# 5.7 Effects of Program/Alternative Implementation on Water Resources

This section analyzes the potential impacts to water quality and peak flows due to implementing either the Proposed Program or any of the Alternatives.

## *5.7.1 Significance Criteria*

Appendix G of the CEQA Guidelines contains the following significance criteria relating to water quality and quantity. An effect will be considered significant if results of the analysis indicate that any of the following Criteria will be met if implementation of the Program would:

a) Violate any water quality standards or waste discharge requirements;
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (i.e., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted);
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;
f) Otherwise substantially degrade water quality;
g) Place housing within a 100-year flood hazard area, as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
h) Place structures within a 100-year flood hazard area that would impede or redirect flood flows;
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; or
j) [Cause] Inundation by seiche, tsunami, or mudflow.

## *5.7.2 Determination Threshold*

The Federal Clean Water Act and State Porter-Cologne Water Quality Control Act are the primary laws regulating water quality in California. Both contain reference to “designated” or “beneficial” uses and water quality “criteria” or “objectives”. The concept of “anti-degradation” is also common to both laws and refers to restrictions on activities that will or could decrease the water quality of a receiving body of water even if the water body currently exceeds defined water quality criteria. Although the aforementioned laws ensure that water quality objectives are similar

across California, numeric thresholds for water quality are specific to individual regions and waterbodies.

The nine State Regional Water Quality Control Boards develop and implement Basin Plans, which contain the numeric and/or narrative water quality objectives for specific waterbodies in each region. There are also specific analyses and recovery plans for waterbodies listed as impaired on the 303(d) list. It was beyond the scope of this analysis to predict a numeric change in each of the 18 water quality parameters listed in the Basin Plans for each of the 5,600 Cal-Water 2.2 basins in the analysis area. Instead, the water quality parameters most likely to be affected by VTP treatments were selected for analysis at an intensity level that could be achieved on a statewide basis.

The determination thresholds used in the water quality analyses were based on the following narrative standards, which originate in State and Federal water quality control regulation.

The Program and Alternatives will have a significant adverse effect if treatments ultimately result in:

a) A significant degradation of water quality;
b) Violations of basin plan objectives; or
c) Impact a beneficial use.

Determinations were made at the bioregional level based on modeled effects at the Cal 2.2 planning watershed scale. The ranges of numeric thresholds established in the Regional Basin Plans were reviewed in order make determinations regarding the narrative standards cited above.

### *5.7.3 Data and Assumptions*

Based on a review of the literature it was determined that the following water quality parameters were most likely to be directly affected by VTP treatments: sediment, temperature, fecal coliform levels, and peak flows. Due to the types of treatments and retention of streamside buffers in the Program, other water quality parameters (nutrients, pH, toxicity, dissolved oxygen, etc.) were not considered to be at risk from VTP treatments and were not analyzed. The potential effects of herbicide applications on water quality are addressed in Section 5.17. A modeling approach was used to analyze potential effects due to sediment impairment and peak flows and is presented below. Modeling was not used in regards to stream temperature or fecal coliform.

In order to analyze the potential effects of implementing the Program or Alternatives it was necessary to consider the types of treatments proposed, the extent of those treatments and the Landscape Constraints (LCs) and Minimum Management Requirements (MMRs) included in the VTP, which are designed to moderate potential impacts to water quality (Chapters 2 and 3). LCs 1-5 and MMRs 1, 2, 6,12 and 17 were designed to protect water quality. The description of treatment intensity and extent are described separately for each of the water quality parameter sections below.

- Modeling Approach- Sediment and Peak Flows

By altering infiltration rates and evapotranspiration rates, and disturbing the soil VTP treatments have the potential to increase overland flow rates and sediment yield, both of which directly influence sediment concentrations and turbidity in receiving waters as well as peak flows. In general, the more vegetation removed and the more bare ground exposed, the greater the potential to increase erosion and ultimately impact water quality. Robichaud, MacDonald and Foltz (2007) summarized this relationship as follows:

> "Erosion rates tend to be positively correlated with percent bare soil and the amount of surface disturbance, and these two factors generally are proportional to the number of trees being harvested (Haupt and Kid 1965). In general, erosion rates are acceptably low when the proportion of bare soil is less than 30 to 40 percent (Benavides-Solorio and MacDonald, 2005; Gary, 1975; Swank and others, 1989)."

In order to compare the potential impacts to sediment water quality and peak flows between the Proposed Program and the Alternatives it was first necessary to develop estimates of intensity for each of the individual VTP treatment types (prescribed fire, mechanical, etc.). The estimates of intensity for each treatment type and fire regime were based on the percent of vegetation removed and the percent bare ground typically left after treatment (Table 5.0.3). The relative intensity of the Proposed Program and each of the Alternatives was then estimated based on the proportion of each of the treatment types carried out (see Table 5.0.1).

In addition to an estimate of the intensity of each treatment type a model was developed to predict the potential extent of VTP treatments that would occur in each bioregion over a 10-year time period. The 10-year time period was chosen because, except for roads, most VTP treatments will recover to near pre-treatment condition (re-vegetate and decrease bare ground) in that time period. The extent of VTP treatments was expressed as the percent of each Cal 2.2 watershed projected to be treated by VTP projects. The number of watersheds within each percent-disturbed-area class was then summarized for each bioregion for the Proposed Program (Table 5.0.7) and the Alternatives (Table 5.0.8).

Estimates of the intensity and extent of each treatment type were the basis for analyzing potential impacts to sediment effects on water quality and peak flows. Specific site factors such as slope, soil type and distance to stream channel were not possible to analyze since the locations of future VTP projects could occur anywhere within the 5,600 watersheds in the program area. As a result this analysis of water quality is similar to a cumulative effects and not a site-specific analysis of a particular project. Given the vast scope of this analysis and lack of site-specific information, many of the more detailed physical watershed effects computer models (SEDMODL, WEPP, WRENSS, KWCEA, etc.) normally used to link treatment effects and water quality were not useful for this analysis. Menning et al., (1996) came to a similar conclusion when attempting to evaluate treatment effects across the Sierra Nevada Mountains in the Sierra Nevada Ecosystem Project (SNEP) analysis. As with Menning et al., (1996) this analysis uses a modified version of the USFS Equivalent Roaded Acre (ERA) methodology.

The ERA methodology is a "lumped, conceptual model that quantifies total disturbance in the watershed through the use of empirical coefficients and recovery curves for each activity (MacDonald and Coe, 2004)". The primary limitations of the ERA model are: 1) it does not separate

effects on sedimentation from peak flows, 2) evaluation of recovery time is linked to causes of the effects rather than the effects themselves, 3) results are not spatially explicit (location of the project in the watershed is not accounted for) and 4) ERA describes a level of risk due to management activities but does not offer an index of actual effects (Menning et al., 1996, MacDonald and Coe, 2004). Despite these shortcomings ERA has proven to be a useful, quantitative accounting procedure for estimating potential effects of management activities on water quality and peak flows (McGurk and Fong, 1995; USDA Forest Service 2003; USDA Forest Service, 2005; USDA Forest Service, 2007).

The analysis used in this EIR is a variant of the ERA methodology that was limited to analysis of treatments within the VTP program, rather than the cumulative effects of all disturbance activities in each watershed. Briefly, the ERA method relies on developing an estimate of the relative intensity of each treatment type and multiplying that by the number of acres treated by treatment type in each watershed. The relative intensity of each treatment is based on assigning a coefficient to each treatment type using the common currency of an un-surfaced dirt road as the most intense activity possible in terms of concentrating flows and producing sediment (USDA, 1988). An acre of road was assigned a coefficient of 1.0; all other activities were assigned a coefficient with a fractional value of 1. Mechanical treatments were assigned the highest disturbance coefficient(s), followed by prescribed burning, hand, herbicide and herbivory (Table 5.7.1 and 5.7.2).

The ERA coefficients assigned to each treatment type were based in part on the table of vegetation removal and disturbed ground (Table 5.0.3) as well as review of ERA coefficients for various activities used in USFS regional analyses, particularly the Eldorado National Forest coefficients cited in Menning et al., (1996). The ERA coefficients were modified to reflect the fact the relative treatment intensity was higher for prescribed fire and mechanical treatment types in crown fire-dominated ecosystems (chaparral and grasslands compared to surface fire vegetation types (forest/woodland—see Table 5.0.2). The ERA values assigned to crown fire vegetation types were reviewed by a USFS Hydrologist familiar with ERA analyses in those vegetation types (Moser, pers. comm. 2007).

**Table 5.7.1**
**ERA Treatment Coefficients for Surface Fire Regime Vegetation Type**

| | Prescribed Fire | Mechanical | Hand | Herbicide | Herbivory |
|---|---|---|---|---|---|
| Year 1 | 0.05 | 0.15 | 0.05 | 0.05 | 0.0135 |
| Year 5 | 0 | 0.1 | 0 | 0 | 0 |
| Year 10 | 0 | 0.05 | 0 | 0 | 0 |

**Table 5.7.2**
**ERA Treatment Coefficients for Crown Fire Regime Vegetation Type**

| | Prescribed Fire | Mechanical | Hand | Herbicide | Herbivory |
|---|---|---|---|---|---|
| Year 1 | 0.18 | 0.4 | 0.05 | 0.05 | 0.0135 |
| Year 5 | 0.1 | 0.3 | 0 | 0 | 0 |
| Year 10 | 0.05 | 0.2 | 0 | 0 | 0 |

All ERA coefficients were originally developed for the Eldorado N.F. and were included in the SNEP addendum (Menning et al., 1996). Coefficients for surface fire vegetation types were approximated from similar treatment types on the Eldorado National Forest. Coefficients for crown fire vegetation types were based on the following categories in the Eldorado N.F. Prescribed fire = "High intensity wildfire", Mechanical treatment = "Ripped and obliterated roads and landings."(Moser, pers. comm., 2007).

An average ERA coefficient was calculated for the Proposed Program and each Alternative, based on the proportional mixture of treatment types in each (Table 5.0.1). The ERA coefficients for the Program and each Alternative were then multiplied by the number of acres potentially treated in each Cal 2.2 Watershed over a 10-year time period (Table 5.0.7 and 5.0.8). The ERA "acreage" values for each watershed were then divided by the total watershed area to get an ERA value expressed as the percentage of area of each watershed. ERA values per watershed were assigned to bins and the number of watersheds in each bioregion that fell into these bin categories were summed for the Proposed Program and the Alternatives.

The ERA values calculated in this analysis represent only the disturbance related to implementation of VTP projects (Tables 5.7.4 and 5.7.5). Other disturbances in a watershed such as the road building and maintenance, timber harvest, wildfire, other vegetation management projects, housing construction, etc., also would contribute to potential effects on water quality or peak flows. The ERA method includes the concept of a Threshold of Concern (TOC) for each watershed, which is an estimate of the maximum amount of disturbance (from all sources) in a watershed that can occur without initiating adverse water quality or peak flow effects. TOCs generally range from 10-20% ERA, depending on the inherent sensitivity of the watershed (USDA, 1988; Menning et al., 1996).

Since it was not possible to develop TOCs for each of the 5,600 watersheds in the analysis area due to data limitations, it was conservatively assumed that all watersheds were highly sensitive to disturbance, which equates to a TOC of 10-14%. Guidance from the Plumas National Forest Empire Environmental Impact Statement indicates that disturbances that increase the ERA of a watershed by 25-30% of the TOC will tend to produce small, but detectable increases in peak flows (USDA, 2005). Using the presumed statewide TOC of 10-14% means that ERA increases above 2.5-3.5% could begin to produce detectable impacts to peak flows and, presumably, water quality.

For this analysis, watersheds with less than 2% ERA due to VTP treatments were judged to be at very low risk of affecting sediment, water quality or peak flows. Watersheds with 2-5% ERA due to VTP treatments were at moderate risk of water quality/quantity effects; 5-10% was considered high risk and; greater than 10% ERA would indicate extreme risk of adverse impacts to water quality/quantity due to VTP treatments. These thresholds have been set conservatively and may need to be adjusted as results become available from site-specific observations.

### *5.7.4 Direct Effects Common to all Bioregions from Implementing the Program/Alternatives*

Table 5.7.3 summarizes the information from the balance of this subchapter on the effects of implementing the Program across the State by bioregion regarding water quality and peak flows. Generally, prescribed fire and mechanical treatments were predicted to have negligible effects in bioregions dominated by surface fire regime vegetation types and moderate risk of adverse effects in bioregions dominated by crown fire regime vegetation types. Hand and herbivory treatments were predicted to have negligible adverse effects regardless of vegetation type. Also, small watersheds (<5,000 acres) were more susceptible to water quality and peak flow impacts than larger watersheds. Effects due to herbicides are discussed in Section 5.17.

**Table 5.7.3**
**Summary Of Effects [1/] on Water Quality and Peak Flows From Implementing the Proposed Program**

| Bioregion | Prescribed Fire | Mechanical | Hand | Herbivory |
|---|---|---|---|---|
| Klamath North Coast | NA | NA | NA | NA |
| Modoc | NA | NA | NA | NA |
| Sacramento Valley | MA | MA | NA | NA |
| Sierra | NA | NA | NA | NA |
| Bay Area | NA | NA | NA | NA |
| San Joaquin | MA | MA | NA | NA |
| Central Coast | MA | MA | NA | NA |
| Mojave | NA | NA | NA | NA |
| South Coast | MA | MA | NA | NA |
| Colorado Desert | MA | MA | NA | NA |

1/ Key to effects; adverse effects are those effects which degrade the diversity, structure, size, integrity, abundance or number of; or are outside the natural range of variability, for the resource at issue. Beneficial effects are those effects that improve the diversity, structure, size, integrity, abundance or number of; or are within the natural range of variability, for the resource at issue. SA/SB – significant adverse effects are those effects that are substantial, highly noticeable, at the watershed scale; and often irreversible. MA/MB - moderately adverse or beneficial effects - those effects that can be detected beyond the affected area, but are transitory and usually reversible. NA/NB - negligible adverse or beneficial effects - those effects that are imperceptible or undetectable.

- Sediment- Potential Effects on Water Quality

At the statewide level, for the Proposed Program and all of the Alternatives, 96 to 99% of watersheds were projected to have less than 2% ERA due to VTP treatments after 10 years, thus being at low risk of impairing water quality/quantity (Table 5.7.4 for the Program and Table 5.7.5 for the Alternatives). For the Program and Alternatives 2 and 3 approximately 1% of watersheds were projected to be at high (>5% ERA) or extreme risk (>10% ERA) for water quality/quantity effects. At the statewide scale, none of the Alternatives or the Proposed Program were significantly different from one another - this is due to the overwhelming effect of scale and the coarse grain of this analysis. The VTP is small and the State is huge. The annual acreage proposed for treatment within the VTP ranges from 47,000 acres in Alternative 1 to 216,910 acres for the Proposed Program and Alternatives 2 and 3, which is between 0.1% and 0.5% of the 37 million acre program area each year. Essentially, there were so few projects spread over so many acres that the probability of many occurring in a single watershed was very low, even after 10 years. Additionally most of the

treatment types (except prescribed fire and mechanical in crown fire regimes) are relatively low intensity, which combined with the small number of treatments in each watershed, resulted in predominantly low ERA values- regardless of alternative.

**Table 5.7.4**
**Percentage of Watersheds in Each Bioregion that Fall into ERA Disturbance Categories for the Proposed Program**

| Bioregion | Equivalent Roaded Acre Values per Watershed After 10 Years | | | | | |
|---|---|---|---|---|---|---|
| | 0% | 0-1% | 1-2% | 2-5% | 5-10% | >10% |
| | Proposed Program | | | | | |
| Klamath/North Coast | 57.88% | 40.42% | 1.31% | 0.20% | 0.20% | |
| Modoc | 43.33% | 51.99% | 3.12% | 1.04% | 0.17% | 0.35% |
| Sacramento Valley | | 32.86% | 18.57% | 20.00% | 14.29% | 14.29% |
| Sierra Nevada | 38.53% | 56.91% | 3.58% | 0.91% | 0.07% | |
| Bay Area / Delta | 36.69% | 56.65% | 5.85% | 0.60% | 0.20% | |
| San Joaquin | 31.37% | 42.48% | 11.11% | 9.15% | 4.58% | 1.31% |
| Central Coast | 30.27% | 52.21% | 12.38% | 5.02% | 0.12% | |
| Mojave | 87.25% | 10.29% | 1.96% | 0.49% | | |
| South Coast | 9.56% | 67.24% | 9.56% | 7.85% | 3.07% | 2.73% |
| Colorado Desert | 5.41% | 75.68% | 8.11% | 5.41% | 5.41% | |
| **Total** | **42.30%** | **49.46%** | **5.07%** | **2.14%** | **0.63%** | **0.39%** |

**Table 5.7.5 Percentage of Watersheds in Each Bioregion That Fall Into Disturbance Categories for the Four Alternatives**

| Equivalent Roaded Acre Values per Watershed After 10 Years | | | | | | |
|---|---|---|---|---|---|---|
| | 0% | 0-1% | 1-2% | 2-5% | 5-10% | >10% |
| Alternative 1- Status Quo | | | | | | |
| Klamath/North Coast | 86.20% | 13.73% | 0.07% | | | |
| Modoc | 95.67% | 4.33% | | | | |
| Sacramento Valley | 7.14% | 55.71% | 15.71% | 15.71% | 5.71% | |
| Sierra Nevada | 76.84% | 22.60% | 0.42% | 0.14% | | |
| Bay Area / Delta | 75.40% | 23.19% | 0.81% | 0.60% | | |
| San Joaquin | 62.75% | 27.45% | 6.54% | 2.61% | 0.65% | |
| Central Coast | 67.52% | 29.90% | 2.21% | 0.37% | | |
| Mojave | 96.57% | 3.43% | | | | |
| South Coast | 59.73% | 31.40% | 4.78% | 2.39% | 1.71% | |
| Colorado Desert | 27.03% | 67.57% | 2.70% | 2.70% | | |
| Total | 78.09% | 20.02% | 1.16% | 0.55% | 0.18% | |
| Alternative 2 - No Herbicide | | | | | | |
| Klamath/North Coast | 58.14% | 39.76% | 1.44% | 0.59% | 0.07% | |
| Modoc | 43.67% | 50.78% | 3.64% | 1.56% | 0.17% | 0.17% |
| Sacramento Valley | | 31.43% | 14.29% | 25.71% | 11.43% | 17.14% |
| Sierra Nevada | 39.02% | 55.72% | 4.28% | 0.77% | 0.21% | |
| Bay Area / Delta | 34.27% | 57.66% | 6.05% | 1.61% | 0.40% | |
| San Joaquin | 30.07% | 42.48% | 7.84% | 12.42% | 4.58% | 2.61% |
| Central Coast | 29.78% | 49.63% | 14.46% | 5.39% | 0.74% | |
| Mojave | 87.25% | 10.78% | 0.98% | 0.98% | | |
| South Coast | 12.63% | 61.09% | 11.26% | 8.19% | 4.10% | 2.73% |
| Colorado Desert | 5.41% | 75.68% | 5.41% | 8.11% | 5.41% | |
| Total | 42.38% | 48.25% | 5.55% | 2.63% | 0.75% | 0.45% |
| Alternative 3 - Water Quality | | | | | | |
| Klamath/North Coast | 58.67% | 39.96% | 0.85% | 0.46% | 0.07% | |
| Modoc | 42.81% | 52.69% | 2.77% | 1.39% | 0.17% | 0.17% |
| Sacramento Valley | | 34.29% | 12.86% | 24.29% | 15.71% | 12.86% |
| Sierra Nevada | 39.65% | 55.51% | 3.93% | 0.56% | 0.28% | 0.07% |
| Bay Area / Delta | 37.30% | 55.65% | 6.25% | 0.60% | 0.20% | |
| San Joaquin | 29.41% | 44.44% | 9.15% | 11.76% | 3.27% | 1.96% |
| Central Coast | 31.62% | 48.65% | 14.71% | 4.78% | 0.25% | |
| Mojave | 87.25% | 10.29% | 1.96% | 0.49% | | |
| South Coast | 10.92% | 62.80% | 11.95% | 7.51% | 5.46% | 1.37% |
| Colorado Desert | 2.70% | 78.38% | 8.11% | 5.41% | 5.41% | |
| Total | 43.00% | 48.30% | 5.38% | 2.23% | 0.77% | 0.32% |
| Alternative 4 - Air Quality | | | | | | |
| Klamath/North Coast | 77.89% | 22.04% | 0.07% | | | |
| Modoc | 56.33% | 41.94% | 1.21% | 0.35% | 0.17% | |
| Sacramento Valley | 4.29% | 51.43% | 15.71% | 21.43% | 5.71% | 1.43% |
| Sierra Nevada | 64.77% | 34.88% | 0.35% | | | |
| Bay Area / Delta | 63.71% | 34.88% | 1.21% | 0.20% | | |
| San Joaquin | 50.98% | 37.25% | 7.84% | 3.27% | 0.65% | |
| Central Coast | 55.39% | 42.16% | 2.08% | 0.37% | | |
| Mojave | 93.63% | 6.37% | | | | |
| South Coast | 37.20% | 51.88% | 5.80% | 3.75% | 1.02% | 0.34% |
| Colorado Desert | 27.03% | 67.57% | 5.41% | | | |
| Total | 64.25% | 33.50% | 1.39% | 0.66% | 0.16% | 0.04% |

Alternative 1 resulted in the fewest number of watersheds having post treatment ERA values greater than 5%, followed by Alternative 4. These two Alternatives treated the fewest number of acres per year at 47,000 and 93,060 acres, respectively - which largely explains why the potential impacts were lowest at the state and bioregional scale. The Proposed Program and Alternatives 2 and 3 treat the same number of acres per year (216,910), but with varying treatment mixtures and resulting intensities. At the statewide and bioregional scales there was no significant difference in projected proportion of watersheds with ERA Values exceeding 2% between the Proposed Program, Alternative 2 or Alternative 3. Again, scale overwhelmed potential differences due to variations in treatment intensity.

However, at the project scale and within a single watershed Alternative 3 would have the lowest risk of impacting water quality due to the more protective Landscape Constraints and MMRs compared to the other alternatives and the Program. Alternative 4, which limits the amount of prescribed burning, has a greater proportion of projects using mechanical treatments. Since mechanical treatments are estimated to result in greater ground disturbance than the other treatments, it is likely that within a single watershed fewer acres could be treated under Alternative 4 without initiating water quality impacts compared to the other alternatives.

Generally, the ERA analysis presented above indicates that, for all alternatives, in the vast majority of the watersheds across the state (96-99%) the number of projects will be so few (< 3 in ten years) and the intensity of treatments low enough that water quality impacts are very unlikely. In watersheds where multiple treatments accumulate over time Alternative 3 will permit the greatest acreage to be treated without impacting water quality. Alternative 4 would permit the fewest acres treated in a single watershed due the emphasis on mechanical treatments.

There are no watershed-level studies of the impacts to water quality from the suite of treatments contained within the VTP. The majority of studies have focused on treatments/disturbances that are more intense than those contained in the VTP; including wildland fire, clear-cut timber harvest, road construction, etc. Prescribed burning has received some study. Prescribed herbivory (e.g. goats maintaining fuel breaks), hand treatments, understory thinning and mechanical treatments have received very little study. The effects of herbicide usage are covered in Section 5.17.

In surface fire vegetation types (i.e. forested areas) the majority of VTP treatment types are relatively 'low-impact' compared to commercial forestry operations and wildfire. Non-commercial thinning, removal of understory vegetation, hand pile and burn, and low intensity prescribed burning are all common in surface fire vegetation types. VTP treatments in crown fire regime ecosystems remove more live vegetation and leave more disturbed soil than VTP treatments in surface fire regime vegetation types. Moderate to high intensity prescribed fire, complete removal of vegetation via heavy equipment, and broadcast herbicide applications are commonly used in crown fire regime vegetation types.

Research indicates that when cover of vegetation and litter exceeds 75% only about 2% of rainfall becomes runoff and erosion is low (Robichaud et al., 2000). Conversely, when ground cover is reduced to less than 10% through severe disturbance, runoff can increase by 70% and erosion can increase by three orders of magnitude (Robichaud et al., 2000). Ground cover may be reduced to

less than 10% after high severity wildland fire and road construction. In surface fire regime vegetation types most VTP treatments typically retain >75% ground cover (Table 5.0.3). In crown fire vegetation types, residual canopy cover and undisturbed ground are often much lower after treatment (Table 5.0.3).

Although roads occupy a relatively small percent of the area in most forest or wildland settings they are typically responsible for the majority of sediment originating from management activities (Megahan and King, 2004; Gucinski et. al., 2001; others). Roads increase sediment generation and delivery through increased surface erosion, increased incidence of landsliding, and concentration of peak flows leading to channel scour. Typically, haul road and skid road construction and subsequent yarding and hauling practices are responsible for the majority of road-related erosional impacts.

No new haul roads or skid roads will be constructed as part of the VTP. Very few of the VTP treatment types include yarding or hauling of logs. Road-related erosion impacts from the VTP will be limited to re-opening some existing roads to access treatment sites, light truck traffic during project implementation, and heavy equipment hauling at the beginning and end of some mechanical treatment projects (See MMR 17). Overall, road-related erosion, which is typically a dominant source of erosion from wildland management, would be very minor in the VTP projects.

Within the VTP, prescribed fire and mechanical treatments are the management activities most likely to increase the risk of soil erosion (USDA, 2003). Fire severity has a direct influence on post fire erosion rates. Low intensity fires generate minimal increases in erosion and return to background rates in less than five years, while high severity fires can generate order of magnitude increases in sediment yield and require a decade or more to return to background conditions. Slope is also a major factor affecting post fire erosion rates, with most of the higher reported sediment yields occurring in steep settings. In forests and woodlands, sediment yields from surface fires range from 0.1 to 6 Mg/ha/year after prescribed burns and 0.01 to 110 Mg/ha/year after wildland fires (Robichaud et. al., 2000). Post fire erosion rates in forested areas returned to baseline conditions in 2-4 years after low intensity fires, but took as long as 7-14 years after severe wildland fires (Robichaud et. al., 2000). Empirical field data collected by Lee MacDonald contained in the Herger-Feinstein Quincy Library Group FSEIS (USDA, 2003a) yielded the following conclusions:

> *"At the scale of the entire (project area), estimated "worse case" first year sediment reaching perennial and intermittent channels from mechanical and prescribed fire treatments is considered minimal and approximately equal to background erosion rates (0.09 tons/treated hectare from mechanical treatments and 0.14 tons/treated hectare from prescribed fire versus 0.1 tons/hectare/year background)."*

Prescribed fires in chaparral systems often burn at moderate to high severity, which is more similar to wildfire than the low intensity broadcast burns conducted in the understory of forested systems (DeBano, 1989; Wohlgemuth pers. comm., 2007). In chaparral, sediment yields after moderate severity prescribed fires have been reported as generating 10 to 30% of the sediment yields generated after high severity wildfires (Wohlgemuth, 2001). Compared to erosion rates from unburned areas, sediment yields increased from less than 1 Mg/ha/year to between 3 and 7 Mg/ha/year (300 to 700% increase) after prescribed fire and 30 to 60 Mg/ha/year after wildfire

(3,000 to 6,000% increase) (Robichaud et al., 2000). Wohlgemuth (2001) reported that in one Southern California chaparral watershed a high severity wildfire that burned through an area that was previously burned in a prescribed fire burned at lower intensity and produced only 10-20% of the sediment produced by wildfire in adjacent areas (1.083 Mg/ha versus 20.183 Mg/ha/year). Wohlgemuth (2001) also reported that post fire sediment yields returned to background levels in 2-4 years for both high and low severity fires.

Mastication of understory vegetation is one of the more intensive mechanical treatments, however it may have minimal effects on erosion or runoff rates where vegetation volumes are high prior to treatment. Hatchet et al., (2004) found that an excavator based masticator working in mixed conifer forests in the Tahoe basin generated 0-9% bare ground and insignificant soil compaction after treatment, and concluded that "erosion impacts would be slight to insignificant" where a mulch layer 4 to 8 inches thick was developed during the mastication process. The key to reduced impacts after mastication is the thick layer of ground-up vegetation (mulch) that the machine operates on top of and leaves behind after treatment. However, in vegetation types such as desert scrub where the volume of vegetation is relatively low, mastication may have a much more dramatic impact on erosion rates due to the minimal mulch cover created during treatment.

Elliot and Miller (2002) prepared an analysis of implementing the National Fire Plan, which used the WEPP model to compare wildland fire, prescribed fire and thinning to one another. The analysis indicated that the erosion from wildfire would be about 40 times that of prescribed burning (assuming that the prescribe burn was conducted with 90 meter streamside buffers). The model estimated thinning at about 70% of the erosion potential of prescribed fire, or 1% of wildfire. For stands that were thinned and followed by prescribed fire, 85% ground cover was assumed post treatment and 45% ground cover was assumed post wildfire. The analysis was based on the assumption that if an acre was not treated, it would eventually burn in a wildfire - thus erosion rates from wildfire are used as the "baseline" or "background" condition, rather than the condition that existed prior to treatment (unburned, unmanaged).

Descriptions of hand treatments in the Herger-Feinstein Quincy Library Group Final Supplemental EIS indicate that due to the lack of ground disturbance or soil compaction "no water quality effects are anticipated to result from hand treatments (USDA, 2003)." The same document also indicated that soil erosion from herbicide application was minimal to non-existent.

- Peak Flows

The analysis of VTP treatments on peak flows relies on the same ERA analysis presented in the effects of sediment to water quality section and the conclusions reached were the same. The following review of relevant literature is meant to provide a check on the conclusions reached using the ERA analysis.

Research indicates that approximately 15-20% of the vegetation in a watershed needs to be removed within a decade in order to generate a statistically significant change in water yield (Stednick, 1996; MacDonald and Stednick, 2003). Changes in peak flows are roughly proportional to the percent of vegetation removed. For example, compared to untreated control watersheds peak flows increased by 20-28 percent after removing 30-50% of the forest canopy in northern Arizona, while peak flows increased by 90 percent after removing 77 percent of the canopy in another

watershed and by 170 percent after removing 100% of the vegetation in a clearcut watershed (MacDonald and Stednick, 2003).

In forested systems (surface fire regimes) timber harvest-related effects on peak flows are less pronounced than timber harvest related effects on sediment production (MacDonald et al., 2004). Maximum increases in sediment yield from small research watersheds have been reported at one or two orders of magnitude, while winter peak flow increases are typically only 10-20% above background (MacDonald et al., 2004). These results were predominantly from intensive forestry operations, including clear-cutting a significant portion of the watershed. However the pattern is instructive, in that management-related effects in forested vegetation types tend to be more significant for sediment yield than for peak flows. Also, most of the literature indicates that erosion risk from VTP type treatments is low, so by inference risk of increased peak flows would be even lower. In reference to forested vegetation types Robichaud et al., (2010) noted "no measurable increase in runoff can be expected from thinning operations that remove less than 15% of the forest cover." Based on this research, the risk of increased peak flows due to VTP treatments in surface fire vegetation types is very low because none of the VTP treatments will significantly reduce forest canopy cover.

However, in crown fire regime vegetation types where reductions in vegetative cover average 50-70% and the percent bare ground averages 35-50% after prescribed fire and mechanical treatments, the risk of increasing peak flows may be significant (USDA, 2007). The effect of lower canopy cover and higher bare ground is accentuated by the fact that soils are typically thin in chaparral systems and high severity fires can create hydrophobic soils, either of which can lead to elevated overland flow rates (DeBano, 1989). In crown fire dominated ecosystems (chaparral and grasslands) increases in peak flows after wildfire tend to be extreme, exceeding 1,000% in many cases (Robichaud et al., 2000). Although the potential exists to create hydrophobic soils through prescribed burning, burning prescriptions typically are successful at keeping severity low enough to prevent formation of hydrophobic soils (DeBano, 1989).

- Water Temperature- Potential Effects on Water Quality

The potential mechanisms by which VTP treatments could increase stream water temperatures include: removal/burning of riparian vegetation, resulting in increased solar gain on the stream surface and decreased water volume in small streams due water drafting for fire control.

The Proposed Program and Alternatives 2 and 4 include the following Landscape Constraints and MMRs, intended to reduce potential impacts to stream temperature from direct solar gain:

*Riparian vegetation, as well as any vegetation significant to maintenance of watercourse shade, will be not be disturbed within the WLPZ established on each side of all Class I and II watercourses. WLPZs are measured by slope distance from the high water mark of the streamcourse. Vegetation within and adjacent to Class III watercourses will be retained, as feasible, to trap sediment.*

Alternative 3 increases the width of the WLPZs for all VTP projects to the maximum width specified in the FPRs. Establishing streamside management zones in which vegetation removal, fuel reduction and ground disturbance are limited is effective in minimizing the adverse effects of vegetation management on water temperature (Murphy, 1995; CAL FIRE, 1997).

In general, VTP treatments do not target overstory trees for removal. Considering that few or no overstory trees would typically be removed within or outside WLPZs, and disturbance of understory vegetation is limited within 50 feet of the watercourse, there is very low risk that VTP treatments could decrease shade on Class I or II streams enough to increase stream water temperatures. Occasionally a VTP project may include a prescription to remove non-native or undesired native overstory tree species to improve habitat, however Landscape Constraints 1, 3 and 5 provide protection measures to prevent degradation of habitat or water quality when overstory trees are removed near watercourses. For the Proposed Program and Alternatives 2, 3 and 4 there is no requirement to retain overstory trees along Class III streams, however these are seasonal streams that do not flow during the summer months, and thus are not subject to increased solar radiation on the stream surface when these streams are flowing.

The other potential mechanism by which VTP projects could increase stream temperatures is reduction of stream flows. Removal/burning of vegetation will not decrease summer low flows because reductions in vegetation result in reduced transpirational losses from the watershed and typically result in increased, rather than decreased flows (Stednick, 1996). Water drafting is another mechanism that could reduce stream flow and result in increased water temperatures. Minimum Management Requirement (MMR) 15 (Chapter 2) for the Proposed Program and Alternatives 2-4 addressed this issue.

For streams without special status species this MMR will not apply. However, this is not likely to have a significant adverse impact on water temperature because most treatments that require water drafting (prescribed fire and mechanical) are not conducted during the critical low flow months of July, August, and September. Most VTP treatments occur from late fall through spring, when streamflows are likely to be higher and more resilient to the relatively minor water withdrawals required for VTP treatments. Water drafting for VTP treatments is mostly limited to filling one or two fire engines for fire line control, not continuous use for watering roads.

- Coliform Bacteria- Potential Effects on Water Quality

Prescribed herbivory will be used to maintain a portion of the fuels treatments in the VTP. At the statewide scale there will be up to 21,690 acres per year treated using prescribed herbivory, representing 0.05% of the program area (Table 5.0.1). The presence of warm-blooded, grazing animals increases the risk of introducing bacterial contamination into the stream channel, and the contamination risk increases with the intensity of grazing (Tiedman et al., 1989). Fecal coliform (FC) is the standard water quality indicator used to assess the potential for pathogenic contamination of surface water and is used in setting water quality standards.

Direct defecation in the stream channel by animals is the primary mechanism for introducing FC into the water column, however FC may also be transported to the stream channel via contaminated sediment suspended in overland flow. The types of animals (cattle, sheep, goats, etc.), the number of animals, season and duration of treatment, slope, proximity to stream channels, soil characteristics, vegetation types, and local hydrology all affect the risk of FC contamination. It is not possible to predict the myriad combinations of these factors, which may be implemented within the VTP in order to predict potential effects. Therefore, site specific BMPs will be required to address this issue for each project (see Mitigation Measure 5.7-3).

Proposed Program Effects and Goals

The Proposed Program would help to reduce the detrimental environmental effects of wildfire to watersheds and thus to soil resources (Goal 6) by helping reduce fire severity across the landscape, particularly in watersheds where 35% or more of the watershed is treated which helps to reduce wildfire extent and severity.

Alternatives Effects and Goals

Implementation of Alternative 2 would meet Goal 6 at approximately the same rate and to the same extent as the Proposed Program. Alternative 3 would initially meet Goal 5 at approximately the same rate and to the same extent as the Proposed Program. However over the long term, Alternative 3 only treats about 13.7 million acres with prescribed fire and mechanical treatments which is only about 40% of the acres that would be treated under the Program, thus, this Alternative over the long term would not meet Goal 5 as effectively as the Proposed Program. Alternative 1 would not meet Goal 5 at the same rate or to the same extent as the Proposed Program since it would treat so few acres and substantially more acres would likely burn at high intensity. Alternative 4, like Alternative 1 would not meet Goal 5 at the same rate or to the same extent as the Proposed Program since it would treat so few acres and substantially more acres would likely burn at high intensity.

### *5.7.5 Bioregion Specific Direct Effects of Implementing the Program/ Alternatives on Water Quality*

- Sediment- Potential Effects on Sediment and Peak Flows

For the Proposed Program and all of the Alternatives the Sacramento Valley, San Joaquin, South Coast and Colorado Desert, and to a lesser extent Central Coast Bioregions had the greatest proportion of watersheds at moderate (2-5% ERA) or higher risk of water quality/quantity impairment. Part of this effect was due to the fact that (except for the Central Coast) these bioregions had relatively few total watersheds and many of them were small (<5,000 acres). The other reason for the higher ERA values was that, except for the Colorado Desert, these bioregions were dominated by crown fire regime vegetation types, which correlate with higher intensity treatments (higher ERA coefficients, Table 5.7.2 and 5.7.3). In general, these results indicate that small watersheds with a high number of relatively intense treatments are more prone to water quality/quantity impacts than larger or less intensively treated watersheds.

The results from the bioregional analysis of potential impacts to water quality from VTP projects (noted above) indicates little overlap with bioregions designated by the State as the "high priority landscape[1]" for water quality (CAL FIRE, 2010). The high priority landscape includes the North Coast/Klamath Bioregion, and selected watersheds in the Sierra and South Coast Bioregions (CAL FIRE, 2010). Thus, the additional potential risk attributable to VTP projects will not occur in watersheds already deemed by the State to be high quality and at elevated risk of impairment to water quality.

[1] According to CAL FIRE (2010), "The high priority landscape (HPL) identifies watersheds that support a broad range of beneficial uses and coincide with high threats to water quality. The analysis highlights areas where stewardship projects have the highest potential to protect and enhance water quality."

### *5.7.6 Indirect Effects of Implementing the Program/Alternatives on Water Quality*

The indirect effects of implementing any of the alternatives is a decreased burn severity on treated acres in the event that a wildfire burns through a treated area. The analyses in this chapter and the literature indicate that impacts to water quality are proportional to the intensity of disturbance. High severity wildfires followed by significant storm events are amongst the most extreme disturbances that occur in California. Thus, VTP treatments, which have the potential to reduce burn severity, may also result in decreased water quality impacts, specifically sediment, temperature and peak flows (Elliot and Miller, 2002; Wohlgemuth, 2001). The Program and Alternatives 2 and 3, which treat the most acres, maximize this potential benefit.

However, the potential beneficial effects of VTP treatments on water quality will not be realized on every acre treated, because the odds of a wildfire burning through a treated area during the approximately 10-year post treatment window of treatment effectiveness are variable and low for much of California. Analysis conducted in Section 5.2 for the Program (216,910 acres treated per year) indicates that, "Due to treatments, particularly in the South Coast, Central Coast and Sierra bioregions, the number of acres severely burned could fall from 124,000 acres per year to ~ 98,000 acres per year. Part of the reason that there is not a larger effect is that only about 41,500 acres of treatments in any one- year period could be expected to burn in a wildfire." Analyses in Section 5.2 further indicate that areas that have high fire frequencies over the past 50 years are most likely re-burn a treated area. Thus, VTP treatments in the South Coast, Central Coast and Sierra bioregions are most likely to realize the beneficial effect of reduced impacts to water quality via reduced severity of wild fires.

### *5.7.7 Similar Effects Described Elsewhere*

The effects of VTP implementation associated with water quality, particularly with regard to increased soil erosion or geologic instability are discussed in Section 5.15, *Geology and Soils*. The effects of changes in water quality parameters on Aquatic Biota are discussed in Section 5.5.1, *Aquatic Resources*.

### *5.7.8 Determinations Regarding Water Quality*

- Sediment- Determination of Effects on Water Quality

A concentration of prescribed fire and mechanical treatments in a crown fire regime vegetation type dominated landscape represents the highest risk of water quality impairment (of the treatment types and landscape types analyzed) and could result in significant, negative effects on water quality due to sediment, particularly in small (<5,000 acre) watersheds. The risk of water quality impairment due to excessive sedimentation is lower for surface fire regime dominated landscapes, though still possible where a large portion of a small watershed is treated in a short amount of time. Mitigation Measures 5.7-1 and 5.7-2 were developed to mitigate this risk.

After considering the Landscape Constraints, Minimum Management Requirements, and Mitigation Measure 5.7-1 and 5.7-2 (see below), along with the results of ERA analysis, neither the Program nor any of the Alternatives would cross the following thresholds of significance:

1) Significantly degrade water quality,

2) Violate basin plan objectives, and/or
3) Impact a beneficial use related to effects of sediment on water quality.

Alternative 1 would result in the fewest number of watersheds statewide with moderate or higher risk of sediment water quality impairment. However, since the Landscape Constraints and Minimum Management Requirements do not apply to Alternative 1 the risk of site-specific impacts are higher on a per watershed basis for this alternative.

The review of relevant literature corroborates the conclusion that the Proposed Program and the Alternatives have a very low risk of causing adverse impacts to sediment water quality at the Cal 2.2 watershed scale. However, localized discharges of sediment are likely to occur, particularly after intense winter storms following treatment.

There are also potential beneficial effects of VTP treatments on sediment impacts to water quality due to reducing the acreage of land burned at high severity by wildfire, which, as noted, typically leads to high erosion rates (Section 5.2). Elliot and Miller (2002) and Wohlgemuth (2001) both addressed this potential beneficial effect of vegetation treatment projects. Essentially, every treated acre represents an acre with decreased fire severity ranking during the next wildfire, IF a wildfire burns the treated area within approximately 10 years after treatment. The Proposed Program and Alternatives 2 and 3 would maximize this beneficial effect due to the greater area treated.

- Peak Flows – Determination regarding effects on Water Quantity

As with sediment impacts, a concentration of prescribed fire and mechanical treatments in a crown fire regime vegetation type dominated landscape represents the highest risk of increased peak flows, particularly in small (<5,000 acre) watersheds. The risk of significantly increased peak flows is lower for surface fire regime dominated landscapes, though still possible where a large portion of a small watershed is treated in a short amount of time. Mitigation Measures 5.7-1 and 5.7-2 were developed to mitigate this risk.

After considering the Landscape Constraints, Minimum Management Requirements, and Mitigation Measure 5.7-1, 5.7-2 and 5.7-3 (see below), along with the results of ERA analysis, neither the Program nor any of the alternatives would cross the following thresholds of significance:

1) significantly degrade water quality,
2) violate basin plan objectives, and/or
3) impact a beneficial use related to effects of sediment on water quality.

Alternative 1 would result in the fewest number of watersheds statewide with moderate or higher risk of adverse peak flows.

The review of relevant literature corroborates the conclusion that the Proposed Program and the Alternatives have a low risk of causing adverse impacts to peak flows at the Cal 2.2 watershed scale after implementing Mitigation Measure 5.7-1.

- Temperature- Determination regarding Effects on Water Quality

After considering the Landscape Constraints, Minimum Management Requirements, and Mitigation Measure 5.7-1, 5.7-2 and 5.7-3 (see below), along with the results of ERA analysis,

neither the Program nor any of the Alternatives would cross the following thresholds of significance:

1) Significantly degrade water quality,
2) Violate basin plan objectives, and/or
3) Impact a beneficial use related to effects of sediment on water quality.

There is a significant risk of adverse impacts to water temperature under Alternative 1 because of the lack of streamside buffers in this alternative. The risk of increased temperature is greatest in crown fire vegetation types where significant removal/burning of the majority of vegetation on a site is likely under any treatment type. The risk is lower in surface fire vegetation types because VTP treatments typically retain overstory vegetation, which will provide adequate stream shade in most cases.

- Fecal Coliform- Determination Regarding Effects on Water Quality

The risk of significant FC contamination at the bioregional scale is low due to the small scale of the proposed treatment type within the VTP (0.05% of program area per year). However, in order to prevent potential FC contamination it will be necessary for the project proponent to develop and implement standard BMPs suitable for control of animal wastes – Mitigation Measure 5.7-3. After considering the Landscape Constraints, Minimum Management Requirements, and Mitigation Measures 5.7-1 and 5.7-3 (see below), neither the Program nor any of the Alternatives would cross the following thresholds of significance:

1) Significantly degrade water quality,
2) Violate basin plan objectives

## *5.7.9 Mitigation Measures for the Proposed Program*

The following mitigation measures will be used to help reduce potentially significant effects to less than significant. Small watersheds (<5,000 acres) with crown fire regime vegetation are at the highest risk of sediment-impaired water quality due to VTP treatments. Mitigation Measure 5.7-1 will be used to help reduce potentially significant effects to less than significant.

**Mitigation Measure 5.7-1.** The ERA of proposed VTP treatments shall be calculated for all Cal 2.2 watersheds that will be directly affected by the proposed project. If the ERA value for the proposed project will exceed 2%, a more detailed watershed-specific analysis of potential water quality effects shall be required (see ERA formula below). A *qualitative* analysis will be required where VTP related ERA is projected to fall between 2 and 5 percent. A *quantitative* analysis will be required where VTP related ERA is projected to exceed 5 percent. The coefficients for each treatment type are provided in Tables 5.7.2 and 5.7.3.

**ERA Calculation Formula: $ERA\% = \{[\sum_{1-x} (Tc_1 * Ta_1)]/Wa\} * 100$**

$Tc_x$= Treatment Type Coefficient (look up in Tables 5.7.2 and 5.7.3)
$Ta_x$ = Treatment Acreage
where $_x$ = each type of treatment and corresponding acreage used in the project.
Wa = Cal 2.2 watershed area expressed in acres

*Explanation and Rationale:* For example, it would be possible to stay below the 2% ERA threshold if the suite of treatments in the Proposed Program was applied to ~ 3,300 acres of a 5,000-acre watershed in a decade if the watershed were composed of surface fire regime vegetation type or ~740 acres if the vegetation type was crown fire regime. In order to treat more acres in a watershed a detailed, watershed-specific analysis would have to be completed which indicated there was a low risk of impairment to water quality/quantity.

The intensity of site-specific analyses shall reflect the risk posed by the project. Higher intensity and/or more extensive treatments, particularly on steep slopes with erodible soils, should receive more analytical effort. If the ERA for VTP projects is predicted to fall between 2 and 5% a qualitative analysis similar to the "explain and justify" language contained in the Forest Practice Rules will be required which would be a description of site-specific factors, types of treatments and current condition of the watercourse with an estimate of potential effects. For projects where ERA is predicted to exceed 5% after project implementation the project proponent will have to quantitatively "predict" potential impacts and "verify" that actual impacts did not exceed projected impacts through monitoring. Prediction could be based on extrapolation of empirical data (i.e. sediment budgets or studies of similar treatments in similar settings) or modeling (i.e. WEPP FuME, SEDMODL2, watershed specific ERA, etc.). Verification could be based on checklist type hillslope monitoring- recording physical evidence of rilling, gullying or sediment delivery at the project site after 1 or 2 winters and reporting results to CAL FIRE. Water column monitoring is not likely to be feasible or useful as a mitigation.

**Mitigation Measure 5.7-2.** A protective buffer zone shall be designated on Class III watercourses in order to prevent introduction of sediment into Class III channels or accelerate sediment transport through Class III channels due to VTP treatments. The width of buffer zones shall be a minimum of 25 feet where slopes are less than 30% and 50 feet where slopes exceed 30%. Heavy equipment shall be excluded except at designated crossings in these buffers (ELZ) and broadcast burn intensity will be minimized so that the loss of large fuels (1,000 hour fuels [greater than 9 inches in diameter]) shall be minimized. The project proponent shall develop measures to limit ground disturbance and consumption of wood within streamcourses that contribute to channel stability.

*Rationale:* The Landscape Constraints and Minimum Management Requirements (Chapters 2 and 3) for the Program and Alternatives 2, 3, and 4 do not include any protection for Class III streams. Class III streams occupy a large percentage of the landscape and effectively transport sediment to larger Class I and II streams. Sediment transport in Class III streams is often controlled by accumulated woody debris, which forms a stepped profile and meters out sediment over time. If the woody debris in Class III channels is removed or burned up sediment transport may be accelerated.

Examples of protective measures for Class III buffers include: general exclusion of heavy equipment except for designated crossing points, use of fire control lines through wetting vegetation rather than bare ground fire lines, using backing fires through Class IIIs, etc.

**Mitigation Measure 5.7-3.** For any project that includes prescribed herbivory within the WLPZ of a Class I or II watercourse or the protective buffer of a Class III watercourse (see Mitigation

Measure 5.7-3) the following measures shall be followed. The grazed area must be part of a Recognized Nonpoint Source Management Plan (California Rangeland Water Quality Management Plan) approved by NRCS or local Regional Water Quality Control Board. Alternately, each VTP project must include a description of appropriate Best Management Practices (BMPs) that will be implemented in order to control nonpoint source pollution due to grazing activities. The description of BMPs must be approved by a state Certified Rangeland Manager (CRM). Appropriate BMPs are described in the National Range and Pasture Handbook (NRCS, 2003) and the UCANR Rangeland Water Quality Fact Sheets (UCANR).

The following BMPs are typically used to protect sensitive areas (such as streambanks, wetlands, estuaries, ponds, lake shores, and riparian zones): (a) exclude livestock, (b) provide stream crossings or hardened access to watering areas, (c) provide alternative drinking water locations away from surface waters, (d) locate salt and additional shade, if needed, away from sensitive areas, or (e) use improved grazing management (e.g., herding) to reduce the physical disturbance and reduce direct loading of animal waste and sediment caused by livestock.

*Rationale:* There is a potential for substantial adverse effects to water quality due to grazing. The Landscape Constraints and Minimum Management Requirements do not include provisions to prevent water quality impacts due to grazing. The mitigation measure is consistent with standard range management practices and is known to be effective in preventing impacts to water quality.