMARY OF GEOLOGY AND SOILS IMPACTS FOR THE PROJECT

Impact	Action Site	No-Action Alternative	Proposed Action	Alternative 1	Proposed Action with Mitigation	Alternative 1 with Mitigation
2. Construction activities associated with the project could potentially result in increased erosion and short-term sedimentation of the Trinity River.	All sites	NI	S	S	LS	LS
3. Implementation of the project would interfere with existing, proposed, or potential development of mineral resources.	All sites	NI	LS	LS	N/A[1]	N/A[1]

Notes:
LS = Less than Significant S = Significant SU = Significant Unavoidable
NI = No Impact B = Beneficial N/A = Not Applicable
[1]Because this potential impact is less than significant, no mitigation is required.

All Sites (Conner Creek, Valdor Gulch, Elkhorn, and Pear Tree Gulch)

Impact 3.3-1: Implementation of the project could result in the exposure of structures and people to geologic hazards, including ground shaking and liquefaction. ***No Impact for No-Action Alternative, Proposed Action, and Alternative 1***

No-Action Alternative

Under the No-Action Alternative, no construction activities would occur. There would be no new exposure of structures and people to geologic hazards.

Proposed Action and Alternative 1

Under the Proposed Action and Alternative 1, no permanent structures or facilities would be constructed. There would be no new exposure of structures and/or people to geologic hazards.

Mitigation Measures

No-Action Alternative, Proposed Action, and Alternative 1

Since no significant impact was identified, no mitigation is required.

Significance After Mitigation: ***N/A.***

Impact 3.3-2: Construction activities associated with the project could potentially result in increased erosion and short-term sedimentation of the Trinity River. ***No Impact for No-Action Alternative; Significant Impact for Proposed Action and Alternative 1***

No-Action Alternative

Under the No-Action Alternative, the project would not be constructed. Therefore, no construction-related erosion or associated sedimentation of the Trinity River would occur.

Proposed Action

Construction of the Proposed Action would temporarily result in soil disturbance, soil compaction within proposed access road and construction staging areas, disruption of soil cohesion and armoring, and increased soil exposure to energetic weather conditions, which would increase the short-term potential for wind and water erosion. Increased wind and water erosion and associated downstream sedimentation within the Trinity River would more likely occur if soils were left exposed during high flow events or periods of high precipitation. Impacts of turbidity levels specific to water quality degradation are analyzed in Section 3.5, Water Quality, and associated impacts to anadromous fisheries are analyzed in Section 3.6, Fishery Resources.

Susceptibility to erosion is controlled by several factors, including terrain, land use, vegetation, soil type, and local climate. A soil with high erodibility typically experiences more erosion than a soil with low erodibility. However, in the absence of an adverse condition (i.e., rainfall, lack of vegetation), a soil that is classified as highly erodible may not experience significant erosion. In general, significant soil erosion would occur only at locations at the margins of constructed features (e.g., feathered edges, side channels, floodplains) where a combination of fine sandy to silty soils occurs. The potential for increases in soil erosion and sedimentation is considered a significant impact but the frequent mobilization of channel bed surfaces is an objective in restoring “healthy river attributes.”

For comparative purposes, Table 3.3-2 shows the area and volume of materials that would be excavated (cut) from the four rehabilitation sites, the area and volume that would be placed in upland areas (fill), and the area in staging areas and access roads that would be subject to soil compaction under the Proposed Action and Alternative 1.

TABLE 3.3-2.
AREA AND VOLUME OF SOIL DISTURBANCE UNDER THE PROPOSED ACTION AND ALTERNATIVE 1

Rehabilitation Site	Excavation		Spoils		Staging Areas/ Access Roads	
	Proposed Action (acres) yards^3	Alternative 1 (acres) yards^3	Proposed Action (acres) yards^3	Alternative 1 (acres) yards^3	Proposed Action (acres)	Alternative 1 (acres)
Conner Creek	(4.49) 19,900	(3.64) 16,400	(2.99) 19,900	(2.99) 19,900	(2.21)	(2.21)
Valdor Gulch	(9.07) 38,900	(9.07) 38,900	(6.49) 38,900	(6.49) 38,900	(3.64)	(3.64)
Elkhorn	(3.54) 22,450	(2.28) 13,980	(3.88) 22,450	(2.52) 13,980	(3.03)	(3.04)
Pear Tree Gulch	(1.48) 9,900	(1.48) 9,900	(2.48) 9,900	(2.48) 9,900	(0.25)	(0.25)
Total Acres Total Yards^3	***(18.68) 91,150***	***(16.47) 79,180***	***(15.84) 91,150***	***(14.48) 82,680***	***(9.13)***	***(9.14)***

Alternative 1

Similar to the Proposed Action, construction activities associated with Alternative 1 would temporarily result in soil disturbance, soil compaction within proposed road and construction staging areas, disruption of soil cohesion and armoring, and increased soil exposure to energetic weather conditions, which would increase the short-term potential for wind and water erosion. Increased wind and water erosion and associated downstream sedimentation within the Trinity River are more likely to occur if soils are left exposed during high flow events or periods of high precipitation. Table 3.2-2 illustrates that Alternative 1 would result in less disturbed area and substantially less volume in terms of material excavated and displaced at the Conner Creek and Elkhorn sites. Soil compaction that would occur as a result of construction staging and access road areas would be similar to the Proposed Action. Construction activities for the Valdor Gulch and Pear Tree Gulch sites are common to both action alternatives. Although the area and volume of material that would be affected under Alternative 1 are less than under the Proposed Action, the potential for increases in soil erosion and sedimentation are considered a significant impact but the frequent mobilization of channel bed surfaces is an objective in restoring "healthy river attributes."

Mitigation Measures

No-Action Alternative

Since no significant impact was identified, no mitigation is required.

Significance After Mitigation: ***N/A.***

Proposed Action and Alternative 1

2a: Reclamation or its contractors shall implement the following measures during construction activities:

- Areas where ground disturbance would occur shall be identified in advance of construction and limited to only those areas that have been approved by Reclamation.
- All construction vehicular traffic shall be confined to the designated access routes and staging areas.
- Disturbance shall be limited to the minimum necessary to complete all rehabilitation activities.
- All supervisory construction personnel shall be informed of environmental concerns, permit conditions, and final project specifications.

3b: Reclamation or its contractors shall prepare and implement an erosion and sedimentation control plan (Storm Water Pollution Prevention Plan [SWPPP]) prior to the start of construction. Measures for erosion control will be prioritized based on proximity to the river. The following measures shall be used as a guide to develop this plan:

- Restore disturbed areas to pre-construction contours to the fullest extent feasible.
- Salvage, store, and use the highest quality soil for revegetation.
- Discourage noxious weed competition and control noxious weeds.
- Clear or remove roots from steep slopes immediately prior to scheduled construction.
- Leave drainage gaps in topsoil and spoil piles to accommodate surface water runoff.
- To the fullest extent possible, cease excavation activities during significantly wet or windy weather.
- Use bales and/or silt fencing to intercept sediment as appropriate.
- Before seeding disturbed soils, work the topsoil to reduce compaction caused by construction vehicle traffic.
- Rip feathered edges (and floodplain surfaces where appropriate) to approximately 18 inches depth. This furrowing of the river's edge will remove plant roots to allow mobilization of the bed, but will also intercept sediment before it reaches the waterway.
- Spoil sites shall be located such that they do not drain directly into a surface water feature, if possible. If a spoil site drains into a surface water feature, catch basins shall be constructed to intercept sediment before it reaches the feature. Spoil sites shall be graded and vegetated to reduce the potential for erosion.
- Sediment control measures shall be in place prior to the onset of the rainy season and will be monitored and maintained in good working condition until river levels rise and inundate the floodplain. If work activities take place during the rainy season, erosion control structures must be in place and operational at the end of each construction day.

Significance After Mitigation: Less than Significant.

Impact 3.3-3: Implementation of the project would interfere with existing, proposed, or potential development of mineral resources. ***No Impact for the No-Action Alternative; Less-than-Significant Impact for the Proposed Action and Alternative 1***

No-Action Alternative

Under the No-Action Alternative, the project would not be implemented, and the current mineral activities would continue unimpeded.

Proposed Action and Alternative 1

There are no current or proposed mining activities operating either under a federally authorized operating plan or through a County SMARA permit within the vicinity of the rehabilitations sites (Hitt, pers. comm. 2005). Therefore, neither action alternative would result in a temporary or permanent reduction of sand, gravel, or aggregate mining activities within the vicinity of the rehabilitation sites. The project area is not mapped as a mineral resource zone (Glen Miller, BLM Environmental Coordinator, pers. comm. 2005).

Mitigation Measures

No-Action Alternative, Proposed Action, and Alternative 1

Since no significant impact was identified, no mitigation is required.

Significance After Mitigation: ***N/A***